Oracle® Fusion Middleware

Developing Mobile Applications with Oracle Mobile Application Framework

2.0

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Documentation that describes how to use Oracle JDeveloper to create mobile applications that run natively on devices.

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Oracle Fusion Middleware Developing Mobile Applications with Oracle Mobile Application Framework 2.0

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Preface

Welcome to the *Developing Mobile Applications with Oracle Mobile Application Framework*.

Audience

This document is intended for developers tasked with creating cross-platform mobile applications that run as natively on the device.

Documentation Accessibility

For information about Oracle's commitment to accessibility, visit the Oracle Accessibility Program website at
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Related Documents

For more information, see the following documents:

- *Oracle Fusion Middleware Installation Guide for Oracle JDeveloper*
- *Oracle Fusion Middleware User's Guide for Oracle JDeveloper*
- *Oracle Fusion Middleware Developer's Guide for Oracle JDeveloper Extensions*
- *Oracle Fusion Middleware Developing Web User Interfaces with Oracle ADF Faces*
- *Oracle Fusion Middleware Developing Oracle ADF Mobile Browser Applications*
- *Oracle Fusion Middleware Administrator's Guide for Oracle Access Management*
- *Oracle Fusion Middleware Developer's Guide for Oracle Access Management*
- *Oracle Fusion Middleware Securing Applications with Oracle Platform Security Services*
- *Oracle Fusion Middleware Understanding Oracle Web Services Manager*
- *Oracle Fusion Middleware Administering Web Services*

- *Oracle Fusion Middleware Securing Web Services and Managing Policies with Oracle Web Services Manager*
- *Oracle Fusion Middleware Java API Reference for Oracle Mobile Application Framework*
- *Oracle Fusion Middleware Tag Reference for Oracle Mobile Application Framework*
- *Oracle Fusion Middleware Java API Reference for Oracle Web Services Manager*
- Oracle JDeveloper *12c Online Help*
- Oracle JDeveloper *12c Release Notes* (included with your Oracle JDeveloper 12*c* installation and on Oracle Technology Network)

Conventions

The following text conventions are used in this document:

Convention	Meaning
boldface	Boldface type indicates graphical user interface elements associated with an action, or terms defined in text or the glossary.
italic	Italic type indicates book titles, emphasis, or placeholder variables for which you supply particular values.
`monospace`	Monospace type indicates commands within a paragraph, URLs, code in examples, text that appears on the screen, or text that you enter.

Part I

Understanding Mobile Application Framework

Describes MAF concepts, technology, and development approach.

Part I contains the following chapters:

1

Introduction to Oracle Mobile Application Framework

This chapter introduces Oracle Mobile Application Framework (MAF), a solution that enables you to create mobile applications that run natively on both iOS and Android phones and tablets.

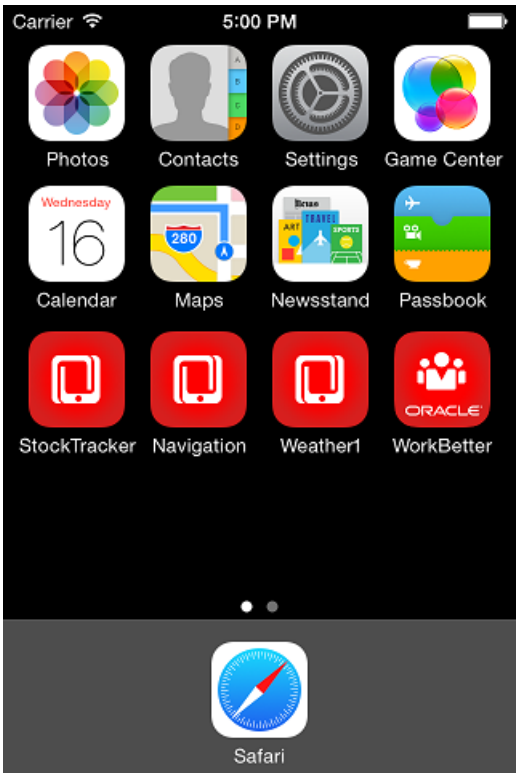
This chapter includes the following sections:

1.1 Introduction to Mobile Application Framework

Oracle Mobile Application Framework is a hybrid mobile architecture, one that uses HTML5 and CSS to render the user interface in the web view, Java for the application business logic, and Apache Cordova to access device features such as GPS activities and e-mail. Because MAF uses these cross-platform technologies, you can build the same application for both Android and iOS devices without having to use any platform-specific tools. After they are deployed to a device, MAF applications behave as applications created using such platform-specific tools as Objective C or the Android SDK. Further, MAF enables you to build the same application for smartphones or for tablets, thereby allowing you to reuse the business logic in the same application and target various types of devices, screen sizes, and capabilities.

The content of a MAF application is comprised of one or more embedded applications known as application features, which are represented as icons within the application's springboard or navigation bar, as shown in Figure 1–1.

Figure 1–1 The Mobile Application Springboard



Application features are essentially the building blocks of a mobile application. Each application feature that is integrated into a MAF application performs a specific set of tasks, and application features can be grouped together to complement each other's functionality. For example, you can pair an application feature that provides customer contacts together with one for product inventory. Because each application feature has its own class loader and web view, features are independent of one another; a single MAF application can be assembled from application features created by several different development teams. Application features can also be reused in other MAF applications. The MAF application itself can be reused as the base for another application, allowing ISVs (independent software vendors) to create applications that can be configured by specific customers.

In addition to hybrid mobile applications that run locally on the device, you can implement application features as any of the following mobile application types, depending on the requirements of a mobile application and available resources:

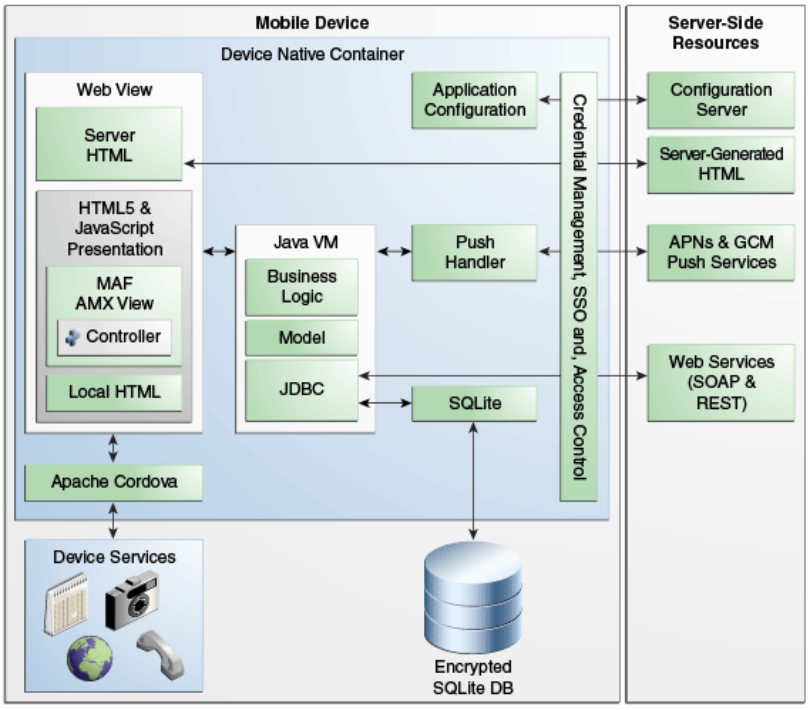
- Mobile web applications—These applications are hosted on a server. Although the code can be portable between platforms, their access to device features and local storage can be limited, as these applications are governed by the device's browser.
- Native applications—These applications are authored in either Xcode or through the Android SDK and are therefore limited in terms of serving both platforms. Reuse of code is likewise limited.

1.2 About the Mobile Application Framework Runtime Architecture

As illustrated in Figure 1–2, Mobile Application Framework is a thin native container which is deployed to a device. It represents the model-view-controller (MVC) development approach, which separates the presentation from the model layer and the controller logic. The thin native container allows the MAF application to function as a

native application on both platforms (iOS, Android) by interacting with the local SQLite database, the Cordova API, and server-side resources. It also enables push notifications.

Figure 1–2 The Oracle Mobile Application Framework Runtime Architecture



- **Web View**—Uses a mobile device's web engine to display and process web-based content. In a MAF application, the web view delivers the user interface by rendering the application markup as HTML 5. You can create the user interface for a mobile application feature by implementing any of the following content types. Application features implemented from various content types can coexist within the same mobile application and can also interact with one another.
  - **MAF AMX Views**—Like an application authored in the language specific to the device's platform, applications whose contents are implemented as MAF Application Mobile XML (AMX) views reside on the device and provide the most authentic device-native user experience. MAF provides a set of code editors that enable you to declaratively create a user interface from components that are tailored to the form factors of mobile devices. You can use these components to create the page layout, such as list view, as well as input components, such as input fields. When you develop MAF AMX views, you can leverage data controls. These components enable you to declaratively create data-bound user interface components, access a web service, and the services of a mobile device (such as camera, GPS, or e-mail). At runtime, the JavaScript engine in the web view renders MAF AMX view definitions into HTML5 and JavaScript. For more information, see Part IV, "Creating the MAF AMX Application Feature."

    Controller—The Controller governs the flow between pages in the mobile application. The Controller enables you to break your application's flow into smaller, reusable task flows and include non-visual components, such as method calls and decision points. For more information, see Section 5.2, "Creating Task Flows."

  - **Server HTML**— The user interface is delivered from server-generated web pages that can open within the application feature's web view. Within the context of Mobile Application Framework, this content type is referred to as *remote URL*. The resources for these browser-based applications do not reside on the device. Instead, the user interface, page flow logic, and business logic are delivered from a remote server. When one of these remotely hosted web applications is allowed to open within the web view, it can use the Cordova JavaScript APIs to access any designated device-native feature or service, such as the camera or GPS capabilities. When implementing an application using the remote URL content, you can leverage an existing browser-based application that has been optimized for mobile use, or use one that has been written specifically for a specific type of mobile device. For applications that can run within the browsers on either desktops or tablets, you can implement the remote URL content using applications created through Oracle ADF Faces rich client-based components. For applications specifically targeted to mobile phones, the remote URL content can be delivered from web pages created using ADF Mobile browser. Not only can applications authored with ADF Mobile browser render on a variety of smartphones, but they can gracefully degrade to the reduced capabilities available on feature phones through user interfaces constructed with Apache Trinidad JavaServer Faces (JSF) components and dynamically selected style sheets. For more information, see Chapter 13, "Implementing Application Feature Content Using Remote URLs."

    Note: Because the content is served remotely, the application is available only as long as the server connection remains active.

  - **Local HTML**—HTML pages that run on the device as a part of the MAF application. Local HTML files can access device-native features services through the Cordova and JavaScript APIs.

- **Cordova**—The Apache Cordova JavaScript APIs that integrate the device's native features and services into a mobile application. Although you can access these APIs programmatically from Java code (or using JavaScript when implementing a MAF mobile application as local HTML), you can add device integration declaratively when you create MAF AMX pages because MAF packages these APIs as data controls.
- **Java Virtual Machine**—Java provides a Java runtime environment for a MAF application. This Java Virtual Machine (JVM) is implemented in device-native code, and is embedded (or compiled) into each instance of the MAF application as part of the native application binary. The JVM is based on the JavaME Connected Device Configuration (CDC) specification.
  - **Business Logic**—Java enables the business logic in MAF applications. Managed Beans are Java classes that can be created to extend the capabilities of Mobile Application Framework, such as providing additional business logic for processing data returned from the server. Managed beans are executed by the embedded Java support, and conform to the JavaME CDC specifications. For more information, see Chapter 7, "Using Bindings and Creating Data Controls."
  - **Model**—Contains the binding layer that connects the business logic components with the user interface. In addition, the binding layer provides the execution logic to invoke REST or SOAP-based web services. For more information, see Section 1.3.1, "About Connected and Disconnected Applications."

  - **JDBC**— The JDBC API enables the model layer to access the data in the encrypted SQLite database through CRUD (Create, Read, Update and Delete) operations.

- **Application Configuration** refers to services that allow application configurations to be downloaded and refreshed, such as URL endpoints for a web service or a remote URL connection. Application configuration services download the configuration information from a WebDav-based server-side service. For more information, see Chapter 9, "Configuring End Points Used in MAF Applications."
- **Credential Management, Single Sign-on (SSO), and Access Control**—Mobile Application Framework handles user authentication and credential management through the Oracle Access Management Mobile and Social (OAMMS) IDM SDKs. MAF applications perform offline authentication, meaning that when users log in to the application while connected, MAF maintains the username and password locally on the device, allowing users to continue access to the application even if the connection to the authentication server becomes unavailable. MAF encrypts the locally stored user information as well as the data stored in the local SQLite database. After authenticating against the login server, a user can access all of the application features secured by that connection. MAF also supports the concept of access control by restricting access to application features (or specific functions of application features) by applying user roles and privileges. For remotely served web content, MAF uses whitelists to ensure that only the intended URIs can open within the application feature's web view (and access the device features). For more information, see Chapter 21, "Securing Mobile Applications."
- **Push Handler**—Enables the MAF application to receive events from the iOS or Android notification servers. The Java layer handles the notification processing.

Resources that interact with the native container include:

- **Encrypted SQLite Database**—The embedded SQLite database that protects locally stored data and is called by the model layer using JDBC. The MAF application generates this lightweight, cross-platform relational database. Because this database is encrypted, it secures data if the device is lost or stolen. Only users who enter the correct user name and password can access the data in the local database. For more information, see Chapter 10, "Using the Local Database."
- **Device Services**—The services and features that are native to the device and integrated into application features through the Cordova APIs.

The device native container enables access to the following server-side resources:

- **Configuration Server** —A WebDav-based server that hosts configuration files used by the application configuration services. The configuration server is delivered as a reference implementation. Any common WebDav services hosted on a J2EE server can be used for this purpose. For more information, see Chapter 9, "Configuring End Points Used in MAF Applications."
- **Server-Generated HTML**—Web content hosted on remote servers used for browser-based application features. For more information, see Chapter 13, "Implementing Application Feature Content Using Remote URLs."
- **APNs and GCM Push Services**—Apple Push Notification Service (APNs) and Google Cloud Messaging (GCM) are the notification providers that send notification events to MAF applications.
- **SOAP and REST Services**—Remotely hosted SOAP- or REST-based web services. These services are accessed through the Java layer.

Note: Application features authored in MAF AMX access REST-XML and SOAP-based data services through data controls.

1.3 About Developing Applications with Oracle Mobile Application Framework

Although the components of a mobile application may be created by a single developer, an application may typically be built from resources provided by different development roles. An application *developer* builds the application data and the user interface logic either as an application or as a reusable program that can be used in an application feature. An application *assembler* gathers different application features into a single application and puts them in a user-friendly, navigable order. An application *deployer* ensures a controlled application deployment. For example, deployment of MAF applications may require certificates and uploads to public vendor sites such as the Apple App Store or GooglePlay.

Note: Depending on the application development team size and your organization, one person may fill many different roles.

Typically, you perform the following activities when building a MAF application:

- Gathering requirements
- Designing
- Developing
- Deploying
- Testing and debugging
- Securing
- Enabling access to the server-side data
- Redeploying
- Retesting and debugging
- Publishing

The steps you take to build a MAF application may be similar to the following:

1. **Gathering requirements**: Create a mobile use case (or user scenario) by gathering user data that describes who the users are, their essential tasks, and the location or context in which they perform them. Consider such factors as the type of information required to complete a task, the information that is available to the user, and how it is accessed or delivered.
2. **Designing**: After you construct a use case, create a wireframe that illustrates all of the steps (and associated user views) in the application's task flow. When creating a task flow, consider how, and when, different users may interact. Does viewing data (such as a push notification) suffice to complete a task? If not, how much data entry does the task require? To frame these tasks within a mobile context, compare completing tasks using a desktop application to a mobile application. A single desktop application may enable multiple functions that might be partitioned into several different mobile applications (or in the context of MAF, several different application features embedded in a mobile application). Because mobile applications are generally used in short bursts (about two minutes at a time), they

must be easily navigable and accommodate the limited data entry of a mobile device.

During the design and development phases, keep in mind that mobile applications may require a set of mobile-specific server side resources, because they may not be able to consume the amount of data delivered through complex web services. In addition, a mobile application may require extensive client side logic to process the copious amounts of data returned by the service.

3. **Developing**: Select the technology that is best suited for application. While the MAF web view supports remote content which may be authored using Apache Trinidad (ADF Mobile browser) or ADF Faces Rich Client components, these applications do not support offline use. Applications authored in MAF AMX, which runs on the client, however, integrate with device services, enabling end users to not only view files and utilize GPS services, but also collaborate with one another by tapping a phone number to call or text. The MAF AMX component set includes data visualization tools (DVTs) that enable you to add analytics that render appropriately on mobile screens. A MAF AMX application supports offline use by transferring data from remote source and storing it locally, enabling end users to view information when they are not connected.

   MAF provides a set of wizards and editors that build not only the basic application itself, but also the application features that are implemented from MAF AMX and local HTML content. Using these tools provides such artifacts as descriptor files for configuring the mobile application and incorporating its application features, a set of default images for splash screens, springboards, navigation bar items that are appropriate to the form-factors of the supported platforms.

   For more information, see the following:

   - Chapter 3, "Getting Started with Mobile Application Development"
   - Chapter 4, "Defining a Mobile Application"
   - Part IV, "Creating the MAF AMX Application Feature"

4. **Deploying**: You deploy the MAF application not only in the context of publishing it to end users, but also for testing and debugging, because MAF applications cannot run until they have been deployed to a device or simulator. Depending on the phase of development, you designate the credential signing options (debug or release). For testing, you deploy the application to a mobile device or simulator. For production, you package it for distribution to application markets such as the Apple App Store or Google Play.

   To deploy an application you first create a deployment profile that describes the target platform and its devices and simulators. Creating a deployment profile includes selecting the splash screen and launch icons used for the application in different orientations (landscape or portrait) and on different devices (phone or tablets). For more information, see Chapter 19, "Deploying Mobile Applications."

5. **Testing and debugging**: During the testing and debugging stage, you optimize the application by deploying it in debug mode to various simulators and devices and then review the debugging output provided through JDeveloper and platform-specific tools. For more information, see Chapter 22, "Testing and Debugging MAF Applications."

6. **Securing**: Evaluate security risks throughout the application development process. While mobile applications have unique security concerns, they share the same vulnerabilities as any application that accesses remotely served data. To ensure client-side security, MAF provides such features as:

- Whitelists that prevent such injection attacks as Cross-Site Scripting (XSS) and Cross-Site Request Forgery (CSRF).
- APIs that generate a strong password to secure access to the SQLite database and encrypt and decrypt its data.
- A set of web service policies that support SSL.
- A `cacerts` file of trusted Certificate Authorities to enforce deployment in SSL

MAF's security configuration includes selecting a login server, such as the Oracle Access Mobile and Social server, or any web page protected by the basic HTTP authentication mechanism, configuring the session management (session and idle timeouts) and also setting the endpoint to the access control service web service, which hosts the application's user roles. For more information, see Chapter 21, "Securing Mobile Applications."

7. **Enabling access to the server-side data**: After ensuring that your application functions as expected at a basic level, you can implement the Java code to access the server-side data. For more information, see Section 1.3.1, "About Connected and Disconnected Applications."
8. **Redeploying**: During subsequent rounds of deployment, ensure that after adding security to your application and enabling access to the server-side data, the application deployment runs as expected and the application is ready for the final testing and debugging.
9. **Retesting and debugging**: During the final round of testing and debugging, focus on the security and the server-side data access functionality, ensuring that their integration into the application did not result in errors and unexpected behavior.
10. **Publishing**: Deploying the application to the production environment typically involves publishing to an enterprise server, the Apple App Store, or Google Play. After you publish the MAF application, end users can download it to their mobile devices and access it by touching the designated icon (see Appendix D, "MAF Application Usage"). The application features bear the designated display icons and display as appropriate to the end user and the user's device.

1.3.1 About Connected and Disconnected Applications

The Java layer enables you to develop MAF applications that can run in connected or disconnected modes. Examples include:

- A basic connected application that includes a user interface backed directly by a web service data control that, in turn, invokes a web service hosted on a server.
- A connected application that uses moderate (or complex) data services. For this type of application, a managed bean backs the user interface logic. The data logic is exposed through a JavaBean data control. The Java classes (POJOs) exposed through these data controls dispatch data queries between the user interface and the service data source. Specifically, these POJOs perform the following functions:
  - Retrieve and persist data from more complex data sources.
  - Handle the data retrieved from a server before it is passed to the user interface.

  When the data source is based on REST-XML or SOAP formats, POJOs persist the data and retrieve it from a REST or web services data control.

  If the application consumes a JavaScript Object Notation (JSON) payload from a REST web service, then neither web service data controls nor SOAP or REST-XML

web services are involved. Instead, you can encapsulate the REST service adapter functions in a POJO that queries and updates the remote data. You then expose the POJO as a JavaBean data control.

- To enable application users to work offline, you can create a disconnected application that uses the SQLite database, which is populated with data. The application manipulates the data stored in the database and also synchronizes the database with the server. The code for these functional areas can be divided into two modules, as follows:
  - The first code module allows the user interface to retrieve data from the local database. JavaBean data controls serve data to the user interface. The JDBC API performs the CRUD operations on the SQLite database.
  - The second code module contains implementation of the Java classes that retrieve data from the server and populate the local database through the JDBC API. This module runs as a background thread if you choose to implement background data synchronization.

Note: These Java classes are exposed as data controls when data is retrieved using REST-XML or SOAP web services. It is called directly if the application consumes JSON responses produced from REST web services.

1.4 Sample Applications

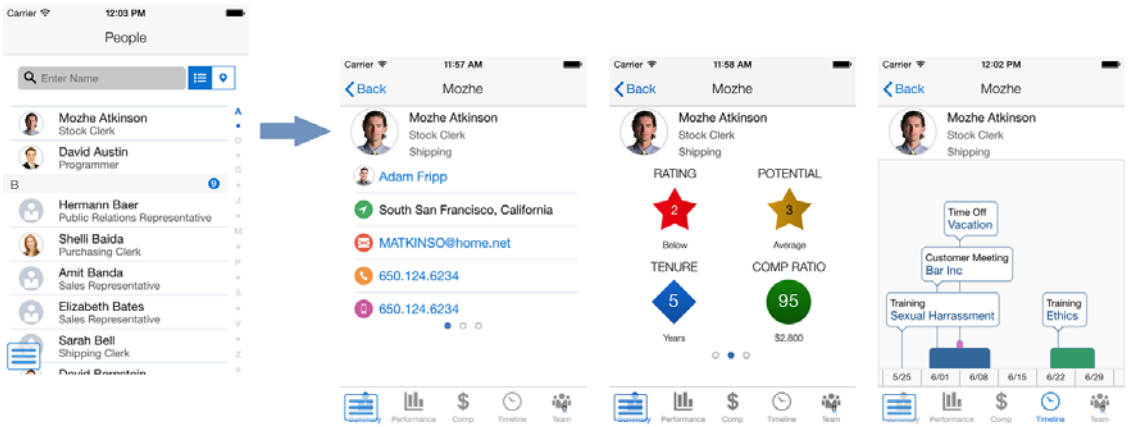
After setting up your development environment (see Chapter 2, "Setting Up the Development Environment"), you can examine the MAF sample applications located in the `PublicSamples.zip` file within the *`jdev_install`*`/jdeveloper/jdev/extensions/oracle.maf/Samples` directory.

The sample applications, such as the WorkBetter application shown in Figure 1–3, illustrate the span of MAF application capabilities, including how applications can interface with remote data using web services and interact with the SQLite database. The sample applications demonstrate the following:

- How to create a basic Hello World application
- How to enable the application to react to lifecycle events
- How to use skinning
- How to develop MAF AMX application features, including the user interface, navigation, managed beans, and data change events

For more information, see Appendix F, "Mobile Application Framework Sample Applications."

Figure 1–3 The WorkBetter Sample Application



Part II

Getting Started

Describes how to set up the development environment for MAF application development and provides instructions on creating a mobile application.

Part II contains the following chapters:

- Chapter 2, "Setting Up the Development Environment"
- Chapter 3, "Getting Started with Mobile Application Development"

2

Setting Up the Development Environment

This chapter provides information on setting up and configuring the Mobile Application Framework (MAF) environment for application development and deployment.

This chapter includes the following sections:

2.1 Introduction to the MAF Environment

Before developing a MAF application, you must set up your development environment by downloading, installing, and configuring various software components.

To set up a typical MAF development environment that consists of an IDE, mobile platform-specific tools, and, possibly, a mobile device, follow steps described in Section 2.2, "Prerequisites for Developing MAF Applications."

2.2 Prerequisites for Developing MAF Applications

Prerequisites for developing an application vary depending on your target platform and the type of work you are planning to do:

- What You Need to Develop an Application for iOS Platform
- What You Need to Develop an Application for Android Platform

You do not need to install any additional tools for creating specific types of MAF application content (HTML, remote URL, or MAF AMX).

2.2.1 What You Need to Develop an Application for iOS Platform

Before you start creating a MAF application for iOS, ensure that you have the following available:

- A computer running Mac OS X

- Oracle JDeveloper (see Section 2.3, "Setting Up JDeveloper").
- Oracle JDeveloper extension for MAF (see Section 2.3, "Setting Up JDeveloper")
- Xcode (see Section 2.4.1, "How to Install Xcode")
- iOS SDK (see Section 2.4.2, "How to Install iOS SDK")

Before you start deploying your application to a development environment (see Chapter 3, "Getting Started with Mobile Application Development"), decide whether you would like to use a mobile device or its simulator: if you are to use a simulator, see Section 2.4.4, "How to Set Up an iPhone or iPad Simulator"; if your goal is to deploy to a mobile device, ensure that, in addition to the components included in the preceding list, you have the following available:

- Various login credentials. For more information, see Chapter 19, "Deploying Mobile Applications."
- iOS-powered device. For more information, see Section 2.4.3, "How to Set Up an iPhone or iPad."

2.2.2 What You Need to Develop an Application for Android Platform

Before you start creating a MAF application for Android, ensure that you have the following available:

- A computer running one of the following operating systems:
  - Microsoft Windows Vista
  - Microsoft Windows 7
  - Mac OS X
- The most recent version of JDK1.7
- Android SDK with Platform 4.0 or later and its tools (see Section 2.5.1, "How to Install the Android SDK")
- Oracle JDeveloper (see Section 2.3, "Setting Up JDeveloper")
- Oracle JDeveloper extension for MAF (see Section 2.3, "Setting Up JDeveloper")

Before you start deploying your application to a development environment (see Chapter 3, "Getting Started with Mobile Application Development"), decide whether you would like to use a mobile device or its emulator: if you are to use an emulator, see Section 2.5.3, "How to Set Up an Android Emulator"; if your goal is to deploy to a mobile device, ensure that, in addition to the components included in the preceding list, you have the following available:

- Various login credentials. For more information, see Chapter 19, "Deploying Mobile Applications."
- Android-powered device. For more information, see Section 2.5.2, "How to Set Up an Android-Powered Device."

2.2.3 What You May Need to Know About Supported IDEs

It is possible to use IDEs other than JDeveloper for MAF application development. One of these IDEs is Eclipse (see `https://www.eclipse.org/downloads`), and to use it you would need to install Oracle Enterprise Pack for Eclipse (OEPE) extension (see `http://www.oracle.com/technetwork/developer-tools/eclipse/overview/index.html`).

2.2.4 What You May Need to Know About Migrating Plug-Ins

Since PhoneGap was absorbed by Apache Cordova, if you have any PhoneGap plug-ins installed, you need to perform the migration to Cordova 2.2 versions of those plug-ins.

2.3 Setting Up JDeveloper

Oracle JDeveloper and its MAF extension are essential tools used in developing MAF applications.

Before you begin:

Consult the Certification and Support Matrix on the MAF documentation page at `http://www.oracle.com/technetwork/developer-tools/maf/documentation/` to determine which release of Oracle JDeveloper is compatible with software listed in Section 2.2, "Prerequisites for Developing MAF Applications" for your target platform.

Download and install the appropriate release of Oracle JDeveloper. Select the Studio Developer (All Features) role when prompted.

Consult the following documentation:

- If your target platform is iOS, see the section about using Oracle JDeveloper on the Mac OS X platform in *Oracle Fusion Middleware Installation Guide for Oracle JDeveloper*.
- If your target platform is Android, see *Oracle Fusion Middleware Installation Guide for Oracle JDeveloper*.

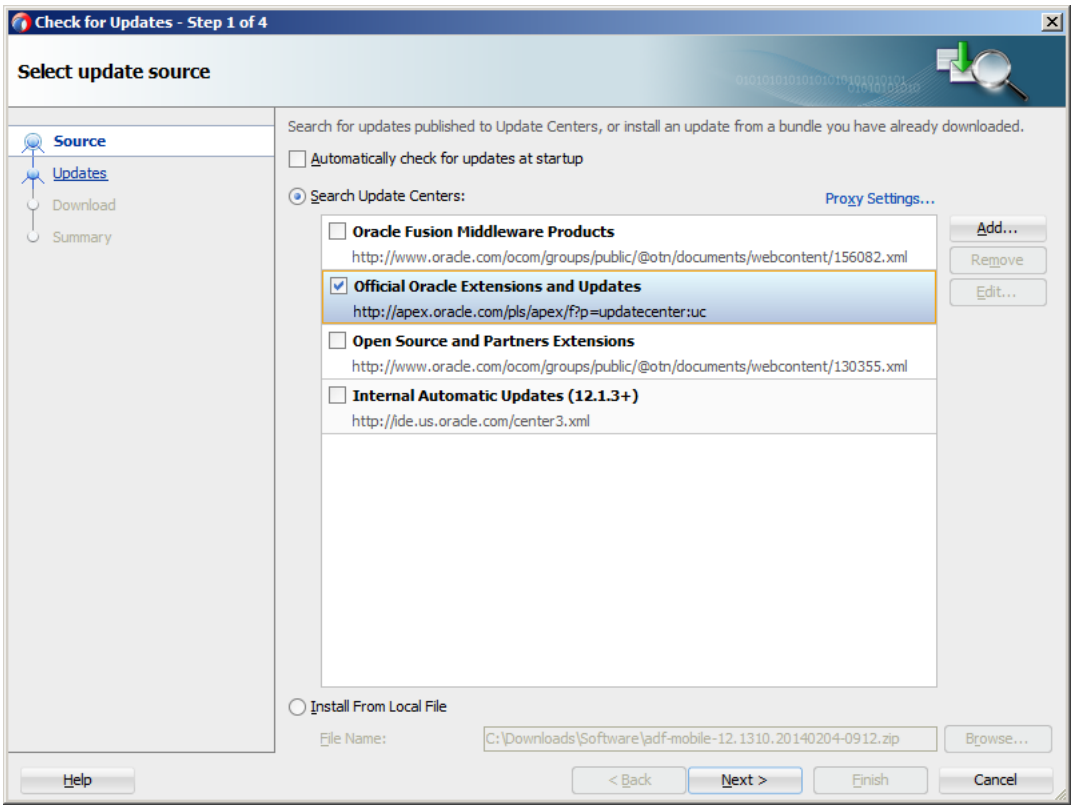
To download and install the MAF extension:

1. In JDeveloper, choose **Help** > **Check for Updates**.

   Note: You might need to configure proxy settings by selecting **Tools > Preferences** from the main menu, and then **Web Browser and Proxy** from the tree on the left of the **Preferences** dialog.

2. In the **Select update source** page that Figure 2–1 shows, select **Official Oracle Extensions and Updates** under the **Search Update Centers**, and then click **Next**.

Figure 2–1 Checking for Updates in JDeveloper

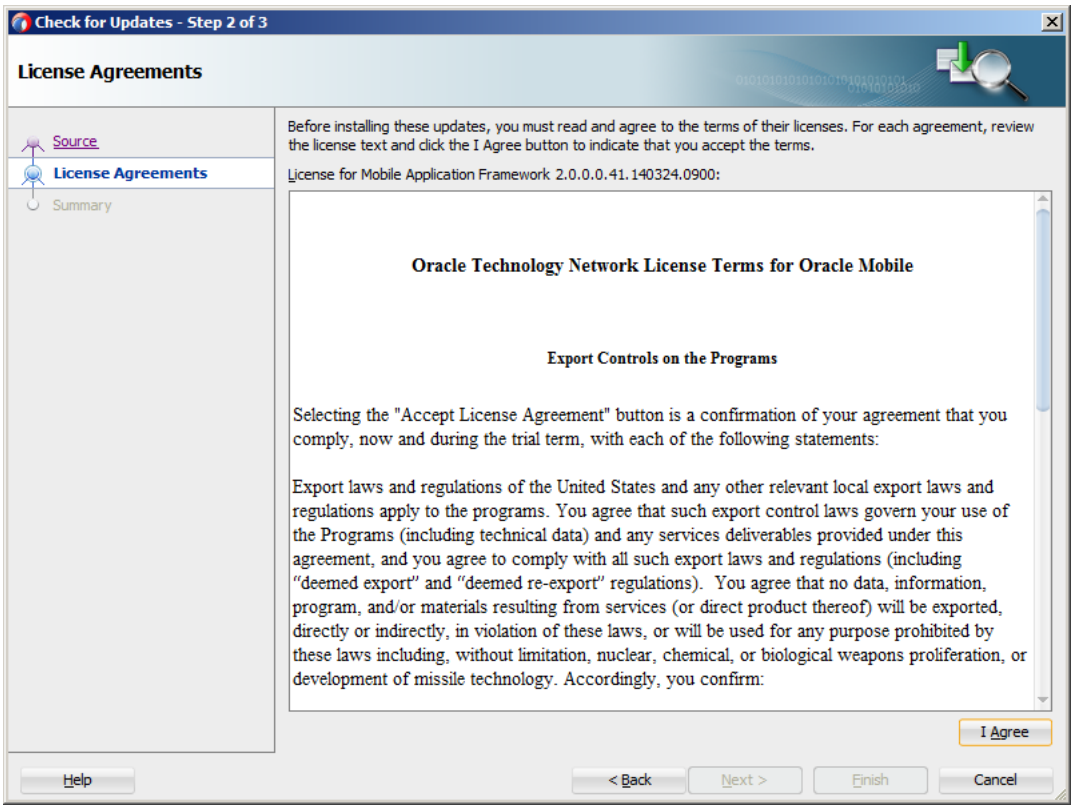


3. In the **Select updates to install** dialog, select the **Mobile Application Framework** update.
4. In the **License Agreements** page, shown in Figure 2–2, review *The Oracle Technology Network License Terms for Oracle Mobile*.

> **Note:** You must comply with all of the license terms and conditions with respect to the Oracle Mobile Application Framework Program available at `http://www.oracle.com/technetwork/indexes/downloads/index.html`.

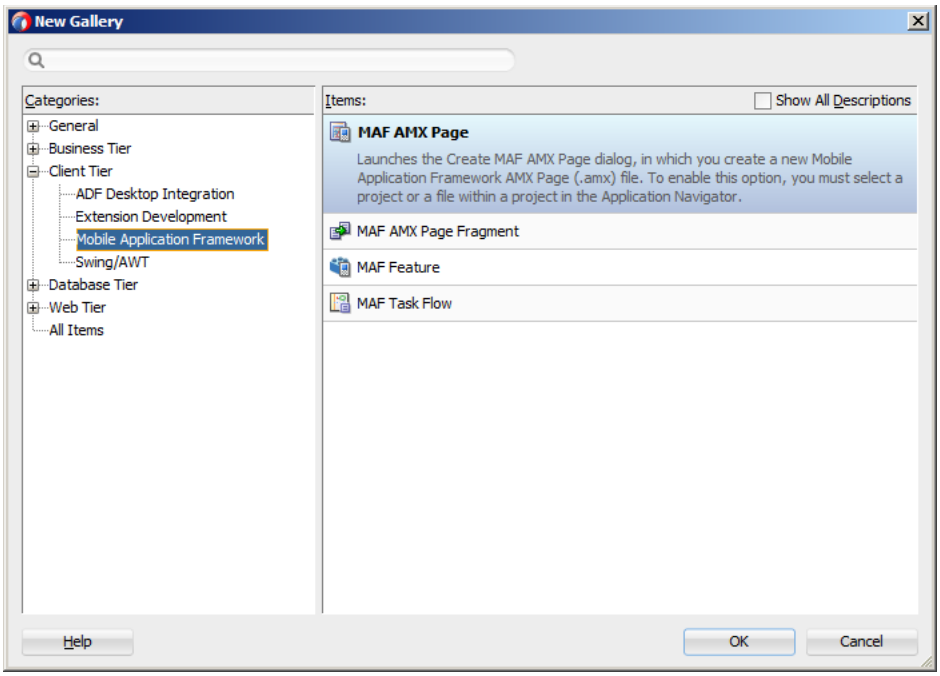
5. Click **I Agree**.

Figure 2–2 Licensing Agreements for Oracle Mobile Application Framework Program



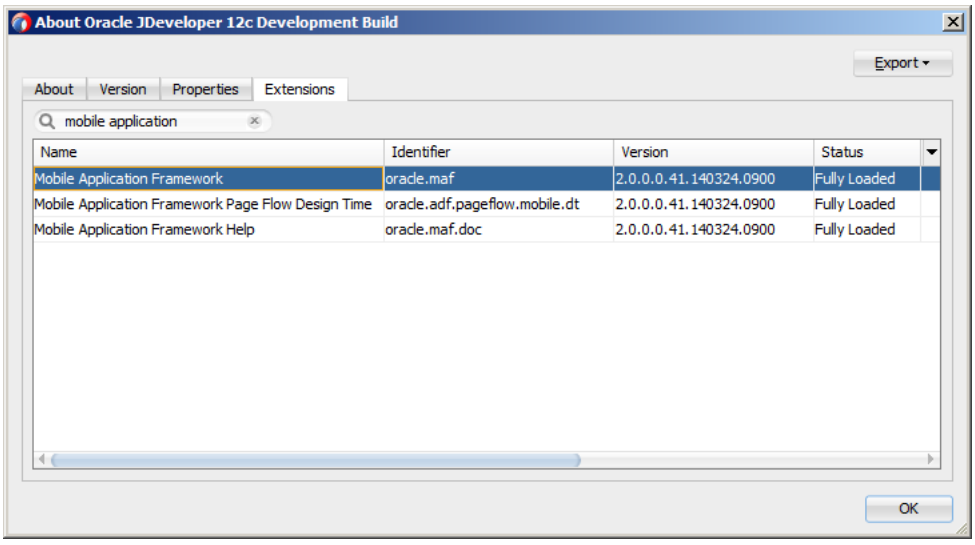
6. Click **Next**, and then click **Finish**.
7. Restart JDeveloper.
8. Check whether or not MAF was successfully added to JDeveloper:
   - Select **File > New > From Gallery** from the main menu to open the **New Gallery** dialog.
   - In the **Categories** tree on the left, expand the **Client Tier** node and make sure it contains **Mobile Application Framework** (see Figure 2–3).

Figure 2–3 Verifying MAF Installation



In addition, verify that you installed the correct version of MAF. To do so, select **Help > About** from the main menu, then select the **Extensions** tab on the About Oracle JDeveloper dialog, and then examine the extension list entries by searching for **Mobile Application Framework**, as Figure 2–4 shows.

Figure 2–4 Verifying MAF Version



In addition to the preceding steps, your development environment must be configured for target platforms and form factors. For more information, see Section 2.3.1, "How to Configure the Development Environment for Platforms and Form Factors."

2.3.1 How to Configure the Development Environment for Platforms and Form Factors

Before you start developing and deploying a MAF application, you may need to configure JDeveloper Preferences for appropriate platforms (see Section 2.3.1.2, "Configuring the Environment for Target Platforms") and form factors (see Section 2.3.1.1, "Configuring the Environment for Form Factors").

2.3.1.1 Configuring the Environment for Form Factors

A form factor is a specific device configuration. Each form factor is identified by a name that you specify for it and contains information on the specified resolution denoted by pixel width and pixel height.

Since form factors defined in preferences are used in the MAF AMX page Preview tab (see Section 5.3.2.2, "Using the Preview"), you may choose to perform this configuration if you are planning to include a MAF AMX application feature as part of your MAF application and you do not want to accept the default settings. During development, you can select or switch between various form factors to see how a MAF AMX page is rendered. You can also see multiple form factors applied to the same page using the split screen view.

For more information, see Section 4.12.1, "About the maf-config.xml File."

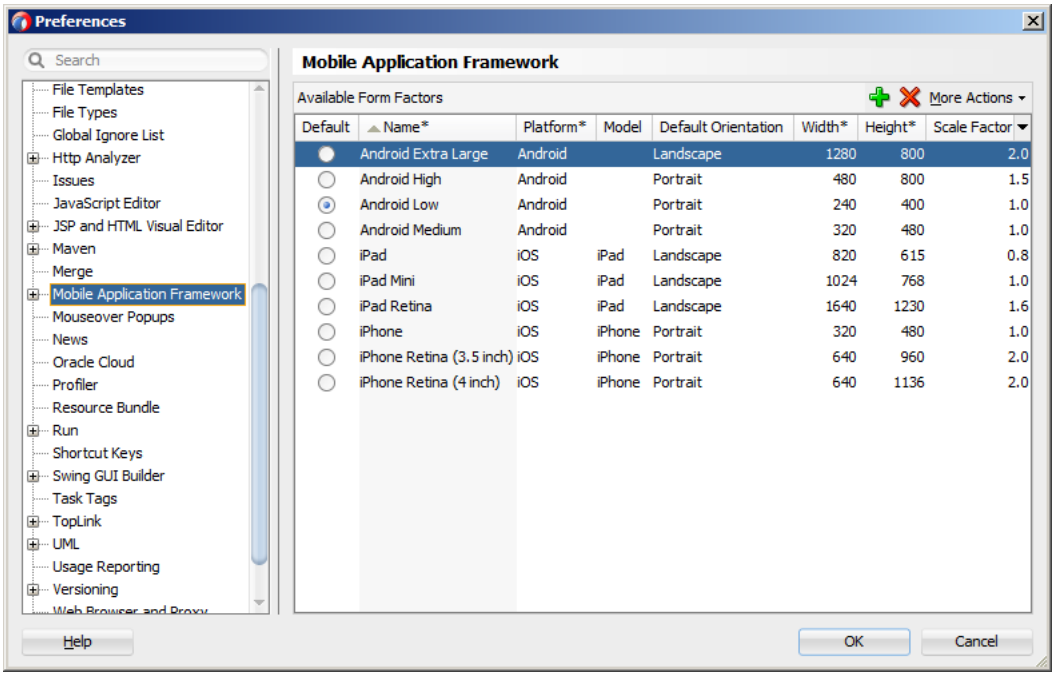
Before you begin:

Download and install JDeveloper and the MAF extension, as described in Section 2.3, "Setting Up JDeveloper."

To configure the form factors:

1. Open Preferences by selecting **Tools > Preferences** from the main menu in JDeveloper.
2. In the **Preferences** dialog that Figure 2–5 shows, select **Mobile Application Framework** from the tree on the left.

Figure 2–5 Defining Form Factors



The **Mobile Application Framework** page is populated with available form factors and the default is set to Android Low.

This preference page allows you to create and manage a set of named form factors that combine a screen resolution size and platform.

3. To create a new form factor, click the green plus sign (New), and then set the following:
   - **Name**: a meaningful string that is used to identify the form factor.
   - **Platform**: the platform of the mobile device.
   - **Model**: the type of the mobile device.
   - **Default Orientation**: the default device orientation used in the MAF AMX page Preview tab. It might be Portrait or Landscape. Select this setting from the drop-down list of values. The default value is Portrait and it is prepopulated during creation of the new form factor.
   - **Width**: width, in pixels. This value must be a positive integer, and its input is validated.
   - **Height**: height, in pixels. This value must be a positive integer, and its input is validated.
   - **Scale Factor**: the display scale factor. This value must be either one of 1.0, 2.0, or 3.0.

   Note: If you do not set the name and resolution for your form, MAF will display an error message.

4. If you need to revert to default settings, click **More Actions > Restore Defaults**.
5. Click **OK** to finalize your settings.

2.3.1.2 Configuring the Environment for Target Platforms

For successful packaging and deployment of your application to target platforms supported by MAF, JDeveloper must be provided with such information as the name of the platform and directories on your development computer that are to house the platform-specific tools and data. For convenience, MAF prepopulates JDeveloper Preferences with these settings. Depending on several factors related to the application signing, you may need to edit some of the fields.

Before you begin:

Download and install JDeveloper and the MAF extension, as described in Section 2.3, "Setting Up JDeveloper."

Depending on your target platform, download and configure either the Android SDK (see Section 2.5.1, "How to Install the Android SDK") or iOS SDK and Xcode (see Section 2.4.2, "How to Install iOS SDK" and Section 2.4.1, "How to Install Xcode").

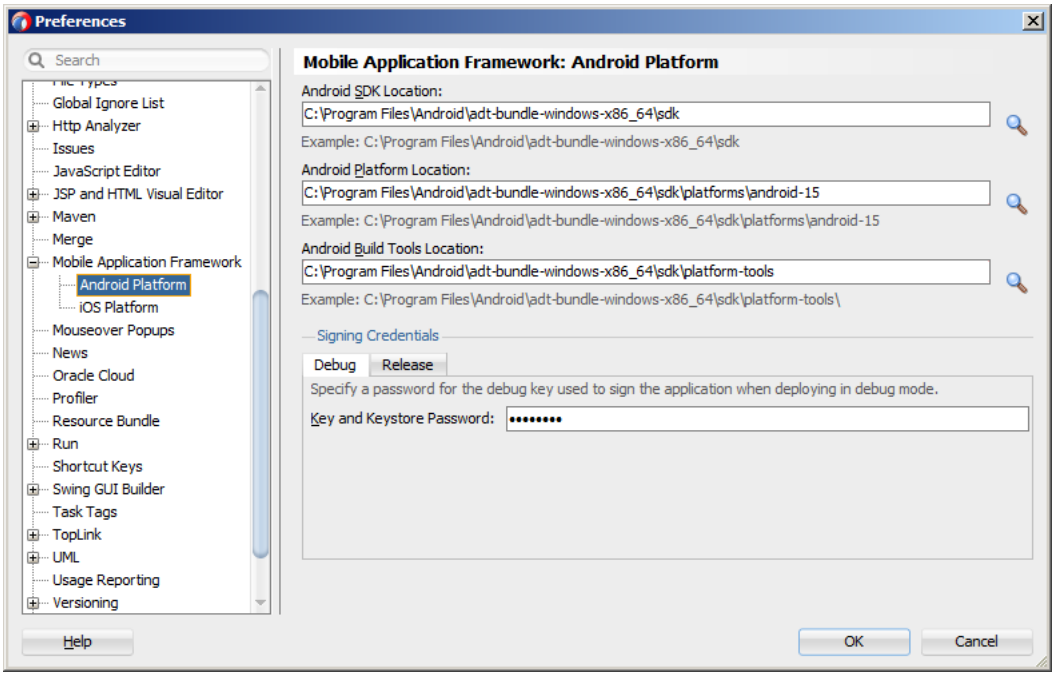
To configure your environment for target platforms:

1. Select **Tools > Preferences** from JDeveloper's main menu to open Preferences.
2. In the **Preferences** dialog that Figure 2–5 shows, select either **Mobile Application Framework > Android Platform** or Mobile Application Framework > iOS Platform from the tree to open a page that contains the path and configuration parameters for the supported platforms, as Figure 2–6 and Figure 2–7 show.

Each platform-specific page hosts the preferences for the platform SDK (Android or iOS), collecting any necessary information such as the path that MAF needs to compile and deploy either Android or iOS projects:

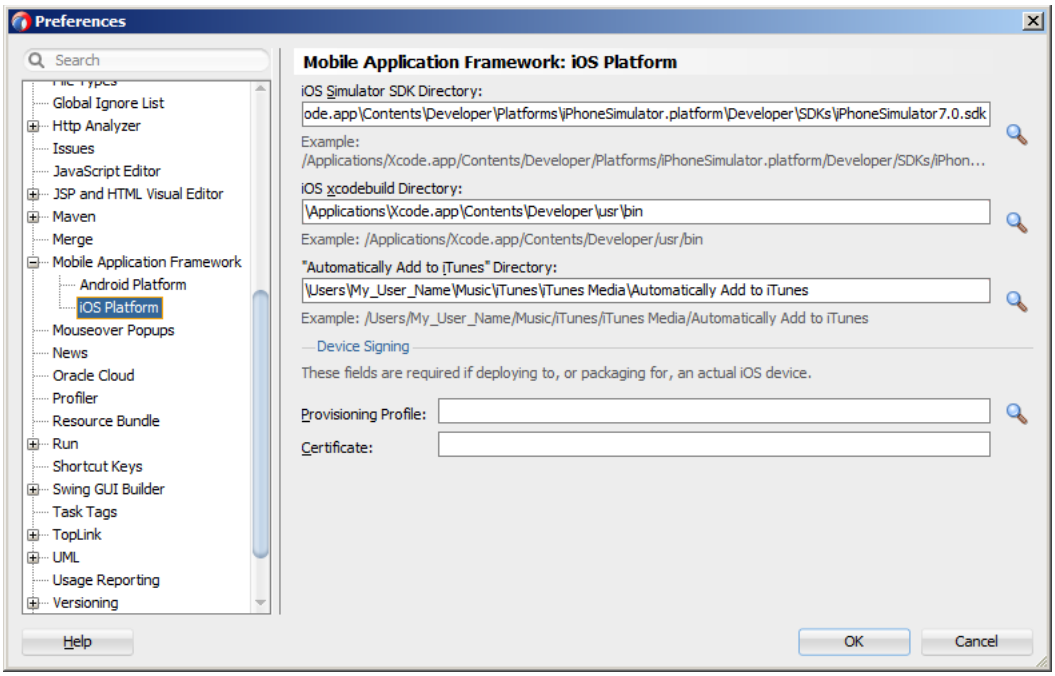
- For Android platform, specify the Android SDK location on your computer, the local directory of your target Android platform, and provide information on the signing credentials (see Figure 2–6).

Figure 2–6 Configuring Platform Preferences for Android



- For iOS platform (see Figure 2–7), specify the following:
  - iOS Simulator SDK location on your Mac OS-powered computer
  - Location of the Xcodebuild utility (see Section 19.4.1, "How to Deploy an iOS Application to an iOS Simulator")
  - Location of the iTunes media files, including the mobile applications that are synchronized to the iOS-powered device
  - The iOS-powered device signing information (see Section 19.2.4.2, "Setting the Device Signing Options")

Figure 2–7 Configuring Platform Preferences for iOS



2.4 Setting Up Development Tools for iOS Platform

In addition to general-purpose tools listed in Section 2.2, "Prerequisites for Developing MAF Applications," you might want to set up an iPhone or iPad when getting ready for development of a MAF application for the iOS platform (see Section 2.4.3, "How to Set Up an iPhone or iPad").

Since iPhone and iPad simulators are included in the iOS SDK installation, you do not need to separately install them. For more information, see Section 2.4.4, "How to Set Up an iPhone or iPad Simulator."

2.4.1 How to Install Xcode

You download Xcode from `http://developer.apple.com/xcode/`.

After installing Xcode, you have to run it at least once and complete the Apple licensing and setup dialogs. If these steps are not performed, any build and deploy cycle from JDeveloper to Xcode or device simulator will fail with a "Return code 69" error.

> **Note:** Since older versions of Xcode are not available from the Mac App Store, in order to download them you must obtain an Apple ID from `http://appleid.apple.com`, and then register this Apple ID with the Apple Developer Program to gain access to the Apple developer site at `http://developer.apple.com`.

2.4.2 How to Install iOS SDK

You download iOS SDK from the iOS Dev Center at `http://developer.apple.com/devcenter/ios/`.

Note: Since older versions of iOS SDK are not available from the Mac App Store, in order to download them you must obtain an Apple ID from `http://appleid.apple.com`, and then register this Apple ID with the Apple Developer Program to gain access to the Apple developer site at `http://developer.apple.com`.

2.4.3 How to Set Up an iPhone or iPad

In your MAF application development and deployment, you can use either the iPhone, iPad, or their simulators (see Section 2.4.4, "How to Set Up an iPhone or iPad Simulator"). If you are planning to use an actual iPhone or iPad, which is preferable for testing (see Section 22.2, "Testing MAF Applications"), you need to connect it to your computer to establish a link between the two devices.

To deploy to an iOS-powered device, you need to have an iOS-powered device with a valid license, certificates, and distribution profiles. For more information, see Chapter 19, "Deploying Mobile Applications."

Note: Since Apple's licensing terms and conditions may change, ensure that you understand them, comply with them, and stay up to date with any changes.

2.4.4 How to Set Up an iPhone or iPad Simulator

In your MAF application development and deployment, you can use either the iOS-powered device itself (see Section 2.4.3, "How to Set Up an iPhone or iPad") or its simulator. Deploying to a simulator is usually much faster than deploying to a device, and it also means that you do not have to sign the application first.

A simulator can be invoked automatically, without any additional setup.

Note: Before attempting to deploy your application from JDeveloper to a device simulator, you must first run the simulator.

If you are planning to use web services in your application and you are behind a corporate firewall, you might need to configure the external network access. You do so by modifying the network settings in the System Preferences on your development computer. For more information, see Section 8.7, "Configuring the Browser Proxy Information."

2.5 Setting Up Development Tools for Android Platform

In addition to the general-purpose tools listed in Section 2.2, "Prerequisites for Developing MAF Applications," you might want to set up an Android-powered device when getting ready for development of a MAF application for the Android platform (see Section 2.5.2, "How to Set Up an Android-Powered Device").

Since emulators are included in the Android SDK installation, you do not need to separately install them. However, you cannot use an emulator until you create its configuration (see Section 2.5.3, "How to Set Up an Android Emulator").

To develop for the Android platform, you can use any operating system that is supported by both JDeveloper and Android.

For more information, see the "Developer Tools" section of the Android Developers website at http://developer.android.com/tools/index.html.

2.5.1 How to Install the Android SDK

Android SDK includes development tools that you need to build applications for Android-powered devices. Since the Android SDK is modular, it allows you to download components separately depending on your target Android platform and your application requirements.

When choosing the platform, keep in mind that MAF supports Android 4.0 or later.

Before you begin:

Ensure that your environment meets the operating system, JDK version, and hardware requirements listed in the "Get the Android SDK" section of the Android Developers website at http://developer.android.com/sdk/index.html.

> **Note:** Ant and Linux requirements are not applicable to the MAF development environment; Eclipse might be applicable depending on your IDE of choice.

To install the Android SDK:

1. Download the Android SDK starter package from http://developer.android.com/sdk/index.html.
2. Complete the installation by following the instructions provided in the "Setting Up an Existing IDE" section of the Android Developers website at http://developer.android.com/sdk/installing.html.

> **Note:** If you are not planning to use Eclipse, skip step 3 in the Android SDK installation instructions.

2.5.2 How to Set Up an Android-Powered Device

In your MAF application development and deployment, you can use either the Android device itself, which is preferable for testing (see Section 22.2, "Testing MAF Applications"), or an emulator (see Section 2.5.3, "How to Set Up an Android Emulator").

For information on how to set up the Android-powered device, follow the instructions from the "Using Hardware Devices" section of the Android Developers website at http://developer.android.com/tools/device.html.

> **Note:** You might experience issues when using USB connectivity for the device-based debugging. For more information, see Section 22, "Testing and Debugging MAF Applications."

Your target Android-powered device might not be listed in the USB device driver's `.inf` file, resulting in the failure to install the Android Debug Bridge (ADB). You can eliminate this issue as follows:

1. Find the correct values for your device.

2. Update the `[Google.NXx86]` and `[Google.NTamd64]` sections of the `android_winusb.inf` file.

For more information, see the "Google USB Driver" section of the Android Developers website at `http://developer.android.com/sdk/win-usb.html`.

2.5.3 How to Set Up an Android Emulator

In your MAF application development and deployment, you can use either the Android device itself (see Section 2.5.2, "How to Set Up an Android-Powered Device") or its emulator. Deploying to an emulator is usually much faster than deploying to a device, and it also means that you do not have to sign the application first.

For information on how to create an emulator configuration called Android Virtual Device (AVD), follow the instructions from the "Managing Virtual Devices" section of the Android Developers website at `http://developer.android.com/tools/devices/index.html`. When creating an AVD through the Create New Android Virtual Device dialog (see "Managing AVDs with AVD Manager" at `http://developer.android.com/tools/devices/managing-avds.html`), review all the settings to ensure that configuration matches what you are planning to emulate. In particular, you should verify the following

- The Target field should define the desired Android platform level for proper emulation.
- The CPU/ABI field should reflect the Intel Atom system image (see Section 2.5.3.2.1, "Configuring AVD for Intel HAXM").
- The SD card field should be defined based on whether the application uploads files or files install themselves to the SD card.
- Default settings for the Hardware field (see the "Hardware Options" table at `http://developer.android.com/tools/devices/managing-avds.html#hardwareopts`) should be acceptable for a typical MAF application. For additional hardware capabilities you may want to use in your application, such as cameras or geolocation services, create new properties.

You need to create an AVD for each Android platform on which you are planning to test your application.

For information on how to use the emulator, see the "Using the Android Emulator" section in the Android Developers website at `http://developer.android.com/tools/devices/emulator.html`.

2.5.3.1 Configuring the Android Emulator

After the basic Android emulator setup is complete, you may choose to perform the following configurations:

- Save the emulator state (see Section 2.5.3.1.1, "Saving the Emulator State")
- Create, save, and reuse the SD card (see Section 2.5.3.1.2, "Creating, Saving, and Reusing the SD Card")
- Configure the network (see Section 2.5.3.1.3, "Configuring the Network")
- Configure the network proxy (see Section 2.5.3.1.4, "Configuring the Network Proxy")

2.5.3.1.1 Saving the Emulator State You can reduce the emulator's load time by saving the emulator state or reusing the saved state. To do so, you manipulate the `avd` files or

folders that are located in the `C:\Users\username\.android\avd` directory (on a Windows computer). Each `avd` folder contains several files, such as `userdata.img`, `userdata.qemu.img`, and `cache.img`. You can copy the `cache.img` file to another emulator's `avd` folder to use that state with another emulator.

Alternatively, you can use the command line to run relevant commands, such as, for example, `-snapshot-list`, `-no-snapstorage`, and so on. You can access these commands through `emulator -help` command.

> **Caution:** When using this utility, keep in mind that in the process of loading, all contents of the system, including the user data and SD card images, will be overwritten with the contents they held when the snapshot was made. Unless saved in a different snapshot, any changes will be lost.

2.5.3.1.2 Creating, Saving, and Reusing the SD Card The "SD Card Emulation" section of the Android Developers website at http://developer.android.com/tools/devices/emulator.html#sdcard lists reasons for creating, saving, and reusing the SD card. You can perform these operations by executing the following commands:

- To create an SD card:

  ```
  C:\android sdk directory\tools>mksdcard -l SD500M 500M C:\Android\sd500m.img
  ```

- To list existing AVDs:

  ```
  C:\android sdk directory\tools>android list avd
  ```

  This produces a listing similar to the following:

  ```
  Name:    AndroidEmulator1
  Device:  Nexus S (Google)
  Path:    C:\Users\username\.android\avd\AndroidEmulator1.avd
  Target:  Android 4.2.2 (API level 17)
  Tag/ABI: default/x86
  Skin:    480x800
  ------------
  Name:    AndroidEmulator2
  Device:  Nexus S (Google)
  Path:    C:\Users\username\.android\avd\AndroidEmulator2.avd
  Target:  Android 4.2.2 (API level 17)
  Tag/ABI: default/armeabi-v7a
  Skin:    480x800
  Sdcard:  500M
  ```

- To start the AndroidEmulator2 with the SD card that has just been created:

  ```
  C:\Android\android sdk directory\tools>emulator -avd AndroidEmulator2 -sdcard
  C:\Android\sd500m.img
  ```

- To list the running Android emulator instances:

  ```
  C:\Android\android sdk directory\platform-tools>adb devices
  ```

- To copy a test image to the SD card (this requires the emulator to restart):

  ```
  C:\Android\sdk\platform-tools>adb push test.png sdcard/Pictures
  85 KB/s (1494 bytes in 0.017s)
  ```

For more information, see the Android Tools Help at http://developer.android.com/tools/help/index.html.

2.5.3.1.3 Configuring the Network From the Android emulator, you can access your host computer through the 10.0.2.2 IP. To connect to the emulator from the host computer, you have to execute the `adb` command from a command line on your development computer or from a script to set up the port forwarding.

To forward socket connections, execute

```
adb forward local remote
```

using the following forward specifications:

- `tcp:port`
- `localabstract:unix domain socket name`
- `localreserved:unix domain socket name`
- `localfilesystem:unix domain socket name`
- `dev:character device name`
- `jdwp:process pid` (remote only)

For example, an arbitrary client can request connection to a server running on the emulator at port 55000 as follows:

```
adb -e forward tcp:8555 tcp:55000
```

In this example, from the host computer, the client would connect to `localhost:8555` and communicate through that socket.

For more information, see the "Android Debug Bridge" section in the Android Developers website at http://developer.android.com/tools/help/adb.html.

2.5.3.1.4 Configuring the Network Proxy If your development computer is behind a corporate firewall, you might need to configure a proxy by using one of the following technics:

1. Execute this command to start the emulator and initiate its connection with the browser:

   ```
   emulator -avd myavd -http-proxy myproxy
   ```

2. Start the emulator and then use its Settings utility as follows:
   1. Select Wireless & Networks
   2. Select Mobile Networks > Access Point Names
   3. Select the appropriate internet option
   4. Set the proxy, port, username, and password using the Edit access point list

2.5.3.2 Speeding Up the Android Emulator

The Intel Hardware Accelerated Execution Manager (Intel HAXM) is designed to accelerate the Android-powered device emulator by making use of Intel drivers.

The Intel HAXM is available for computers running Microsoft Windows, Mac OS X, and a separate kernel-based virtual machine option (KRM) for Linux. See http://software.intel.com/en-us/android/articles/intel-hardware-

accelerated-execution-manager to access installation guides and detailed descriptions of system requirements for each operating system.

Regardless of which operating system your development computer is running on, it must have the following:

- Version 17 or later of the Android SDK installed (see Section 2.5.1, "How to Install the Android SDK").
- Intel processor with support for Intel VT-x, EM64T and Execute Disable (XD) Bit functionality at the BIOS level.
- At least 1 GB of available RAM.

To download the Intel HAXM, either use the Android SDK Manager (see *Speeding Up the Android Emulator on Intel Architecture*) or use the following Intel locations:

- Download for Microsoft Windows
- Download for Mac OS X
- Download for Linux

To install the Intel HAXM, follow steps described in the "Speeding Up the Android Emulator on Intel Architecture" article available at http://software.intel.com/en-us/android/articles/speeding-up-the-android-emulator-on-intel-architecture. Particularly important is to configure AVD (see Section 2.5.3.2.1, "Configuring AVD for Intel HAXM").

If your development computer is running either Microsoft Windows 8.*n* or later, or Mac OS X 10.9.*n* or later, you have to apply a Hotfix provided by Intel before using emulator with the Intel HAXM.

> **Note:** If you do not apply the Hotfix, your computer will freeze and you will loose your work.

To download the Hotfix, use the following locations:

- Download for Microsoft Windows
- Download for Mac OS X

For more information, see the following:

- *Installation Guide and System Requirements - Windows*
- *Installation Guide and System Requirements - Mac OS X*
- *Installation Guide and System Requirements - Linux*

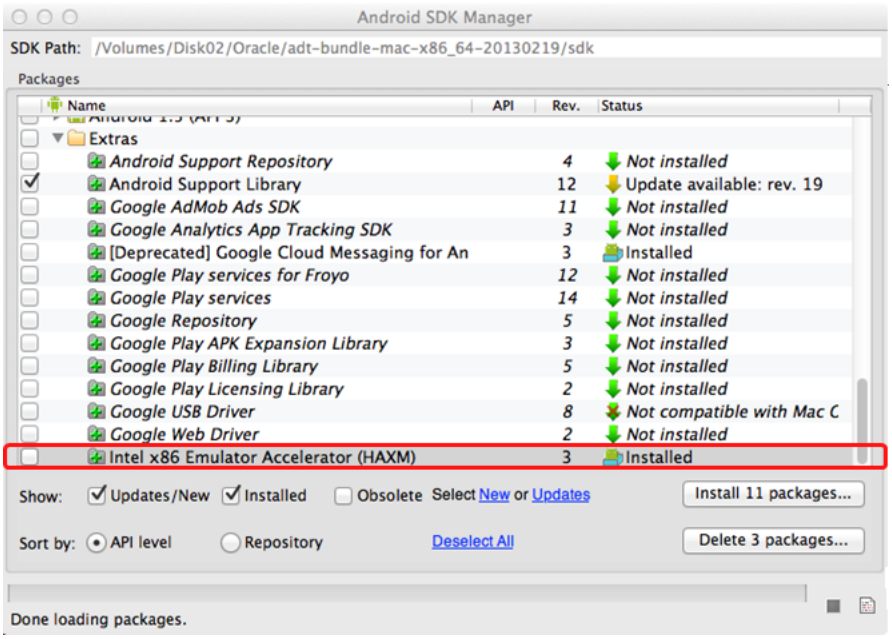
2.5.3.2.1 Configuring AVD for Intel HAXM

When enabling the Intel HAXM, ensure that you download the Intel system image for the Android API level using the Android SDK Manager (see Figure 2–8). As described in *Speeding Up the Android Emulator on Intel Architecture*:

- After you have installed the Android SDK, open the SDK Manager and then find the Intel HAXM in the extras section.
- Select **Intel x86 Emulator Accelerator (HAXM)** and click **Install packages**.

  Once you have installed the package, the status changes to Installed, which is not accurate: the SDK only copies the Intel HAXM executable on your computer; you have to manually install the executable.

Figure 2–8 Downloading Intel System Image in Android SDK Manager

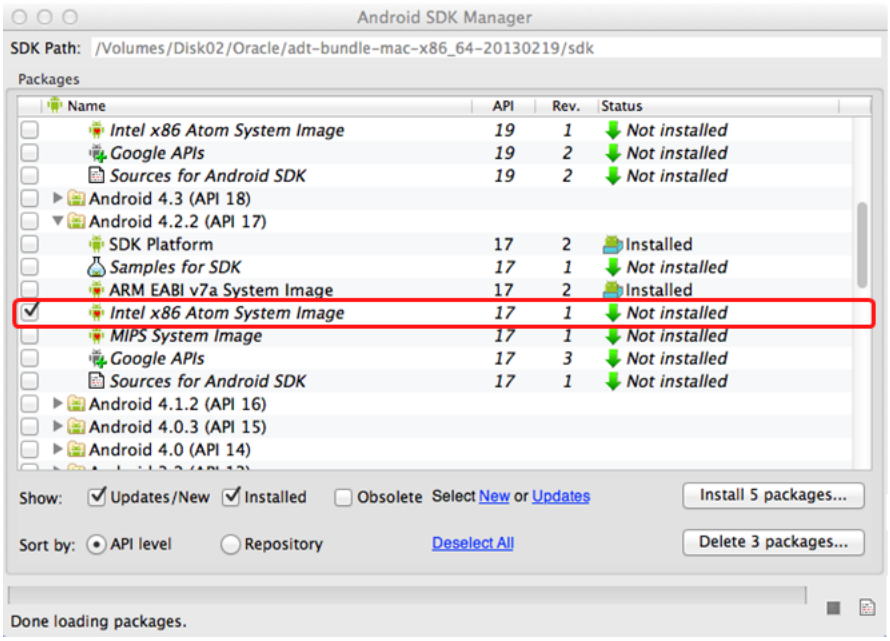


- To install the Intel HAXM executable, depending on your development platform search your hard drive for one of the following:
  - On Windows, search for `IntelHaxm.exe`
  - On Mac OS X, search for `IntelHaxm.dmg`

  If you accepted default settings, the executable should be located at `C:\Program Files\Android\android-sdk\extras\Intel\Hardware_Accelerated_Execution_Manager\IntelHaxm.exe` on Windows.

The Intel HAXM only functions in combination with one of the Intel Atom processor x86 system images, which are available for Android 2.3.3 (API 10), 4.0.3 (API 15), 4.1.2 (API 16), 4.2.2 (API 17). These system images can be installed exactly like the ARM-based images through the Android SDK Manager.

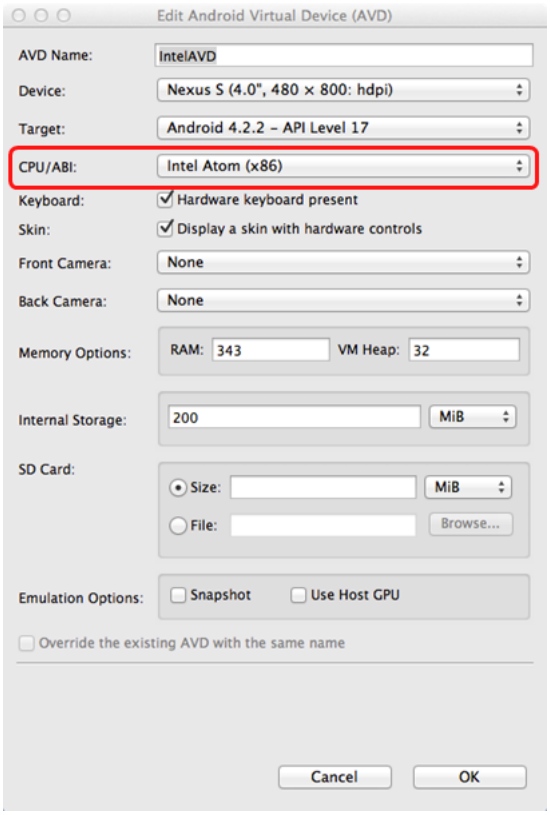
Figure 2–9 Installing Intel Atom System Image



To complete the process, use the AVD Manager to create a new virtual device that has hardware-accelerated emulation by selecting **Intel Atom (x86)** as the CPU/ABI, (see Figure 2–10).

Note: This option appears in the list only if you have the Intel x86 system image installed.

Figure 2–10 Creating Accelerated AVD



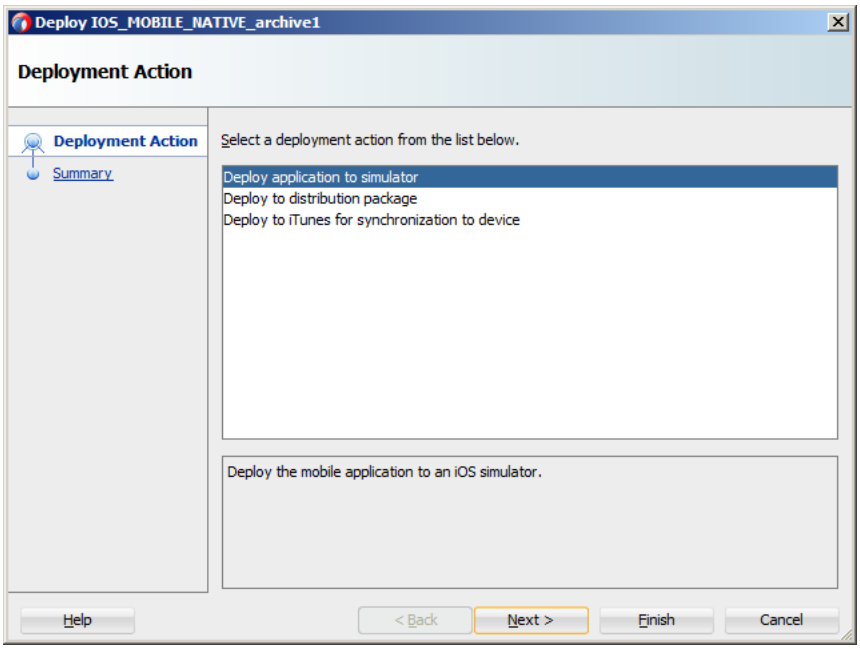
2.6 Testing the Environment Setup

You can test your environment setup as follows:

1. In JDeveloper, open the HelloWorld sample application by selecting the `HelloWorld.jws` file (see Appendix F, "Mobile Application Framework Sample Applications").
2. Select Application > Deploy from the main menu.

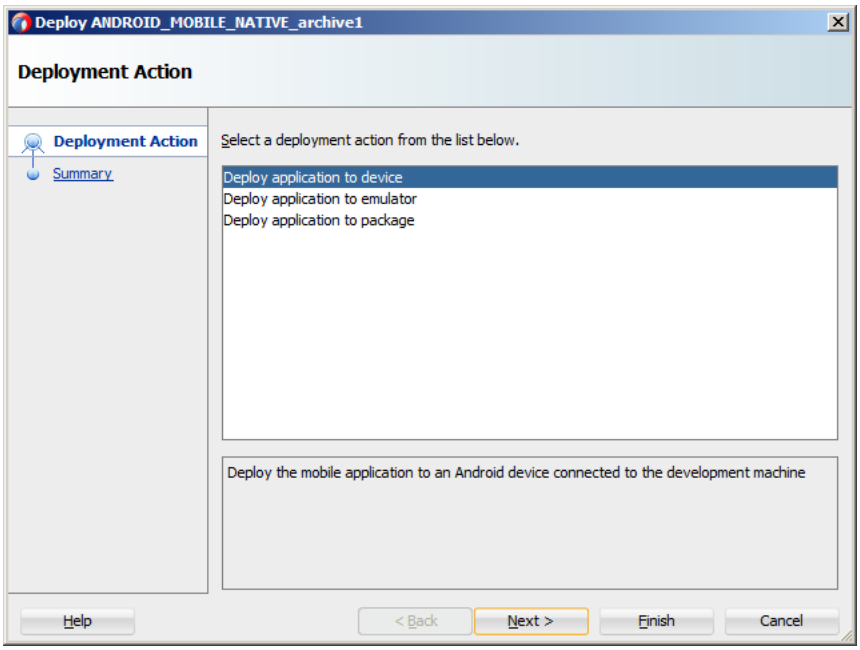
   For more information, see Chapter 19, "Deploying Mobile Applications."
3. From the drop-down menu, select the deployment profile for the platform to which you wish to deploy the application.
4. Since for the environment setup testing purposes testing on an iOS-powered device simulator or Android-powered device emulator is preferable because it does not require signing of the application, you should select one of the following deployment actions using the **Deploy** dialog:
   - For iOS, select **Deploy application to simulator**, as Figure 2–11 shows.

Figure 2–11 Selecting Deployment Action for iOS



- For Android, select **Deploy application to emulator**, as Figure 2–12 shows. Ensure that the emulator is running before you start the deployment.

Figure 2–12 Selecting Deployment Action for Android



5. Click **Next** on the Deploy dialog to verify the Summary page, and then click **Finish**.

   For more information, see one of the following:

   - Section 19.4.1, "How to Deploy an iOS Application to an iOS Simulator"

- Section 19.3.1, "How to Deploy an Android Application to an Android Emulator"

For more information on deployment, see Chapter 19, "Deploying Mobile Applications."

After a successful deployment (which might take a few minutes), your iOS-powered device simulator or Android-powered device emulator will display the HelloWorld application icon that you have to activate to launch the application.

3

Getting Started with Mobile Application Development

This chapter describes how to use the Oracle JDeveloper wizards and tools to create a basic application using Oracle Mobile Application Framework (MAF) and also describes the artifacts that are automatically generated when you create an application.

This chapter includes the following sections:

3.1 Introduction to Declarative Development for MAF Applications

Because MAF is integrated within the JDeveloper design time, you can create, deploy, and test simple mobile applications (and most parts of more complex mobile applications as well) without writing a single line of code.

3.2 Creating an Application Workspace

The Oracle Mobile Application Framework extension provides JDeveloper with the application templates that seed the completed project with basic files. The first steps in building a MAF application are to assign it a name and to specify a directory where its source files will be saved. By creating an application with the application templates provided by JDeveloper, the workspace is automatically organized into projects, along with the required configuration files.

3.2.1 How to Create a Workspace for a Mobile Application

You create an application using the application creation wizard.

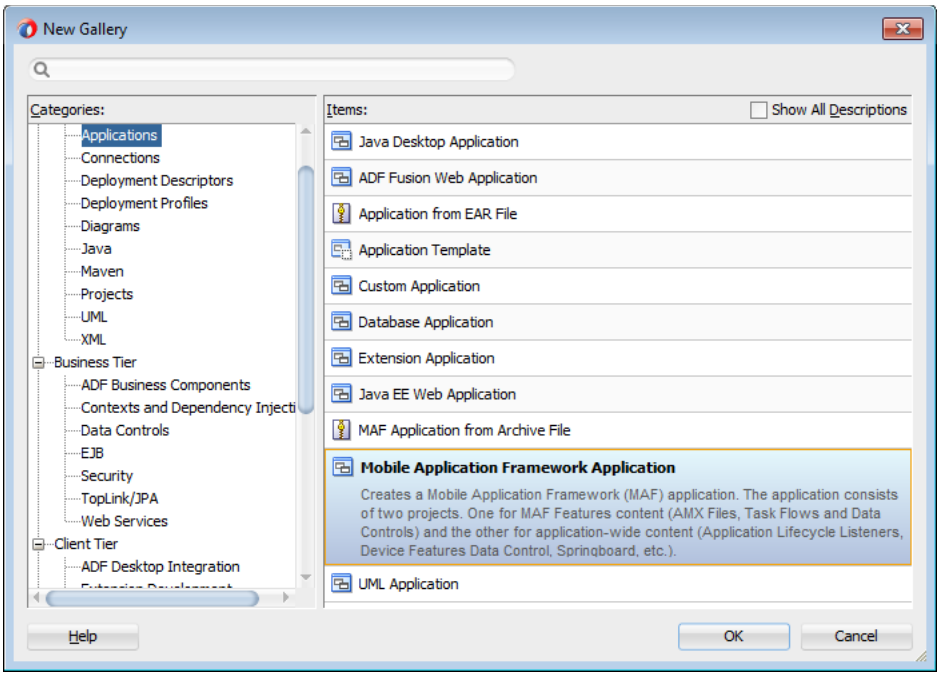
Before you begin:

You must download the MAF application extension. For more information, see Section 2.3, "Setting Up JDeveloper." You may need to download and configure the MAF application extension for all target platforms.

To create a mobile application:

1. Choose **File**, then **New**, and then **Application**.

Figure 3–1 Selecting the MAF Application Template

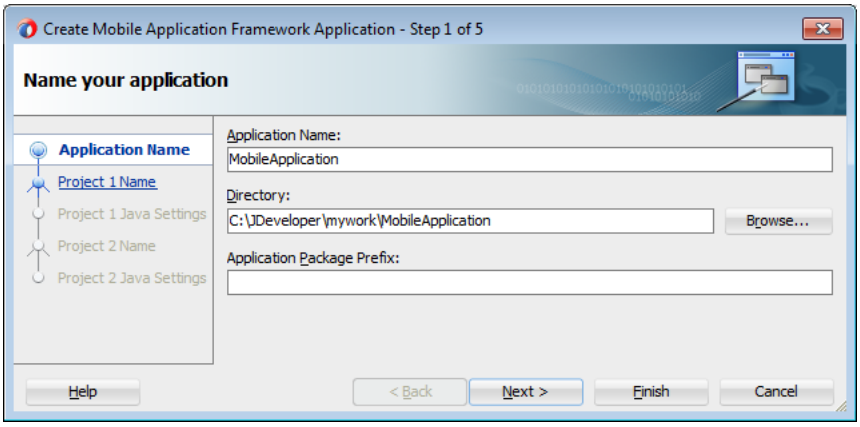


2. In the New Gallery, shown in Figure 3–1, choose **Mobile Application Framework** and click **OK**.

3. In the **Application Name** field, enter a name for the application, such as *MobileApplication* in Figure 3–2. If needed, enter a new location for the project in the **Directory** field. Make sure that the application package is unique by entering a prefix for it in the **Application Package Prefix** field. Click **Next**.

   The application is the top-level structure of the MAF application. It organizes the different tiers of projects that you define in the subsequent pages of this wizard.

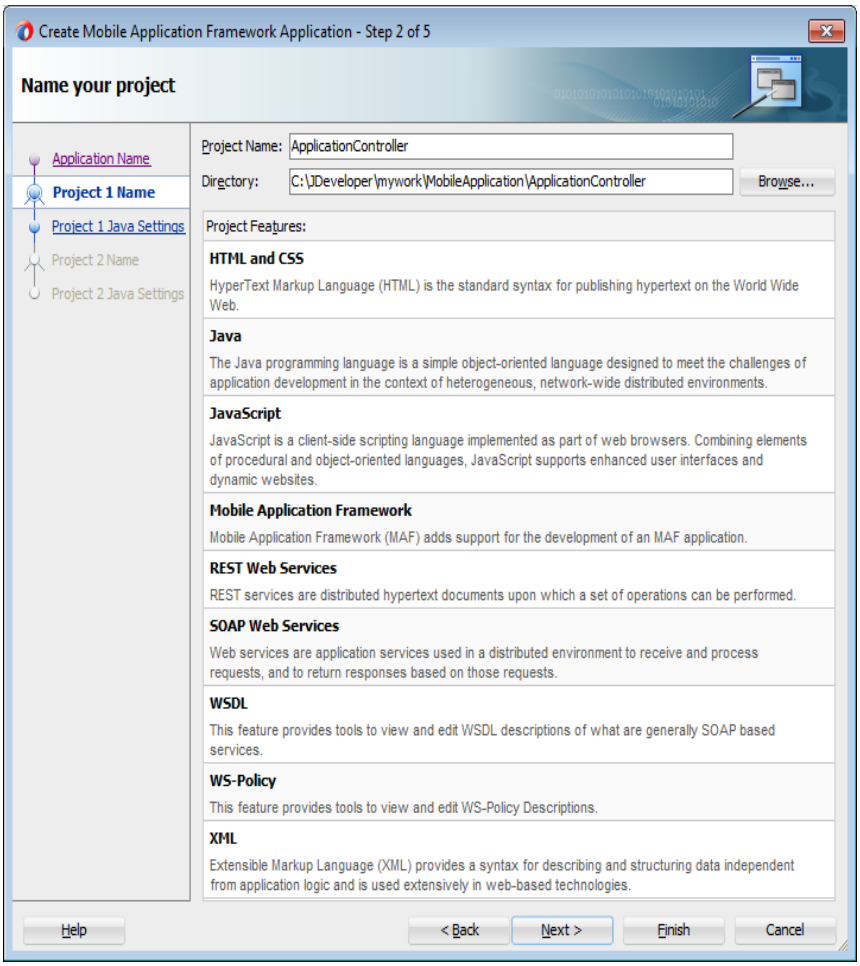
Figure 3–2 Naming the MAF Application



4. In the Project 1 Name page, change the name and location of the application controller project (if needed), as shown in Figure 3–3. Otherwise, accept the default name of the project, *ApplicationController*. This Project Feature window of the page lists the technologies available to the application controller project.

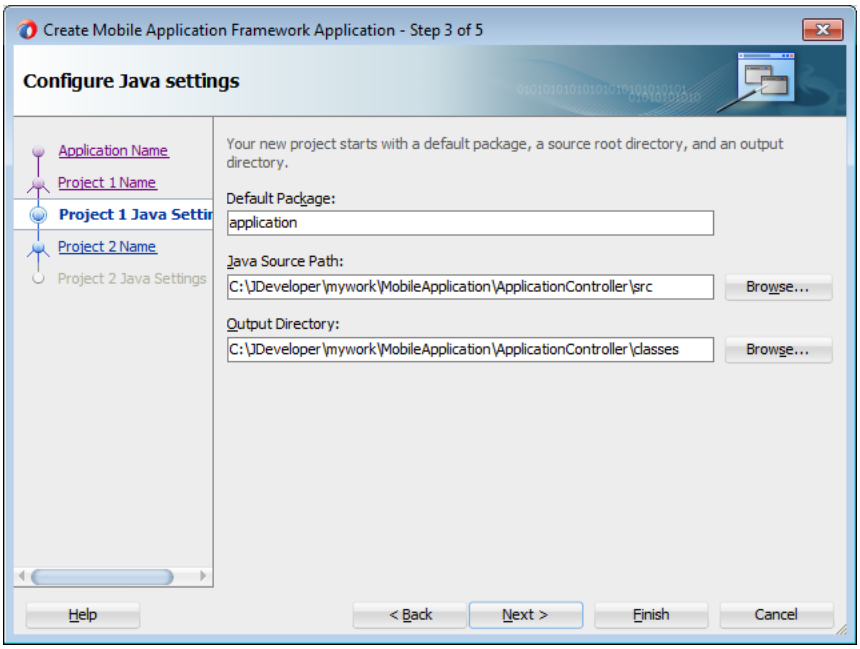
This project stores all of the application-wide resources. For more information, see Table 3–1.

Figure 3–3 Application Controller Project and Its Project Features



5. Click **Next** to go to the Java Settings page for the application controller project (Project 1 Java Settings, shown in Figure 3–4). Accept, or change, the default package name for the application controller project (`application`) and the location for the Java `SOURCEPATH` directory (`src`) and the Java output directory (`classes`).

Figure 3–4 Configuring the Java Settings for the Application Controller Project

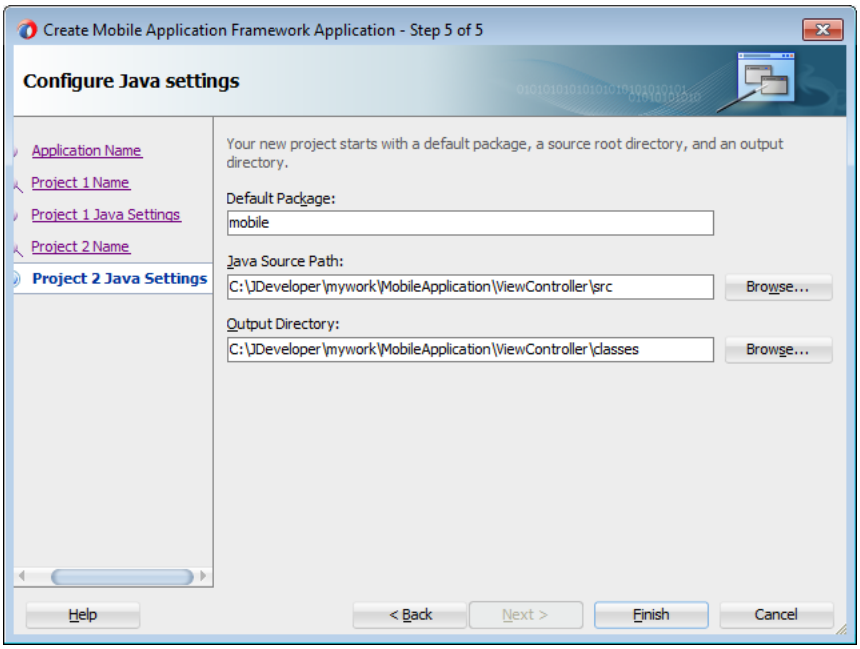


6. Click **Next** to go to the Project 2 Name page, where you can, if needed, rename the view controller project. The page's Project Features window, shown in Figure 3–5, lists the technologies available to the MAF view controller project. For information on the artifacts created within the view controller project, see Table 3–2.

Figure 3–5 MAF View Controller Project

7. Click **Next**. In the Java settings page for the view controller project, shown in Figure 3–6, accept (or change) the default package name for the application controller project (`mobile`), the location for the project's Java `SOURCEPATH` directory (`src`) and the Java output directory (`classes`).

Figure 3–6 Java Settings for the View Controller Project



8. Click **Finish** to complete the creation of the MAF application and its projects.

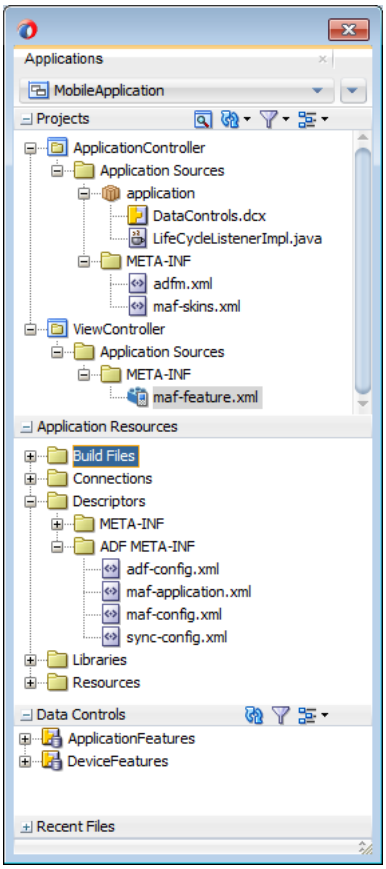
> **Tip:** In addition to creating a MAF application following the above steps, you can open the HelloWorld sample application (located in the `PublicSamples.zip` file within the *`jdev_install`*`/jdeveloper/jdev/extensions/oracle.maf/Samples` directory on your development computer) and view the artifacts that JDeveloper generates after you complete the application creation wizard.

3.2.2 What Happens When You Create a MAF Application

After you create a MAF application project, JDeveloper adds application-level and project-level artifacts, which you access from the Applications window shown in Figure 3–7. These artifacts include two stub descriptor files: one used for configuring the MAF application itself, such as its name, the application lifecycle listener (`LifeCycleListenerImpl.java`), the login server connections for the embedded application features, and another that describes which application features comprise the MAF application. These files, which are called `maf-application.xml` and `maf-feature.xml`, are described in Section 3.2.2.1, "About the Application Controller Project-Level Resources" and Section 3.2.2.3, "About the View Controller Project Resources," respectively.

JDeveloper also creates the DeviceFeatures data control. The Apache Cordova Java API is abstracted through this data control, thus enabling the application features implemented as MAF AMX to access various services embedded on the device. JDeveloper also creates the ApplicationFeatures data control, which enables you to build a springboard page. By dragging and dropping the operations provided by the DeviceFeatures data control into a MAF AMX page (which is described in Section 7.11, "Using the DeviceFeatures Data Control"), you add functions to manage the user contacts stored on the device, create and send both e-mail and SMS text messages, ascertain the location of the device, use the device's camera, and retrieve images stored in the device's file system.

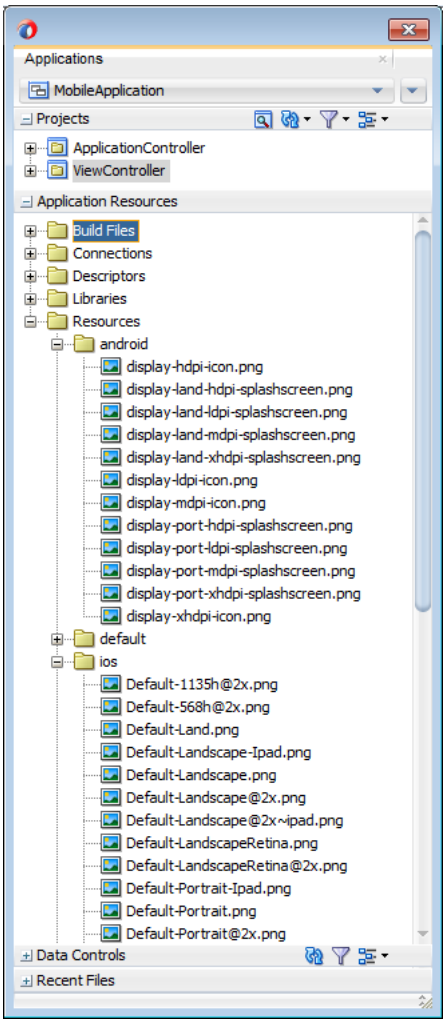
Figure 3–7 JDeveloper-Generated MAF Application Artifacts



3.2.2.1 About the Application Controller Project-Level Resources

JDeveloper generates the files for the MAF application in the application controller project. These files, described in Table 3–1, contain configuration files for describing the metadata of the MAF application. You access these files from the Application Resources pane of the Applications window, shown in Figure 3–8.

Figure 3–8 Mobile Application Artifacts Accessed from the Application Resources Pane



The application controller project, which contains the application-wide resources, provides the presentation layer of the MAF application in that it includes metadata files for configuring how the application will display on a mobile device. This project dictates the security for the MAF application and can include the application's login page, an application-wide resource. The application controller project is essentially a consumer of the view controller project, which defines the application features and their content. For more information, see Section 3.2.2.3, "About the View Controller Project Resources."

> **Tip:** Place code that supports application-wide functionality, such as an application-level lifecycle listener, in the application controller project.

Table 3–1 Mobile Application-Level Artifacts Accessed Through Application Resources

Artifact(s)	File Location	Description
`maf-application.xml`	*application workspace directory*`\.adf\Meta-INF` For example: `JDevloper\mywork\application name\.adf\META-INF`	A stub XML application descriptor file that enables you to define the MAF application. Similar to the application descriptors for ADF Fusion Web applications, this file enables you to define the content for an application, its navigation behavior, and its user authentication requirements. For more information, see Section 4.2, "About the Mobile Application Configuration File."
`maf-config.xml`	*application workspace directory*`\.adf\Meta-INF` For example: `JDeveloper\mywork\application name\.adf\META-INF`	Use to configure the default skin used for MAF applications. For more information, see Section 4.12, "Skinning Mobile Applications."
Application images	*application workspace directory*`\Application Resources\resources\ios` For example: `JDeveloper\mywork\application name\resources\ios`	A set of images required for the deployment of iOS and Android applications. These include PNG images for application icons and splash screens. Deployment to an iOS-powered device, such as an iPhone, requires a set of images in varying sizes. The default iOS images provided with the project include: ▪ images used when the device is in both landscape and portrait orientations ▪ images used for retina displays (that is, `icon.png` and `icon@2x.png`) ▪ an iPad image (`icon-72.png`) To override these images, see Section 19.2.4.3, "Adding a Custom Image to an iOS Application."
`cacerts`	*application workspace directory*`\Application Resources\resources\Security\cacerts` For example: `JDeveloper\mywork\application name\resources\Security\cacerts`	The `cacerts` certificate file, a system-wide keystore that identifies the CA certificates to JVM 1.4. You can update this file using the Java keytool utility. You can create a custom certificate file using keytool as described in Section 21.8, "Supporting SSL." Any certificate file must reside within the `Security` directory.
`logging.properties`	*application workspace directory*`\src\.META-INF\logging.properties` For example: `JDeveloper\mywork\application name\src\META-INF\logging.properties`	Enables you to set the application error logging, such as the logging level and logging console. For more information, see Section 22.4, "Using and Configuring Logging."

Table 3–1 (Cont.) Mobile Application-Level Artifacts Accessed Through Application

Artifact(s)	File Location	Description
`cvm.properties`	*application workspace directory*`\src\.META-INF\cvm.properties` For example: `JDeveloper\mywork\application name\src\META-INF\cvm.properties`	The configuration file for the Java virtual machine, JVM 1.4. Use this file to configure the application startup and heap space allotment, as well as Java and JavaScript debugging options. For more information, see Section 22.3.5, "How to Enable Debugging of Java Code and JavaScript."
`adf-config.xml`	*application workspace directory*`\.adf\META-INF` For example: `JDeveloper\mywork\application\.adf\META-INF`	Used to configure application-level settings, including the Configuration Service parameters. See also Chapter 9, "Configuring End Points Used in MAF Applications."
`connections.xml`	*application workspace directory*`\.adf\META-INF` For example: `JDeveloper\mywork\application name\.adf\META-INF`	The repository for all of the connections defined in the MAF application.
`wsm-assembly.xml`	*application workspace directory*`\.adf\META-INF` For example: `JDeveloper\mywork\application name\.adf\META-INF`	Stores the web service policy definitions used for secured web services.
`sync-config.xml`	*application workspace directory*`\.adf\META-INF` For example: `JDeveloper\mywork\application name\.adf\META-INF`	The configuration file for the offline cache of data returned from REST web services. Caching not only improves the user experience by boosting performance, but allows users to read and view data when they are working in an off-line mode. For more information, see Section 3.2.2.2, "What You May Need to Know About the sync-config.xml File."

Within the application controller project itself, shown in Figure 3–9, JDeveloper creates the following artifacts, listed in Table 3–2.

Figure 3–9 Application Controller Project

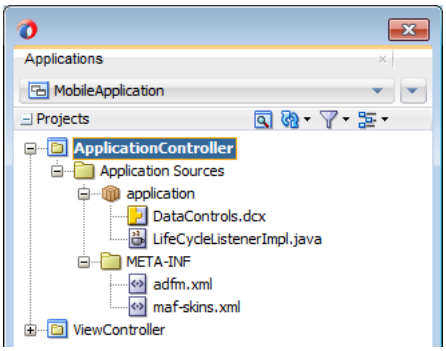


Table 3–2 Application Controller Artifacts

Artifact(s)	File Location	Description
`LifeCycleListenerImpl.java`	*application workspace directory*`\ApplicationController\src\application` For example: `JDeveloper\mywork\application name\ApplicationController\src\application`	The default application lifecycle listener (ALCL) for the MAF application.
`maf-skins.xml`	*application workspace directory*`\ApplicationController\src\META-INF` For example: `JDeveloper\mywork\application name\ApplicationController\src\META-INF`	Defines the available skins and also enables you to define new skins. For more information, see Section 4.12, "Skinning Mobile Applications."
`adfm.xml`	*application workspace directory* `\ApplicationController\adfm src\META-INF` For example: `JDeveloper\mywork\application name\ApplicationController\adfmsrc\META-INF`	Maintains the paths (and relative paths) for the `.cpx`, `.dcx`, `.jpx`, and `.xcfg` files (registries of metadata).
`DataControls.dcx`	*application workspace directory*`\ApplicationController\adfmsrc\` For example: `JDeveloper\mywork\application name\ApplicationController\adfmsrc\`	The data controls registry. For information on using the DeviceFeatures data control, which leverages the services of the device, see Section 7, "Using Bindings and Creating Data Controls." For information on the ApplicationFeatures data control, which enables you to create a springboard page that calls the embedded application features, see Section 4.5.5, "What You May Need to Know About Custom Springboard Application Features with MAF AMX Content."

3.2.2.2 What You May Need to Know About the sync-config.xml File

Rather than implement caching capabilities in the application code, you can set them by editing the properties in the `sync-config.xml` file. Example 3–1 illustrates the default version of this file, which you can update using the Source editor in JDeveloper. The MAF runtime reads this file after it is deployed. Typically, MAF copies the `sync-config.xml` file to the following platform-specific locations. On Android systems, this file is located at:

application workspace directory`/deploy/`*deployment profile name*`/`*deployment profile name.apk*`/assets/assets.zip/.adf/META-INF/`

For iOS, the `sync-config.xml` file is located at:

application workspace directory`/deploy/`*deployment profile name*`/temporary_xcode_project/assets.zip/.adf/META-INF/`

Note: Although this is an application-wide resource, you can include the `sync-config.xml` file in a feature archive (FAR) file. Similar to a `connections.xml` file, when the FAR is consumed by a MAF application, its `sync-config.xml file` is merged with the application's `sync-config.xml`. For more information, see Section 3.2.2.4, "About Automatically Generated Deployment Profiles" and Section 4.13.5, "What You May Need to Know About Using a FAR to Update the sync-config.xml File."

Example 3–1 illustrates the default `sync-config.xml` file. The properties in this file enable you to configure the caching policy for:

- Static lists that seldom change.
- Large collections that frequently change (fetching deltas rather than refreshing the entire list).
- Highly dynamic data, where the results are highly contextual and should therefore be refreshed rather than cached.
- Caching individual resource and its direct children, both with one-to-one and one-to-*n* cardinality.

Example 3–1 The sync-config.xml File

```
<?xml version="1.0" encoding="UTF-8"?>
<Settings xmlns="http://xmlns.oracle.com/sync/config">
  <BaseUri>http://127.0.0.1</BaseUri>
  <AppId/>
  <LazyPersistence/>
  <RefreshPolicy/>
  <DbStorageFolderPath/>
  <FileStorageFolderPath/>
  <Policies>
    <DefaultPolicy>
      <FetchPolicy>FETCH_FROM_SERVICE</FetchPolicy>
      <UpdatePolicy>UPDATE_IF_ONLINE</UpdatePolicy>
      <ExpirationPolicy>NEVER_EXPIRE</ExpirationPolicy>
      <EvictionPolicy>MANUAL_EVICTION</EvictionPolicy>
    </DefaultPolicy>
  </Policies>
</Settings>
```

3.2.2.3 About the View Controller Project Resources

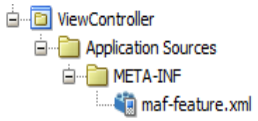
The view controller project (which is generated with the default name, `ViewController`, as illustrated in Figure 3–10) houses the resources for the application features. Unlike the application controller project described in Section 3.2.2.1, "About the Application Controller Project-Level Resources," the view controller project's metadata files describe the resources at the application feature-level, in particular the various application features that can be aggregated into a MAF application so that they can display on a mobile device within the springboard of the MAF application itself or its navigation bar at runtime. Further, the application feature metadata files describe whether the application feature is comprised of HTML or MAF AMX pages. In addition, the view controller project can include these application pages as well as application feature-level resources, such as icon images to represent the application feature on the springboard and navigation bar defined for the MAF application.

Tip: Store code specific to an application feature within the view controller project. Use the application controller project as the location for code shared across application features, particularly those defined in separate view controller projects.

The view controller project can be decoupled from the application controller project and deployed as an archive file for reuse in other mobile applications as described in Section 4.13, "Working with Feature Archive Files." In rare cases, an application controller project can consume more than one view controller project.

Note: Adding a MAF view controller project as a dependency of another MAF view controller project, or as a dependency of a MAF application controller project, prevents the deployment of a MAF application. For more information, see Section 4.6.2, "What You May Need to Know About Feature Reference IDs and Feature IDs."

Figure 3–10 View Controller Project



As shown in Table 3–3, these resources include the configuration file for application features called `maf-feature.xml`.

Table 3–3 View Controller Artifacts

Artifact(s)	File Location	Description
`maf-feature.xml`	*application workspace directory*`\src\META_INF\maf-feature.xml` For example: `JDeveloper\mywork\application name\ViewController\src\META-INF`	A stub XML descriptor file that enables you to define application features. For more information, see Section 4.8, "About the Mobile Application Feature Configuration File." After you have configured the Mobile Preferences as described in Section 2.3.1, "How to Configure the Development Environment for Platforms and Form Factors," you can deploy this application using the default deployment profile settings. For more information, see Chapter 19, "Deploying Mobile Applications."
Application-Specific Content	*application workspace directory*`\ViewController\public_html` For example: `JDeveloper\mywork\application name\ViewController\public_html`	The application features defined in `maf-feature.xml` display in the `public_html` directory. Mobile content can include MAF AMX pages, CSS files, and task flows. Any custom images that you add to an application feature must be located within this directory. For more information, see Section 4.10.2, "What You May Need to Know About Selecting External Resources."

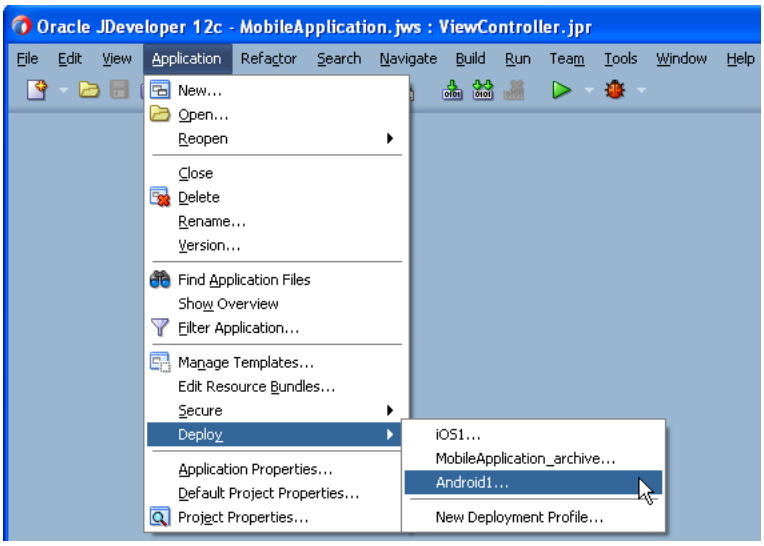
3.2.2.4 About Automatically Generated Deployment Profiles

A deployment profile defines the way the application is packaged into the archive that will be deployed to the target environment (such as a mobile device, an emulator, or an application marketplace, such as the iOs App Store). The deployment profile:

- Specifies the format and contents of the archive file that will be created
- Lists the source files, deployment descriptors, and other auxiliary files that will be packaged
- Describes the type and name of the archive file to be created
- Highlights dependency information, platform-specific instructions, and other information

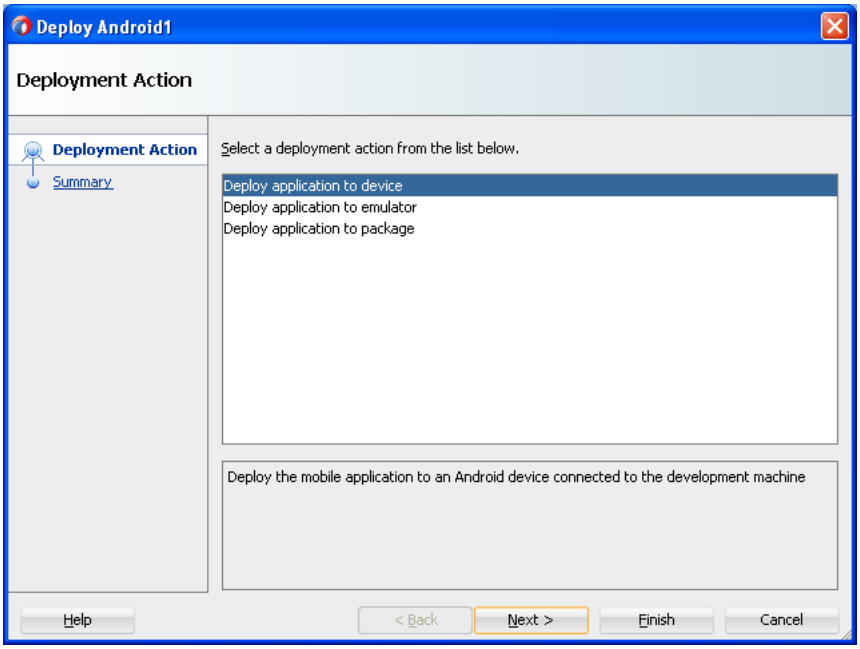
After you create an application, MAF generates deployment profiles that are seeded with default settings and image files. Provided that you have configured the environment correctly, you can use these profiles to deploy a MAF application immediately after creating it by choosing **Application** and then **Deploy**, as shown in Figure 3–11.

Figure 3–11 Default Deployment Profiles



Using the Deployment Action page, shown in Figure 3–12, you then select the appropriate deployment target.

Figure 3–12 Selecting a Deployment Target



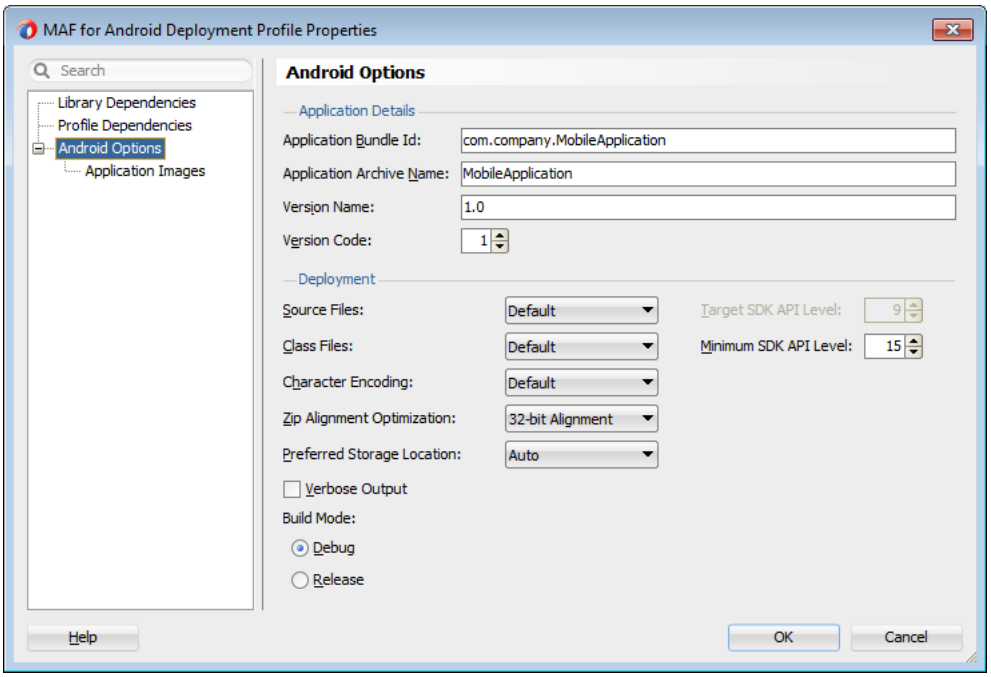
Note: iOS and Android application deployments to simulators and devices have distinct environment set up and configuration requirements. For more information, see the "Before You Begin" sections throughout Section 19.3, "Deploying an Android Application," and Section 19.4, "Deploying an iOS Application."

As illustrated in Figure 3–11, MAF creates application-level profiles for both supported platforms (iOS and Android) and names them *iOS1* and *Android1*.

Note: MAF increments the name of each new deployment profile by 1. For example, *iOS2*, *iOS3*.

You can accept the default values used for these profiles, or edit them by selecting the profile from the Deployment page of the Application Properties dialog and then clicking **Edit**. Figure 3–13 illustrates the Options page for a default Android application profile. For information on the values configured for MAF application profiles, see Section 19.2.3, "How to Create an Android Deployment Profile" and Section 19.2.4, "How to Create an iOS Deployment Profile."

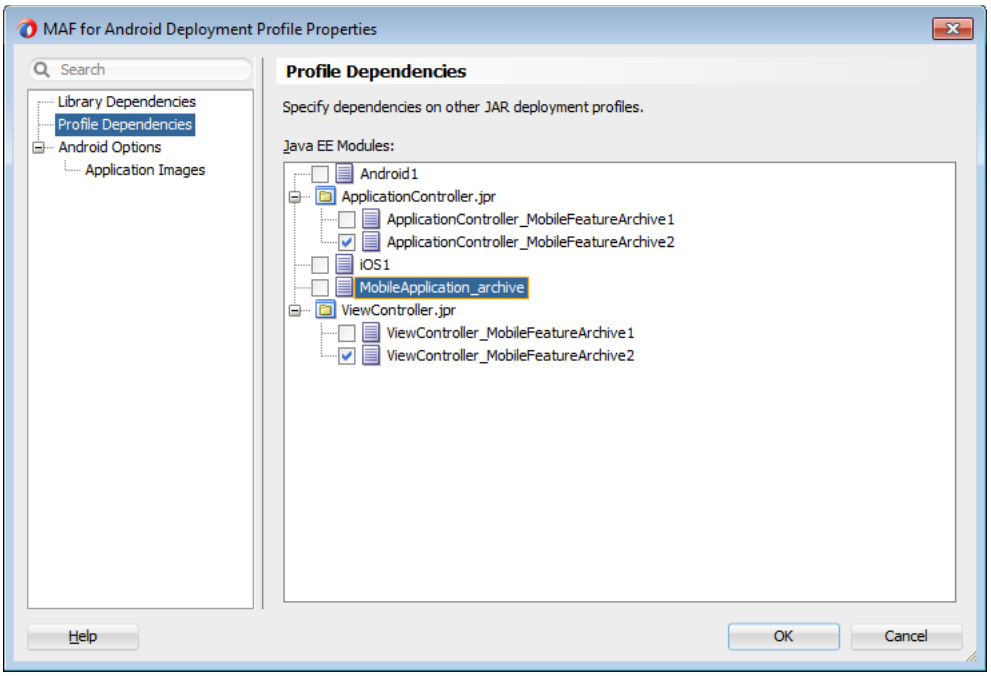
Figure 3–13 Editing a Default Deployment Profile



MAF packages the application and view controller projects as separate Feature Archive (FAR) files. These JAR files of MAF files are used as resources for other applications and are described in Section 19.5, "Deploying Feature Archive Files (FARs)." Because MAF creates these FAR files as dependencies to the MAF application profile, you can include or exclude them using the Profile Dependencies page of the Application Properties dialog, as illustrated in Figure 3–14.

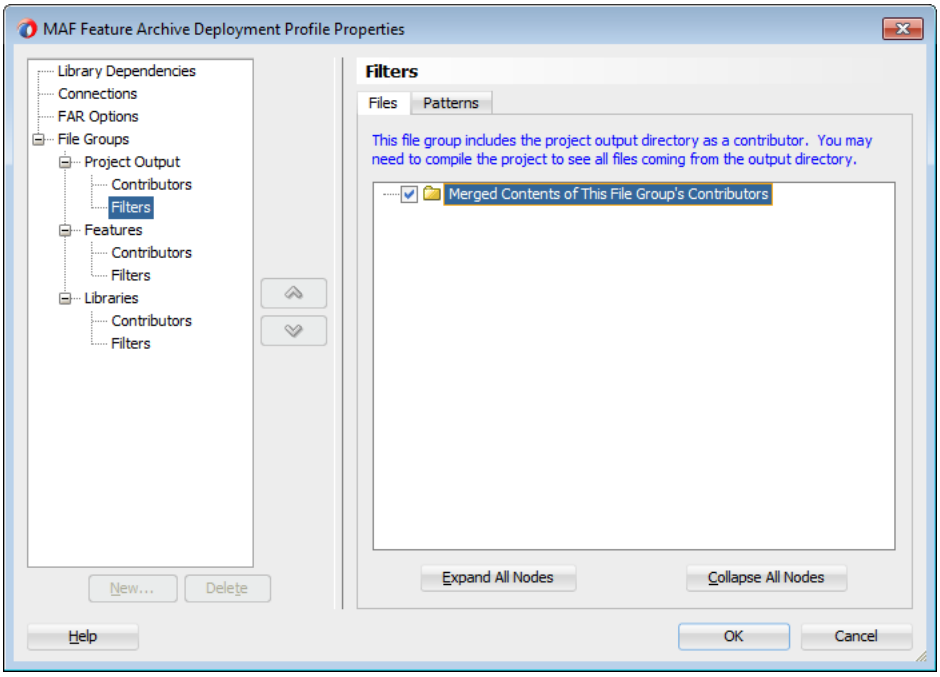
Note: The application controller project must contain a single FAR profile dependency; otherwise, the deployment will fail.

Figure 3–14 Editing FAR Contents from MAF Projects



Using the File Groups-related pages of the Project Properties dialog, you can customize the contents of the view controller FAR file, as shown in Figure 3–15. For more information on the Project Properties dialog, see the Oracle JDeveloper online help and also the "Configuring Deployment Profiles" in *Oracle Fusion Middleware User's Guide for Oracle JDeveloper*.

Figure 3–15 Editing the View Controller Project's FAR

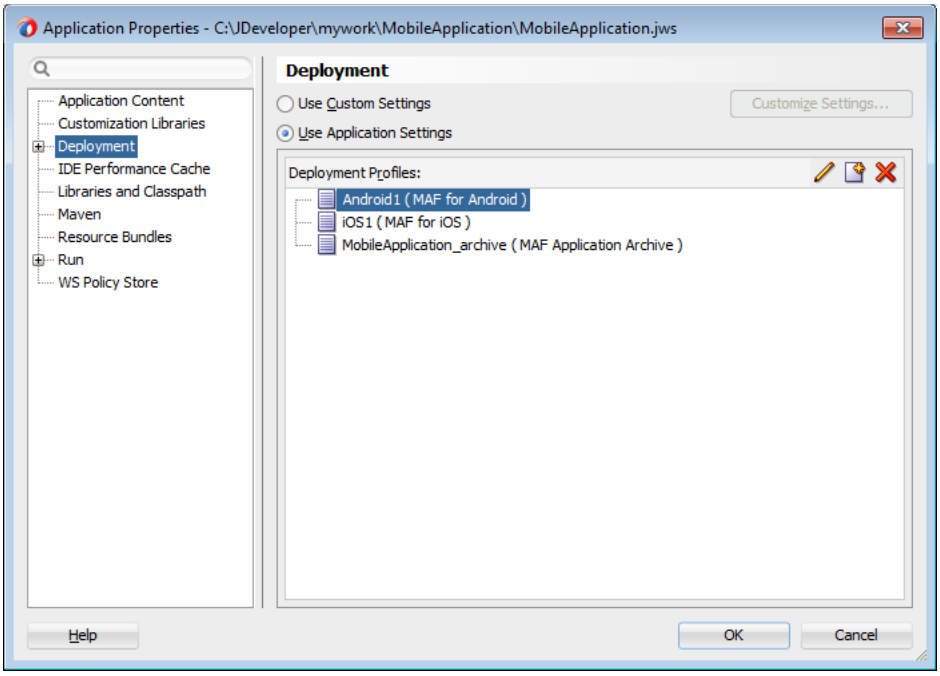


In addition to the platform-specific deployment profiles, MAF also creates a deployment profile that enables you to package the MAF application as a Mobile

Application Archive (`.maa`) file. Using this file, you can create a new MAF application using a pre-existing application that has been packaged as an `.maa` file. For more information, see Section 19.6, "Creating a Mobile Application Archive File" and Section 19.7, "Creating Unsigned Deployment Packages."

By default, this deployment file bears the name of the MAF application followed by _*archive*. As illustrated in Figure 3–11, this profile is called *Employees_archive* and, if needed, can be edited using the Application Properties dialog.

Figure 3–16 Editing the Default Deployment Profiles Using the Application Properties Dialog

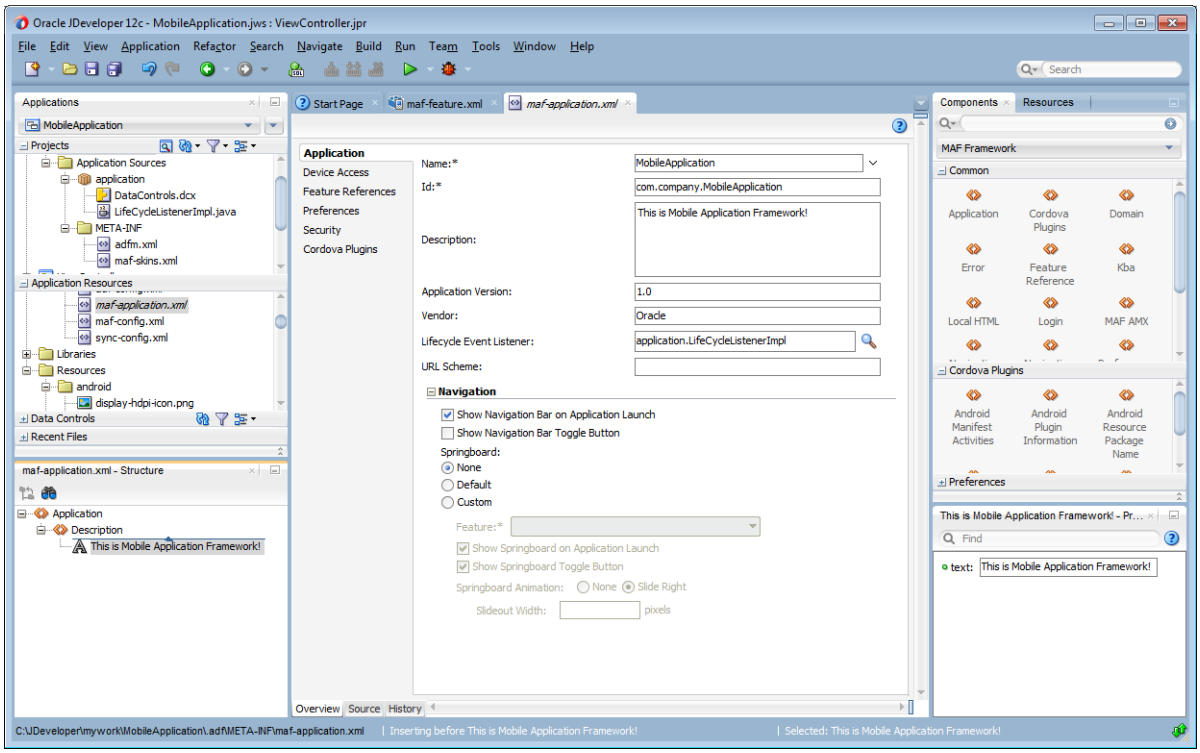


For more information on editing deployment profiles using the Application Properties dialog pages, see the "Viewing and Changing Deployment Profile Properties" section in *Oracle Fusion Middleware User's Guide for Oracle JDeveloper* and the Oracle JDeveloper online help for the Application Properties and Project Properties dialogs.

3.2.3 What You May Need to Know About Editing MAF Applications and Application Features

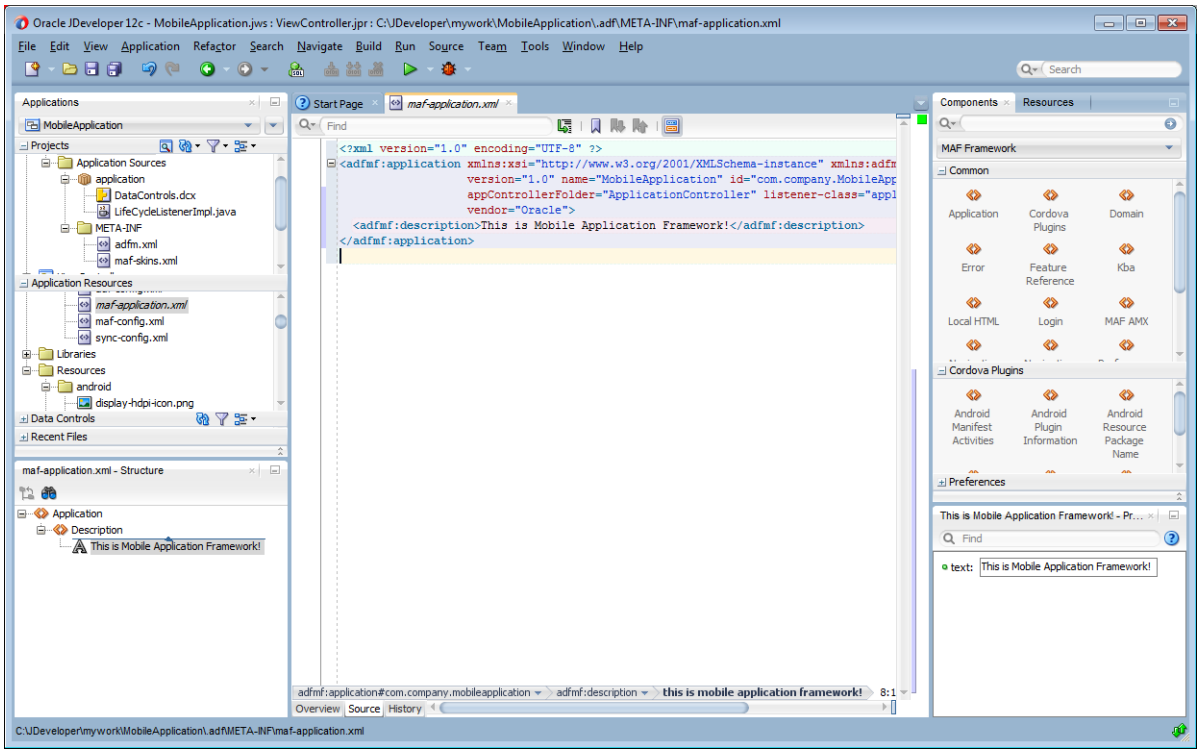
Creating an application results in the generation of the `maf-application.xml` file, which enables you to configure the mobile application and also the `maf-feature.xml` file, which you use to add, remove, or edit the application features embedded within the mobile application. The MAF extension provides you with overview editors for both of these files, enabling you to declaratively change them. Figure 3–17 shows an example of the overview editor of the `maf-application.xml` file.

Figure 3–17 Overview Editor of the Mobile Application



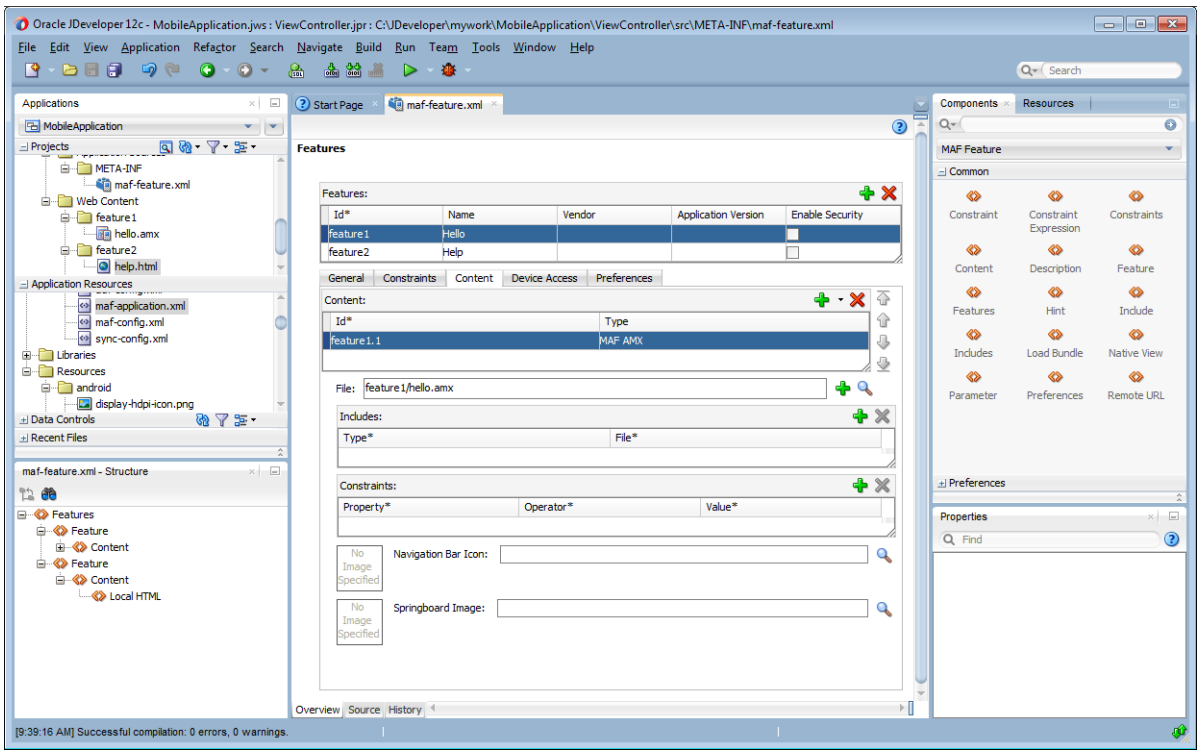
As shown in Figure 3–17, the `maf-application.xml` file is located in the Applications window in the **Application Resources** panel, under the **Descriptors** and **ADF META-INF** nodes. You can open this file by double-clicking it from this location. When you access this file, JDeveloper not only opens the associated overview editor, but also displays the pertinent page components in the Components window, which you can drag and drop into either the Source page of the editor or the Structure window, as shown in Figure 3–18. Section 4.2, "About the Mobile Application Configuration File" describes the components of the `maf-application.xml` page.

Figure 3–18 Using the Source Editor, Structure Window, and Properties Editor for the MAF Application



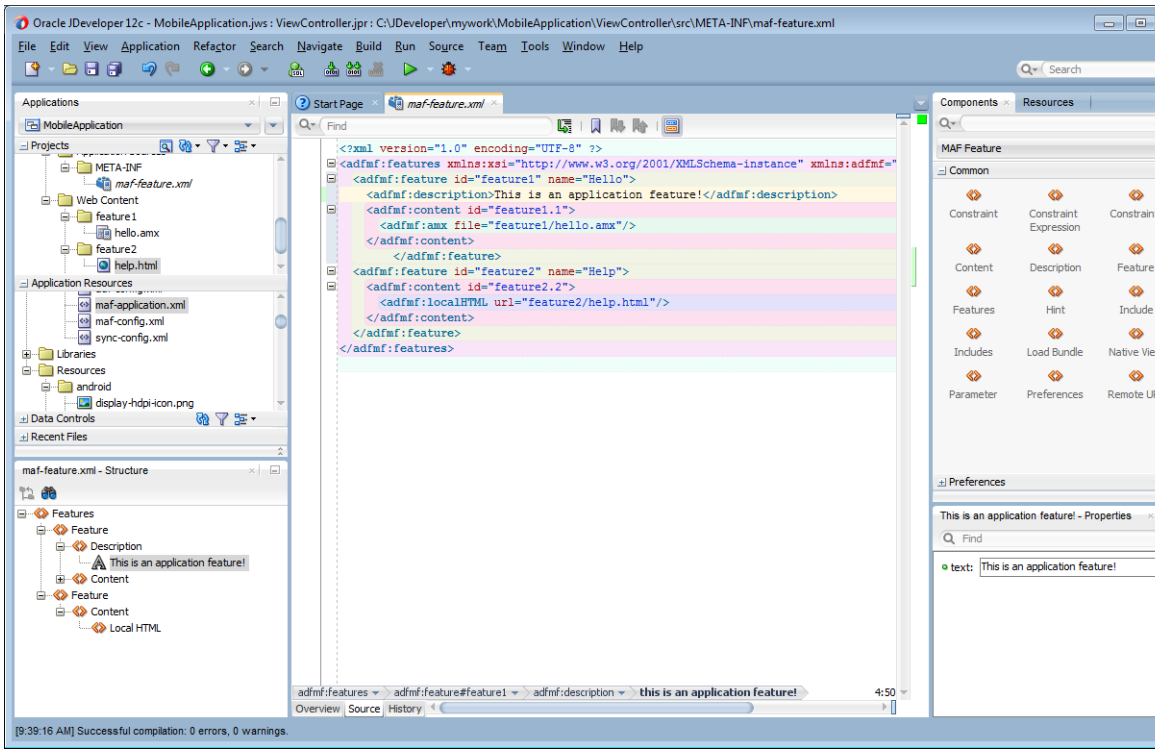
As illustrated in Figure 3–19, the `maf-feature.xml` configuration file is located in the Applications window in the **Project** panel under the **view controller** and **META-INF** nodes. You use this file to compose the content for the MAF application.

Figure 3–19 Overview Editor for Application Features



Like the overview editor for the `maf-application.xml` file, JDeveloper presents the MAF components used for building the elements of the `adfmf-features.xml` configuration file, which are described in Section 4.8, "About the Mobile Application Feature Configuration File." You can use the Overview page or you can drag and drop components from the Components window into the Structure window or into the Source editor itself. When you select the `maf-feature.xml` file, JDeveloper populates the Components window with MAF Feature components.

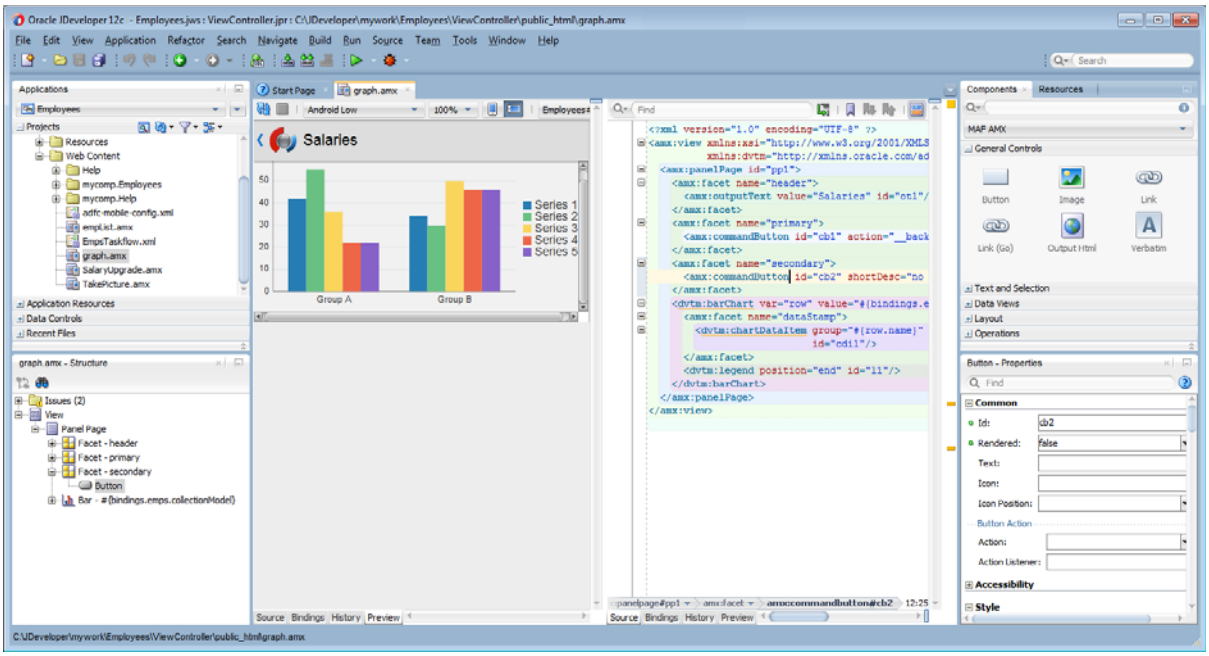
Figure 3–20 Using the Source Editor, Structure Window, and Components Window for Application Features



3.2.4 Creating an Application Workspace for a MAF AMX Application

As described in Chapter 5, "Creating MAF AMX Pages," the MAF AMX components enable you to build pages that run identically to those authored in a platform-specific language. MAF AMX pages enable you to declaratively create the user interface using a rich set of components. Figure 3–21 illustrates the declarative development of a MAF AMX page.

Figure 3–21 Creating a MAF AMX Page



These pages may be created by the application assembler, who creates the MAF application and embeds application features within it, or they can be constructed by another developer and then incorporated into the MAF application either as an application feature or as a resource to a MAF application.

The project in which you create the MAF AMX page determines if the page is used to deliver the user interface content for a single application feature, or be used as a resource to the entire MAF application. For example, a page created within the application controller project, as shown in Figure 3–25, would be used as an application-wide resource.

> **Tip:** To make pages easier to maintain, you can break it down in to reusable segments known as page fragments. A MAF AMX page may be comprised one or more page fragments.

MAF enables you to arrange MAF AMX view pages and other activities into an appropriate sequence through the MAF task flow. As described in Section 5.2, "Creating Task Flows," a MAF task flow is visual representation of the flow of the application. It can be comprised of MAF AMX-authored user interface pages (illustrated by such view activities, such as the WorkBetter sample application's default *List* page and the *Detail* page in Figure 3–22) and nonvisual activities that can call methods on managed beans. The non-visual elements of a task flow can be used to evaluate an EL expression or call another task flow. As illustrated by Figure 3–22, MAF enables you to declaratively create the task flow by dragging task flow components onto a diagrammer. MAF provides two types of task flows: a bounded task flow, which has a single point of entry, such as the *List* page in the WorkBetter sample application, and an unbounded task flow, which may have multiple points of entry into the application flow. The WorkBetter sample application is located in the `PublicSamples.zip` file within the *`jdev_install`*`/jdeveloper/jdev/extensions/oracle.maf/Samples` directory on your development computer.

Figure 3–22 MAF Task Flow

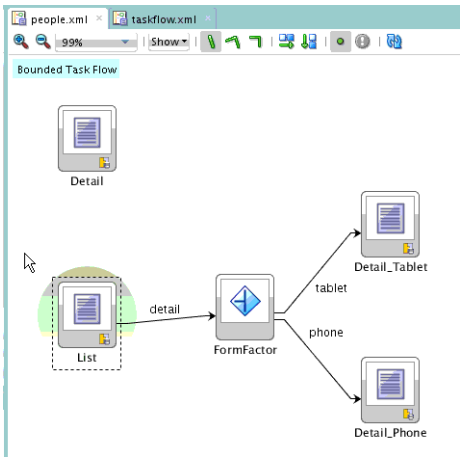
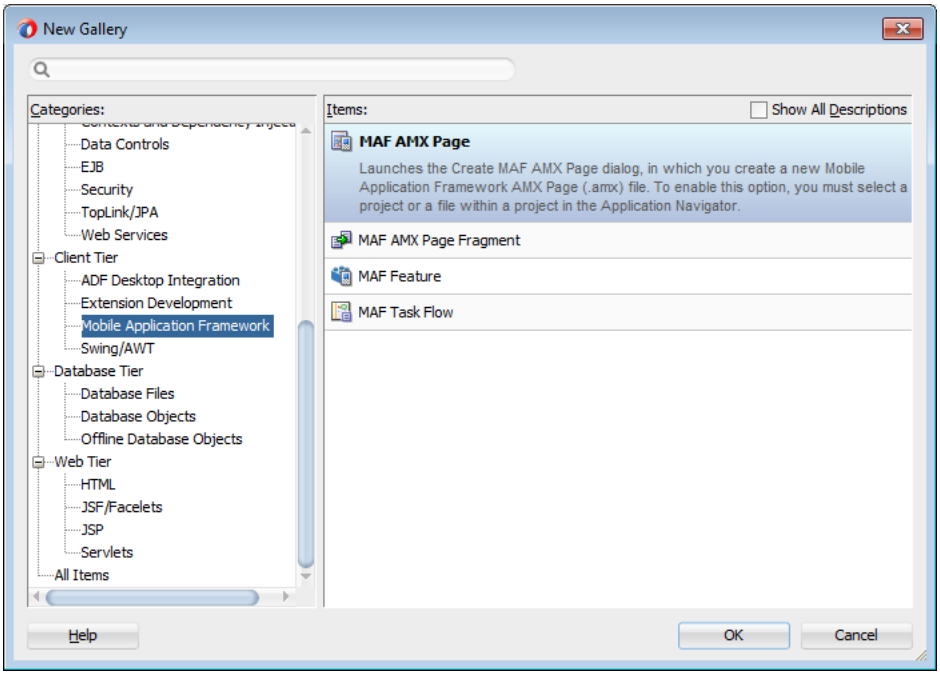


Figure 3–23 shows wizards that MAF provides to add MAF task flows, AMX pages, reusable portions of MAF AMX pages called MAF page fragments, and application features. To access these wizards, select a view controller or application controller project within the Applications window and choose **File** > **New**. Select one of the wizards after selecting **Mobile Application Framework** within the **Client Tier**.

Figure 3–23 Wizards for Creating Resources for Application Features



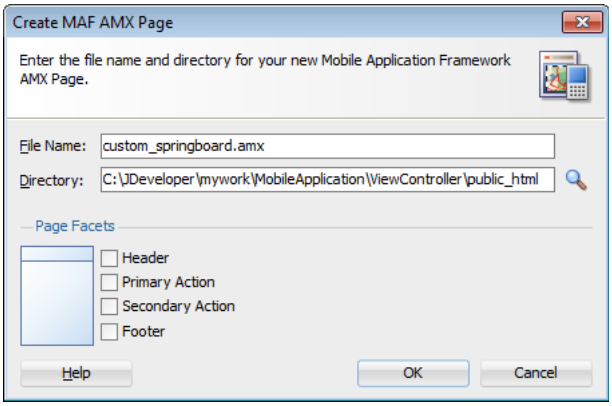
3.2.4.1 How to Create a MAF AMX Page

You can use the MAF AMX Page wizard to create AMX pages used for the user interface for an application feature, or as an application-level resource (such as a login page) that can be shared by the application features that comprise the MAF application. For more information on application feature content, see Section 4.10.1, "How to Define the Application Content."

To create a MAF AMX page as content for an application feature:

1. In the Applications window, right-click the view controller project.
2. Choose **File** and then **New**.
3. From the Client Tier node in the New Gallery, choose **MAF AMX Page** and then click **OK**.
4. Complete the Create MAF AMX Page dialog, shown in Figure 3–24, by entering a name in the **File Name field**. In the **Directory** field, enter the file location, which must be within the `public_html` folder of the view controller project.

Figure 3–24 Creating a MAF AMX Page in a View Controller Project



5. Select (or deselect) the Facets within the Panel Page that are used to create a header and footer. Click **OK**.

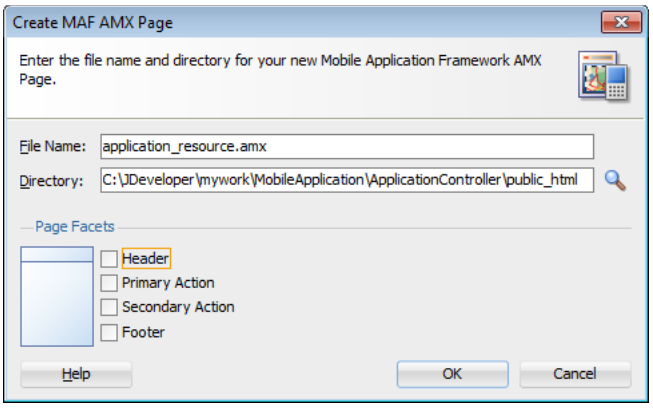
   For more information, see Section 6.2.2, "How to Use a Panel Page Component."

6. Build the MAF AMX page. For more information about using the AMX components, see Section 5.3.1.2, "Creating MAF AMX Pages." See also Section 4.10.1, "How to Define the Application Content."

To create a MAF AMX page as a resource to a MAF application:

1. In the Applications window, select the application controller project.
2. Choose **File** and then **New**.
3. From the Client Tier node in the New Gallery, select **MAF AMX Page**, and then click **OK**.
4. Complete the Create MAF AMX Page dialog, shown in Figure 3–25, by entering a name in the **File Name** field. In the **Directory** field, enter the file location, which must be within the `public_html` folder of the application controller project. Click **OK**.

Figure 3–25 Creating a MAF AMX Page in an Application Controller Project



5. Build the MAF AMX page. For more information, see Section 5.3.1.2, "Creating MAF AMX Pages."

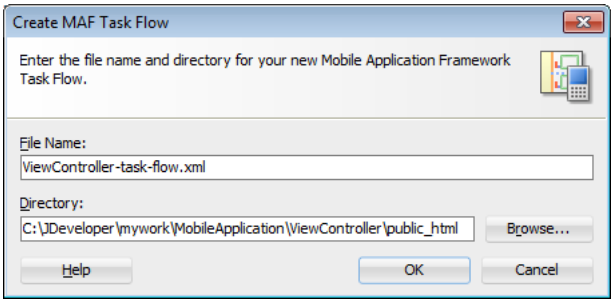
3.2.4.2 How to Create MAF Task Flows

You can deliver the content for an application feature as a MAF task flow.

To create a MAF Task Flow as content for an application feature:

1. In the Applications window, select the view controller project.
2. Choose **File** and then **New**.
3. From the Client Tier node in the New Gallery select **MAF Task Flow** and then click **OK**.
4. Complete the Create MAF Task Flow dialog, shown in Figure 3–26, by entering a name in the **File Name** field. In the **Directory** field, enter the file location, which must be within the `public_html` folder of the view controller project. Click **OK**.

Figure 3–26 Creating a MAF Task Flow in a View Controller Project



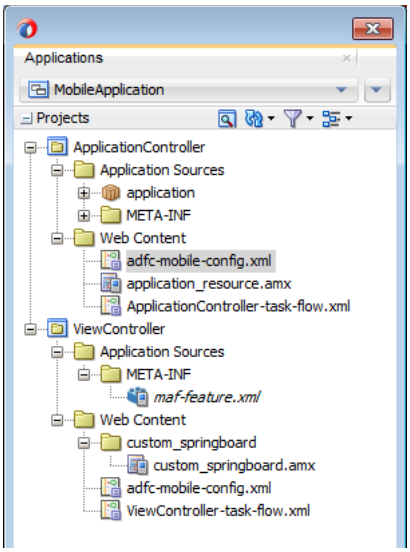
5. Build the task flow. See also Section 5.2, "Creating Task Flows."

3.2.4.3 What Happens When You Create MAF AMX Pages and Task Flows

JDeveloper places the MAF AMX pages and task flows in the **Web Content** node of the view controller project, as shown by `custom_springboard.amx` and `ViewController-task-flow.xml` (the default name for a task flow created within this project) in Figure 3–27. These artifacts are referenced in the `maf-feature.xml` file as described in Section 4.6, "Configuring the Application Features within a Mobile Application." Other resources, such as the customized application splash screen (or launch) images and navigation bar images, are also housed in the **Web Content** node.

For more information, refer to Table 3–3. To manage the unbounded task flows, JDeveloper generates the `adfc-mobile-config.xml` file. Using this file, you can declaratively create or update a task flow by adding the various task flow components, such as a view (a user interface page), the control rules that define the transitions between various activities, and the managed beans to manage the rendering logic of the task flow.

Figure 3–27 MAF AMX Pages and Task Flows within Application Controller and View Controller Projects

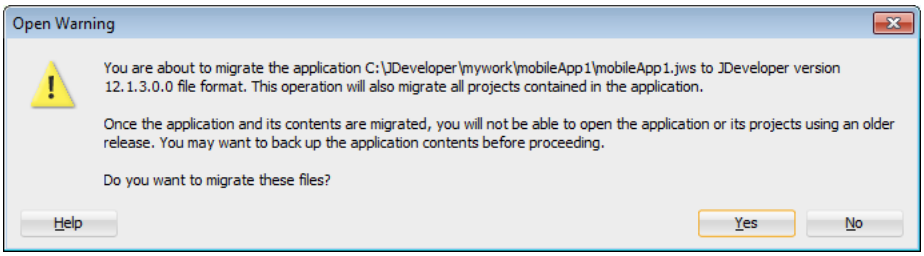


JDeveloper places the MAF AMX page and task flow as application resources to the mobile application in the **Web Content** node of the application controller project. As illustrated in Figure 3–27, the file for the MAF AMX page is called `application_resource.amx` and the task flow file is called `ApplicationController-task-flow.xml` (the default name).

3.3 Migrating ADF Mobile Applications

MAF automatically migrates the configuration of applications written in Versions 11.1.2.3.0 and 11.1.2.4.0 of ADF Mobile. After you open the workspace (`.jws`) file of an ADF Mobile application, MAF alerts you that the application is not the current version by presenting the Open Warning dialog (illustrated in Figure 3–28), that prompts you to continue with the migration, or dismiss the dialog and close the file.

Figure 3–28 Open Warning Dialog

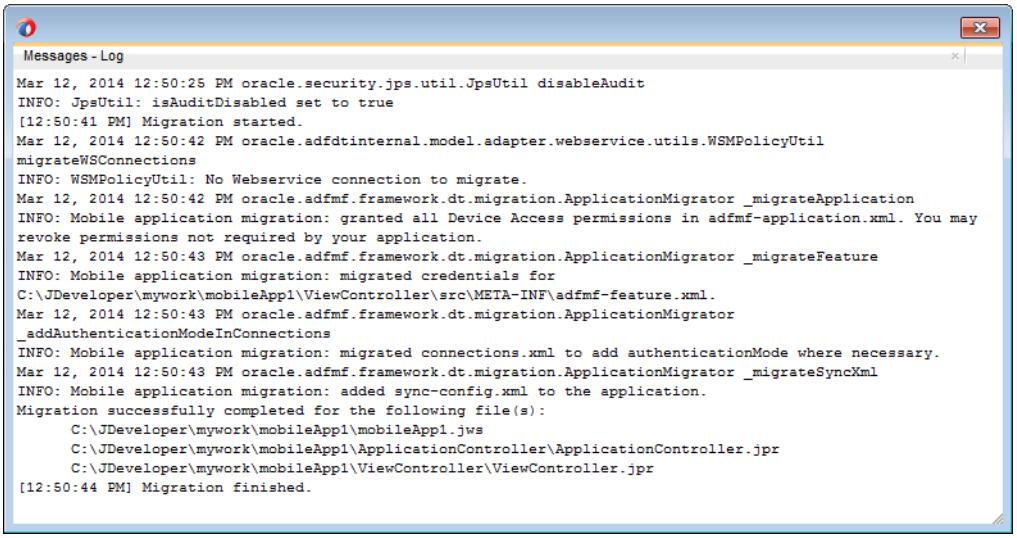


MAF writes the status of the migration to the Log window, as illustrated by Figure 3–29. The migration process also logs the following warning if it detects that the application to migrate uses the old configuration service API.

```
The MAF 2.0 Configuration Service API is not backwards compatible with previous
versions and cannot be migrated automatically. Refer to Section 9.3 "Migrating
the Configuration Service API" in Oracle Fusion Middleware Developing Mobile
Applications with Oracle Mobile Application Framework 2.0. for information on
migrating to the new API.
```

For more information, see Section 9.6, "Migrating the Configuration Service API."

Figure 3–29 Migration Log



3.3.1 What Happens When You Migrate an ADF Mobile Application

Table 3–4 describes how migration affects ADF Mobile artifacts.

Table 3–4 Migration of ADF Mobile Artifacts and Configuration

File Name	Change
`adfmf-feature.xml`	The migration makes the following changes: ▪ Renames the file as `maf-feature.xml`. ▪ Replaces the `credentials` attribute with `securityEnabled=true`. ▪ Transcribes the `credentials` attribute definition (defined as either `local` or `remote`) as a hybrid connection definition (`<authenticationMode value="hybrid"/>`) in the `connections.xml` file.
`adfmf-application.xml`	The migration makes the following changes: ▪ Renames the file as `maf-application.xml`. ▪ Grants permissions to all device features and services (`access = true`). You can remove any unneeded permissions.

Table 3–4 (Cont.) Migration of ADF Mobile Artifacts and Configuration

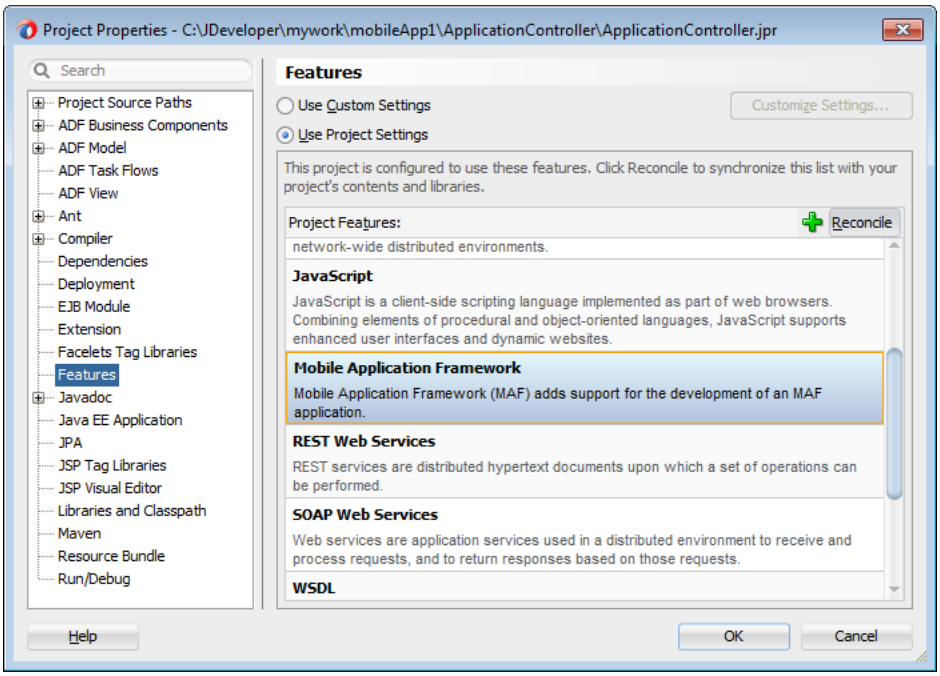
File Name	Change
`connections.xml`	The migration removes the secure SOAP web service connections defined by the `<policy-references>` element from the `connections.xml` file. These definitions are populated to the `wsm-assembly.xml` file. The migration creates stub `connections.xml` and `wsm-assembly.xml` files if the ADF Mobile application does not include a `connections.xml` file. If the ADF Mobile application includes a `connections.xml` that has no web services policy definitions, then the migration creates a stub `wsm-assembly` file.

`adfmf-config.xml`	The migration renames the file as `maf-config.xml`. It also adds the default skin version for the skin family if the skin family is the default skin family and the skin version is not specified. For example, the `maf-config.xml` may be modified to include the following values:
	`<skin-family>mobileAlta</skin-family>`
	`<skin-version>v1.1</skin-version>`

`adfmf-skins.xml`	The migration renames the file as `maf-skins.xml`.
`sync-config.xml`	The migration adds this file to the `ADF META-INF` directory.

The application migrates from the ADF Mobile Framework technology to use the Mobile Application Framework technology as a project feature. Figure 3–30 shows the Features page for an application controller project that uses the Mobile Application Framework technology. Choose **Project Properties > Features** to view this dialog.

Figure 3–30 Mobile Application Framework Project Feature



MAF does not override the icon, splash screen, or navigation bar images created for the ADF Mobile application; the image files within the application controller's `resources` file are retained. Likewise, any images used for application features are also retained. See also Section 3.2.2.1, "About the Application Controller Project-Level

Resources."

3.3.1.1 About Migrating Web Service Policy Definitions

MAF stores web service policy definitions in the `wsm-assembly.xml` file. ADF Mobile applications store this information in the `connections.xml` file. Example 3–2 illustrates `oracle/wss_username_token_client_policy` by the `<policy-references>` element in the `connections.xml` file.

Example 3–2 The connections.xml File

```
<policy-references xmlns="http://oracle.com/adf">policy-reference category="security"
                   uri="oracle/wss_username_token_client_policy"
                   enabled="true"
                   id="oracle/wss_username_token_client_policy" xmlns=""/>
</policy-references>
```

Example 3–3 illustrates the policy defined in the `wsm-assembly.xml` file.

Example 3–3 The wsm-assembly.xml File

```
<wsp:PolicyReference xmlns:wsp="http://www.w3.org/ns/ws-policy"
                     DigestAlgorithm="http://www.w3.org/ns/ws-policy/Sha1Exc"
                     URI="oracle/wss_username_token_client_policy"
                     orawsp:status="enabled"
                     orawsp:id="2"/>
```

3.3.2 What You May Need to Know About FARs in Migrated Applications

MAF does not migrate the `adfmf-feature.xml` file packaged within a Feature Archive (FAR) file. You replace the ADF Mobile FARs used by a migrated application to make sure that the `credentials` attribute has been replaced by `securityEnabled=true` in the FAR's `maf-feature.xml` file.

After you migrate the application:

1. Choose **Application Properties > Libraries and Classpath**.
2. Select the FAR and click **Remove**.
3. Import the FAR containing the migrated view controller as described in Section 4.13.1, "How to Use FAR Content in a MAF Application."
4. Migrate the ADF Mobile application that contains the view controller project that was packaged as a FAR.

> **Note:** A FAR cannot include both an `adfmf-feature.xml` file and a `maf-feature.xml` file.

   1. Deploy the view controller project as a FAR.
   2. Import the FAR into the migrated application as described in Section 4.13.1, "How to Use FAR Content in a MAF Application."

3.3.3 Migrating Applications in Headless Mode

Oracle JDeveloper provides a set of migrators that enable you to migrate applications using the `ojmigrate` command line utility. To migrate a workspace (`.jws`) file (and all

of its project files), first navigate to the `jdev\bin` directory (`Oracle_Home\jdeveloper\jdev\bin`) of the Oracle JDeveloper 12*c* installation, then enter the following at the command prompt:

```
ojmigrate workspace.jws
```

You can migrate one or more workspaces using this command. For example, enter the `.jws` file locations as follows:

```
ojmigrate C:\JDeveloper\mywork\ADFMobileApp1\ADFMobileApp1.jws
          C:\JDeveloper\mywork\ADFMobileApp2\ADFMobileApp2.jws
```

While you can migrate a small number of workspace files using this method, you can migrate several files using a text file listing the `.jws` file locations. The syntax is as follows, with the location of the text file prefixed with an at sign (@):

```
ojmigrate @file
```

For example, enter `ojmigrate @C:\migrate.txt`.

Example 3–4 illustrates the contents of the text file, where each file location must be on a new line:

Example 3–4 Listing the .jws File Locations in a Text File

```
C:\JDeveloper\mywork\ADFMobileApp1\ADFMobileApp1.jws
C:\JDeveloper\mywork\ADFMobileApp2\ADFMobileApp2.jws
C:\JDeveloper\mywork\ADFMobileApp3\ADFMobileApp3.jws
C:\JDeveloper\mywork\ADFMobileApp4\ADFMobileApp4.jws
C:\JDeveloper\mywork\ADFMobileApp5\ADFMobileApp5.jws
```

> **Tip:** You can automatically populate a text file with the `.jws` locations using the LINUX or UNIX `find` command as follows:
>
> ```
> find . -name "*.jws" -printf "%P\n" > filename.txt
> ```

After you run this command, verify that the applications have been migrated.

Use the `-failFast` option (`ojmigrate -failFast @file`) to stop the migrators after the first application listed in the text file fails to migrate. Using this command you can analyze the errors that prevent the migration.

If the application requires additional data, you can create an output file that lists them as name-value pairs by using the `-generateDefaults` option as follows:

```
ojmigrate -generateDefaults @migrate.txt
```

If the application file requires additional defaults, the `-generateDefaults` option creates a property file named for the `.jws` file (*workspacefilename*`.migration.properties`). After you examine the `.properties` file and change the values accordingly, migrate the workspace using the `ojmigrate` command without the `-generateDefaults` option (for example, `ojmigrate @file`).

Part III

Developing MAF Applications

Describes how to declaratively develop a MAF application using the overview editors.

Part III contains the following:

4

Defining a Mobile Application

This chapter describes using the Oracle Mobile Application Framework overview editors to define the display behavior of the mobile application's springboard and navigation bar and how to designate content by embedding application features.

This chapter includes the following sections:

4.1 Introduction to Defining Mobile Applications

A mobile application can have one or more view controller-type projects, each of which describes a set of features in a `maf-feature.xml` file. As described in Chapter 3, "Getting Started with Mobile Application Development," MAF provides you with the `maf-application.xml` configuration file for the mobile application itself, and the `maf-feature.xml` file, which you use to define the content of the application. While you can manually change these files, MAF provides two overview editors that enable you to build these files declaratively.

4.1.1 Using the Overview Editor for maf-application.xml

The overview editor enables you to configure the `maf-application.xml` file to describe a mobile application and its resources. Each page of the editor enables you to add or update the elements of the configuration file.

4.2 About the Mobile Application Configuration File

The `maf-application.xml` configuration file enables you to set the basic configuration of the mobile application by designating its display name, a unique application ID (to prevent naming collisions) and also by selecting the application features that will display on the application springboard (the equivalent of a home page on a smartphone). Further, this file enables you to create the user preferences pages for the mobile application. This file, which is generated by JDeveloper after you complete the application creation wizard as described in Section 3.2, "Creating an Application Workspace," is comprised of the elements listed in Table 4–2.

Table 4–1 Elements of the Application Descriptor File

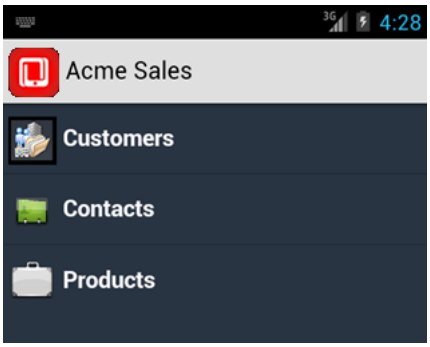
Element	Description
`<adfmf:application>`	The root element of `maf-application.xml`.
`<adfmf:description>`	A description of the application.
`<adfmf:featureReference>`	A feature reference denotes which of the application features packaged in the FAR (Feature archive file) or defined in the `maf-feature.xml` file is relevant to the content of the mobile application. You define the character and content of mobile applications by selecting feature references. For more information about FARs, see Section 4.13, "Working with Feature Archive Files."
`<adfmf:preferences>`	Enables you to set the user preference options and behavior at the application level. You can also set how user preferences display and behave for the application features in the `maf-feature.xml` file. For more information, see Chapter 14, "Enabling User Preferences."
`<adfmf:login>`	Enables you to set the login page for an application feature. For more information, see Chapter 21, "Securing Mobile Applications."
`<adfmf:navigation>`	Enables you to define the behavior of the navigation bar and the springboard. A springboard is a home page in which all of the application icons and labels for the embedded application features are organized in a List View. A springboard provides a top-level view of all of the applications available to a user, who can page through and select applications. For more information, see Section 4.5, "Configuring the Springboard and Navigation Bar Behavior."

Example 4–1 illustrates the `maf-application.xml` file for an application called Acme Sales, a mobile application whose content includes a customer contacts application (`<adfmf:featureReference id="customers" showOnNavigationBar="true"/>`) which displays on the springboard, as shown in Figure 4–1.

Example 4–1 The maf-application.xml File

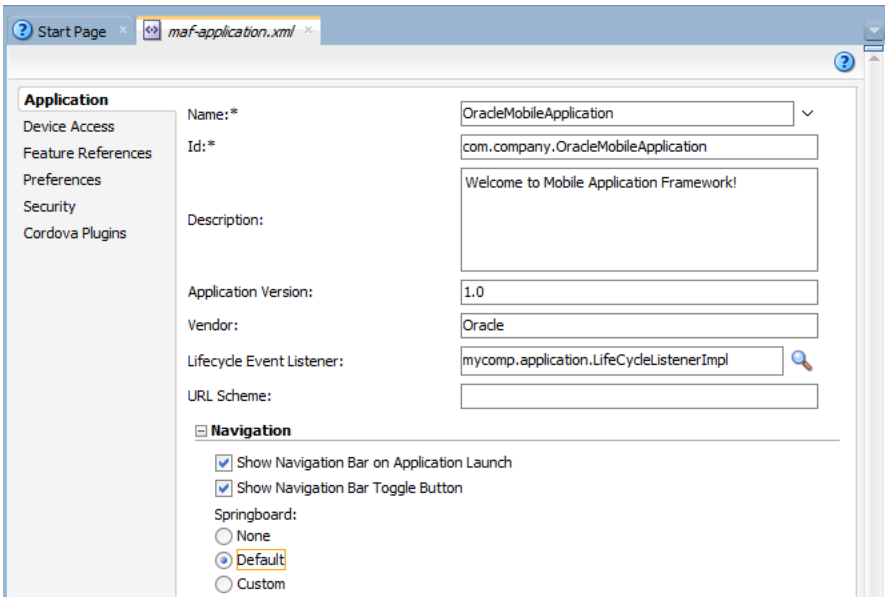
```
<?xml version="1.0" encoding="UTF-8" ?>
<adfmf:application xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
                  xmlns:adfmf="http://xmlns.oracle.com/adf/mf"
                  name="Acme Sales"
                  id="com.company.AcmeSales"
                  appControllerFolder="ApplicationController"
                  version="1.0"
                  vendor="Oracle"
                  listener-class="application.LifeCycleListenerImpl">
    <adfmf:description>Sample Application</adfmf:description>
<adfmf:featureReference id="Customers"
                        showOnSpringboard="true"
                        showOnNavigationBar="true"/>
<adfmf:featureReference id="HCM"
                        showOnSpringboard="true"
                        showOnNavigationBar="true"/>
<adfmf:featureReference id="PROD"
                        showOnSpringboard="true"
                        showOnNavigationBar="true"/>
    <adfmf:preferences>
        <adfmf:preferenceGroup id="Root.Security" label="Security">
            <adfmf:preferenceText id="OracleSecurityProvider_serviceURL"
                                  label="Security URL"
                                  default="http://somecomputer.example.com:someaddress/
                                           idaas_rest/rest/tokenservice1/tokens/getprofile"/>

            <adfmf:preferenceText id="OracleADFMobile_UserName" label="User Name" default="sean"/>
            <adfmf:preferenceText id="OracleADFMobile_Password" label="Password" default="welcome1"
                                                                secret="true"/>
        </adfmf:preferenceGroup>
    </adfmf:preferences>
    <adfmf:navigation>
        <adfmf:springboard enabled="false"/>
        <adfmf:navigationBar enabled="true"/>
    </adfmf:navigation>
</adfmf:application>
```

Figure 4–1 Application Features Displaying in the Mobile Application's Springboard



You can modify these elements declaratively using the overview editor, shown in Figure 4–2, or manually using the Source editor. You can use either of these approaches interchangeably.

Figure 4–2 The Overview Editor for the maf-application.xml File



4.3 Setting the Basic Information for a Mobile Application

The Application page enables you to set the name, application ID, and how the mobile application displays.

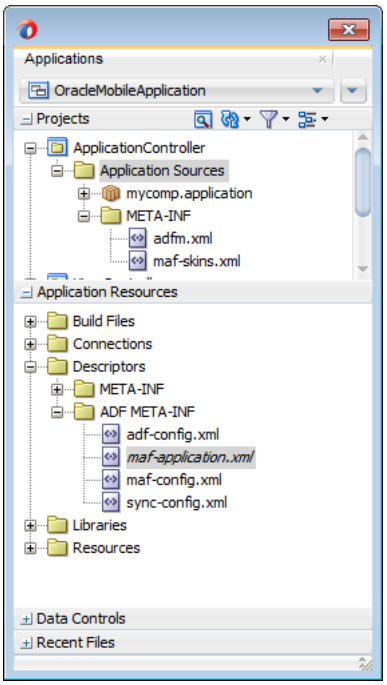
4.3.1 How to Set the ID and Display Behavior for a Mobile Application

The Application page of the overview editor, shown in Figure 4–2, enables you to name the mobile application and control the display of the mobile application within the springboard and navigation bar.

Before you begin:

Open the overview editor for the `maf-application.xml` file by double-clicking the `maf-application.xml` file (located in the **ADF META-INF** node of the Application Resources panel, as shown in Figure 4–3).

Figure 4–3 Selecting the maf-application.xml File in the Applications Window.



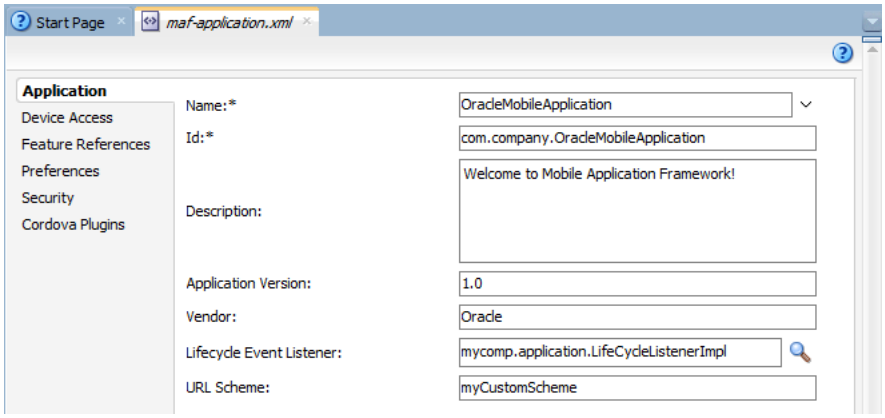
To set the basic information for a mobile application:

1. Choose the **Application** page and if needed, choose the Overview tab.

> **Note:** By default, the editor opens the Application page.

Figure 4–4 shows the portion of the application page where you define the basic information.

Figure 4–4 Setting the Basic Information for the Mobile Application



2. Enter a display name for the application in the **Name** field. This attribute can be localized. For more information, see Section 4.11.1, "Working with Resource Bundles."

> **Note:** MAF uses the value entered in this field as the name for the iOS archive (`.ipa` or `.app`) file that it creates when you deploy the application to an iOS-powered device or simulator. For more information, see Section 19.2.4, "How to Create an iOS Deployment Profile."

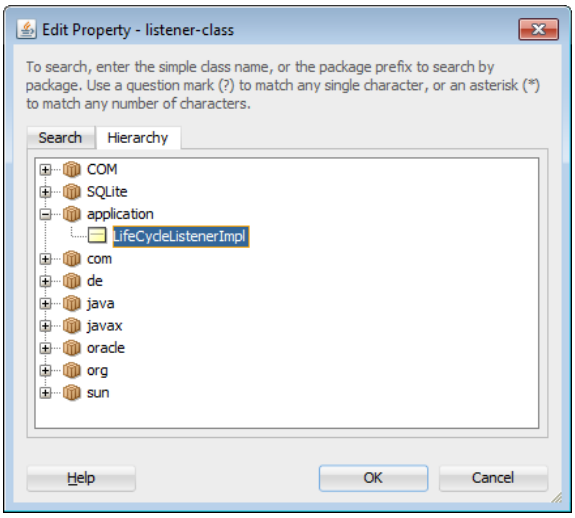
3. Enter a unique ID in the **Id** field.

   To avoid naming collisions, Android and iOS use reverse package names, such as *com.company.application*. JDeveloper prefixes *com.company* as a reverse package to the application name, but you can overwrite this value with another as long as it is unique and adheres to the ID guidelines for both iOS- and Android-powered devices. For iOS application, see the "Creating and Configuring App IDs" section in *iOS Team Administration Guide* (available from the iOS Developer Library at `http://developer.apple.com/library/ios`). For Android, refer to the document entitled "The AndroidManifest.xml File," which is available from the Android Developers website (`http://developer.android.com/guide/topics/manifest/manifest-intro.html`). You can overwrite this ID in the deployment profiles described in Section 19.2.3, "How to Create an Android Deployment Profile" and Section 19.2.4, "How to Create an iOS Deployment Profile."

   > **Note:** To ensure that an application deploys successfully to an Android-powered device or emulator, the ID must begin with a letter, not with a number or a period. For example, an ID comprised of a wholly numeric value, such as 925090 (*com.company.925090*) will prevent the application from deploying. An ID that begins with letters, such as hello925090 (*com.company.hello925090*) will enable the deployment to succeed.

4. Enter a short, but detailed summary of the application that describes the application's purpose in the **Description** field.
5. Enter the version in the **Version** field.
6. Enter the name of the vendor who originated this application in the **Vendor** field.
7. Click **Browse** in the **Lifecycle Event Listener** field to invoke the Edit Property dialog, shown in Figure 4–5, to register the event listener that enables runtime calls for start, stop, activate, and deactivate events. You must enter the fully qualified class name of the event listener. This is an optional field.

Figure 4–5 Retrieving the Application Event Listener



The default application listener class is `application.LifeCycleListenerImpl`. MAF does not register this class by default, because it starts the JVM and therefore may not be preferable for each mobile application. You must instead register this class manually using the Edit Property dialog, shown in Figure 4–5. After you close this dialog, JDeveloper updates the `<adfmf:application>` element with a `listener-class` attribute, as illustrated in Example 4–2.

> **Note:** The application lifecycle listener must remain within the application controller project (its default location).

Example 4–2 Adding the listener-class Attribute

```
<adfmf:application xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
                   xmlns:adfmf="http://xmlns.oracle.com/adf/mf"
                   name="OracleMobileApplication"
                   id="com.company.OracleMobileApplication"
                   appControllerFolder="ApplicationController"
                   listener-class="application.LifeCycleListenerImpl"
                   version="1.1"
                   vendor="Oracle">
   <adfmf:description>This is a mobile application</adfmf:description>
   <adfmf:featureReference id="feature1"/>
</adfmf:application>
```

For more information, see Section 4.7, "About Lifecycle Event Listeners."

4.4 Invoking a Mobile Application Using a Custom URL Scheme

A custom URL scheme can be used to invoke a native application from other applications.

To invoke a mobile application from another application, perform the following:

1. Register a custom URL scheme. You configure this URL scheme in the overview editor of the `maf-application.xml` file using the **URL Scheme** field, as shown in Figure 4–4. The URL with this scheme can then be used to invoke the mobile application and pass data to it.

2. In the application controller project, create a custom URL event listener class (for example, `CustomURLEventListener`) that is notified of the URL. This class must implement the `oracle.adfmf.framework.event.EventListener` interface that defines an event listener. For more information on the `oracle.adfmf.framework.event.EventListener` interface, see *Oracle Fusion Middleware Java API Reference for Oracle Mobile Application Framework*.

   Override and implement the `onMessage(Event e)` method that gets called with the URL that is used to invoke this mobile application. The `Event` object can be used to retrieve useful information about URL payload and the application state. To get `URL` payload, use the `Event.getPayload` method. To get the application state at the time of URL event, use the `Event.getApplicationState` method. For more information, see the `Event` class in *Oracle Fusion Middleware Java API Reference for Oracle Mobile Application Framework*.

3. Register an application lifecycle event listener (ALCL) class. For more information, see Section 4.3, "Setting the Basic Information for a Mobile Application" and Section 4.7, "About Lifecycle Event Listeners."

   Get an `EventSource` object in the `start` method of the ALCL class that represents the source of the custom URL event:

   ```
   EventSource openURLEventSource =
   EventSourceFactory.getEventSource(EventSourceFactory.OPEN_URL_EVENT_SOURCE_
   NAME);
   ```

   Create and add an object of the custom URL event listener class to the event source:

   ```
   openURLEventSource.addListener(new CustomURLEventListener());
   ```

A mobile application can invoke another native application in two ways:

- Using an `amx:goLink` on a MAF AMX page whose URL begins with the custom URL scheme registered by the native application. For example:

  ```
  <amx:goLink text="Open App" id="gl1" url="mycustomurlscheme://somedata"/>
  ```

- Using an HTML link element on an HTML page whose `href` attribute value begins with the custom URL scheme registered by the native application. For example:

  ```
  <a href="mycustomurlscheme://somedata">Open App</a>
  ```

4.5 Configuring the Springboard and Navigation Bar Behavior

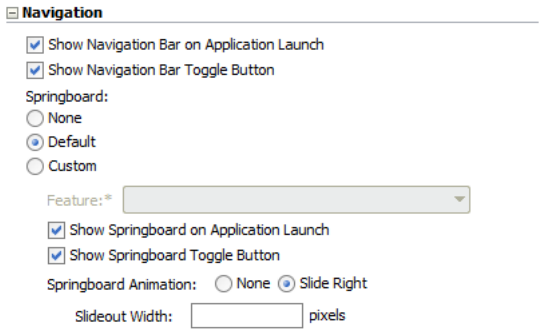
You can configure the mobile application to control the display behavior of the springboard and the navigation bar in the following ways:

- Hide or show the springboard and navigation bar to enable the optimal usage of the mobile device's real estate. These options override the default display behavior for the navigation bar, which is shown by default unless otherwise specified by the application feature.
- Enable the springboard to slide from the right. By default, the springboard does not occupy the entire display, but instead slides from the left, pushing the active content (which includes the navigation bar's Home button and application features) to the right.

4.5.1 How to Configure Application Navigation

The Navigation options of the Applications page, shown in Figure 4–6, enable you to hide or show the navigation bar, select the type of springboard used by the application, and define how the springboard reacts when users page through applications.

Figure 4–6 The Navigation Options of the Application Page



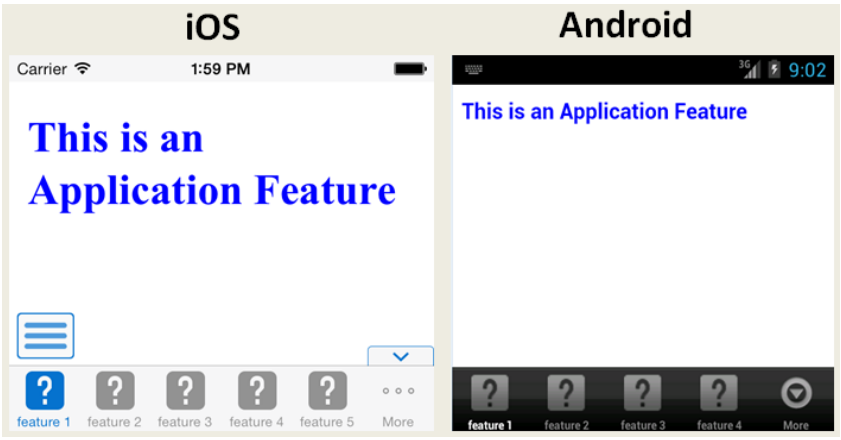
Before you begin:

You must select the Application page of the `maf-application.xml` overview editor.

To set the display behavior for the navigation bar:

1. Select **Show Navigation Bar on Application Launch** to enable the mobile application to display its navigation bar (instead of the springboard), by default, as shown in Figure 4–7.

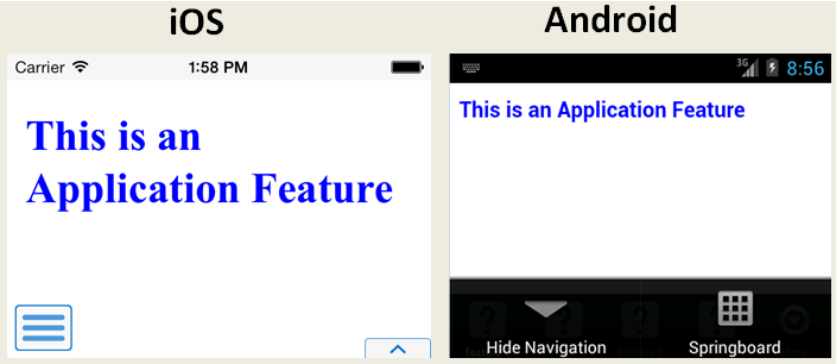
Figure 4–7 The Navigation Bar, Shown By Default



   If you clear this option, then you hide the navigation bar when the application starts, presenting the user with the springboard as the only means of navigation. Because the navigation bar serves the same purpose as the springboard, hiding it can, in some cases, remove redundant functionality.

2. Select **Show Navigation Bar Toggle Button** to hide the navigation bar when the content of a selected application feature is visible. Figure 4–8 illustrates this option, showing how the navigation bar illustrated in Figure 4–7 becomes hidden by the application feature content.

Figure 4–8 Hiding the Navigation Bar



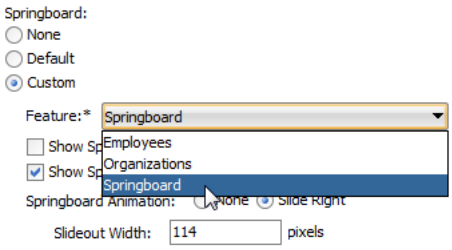
This option is selected by default; the navigation bar is shown by default if the show or hide state is not specified by the application feature.

To set the display behavior for the springboard:

1. Select the type of springboard (if any):
   - **None**—Select this option if the springboard should not be displayed in the application.
   - **Default**—Select to display the default springboard provided by MAF, which uses styles illustrated in Figure 4–1. The default springboard is implemented as a MAF AMX page. For more information, see Section 4.5.5, "What You May Need to Know About Custom Springboard Application Features with MAF AMX Content."
   - **Custom**—Select to use a customized springboard. You may, for example, create a custom springboard that arranges the embedded application features in a grid layout pattern, or includes a search function, or data, such as a list of common tasks (*My Reports*, or *My Leads*, for example). This application, which can be implemented either as an HTML page or as a MAF Mobile AMX page, is declared as an application feature in the `maf-feature.xml` file (which is located within a view controller project). For more information, see Section 4.9.1, "How to Define the Basic Information for an Application Feature."For information on enabling navigation within a customized springboard written in HTML, see Chapter B, "Local HTML and Application Container APIs."
     - **Feature**—Select the application feature used as a springboard, as shown in Figure 4–7. See the APIDemo sample application for an example of a custom springboard. For more information, see Appendix F, "Mobile Application Framework Sample Applications."

Note: MAF's design time prompts you to set the **Show on Navigation Bar** and **Show on Springboard** options to `false` when you designate an application feature as a custom springboard. This ensures that the page behaves as a springboard rather than as an application feature that users launch from a navigation bar or from a springboard. For more information, see Section 4.6.1, "How to Designate the Content for a Mobile Application."

Figure 4–9 Selecting an Application Feature as a Custom Springboard



2. Select **Show Springboard on Application Launch** to enable the mobile application to display the springboard to the end user after the mobile application has been launched. (This option is only available for the **Default** or **Custom** options.)
3. Select **Show Springboard Toggle Button** to enable the display of the springboard button, shown in Figure 4–10, that displays within an application feature. Figure 4–7, "The Navigation Bar, Shown By Default" shows this button within the context of an application feature. This option is only available for the **Default** or **Custom** options.

Figure 4–10 The Springboard Toggle Button

To set the slideout behavior for the springboard:

1. Select **Springboard Animation** and then choose **Slide Right**. The springboard occupies an area determined by the number of pixels (or the percent) entered for the **Slideout Width** option. If you select **None**, then the springboard cannot slide from the right (that is, MAF does not provide the animation to enable this action). The springboard takes the entire display area.

> **Note:** The slideout option is only applicable when you select either the **Custom** or **Default** springboard options.

2. Set the width (in pixels). The default width of a springboard on an iOS-powered device is 320 pixels. On Android-powered devices, the springboard occupies the entire screen by default, thereby taking up all of the available width.

> **Note:** If the springboard does not occupy the entire area of the display, then an active application feature occupies the remainder of the display. For more information, see Section 4.5.3, "What Happens When You Set the Animation for the Springboard."

4.5.2 What Happens When You Configure the Navigation Options

Setting the springboard and navigation bar options updates or adds elements to the `adfmf:application.xml` file's `<adfmf:navigation>` element. For example, selecting **None** results in the code updated with `<springboard enabled="false">` as illustrated in Example 4–3.

Example 4–3 Preventing the Display of the Springboard

```
<adfmf:application>
  ...
  <adfmf:navigation>
     <adfmf:navigationBar enabled="true"/>
     <adfmf:springboard enabled="false"/>
  </adfmf:navigation>
</adfmf:application>
```

> **Tip:** By default, the navigation bar is enabled, but the springboard is not. If you update the XML manually, you can enable the springboard as follows:
>
> ```
> <adfmf:application>
>   ...
> <adfmf:navigation>
>     <adfmf:springboard enabled="true"/>
>   </adfmf:navigation>
>   ...
> </adfmf:application>
> ```

Example 4–4 illustrates how the `enabled` attribute is set to `true` when you select **Default**.

> **Note:** Because the springboard fills the entire screen of the device, the navigation bar and the springboard do not appear simultaneously.

Example 4–4 Enabling the Display of the Default Springboard

```
<adfmf:application>
  ...
  <adfmf:navigation>
     <adfmf:navigationBar enabled="true"/>
     <adfmf:springboard enabled="true"/>
  </adfmf:navigation>
</adfmf:application>
```

If you select **Custom** and then select the application feature used as the springboard, the editor populates the `<adfmf:navigation>` element as illustrated in Example 4–5. The `id` attribute refers to an application feature defined in the `maf-feature.xml` file that is used as a custom springboard.

Example 4–5 Configuring a Custom Springboard

```
<adfmf:navigation>
    <adfmf:springboard enabled="true">
      <adfmf:springboardFeatureReference id="springboard"/>
    </adfmf:springboard>
  </adfmf:navigation>
```

4.5.3 What Happens When You Set the Animation for the Springboard

Example 4–6 shows the navigation block of the `maf-application.xml` file, where the springboard is set to slideout and occupy a specified area of the display (213 pixels).

Example 4–6 Configuring Springboard Animation

```
<adfmf:navigation>
   <adfmf:navigationBar enabled="true"
                        displayHideShowNavigationBarControl="true"/>
   <!-- default interpretation of width is pixels -->
   <adfmf:springboard enabled="true"
                      animation="slideright"
                      width="213"
                      showSpringbaordAtStartup="true"/>
</adfmf:navigation>
```

The following line disables the animation:

```
<adfmf:springboard enabled="true" animation="none"/>
```

The following line sets the springboard to occupy 100 pixels from the left of the display area and also enables the active application feature to occupy the remaining portion of the display:

```
<adfmf:springboard enabled="true" animation="slideright" width="100px"/>
```

In addition to the animation, Example 4–6 demonstrates the following:

- The use of the `showSpringboardAtStartup` attribute, which defines whether the springboard displays when the application starts. (By default, the springboard is displayed.)
- The use of the `navigationBar`'s `displayHideShowNavigationBarControl` attribute.

To prevent the springboard from displaying, set the `enabled` attribute to `false`.

4.5.4 What You May Need to Know About Custom Springboard Application Features with HTML Content

The default HTML springboard page provided by MAF uses the following technologies, which you may also want to include in a customized login page:

- Cascading Style Sheets (CSS)—Defines the colors and layout.
- JavaScript—The `<script>` tag embedded within the springboard page contains references to the methods described in Chapter B, "Local HTML and Application Container APIs" that call the Apache Cordova APIs. In addition, the HTML page uses JavaScript to respond to the callbacks and to detect page swipes. When swipe events are detected, JavaScript enables the dynamic modification of the style sheets to animate the page motions.

  A springboard authored in HTML (or any custom HTML page) can leverage the Apache Cordova APIs by including a `<script>` tag that references the `base.js` library. You can determine the location of this library (or other JavaScript libraries) by first deploying a MAF application and then locating the `www/js` directory within platform-specific artifacts in the `deploy` directory. For an Android application, the `www/js` directory is located within the Android application package (`.apk`) file at:

  application workspace directory`/deploy/`*deployment profile name*`/`*deployment profile name*`.apk/assets/www/js`

  For iOS, this library is located at:

  application workspace directory`/deploy/`*deployment profile name*`/temporary_xcode_project/www/js`

For more information, see Section B.1, "Using MAF APIs to Create a Custom HTML Springboard Application Feature."

- WebKit—Provides smooth animation of the icons during transitions between layouts as well as between different springboard pages. For more information on the WebKit rendering engine, see `http://www.webkit.org/`.

Springboards written in HTML are application features declared in the `maf-feature.xml` file and referenced in the `maf-application.xml` file.

4.5.5 What You May Need to Know About Custom Springboard Application Features with MAF AMX Content

Like their HTML counterparts, springboards written using MAF AMX are application features that are referenced by the mobile application, as described in Section 4.6.1, "How to Designate the Content for a Mobile Application." Because a springboard is typically written as a single MAF AMX page rather than as a task flow, it uses the `gotoFeature` method, illustrated by the method expression in Example 4–7, to launch the embedded application features.

> **Note:** A custom springboard page (authored in either HTML or MAF AMX) must reside within a view controller project which also contains the `maf-feature.xml` file. For more information, see Section 4.6.1, "How to Designate the Content for a Mobile Application."

The default springboard (`adfmf.default.springboard.jar`, located in *`jdev_install`*`\jdeveloper\jdev\extensions\oracle.maf\lib`) is a MAF AMX page that is bundled in a Feature Archive (FAR) JAR file and deployed with other FARs that are included in the mobile application. This JAR file includes all of the artifacts associated with a springboard, such as the `DataBindings.cpx` and `PageDef.xml` files. This file is only available after you select **Default** as the springboard option in the `maf-application.xml` file. Selecting this option also adds this FAR to the application classpath. For more information, see Section 19.5, "Deploying Feature Archive Files (FARs)."

The default springboard (`springboard.amx`, illustrated in Example 4–7) is implemented as a MAF AMX application feature.

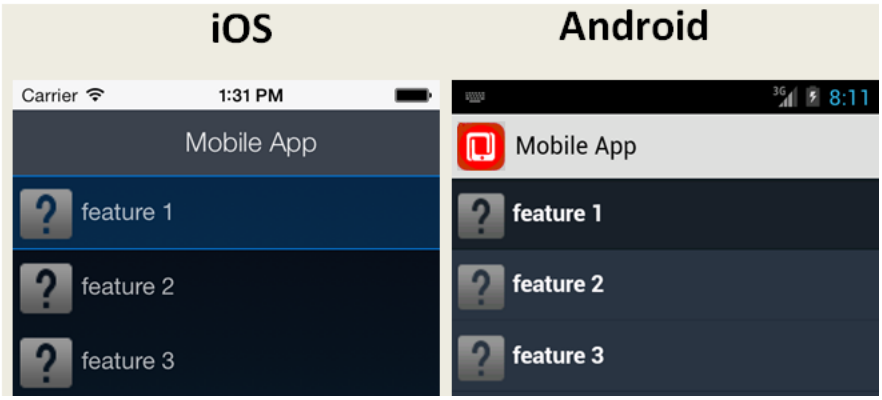
Example 4–7 The Default Springboard page, springboard.amx

```
<?xml version="1.0" encoding="UTF-8" ?>
<amx:view xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
          xmlns:amx="http://xmlns.oracle.com/adf/mf/amx"
          xmlns:dvtm="http://xmlns.oracle.com/adf/mf/amx/dvt">
   <amx:panelPage id="pp1">
      <amx:facet name="header">
         <amx:outputText value="#{bindings.name.inputValue}" id="ot3"/>
      </amx:facet>
      <amx:listView var="row"
                    value="#{bindings.features.collectionModel}"
                    fetchSize="#{bindings.features.rangeSize}"
                    id="lv1"
                    styleClass="amx-springboard">
         <amx:listItem showLinkIcon="false"
                       id="li1"
                       actionListener="#{bindings.gotoFeature.execute}">
```

```
                <amx:tableLayout id="tl1"
                                 width="100%">
                   <amx:rowLayout id="rl1">
                      <amx:cellFormat id="cf11"
                                      width="46px"
                                      halign="center">
                          <amx:image source="#{row.image}"
                                     id="i1"
                                     inlineStyle="width:36px;height:36px"/>
                      </amx:cellFormat>
                      <amx:cellFormat id="cf12"
                                      width="100%"
                                      height="43px">
                         <amx:outputText value="#{row.name}"
                                         id="ot2"/>
                      </amx:cellFormat>
                   </amx:rowLayout>
                </amx:tableLayout>
                   <amx:setPropertyListener from="#{row.id}"
                                            to="#{pageFlowScope.FeatureId}"/>
            </amx:listItem>
         </amx:listView>
      </amx:panelPage>
</amx:view>
```

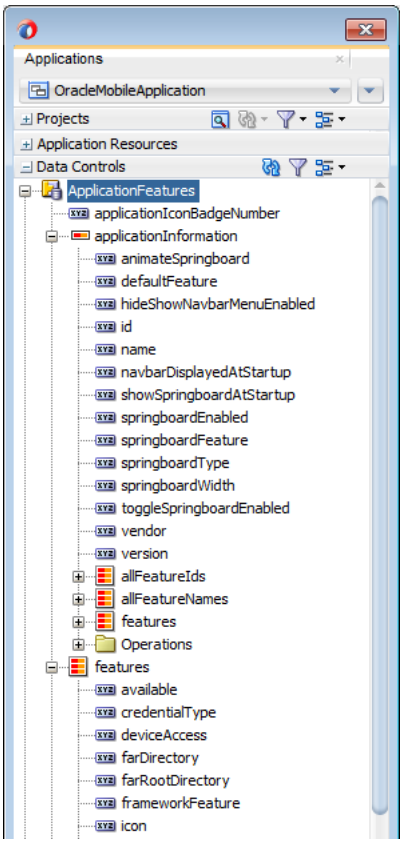
As shown in Figure 4–11, a MAF AMX file defines the springboard using a List View whose List Items are the mobile application's embedded application features. These application features, once deployed, are displayed by their names and associated icons. The `gotoFeature` method of the `AdfmfContainerUtilities` API provides the page's navigation functions. For a description of using this method to display a specific application feature, see Section B.2.6, "gotoFeature." See also Section 6.3.15, "How to Use List View and List Item Components."

Figure 4–11 The Default Springboard



MAF provides the basic tools to create a custom springboard (or augment the default one) in the ApplicationFeatures data control. This data control, illustrated in Figure 4–12, enables you to declaratively build a springboard page using its data collections of attributes that describe both the mobile application and its application features. For an example of a custom springboard page, see the APIDemo sample application. For more information on this application (and other samples that ship with MAF), see Appendix F, "Mobile Application Framework Sample Applications."

Figure 4–12 ApplicationFeatures Data Control



The methods of the ApplicationFeatures data control enable you to add navigation functions. These `adfmf.containerUtilities` methods are described in Table 4–2. For more information, see Section B.2, "The MAF Container Utilities API." See also Chapter 7, "Using Bindings and Creating Data Controls."

Table 4–2 ApplicationFeature Methods

Method	Description
`gotoDefaultFeature`	Navigates to default application feature.
`gotoFeature`	Navigates to a specific application as designated by the parameter that is passed to this method.
`gotoSpringboard`	Navigates to the springboard.
`hideNavigationbar`	Hides the navigation bar.
`showNavigationbar`	Displays the navigation bar (if it is hidden).
`resetFeature`	Resets the application feature that is designated by the parameter passed to this method.

4.5.6 What You May Need to Know About the Runtime Springboard Behavior

If you chose the **Show Springboard on Application Launch** option and defined the slideout width to full size of the screen, then MAF loads the default application feature in the background at startup. When the mobile application hibernates, MAF hides the springboard.

4.6 Configuring the Application Features within a Mobile Application

Each mobile application must have at least one application feature.

4.6.1 How to Designate the Content for a Mobile Application

Figure 4–14 shows the Feature References page, which enables you to build the content for the mobile application. As noted in Section 4.2, "About the Mobile Application Configuration File," the mobile application descriptor file's `<adfmf:featureReference>` element designates these application features.

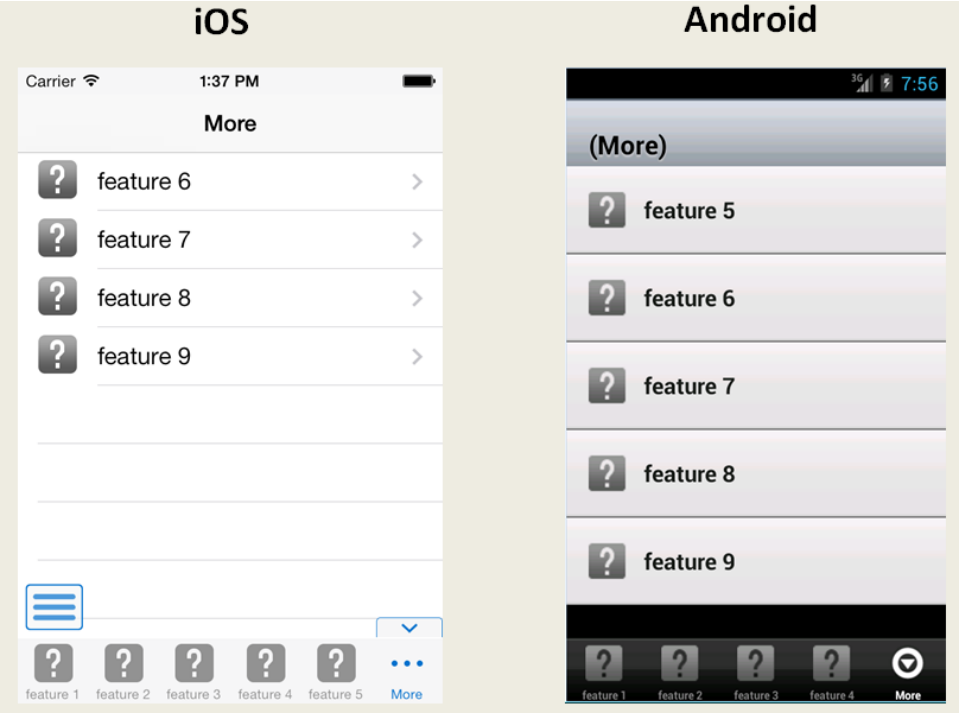
Example 4–8 Designating Feature References the in the maf-application.xml File

```
<adfmf:featureReference id="Prod"
                        showOnNavigationBar="true"
                        showOnSpringboard="true"/>
<adfmf:featureReference id="Customers"
                        showOnNavigationBar="true"
                        showOnSpringboard="true"/>
<adfmf:featureReference id="HCM"
                        showOnNavigationBar="true"
                        showOnSpringboard="true"/>
<adfmf:featureReference id="custom_springboard"
                        showOnNavigationBar="false"
                        showOnSpringboard="false"/>
<adfmf:navigation>
   <adfmf:springboard enabled="true">
      <adfmf:springboardFeatureReference id="custom_springboard"/>
   </adfmf:springboard>
</adfmf:navigation>
```

Example 4–8 shows some of the defined feature references and their associated attributes. The overview editor displays these feature references in the Feature References table. Figure 4–14 shows the defined feature references for HCM and PROD that represent the Customers and Products application features, respectively. Using this page, you enter the references to the application feature and set its display within the mobile application's springboard, as shown in Figure 4–1.

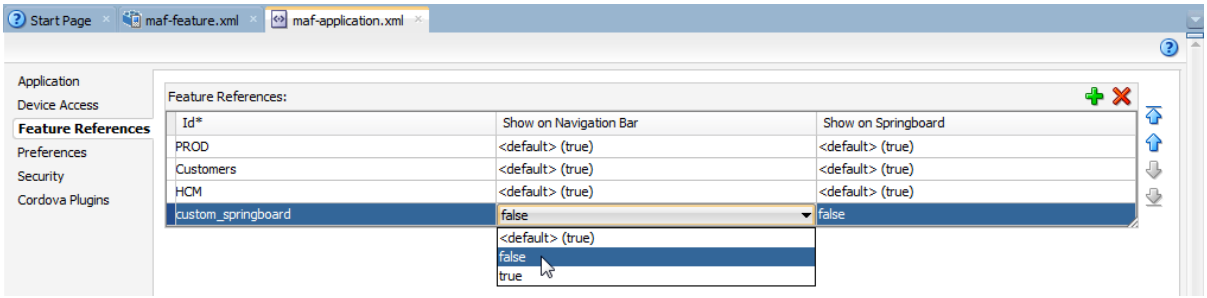
In addition, the page enables you to set the order in which the application features display on the navigation bar and springboard. At runtime, the width of the device screen can limit the number of application features that display on the navigation bar. Those that cannot be accommodated on the navigation bar display under a More tab, as shown in Figure 4.13. Users can reorder the application features within the More tab by using the Edit function.

Figure 4–13 The More Tab



Note: Because building a mobile application is an iterative process, you can add, delete or update feature references as new FARs become available (and new application features are added to the `maf-feature.xml` file).

Figure 4–14 Designating Application Features Using the Feature References Page



Before you begin:

You must have application features configured in the `maf-feature.xml` file, as described in Section 4.9, "Setting the Basic Configuration for the Application Features." In addition, you must open the `maf-application.xml` overview editor.

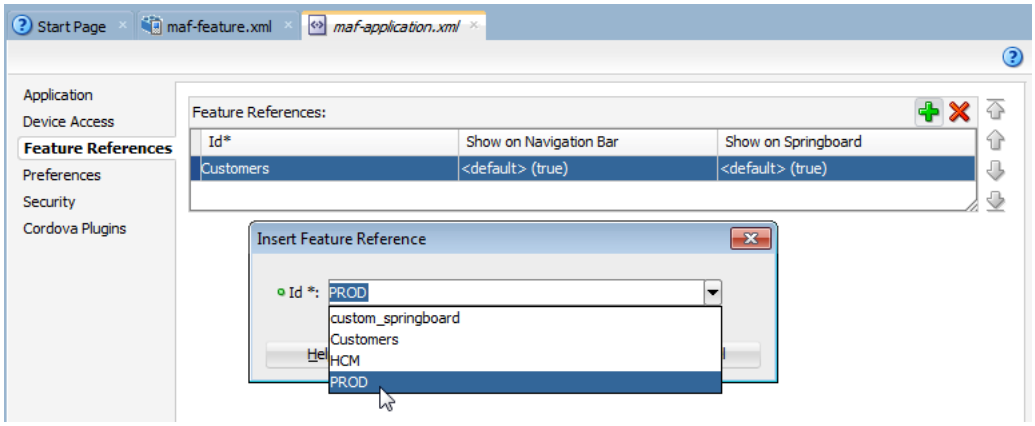
To designate feature references:

1. Click the **Feature References** page of the `maf-application.xml` overview editor.
2. Click **Add**.
3. In the Insert Feature Reference dialog, select the ID of the application feature from the dropdown list, as shown in Figure 4–15. You can also add references to

application features that are contained in an imported feature archive (FAR) file. For more information, see Section 4.13.2, "What Happens When You Add a FAR as a Library."

This dialog lists all of the application features described in the `<adfmf:feature>` elements of the `maf-feature.xml` file Using this dialog ensures that the `id` attributes of both the `<adfmf:featureReference>` and `<adfmf:feature>` elements match. See also Section 4.6.2, "What You May Need to Know About Feature Reference IDs and Feature IDs."

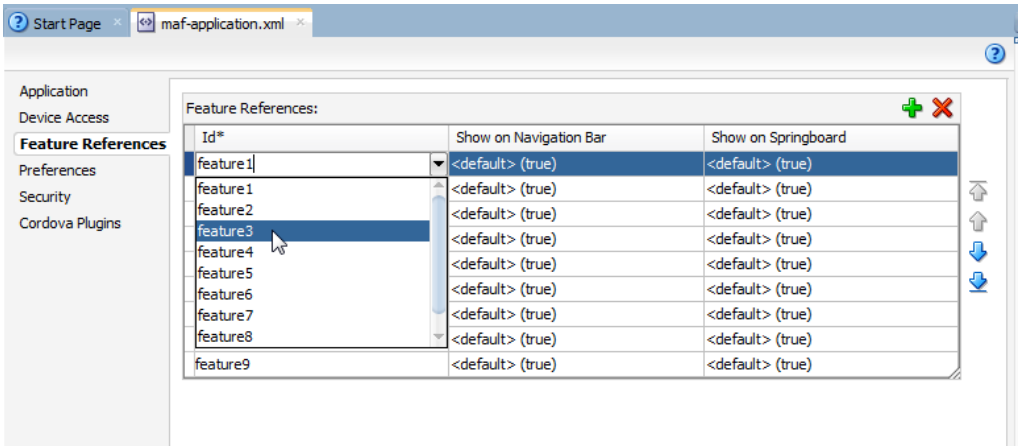
Figure 4–15 Selecting the Content for the Mobile Application



4. If needed, use the up- and down-arrows shown in Figure 4–15 to arrange the display order of the feature references, or use the dropdown list in rows of the Id column, shown in Figure 4–16, to reorder the feature references. The top-most application feature is the default application feature. Depending on the security configuration for this application, MAF can enable users to login anonymously to view unsecured content, or it can prompt users to provide their authentication credentials. For more information, see Section 21.1, "About Mobile Application Framework Security."

> **Note:** The top-most ID in the Feature References table is the first application feature to display within the mobile application. See, for example, the Feature 1 application feature illustrated in Figure 4–7.

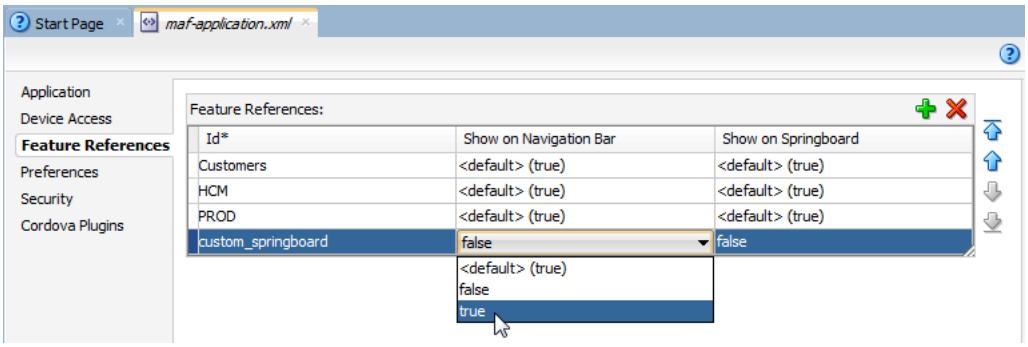
Figure 4–16 Reordering Feature References



5. Set the springboard and navigation bar display behavior for the application feature by selecting `true` or `false` from the dropdown lists in the rows of the **Show on Navigation Bar** and **Show on Springboard** columns. Figure 4–17 shows selecting these options to prevent an application feature from displaying in the navigation bar.

   Tip: Set these options to `false` if the application uses a custom springboard or if the application feature will display as a sliding window. For more information, see Section 4.7.6, "Enabling Sliding Windows."

Figure 4–17 Changing the Navigation Options



The springboard and the navigation bar display by default (that is, these attributes are set to `true`). If both the navigation bar and springboard attributes are set to `false`, then the application feature only displays if it is in the first position. See also Section B.2.11, "hideNavigationBar" and Section B.2.12, "showNavigationBar."

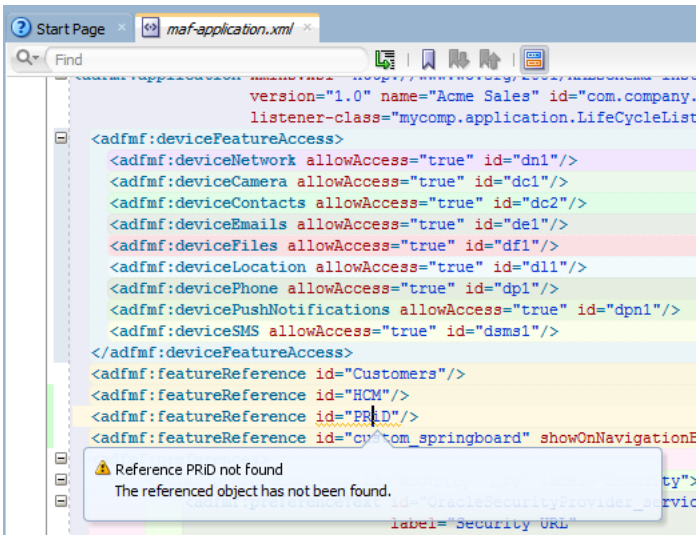
Note: Because springboard applications do not display on the navigation bar or within the springboard of a mobile application, **Show on Navigation Bar** and **Show on Springboard** must both be set to `false` for feature references used as custom springboard application features. See also Section 4.5.5, "What You May Need to Know About Custom Springboard Application Features with MAF AMX Content."

4.6.2 What You May Need to Know About Feature Reference IDs and Feature IDs

A mobile application can contain many projects and can therefore also include multiple `maf-feature.xml` files. In the application configuration file, a feature reference relates to a feature described by a `maf-feature.xml` file. The ID of an `<adfmf:featureReference>` identifies where the corresponding application feature is defined. In other words, the `id` attributes for `<adfmf:featureReference>` elements in the `maf-application.xml` file must be the same as the `id` attribute defined for `<adfmf:feature>` element in `maf-feature.xml`. For example, `<adfmf:featureReference id="customers">` in `maf-application.xml` is defined by `<adfmf:feature id="customers">` in `maf-feature.xml`. JDeveloper audits the references between the application and feature descriptor files in the same mobile application, and warns you when it finds discrepancies. As shown in Figure 4–18, JDeveloper highlights the mismatch within the code between a feature reference and the features declared in the features application descriptor file with a wavy underline and a *Reference not Found* warning, which in this case is a feature reference ID defined as `Prid` rather than the correct `Prod`. For more information on JDeveloper's syntax

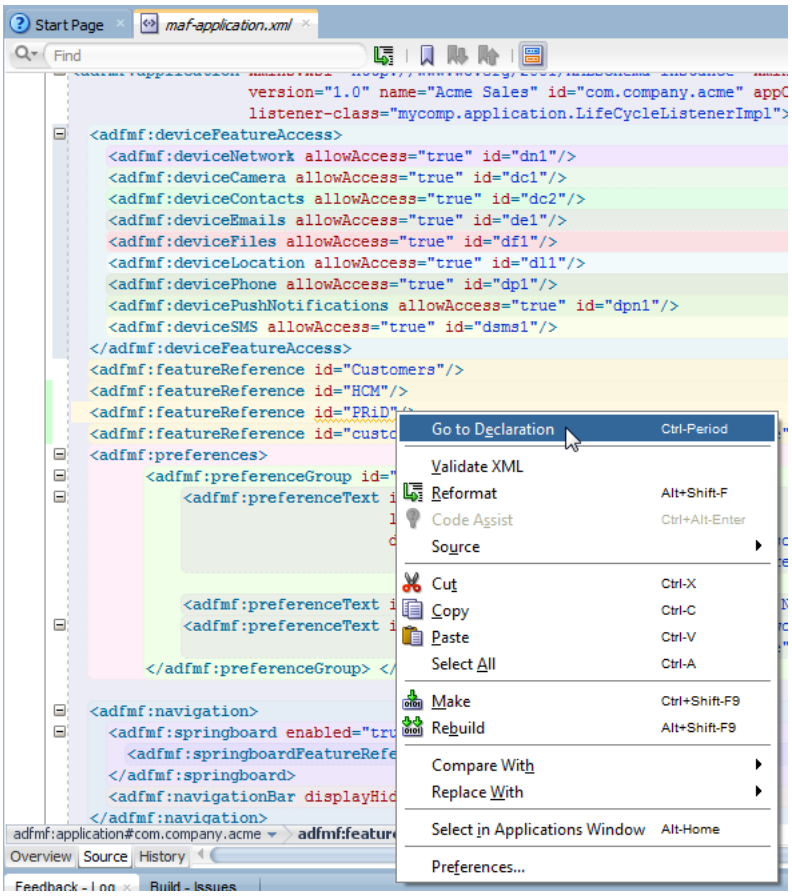
auditing, see the "Auditing and Monitoring Java Projects" chapter in *Oracle Fusion Middleware User's Guide for Oracle JDeveloper*.

Figure 4–18 Auditing id Attributes



If the ID for an `<adfmf:featureReference>` is defined in the `maf-feature.xml` file, you can use **Go To Declaration** in the context menu, as shown in Figure 4–19, to traverse from the `id` of a `<adfmf:featureReference>` in the `maf-application.xml` file to the corresponding `id` of the `<adfmf:feature>` in the `maf-feature.xml` file.

Figure 4–19 Finding Application Feature Declarations in the maf-feature.xml File



The feature IDs must be unique across an application. Because application features can be reused, use proper naming conventions to ensure that their feature IDs are unique.

Note: Do not add a MAF view controller project as a dependency of another MAF view controller project or as a dependency of a mobile application controller project. Doing so adds an `<adfmf:feature>` element in the added view controller project with the same `id` attribute as the `<admf:feature>` element in the `maf-feature.xml` file of the original MAF view controller project. As a result, the deployment framework terminates the deployment, because it detects that the `id` attributes for the `<adfmf:feature>` element are not unique across the mobile application.

4.7 About Lifecycle Event Listeners

Within the MAF runtime, classes implement various `LifeCycleListener` methods to communicate with event notifications sent from the native operating system frameworks to the JVM. These event notifications describe various states (starting, stopping, or hibernating) for both the mobile application and its embedded application features. MAF invokes the class functions to the JVM using a generic invoke message.

The overview editors for both the `maf-application.xml` and `maf-feature.xml` files enable you to declaratively add a lifecycle listener class that MAF calls when events

occur. After you enter a fully qualified class name (including the package) using the Class and Package Browser in the overview editor's LifeCycle Event Listener Class field, JDeveloper populates the XML page with the `listener-class` attribute. For mobile applications, this attribute is included in the `<adfmf:application>` element, as shown in Example 4–9.

Example 4–9 The listener-class Attribute in the maf-application.xml File

```
<adfmf:application xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
                  xmlns:adfmf="http://xmlns.oracle.com/jdev/adfmf"
                  id="app-20110308"
                  name="#{strings.Title}"
                  vendor="Oracle"  version="1.0"
                  listener-class="oracle.adfmf.application.AppListener">

...

</adfmf:application>
```

Within the `maf-feature.xml` file, the `listener-class` attribute is contained within the `<adfmf:feature>` attribute, as shown in Example 4–10.

Example 4–10 The listener-class Attribute in the maf-feature.xml File

```
...

   <adfmf:feature id="mycompany.phonelist"
                  name="Phone List"
                  icon="mycompany.phonelist/phoneicon.png"
                  listener-class="oracle.adfmf.feature.LifeCycleListener">
                  image="mycompany.phonelist/phoneimage.png"
      <adfmf:content id="general">

         <adfmf:amx file="mycompany.phonelist/phone.amx"/>
      </adfmf:content>

   </adfmf:feature>

...
```

After you create a mobile application, JDeveloper creates a lifecycle listener class for the application called `LifeCycleListenerImpl.java`. You can implement specific methods using this file, as illustrated in Chapter 17, "Enabling Push Notifications." The Lifecycle Events sample application provides an example of declaring the event listener class in both the `maf-application.xml` and `maf-feature.xml` files. This sample application is in the `PublicSamples.zip` file at the following location within the JDeveloper installation directory of your development computer:

jdev_install`/jdeveloper/jdev/extensions/oracle.maf/Samples`

4.7.1 Events in Mobile Applications

Lifecycle listener classes for mobile applications must implement the `start`, `stop`, `activate`, and `deactivate` methods of the `LifeCycleListener` interface, as illustrated in Example 4–11 to execute the application lifecycle events.

Example 4–11 The LifeCycleListener Interface for a Mobile Applications

```
package oracle.adfmf.application;

public interface LifeCycleListener
{
   void start();
   void stop();
   void activate();
   void deactivate();
}
```

> **Note:** The application lifecycle listener is executed with an anonymous user (that is, there is no user associated with any of its methods and no secure web service is called).

The `AppListener` class, shown in Example 4–12, uses the `LifeCycleListener` method calls for starting or stopping events as well as those used when the application is about to hibernate (`deactivate`) or return from hibernating (`activate`). For more information, see Section 4.7.2, "Timing for Mobile Application Events." See also the LifeCycleListener interface in *Oracle Fusion Middleware Java API Reference for Oracle Mobile Application Framework*.

Example 4–12 Implementation of the LifeCycleListener Interface

```
package some.package;
import oracle.adfmf.application.LifeCycleListener;

public class AppListener implements LifeCycleListener
{
    public AppListener()
    {
        super();
    }
    public void start()
    {
        // Perform application startup tasks...
    }
    public void stop()
    {
        // Perform tasks to stop the application...
    }
    public void activate()
    {
        // Perform appplication activation tasks...
    }
    public void deactivate()
    {
        // Perform application deactivation tasks...
    }
}
```

The application controller project of the LifeCycleEvents sample application, described in Appendix F, "Mobile Application Framework Sample Applications," contains a class (`LifeCycleListenerImpl.java`) that implements the `LifeCycleListener` interface.

Note: Managed beans and data bindings must be initialized before the startup lifecycle code executes.

4.7.2 Timing for Mobile Application Events

MAF calls application lifecycle methods at specific times during the mobile application's startup, shutdown, and hibernation. Table 4–3 describes when these methods are called and also notes their Objective-C counterparts.

Table 4–3 MAF Lifecycle Methods

Method	Timing	When Called	Usage	Relation to iOS Application Delegate Methods
`start`	Called after the mobile application has completely loaded the application features and immediately before presenting the user with the initial application feature or the springboard. This is a blocking call.	When the application process starts.	Uses include: ■ Determining if there are updates to the mobile application. ■ Requesting a remote server to download data to the local database.	This event does not correspond to a specific application delegate method. It is called after the `maf-application.xml` and `maf-feature.xml` files have loaded, just prior to hiding the splash screen.

Table 4–3 (Cont.) MAF Lifecycle Methods

Method	Timing	When Called	Usage	Relation to iOS Application Delegate Methods
`stop`	Called as the mobile application begins its shutdown.	When the application process terminates.	Uses include: ■ Logging off from any remote services. ■ Uploading any data change to the server before the application is closed.	This is called in the `applicationWillTerminate:` method on the application delegate.
`activate`	Called as the mobile application activates from being situated in the background (hibernating). This is a blocking call.	After the `start` method is called.	Uses include: ■ Reading and re-populating cache stores. ■ Processing web service requests. ■ Obtaining required resources. ■ Checkpointing. For more information, see Section 4.7.3, "Using the activate and deactivate Methods to Save Application State."	This is called in the `applicationDidBecomeActive:` method on the application delegate.
`deactivate`	Called as the mobile application deactivates and moves into the background (hibernating). This is a blocking call.	Before the `stop` method is called.	Uses include: ■ Writing the restorable state. ■ Checkpointing. For more information, see Section 4.7.3, "Using the activate and deactivate Methods to Save Application State." ■ Closing the database cursor and the database connection.	This is called in the `applicationWillResignActive:` method on the application delegate.

4.7.3 Using the activate and deactivate Methods to Save Application State

Because checkpointing saves the application state, you can enable users to continue using the last page of a mobile application that was active before it began to hibernate by adding checkpoint entries to the `activate` and `deactivate` methods. The lifecycle listener reads the checkpoint entries added to the `activate` class and allows the processes to resume after the application has returned from hibernating; users can

continue with application uninterrupted by not having to log in a second time. If the application is terminated during hibernation, you can enable the application to resume by specifying that checkpoint information be written to a database or to a device's cache directory as part of the `deactivate` method. The application resumes at the same page by reading this checkpoint information during activation.

4.7.4 About Application Feature Lifecycle Listener Classes

A mobile application feature lifecycle listener class, such as `FeatureListenerPhoneList`, illustrated in Example 4–14, must implement the `activate` and `deactivate` methods of the `LifeCycleListener` interface, as shown in Example 4–13.

Example 4–13 Application Feature LifeCycleListener Interface

```
package oracle.adfmf.feature;
public interface LifeCycleListner
{
   void activate();
   void deactivate();
}
```

Example 4–14 illustrates a class called `FeatureListenerPhoneList` that uses the `activate` and `deactivate` methods by implementing the `LifeCycleListener` to show and hide the application feature as described in Table 4–4. These methods hide the application feature when it hibernates, or display it when it returns from hibernating.

> **Note:** As noted in *Oracle Fusion Middleware Java API Reference for Oracle Mobile Application Framework*, both the `activate` and `deactivate` methods are blocking calls. Because these methods freeze the user interface until they have executed completely, any long-running process included within them will delay the activation of an another application feature. If an application does not require a long-running process to complete before it is deactivated, include it in a background thread rather than within these methods.

Example 4–14 Implementing the Application Feature Lifecycle

```
package some.package;

import oracle.adfmf.feature.LifeCycleListener;

public class FeatureListenerPhoneList implements LifeCycleListener
{
    public FeatureListenerPhoneList()
    {
        super();
    }
    public void activate()
    {
        // Perform application activation tasks...
    }
    public void deactivate()
    {
        // Perform application deactivation tasks...
    }
```

```
}
```

Tip: The LifeCycle Events sample application provides an example of using the `LifeCycleListener` interface at the application feature level through the `Feature1Handler.java` and `Feature2Handler.java` files. These files are located within the view controller project's Application Sources folder.

4.7.5 Timing for Activate and Deactivate Events in the Application Feature Lifecycle

By implementing an application feature lifecycle listener class, you enable an application feature to automatically obtain any data changes to the `applicationScope` variable or to application feature-specific variables that changed when the application feature was deactivated. Table 4–4 describes when the activate and deactivate events are fired for an application feature. For more information, see *Oracle Fusion Middleware Java API Reference for Oracle Mobile Application Framework*.

Table 4–4 The activate and deactivate Methods for Application Features

Method	Timing	When Called	Usage
`activate`	Called before the current application feature is activated.	Called when a user selects the application feature for the first time after launching a mobile application, or when the application has been re-selected (that is, brought back to the foreground).	Uses include: ▪ Reading the `applicationScope` variable. ▪ Setting the current row on the first MAF AMX view.
`deactivate`	Called before the next application feature is activated, or before the application feature exits.	Called when the user selects another application feature.	You can, for example, use the `deactivate` event to write the `applicationScope` variable, or any other state information, for the next application feature to consume.

4.7.6 Enabling Sliding Windows

By implementing the `oracle.adfmf.framework.api.AdfmfSlidingWindowUtilities` interface in the application lifecycle listener (ALCL), you can use an application feature as a sliding window, which displays concurrently with the other application features that display within the navigation bar or springboard. You can use a sliding window to display content that always present within the application, such as a global tool bar, or for temporary (pop-up) content, such as a help window. For information on displaying application features within the springboard or navigation bar, see Section 4.6.1, "How to Designate the Content for a Mobile Application." For information on using the methods of the `AdfmfSlidingWindowUtilities` API, refer to *Oracle Fusion Middleware Java API Reference for Oracle Mobile Application Framework*.

4.8 About the Mobile Application Feature Configuration File

The `maf-feature.xml` file, an example of which is illustrated in Example 4–15, enables you to configure the actual mobile application features that are referenced by the `<adfmf:featureReference>` element in the corresponding `maf-application.xml` file.

Example 4–15 The maf-feature.xml File

```
<?xml version="1.0" encoding="UTF-8" ?>
<adfmf:features xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
                xmlns:adfmf="http://xmlns.oracle.com/adf/mf">
    <adfmf:feature id="PROD"
                   name="Products"
                   icon="images/logo.png">
        <adfmf:constraints>
        </adfmf:constraints>
        <adfmf:description>Products</adfmf:description>
        <adfmf:content id="PROD.1">
            <adfmf:amx file="PROD/products_page.amx"/>
        </adfmf:content>
    </adfmf:feature>
    <adfmf:feature id="HCM"
                   name="Contents"
                   icon="images/directory.png">
        <adfmf:description>People Finder</adfmf:description>
        <adfmf:content id="HCM.1">
            <adfmf:remoteURL connection="Connections1"/>
        </adfmf:content>
    </adfmf:feature>
    <adfmf:feature id="Customers.1"
                   name="Customers"
                   icon="images/people.png">
        <adfmf:constraints>
            <adfmf:constraint property="user.roles"
                              operator="equal"
                              value="field sales"/>
            <adfmf:constraint property="user.roles"
                              operator="not"
                              value="consultant"/>
        </adfmf:constraints>
        <adfmf:description>Customers</adfmf:description>
        <adfmf:content id="Customers.2">
            <adfmf:localHTML url="Customers/customers_page.html"/>
        </adfmf:content>
    </adfmf:feature>
</adfmf:features>
```

By defining the elements of the `maf-feature.xml` file, you set the behavior for the application features by, in turn, defining the child elements of the `<Feature>` element, the top-most element in the XML file under the root element, `<adfmf:features>`. The `<Feature>` element itself describes the basic information of the application feature, including its name, version, and whether or not it participates in security. For the latter, see Chapter 21, "Securing Mobile Applications." The child elements of the `<Feature>` elements are listed in Table 4–5. Like the overview editor for the `maf-application.xml` descriptor file, you can update this file with these elements (or edit them) declaratively using the overview editor for the `maf-feature.xml` file, described in Section 4.9, "Setting the Basic Configuration for the Application Features."

Table 4–5 Child Elements of <Feature> Element

Element	Description
`<adfmf:content>`	Describes the format that the application feature uses for a particular device or user. The content (generally, the user interface) of an application feature can be written as MAF AMX pages, HTML5 pages, or be delivered from web pages hosted on a remote web server. For more information on designating content as a web application, see Chapter 13, "Implementing Application Feature Content Using Remote URLs."
`<adfmf:constraint>`	Determines whether a given application feature can be displayed in the application at runtime. Constraints can be used to allow or prevent the use of an application feature based on such criteria as user roles or device properties. For more information, see Chapter 15, "Setting Constraints on Application Features."

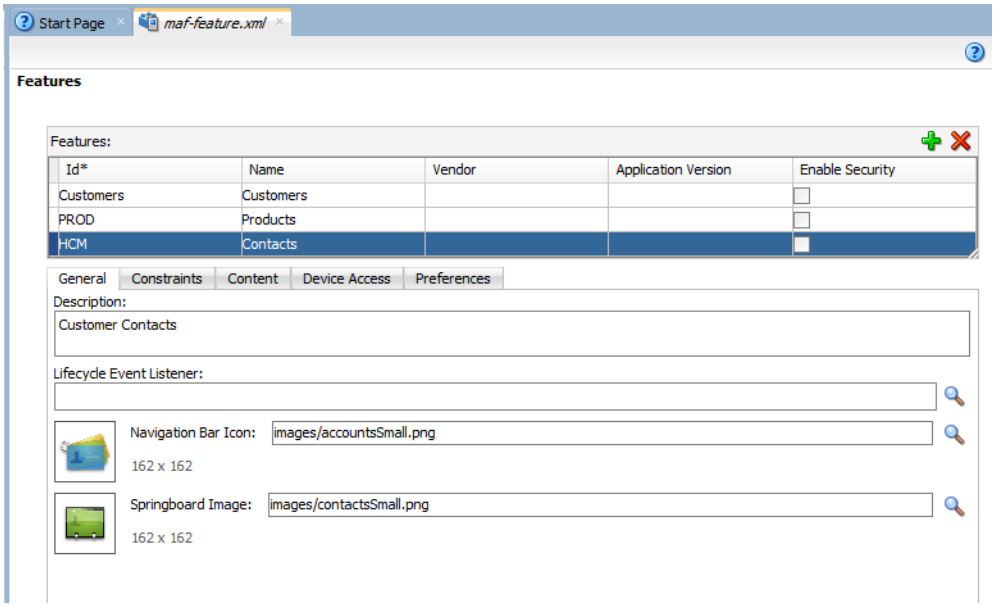
4.9 Setting the Basic Configuration for the Application Features

Each mobile application must have at least one application feature. Because each application feature can be developed independently from one another (and also from the mobile application itself), the overview editor for the `maf-feature.xml` file enables you to define the child elements of `<adfmf:features>` to differentiate the application features by assigning each a name, an ID, and setting how their content can be implemented. Using the overview editor for application features, you can also control the runtime display of the application feature within mobile application and designate when an application feature requires user authentication.

4.9.1 How to Define the Basic Information for an Application Feature

The General tab of the overview editor, shown in Figure 4–20, enables you to add an application feature, designate its basic information, and its display icons.

Figure 4–20 The General Tab of the Application Feature



Before you begin:

If an application feature uses custom images for the navigation bar and springboard rather than the default ones provided by MAF, you must create these images to the specifications described by the Android Developers website (`http://developer.android.com/design/style/iconography.html`) and in the "Custom Icon and Image Creation Guidelines" chapter in *iOS Human Interface Guidelines*, which is available from the iOS Developer Library (`http://developer.apple.com/library/ios/navigation/`).

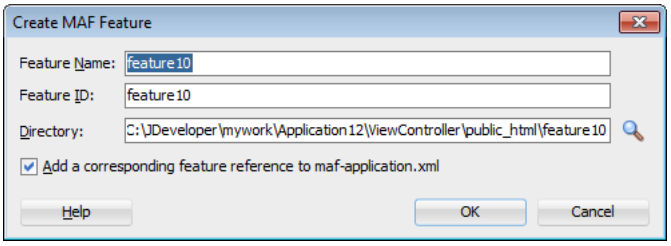
You place these images in the view controller project's `public_html` directory. See also Section 4.10.2, "What You May Need to Know About Selecting External Resources."

In addition, you must open the `maf-feature.xml` file and select the General tab.

To set the basic information for the application feature:

1. Choose the General tab.
2. Click **Add** in the Features table.
3. Complete the Create MAF Feature dialog, shown in Figure 4–18, and then click **OK**. To complete this dialog:
   - Enter a display name for the application feature in the **Feature Name** field.
   - Enter a unique identifier for the application feature in the **Feature ID** field.
   - If needed, change the location for the application feature to any directory within the `public_html` directory (the default parent directory). Enter this location in the **Directory** field.
   - To include the newly defined application feature in the mobile application, add a new `<adfmf:featureReference>` element to the `maf-application.xml` file with the `id` attribute that matches the value that you entered in the **Feature ID**. Choose **Add a corresponding feature reference to maf-application.xml**. The table in the Feature References page, shown in Figure 4–14, includes the feature reference after you complete the dialog. See also Section 4.6.2, "What You May Need to Know About Feature Reference IDs and Feature IDs."

Figure 4–21 Adding an Application Feature



4. In the General tab of the overview editor, enter the originator of the application feature in the **Vendor** field. This is an optional value.
5. Enter the version number of the application feature in the **Version** field. This is an optional value.
6. Enter a brief description of the application's purpose in the **Description** field. This is an optional value.
7. Enter the fully qualified class name (including the package, such as `oracle.adfmf.feature`) using the Class and Package Browser in the **Lifecycle Event Listener** field to enable runtime calls for start, stop, hibernate, and return to

hibernate events. For more information, see Section 4.7, "About Lifecycle Event Listeners." This is an optional value.

8. In the Navigation Bar Icon and Springboard Image fields, browse to, and select, images from the project to use as the icon in the navigation bar and also an image used for the display icon in the springboard. You can also drag and drop the image files from the Applications window into the file location field. This is an optional value.

4.10 Defining the Content Types for an Application Feature

The content type for an application feature describes the format of the user interface, which can be constructed using MAF AMX components or HTML(5) tags. An application feature can also derive its content from remotely hosted pages that contain content appropriate to a mobile context. These web pages might be a JavaServer page authored in Apache Trinidad for smartphones, or be comprised of ADF Faces components for applications that run on tablet devices. The application features embedded in a mobile application can each have different content types.

Tip: Design a mobile application with more than one content type.

While a mobile application includes application features with different content types, applications features themselves may have different content types to respond to user- and device-specific requirements. For information on how the application feature delivers different content types, see Chapter 15, "Setting Constraints on Application Features." Adding a child element to the `<adfmf:content>` element, shown in Example 4–16, enables you to define how the application feature implements its user interface.

Example 4–16 The <adfmf:content> Element

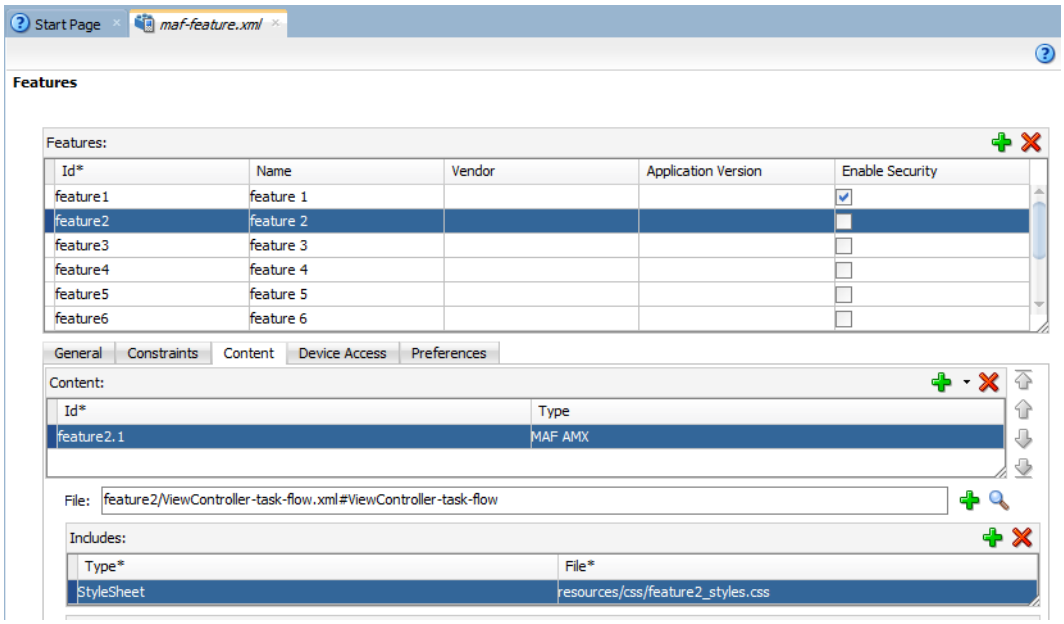
```
<adfmf:content id="Feature1">
      <adfmf:amx file="FeatureContent.amx">
</adfmf:content>
```

4.10.1 How to Define the Application Content

The Content tab of the overview editor, shown in Figure 4–22, provides you with dropdown lists and fields for defining the target content-related elements and attributes shown in Example 4–16. The fields within this tab enable you to set constraints that can control the type of content delivered for an application feature as well as the navigation and springboard icon images that it uses.

Each content type has its own set of parameters. As shown in Figure 4–22, for example, you must specify the location of the MAF AMX page or task flow for the application features that you implement as MAF AMX content. In addition, you can optionally select a CSS file to give the application feature a look and feel that is distinct from other application features (or the mobile application itself), or select a JavaScript file that controls the actions of the MAF AMX components.

Figure 4–22 Defining the Implementation of the Application Feature



Before you begin:

Each content type has its own prerequisites, as follows:

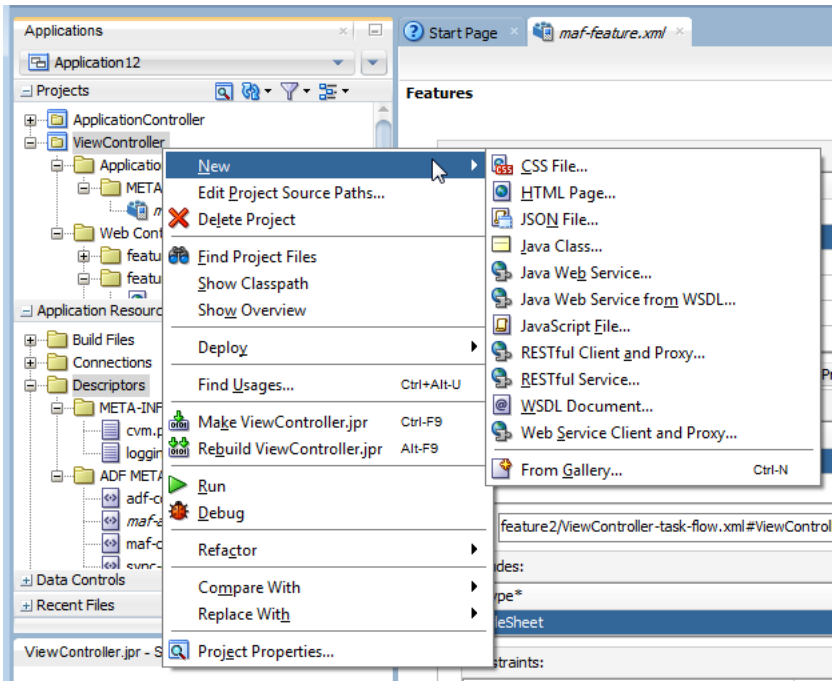
- **MAF AMX**—The default content type for application features, which includes both individual MAF AMX pages and task flows. You can build the MAF AMX content declaratively using a set of mobile-specific user interface components, ADF data bindings, and data controls that integrate device services, such as a camera, and data visualization tools, such as charts, graphs, and thematic maps. For information on building a MAF AMX page, see Chapter 5, "Creating MAF AMX Pages."

  An application feature implemented as MAF AMX requires an existing view (that is, a single MAF AMX page) or a bounded or unbounded task flow. Including a JavaScript file provides rendering logic to the MAF AMX components or overrides the existing rendering logic. Including a style sheet (CSS) with selectors that specify a custom look and feel for the application feature, one that overrides the styles defined at the mobile application level that are used by default for application features. In other words, you ensure that the entire application feature has its own look and feel.

  If you create the MAF AMX pages as well as the mobile application that contains them, you can create both using the wizards in the New Gallery. You access these wizards by first highlighting the view controller project in the Applications window and then by choosing **New**. Alternatively, you can create a MAF AMX page using the context menu shown in Figure 4–23 that appears when you right-click the view controller project in the Applications window and then choose **New**.

  Note: When manually editing references to task flows, MAF AMX pages, CSS and JavaScript files in the `maf-feature.xml` file, keep in mind that file systems used on devices may enforce case-sensitivity and may not allow special characters. To ensure that these files can be referenced, check the mobile device specification.

Figure 4–23 Context Menu for Creating a MAF Page



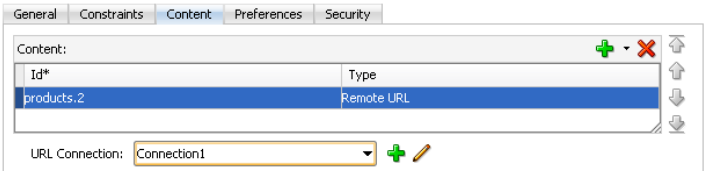
- **Remote URL**—A reference to a web application. You can enhance an existing web application for mobile usage and extend device services. Remote content can complement both MAF AMX and local HTML content by providing a local data cache and a full set of server-side data and functionality. The remote URL implementation requires a valid web address as well as a hosted mobile application. For more information, see Chapter 13, "Implementing Application Feature Content Using Remote URLs."
- **Local HTML**—Reference a HTML page that is packaged within your mobile application. Such HTML pages can reference JavaScript, as demonstrated by the `HelloWorld` sample application described in Appendix F, "Mobile Application Framework Sample Applications." Consider using this content type to implement application functionality through usage of the Cordova JavaScript APIs if the MAF is not best suited to implementing your application's functionality. For more information about JavaScript APIs and the MAF, see Appendix B, "Local HTML and Application Container APIs."

To define the application content as Remote URL or Local HTML:

1. Select an application feature listed in the Features table in the `maf-feature.xml` file.
2. Click **Content**.
3. Click **Add** to create a new row in the Content table.
4. Select one of the following content types to correspond with the generated ID:
   - **Remote URL**
   - **Local HTML**
5. Define the content-specific parameters:

- For remote URL content, select the connection, as shown in Figure 4–24, that represents address of the web pages on the server (and the location of the launch page).

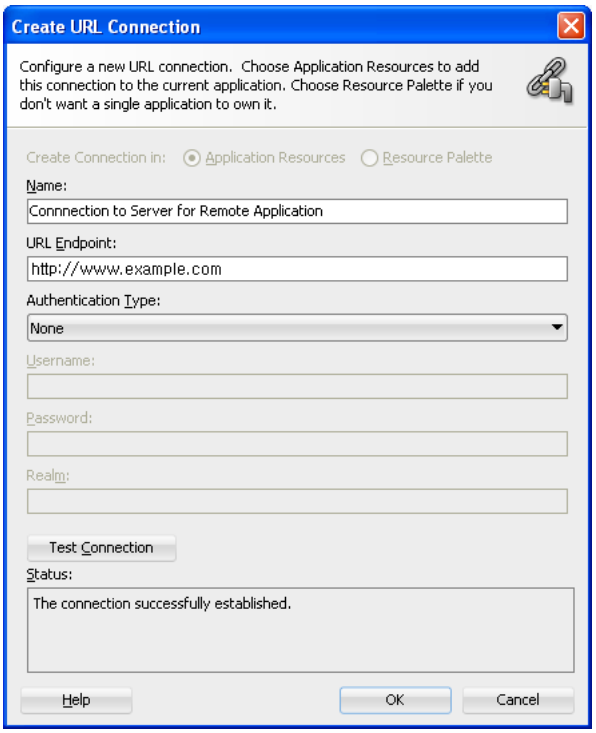
Figure 4–24 Selecting the Connection for the Hosted Application



You can create this connection by first clicking **Add** and then completing the Create URL Connection dialog, shown in Figure 4–25. For more information on this dialog, see the online help for Oracle JDeveloper. This connection is stored in the `connections.xml` file.

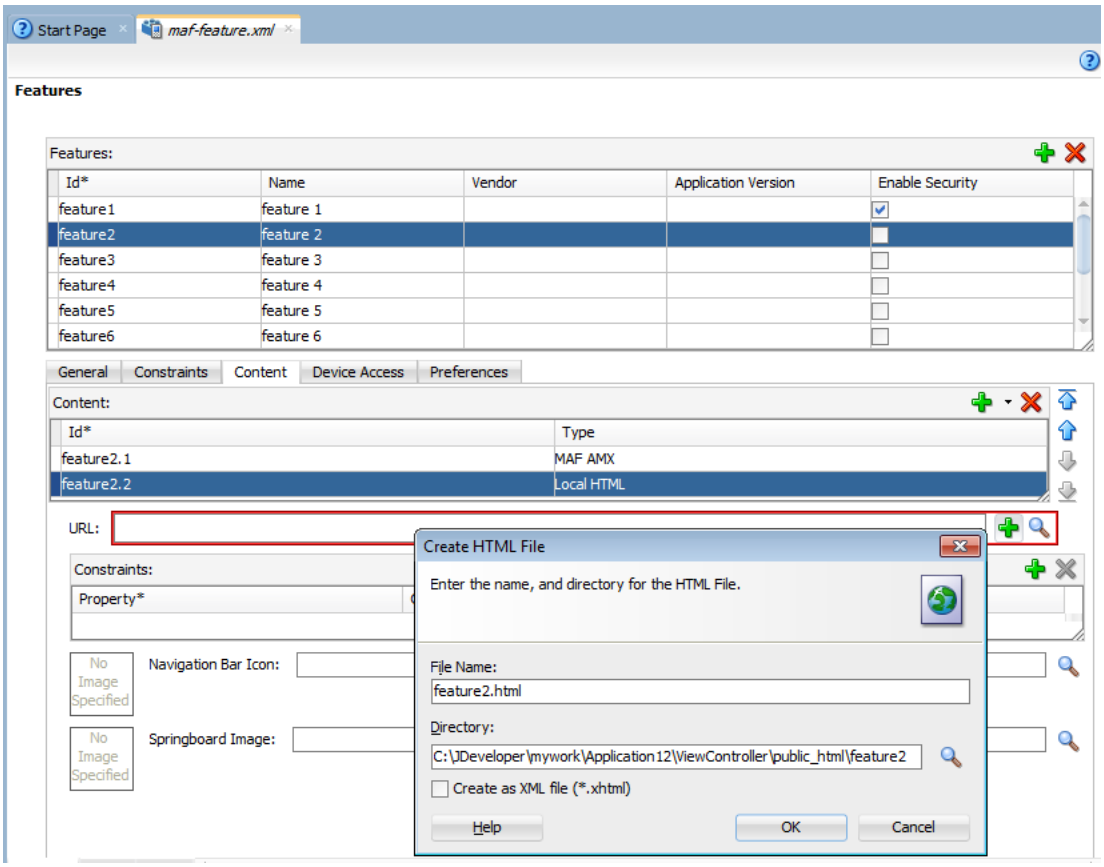
Note: This connection can only be created as an application resource.

Figure 4–25 Creating a URL Connection



- For local HTML content, enter the location of the local bundle or create the HTML page by clicking **Add** in the URL field, completing the dialog as shown in Figure 4–26, and then building the page using JDeveloper's HTML editor. Because this is an application feature, this page is stored within the Web Content folder of the view controller project.

Figure 4–26 Creating the Local HTML Page as the Content for an Application Feature

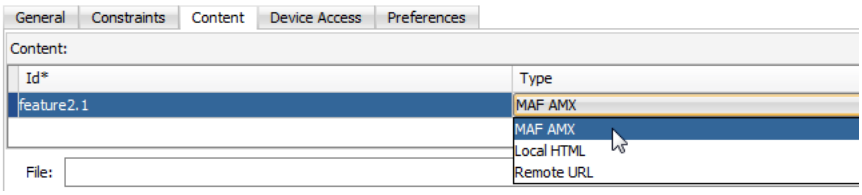


6. If needed, do the following:
   - Enter constraints that describe the conditions under which this content is available to users. For more information, see Chapter 15, "Setting Constraints on Application Features."
   - Select navigation bar and springboard images.

To designate the application feature content as MAF AMX:

1. Select the application feature.
2. Click **Content**.
3. If needed, click **Add** to create a row in the Content table and the choose **MAF AMX** from the dropdown list in the Type column as shown in Figure 4–27.

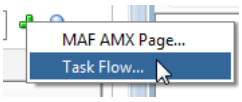
Figure 4–27 Selecting MAF AMX as the Content Type



4. In the File field, click **Browse**, and choose either **MAF AMX Page** or **Task Flow**, as shown in Figure 4–28, to navigate to, and retrieve, the location of the MAF AMX

page or the bounded task flow. Alternatively, you can drag and drop a MAF AMX page from the Applications window into the file location field.

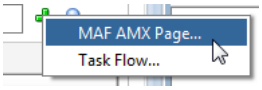
Figure 4–28 Browsing for the File Location in the File Field



5. Alternatively, create the page or task flow. To do this:

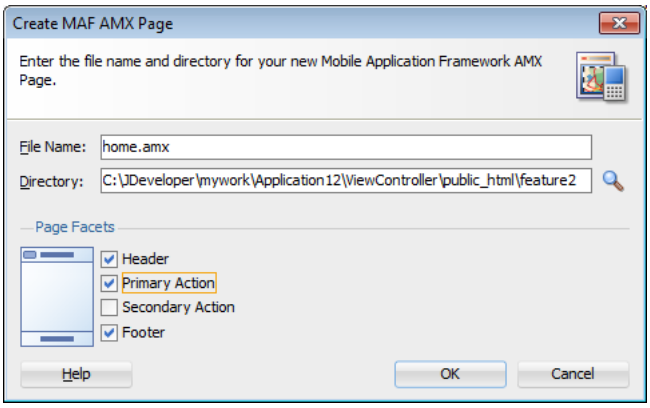
   a. Click **Add** in the File field and then choose either **MAF AMX** or **Task Flow** as shown in Figure 4–29.

Figure 4–29 Adding a MAF AMX Page or Task Flow from the File Field



   b. Complete the *create* dialogs, such as the Create MAF AMX Page dialog shown in Figure 4–30.

Figure 4–30 The Create MAF AMX Page Dialog



   c. Build the MAF AMX page or Task flow using an editor.

6. If needed, do the following:

   - Enter the JavaScript files by clicking **Add** in the Includes table, choose **JavaScript**, and then browse to the location of the file. For more information, see Section 4.12.9, "Overriding the Default Skin Styles."
   - Override the default style sheet designated in `maf-config.xml` by first clicking **Add** and then by choosing **Stylesheet**. Browse to the location of the file. For more information, see Section 4.12, "Skinning Mobile Applications."
   - Enter the constraints, as described in Chapter 15, "Setting Constraints on Application Features."
   - Select navigation bar and springboard images.

Note: The images, style sheet, and JavaScript files must reside within the `public_html` folder to enable deployment. See Section 4.10.2, "What You May Need to Know About Selecting External Resources."

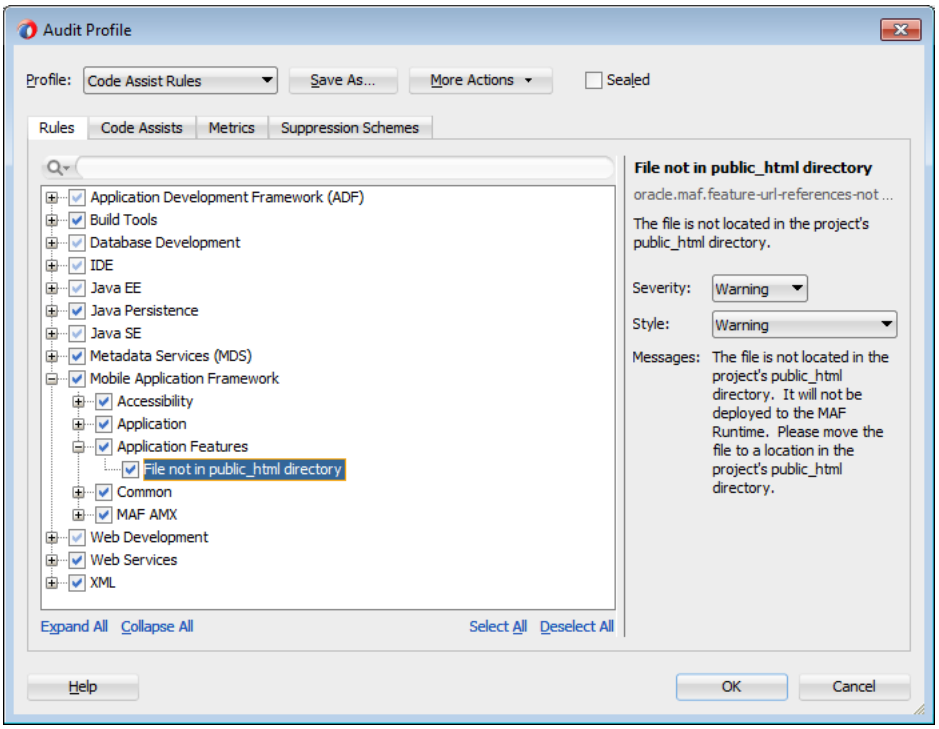
4.10.2 What You May Need to Know About Selecting External Resources

To enable deployment, all resources referenced by the following attributes must be located within the `public_html` directory of the view controller project.

- The `icon` and `image` attributes for `<adfmf:feature>` (for example, `<adfmf:feature id="PROD" name="Products" icon="feature_icon.png" image="springboard.png">`). See also Section 4.9.1, "How to Define the Basic Information for an Application Feature."
- The `icon` and `image` attributes for `<adfmf:content>` (for example, `<adfmf:content id="PROD" icon="feature_icon.png" image="springboard_image.png">`). See also Section 4.10, "Defining the Content Types for an Application Feature."
- The `file` attribute for `<adfmf:amx>` (for example, `<adfmf:amx file="PRODUCT/home.amx" />`). See also Section 4.10, "Defining the Content Types for an Application Feature."
- The `url` attribute for `<adfmf: localHTML>` (for example, `<adfmf:localHTML url="oracle.hello/index.html"/>`). See also Section 4.10, "Defining the Content Types for an Application Feature" and Section 21.5.3.2, "The Custom Login Page."
- The file attribute defined for `type=stylesheet` and `type=JavaScript` in `<adfmf:includes>` (for example, `<adfmf:include type="JavaScript" file="myotherfile.js"/>` or `<adfmf:include type="StyleSheet" file="resources/css/stylesheet.css" id="i3"/>`). See also Section 4.12, "Skinning Mobile Applications."

MAF does not support resources referenced from another location, meaning that you cannot, for example, enter a value outside of the `public_html` directory using `../` as a prefix. To safeguard against referencing resources outside of `public_html`, MAF includes an audit rule called *File not in public_html directory*. You can access the MAF audit profiles, shown in Figure 4–31, from the Audit Profiles node in Preferences by choosing **Tools** > **Preferences** > **Audit** > **Profiles**.

Figure 4–31 MAF Audit Profiles



When this profile is selected, JDeveloper issues a warning if you change the location of a resource. As shown in Figure 4–32, JDeveloper displays such a warning when the default values are overridden. For information on auditing, see the "Auditing and Monitoring Java Projects" chapter in *Oracle Fusion Middleware User's Guide for Oracle JDeveloper*.

Figure 4–32 The External Resource Warning

4.11 Working with Localized Content

Localization is the process of adapting an application for a specific local language or culture by translating text and adding locale-specific components. By configuring the MAF application and its user interface pages to use different locales, you enable a MAF application to appear as though it has been authored for the language set on the mobile device. For example, if you intend to broaden the use of a MAF application by enabling it to be viewed by French speakers, you can localize the application so that its text strings and images used in both the device's springboard and within the MAF web view display in French (that is, *products* is transformed into *les produits*, and so on).

JDeveloper provides automatic translation of these text resources into 28 languages.

After you define translatable strings (such as validator error messages, or attribute control hints), JDeveloper stores them in a project-level resource bundle file. MAF specifies English language text resources (although you can use any tool to generate resource bundle files in other languages). You can configure a mobile application to store translatable UI strings at both the application and view controller project level.

4.11.1 Working with Resource Bundles

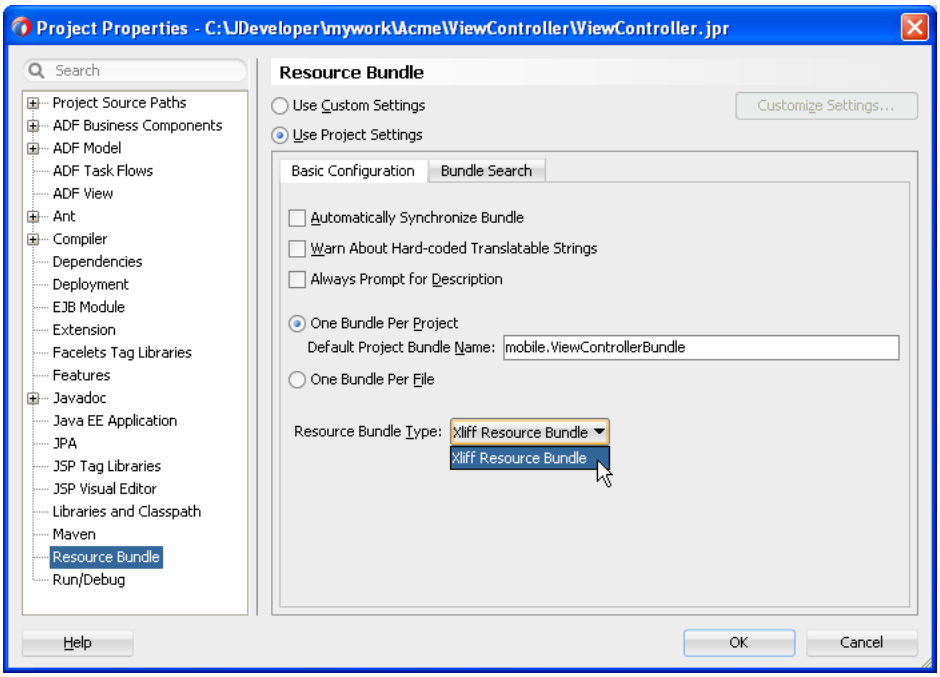
MAF uses only XLIFF (XML Localization Interchange File Format) files for localization, meaning that JDeveloper produces resource bundle `.xlf` files to store the strings. For information on XLFF, see

`http://docs.oasis-open.org/xliff/xliff-core/xliff-core.html`.

4.11.1.1 How to Set Resource Bundle Options

You can create resource bundles for the view controller and application controller projects using Resource Bundle Settings page for projects, shown in Figure 4–33.

Figure 4–33 Project Properties Resource Bundle Page



To set the resource bundle options for a project:

1. In the Applications window, double-click the project.
2. In the Project Properties dialog, select **Resource Bundle**.
3. To automatically generate a default resource file, select **Automatically Synchronize Bundle**.
4. Select one of the following resource bundle file options:
   - **One Bundle Per Project** —Configured in a file named `<ProjectName>.xlf`. For more information, see Section 4.11.1.2, "What Happens When You Select Resource Bundle Options."

- **One Bundle Per File**— Creates a new bundle each time you put a resource into file (`maf-feature.xml`, `maf-application.xml` or a MAF AMX page). As a result, each file has its own bundle. This option limits the number of resource bundles to one per file; if you select this option, JDeveloper prevents you from creating a second bundle.

5. Click **OK**.

> **Note:** **Xliff Resource Bundle** is the only resource bundle format used by MAF. For more information on this page, see the online help for Oracle JDeveloper.

4.11.1.2 What Happens When You Select Resource Bundle Options

JDeveloper generates one or more resource bundles of a particular type based on the selections that you make in the resource bundle options part of the Project Properties dialog, as illustrated in Figure 4–33. It generates a resource bundle the first time that you invoke the Select Text Resource dialog, as illustrated in Figure 4–35.

If you select **One Bundle Per Project** and the `List Resource Bundle` value from the **Resource Bundle Type** dropdown list. The first time that you invoke the Select Text Resource dialog, JDeveloper generates one resource bundle for the project.

By default, JDeveloper creates the generated resource bundle in the view subdirectory of the project's Application Sources directory.

4.11.1.3 How to Enter a String in a Resource Bundle

At the project-level, you create resource bundle files when you use the resource bundle dialog, accessed by clicking **Select Text Resource** in the Properties window. This dialog enables you to automatically create text resources in the base resource bundle for `maf-application.xml` and `maf-feature.xml` attributes listed in Table 4–6 and Table 4–7.

At the application level, you can localize strings for such attributes as application names or preference page labels, which are listed in Table 4–6.

Table 4–6 Localizable MAF Application Attributes

Element	Attribute(s)
`<adfmf:Application>`	`name`
`<adfmf:PreferenceGroup>`	`label`
`<adfmf:PreferencePage>`	`label`
`<adfmf:PreferenceBoolean>`	`label`
`<adfmf:PreferenceText>`	`label`
`<adfmf:PreferenceNumber>`	`label`
`<adfmf:PreferenceList>`	`label`
`<adfmf:PreferenceValue>`	`name`

At the project (view controller) level, you can localize application feature-related attributes listed in Table 4–7.

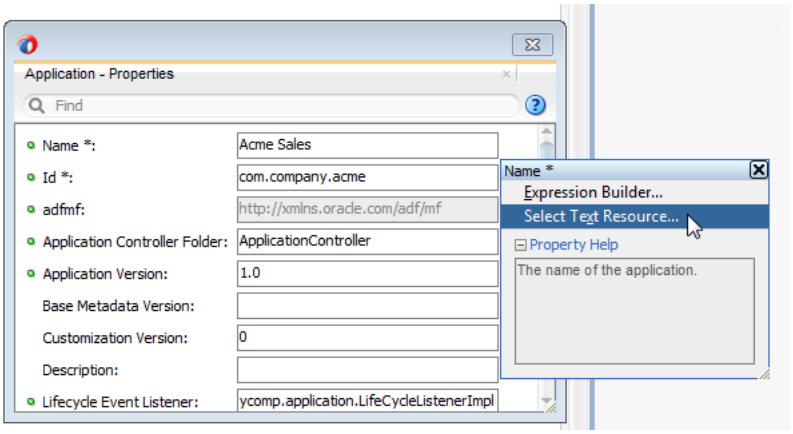
Table 4–7 Localizable Application Feature Attributes

Element	Attribute(s)
<adfmf:Feature>	name
<adfmf:Constraint>	value
<adfmf:Parameter>	value
<adfmf:PreferencePage>	label
<adfmf:PrefrenceGroup>	label
<adfmf:PreferenceBoolean>	label
<adfmf:PreferenceText>	label
<adfmf:PreferenceNumber>	label
<adfmf:PreferenceList>	label
<adfmf:PreferenceValue>	name

To create localized strings in a resource bundle:

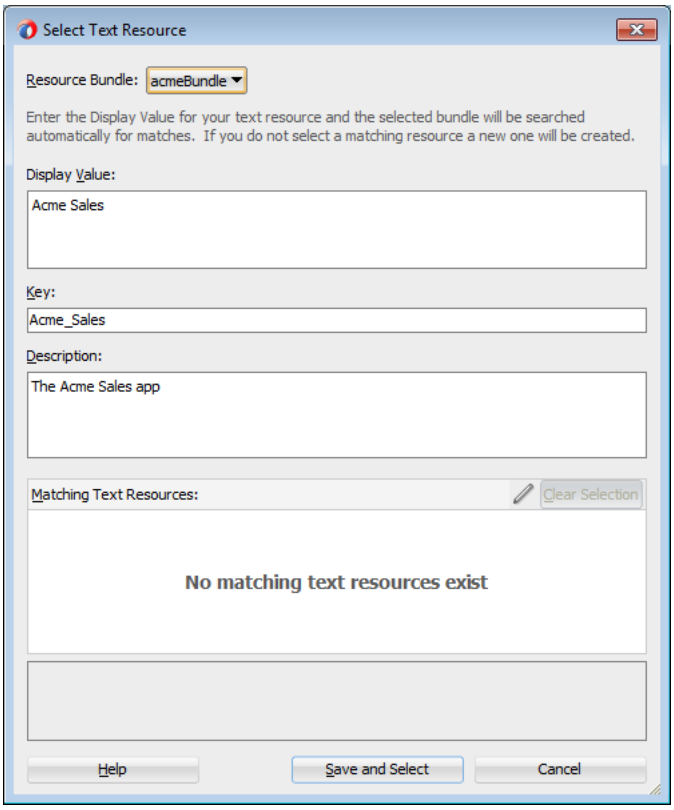
1. Select an attribute in the Properties window, such as `Name` in Figure 4–34.
2. Choose **Select Text Resource**. Figure 4–34 shows the application name attribute selected in the Properties window.

Figure 4–34 Selecting the Text Resource Dialog



3. In the Select Text Resource dialog, shown in Figure 4–35, create a new string resource by entering a display name, key, and then click **Save and Select**.

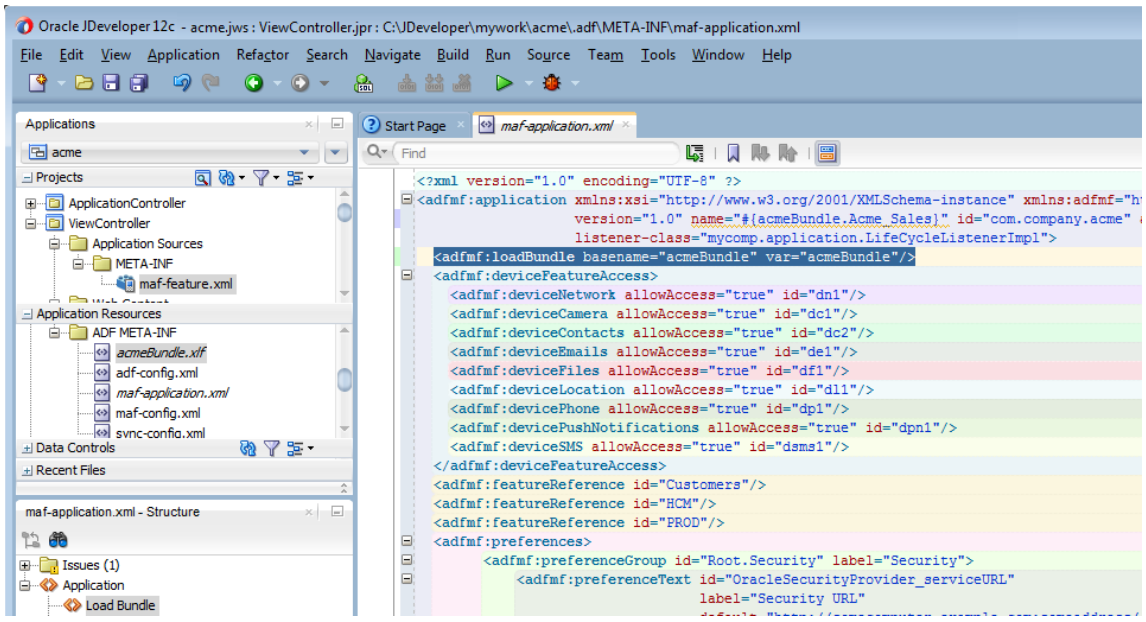
Figure 4–35 Select Text Resource Dialog



4.11.1.4 What Happens When You Add a Resource Bundle

After you add a resource in the Select Text Resource dialog, JDeveloper creates a new project resource bundle containing the specified display name string and key file in the ADF Meta-INF file, as shown by `acmeBundle.xlf` in Figure 4–36.

Figure 4–36 The Application Resource Bundle



If an attribute has been localized for the first time, JDeveloper adds an `<adfmf:loadbundle>` element whose `basename` attribute refers to the newly created resource bundle.

JDeveloper also changes the localized attribute string to an EL expression that refers to the key of the string defined in the resource bundle. For example, JDeveloper changes an application name attribute called Acme Sales to `name="#{acmeBundle.Acme_Sales}"` based on the ACME_SALES value entered for the Key in the Select Text Resource Dialog.

JDeveloper adds each additional string that you localize to the same resource bundle file because there is only one resource bundle file at the application level.

Each `maf-application.xml` and `maf-feature.xml` file contains only one `adfmf:loadBundle` element. When you deploy an application, the resource bundles are converted into the language format expected by the runtime.

4.11.1.5 How to Localize Strings in MAF AMX components:

You can create resource bundles for attributes of such MAF AMX components as the `text` attribute of `<amx:commandButton>`. Table 4–8 lists these MAF AMX (`amx`) components.

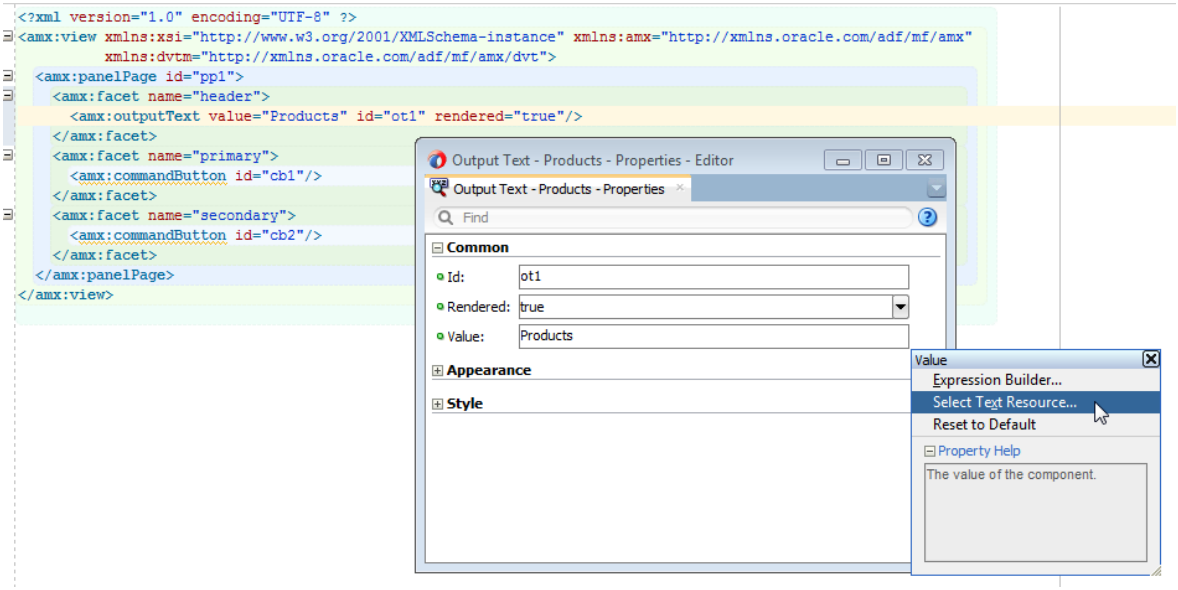
Table 4–8 Localizable Attributes of MAF AMX Components

Component	Attribute
`<amx:inputDate>`	`label`
`<amx:inputNumberSlider>`	`label`
`<amx:panelLabelAndMessage>`	`label`
`<amx:selectBooleanCheckBox>`	`label`
`<amx:selectBooleanSwitch>`	`label`
`<amx:selectItem>`	`label`
`<amx:selectManyCheckBox>`	`label`
`<amx:selectManyChoice>`	`label`
`<amx:selectOneButton>`	`label`
`<amx:selectOneChoice>`	`label`
`<amx:selectOneRadio>`	`label`
`<amx:commandButton>`	`text`
`<amx:commandLink>`	`text`
`<amx:goLink>`	`text`
`<amx:inputText>`	`label`, `value`, `hintText`
`<amx:outputText>`	`value`

To use strings in MAF AMX components:

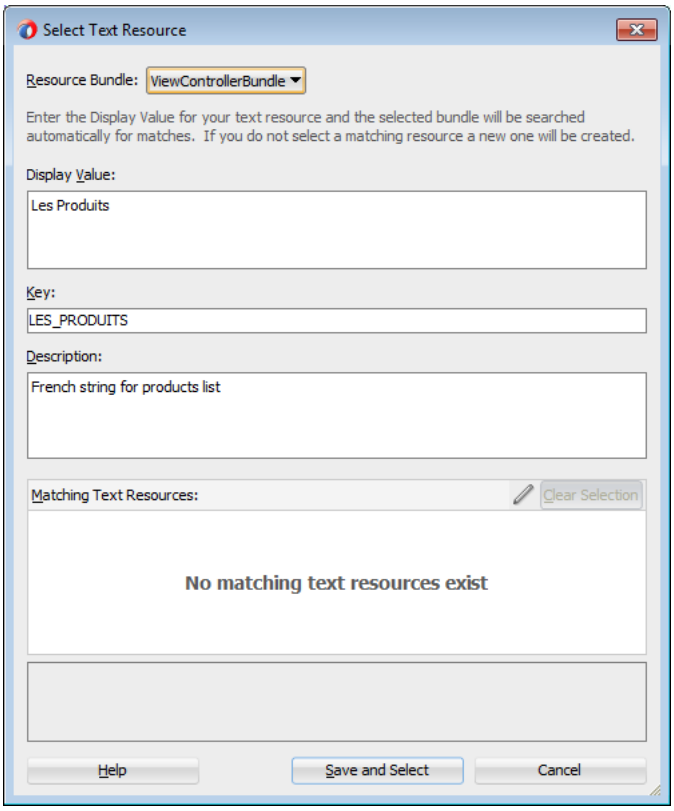
1. Select an attribute in the Properties window, such as the value attribute defined for the `<amx:outputText>` component in Figure 4–37.

Figure 4–37 Selecting a Text Resource for a MAF AMX Component



2. Choose **Select Text Resource**.
3. In the Select Text Resource dialog, shown in Figure 4–38, create a new string resource by entering a display name, key, and then click **Save and Select**

Figure 4–38 Adding a String to a Resource Bundle



4.11.1.6 What Happens When You Create Project-Level Resource Bundles for MAF AMX Components

When you localize a component, such as the `value` attribute for a `<amx:outputText>` component in Example 4–17, JDeveloper transforms the string into an EL expression (such as `#{viewcontrollerBundle.LES_PRODUITS}` in Example 4–17).

Example 4–17 Localizing a MAF AMX Component

```
<amx:facet name="header">
      <amx:outputText value="#{viewcontrollerBundle.LES_PRODUITS}"
                      id="ot1"
                      rendered="true"/>
    </amx:facet>
```

In addition, JDeveloper creates the resource bundle under the project default package, similar to `ViewControllerBundle.xlf` in Example 4–18. In the generated `<amx:loadBundle>` component, the `basename` represents this package, as illustrated in Example 4–18.

Example 4–18 The <amx:loadBundle> Component

```
<amx:loadBundle basename="mycomp.mobile.ViewControllerBundle"
                var="viewcontrollerBundle"
                id="lb1"/>
```

4.11.1.7 What You May Need to Know About Localizing Image Files

If an image contains text or reflects a specific country or region (for example, a picture of a flag), you can specify an alternate image as part of the localization process. You cannot hard-code the image, such as `icon="/feature1/test.png"`. Instead, you must edit the `ViewControllerBundle.xlf` file manually by adding a `<trans-unit>` element for the image path, as illustrated in Example 4–19.

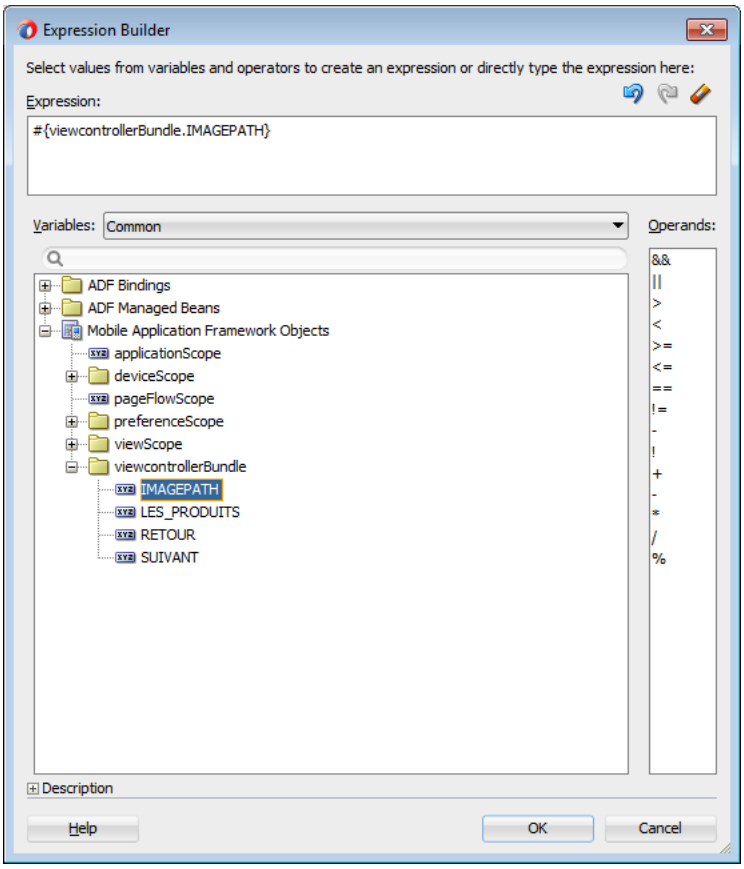
Example 4–19 Defining the Resource for an <amx:image> Component

```
<trans-unit id="IMAGEPATH">
     <source>/feature1/test.jpg</source>
     <target/>
</trans-unit>
```

> **Note:** The image location defined in the `<source>` element in Example 4–19 is relative to the location of the application feature file in `ViewController\public_html`. Alternatively, you can enter the name of the image file, such as `<source>test.png</source>`. See also Section 4.10.2, "What You May Need to Know About Selecting External Resources."

After you update `ViewControllerBundle.xlf`, use the Expression Builder to define an EL expression for the `source` attribute for the `icon` attribute, as shown in Figure 4–39.

Figure 4–39 Creating the EL Expression for a Localized Icon Image



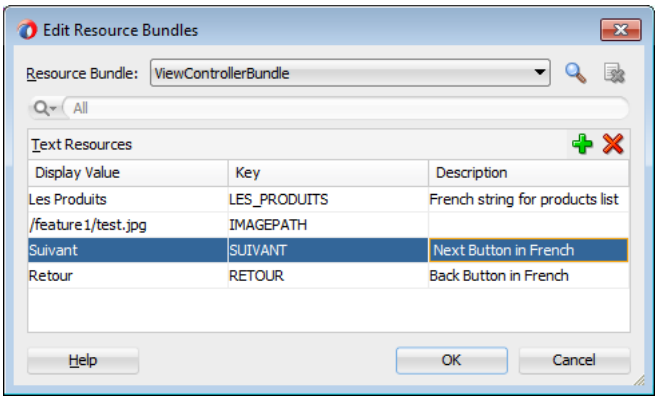
4.11.1.8 How to Edit a Resource Bundle File

After you have created the XLIFF file, you can edit it using the source editor.

To edit a resource bundle file:

1. From the main menu, choose **Application > Edit Resource Bundles**.
2. In the Edit Resource Bundles dialog, shown in Figure 4–40, select the resource bundle file you want to edit from the **Resource Bundle** dropdown list, or click the **Search** icon to launch the Select Resource Bundle dialog if the resource bundle file you want to edit does not appear in the **Resource Bundle** dropdown list.

Figure 4–40 Editing Resource Bundle Strings



3. In the Select Resource Bundle dialog, select the file type from the **File type** dropdown list. Navigate to the resource bundle you want to edit. Click **OK**.
4. In the Edit Resource Bundles dialog, click the **Add** icon to add a key-value pair, as shown in Figure 4–40. When you have finished, click **OK**.

4.11.1.9 What You May Need to Know About XLIFF Files for iOS Applications

One or more XLIFF files must exist at the location described by the `<adfmf:loadBundle>` element. A family of XLIFF files includes the following:

- Base XLIFF File—The name of the base XLIFF file must match the last token in the path specified by the `basename` attribute. This file bears the `.xlf` extension, such as `ViewControllerBundle.xlf`. In the following definition, the file is called `ViewControllerBundle`:

  ```
  <adfmf:loadBundle var="stringBundle" basename="view.ViewControllerBundle"/>
  ```

- Zero, or more, localized XLIFF Files—There can be zero (or many) localized XLIFF files for each base XLIFF file. For each file:
  - The file extension must be `.xlf`.
  - Must be co-located in the same directory as the corresponding base XLIFF file.
  - The file name is in the following format:

    ```
    <BASE_XLIFF_FILE_NAME>_<LANGUAGE_TOKEN>.xlf
    ```

    Where:

    * `<BASE_XLIFF_FILE_NAME>` is the base XLIFF file name, without the `.xlf` extension.
    * `<LANGUAGE_TOKEN>` is in the following format:

      ```
      <ISO-639-lowercase-language-code>
      ```

      Note: MAF does not support countries or regions.

      For example, for Spain, the language token is `es`.

    For example, localized file names for XLIFF files referencing a base XLIFF named `stringBundle.xlf` for language codes `en`, `es`, and `fr` would be:

    * `stringBundle_en.xlf`
    * `stringBundle_es.xlf`
    * `stringBundle_fr.xlf`

4.11.1.10 Internationalization for iOS Applications

The localizable elements of the `maf-application.xml` and `maf-feature.xml` files reference internationalized strings through the use of EL-like strings in the attributes listed in Table 4–7 and Table 4–6. Because these configuration files are read early in the application lifecycle, these strings are not evaluated as EL statements at runtime. Instead, these strings are taken as the full key for the translated string in the native device translation infrastructure.

Although the Expression Language syntax is `"${BUNDLE_NAME.STRING_KEY}"`, MAF uses the entire string enclosed by `"#{}"` as the key to look up the translated string.

These strings are in the form of `#{bundleName.['My.String.ID']}`, where the XLIFF string is separated by periods and `#{bundleName.['MyStringID']}`, which is used only for string identifiers that are not separated by periods. Example 4–20 illustrates the latter, such as `#{strings.CONTACTS}`, that modify the `name` attribute. For the iOS native framework, the deployment ensures that the content of that statement matches the proper key in the `*.string` file used for translation.

Only the attributes that are displayed to the end user, or control the location of content displayed to the end user, support the use of internationalized strings. These include the following attributes:

- The `<adfmf:application>` element's `name` attribute
- The `<adfmf:feature>` element's `name` attribute
- The `<adfmf:feature>` element's `icon` attribute
- The `<adfmf:feature>` element's `image` attribute
- The `<adfmf:content>` element's `icon` attribute
- The `<adfmf:content>` element's `image` attribute

Example 4–20 shows an application feature with `name`, `icon`, and `image` attributes use internationalization strings.

Example 4–20 Internationalization Using Strings

```
<adfmf:feature id="CTCS" name="#{strings.CONTACTS}"
                         icon="#{strings.CONTACTS_ICON}"
                         image="#{strings.CONTACTS_IMAGE}">
        <adfmf:constraints>
            <adfmf:constraint property="user.roles"
                              operator="contains"
                              value="employee" />
        </adfmf:constraints>
        <adfmf:description>The HTML Device Contacts</adfmf:description>
        <adfmf:loadBundle basename="mobile.adfmf-stringsBundle"
                          var="strings"/>
        <adfmf:content id="CTCS.Generic">
            <adfmf:constraints />
            <adfmf:localHTML url="contacts.html" />
        </adfmf:content>
  </adfmf:feature>
```

When you define the `<adfmf:loadBundle>` elements, as shown in Example 4–21, you create the mapping of bundle names to actual bundles. The bundle name is used when the expression is evaluated.

Example 4–21 Mapping Bundle Names Using <adfmf:loadBundle>

```
   <adfmf:constraints>
      <adfmf:constraint property="user.roles"
                        operator="contains"
                        value="employee" />
   </adfmf:constraints>
        <adfmf:description>The HTML Device Contacts</adfmf:description>
        <adfmf:loadBundle basename="mobile.adfmf-featureBundle"
                          var="mobileBundle"/>
        <adfmf:loadBundle basename="mobile.adfmf-stringsBundle"
                          var="strings"/>
```

MAF's runtime holds the `<adfmf:loadBundle>` elements until it first accesses the JVM. It sends a message to the JVM to initialize the mapping of the base names of the packages to EL names of the bundles. Example 4–22 illustrates the structure of the message sent to the JVM.

Example 4–22 The Message Initializing Mapping of Base Names to EL Names

```
{classname:"oracle.adfmf.framework.api.Model",method:"setBundles",
 params:[[{basename:"mobile.adfmf-featureBundle",elname:"mobileBundle"},
          {basename:"mobile.adfmf-stringsBundle",elname:"strings"}]]}
```

4.12 Skinning Mobile Applications

MAF's use of CSS (Cascading Style Sheet) language-based skins ensures that all application components within a mobile application (including those used in its constituent application features) share a consistent look and feel. Rather than altering how a mobile application looks by re-configuring MAF AMX or HTML components, you can instead create, or extend, a skin that changes how components display. Any changes made to a skin take effect when an application starts, because MAF applies skins at runtime.

As noted in Section 3.2.2, "What Happens When You Create a MAF Application," the artifacts resulting from the creation of an application controller project include two skinning-related files, `maf-config.xml` and `maf-skins.xml`. You use these files to control the skinning for the mobile application. The `maf-config.xml` file designates the default skin family used to render application components and the `maf-skins.xml` file enables you to customize the default skin family or define a new one.

4.12.1 About the maf-config.xml File

After you create a mobile application, JDeveloper populates the `maf-config.xml` file to the mobile application's **META-INF** node. The file itself is populated with the base MAF skin family, `mobileAlta`, illustrated in Example 4–23.

Example 4–23 The Default Skin, mobileAlta, in the maf-config.xml File

```
<?xml version="1.0" encoding="UTF-8" ?>
<adfmf-config xmlns="http://xmlns.oracle.com/adf/mf/config">
  <skin-family>mobileAlta</skin-family>
  <skin-version>v1.1</skin-version>
  <generic-type>
    <conversion>
      <validated>false</validated>
    </conversion>
  </generic-type>
</adfmf-config>
```

> **Note:** You can determine the skin value at runtime using EL expressions. For more information, see Section 4.12.12, "Enabling Dynamic Skin Selection at Runtime."

MAF applies skins as a hierarchy, with device-specific skins occupying the top tier, followed by platform-specific skins, and then the base skin, `mobileAlta`. In terms of MAF's `mobileAlta` skin family, this hierarchy is expressed as follows:

1. `mobileAlta.<DeviceModel>` (for example, `mobileAlta.iPhone5,3`)
2. `mobileAlta.iOS` or `mobileAlta.Android`
3. `mobileAlta`

MAF gives precedence to selectors defined at the device-specific level of this hierarchy. In other words, MAF overwrites a selector defined in `mobileAlta.iOS` with the `mobileAlta.iPhone` definition for the same selector. The `<extends>` element, described in Section 4.12.3, "About the maf-skins.xml File," defines this hierarchy for the MAF runtime. For more information on how skins are applied at various levels, see Section 4.12.10, "What You May Need to Know About Skinning."

4.12.2 What You May Need to Know About MAF Styles

The underlying skinning styles for the base skin family, `mobileAlta`, are defined in the `amx.css`, `amx-mobileAlta-1.0.css`, and `amx-v1.1.css` files. These files, which define the selectors for MAF AMX pages, reside in the `www\css` directory. To access this directory, you must first deploy a mobile application to a simulator or device and then traverse to the `deploy` directory (for example, `C:\JDeveloper\mywork\`*`application name`*`\deploy`). The `www\css` directory resides within the platform-specific artifacts generated by the deployment. For iOS deployments, the directory is located within the `temporary_xcode_project` directory. For Android deployments, this directory is located in the `assets` directory of the Android application package (`.apk`) file.

Caution: Do not write styles that rely on the MAF DOM structures. Further, some of the selectors defined in these files may not be supported.

4.12.3 About the maf-skins.xml File

The `maf-skins.xml` file, located in the **META-INF** node of the application controller project, uses the `<skin>` and the `<skin-addition>` elements. Use the `<skin>` element to create a new skin by extending an existing skin. The `<skin-addition>` element adds a style sheet to an existing skin.

By default, this file is empty, but the elements listed in Table 4–9 describe the child elements that you can use to populate this file to extend `mobileAlta` or to define the CSS files that are available to the application. You use the `<skin>` element to create new skins or to extend an existing skin.

Table 4–9 Child Elements of the <skin> Element

Elements	Description
`<id>`	A required element that identifies the skin in the `maf-skins.xml` file. The value you specify must adhere to one of the following formats: ▪ skinFamily-version ▪ skinFamily-version.platform For example, specify `mySkin-v1.iOS` if you want to register a skin for your application that defines the appearance of your application when deployed to an Apple iPad or iPhone. Substitute `iOS` by `iPad` or `iPhone` if the skin that you register defines the appearance of your application on one or other of the latter devices. Specify `.android` if you want to register a skin that defines the appearance of your application when deployed to the Android platform.
`<family>`	A required element that identifies the skin family.

`<extends>`	Use this element to extend an existing skin by specifying the skin id of the skin you want to extend.
	`<skin>`
	`<id>mySkin-v1</id>`
	`<family>mySkin</family>`
	`<extends>mobileAlta-v1.1</extends>`
	`<style-sheet-name>styles/myskin.css</style-sheet-name>`
	`<version>`
	`<name>v1</name>`
	`</version>`
	`</skin>`

`<style-sheet-name>`	Use a relative URL to specify the location of the CSS file within your mobile application's project. For example, the `maf-skins.xml` file in the SkinningDemo sample application contains the following reference to the `v1.css` style sheet in the `css` directory of the application controller project: `<style-sheet-name>css/v1.css</style-sheet-name>`
`<version>`	Specify different versions of a skin. For more information, see Section 4.12.7, "How to Version MAF Skins."

Table 4–10 lists elements that you can use to define the `<skin-addition>` element in a MAF CSS when you integrate a style sheet into an existing skin.

Table 4–10 The <skin-addition> Child Elements

Element	Description
`<skin-id>`	Specify the ID of the skin that you need to add an additional style sheet to. Possible values include the skins provided by MAF (for example, `mobileAlta-v1.1.iOS`) or a custom skin that you create.
`<style-sheet-name>`	Use a relative URL to specify the location of the CSS file within your mobile application's project. For example, the `maf-skins.xml` file in the SkinningDemo sample application contains the following reference to the `v1.css` style sheet in the `css` directory of the application controller project: `<style-sheet-name>css/v1.css</style-sheet-name>`

Example 4–24 illustrates designating the location of the CSS file in the `<style-sheet-name>` element and the target skin family in `<skin-id>`.

Example 4–24 Using the <skin-addition> Element

```
<?xml version="1.0" encoding="UTF-8" ?>
<adfmf-skins xmlns="http://xmlns.oracle.com/adf/mf/config">
  <skin-addition>
    <skin-id>mobileFusionFx-v1.1.iOS</skin-id>
    <style-sheet-name>skins/mystyles.iphone.addition1.css</style-sheet-name>
  </skin-addition>
</adfmf-skins>
```

You can use the `<skin-id>` and `<style-sheet-name>` elements to render to a particular iOS or Android device, or alternatively, you can define these elements to handle the styling for all of the devices of a platform. Table 4–11 provides examples of using these elements to target all of the devices belonging to the iOS platform, as well as specific iOS device types (tablets, phones, and simulators).

> **Tip:** Consider using the DeviceDemo sample application, described in Appendix F, "Mobile Application Framework Sample Applications," to retrieve information about the device model.

Table 4–11 Platform- and Device-Specific Styling

Device	Example

iPhone	`<skin-addition>`
	`<skin-id>mobileAlta-v1.1.iPhone5,1</skin-id>`
	`<style-sheet-name>iPhoneStylesheet.css</style-sheet-name>`
	`</skin-addition>`

iPad	`<skin-addition>`
	`<skin-id>mobileAlta-v1.1.iPad4,2</skin-id>`
	`<style-sheet-name>iPadStylesheet.css</style-sheet-name>`
	`</skin-addition>`

iPhone Simulator	`<skin-addition>`
	`<skin-id>mobileAlta-v1.1.iPhone Simulator x86_64</skin-id>`
	`<style-sheet-name>iPhoneSimStylesheet.css</style-sheet-name>`
	`</skin-addition>`

All iOS Devices	`<skin-addition>`
	`<skin-id>mobileAlta-v1.1.iOS</skin-id>`
	`<style-sheet-name>iOSSimStylesheet.css</style-sheet-name>`
	`</skin-addition>`

4.12.4 How to Add a Custom Skin to an Application

To add a custom skin to your application, create a CSS file within JDeveloper, which places the CSS in a project's source file for deployment with the application.

To add a custom skin to an application:

1. In the Applications window, right-click the **ApplicationController** project and choose **New > CSS File**.
2. In the Create Cascading Style Sheet dialog, specify a name and directory for the CSS file.
3. Click **OK**.

4.12.5 How to Specify a Skin for an Application to Use

You configure values in the `maf-config.xml` file that determine what skin the application uses.

To specify a skin for an application to use:

1. In the Applications window, double-click the `maf-config.xml` file. By default, this is in the Application Resources pane under the **Descriptors** and **ADF META-INF** node.
2. In the `maf-config.xml` file, specify the value of the `<skin-family>` element for the skin you want to use and, optionally, the `<skin-version>` element.

   Example 4–25 shows the configuration required to make a mobile application use the `mobileAlta.v1.1` skin.

Example 4–25 Configuration to Specify a Skin for an Application

```
<adfmf-config xmlns="http://xmlns.oracle.com/adf/mf/config">
  <skin-family>mobileAlta</skin-family>
  <skin-version>v1.1</skin-version>
</adfmf-config>
```

> **Note:** Set an EL expression as the value for the `<skin-family>` element if you want to dynamically select the skin the application uses at runtime. For more information, see Section 4.12.12, "Enabling Dynamic Skin Selection at Runtime."

To add a new style sheet to a skin

1. Drag and drop a `<skin-addition>` element from the Components window to the Structure window.
2. Populate the `<skin-addition>` element with the elements described in Table 4–10 by completing the Insert skin-addition dialog, shown in Figure 4–41.
   - Enter the identifier of the skin to which you want to add a new style.
   - Retrieve the location of the CSS file.

Figure 4–41 The Insert skin-addition Dialog

3. Click **OK**.

Caution: Creating custom styles that use DOM-altering structures can cause mobile applications to hang. Specifically, the `display` property causes rendering problems in the HTML that is converted from MAF AMX. This property, which uses such values as `table`, `table-row`, and `table-cell` to convert components into a table, may result in table-related structures that are not contained within the appropriate parent table objects. Although this problem may not be visible within the application user interface itself, the logging console reports it through a Signal 10 exception.

4.12.6 How to Register a Custom Skin

You register a custom skin by adding the property values to the `maf-skins.xml` file that identify the custom skin to your application.

To register a custom skin:

1. In the Applications window, expand **ApplicationController** > **Application Sources** > **META-INF** and double-click **maf-skins.xml**.
2. In the Structure window, right-click the **adfmf-skins** node and choose **Insert Inside adfmf-skins** > **skin**.
3. In the Insert skin dialog, complete the fields as follows:
   - **family**—Enter a value for the family name of your skin.

     You can enter a new name or specify an existing family name. If you specify an existing family name, you need to version skins, as described in Section 4.12.7, "How to Version MAF Skins," to distinguish between skins that have the same value for family.

     The value you enter is set as the value for a `<family>` element in the `maf-skins.xml` where you register the skin that you create. At runtime, the `<skin-family>` element in the application's `maf-config.xml` uses this value to identify the skin that an application uses.
   - **id**—Enter an ID for the skin that uses one of the following naming formats: `skinFamily-version` or `skinFamily-version.platform`. For example, `mySkinFamily-v1.1.android`.
   - **extends**—Enter the name of the parent skin that you want to extend. For example, if you want your custom skin to extend the `mobileAlta-v1.1` skin, enter `mobileAlta-v1.1`.
   - **style-sheet-name**—Enter or select the name of the style sheet.
4. Click **OK**.

4.12.7 How to Version MAF Skins

You can specify version numbers for your skins in the `maf-skins.xml` file using the `<version>` element. Use this optional capability if you want to distinguish between skins that have the same value for the `<family>` element in the `maf-skins.xml` file. This capability is useful in scenarios where you want to create a new version of an existing skin in order to change some existing behavior. Note that when you configure an application to use a particular skin, you do so by specifying values in the `maf-config.xml` file, as described in section Section 4.12.5, "How to Specify a Skin for an Application to Use."

You specify a version for your skin by entering a value for the `<version>` element in the `maf-skins.xml` file.

> **Best Practice:** Specify version information for each skin that you register in the application's `maf-skins.xml` file.

To version a MAF skin:

1. In the Applications window, double-click the `maf-skins.xml` file. By default, this is in the **META-INF** node of the application controller project.
2. In the Structure window, right-click the **skin** node for the skin that you want to version and choose **Insert inside skin** > **version**.
3. In the Insert version dialog, select **true** from the default list if you want your application to use this version of the skin when no value is specified in the `<skin-version>` element of the `maf-config.xml` file, as described in Section 4.12.5, "How to Specify a Skin for an Application to Use."
4. Enter a value in the name field. For example, enter `v1` if this is the first version of the skin.
5. Click **OK**.

4.12.8 What Happens When You Version Skins

The version information that you configure for skins takes precedence over platform and device values when an application applies a skin at runtime. At runtime, a mobile application applies a device-specific skin before it applies a platform-specific skin. If skin version information is specified, the application first searches for a skin that matches the specified skin version value. If the application finds a skin that matches the skin version and device values, it applies this skin. If the application cannot find a skin with the specified skin version in the device-specific skins, it searches for a skin with the specified version in the platform-specific skins. If it does not find a skin that matches the specified version in the available platform-specific skins, it searches the base skins.

Example 4–26 shows an example `maf-skins.xml` that references three skins (`customFamily-v1.iphone5,3`, `customFamily-v2.iPhone` and `customFamily-v3.iPhone`). Each of these skins have the same value for the `<family>` element (`customFamily`). The values for the child elements of the `<version>` elements distinguish between each of these skins.

At runtime, an application that specifies `customFamily` as the value for the `<skin-family>` element in the application's `maf-config.xml` file uses `customFamily-v1.iphone5,3` because this skin is configured as the default skin in the `maf-skins.xml` file (`<default>true</default>`). You can override this behavior by specifying a value for the `<skin-version>` element in the `maf-config.xml` file, as described in Section 4.12.5, "How to Specify a Skin for an Application to Use." For example, if you specify `v2` as a value for the `<skin-version>` element in the `maf-config.xml` file, the application uses `customFamily-v2.iPhone` instead of `customFamily-v1.iphone5,3` that is defined as the default in the `maf-skins.xml` file.

If you do not specify the skin version to pick (using the `<skin-version>` element in the `maf-config.xml` file), then the application uses the skin that is defined as the default using the `<default>true</default>` element in the `maf-skins.xml` file. If you do not specify a default skin, the application uses the last skin defined in the `maf-skins.xml` file. In Example 4–26, the last skin to be defined is `customFamily-v3.iPhone`.

Example 4–26 maf-skins.xml File with Versioned Skin Files

```
<?xml version="1.0" encoding="UTF-8" ?>
<adfmf-skins xmlns="http://xmlns.oracle.com/adf/mf/skin">
  <skin id="s1">
    <family>customFamily</family>
    <id>customFamily-v1.iphone5,3</id>
    <extends>customFamily-v1.iOS</extends>
    <style-sheet-name>iphone.css</style-sheet-name>
    <version>
      <default>true</default>
      <name>v1</name>
    </version>
  </skin>
  <skin id="s2">
    <family>customFamily</family>
    <id>customFamily-v2.iPhone</id>
    <extends>customFamily-v1.iOS</extends>
    <style-sheet-name>iphone-v2.css</style-sheet-name>
    <version>
      <name>v2</name>
    </version>
  </skin>
  <skin id="s3">
    <family>customFamily</family>
    <id>customFamily-v3.iPhone</id>
    <extends>customFamily-v1.iOS</extends>
    <style-sheet-name>iphone-v3.css</style-sheet-name>
    <version>
      <name>v3</name>
    </version>
  </skin>
</adfmf-skins>
```

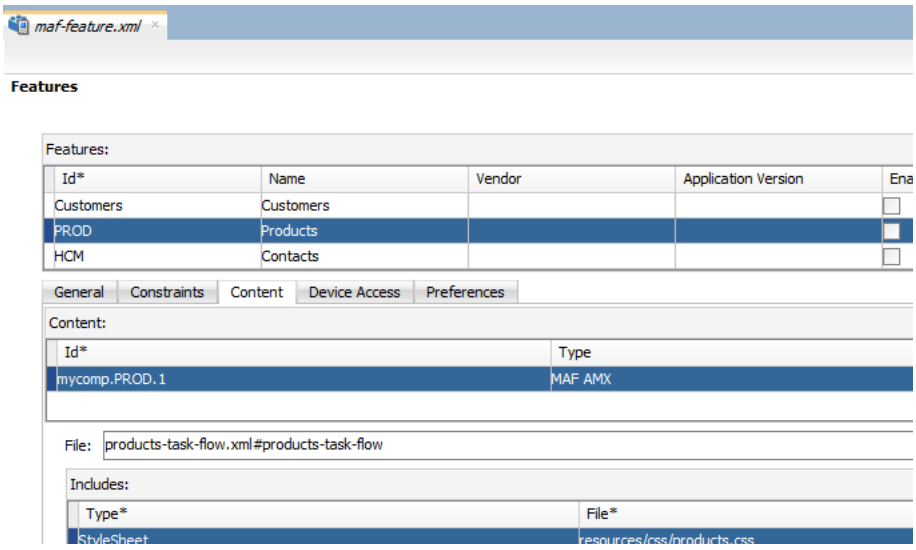
4.12.9 Overriding the Default Skin Styles

For a MAF AMX application, you can designate a specific style for the application feature implemented as MAF AMX, thereby overriding the default skin styles set at the application-level within the `maf-config.xml` and `maf-skins.xml` files. You add individual styles to the application feature using a CSS file as the *Includes* file.

4.12.9.1 How to Apply New Style Classes to an Application Feature

The Includes table in the overview editor for the `maf-feature.xml` files enables you to add a cascading style sheet (CSS) to a MAF AMX application feature.

Figure 4–42 The Includes Table



Before you begin:

Create a MAF task flow as described in Section 5.2, "Creating Task Flows." Create or add a Cascading Style Sheet (CSS) file for the skin. You can create the CSS file by selecting the view controller project and then choosing **New > CSS File**. Alternatively, you can package the CSS file in a JAR file as follows:

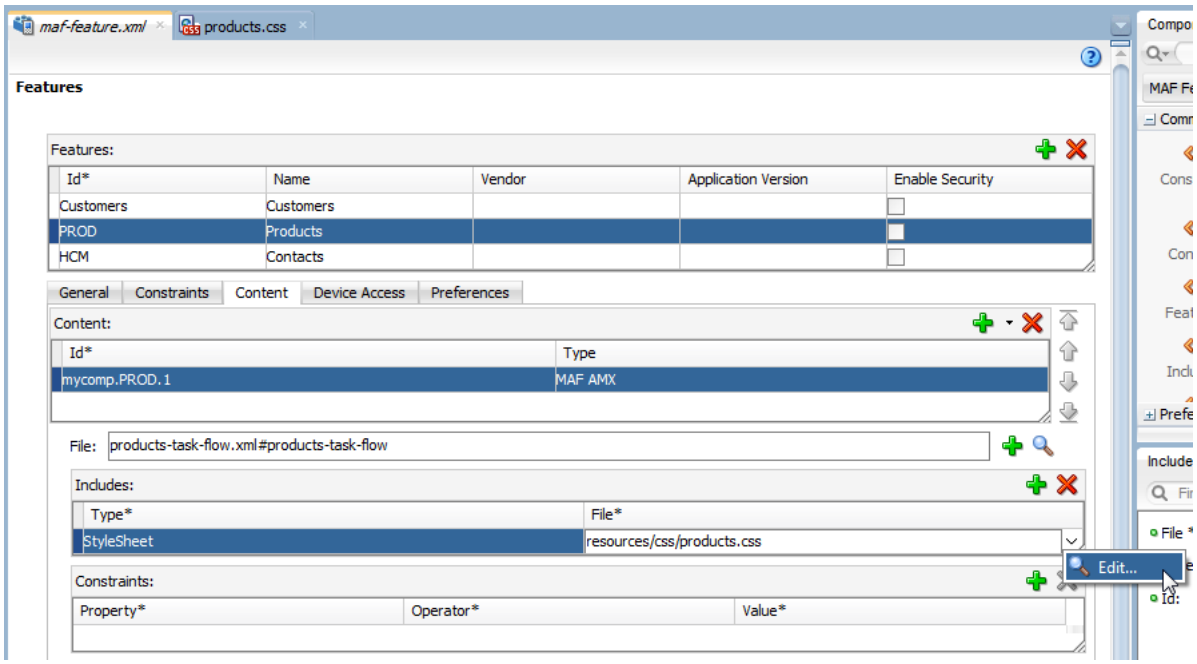
1. From the main menu, choose **Application > Project Properties**.
2. In the Project Properties dialog, select the **Libraries and Classpath** page and click **Add JAR/Directory**.
3. In the Add Archive or Directory dialog, navigate to the JAR file that contains the ADF skin you want to import and click **Select**.

   The JAR file appears in the Classpath Entries list.
4. Click **OK**.

How to add a style to an application feature:

1. Click **Add** to create a new row in the Includes table.
2. Choose **Stylesheet** from the dropdown menu in the Type column, as shown in Figure 4–43.

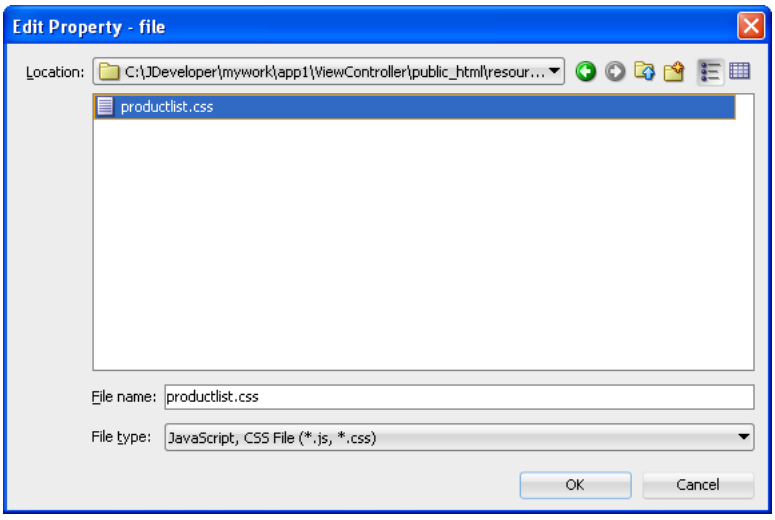
Figure 4–43 Selecting the StyleSheet Option



3. In the File column, click **Edit**, as shown in Figure 4–43.
4. Select the CSS from the Edit Property dialog, shown in Figure 4–44, and then click **OK**.

> **Note:** The `.css` file must reside within the view controller project; you cannot include a `.css` file that resides in the application controller project.

Figure 4–44 Selecting the CSS for the Application Feature

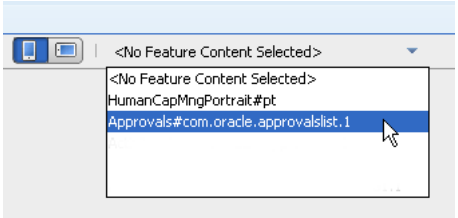


4.12.9.2 What Happens When You Apply a Skin to an Application Feature

After you add a CSS (or JavaScript file) to the Includes table, the CSS pages added to the application feature can be applied to a MAF AMX page by selecting the application

feature from the Feature Content dropdown menu in the preview pane of the MAF AMX editor, as shown in Figure 4–45.

Figure 4–45 The Feature Content Dropdown Menu



4.12.10 What You May Need to Know About Skinning

The CSS files defined in the `maf-skins.xml` file, illustrated in Example 4–27, show how to extend a skin to accommodate the different display requirements of the Apple iPhone and iPad. These styles are applied in a descending fashion. The SkinningDemo sample application provides a demonstration of how customized styles can be applied when the application is deployed to different devices. This sample application is in the `PublicSamples.zip` file at the following location within the JDeveloper installation directory of your development computer:

jdev_install`/jdeveloper/jdev/extensions/oracle.maf/Samples`

For example, at the iOS level, the stylesheet (`mobileAlta` in Example 4–27) is applied to both an iPhone or an iPad. For device-specific styling, define the `<skin-id>` elements for the iPhone and iPad skins. The skinning demo application illustrates the use of custom skins defined through this element.

Example 4–27 Skinning Levels Defined in the maf-skins.xml File

```
<?xml version="1.0" encoding="UTF-8" ?>
<adfmf-skins xmlns="http://xmlns.oracle.com/adf/mf/skins">
    <skin>
        <id>mobileAlta-v1.1.iPhone</id>
        <family>mobileAlta</family>
        <extends>mobileAlta-v1.1.iOS</extends>
        <style-sheet-name>skins/mobileAlta-v1.1.iphone.css</style-sheet-name>
    </skin>
    <skin>
        <id>mobileAlta-v1.1.iPad</id>
        <family>mobileAlta</family>
        <extends>mobileAlta-v1.1.iOS</extends>
        <style-sheet-name>skins/mobileAlta-v1.1.ipad.css</style-sheet-name>
    </skin>
    <skin>
        <id>mobileAlta-v1.1.iPod</id>
        <family>mobileAlta</family>
        <extends>mobileAlta-v1.1.iOS</extends>
        <style-sheet-name>skins/mobileAlta-v1.1.ipod.css</style-sheet-name>
    </skin>
    <!--  Skin Additions -->
    <skin-addition>
        <skin-id>mobileAlta-v1.1.iPhone</skin-id>
        <style-sheet-name>skins/mystyles.iphone.addition1.css</style-sheet-name>
    </skin-addition>
    <skin-addition>
        <skin-id>mobileAlta-v1.1.iPhone</skin-id>
```

```
        <style-sheet-name>skins/mystyles.iphone.addition2.css</style-sheet-name>
    </skin-addition>
    <skin-addition>
        <skin-id>mobileAlta-v1.1.iOS</skin-id>
        <style-sheet-name>skins/mystyles.ios.addition2.css</style-sheet-name>
    </skin-addition>
</adfmf-skins>
```

4.12.11 What You May Need to Know About Migrating Skinning Styles

Applications created by MAF derive their styles from the `mobileFusionFX` skin family. Like the `mobileAlta` skin family, such device- and platform-specific styles as `mobileFusionFx.iPhone` and `mobileFusionFx.iOS` are applied before the base skin itself, `mobileFusionFx`. To ensure that an application has the look and feel of the `mobileAlta` skin replace `<skin-family>mobileFusionFx</skin-family>` in the `maf-config.xml` file as follows:

```
<?xml version="1.0" encoding="UTF-8" ?>
<adfmf-config xmlns="http://xmlns.oracle.com/adf/mf/config">
  <skin-family>mobileAlta-v1.1</skin-family>
</adfmf-config>
```

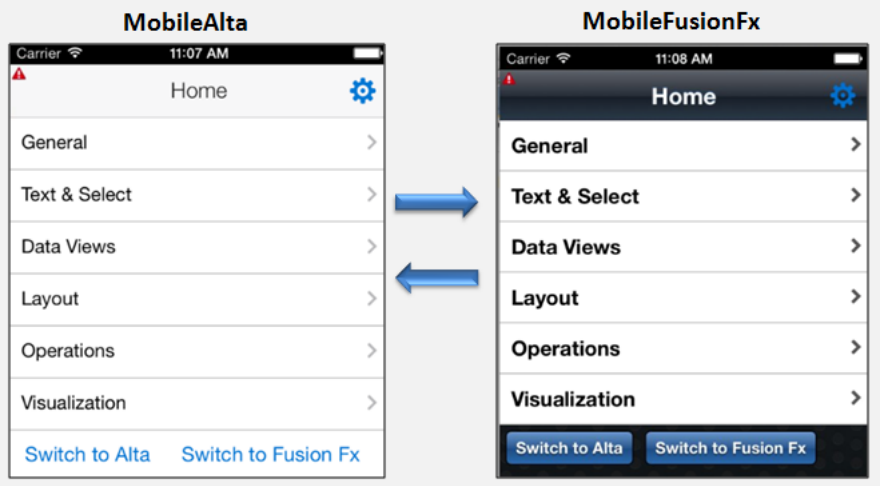
Tip: You can designate any skin by updating the `<skin-family>` element.

4.12.12 Enabling Dynamic Skin Selection at Runtime

You can configure your application to enable end users select an alternative skin at runtime. You might configure this functionality when you want end users to render the application using a skin that is more suitable for their needs.

Figure 4–46 shows how you might implement this functionality by displaying buttons to allow end users to change the skin the application uses at runtime. Configure the buttons on the page to set a scope value that can later be evaluated by the `skin-family` property in the application's `maf-config.xml` file.

Figure 4–46 Changing an Application's Skin at Runtime (on iOS)



4.12.12.1 How to Enable End Users Change an Application's Skin at Runtime

You enable end users change an application's skin by exposing a component that allows them to update the value of the `skin-family` property in the application's `maf-config.xml` file.

To enable end users change an application's skin at runtime:

1. Open the page where you want to configure the component(s) that you use to set the skin family property in the `maf-config.xml` file.
2. Configure a number of components (for example, button components) that allow end users to choose one of a number of available skins at runtime, as shown in Figure 4–46.

   Example 4–28 shows how you configure `amx:commandButton` components that allow end users to choose available skins at runtime, as shown in Figure 4–46. Each `amx:commandButton` component specifies a value for the `actionListener` attribute. This attribute passes an `actionEvent` to a method (`skinMenuAction`) on a managed bean named `skins` if an end user clicks the button.

Example 4–28 Using a Component to Set the Skin Family

```
...
<amx:commandButton text="Switch to Alta"
     actionListener="#{applicationScope.SkinBean.switchToMobileAlta}" id="cb1"/>
<amx:commandButton text="Switch to Fusion Fx"
     actionListener="#{applicationScope.SkinBean.switchToMobileFusionFx}" id="cb2"/>
...
```

3. Write a managed bean in the application's view controller project to store the value of the skin selected by the end user. Example 4–29 shows a method that takes the value the end user selected and uses it to set the value of `skinFamily` in the managed bean. Example 4–29 also shows a method that resets all features in the application to use the new skin.

Example 4–29 Managed Bean to Change an Application's Skin

```
package application;

import javax.el.ValueExpression;
import oracle.adfmf.amx.event.ActionEvent;
import oracle.adfmf.framework.FeatureInformation;
import oracle.adfmf.framework.api.AdfmfContainerUtilities;
import oracle.adfmf.framework.api.AdfmfJavaUtilities;
import oracle.adfmf.java.beans.PropertyChangeListener;
import oracle.adfmf.java.beans.PropertyChangeSupport;

public class SkinBean

{
    private String skinFamily = "mobileAlta";
    private PropertyChangeSupport propertyChangeSupport = new PropertyChangeSupport(this);

    public void setSkinFamily(String skinFamily) {
        String oldSkinFamily = this.skinFamily;
        this.skinFamily = skinFamily;
        propertyChangeSupport.firePropertyChange("skinFamily", oldSkinFamily, skinFamily);

    }
```

```
    public String getSkinFamily() {
        return skinFamily;
    }

    public void addPropertyChangeListener(PropertyChangeListener l) {
        propertyChangeSupport.addPropertyChangeListener(l);
    }

    public void removePropertyChangeListener(PropertyChangeListener l) {
        propertyChangeSupport.removePropertyChangeListener(l);
    }

    public void switchToMobileAlta(ActionEvent ev){
        this.switchSkinFamily("mobileAlta");
    }

    public void switchToMobileFusionFx(ActionEvent ev) {
        this.switchSkinFamily("mobileFusionFx");
    }

    public void switchSkinFamily(String family) {
        this.setSkinFamily(family);
        // reset all the features individually as follows to load the new skin
        FeatureInformation[] features = AdfmfContainerUtilities.getFeatures();
        for (int i = 0; i < features.length; i++) {
            AdfmfContainerUtilities.resetFeature(features[i].getId());
        }
    }
}
```

4. In the Applications window, expand the **Application Resources** panel, expand **Descriptors > ADF Meta-INF** node and double-click the **maf.config.xml** file.
5. In the `maf-config.xml` file, write an EL expression to dynamically evaluate the skin family:

   ```
   <skin-family>#{applicationScope.SkinBean.skinFamily}</skin-family>
   ```

4.12.12.2 What Happens at Runtime: How End Users Change an Application's Skin

At runtime, the end user uses the component that you exposed to select another skin. In Example 4–28, this is one of a number of `amx:commandButton` components. This component submits the value that the end user selected to a managed bean that, in turn, sets the value of a managed bean property (`skinFamily`). At runtime, the `<skin-family>` property in the `maf-config.xml` file reads the value from the managed bean using an EL expression. The managed bean in Example 4–29 also reloads the features in the application to use the newly-specified skin.

> **Tip:** Similar to the `<skin-family>` property, you can use an EL expression to set the value of the `<skin-version>` property in the `maf-config.xml` file at runtime.

As an alternative to resetting the application's features individually to load the new skin, as demonstrated in Example 4–29, you can invoke the `resetApplication` method from the following class:

`oracle.adfmf.framework.api.AdfmfContainerUtilities`

For more information, see *Oracle Fusion Middleware Java API Reference for Oracle Mobile Application Framework*.

4.13 Working with Feature Archive Files

The `maf-application.xml` file references at least one application feature. These application features, when packaged into a JAR file known as a Feature Archive file (FAR), provide the reusable content that can be consumed by other mobile applications. A FAR is essentially a self-contained collection of everything that an application feature requires, such as icon images, resource bundles, HTML files, JavaScript files, or other implementation-specific files. As described in Section 19.5, "Deploying Feature Archive Files (FARs)," the contents of a FAR includes a single `maf-feature.xml` file, which identifies each of the packaged application features by a unique ID. You can edit this file, as described in Section 4.8, "About the Mobile Application Feature Configuration File," to update such feature properties as content implementation (local or remote HTML files or MAF AMX pages) and display based on such factors as user roles and privileges, or device properties. A mobile application can reference one FAR, several of them, or none at all.

You can add a FAR as either an application library or as a view controller project. You cannot customize the FAR's contents when you add it as project library, nor can you reuse its individual artifacts. A mobile application consumes the FAR in its entirety when it is added as a library file. For example, a FAR's task flow cannot be the target of a task flow call activity. Adding a FAR as a view controller project, however, enables you to customize its artifacts, as described in Section 4.14, "Customizing MAF Files Using Oracle Metadata Services."

4.13.1 How to Use FAR Content in a MAF Application

You make an application feature available to a mobile application by adding it to the consuming application's class path.

> **Note:** You can only add the FAR to the application controller project; you cannot add a FAR to the view controller project.

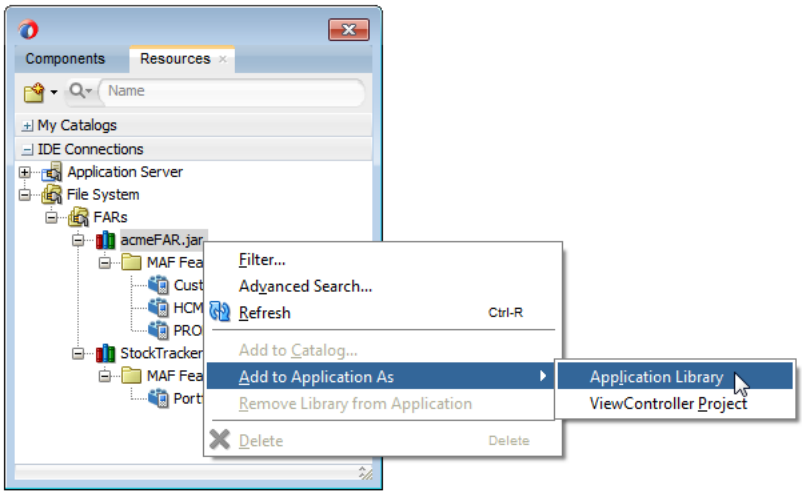
Before you begin:

Deploy the application feature as a Feature Archive file, as described in Section 19.5.2, "How to Deploy the Feature Archive Deployment Profile."

How to add application feature content to a mobile application as a library:

1. Open the Resources window, choose **New**, then **IDE Connections**, and then choose **File System**.
2. Complete the File Systems Connection dialog to create a file connection to the directory that contains the Feature Archive JAR file. For more information, refer to the Oracle JDeveloper Online help.
3. Right-click the Feature Archive file (which is noted as a JAR file) in the Resources window.
4. Choose **Add to Application As** and then choose **Library** to add the consuming application's classpath, as shown in Figure 4–47.

Figure 4–47 Adding a FAR to a Mobile Application as a Library

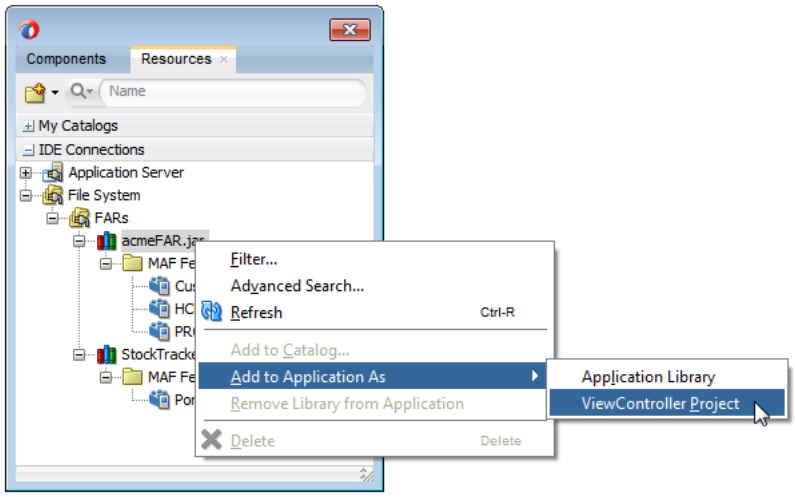


Tip: Choose **Remove Library from Application** to remove the feature archive JAR from the consuming application's classpath.

How to add a FAR as a view controller project:

1. Open the Resources window, choose **New**, then **IDE Connections**, and then choose **File System**.
2. Complete the File Systems Connection dialog to create a file connection to the directory that contains the Feature Archive JAR file. For more information, refer to the Oracle JDeveloper Online help.
3. Right-click the Feature Archive file (which is noted as a JAR file) in the Resources window.
4. Choose **Add to Application As** and then choose **ViewController Project**, as shown in Figure 4–48.

Figure 4–48 Adding a FAR to a Mobile Application as a View Controller Project

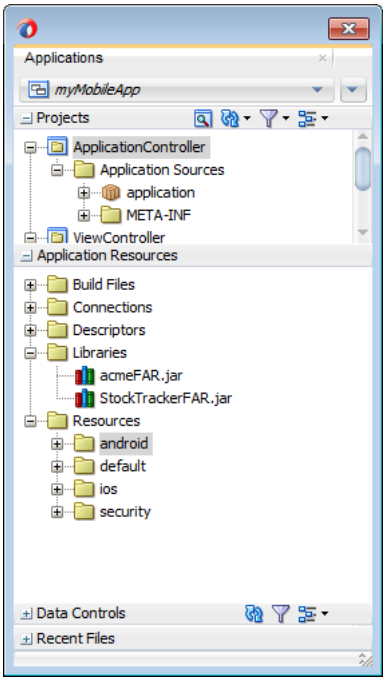


4.13.2 What Happens When You Add a FAR as a Library

After you add a FAR as a library (or manually to the application's classpath):

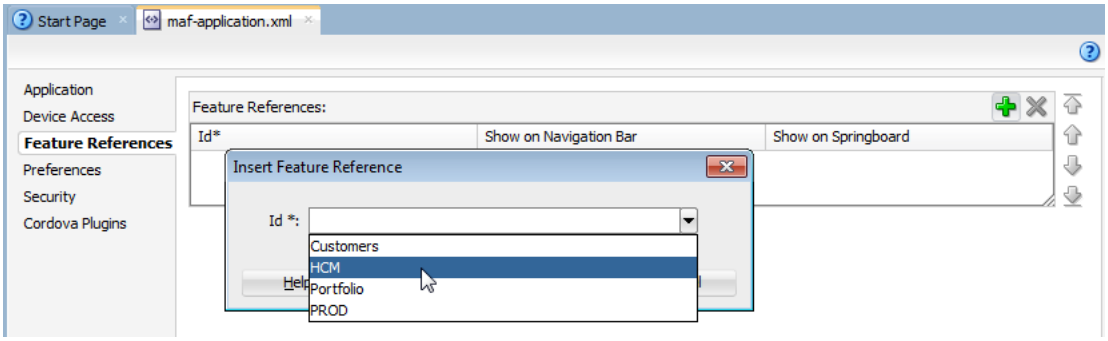
- The contents of the FAR display in the Application Resources under the **Libraries** node, as shown in Figure 4–49.

Figure 4–49 The FAR JAR File in the Application Resources of the Consuming Application



- Every application feature declared in the `maf-feature.xml` files included in the JARs becomes available to the consuming application, as illustrated by Figure 4–50 where the dropdown lists IDs of the available application features belonging to `AcmeFAR.jar` (HCM, PROD, and Customers) as well as one called Portfolio that is defined in another Feature Archive that has been added to the application, `StockTrackerFAR.jar`. See also Section 4.6.1, "How to Designate the Content for a Mobile Application."

Figure 4–50 Referencing the Application Features Defined in Various maf-feature.xml Files



Tip: Manually adding the Feature Archive JAR to the application classpath also results in the application features displaying in the Insert Feature Reference dialog.

Alternatively, you can add or remove an application feature from the Resources window as follows:

1. Expand the feature archive JAR in the Resources window.
2. From the MAF Features folder, right-click an application feature.
3. Choose **Add Feature Reference to maf-application.xml**, as shown in Figure 4–51, or **Remove Feature Reference from maf-application.xml**, shown in Figure 4–52. Figure 4–51 illustrates adding an application feature called customers from `acmeFAR.jar`, an imported FAR.

Figure 4–51 Adding a Feature Reference

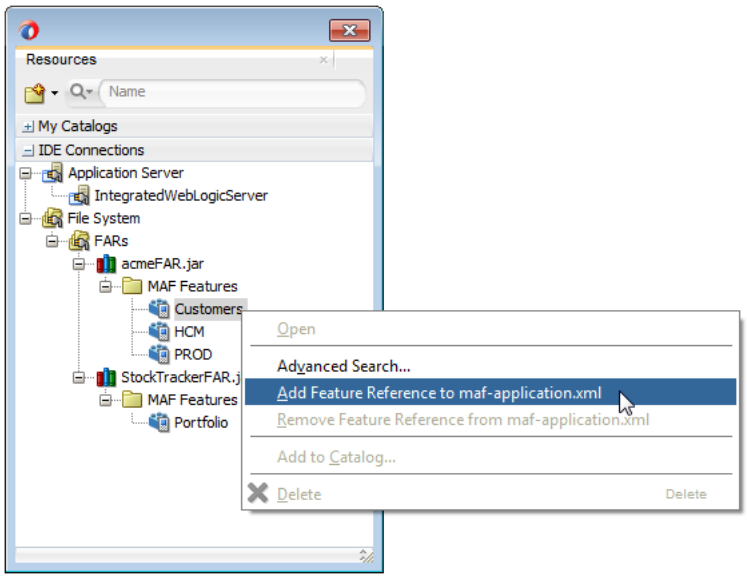
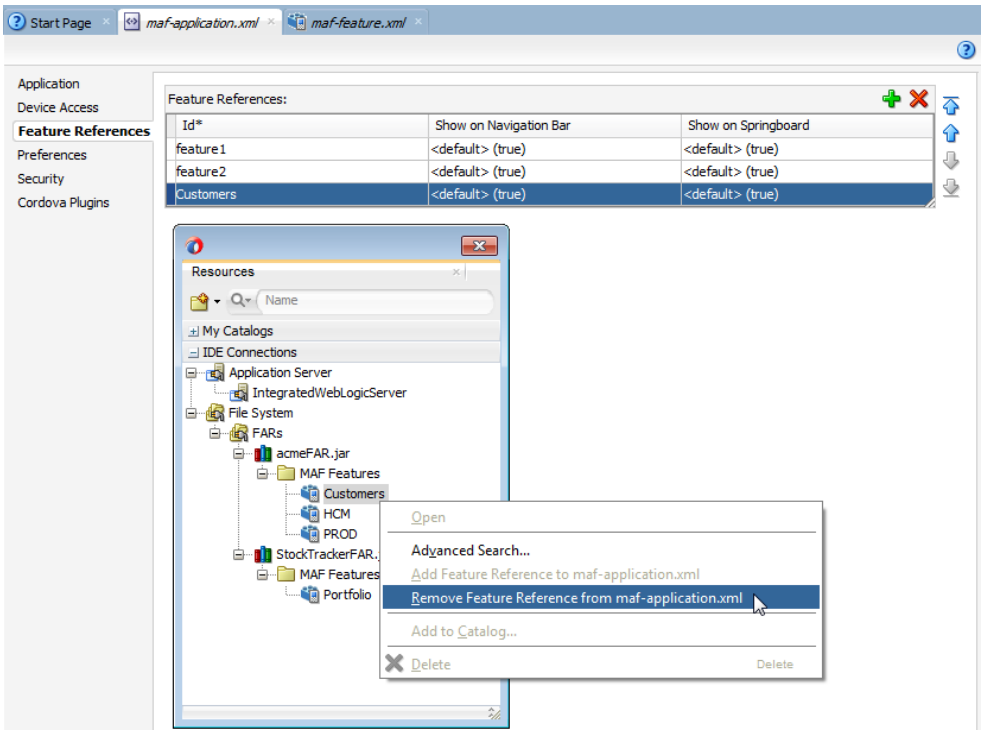


Figure 4–52 illustrates removing the *customers* feature reference (initially added from the imported FAR, `acmeFAR.jar`) from the `maf-application.xml` file.

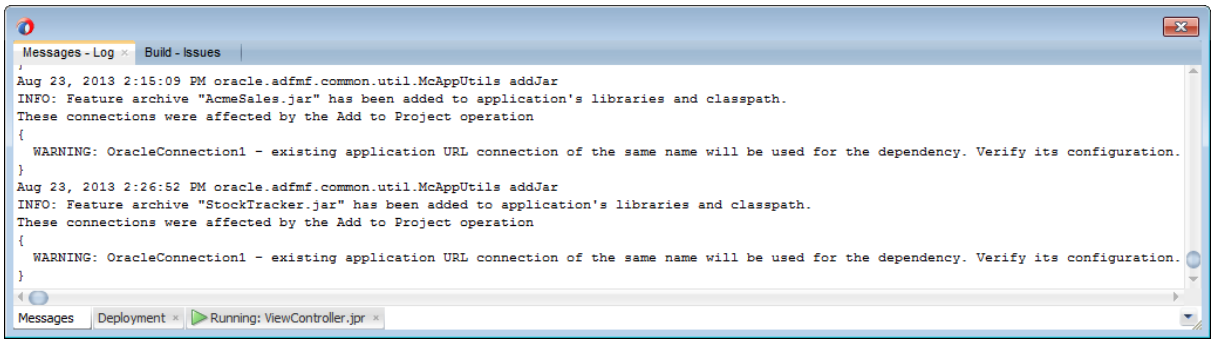
Figure 4–52 Removing a Feature Reference



- The information in the `connections.xml` file located in the Feature Archive JAR is merged into the consuming application's `connections.xml` file. The Log window, shown in Figure 4–53, displays naming conflicts.

> **Note:** You must verify that the connections are valid in the consuming application.

Figure 4–53 The Messages Log Window Showing Name Conflicts for Connections



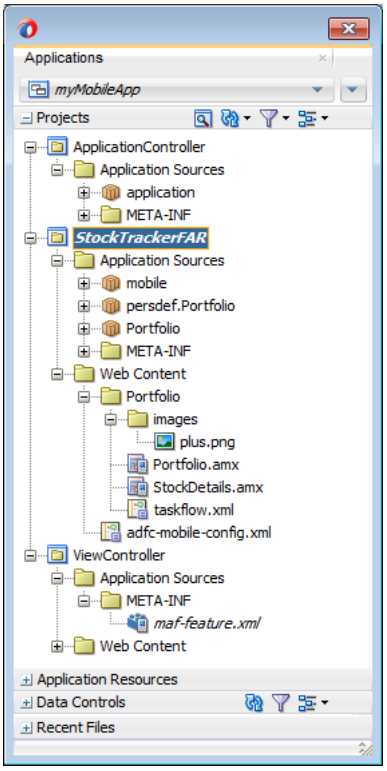
4.13.3 What Happens When You Add a FAR as a View Controller Project

When you add a FAR as a view controller project:

- MAF generates a view controller project that bears the same name as the imported FAR. Figure 4–54 illustrates how MAF creates a view controller project (a `.jpr` file) for an imported FAR file called *StockTracker* (which is illustrated as *`StockTrackerFAR.jar`* in Figure 4–48). This view controller project contains the default structure and metadata files of a MAF view controller project, as described

in Section 3.2.2.3, "About the View Controller Project Resources." In particular, the FAR view controller project includes the `maf-feature.xml` file. If the MAF application contains other view controller projects, you must ensure that none of these projects include application features with the same ID. See also Section 4.13.4, "What You May Need to Know About Enabling the Reuse of Feature Archive Resources."

Figure 4–54 The Imported FAR as a View Controller Project within a Mobile Application



- As with a FAR imported as a library, the information in the `connections.xml` file located in the Feature Archive JAR is merged into the consuming application's `connections.xml` file. MAF will create a `connections.xml` file if one does not already exist in the target application. Likewise, the `sync-config.xml` file is merged into the consuming applications's `sync-config.xml` file.
- MAF makes any `.class` and JAR files included in the FAR available as a library to the view controller project by copying them into its `lib` directory (such as `C:\jdeveloper\mywork\`*`application\FAR view controller project`*`\lib`). MAF compiles these files into a file called `classesFromFar.jar`.
- Unlike a FAR imported as a library, you can customize the files of a view controller project.

> **Note:** Because the original resource bundles included in FAR might not be usable in the generated view controller project, you must create new resources bundles within the project as described in Section 4.14.6.1, "How to Enable Customizations in Resource Bundles."

- Like a FAR imported as a library, every application feature declared in the FAR's `maf-feature.xml` file becomes available to the consuming application.

4.13.4 What You May Need to Know About Enabling the Reuse of Feature Archive Resources

To ensure that the resources of a FAR can be used by an application, both the name of the FAR and its feature reference IDs must be globally unique; ensure there are no duplicate feature reference IDs in the `maf-application.xml` file. Within the FAR itself, the `DataControl.dcx` file must be in a unique package directory. Rather than accepting the default names for these package directories, you should instead create a unique package hierarchy for the project. You should likewise use a similar package naming system for the feature reference IDs.

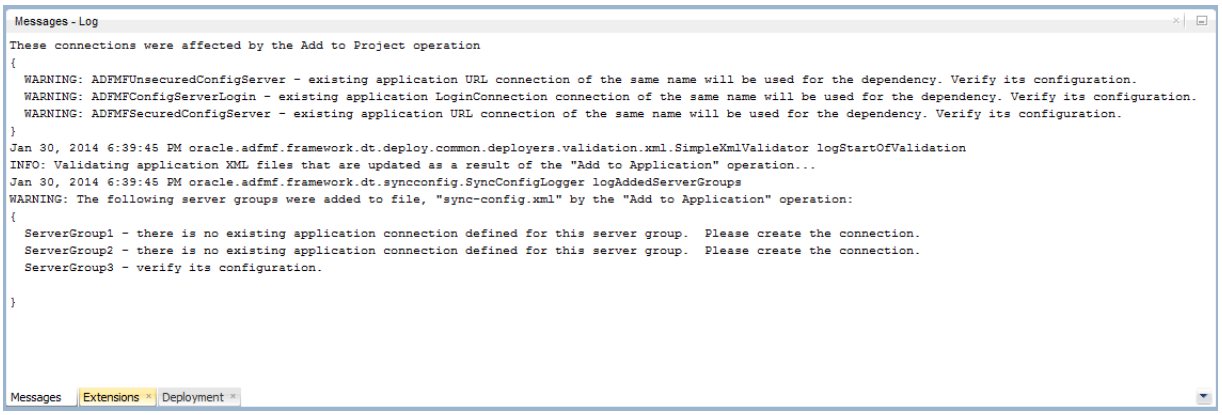
4.13.5 What You May Need to Know About Using a FAR to Update the sync-config.xml File

The `sync-config.xml` file enables the mobile application to not only cache the data retrieved from server-side resources accessed through various types of web services (SOAP, REST-XML, or REST with JSON payloads) to the embedded SQLite database, but also enables the application to update this data within the cache and to the server-side resource.

The `sync-config.xml` file is included in the Feature Archive file when the view controller project is deployed as a FAR. Like the `connections.xml` file, MAF merges the contents of the `sync-config.xml` file in the FAR (`jar-sync-config.xml`) with those of the consuming application's `sync-config.xml` file after you add the FAR to the application. Because the `sync-config.xml` file describes the web service endpoints used by the mobile application, you can update the endpoints for all of the web services used by the application features that comprise a mobile application by adding a FAR as described in Section 4.13.3, "What Happens When You Add a FAR as a View Controller Project."

After you add the FAR to the application, MAF logs messages that prompt you to verify and, if needed, modify the application's `sync-config.xml` and `connections.xml` files. As illustrated in Figure 4–55, these messages reflect the state of the `sync-config.xml` file in the consuming application.

Figure 4–55 The Messages Log



If the consuming application lacks the `sync-config.xml` file, then MAF adds the file to the application and writes a message similar to the following:

```
oracle.adfmf.framework.dt.deploy.features.deployers.SyncConfigMerger _logNoSyncConfigInAppUsingFar
WARNING: The application does not contain a synchronization file, "sync-config.xml". Creating one
containing the synchronization configuration in the Feaure Archive.
```

MAF writes a log message similar to the following that requests that you verify (or create) a connection if the `sync-config.xml` file's `<ServerGroup>` elements do not have corresponding `<Reference>` elements defined in the consuming application's `connections.xml` file:

```
oracle.adfmf.framework.dt.deploy.features.deployers.SyncConfigMerger _logAddedServerGroups
WARNING: The following server groups were added sync-config.xml by the Add to Application
operation:
{
  ServerGroup1 - there is no existing application connection defined for this server group.
Please create the connection.

  ServerGroup2 - verify its configuration.
}
```

If the `<ServerGroup>` definitions in the consuming application's `config-sync.xml` file duplicate those of the counterpart `config-sync.xml` file included in the FAR, then MAF writes the following `SEVERE`-level message to the log:

```
oracle.adfmf.framework.dt.deploy.features.deployers.SyncConfigMerger _logDuplicateServerGroups
SEVERE: Cannot merge the server groups from the Feature Archive because the following definitions
already exist:
ServerGroup1
ServerGroup2
```

4.14 Customizing MAF Files Using Oracle Metadata Services

Oracle Metadata Services (MDS) enables applications to be rebranded, customized, and personalized at runtime. MDS enables a single application to adapt to different industries, locations, or user groups. In the latter case, for example, you can use MDS to tailor the look and feel to a user group, or user responsibility.

A customized application contains a base application along with one or more layers of customizations. An application can have multiple customization layers and each layer can have multiple layer values. You can apply these layer values in a specified order in terms of precedence on top of the base metadata. MDS stores these customizations in a MDS Repository and retrieves them at runtime. Because MDS saves the customizations made in a separate MDS Repository, the base application remains unchanged. For more information about configuring Metadata Services Repositories, see the "Managing the Metadata Repository" chapter in *Oracle Fusion Middleware Administrator's Guide*.

MDS enables two customization patterns:

- Seeded Customization—For seeded customization, you adapt a general application to a particular group, such as a specific industry or a site by defining layers of customization that are applied at runtime. These seeded customizations exist as part of the deployed application and endure for the life of a given deployment.
- User Customization (change persistence)—Enables an end user to personalize the content of an application at runtime to suit individual preferences (for example, a user can select which columns display on a table). These changes persist across user sessions; they display consistently each time the user accesses the application.

You can customize the following artifacts of a mobile application using the MDS framework:

- The `maf-feature.xml` file
- The `maf-skins.xml` file
- The `maf-application.xml` file
- The `maf-config.xml` file
- MAF AMX files and metadata files (see Chapter 11, "Customizing MAF AMX Application Feature Artifacts").

You customize an application using the MDS framework by performing the following tasks:

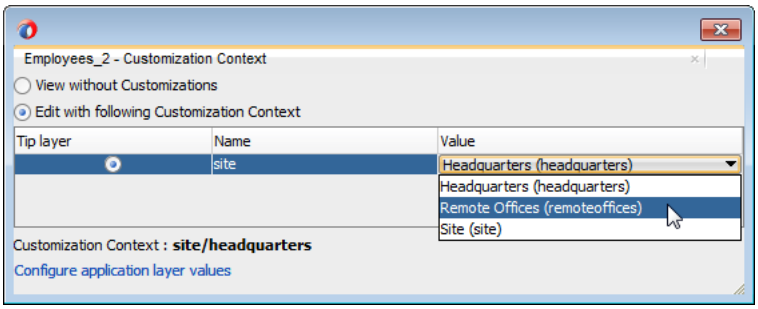
1. Creating customization layers— Create one or more global or application-specific customization layers. For more information, see Section 4.14.1, "How to Create a Customization Layer."
2. Creating a customization class— MDS uses a customization class to determine which customization to apply to the base application. Each customization class defines a base customization layer. Do not create this file in the mobile application that you plan to customize. For more information, see Section 4.14.2, "How to Create a Customization Class."
3. Enabling the design time to access the customization—Perform the following tasks:
   a. Package the customization class (a `.java` file) as a JAR file.
   b. Add the JAR file to one of the projects of the mobile application.

      For more information, see Section 4.14.3, "How to Enable the Design Time to Access the Customization Class."
4. Adding the customization class to the `cust-config` section of the `adf-config.xml` file—Register the customization classes in the order of precedence.
5. Launching JDeveloper in the Customization Developer role (or switching to that role)—For more information, see the "Working with JDeveloper Roles" section in *Oracle Fusion Middleware User's Guide for Oracle JDeveloper*.

   Note: You can customize existing files using the Customization Developer role but you cannot create new files.

6. Select the customization layer from the Customization Context window, as shown in Figure 4–56.

Figure 4–56 Selecting the Customization Layer (Tip Layer)



Note: When you work in the Customization Developer role, the layer and layer value that you select in the Customization Context window is called the tip layer. The changes you make while in the Customization Developer role are applied only to this layer.

7. Deploying the application to a device, emulator, or as a platform-specific application package—You have to use the Customization Developer role to deploy a customized application. To deploy in the Customization Developer role:

   a. Launch the application in the Customization Developer role.

   b. In the Customization Context window, shown in Figure 4–56, select the layer and value for which you want to implement customizations.

   c. Select from among the deployment options (accessed by choosing **Application**, then **Deploy**, and then by selecting the deployment profile). For more information, see Chapter 19, "Deploying Mobile Applications."

   d. Perform a separate deployment for each customization context.

   During deployment, the base file and the delta files are merged to create the customized version of the application at runtime. The deployed application has no MDS dependencies.

   Tip: You can deploy the customized application as a MAF Application Archive (`.maa`) file and then import it into an application to perform additional customization and upgrades. The delta files included in the `.maa` file are merged with the base files after deployment. For more information, see Section 4.14.7, "Upgrading a Mobile Application with Customizations."

4.14.1 How to Create a Customization Layer

Customizations can be global (that is, available to an entire instance of JDeveloper), or application-specific. JDeveloper stores global customizations in the `CustomizationLayerValues.xml` file located at `jdev_install/jdeveloper/jdev/CustomizationLayerValues.xml`. By default, this file is seeded with layer values called `site1` and `site2`. They are defined using the `<cust-layer-value>` element as follows:

```
<cust-layers xmlns="http://xmlns.oracle.com/mds/dt">
   <cust-layer id-prefix="s" name="site">
      ...
         <cust-layer-value id-prefix="1" display-name="Site One" value="site1"/>
         <cust-layer-value id-prefix="2" display-name="Site Two" value="site2"/>
```

```
    ...
  <cust-layer-value display-name="Site" value="site"/>
</cust-layer>
```

Any layer values defined in this file can be overridden at runtime by those defined in an application-specific `CustomizationLayerValues.xml` file.

To create an application-specific CustomizationLayerValues.xml file:

1. In the Applications window, expand the Application Resources folder.
2. Expand the ADF-META INF folder and open the `adf-config.xml` file.
3. In the MDS page of the overview editor, click **Configure Design Time Customization Values**.
4. Open the `CustomizationLayerValues.xml` file and update the seeded layer values (`Site One` and `Site Two`) as needed. For example:

```
<cust-layers xmlns="http://xmlns.oracle.com/mds/dt">
  <cust-layer name="site" id-prefix="s">
    <!-- Generated id-prefix would be "s1" and "s2" for values
     site1" and "site2"-->
    <cust-layer-value value="headquarters" display-name="Headquarters"
     id-prefix="1"/>
    <cust-layer-value value="remoteoffices" display-name="Remote Offices"
     id-prefix="2"/>
...
```

4.14.2 How to Create a Customization Class

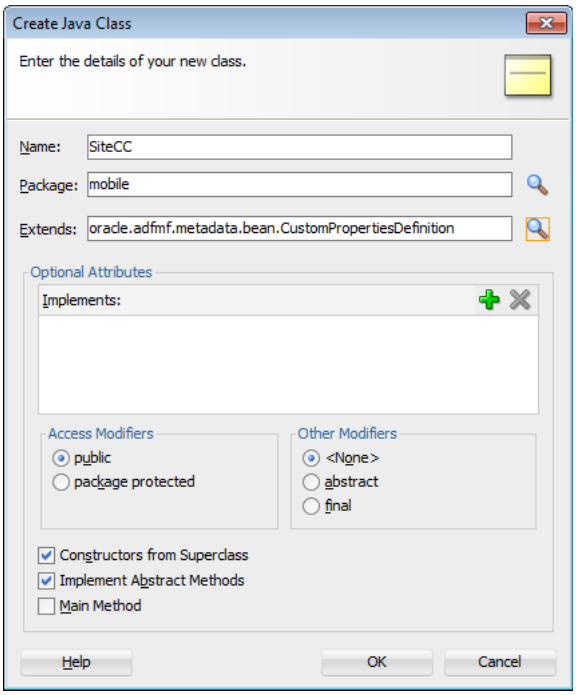
Do not create this file in the mobile application that you plan to customize. Instead, create a separate Java application for the customization class. After you complete the Java class, you import it into the mobile application that you plan to customize.

To create a customization class:

1. Create a Java application.
2. Click **File**, **New**, and then **Project**.
3. In the New Gallery, choose **Java Application Project**. Complete the wizard.
4. In the Applications window, right click the Java application project and then choose **Project Properties**.
5. In the Project Properties dialog, select **Libraries and Classpath**, and then click **Add Library**.
6. In the Add Library dialog, select **MDS Runtime** and then click **OK**. Click **OK** to close the Project Properties dialog.
7. In the Applications window, right-click the Java application project and then choose **New** and then **Java Class**.
8. In the Create Java Class dialog, enter the class' name and package.
9. In the Extends field, browse the class hierarchy and retrieve `oracle.mds.cust.CustomizationClass`, as shown in Figure 4–57. Click **OK**.

Note: **Implement Abstract Methods** (the default setting) must be selected in the Create Java Class dialog.

Figure 4–57 Creating the Customization Class



10. Update the stub file. Example 4–30 illustrates a customization class.

Example 4–30 Customization Class

```
package mobile;

import java.io.IOException;
import java.io.InputStream;
import java.util.Properties;
import oracle.mds.core.MetadataObject;
import oracle.mds.core.RestrictedSession;
import oracle.mds.cust.CacheHint;
import oracle.mds.cust.CustomizationClass;

public class SiteCC extends CustomizationClass {
    private static final String DEFAULT_LAYER_NAME = "site";
    private String mLayerName = DEFAULT_LAYER_NAME;
    public SiteCC() {

    }

    public SiteCC (String layerName) {
        mLayerName = layerName;
    }
    public CacheHint getCacheHint() {
               return CacheHint.ALL_USERS;
    }

    public String getName() {

        return mLayerName;
    }

       public String[] getValue(RestrictedSession restrictedSession, MetadataObject metadataObject)
```

```
{
        // This needs to return te site value at runtime.
        //For now, it's always null
           Properties properties = new Properties();
           String configuredValue = null;
           Class clazz = SiteCC.class;
           InputStream is  = clazz.getResourceAsStream("/customization.properties");

           if (is != null){
               try {
                   properties.load(is);
                   String propValue = properties.getProperty(mLayerName);
                   if (propValue != null){
                       configuredValue = propValue;
                   }
               } catch (IOException e) {
                   e.printStackTrace();
               }
           }

           return new String[] {configuredValue};
    }
}
```

11. Rebuild the Java application project.

4.14.3 How to Enable the Design Time to Access the Customization Class

You must first package the customization class as a JAR file and then register the class with the mobile application. To package the customization class and any related artifacts into a JAR file, you must create a deployment profile using the Create Deployment Profile wizard. For more information, see Section 3.2.2.4, "About Automatically Generated Deployment Profiles."

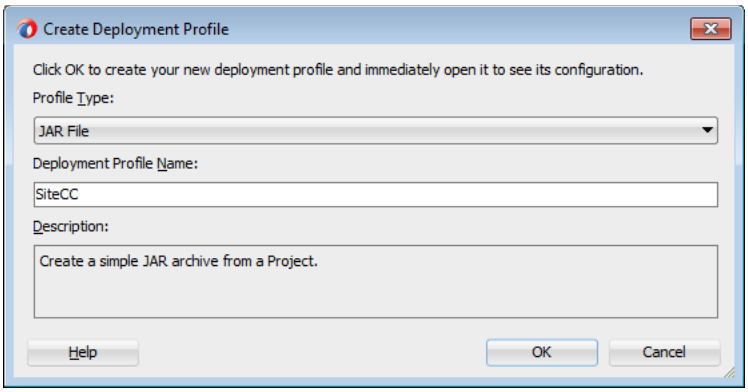
To add customization classes into a JAR:

1. In the Applications window, right-click the Java application project and choose **New > From Gallery**.
2. In the New Gallery, expand **General**, select **Deployment Profiles** and then **JAR File**, and click **OK**.

   Tip: Click the **All Features** tab if the **Deployment Profiles** node does not appear in the **Categories** tree.

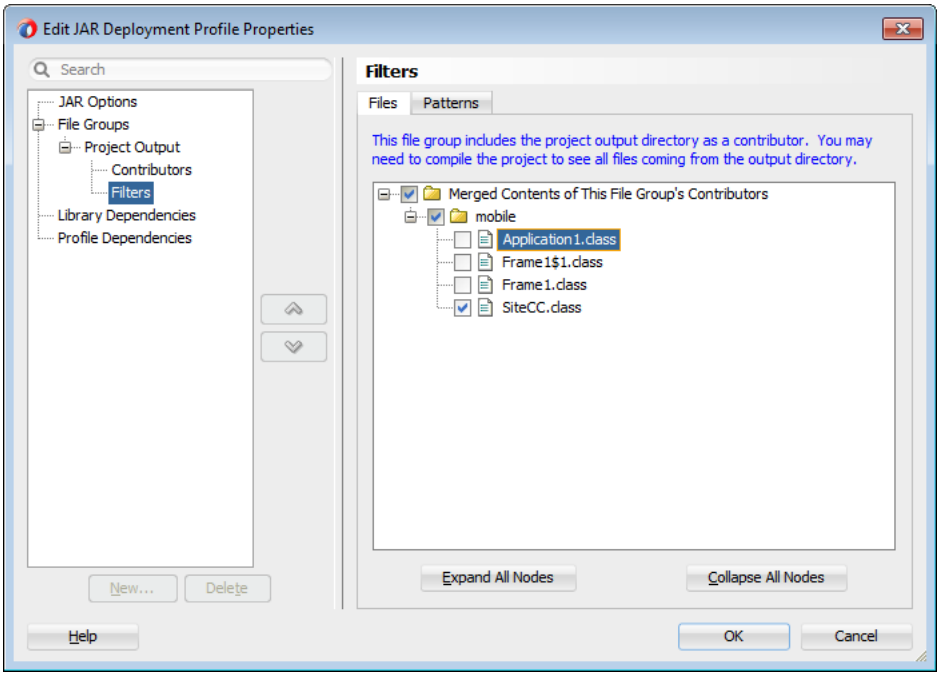
3. In the Create Deployment Profile -- JAR File dialog, enter a name for the project deployment profile (for example, `SiteCC` in Figure 4–58) and then click **OK**.

Figure 4–58 Creating the Deployment Profile for the Customization Class



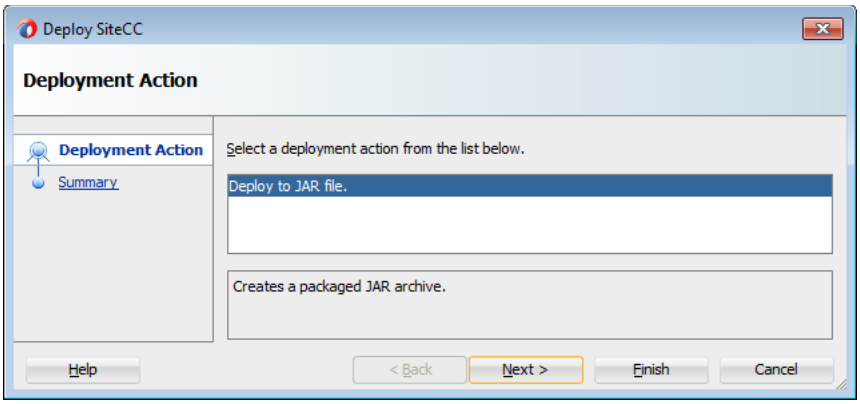
4. In the Edit JAR Deployment Profile Properties dialog, select **JAR Options**.
5. If needed, enter a location for the JAR file. Otherwise, accept the default location.
6. Expand **Files Groups > Project Output > Filters** to list the files that can be selected to be included in the JAR.
7. In Filters page, in the **Files** tab, select the customization classes you want to add to the JAR file, as illustrated in Figure 4–59.

Figure 4–59 Including the Customization Class in the JAR File



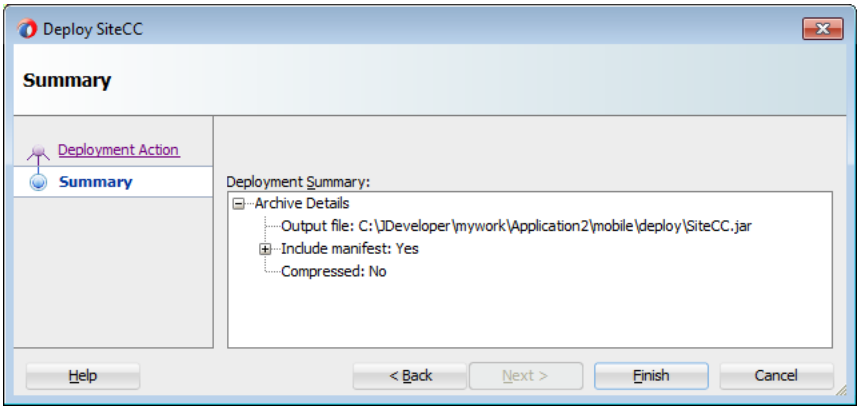
8. Click **OK** to exit the Edit JAR Deployment Profile Properties dialog.
9. Click **OK** again to exit the Project Properties dialog.
10. In the Applications window, right-click the Java application project and then choose the deployment profile. In the Deployment Action page, illustrated in Figure 4–60, **Deploy to JAR** is selected by default. Click **Next**.

Figure 4–60 Deploying the Customization Class to a JAR File



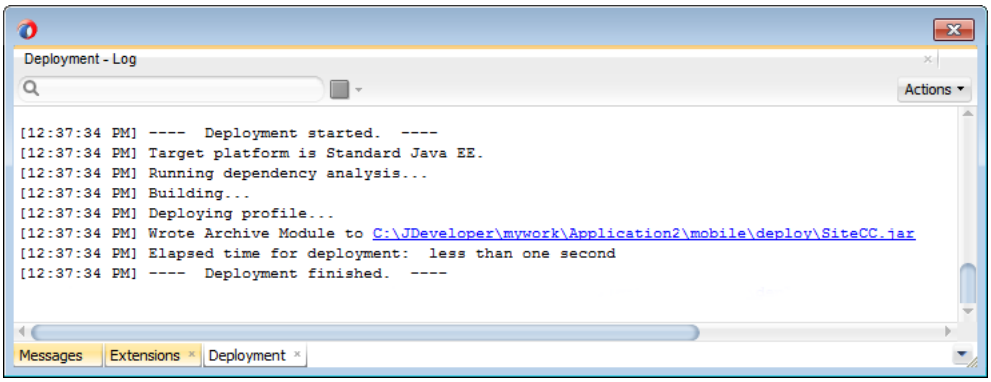
11. Review the confirmation for the output location of the JAR file. Click **OK**.

Figure 4–61 Summary Page (Showing the Output Location for the JAR File)



The log file window, shown in Figure 4–62, displays the status of the deployment.

Figure 4–62 Deployment Log

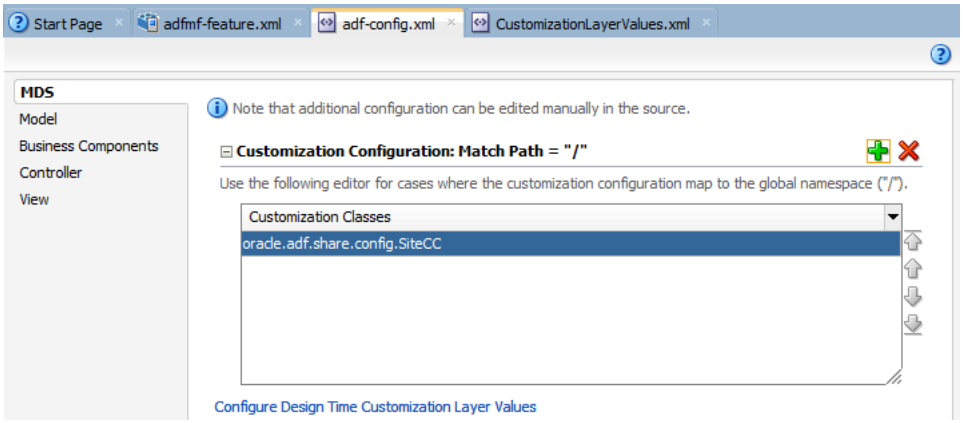


To register the customization class with the mobile application:

1. Open the mobile application.
2. Choose **Application** and then **Application Properties**.
3. Choose **Libraries and Classpath**.

4. Click **Add JAR/Directory**.
5. In the Add Archive or Directory dialog, navigate to the JAR file that contains the customization classes, and click **Open**.
6. Click **OK**.
7. In the overview editor for the MDS page of the `adf-config.xml` file, add the customization class, as illustrated in Figure 4–63.

Figure 4–63 Adding the Customization Class



4.14.4 What You May Need to Know About Web Service Data Controls and Customized Application Deployments

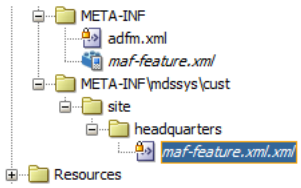
Because web service Java Bean Definition (JDB) files cannot be created by a customization deployment, you must perform a non-customization deployment to create these files before performing a customization deployment, as follows:

1. Launch the application in the Studio Developer role.
2. Choose **Build** and then **Clean All** to remove any web service JDB files that may have become obsolete since the previous deployment.
3. Select from among the deployment options (accessed by choosing **Application**, then **Deploy**, and then by selecting the deployment profile). For more information, see Chapter 19, "Deploying Mobile Applications."
4. Launch the application in the Customization Developer role.
5. Select the same deployment profile chosen in Step 3 to enable the customization deployment to access the JBD files created by the non-customization deployment.

4.14.5 What Happens When You Customize a Mobile Application

When you implement customizations for a mobile application, JDeveloper creates a metadata file for these customizations and a subpackage for storing them. The metadata file contains the customizations for the customized object, which are applied over the base metadata at runtime. JDeveloper gives the new metadata file the same name as the base file for the object, but includes an additional `.xml` extension, as illustrated by `maf-feature.xml.xml` in Figure 4–64.

Figure 4–64 maf-feature.xml Metadata File



4.14.6 Enabling Customizations in Resource Bundles in Mobile Applications

To implement customization for resource keys, you must create additional resource bundle files; you cannot use the base resource bundle file.

4.14.6.1 How to Enable Customizations in Resource Bundles

In the Studio Developer role, create an application or project resource bundle. Edit the bundle that you create to define string values for resource keys.

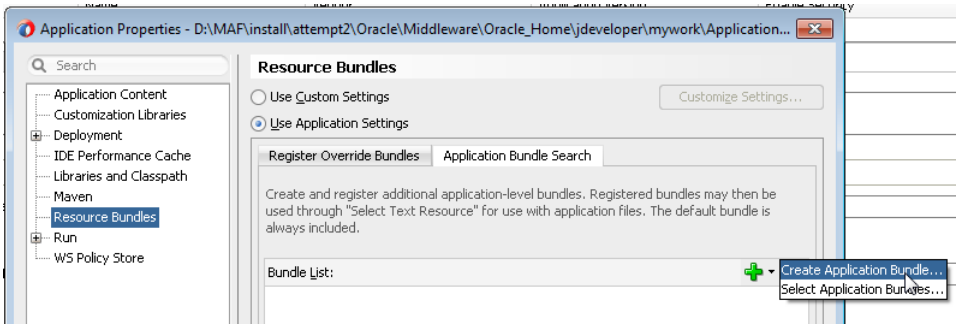
Before you begin:

Familiarize yourself with the "How to Use Multiple Resource Bundles" section in *Oracle Fusion Middleware Developing Fusion Web Applications with Oracle Application Development Framework*.

To create an application resource bundle:

1. In the Studio Developer role, click **Application** > **Application Properties** > **Resource Bundles**.
2. In the Resource Bundle page, click **Application Bundle Search**, then click the dropdown menu icon to the right of the **Add bundle** icon and choose **Create Application Bundle**, as shown in Figure 4–65.

Figure 4–65 Creating an Application Resource Bundle



3. In the Create Xliff File dialog that appears, enter a name for the resource bundle and click **OK**.
4. Edit the resource bundle, as described in Section 4.11.1.8, "How to Edit a Resource Bundle File."

Note: MAF does not support the **Overridden** property in the application-level Resource Bundle page.

---

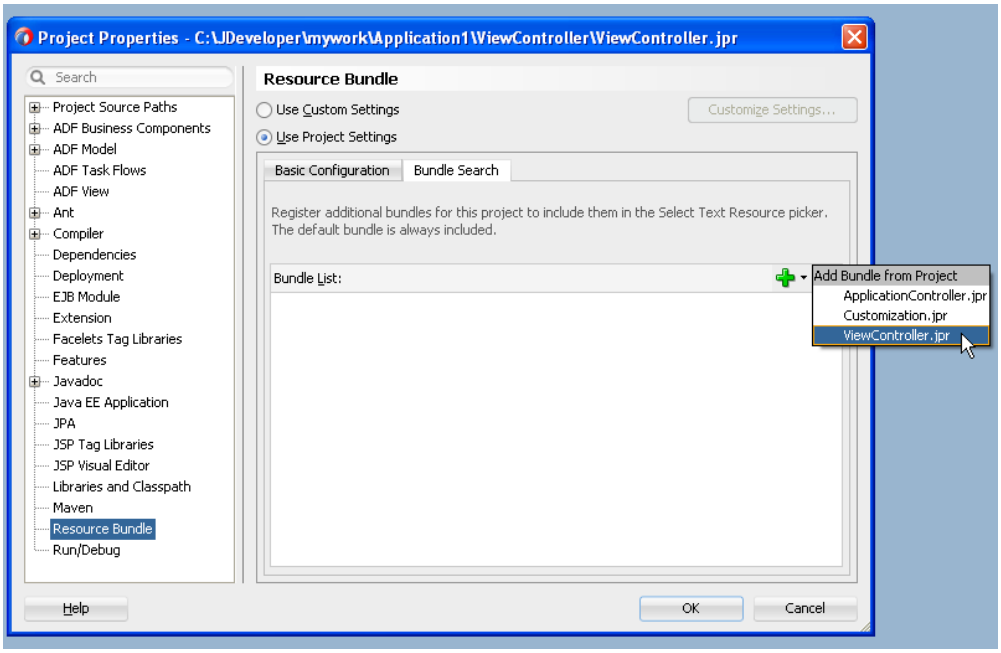
5. In the Customization Developer role, open the Select Text Resource dialog and choose from among the resource bundles that contain the appropriate string. Because you cannot change strings or create new ones in the Customization Developer role, you can only choose from the strings in the selected bundle.

> **Note:** Do not select strings from the base resource bundle in the Customization Developer role, as doing so may cause problems when upgrading the application.

To create a project resource bundle:

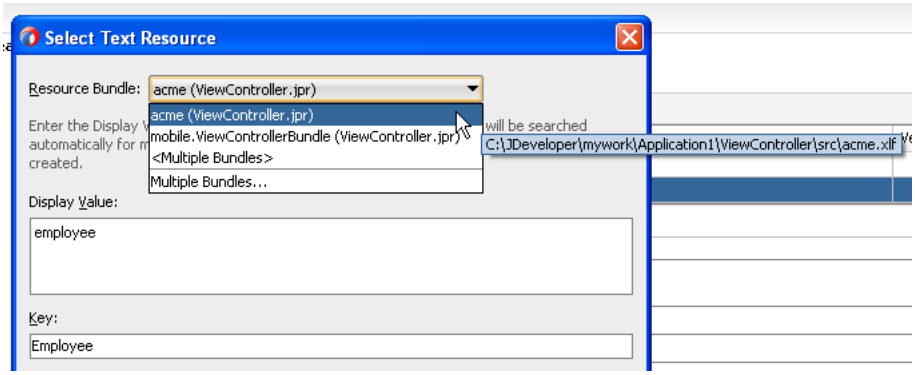
1. In the Studio Developer role, right-click the project where you want to create the resource bundle and choose **New** > **From Gallery** > **General** > **XML** > **XML Localization File (XLIFF)**.
2. In the Create Xliff File dialog that appears, enter a name for the resource bundle and click **OK**.
3. Edit the resource bundle, as described in Section 4.11.1.8, "How to Edit a Resource Bundle File."
4. In the Bundle Search tab of the Resource Bundle page, register the resource bundle by selecting a project (`.jpr`) file, as shown in Figure 4–66.

Figure 4–66 Selecting a Resource Bundle



Registering a resource bundle includes it in the Select Text Resource dialog, shown in Figure 4–67.

Figure 4–67 Selecting a Resource Bundle for a Text Resource



5. Use the Select Text Resource Dialog to define the key as follows:

   a. Select the bundle from the **Resource Bundle** dropdown list.

      The dialog displays the strings that are currently defined in the selected resource bundle.

   b. Enter a new string and then click **Save and Select**.

      JDeveloper writes the string to the selected resource bundle.

6. In the Customization Developer role, open the Select Text Resource dialog and choose from among the resource bundles that contain the appropriate string. Because you cannot change strings or create new ones in the Customization Developer role, you can only choose from the strings in the selected bundle.

> **Note:** Do not select strings from the base resource bundle in the Customization Developer role, as doing so may cause problems when upgrading the application.

4.14.7 Upgrading a Mobile Application with Customizations

Customizations are upgrade-safe because they are saved separately from the base applications. Because customizations retain changes, they enable you to upgrade an application by applying these changes to newer versions of the application. The MAF Application Archive (`.maa`) file provides the mechanism for upgrading mobile applications. When you create an application from an `.maa` file, you can upgrade the application using an updated version of the `.maa` file.

4.14.7.1 How to Upgrade a Mobile Application

Using the Upgrade Mobile Application from Archive wizard, you can upgrade an application to a higher version while retaining the customizations made prior to the upgrade.

Before you begin:

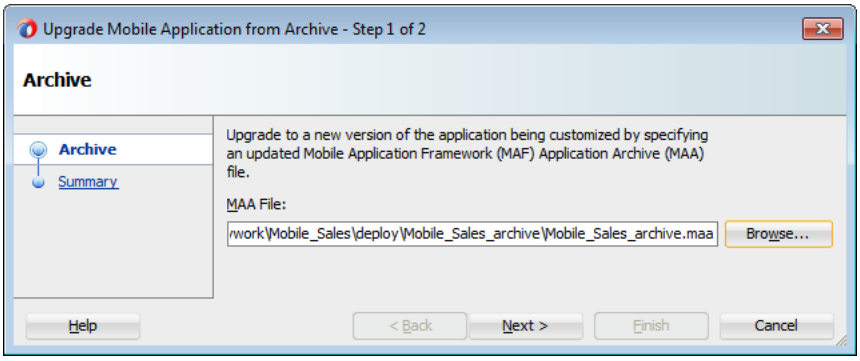
You may want to familiarize yourself with the MAF Application Archive (`.maa`) file. For more information, see Section 19.6, "Creating a Mobile Application Archive File" and Section 19.7, "Creating Unsigned Deployment Packages."

Ensure that the application that is packaged into the `.maa` file and used for the upgrade has the same application ID as the application to which it will be applied. It must also have a higher version number than the application targeted for the upgrade.

To upgrade a mobile application:

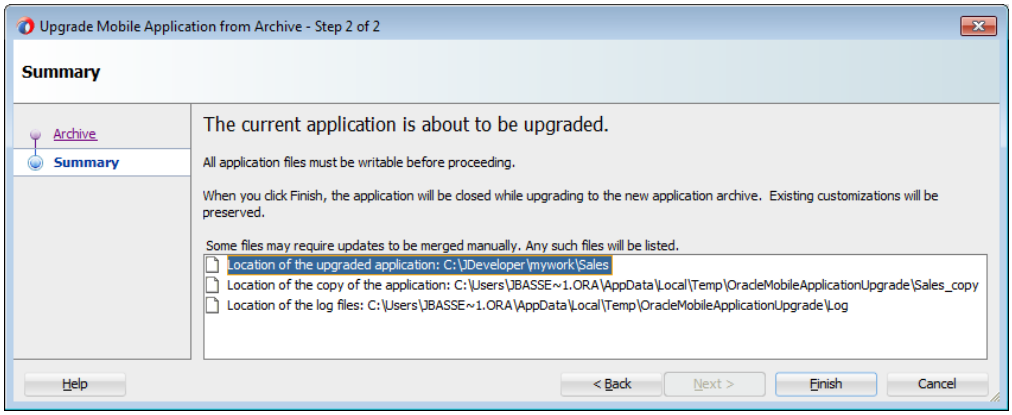
1. Create a mobile application from an `.maa` file.
2. Apply customization to the mobile application, as described in Section 4.14, "Customizing MAF Files Using Oracle Metadata Services" and Section 4.14.6, "Enabling Customizations in Resource Bundles in Mobile Applications."
3. Click **Application** and then choose **Select Mobile Application from Archive**.
4. Browse to and select the `.maa` file. The wizard discontinues the upgrade if the application packaged in the `.maa` has the same (or lower) version number than the current application, or a different application ID.

Figure 4–68 Selecting the .maa File



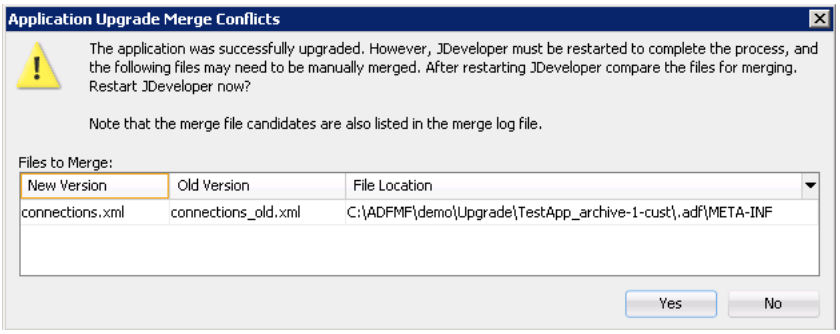
5. Review the Summary page for files that require a manual merge. As noted in Figure 4–69, MAF saves the initial version (Version 1) of the application in the `Temp` directory. The Summary page also notes the temporary location of the log files.

Figure 4–69 Application Upgrade Information



6. If the upgrade completes successfully, restart JDeveloper. JDeveloper notifies you if different versions of a configuration file require reconciliation, as illustrated by Figure 4–70.

Figure 4–70 Manual Merge Notification



During the upgrade, MAF copies a set of files that cannot be customized for both Version 1 of the application and Version 2 (the upgraded version of the application). These files include the `connections.xml` and `adf-config.xml` files. If MAF detects differences between Version 1 and Version 2 `connections.xml` and `adf-config.xml` files, it retains both copies of these files and writes an entry to the merge log file. MAF differentiates Version 1 by appending a version number if version numbers exist to the file name. If version numbers do not exist, MAF adds `_old` to the file name, as illustrated by `connections_old.xml` in Figure 4–70. If needed, you can manually merge the differences into the new version. As illustrated in Figure 4–71, MAF places the merge file log in the temporary location noted in the Summary page. MAF names the files as *`workspace name_timestamp`*.

Figure 4–71 The Merge Log File

```
Sun Nov 24 05:24:10 PST 2013
Please check the following files and manually merge the changes in the old version to the new version if needed

New Version            Old Version                          File Location
=============================================================================
connections.xml      connections old.xml               C:\ADFMF\demo\Upgrade\TestApp archive-1-cust\.adf\META-INF
```

4.14.8 What Happens in JDeveloper When You Upgrade Applications

In addition to copying Version 1 to the `Temp` directory and creating Version 1 and Version 2 copies of the non-upgradable configuration files, MAF also performs the following when you upgrade an application using the Upgrade Mobile Application from Archive wizard:

- Saves the libraries and resource bundles settings for each project in a map keyed with the project file name.
- Saves the resource bundle settings for the workspace.
- Saves the registered customization class in the `adf-config.xml` file.
- Imports the Version 2 `.maa` file to the temporary directory.
- Copies the application from the `.maa` file used for the upgrade to Version 1.
- Updates each Version 2 project (`.jpr`) file with the registered resource bundle and library dependency map. The new version of the library overrides the previous version. However, the Version 1 library remains unchanged if it shares the same name as the library used in Version 1.
- Updates the Version 2 workspace (`.jws`) file with the registered resource bundle settings.
- Updates the Version 2 `adf-config.xml` file to register the customization class.

4.14.9 What You May Need to Know About Upgrading FARs

If the application includes a FAR file that was not packaged in the original `.maa` file that was used to create the application (or included in the `.maa` file that is used to upgrade the application), then you must upgrade the FAR file separately. For example, you can create an application from an `.maa` file, add a FAR file, and then perform customization. You can upgrade the application to use a newer version of the FAR by adding the updated FAR from the Resources window as described in Section 4.13.1, "How to Use FAR Content in a MAF Application."

4.15 Integrating Cordova Plugins into Mobile Applications

Because application created by MAF are hybrid mobile applications, they use the Apache Cordova JavaScript APIs to access the native device APIs. As described in *Plugin Development Guide* in the Cordova Apache Documentation (available through `http://cordova.apache.org/`), a Cordova plugin is comprised of native code built using platform-specific SDKs (Xcode or the Android SDK) and JavaScript.

MAF does not ship with third-party Cordova plugins; they must instead be developed using the SDKs for the platform to which they will be deployed. In other words, you create a plugin for an iOS application using Xcode and use the Android SDK to create plugins for applications targeted to Android-powered devices. In addition to creating the plugin itself, you must also provide any accompanying instructions (that is, a readme or a manifest file) that describe how to add the plugin's resources to the application.

You must ensure that any third-party plugin complies with the version of Cordova supported by MAF. If MAF supports a version of the API that differs from the one used by the plugin, then the functionality that it enables may become unavailable to the mobile application.

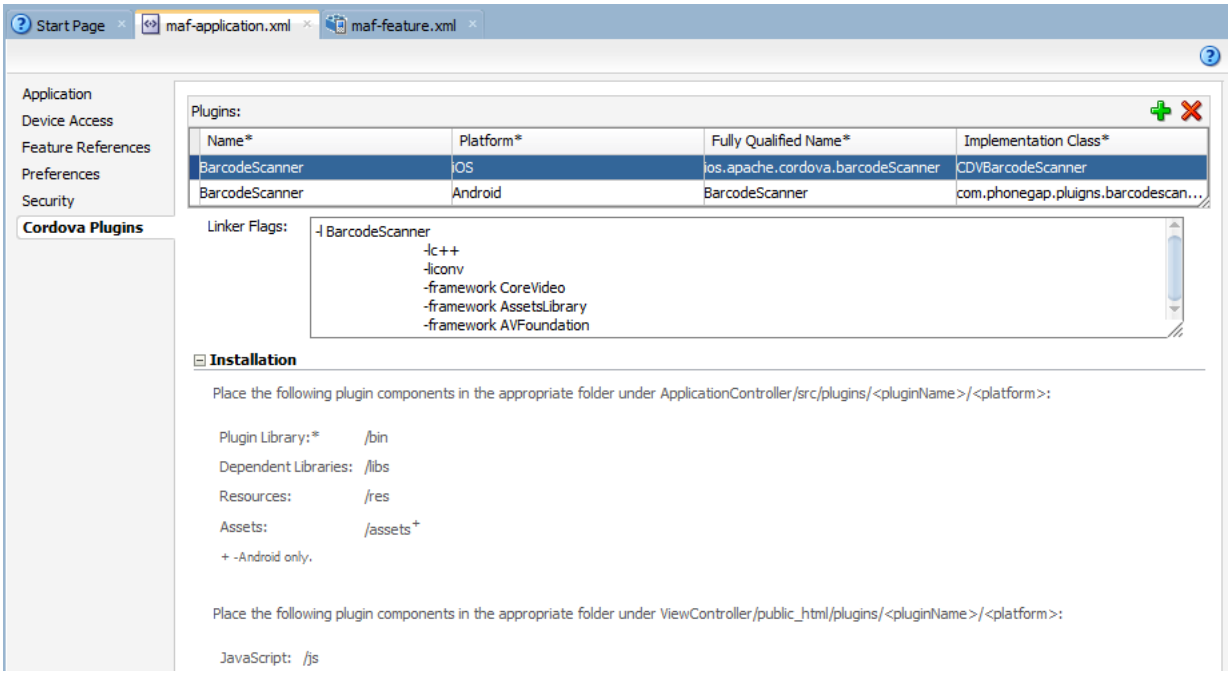
For more information about how you can access JavaScript APIs using MAF, see Appendix B, "Local HTML and Application Container APIs."

Note: Plugins must be compatible with Cordova 2.2.0, the only version supported by MAF.

4.15.1 How to Integrate Cordova Plugins for iOS and Android

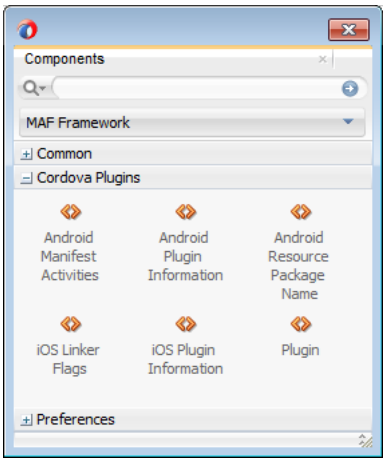
The Cordova Plugins page, illustrated in Figure 4–72, enables you to integrate the plugins to the mobile application by updating the platform-specific XML files (`cordova.plist` file for iOS and the `config.xml` file for Android) as described by the plugin instructions that are provided by the developer of the plugin.

Figure 4–72 The Cordova Plugins Page



In addition to the overview editor, you can configure MAF to use Cordova plugins by dragging the Cordova components from the Components window, shown in Figure 4–73, onto the Source editor or the Structure window. You can also use the Properties window to edit the configuration.

Figure 4–73 The Cordova Plugin Components



Before you begin:

Perform the following:

- Obtain the plugin integration instructions from the plugin developer.
- Obtain the plugin itself (the source code, the JavaScript file, and any additional libraries, resources, or assets).
- Table 4–12 lists the directories that you manually create in the application controller and view controller projects. Once created, copy the plugin artifacts to

the directories. The primary components of a plugin, JavaScript file and the plugin binary libraries, are located in different projects (the view controller project and the application controller project) within a mobile application.

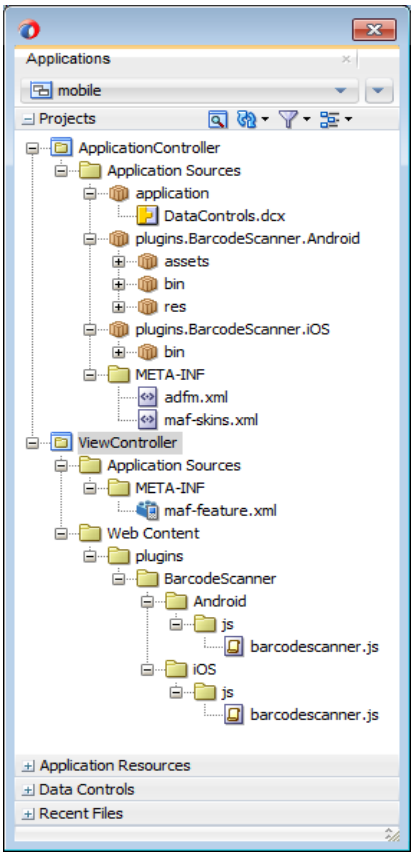
Tip: The Installation section for the Cordova Plugins page provides read-only guidelines for these file locations.

Table 4–12 Locations of Directories to Create Plugin Artifacts

Artifact	File Location	Description
Plugin Library	*application workspace directory*\ApplicationController\src*plugins**Plugin Name**Platform*\bin For example: JDeveloper\mywork\application1\ApplicationController\src\plugins\BarcodeScanner\Android\bin	Contains the plugin binary. This is a required folder, one which must contain this content.
Dependent Libraries	*application workspace directory*\ApplicationController\src*plugins**Plugin Name**Platform*\libs For example: JDeveloper\mywork\application1\ApplicationController\src\plugins\BacodeScanner\Android\libs	Copy any additional, dependent libraries to this location. This is an optional folder.
Resources	*application workspace directory*\ApplicationController\src*plugins**Plugin Name**Platform*\res For example: JDeveloper\mywork\application1\ApplicationController\src\plugins\BacodeScanner\Android\res	Copy additional plugin resources folder. This is an optional folder.
Assets	*application workspace directory*\ApplicationController\src*plugins**Plugin Name**Platform*\assets For example: JDeveloper\mywork\application1\ApplicationController\src\plugins\BarcodeScanner\Android\assets	This folder contains plugin assets. This Android-only artifact is optional.
JavaScript Files	*application workspace directory*\ViewController\public_html\plugins*Plugin Name**Platform*\js For example: JDeveloper\mywork\application1\ViewController\public_html\plugins\BarcodeScanner\Android\js	This directory contains the plugin JavaScript files. This folder is required and must contain a JavaScript file.

Figure 4–74 illustrates these locations in the Applications window.

Figure 4–74 The Plugin Artifacts



- For application features authored in MAF AMX, the task flow's managed bean must contain a handler method that uses the `invokeContainerJavaScriptFunction` as follows:

  ```
  AdfmfContainerUtilities.
  invokeContainerJavaScriptFunction(featureid, methodname, new Object[]
                                                          { params... })
  ```

  This method invokes JavaScript. For an example implementation, see the `ManagedBean.java` file in the APIDemo sample application. This sample application is in the `PublicSamples.zip` file at the following location within the JDeveloper installation directory of your development computer:

  `jdev_install``/jdeveloper/jdev/extensions/oracle.maf/Samples`

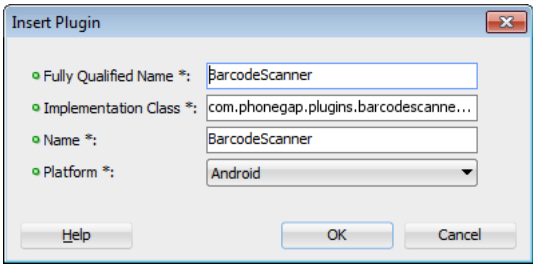
  For more information about the `invokeContainerJavaScriptFunction`, see Section B.2.14, "invokeContainerJavaScriptFunction" and *Oracle Fusion Middleware Java API Reference for Oracle Mobile Application Framework*.

- If you obtain the plugin-related artifacts and the JavaScript files from a FAR, as described in Section 4.15.4, "What You May Need to Know About Integrating Plugins Using FARs," then you must ensure that the plugin has an accompanying JavaScript file. If the FAR consumed by the mobile application does not include the JavaScript file, then you must obtain one, or create one using the FAR developer's instructions. You must also add the FAR to the application as described in Section 4.13.1, "How to Use FAR Content in a MAF Application."

To add an Android plugin:

1. Open the `maf-application.xml` overview editor and choose the Cordova Plugins page.
2. Click **Add**.
3. Complete the Insert Plugin dialog, shown in Figure 4–75.

Figure 4–75 Adding an Android Plugin



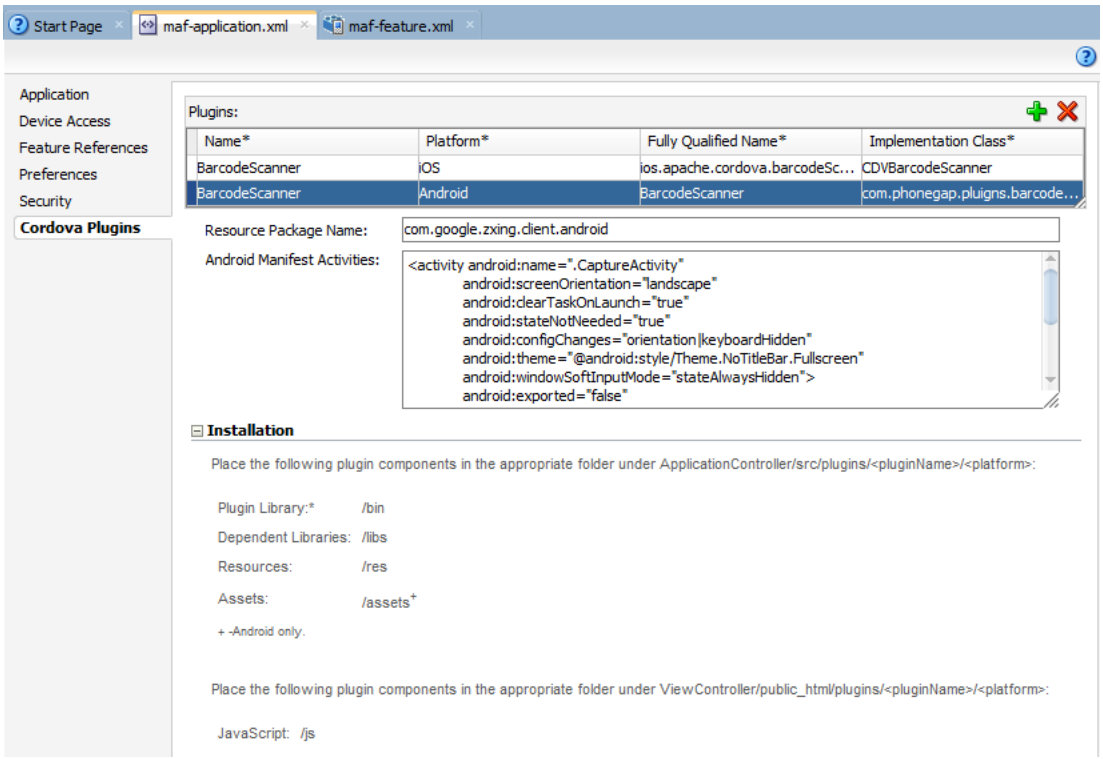
- **Fully Qualified Name**—The fully qualified name of the plugin. This name is provided by the manifest or readme file and maps to the `name` attribute of the plugin element in the `config.xml` file.
- **Implementation Class**—The name of the class that implements the plugin. This name, which is provided by the manifest or readme file, is typically a Java package followed by a class name. It maps to the `value` attribute of the plugin element in the `config.xml` file.
- **Name**—The name of the plugin. This is the name of the folder containing the plugin artifacts as well as the value logged to the deployment when errors are detected.
- **Platform**—Choose **Android**.

4. Click **OK**.

   Tip: You can also access this dialog by dragging a Plugin component from the Cordova Plugins components window onto the editor or into the Structure window.

5. If the plugin requires its own Android resources, enter the Java package that these resources should appear under in the **Resource Package Name** field. Otherwise, leave this field blank. This is an optional value.

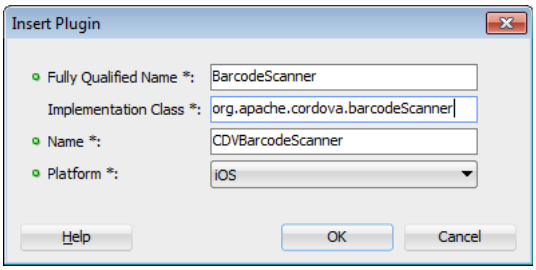
Figure 4–76 Integrating an Android Plugin



To add an iOS plugin:

1. Open the `maf-application.xml` overview editor and choose the Cordova Plugins page.
2. Click **Add**.
3. Complete the Insert Plugin dialog, shown in Figure 4–77.

Figure 4–77 Adding an iOS Plugin



- **Fully Qualified Name**—The fully qualified name of the plugin. This name is provided by the manifest or readme file and maps to the `<key>` element in the `cordova.plist` file.
- **Implementation Class**—The name of the class that implements the plugin. This name is provided by the manifest or readme file and is typically the name of an Objective-C class. It maps to the `<string>` element in the `cordova.plist` file.

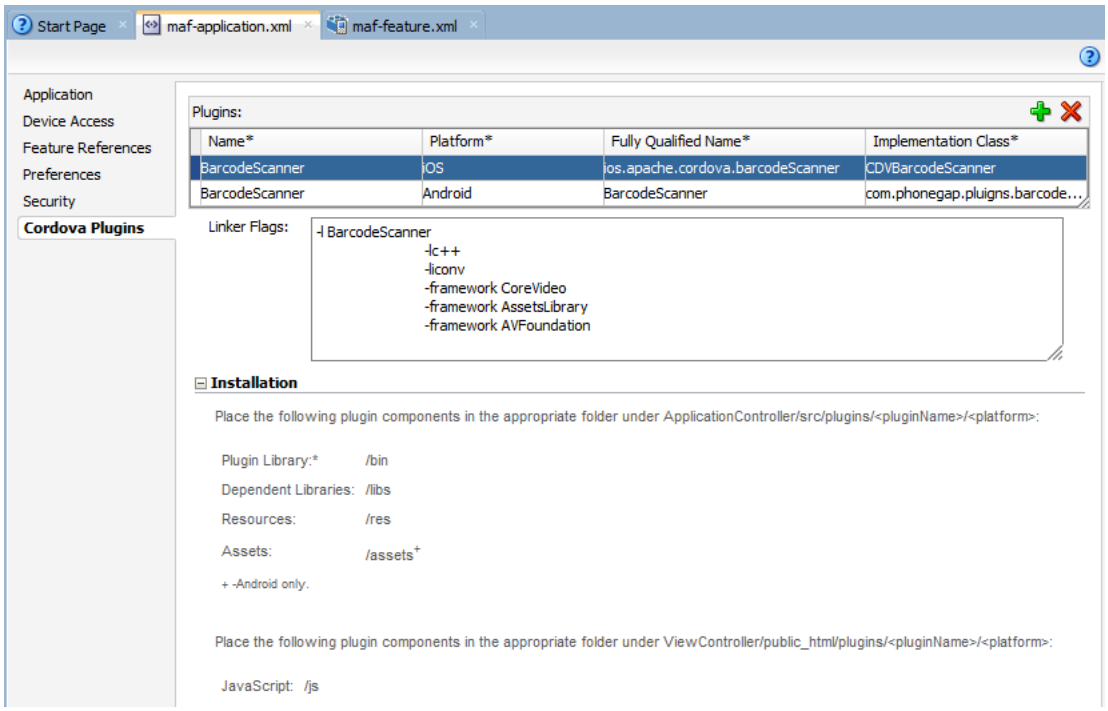
- **Name**—The name of the plugin. This is the name of the folder containing the plugin artifacts as well as the value logged to the deployment when errors are detected.
- **Platform**—Choose **iOS**.

4. Click **OK**.
5. In the **Linker Flags** field, enter any additional linker flags required by the plugin. You must add an option to link to the plugin library, such as `-l BarcodeScanner`. For example:

```
-l BarcodeScanner -lc++ -liconv -framework CoreVideo -framework AssetsLibrary
-framework AVFoundation
```

Consult the readme file to determine if any additional libraries are required.

Figure 4–78 Integrating an iOS Plugin



To enable MAF AMX content to reference the plugin's JavaScript file:

1. Open the `maf-feature.xml` overview editor, then choose the application feature that uses the plugin.
2. Click **Content** and then select **MAF AMX**.

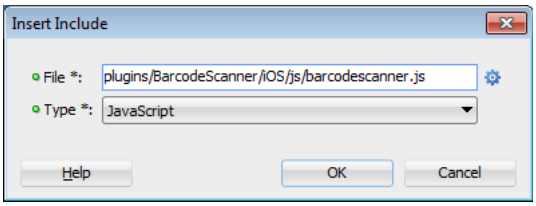
Note: The view controller project must contain a class that invokes JavaScript using the `invokeContainerJavaScriptFunction` in a Java handler as follows:

```
AdfmfContainerUtilities.invokeContainerJavaScriptFunction(

featureid, methodname, new Object[] { params... });
```

---

3. Click **Add** in the Includes table to open the Insert Include dialog.

Figure 4–79 Referencing the Plugin JavaScript File in the View Controller Project



4. Choose **JavaScript**, and then browse to the location of the plugin's JavaScript file, which is located in the view controller project's `public_html` folder. As illustrated in Figure 4–79, the JavaScript file is located within the view controller project at `plugins/`*`plugin name`*`/`*`platform`*`/js/`*`JavaScript file name`*.

To enable a local HTML content to reference the plugin's JavaScript file:

1. Open the `maf-feature.xml` overview editor, then choose the application feature that uses the plugin.
2. Click **Content** and then select **Local HTML**.
3. Reference the JavaScript file using a `<script>` tag in the HTML document, such as `<script type="text/javascript" src="../../../../www/js/barcodescanner.js"></script>` in Example 4–31.

Example 4–31 Referencing the Plugin JavaScript File Using the <script> Tag

```
<!DOCTYPE html>
<html>
  <head>
    <meta name="viewport" content="user-scalable=no,height=device-height,width=device-width" />
    <meta name="apple-mobile-web-app-capable" content="yes" />
    <meta http-equiv="Content-Type" content="text/html; charset=UTF-8"></meta>
    <script type="text/javascript">if (!window.adf) window.adf = {};
                                   adf.wwwPath = "../../../../www/";</script>
    <script type="text/javascript" src="../../../../www/js/base.js"></script>
    <script type="text/javascript" src="../../../../www/js/barcodescanner.js"></script>
    <script type="text/javascript" charset="utf-8">
        function scanBarcode()
        {
          window.plugins.barcodeScanner.scan(
                                          function(result) {
                                           if (result.cancelled)
                                             updateContentNode("the user cancelled the scan");
                                           else
                                           updateContentNode("We got a barcode: " +
                                             result.text);
                                          },
                                          function(error) {
                                             updateContentNode("scanning failed: " + error);
                                          }
                                         )
        }

        function updateContentNode(newContent)
        {
          $("#content").html(newContent);
        }
```

```
    </script>
  </head>
  <body onload="onBodyLoad()">

    <!-- MAIN PAGE -->
    <div data-role="page" id="main" data-url="main.jspx" data-position="fixed">
      <div data-role="header" data-position="fixed">
        <h1>
          Barcode Scanner Test
        </h1>
      </div>
      <div data-role="content" id="content">
        No barcode scanned yet
      </div>
      <div data-role="footer" data-position="fixed">
        <div data-role="navbar">
          <ul>
            <li>
            <a href="javascript:try{scanBarcode();}catch(e){alert(e.description);}"
                data-rel="dialog" data-transition="pop">Scan barcode</a>
            </li>
          </ul>
        </div>
      </div>
    </div>
  </body>
</html>
```

4.15.2 What Happens When You Configure a Plugin

Using the overview editor or the Cordova Plugins components from the Components windows populates the `maf-application.xml` file with a `<adfmf:cordovaPlugins>` element, as illustrated in Figure 4–30. Refer to *Oracle Fusion Middleware Tag Reference for Oracle Mobile Application Framework* for more information on this element and its child elements.

Example 4–32 The <adfmf:cordovaPlugins> Element

```
<adfmf:cordovaPlugins>
    <adfmf:plugin name="BarcodeScanner" platform="iOS"
                  implementationClass="CDVBarcodeScanner"
                  fullyQualifiedName="ios.apache.cordova.barcodeScanner">
      <adfmf:iosPluginInfo>
        <adfmf:linkerFlags>-l BarcodeScanner
                           -lc++
                           -liconv
                           -framework CoreVideo
                           -framework AssetsLibrary
                           -framework AVFoundation</adfmf:linkerFlags>
      </adfmf:iosPluginInfo>
    </adfmf:plugin>
    <adfmf:plugin platform="Android" name="BarcodeScanner"
                  implementationClass="com.phonegap.pluigns.barcodescanner.BarcodeScanner"
                  fullyQualifiedName="BarcodeScanner">
      <adfmf:androidPluginInfo>
        <adfmf:resourcePackageName>com.google.zxing.client.android</adfmf:resourcePackageName>
        <adfmf:androidManifestActivities>&lt;activity android:name=".CaptureActivity"
              android:screenOrientation="landscape"
              android:clearTaskOnLaunch="true"
```

```
            android:stateNotNeeded="true"
            android:configChanges="orientation|keyboardHidden"
            android:theme="@android:style/Theme.NoTitleBar.Fullscreen"
            android:windowSoftInputMode="stateAlwaysHidden"&gt;
            ...
        </adfmf:androidManifestActivities>
      </adfmf:androidPluginInfo>
    </adfmf:plugin>
  </adfmf:cordovaPlugins>
</adfmf:application>
```

4.15.3 How to Add Plugin Preferences

On both the application-level and application feature-level user preferences pages, the Cordova plugin preferences display either at the bottom of a user preference page beneath the preferences defined by the preferences elements described in Chapter 14, "Enabling User Preferences" or as a child preference page that opens from a preference group or from a single item preference list selection.

Before you begin:

Refer to *Preferences and Settings Programming Guide*, which is available through the iOS Developer Library (`http://developer.apple.com/library/ios/navigation/`) for information on the Settings bundle (`Settings.bundle`) and its contents (such as the `Root.plist` file and the `.strings` file).

To merge the Cordova plugin preferences at the bottom of a preference page of an iOS application:

1. Create a resource (`res`) file within the application controller project for the plugin, such as:

   application workspace directory`\ApplicationController\src\plugins\`*plugin name*`\iOS\res`

2. Copy the Settings bundle (`Settings.bundle`) file into the plugin's `res` folder.

To merge the Cordova plugin preferences as a child page in an iOS application:

1. Create a resource (`res`) folder within the application controller project for the plugin, such as:

   application workspace directory`\ApplicationController\src\`*plugins*`\plugin name\iOS\res`

2. Copy the Settings bundle (`Settings.bundle`) file into the plugin's `res` folder.
3. Rename the `Root.plist` file to *`PluginName`*`.Root.plist`, where *`PluginName`* is the name of the plugin. For example, rename this file `BarcodeScanner.Root.plist`.
4. Define a sting ID and localizable value for the title of the child page in the plugin's `.strings` file. This ID must be *`PluginName`*`.page.title` where *`PluginName`* is the name of the plugin. For example:

   `"`*`PluginName`*`.page.title" = "`*`Some Localized Page Title`*`";`

To merge the Cordova plugin preferences at the bottom of a preference page of an Android application:

1. Create a resource (`res`) folder for the plugin in the application controller project, such as:

   application workspace directory`\ApplicationController\src\`*plugins*`\`*plugin name*`\Android\res`

2. Copy the resources that contain the `preferences.xml` file into the plugin's `res` folder. For more information the `preferences.xml` file and defining subscreens, see "Defining Preferences in XML" in *Settings* guide, available from the Android Developers website (`http://developer.android.com/guide/topics/ui/settings.html`) or the Android SDK documentation. For information on how the MAF deployment framework converts preferences, see Section C.2, "Converting Preferences for Android."

To merge the Cordova plugin preferences as a child page in an Android application:

1. Copy the resources that contain the `preferences.xml` file into the plugin's `res` folder.
2. Nest the set of preferences (illustrated in Example 4–33) within another `PreferenceScreen` element as illustrated in Example 4–34.

Example 4–33 Preferences

```
<PreferenceScreen xmlns:android="http://schemas.android.com/apk/res/android">
      <PreferenceCategory android:title="@string/preferences_scanning_title">
            <CheckBoxPreference android:key="preferences_decode_1D"
                                android:defaultValue="true"
                                android:title="@string/preferences_decode_1D_title"/>
            ...
       </PreferenceCategory>
        ...

</PreferenceScreen>
```

Example 4–34 illustrates defining an `android:key` attribute to wrap the `PreferenceScreen` element.

Example 4–34 A Set of Preferences Wrapped in a PreferenceScreen Element

```
<PreferenceScreen xmlns:android="http://schemas.android.com/apk/res/android">
  <PreferenceScreen android:key="wrapperScreen" android:title="Barcode Scanner">
      <PreferenceCategory android:title="@string/preferences_scanning_title">
            <CheckBoxPreference android:key="preferences_decode_1D"
                                android:defaultValue="true"
                                android:title="@string/preferences_decode_1D_title"/>
            ...
       </PreferenceCategory>
        ...
  </PreferenceScreen>
</PreferenceScreen>
```

3. If the preference page requires localization, define the string values in the localized `strings.xml` files. For more information on the `strings.xml` files, see the "String Resources" section in *App Resources Guide*, available from the Android Developers website

(http://developer.android.com/guide/topics/resources/index.html) or the Android SDK documentation. For information on how the MAF deployment framework handles the `strings.xml` file, see Section C.2.3, "Strings.xml."

4.15.4 What You May Need to Know About Integrating Plugins Using FARs

Although the components of a mobile application may be created by a single developer, an application may typically be comprised from resources provided by different developers. Adding third-party plugins illustrates the latter case, with a FAR developer first creating and testing an application feature that uses a plugin before deploying the view controller project as a Feature Archive file (FAR). The FAR developer publishes this FAR to an Application Assembler developer and provides a set of instructions (such as a readme file) for integrating the plugin as well as the JavaScript file. The FAR developer may also provide the Application Assembler developer with a ZIP file of the plugin binary library. The Application Assembler then adds a FAR to a mobile application and uses the instructions to integrate the JavaScript file and plugin binary libraries into the mobile application's projects. The mobile application is subsequently tested, deployed as a platform-specific package, and published. Specifically, the collaboration between the FAR developer and the Application Assembler is comprised of the following:

1. The FAR developer uses Xcode or the Android SDK to create the Cordova plugin library (resulting in an `.a` file for iOS or a JAR file for Android). To enable MAF applications to consume this library, the developer performs the following:

   a. Creates a mobile application. The developer includes the plugin binary to various locations within the application controller project and then adds the JavaScript file to the `public_html` directory in the view controller project. For a user interface implemented as MAF AMX, the JavaScript file is referenced in the `maf-feature.xml` file using the Insert Includes dialog, as described in Section 4.10.1, "How to Define the Application Content." For HTML-based user interfaces, reference this file using a JavaScript includes.

      For MAF AMX-authored application features, JavaScript is invoked by including the `invokeContainerJavaScriptFunction` method in a Java handler. For more information, see Section B.2.14, "invokeContainerJavaScriptFunction" and *Oracle Fusion Middleware Java API Reference for Oracle Mobile Application Framework*.

      In an HTML-authored application feature, JavaScript is called directly by referencing the location of the JavaScript file in the `<script>` tag.

   b. Integrates the Cordova plugin using the Cordova Plugins page of the `maf-application.xml` overview editor and its dialogs.

   c. Deploys the application to a device for testing.

   d. Deploys the view controller project as a FAR. This FAR itself may include such artifacts as MAF AMX and HTML pages that reference the Cordova plugins as well as the JavaScript files.

      Note: The FAR may not always include the JavaScript file.

   e. Although not included in the FAR, the FAR developer provides the Application Assembler developer with a set of instructions to integrate the plugin into a mobile application. Because these instructions are specific to both

the development organization and the plugin itself, the means and format through which they are conveyed (such as a metadata file or a readme file), results from agreements between the FAR and Application Assembler developers. Example 4–35 illustrates a portion of the a `README.md` file that describes how to integrate an iOS plugin:

Example 4–35 The README.md File

```
...
## Adding the plugin to your project ##
* Copy the .h, .cpp and .mm files to the Plugins directory in your project.
* Copy the .js file to your www directory and reference it from your html file(s).
* In the `Supporting Files` directory of your project, add a new plugin by editing
 the file `Cordova.plist` and in the `Plugins` dictionary adding the following
 key/value pair:
  * key: `org.apache.cordova.barcodeScanner`
  * value: `CDVBarcodeScanner`
 Add the following libraries to your Xcode project, if not already there:
  * AVFoundation.framework
  * AssetsLibrary.framework
  * CoreVideo.framework
  * libiconv.dylib
...
```

2. The Application Assembler adds the FAR mobile application, as described in Section 4.13.1, "How to Use FAR Content in a MAF Application."
3. Unless the FAR developer provides a ZIP file of the plugin binary, the Application Assembler must build the plugin using the platform-specific SDKs. The plugin is packaged in the platform-specific package (the `.a` file for iOS or a JAR file for Android).
4. The Application Assembler developer adds the plugin binary libraries to the application controller project and the JavaScript file to the `public_html` directory of the view controller project.
5. Using the Cordova Plugins page of the `maf-application.xml` overview editor and its dialogs, the Application Assembler developer updates the platform-specific XML files (that is, the `cordova.plist` file for iOS and the `config.xml` file for Android) as specified in the instructions. The MAF deployment uses this configuration to incorporate the plugins into the mobile application.

Part IV

Creating the MAF AMX Application Feature

Describes how to create MAF AMX content for a MAF application, including creating task flows, application pages, as well as using UI components, data controls, web services, and the local database.

Part IV contains the following chapters:

5 Creating MAF AMX Pages

This chapter describes how to create the MAF Application Mobile XML (MAF AMX) application feature.

This chapter includes the following sections:

- Section 5.1, "Introduction to the MAF AMX Application Feature"
- Section 5.2, "Creating Task Flows"
- Section 5.3, "Creating Views"

5.1 Introduction to the MAF AMX Application Feature

MAF AMX is a subframework within Mobile Application Framework (MAF) that provides a set of UI components that enable you to create an application feature whose behavior is identical on all supported platforms. MAF AMX allows you to use UI components declaratively by dragging them onto a page editor. A typical MAF AMX application feature includes several interconnected pages that can be navigated through various paths.

> **Note:** When developing interfaces for mobile devices, always be aware of the fact that the screen space is very limited. In addition, touchscreen support is not available on some mobile devices.

For more information, see the following:

- Section 3.2.4, "Creating an Application Workspace for a MAF AMX Application"
- Chapter 3, "Getting Started with Mobile Application Development"
- Chapter 6, "Creating the MAF AMX User Interface"
- Chapter 7, "Using Bindings and Creating Data Controls"

5.2 Creating Task Flows

Task flows allow you to define the navigation between MAF AMX pages. Using your application workspace in JDeveloper (see Section 3.2, "Creating an Application Workspace"), you can start creating the user interface for your MAF AMX application feature by designing task flows. MAF AMX uses navigation cases and rules to define the task flow. These definitions are stored in a file with the default name of `ViewController-task-flow.xml` (see Section 5.2.3, "What You May Need to Know About the ViewController-task-flow.xml File").

A MAF sample application called Navigation (located in the `PublicSamples.zip` file within the *`jdev_install`*`/jdeveloper/jdev/extensions/oracle.maf/Samples` directory on your development computer) demonstrates how to use various navigation techniques, such as circular navigation, routers, and so on.

MAF enables you to create MAF AMX application features that have both bounded and unbounded task flows. As described in Section 5.2.12, "What You May Need to Know About Bounded and Unbounded Task Flows," a bounded task flow is also known as a task flow definition and represents the reusable portion of an application. In MAF, bounded task flows have a single entry point and no exit points. They have their own collections of activities and control-flow rules, as well as their own memory scope and managed-bean life span. Other characteristics of bounded task flows include accepting input parameters (see Section 5.2.12.3.1, "Passing Parameters to a Bounded Task Flow") and generating return values (see Section 5.2.12.3.2, "Configuring a Return Value from a Bounded Task Flow").

You use the MAF AMX Task Flow Designer to create bounded task flows for your application feature. Like the overview editor for task flows, this tool includes a diagrammer (see Section 5.2.4, "What You May Need to Know About the MAF Task Flow Diagrammer") in which you build the task flow by dragging and dropping activities and control flows (see Section 5.2.2, "What You May Need to Know About Task Flow Activities and Control Flows") from the Components window. You then define these activities and the transitions between them using the Properties window.

Unless a task flow has already been created, MAF automatically generates a default unbounded task flow (`adfc-mobile-config.xml` file) when a new MAF AMX page is created.

5.2.1 How to Create a Task Flow

A task flow is composed of the task flow itself and a number of activities with control flow rules between those activities (see Section 5.2.2, "What You May Need to Know About Task Flow Activities and Control Flows"). Typically, the majority of the activities are view activities which represent different pages in the flow. When a method or operation needs to be called (for example, before a page is rendered), you use a method call activity with a control flow case from that activity to the appropriate next activity. When you want to call another task flow, you use a task flow call activity. If the flow requires branching, you use a router activity. At the end of a bounded task flow, you use a return activity which allows the flow to exit and control is sent back to the flow that called this bounded task flow.

You use the navigation diagrammer to declaratively create a bounded task flow for your MAF AMX application feature. When you use the diagrammer, JDeveloper creates the XML metadata needed for navigation to work in your MAF AMX application feature in the `ViewController-task-flow.xml` file (default).

Before you begin:

To design a task flow, the MAF application must include a View Controller project file (see Chapter 3, "Getting Started with Mobile Application Development").

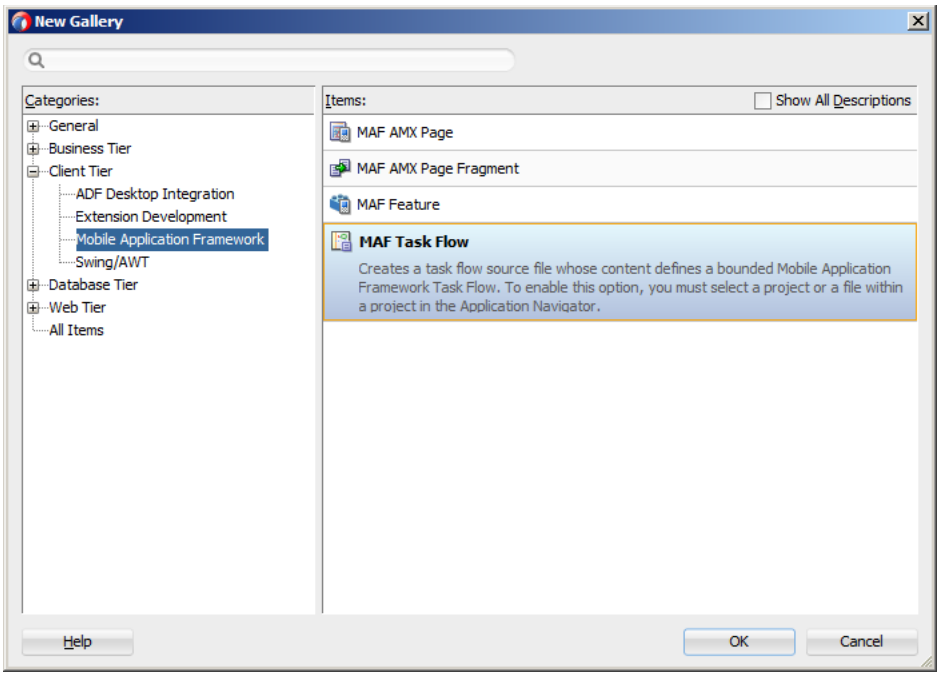
There are two ways to create a task flow in MAF:

- You can create a bounded task flow from the `maf-feature.xml` file. For more information, see Section 4.10.1, "How to Define the Application Content."
- You can use the New Gallery in JDeveloper. For more information, see "To create a task flow from the New Gallery:"

To create a task flow from the New Gallery:

1. From the top-level menu in JDeveloper, click **File**, and then select **New > From Gallery**.
2. In the **New Gallery**, expand the **Client Tier** node, select **Mobile Application Framework,** and then **MAF Task Flow** (see Figure 5–1). Click **OK**.

Figure 5–1 Creating New MAF Task Flow



3. In the **Create MAF Task Flow** dialog (see Figure 5–2), specify the file name and location for your new task flow, and then click **OK** to open the new `<Name>-flow.xml` file in the navigation diagrammer that Figure 5–3 shows.

> **Note:** Task flows should be created within the HTML root of the View Controller project of your MAF application.

> **Note:** JDeveloper increments the number of the task flow according to the number of bounded task flows that already exist in the same pattern.

Figure 5–2 Create MAF Task Flow Dialog

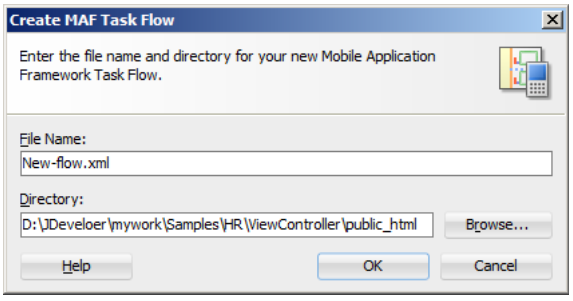
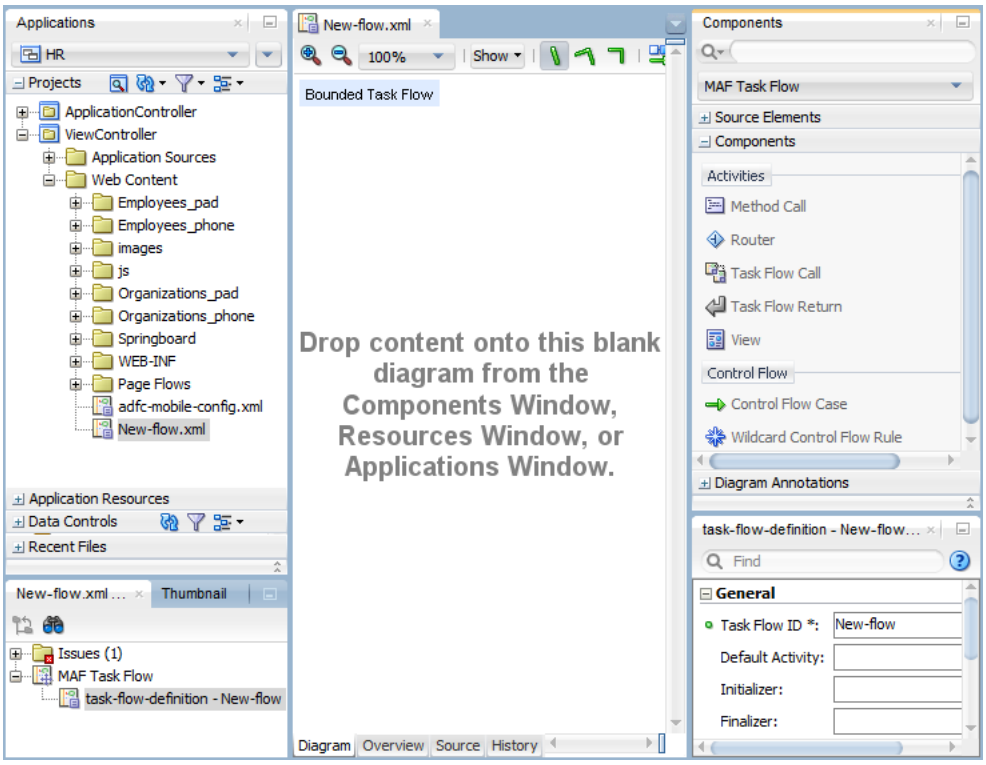


Figure 5–3 New Blank Task Flow

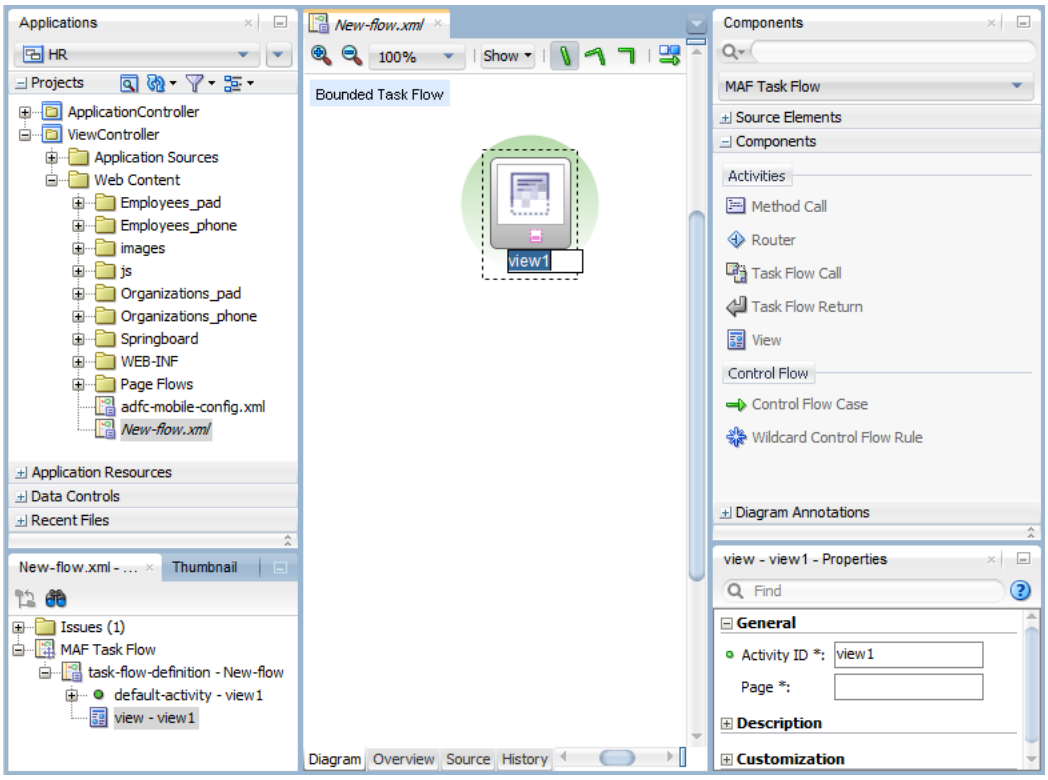


4. In the **Components** window, select **MAF Task Flow**.

   Tip: If the Components window is not displayed, choose **Window > Components** from the main menu. By default, the Components window is displayed in the upper right-hand corner of JDeveloper.

5. From **MAF Task Flow > Components**, select the component you wish to use and drag it onto the diagram. JDeveloper redraws the diagram with the newly added component, as Figure 5–4 shows.

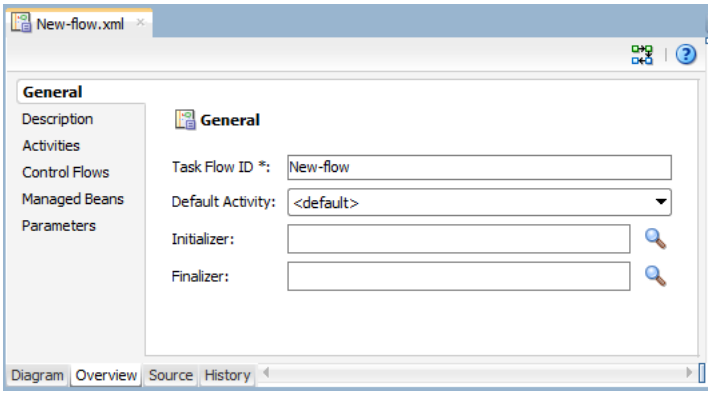
Figure 5–4 Adding Components to Task Flow



For information on how to add activities to a task flow, see Section 5.2.5, "How to Add and Use Task Flow Activities."

For information on how to add control flows, see Section 5.2.6, "How to Define Control Flows."

You can also open the **Overview** tab and use the overview editor to create navigation rules and navigation cases. Press F1 for details on using the overview editor to create navigation.



Additionally, you can manually add elements to the task flow file by directly editing the page in the Source editor. To open the file in the Source editor, click the **Source** tab.

Note: When manually editing the task flow file, keep in mind that all the document file names referring to MAF AMX pages, JavaScript files, and CSS files are case-sensitive.

If special characters (such as an underscore, for example) are used in a file name, you should consult the mobile device specification to verify whether or not the usage of this character is supported.

Once the navigation for your MAF AMX application feature is defined, you can create the pages and add the components that will execute the navigation. For more information about using navigation components on a page, see Section 5.2.6, "How to Define Control Flows."

After you define the task flow for the MAF AMX application feature, you can double-click a view file to access the MAF AMX view. For more information, see Section 5.3, "Creating Views."

5.2.2 What You May Need to Know About Task Flow Activities and Control Flows

A task flow consists of activities and control flow cases that define the transitions between activities.

The MAF Task Flow designer supports activities listed in Table 5–1.

Table 5–1 Task Flow Activities

Activity	Description
View	Displays a MAF AMX page. For more information, see Section 5.2.5.1, "Adding View Activities."
Method Call	Invokes a method (typically a method on a managed bean). You can place a method call activity anywhere in the control flow of a MAF AMX application feature to invoke logic based on control flow rules. For additional information, see Section 5.2.5.3, "Adding Method Call Activities." You can also specify parameters that you pass into a method call that is included in a task flow. These include standard parameters for a method call action in a MAF AMX task flow. When you use the designer to generate a method, it adds the required arguments and type. At runtime, you can define parameters for a method call in a task flow and pass parameters into the method call itself for its usage. For more information, see Part 5.2.5, "How to Add and Use Task Flow Activities."
Router	Evaluates an Expression Language (EL) expression and returns an outcome based on the value of the expression. These outcomes can then be used to route control to other activities in the task flow. For more information, see Section 5.2.5.2, "Adding Router Activities."

Table 5–1 (Cont.) Task Flow Activities

Activity	Description
Task Flow Call	Calls a bounded task flow from either an unbounded or bounded task flow. While a task flow call activity allows you to call a bounded task flow located within the same MAF AMX application feature, you can also call a bounded task flow from a different MAF AMX application feature or from a Feature Archive file (FAR) that has been added to a library (see Section 4.13, "Working with Feature Archive Files"). The task flow call activity supports task flow input parameters and return values. For more information, see Section 5.2.5.4, "Adding Task Flow Call Activities."
Task Flow Return	Identifies the point in an application's control flow where a bounded task flow completes and sends control flow back to the caller. You can use a task flow return only within a bounded task flow. For more information, see Section 5.2.5.5, "Adding Task Flow Return Activities."

The MAF Task Flow designer supports control flows listed in Table 5–2.

Table 5–2 Control Flows

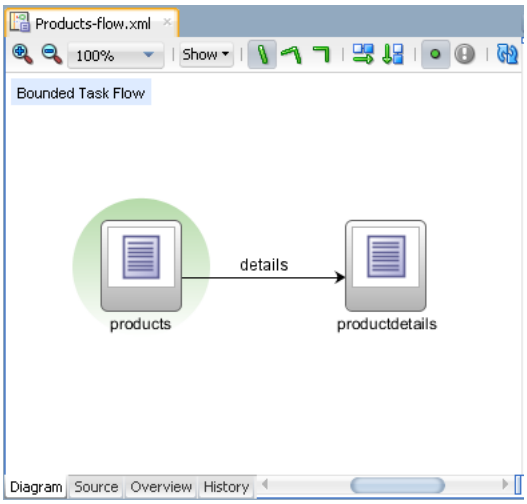
Control Flow	Description
Control Flow Case	Identifies how control passes from one activity to the next in the MAF AMX application feature. For more information, see Section 5.2.6.1, "Defining a Control Flow Case."
Wildcard Control Flow Rule	Represents a control flow case that can originate from any activities whose IDs match a wildcard expression.For more information, see Section 5.2.6.2, "Adding a Wildcard Control Flow Rule."

5.2.3 What You May Need to Know About the ViewController-task-flow.xml File

The `ViewController-task-flow.xml` file enables you to design the interactions between views (MAF AMX pages) by dragging and dropping MAF AMX task flow components from the Components window onto the diagrammer.

Figure 5–5 shows a sample task flow file called `Products-flow.xml`. In this file, the control flow is directed from the `products` page to the `productdetails` page. To return to the `products` page from the `productdetails` page, the built-in `__back` navigation is used (see Section 5.2.7, "What You May Need to Know About MAF Support for Back Navigation").

Figure 5–5 Task Flow File



5.2.4 What You May Need to Know About the MAF Task Flow Diagrammer

As illustrated in Figure 5–5, the task flow diagram and Components window display automatically after you create a task flow using the MAF Task Flow Creation utility. The task flow diagram is a visual editor onto which you can drag and drop activities and task flows from the Components window or from the Applications window. For more information, see Section 5.2.5, "How to Add and Use Task Flow Activities."

5.2.5 How to Add and Use Task Flow Activities

You use the task flow diagrammer to drag and drop activities, views, and control flows.

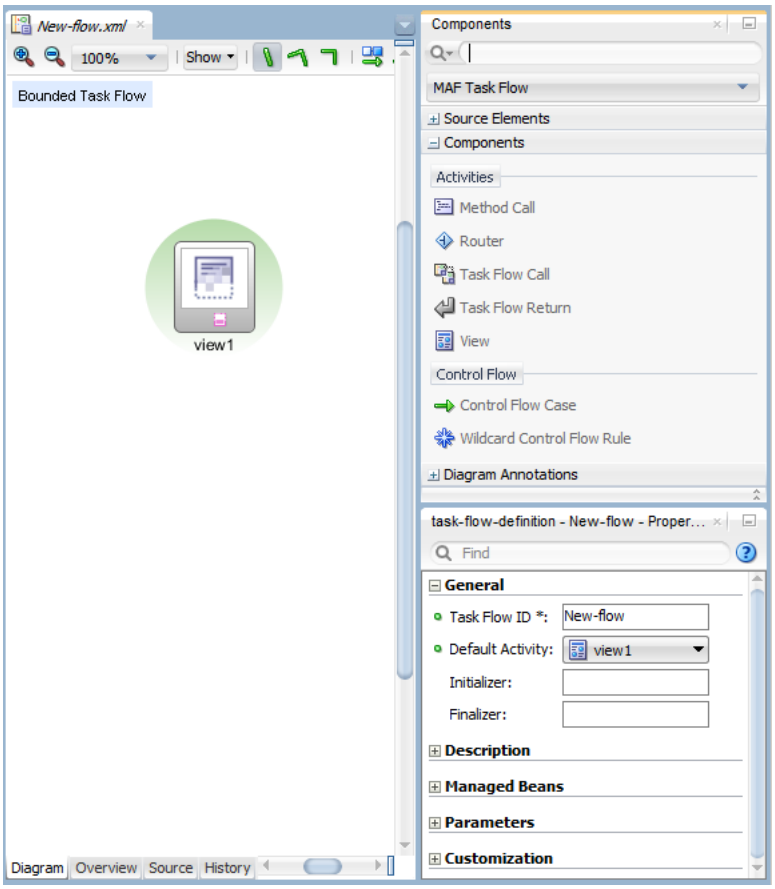
Before you begin:

You must select **MAF Task Flow** from the Components window, as Figure 5–6 shows.

To add an activity to a MAF task flow:

1. In the Applications window, double-click a task flow source file (such as `ViewController-task-flow.xml`) to display the task flow diagram and the Components window, as Figure 5–6 shows. The diagrammer displays the task flow editor. The Components window automatically displays the components available for a MAF task flow.
2. Drag an activity from the Components window onto the diagram. If you drag a view activity onto the diagram and double-click on it, you can invoke the Create MAF AMX Page wizard (see Section 5.2.5.1, "Adding View Activities").

Figure 5–6 The Diagrammer for the Task Flow Editor



Note: There is a default activity that is associated with each bounded task flow.

5.2.5.1 Adding View Activities

One of the primary types of task flow activity is the view activity which displays a MAF AMX page.

XML metadata in the source file of the task flow associates a view activity with a physical MAF AMX page. An `id` attribute identifies the view activity.

You can configure view activities in your task flow to pass control to each other at runtime. For example, to pass control from one view activity (view activity A) to a second view activity (view activity B), you could configure a command component, such as a Button or a Link on the page associated with view activity A. To do so, you set the command component's Action attribute to the control flow case `from-outcome` that corresponds to the task flow activity that you want to invoke (for example, view activity B). At runtime, the end user initiates the control flow case by invoking the command component. It is possible to navigate from a view activity to another activity using either a constant or dynamic value on the Action attribute of the UI component:

- A constant value of the component's Action attribute is an action outcome that always triggers the same control flow case. When an end user clicks the component, the activity specified in the control flow case is performed. There are no alternative control flows.

- A dynamic value of the component's Action attribute is bound to a managed bean or a method. The value returned by the method binding determines the next control flow case to invoke. For example, a method might verify user input on a page and return one value if the input is valid and another value if the input is invalid. Each of these different action values trigger different navigation cases, causing the application to navigate to one of two possible target pages.

For more information, see Section 5.2.9, "How to Specify Action Outcomes Using UI Components."

You can also write an EL expression that must evaluate to `true` before control passes to the target view activity. You write the EL expression as a value for the `<if>` child element of the control flow case in the task flow.

Example 5–1 and Example 5–2 demonstrate what happens when you pass control between View activities:

Example 5–1 shows a control flow case defined in the XML source file for a bounded or unbounded task flow.

Example 5–1 Control Flow Case Defined in XML Source File

```
<control-flow-rule>
   <from-activity-id>Start</from-activity-id>
      <control-flow-case>
         <from-outcome>toOffices</from-outcome>
         <to-activity-id>WesternOffices</to-activity-id>
      </control-flow-case>
</control-flow-rule>
```

As Example 5–2 shows, a Button on a MAF AMX page associated with the Start view activity specifies `toOffices` as the `action` attribute. When the end user clicks the button, control flow passes to the `WesternOffices` activity specified as the `to-activity-id` in the control flow metadata.

Example 5–2 Static Navigation Button Defined in a View Activity

```
<amx:commandButton text="Go" id="b1" action="toOffices">
```

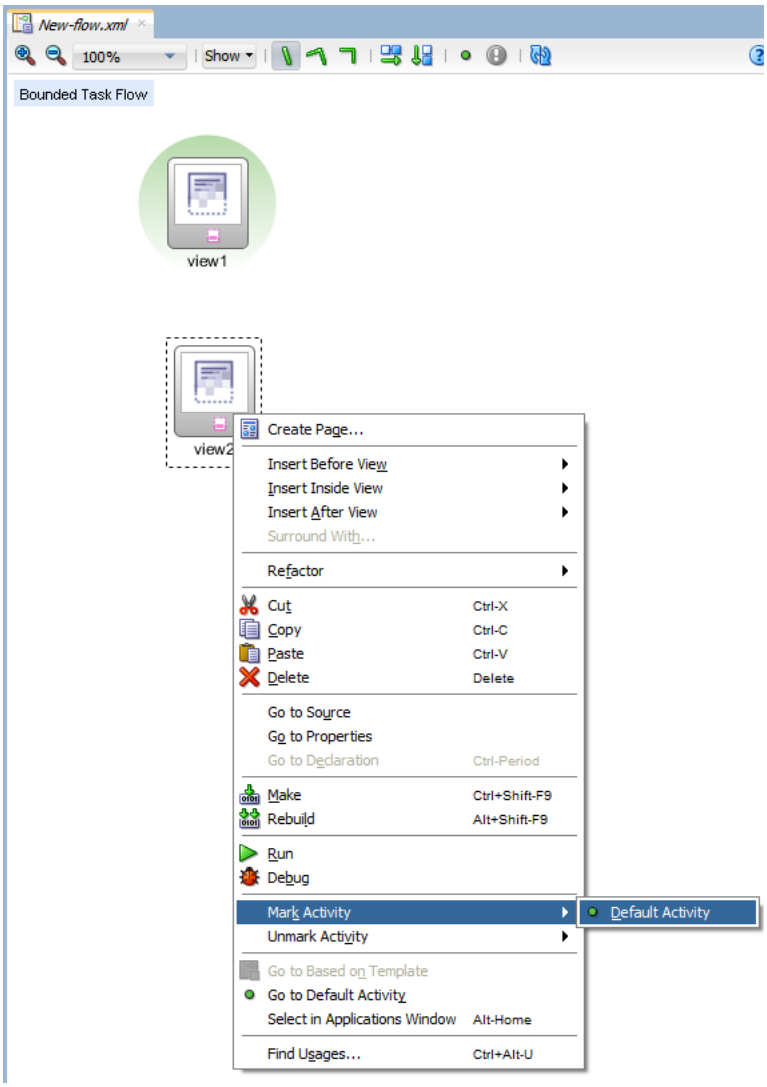
For more information, see the following:

- Section 5.2.5.1, "Adding View Activities"
- Section 5.3.1.2, "Creating MAF AMX Pages"

As previously stated, the view activity is associated in metadata with an actual MAF AMX page which it displays when added to a task flow. You add a view activity by dragging and dropping it from the Components window. You can create an actual MAF AMX page by double-clicking the View activity in the Diagram window and then define characteristics for the page through the displayed dialog (see Figure 5–29, "Create MAF AMX Page Dialog"). You can also create a View activity by dragging and dropping a MAF AMX file in the Applications window onto the Overview editor's Diagram tab.

If you are creating a bounded task flow, you may want to designate a specific activity as the default activity (see Section 5.2.12, "What You May Need to Know About Bounded and Unbounded Task Flows"). This allows the specific activity to execute first whenever the bounded task flow runs. By default, JDeveloper makes the first activity you add to the task flow the default. To change to a different activity, right-click the appropriate activity in the Diagram window and choose **Mark Activity > Default Activity** (see Figure 5–7).

Figure 5–7 Defining Default Activity



5.2.5.2 Adding Router Activities

Use a router activity to route control to activities based on the runtime evaluation of EL expressions.

Each control flow corresponds to a different router case. Each router case uses the following elements to choose the activity to which control is next routed:

- `expression`: an EL expression that evaluates to `true` or `false` at runtime.

  The router activity returns the outcome that corresponds to the EL expression that returns `true`.

- `outcome`: a value returned by the router activity if the EL expression evaluates to `true`.

  If the router case `outcome` matches a `from-outcome` on a control flow case, control passes to the activity that the control flow case points to. If none of the cases for the router activity evaluate to `true`, or if no router activity cases are specified, the `outcome` specified in the router Default Outcome field (if any) is used.

Consider using a router activity if your routing condition can be expressed in an EL expression: the router activity allows you to show more information about the condition on the task flow.

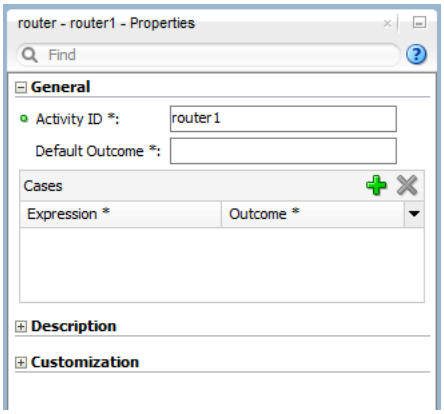
When you drag a Router activity onto the diagram, you can use the Properties window to create an expression whose evaluation determines which control flow rule to follow. Using the Properties window, you configure the **Activity ID** and **Default Outcome** properties of the router activity and add router cases to the router activity.

When defining the Activity ID attribute, write a value that identifies the router activity in the task flow's source file.

When defining the Default Outcome attribute, specify an activity that the router activity passes control to if no control flow cases evaluate to true or if no control flow case is specified.

For each router case that you add, specify values by clicking Add (+) in the **Cases** section that Figure 5–13 shows.

Figure 5–8 Configuring Router Activity



- **Expression**: An EL expression that evaluates to `true` or `false` at runtime.

  For example, to reference the value in an input text field of a view activity, write an EL expression similar to the following:

  ```
  #{pageFlowScope.value=='view2'}
  ```

  If this EL expression returns `true`, the router activity invokes the outcome that you specify in the Outcome field.

- **Outcome**: The outcome the router activity invokes if the EL expression specified by Expression returns `true`.

  Create a control flow case or a wildcard control flow rule for each outcome in the diagram of your task flow. For example, for each outcome in a control flow case, ensure that there is a corresponding `from-outcome`.

When you configure the control flow using a router activity, JDeveloper writes values to the source file of the task flow based on the values that you specify for the properties of the router activity.

5.2.5.3 Adding Method Call Activities

When you drag a Method Call activity onto the diagram, you can use the Properties window to configure the method to call.

Use a method call activity to call a custom or built-in method that invokes the MAF AMX application feature logic from anywhere within the application feature's control flow. You can specify methods to perform tasks such as initialization before displaying a page, cleanup after exiting a page, exception handling, and so on.

You can set an outcome for the method that specifies a control flow case to pass control to after the method finishes. You can specify the outcome as one of the following:

- `fixed-outcome`: upon successful completion, the method always returns this single outcome, for example, `success`. If the method does not complete successfully, an outcome is not returned. If the method type is void, you must specify a `fixed-outcome` and cannot specify `to-string`.

  You define this outcome by setting the **Fixed Outcome** field in the Properties window (see Figure 5–9).

- `to-string`: if specified as `true`, the outcome is based on calling the `toString` method on the Java object returned by the method. For example, if the `toString` method returns `editBasicInfo`, navigation goes to a control flow case named `editBasicInfo`.

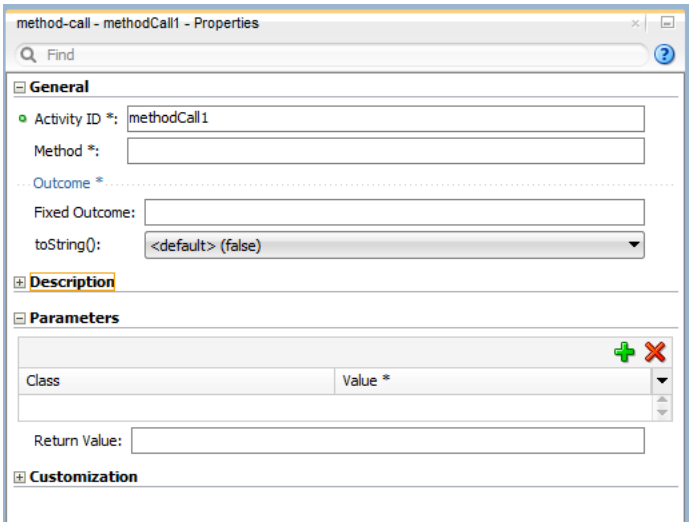
  You define this outcome by setting the **toString()** field in the Properties window (see Figure 5–9).

You can associate the method call activity with an existing method by dropping a data control operation from the Data Controls window directly onto the method call activity in the task flow diagram. You can also drag methods and operations directly to the task flow diagram: a new method call activity is created automatically when you do so. You can specify an EL expression and other options for the method.

You configure the method call by modifying its activity identifier in the **Activity ID** field if you want to change the default value. If you enter a new value, the new value appears under the method call activity in the diagram.

In the **Method** field, enter an EL expression that identifies the method to call. Note that the bindings variable in the EL expression references a binding from the current binding container. In order to specify the bindings variable, you must specify a binding container definition or page definition. For more information, see Section 5.3.2.4.5, "What You May Need to Know About Generated Drag and Drop Artifacts."

Figure 5–9 Configuring Method Call Activity



You can also use the Expression Builder to build the EL expression for the method:

- Choose Method Expression Builder from the Property Editor for the Method field.
- In the Expression Builder dialog, navigate to the method that you want to invoke and select it.

  If the method call activity is to invoke a managed bean method, double-click the method call activity in the diagram. This invokes a dialog where you can specify the managed bean method you want to invoke.

You can specify parameters and return values for a method by using the **Parameters** section of the Properties window (see Figure 5–9). If parameters have not already been created by associating the method call activity to an existing method, add the parameters by clicking Add (+) and setting the following:

- **Class**: enter the parameter class. For example, `java.lang.Double`.
- **Value**: enter an EL expression that retrieves the value of the parameter. For example:

  ```
  #{pageFlowScope.shoppingCart.totalPurchasePrice}
  ```

- **Return Value**: enter an EL expression that identifies where to store the method return value. For example:

  ```
  #{pageFlowScope.Return}
  ```

5.2.5.4 Adding Task Flow Call Activities

You can use a task flow call activity to call a bounded task flow from either the unbounded task flow (see Section 5.2.12.1, "Unbounded Task Flows") or a bounded task flow (see Section 5.2.12.2, "Bounded Task Flows"). This activity allows you to call a bounded task flow located within the same or a different MAF AMX application feature.

The called bounded task flow executes its default activity first. There is no limit to the number of bounded task flows that can be called. For example, a called bounded task flow can call another bounded task flow, which can call another, and so on resulting in the creation of chained task flows where each task flow is a link in a chain of tasks.

To pass parameters into a bounded task flow, you must specify input parameter values on the task flow call activity. These values must correspond to the input parameter definitions on the called bounded task flow. For more information, see Section 5.2.5.4.2, "Specifying Input Parameters on a Task Flow Call Activity."

Note: The value on the task flow call activity input parameter specifies the location within the calling task flow from which the value is to be retrieved.

The value on the input parameter definition for the called task flow specifies where the value is to be stored within the called bounded task flow once it is passed.

Note: When a bounded task flow is associated with a task flow call activity, input parameters are automatically inserted on the task flow call activity based on the input parameter definitions set on the bounded task flow. Therefore, you only need to assign values to the task flow call activity input parameters.

By default, all objects are passed by reference. Primitive types (for example, `int`, `long`, or `boolean`) are always passed by value.

The technique for passing return values out of the bounded task flow to the caller is similar to the way that input parameters are passed. For more information, see Section 5.2.12.3.2, "Configuring a Return Value from a Bounded Task Flow."

To use a task flow call activity:

1. Call a bounded task flow using a task flow call activity (see Section 5.2.5.4.1, "Calling a Bounded Task Flow Using a Task Flow Call Activity")
2. Specify input parameters on a task flow call activity if you want to pass parameters into the bounded task flow (see Section 5.2.5.4.2, "Specifying Input Parameters on a Task Flow Call Activity").

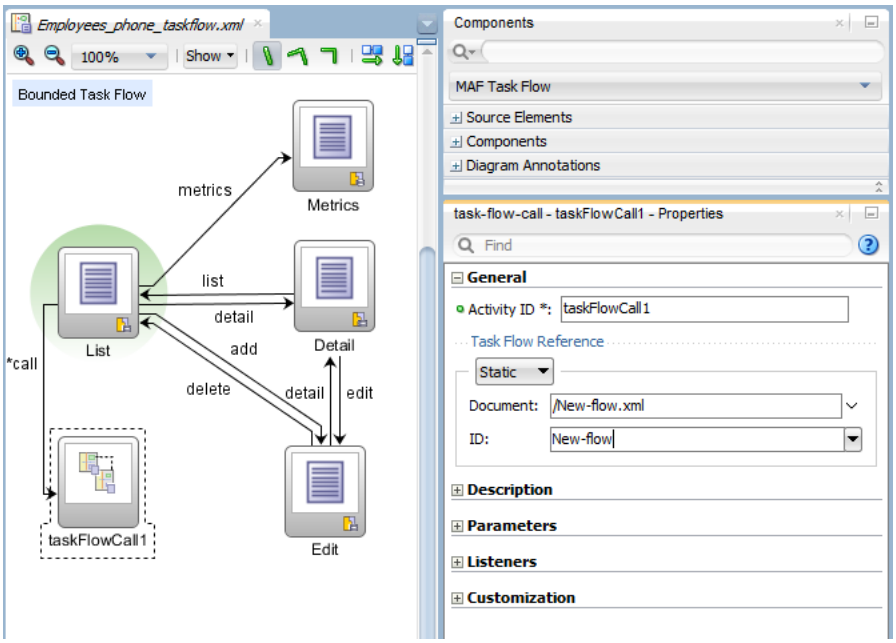
5.2.5.4.1 Calling a Bounded Task Flow Using a Task Flow Call Activity

Add a task flow call activity to the calling bounded or unbounded task flow to call a bounded task flow.

To call a bounded task flow:

1. Open a bounded task flow file in the Diagram view.
2. From the Components window, select **Components > Activities**.
3. Drag and drop a Task Flow Call activity onto the diagram.
4. Choose one of the following options to identify the called task flow:
   - Double-click the newly-dropped task flow call activity to open the Create MAF Task Flow dialog (see Figure 5–2, "Create MAF Task Flow Dialog") where you define settings for a new bounded task flow.
   - Drag an existing bounded task flow from the Applications window and drop it on the task flow call activity.
   - If you know the name of the bounded task flow that you want to invoke, perform the following steps:
     a. In the Diagram view, select the Task Flow Call activity.
     b. In the Properties window, expand the General section, and select **Static** from the **Task Flow Reference** list.
     c. In the **Document** field, enter the name of the source file for the bounded task flow to call.
     d. In the **ID** field, enter the bounded task flow ID contained in the XML source file for the called bounded task flow (see Figure 5–10).

Figure 5–10 Task Flow Call Activity That Invokes a Bounded Task Flow



- If you do not know the name of the bounded task flow to invoke and it is dependent on an end user selection at runtime, perform the following steps:
  - **a.** In the Diagram view, select the Task Flow Call activity.
  - **b.** In the Properties window, expand the General section, and select **Dynamic** from the **Task Flow Reference** list.
  - **c.** Use the Expression Builder to set the value of the **Dynamic Task Flow Reference** property field: write an EL expression that identifies the ID of the bounded task flow to invoke at runtime.

5.2.5.4.2 Specifying Input Parameters on a Task Flow Call Activity The suggested method for mapping parameters between a task flow call activity and its called bounded task flow is to first specify input parameter definitions for the called bounded task flow. Then you can drag the bounded task flow from the Applications window and drop it on the task flow call activity. The task flow call activity input parameters are created automatically based on the bounded task flow's input parameter definition. For more information, see Section 5.2.12.3.1, "Passing Parameters to a Bounded Task Flow."

You can, of course, first specify input parameters on the task flow call activity. Even if you have defined them first, they will automatically be replaced based on the input parameter definitions of the called bounded task flow, once it is associated with the task flow call activity.

If you have not yet created the called bounded task flow, you may still find it useful to specify input parameters on the task flow call activity. Doing so at this point allows you to identify any input parameters you expect the task flow call activity to eventually map when calling a bounded task flow.

To specify input parameters:

1. Open a task flow file in the Diagram view and select a Task Flow Call activity.
2. In the Properties window, expand the Parameters section, and click Add (+) to specify a new input parameter in the Input Parameters list as follows:

- **Name**: enter a name to identify the input parameter.
- **Value**: enter an EL expression that identifies the parameter value. The EL expression identifies the location within the calling task flow from which the parameter value is to be retrieved. For example, enter an EL expression similar to the following:

  ```
  #{pageFlowScope.callingTaskflowParm}
  ```

  By default, all objects are passed by reference. Primitive types (for example, `int`, `long`, or `boolean`) are always passed by value.

3. After you have specified an input parameter, you can specify a corresponding input parameter definition for the called bounded task flow. For more information, see Section 5.2.12.3.1, "Passing Parameters to a Bounded Task Flow."

5.2.5.5 Adding Task Flow Return Activities

A task flow return activity identifies the point in a MAF AMX application feature's control flow where a bounded task flow completes and sends control flow back to the caller. You can use a task flow return activity only within a bounded task flow.

A gray circle around a task flow return activity icon indicates that the activity is an exit point for a bounded task flow. A bounded task flow can have zero or more task flow return activities.

Each task flow return activity specifies an `outcome` that it returns to the calling task flow.

The `outcome` returned to an invoking task flow depends on the end user action. You can configure control flow cases in the invoking task flow to determine the next action by the invoking task flow. Set the **From Outcome** property of a control flow case to the value returned by the task flow return activity's `outcome` to invoke an action based on that outcome. This determines control flow upon return from the called task flow.

To add a task flow return activity:

1. Open a bounded task flow file in the Diagram view.
2. From the Components window, select **Components > Activities**.
3. Drag and drop a Task Flow Return activity onto the diagram.
4. In the Properties window (see Figure 5–11), expand the General section and enter an outcome in the **Name** field.

   The task flow return activity returns this outcome to the calling task flow when the current bounded task flow exits. You can specify only one outcome per task flow return activity. The calling task flow should define control flow rules to handle control flow upon return. For more information, see Section 5.2.6, "How to Define Control Flows."

5. Expand the Behavior section and choose one of the options in the Reentry list.

   If you specify **reentry-not-allowed** on a bounded task flow, an end user can still click the back button on the mobile device and return to a page within the bounded task flow. However, if the end user does anything on the page such as activating a button, an exception (for example, `InvalidTaskFlowReentry`) is thrown indicating the bounded task flow was reentered improperly.

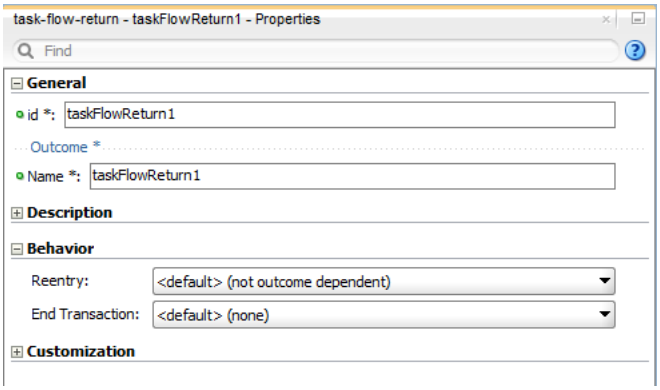
6. From the End Transaction dropdown list, choose one of the following options:

   - **commit**: select to commit the existing transaction to the database.

- **rollback**: select to roll back the transaction to what it was on entry of the called task flow. This has the same effect as canceling the transaction, since it rolls back a new transaction to its initial state when it was started on entry of the bounded task flow.

  If you do not specify commit or rollback, the transaction is left open to be closed by the calling bounded task flow.

Figure 5–11 Configuring Task Flow Return Activity



5.2.5.6 Using Task Flow Activities with Page Definition Files

Page definition files define the binding objects that populate data at runtime. They are typically used in a MAF AMX application feature to bind page UI components to data controls. The following task flow activities can also use page definition files to bind to data controls:

- Method call: You can drag and drop a data control operation from the Data Controls window onto a task flow to create a method call activity or onto an existing method call activity. In both cases, the method call activity binds to the data control operation.
- Router: associating a page definition file with a router activity creates a binding container. At runtime, this binding container makes sure that the router activity references the correct binding values when it evaluates the router activity cases' EL expressions. Each router activity case specifies an outcome to return if its EL expression evaluates to `true`. For this reason, only add data control operations to the page definition file that evaluate to `true` or `false`.
- Task flow call: associating a page definition file with a task flow call activity creates a binding container. At runtime, the binding container is in context when the task flow call activity passes input parameters. The binding container makes sure that the task flow call activity references the correct values if it references binding values when passing input parameters from a calling task flow to a called task flow.
- View: you cannot directly associate a view activity with a page definition file. Instead, you associate the page that the view activity references.

If you right-click any of the preceding task flow activities, except view activity, in the Diagram window for a task flow, JDeveloper displays an option on the context menu that enables you to create a page definition file if one does not yet exist. If a page definition file does exist, JDeveloper displays a context menu option for all task flow activities to go to the page definition file (see Section 5.3.1.5, "Accessing the Page Definition File"). JDeveloper also displays the Edit Binding context menu option when you right-click a method call activity that is associated with a page definition file.

A task flow activity that is associated with a page definition file displays an icon in the lower-right section of the task flow activity icon.

To associate a page definition file with a task flow activity:

1. In the Diagram view, right-click the task flow activity for which you want to create a page definition file and select Create Page Definition from the context menu.
2. In the resulting page definition file, add the bindings that you want your task flow activity to reference at runtime.

For more information about page definition files, see Section 5.3.2.4.5, "What You May Need to Know About Generated Drag and Drop Artifacts."

When the preceding steps are completed, JDeveloper generates a page definition file for the task flow activity at design time. The file name of the page definition file comprises the originating task flow and either the name of the task flow activity or the data control operation to invoke. JDeveloper also generates an EL expression from the task flow activity to the binding in the created page definition file. At runtime, a binding container ensures that a task flow activity's EL expressions reference the correct value.

5.2.6 How to Define Control Flows

You use the following task flow components to define the control flow in your MAF AMX application feature:

- Control Flow Case (see Section 5.2.6.1, "Defining a Control Flow Case")
- Wildcard Control Flow Rule (see Section 5.2.6.2, "Adding a Wildcard Control Flow Rule")

5.2.6.1 Defining a Control Flow Case

You can create navigation using the Control Flow Case component, which identifies how control passes from one activity to the next. To create a control flow, select **Control Flow Case** from the Components window. Next, connect the Control Flow Case to the source activity, and then to the destination activity. JDeveloper creates the following after you connect a source and target activity:

- `control-flow-rule`: Identifies the source activity using a `from-activity-id`.
- `control-flow-case`: Identifies the destination activity using a `to-activity-id`.

To define a control flow case directly in the MAF task flow diagram:

1. Open the task flow source file in the Diagram view.
2. Select **Control Flow Case** from the Components window.
3. On the diagram, click a source activity and then a destination activity. JDeveloper adds the control flow case to the diagram. Each line that JDeveloper adds between an activity represents a control flow case. The `from-outcome` contains a value that can be matched against values specified in the action attribute of the MAF AMX UI components.
4. To change the `from-outcome`, select the text next to the control flow in the diagram. By default, this is a wildcard character.
5. To change the `from-activity-id` (the identifier of the source activity), or the `to-activity-id` (the identifier for the destination activity), drag either end of the arrow in the diagram to a new activity.

5.2.6.2 Adding a Wildcard Control Flow Rule

MAF task flows support the wildcard control flow rule, which represents a control flow `from-activity-id` that contains a trailing wildcard (`foo*`) or a single wildcard character. You can add a wildcard control flow rule to an unbounded or bounded task flow by dragging and dropping it from the Components window. To configure your wildcard control flow rule, use the Properties window.

To add a wildcard control flow rule:

1. Open the task flow source file in the Diagram view.
2. Select **Wildcard Control Flow Rule** in the Components window and drop it onto the diagram.
3. Select **Control Flow Case** in the Components window.
4. In the task flow diagram, drag the control flow case from the wildcard control flow rule to the target activity, which can be any activity type.
5. By default, the label below the wildcard control flow rule is *. This is the value for the **From Activity ID** element. To change this value, select the wildcard control flow rule in the diagram. In the Properties window for the wildcard control flow rule, enter a new value in the **From Activity ID** field. A useful convention is to cast the wildcard control flow rule in a form that describes its purpose. For example, enter `project*`. The wildcard must be a trailing character in the new label.

   Tip: You can also change the From Activity ID value in the Overview editor for the task flow diagram.

6. Optionally, in the Properties window expand the **Behavior** section and write an EL expression in the **If** field that must evaluate to `true` before control can pass to the activity identified by **To Activity ID**.

5.2.6.3 What You May Need to Know About Control Flow Rule Metadata

Example 5–3 shows the general syntax of a control flow rule element in the task flow source file.

Example 5–3 Control Flow Rule Definition

```
<control-flow-rule>
   <from-activity-id>from-view-activity</from-activity-id>
   <control-flow-case>
      <from-action>actionmethod</from-action>
      <from-outcome>outcome</from-outcome>
      <to-activity-id>destinationActivity</to-activity-id>
      <if>#{myBean.someCondition}</if>
   </control-flow-case>
   <control-flow-case>
   ...
   </control_flow-case>
</control-flow-rule>
```

Control flow rules can consist of the following metadata:

- `control-flow-rule`: a mandatory wrapper element for control flow case elements.
- `from-activity-id`: the identifier of the activity where the control flow rule originates (for example, `source`).

A trailing wildcard (*) character in `from-activity-id` is supported. The rule applies to all activities that match the wildcard pattern. For example, `login*` matches any logical activity ID name beginning with the literal `login`. If you specify a single wildcard character in the metadata (not a trailing wildcard), the control flow automatically converts to a wildcard control flow rule activity in the diagram. For more information, see Section 5.2.6.2, "Adding a Wildcard Control Flow Rule."

- `control-flow-case`: a mandatory wrapper element for each case in the control flow rule. Each case defines a different control flow for the same source activity. A control flow rule must have at least one control flow case.
- `from-action`: an optional element that limits the application of the rule to outcomes from the specified action method. The action method is specified as an EL binding expression, such as, for example, `#{backing_bean.cancelButton_action}`.

  In Example 5–3, control passes to `destinationActivity` only if outcome is returned from `actionmethod`.

  The value in `from-action` applies only to a control flow originating from a view activity, not from any other activity types. Wildcards are not supported in `from-action`.
- `from-outcome`: identifies a control flow case that will be followed based on a specific originating activity outcome. All possible originating activity outcomes should be accommodated with control flow cases.

  If you leave both the `from-action` and the `from-outcome` elements empty, the case applies to all outcomes not identified in any other control flow cases defined for the activity, thus creating a default case for the activity. Wildcards are not supported in `from-outcome`.
- `to-activity-id`: a mandatory element that contains the complete identifier of the activity to which the navigation is routed if the control flow case is performed. Each control flow case can specify a different `to-activity-id`.
- `if`: an optional element that accepts an EL expression as a value. If the EL expression evaluates to `true` at runtime, control flow passes to the activity identified by the `to-activity-id` element.

5.2.6.4 What You May Need to Know About Control Flow Rule Evaluation

At runtime, task flows evaluate control flow rules from the most specific to the least specific match to determine the next transition between activities. Evaluation is based on the following priority:

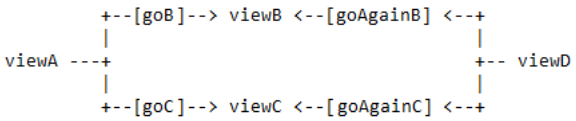
1. `from-activity-id`, `from-action`, `from-outcome`: first, searches for a match in all three elements is performed.
2. `from-activity-id`, `from-outcome`: the search is performed in these elements if no match in all three elements is found.
3. `from-activity-id`: if search in the preceding combinations did not result in a match, search is performed in this element only.

5.2.7 What You May Need to Know About MAF Support for Back Navigation

In the task flow example that Figure 5–12 shows, it is possible to take two separate paths to reach **viewD** based on the action outcome value (see Section 5.2.9, "How to Specify Action Outcomes Using UI Components"): either from **viewA** to **viewB** to

viewD, or from **viewA** to **viewC** to **viewD**.

Figure 5–12 Task Flow with Back Navigation



While you could theoretically keep track of which navigation paths had been followed and then directly implement the `__back` navigation flow, it would be tedious and error-prone, especially considering the fact that due to the limited screen space on mobile devices transitions out of the navigation sequences occur very frequently. MAF provides support for a built-in `__back` navigation that enables moving back through optional paths across a task flow: by applying its "knowledge" of the path taken, MAF performs the navigation back through the same path. For example, if the initial navigation occurred from **viewA** to **viewC** to **viewD**, on exercising the `__back` option on **ViewD** MAF would automatically take the end user back to **ViewA** through **ViewC** rather than through **ViewB**.

For additional information, see the following:

- Section 5.2.3, "What You May Need to Know About the ViewController-task-flow.xml File"
- Section 5.2.10, "How to Create and Reference Managed Beans"
- Section 6.3.5.7, "Enabling the Back Button Navigation"

5.2.8 How to Enable Page Navigation by Dragging

You can enable navigation from one MAF AMX page to another through the use of the Navigation Drag Behavior operation. For more information, see Section 6.3.26, "How to Enable Drag Navigation."

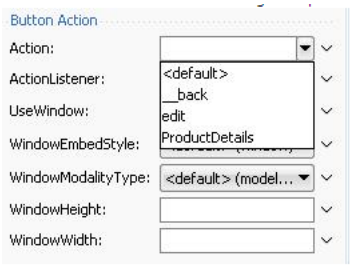
5.2.9 How to Specify Action Outcomes Using UI Components

Using the Properties window, you can specify an action outcome by setting the `action` attribute of one of the following UI components to the corresponding control flow case `from-outcome` leading to the next task flow activity:

- Command Button (see Section 6.3.5, "How to Use Buttons")
- Command Link (see Section 6.3.6, "How to Use Links")
- List Item

You use the UI component's **Action** field (see Figure 5–13) to make a selection from a list of possible action outcomes defined in one or more task flow for a specific MAF AMX page.

Figure 5–13 Setting Actions



A **Back** action (`__back`) is automatically added to every list to enable navigation to the previously visited page.

> **Note:** A MAF AMX page can be referenced in both bounded and unbounded task flows, in which case actions outcomes from both task flows are included in the Action selection list.

5.2.10 How to Create and Reference Managed Beans

You can create and use managed beans in your MAF application to store additional data or execute custom code. You can use JDeveloper's usual editing mechanism to reference managed beans and create references to them for applicable fields. For more information, see Section 7.4, "Creating and Using Managed Beans."

Figure 5–14 shows the **Edit** option for an `action` property in the Properties window. You click this option to invoke the **Edit Property** dialog that Figure 5–15 shows.

Figure 5–14 Edit Dialog

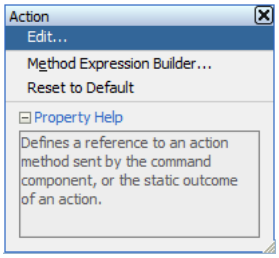


Figure 5–15 Edit Property Dialog for Action

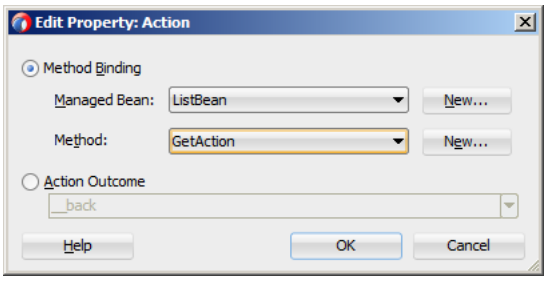


Table 5–7 lists MAF AMX attributes for which the Edit option in the Properties window is available.

Table 5–3 Editable Attributes

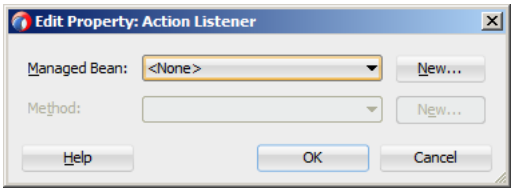
Property	Element
action	amx:commandButton
action	amx:commandLink
action	amx:listItem
action	amx:navigationDragBehavior
action	dvtm:chartDataItem
action	dvtm:ieDataItem
action	dvtm:timelineItem
action	dvtm:area
action	dvtm:marker
actionListener	amx:listItem
actionListener	amx:commandButton
actionListener	amx:commandLink
binding	amx:actionListener
mapBoundsChangeListener	dvtm:geographicMap
mapInputListener	dvtm:geographicMap
moveListener	amx:listView
rangeChangeListener	amx:listView
selectionListener	amx:listView
selectionListener	amx:filmStrip
selectionListener	dvtm:areaDataLayer
selectionListener	dvtm:pointDataLayer
selectionListener	dvtm:treemap
selectionListener	dvtm:sunburst
selectionListener	dvtm:timelineSeries
selectionListener	dvtm:nBox
selectionListener	dvtm:areaChart
selectionListener	dvtm:barChart
selectionListener	dvtm:bubbleChart
selectionListener	dvtm:comboChart
selectionListener	dvtm:horizontalBarChart
selectionListener	dvtm:lineChart
selectionListener	dvtm:funnelChart
selectionListener	dvtm:pieChart
selectionListener	dvtm:scatterChart
valueChangeListener	amx:inputDate
valueChangeListener	amx:inputNumberSlider
valueChangeListener	amx:inputText

Table 5–3 (Cont.) Editable Attributes

Property	Element
valueChangeListener	amx:selectBooleanCheckbox
valueChangeListener	amx:selectBooleanSwitch
valueChangeListener	amx:selectManyCheckbox
valueChangeListener	amx:selectManyChoice
valueChangeListener	amx:selectOneButton
valueChangeListener	amx:selectOneChoice
valueChangeListener	amx:selectOneRadio
valueChangeListener	dvtm:statusMeterGauge
valueChangeListener	dvtm:dialGauge
valueChangeListener	dvtm:ratingGauge
viewportChangeListener	dvtm:areaChart
viewportChangeListener	dvtm:barChart
viewportChangeListener	dvtm:comboChart
viewportChangeListener	dvtm:horizontalBarChart
viewportChangeListener	dvtm:lineChart

Clicking **Edit** for all other properties invokes a similar dialog, but without the Action Outcome option, as Figure 5–16 shows.

Figure 5–16 Edit Property Dialog for Action Listener



The preceding dialogs demonstrate that you can either create a managed bean, or select an available action outcome for the action property.

The **Action Outcome** list shown in Figure 5–15 contains the action outcomes from all task flows to which a specific MAF AMX page belongs. In addition, this list contains a `__back` navigation outcome to go back to the previously visited page (see Section 5.2.9, "How to Specify Action Outcomes Using UI Components" for more information). If a page is not part of any task flow, the only available outcome in the Action Outcome list is `__back`. When you select one of the available action outcomes and click OK, the action property value is updated with the appropriate EL expression, such as the following for a `commandButton`:

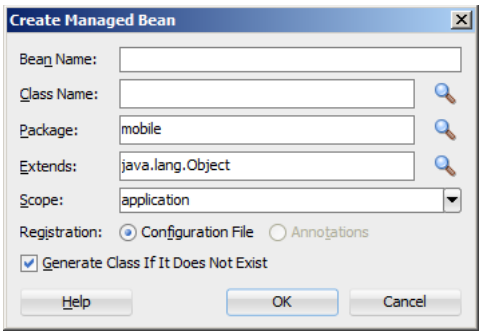
```
<amx:commandButton action="goHome"/>
```

The **Method Binding** option (see Figure 5–15) allows you to either create a new managed bean class or select an existing one.

To create a new managed bean class:

1. Click **New** next to the Managed Bean field to open the Create Managed Bean dialog that Figure 5–17 shows.

Figure 5–17 Create Managed Bean Dialog



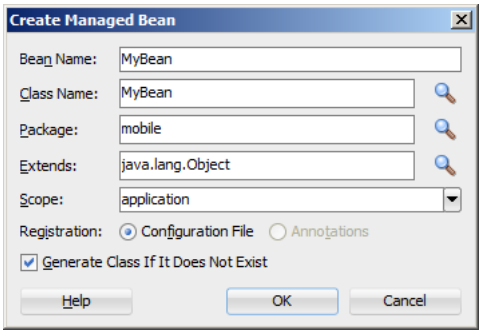
MAF supports the following scopes:

- `application`
- `view`
- `pageFlow`

When you declare a managed bean to a MAF application or the MAF AMX application feature, the managed bean is instantiated and identified in the proper scope, and the bean's properties are resolved and its methods are called through EL. For more information, see Section 7.3, "Creating EL Expressions."

2. Provide the managed bean and class names (see Figure 5–18), and then click **OK**.

Figure 5–18 Setting Managed Bean Name and Class



Example 5–4 shows the newly created managed bean class. The task flow that this MAF AMX page is part of is updated to reference the bean.

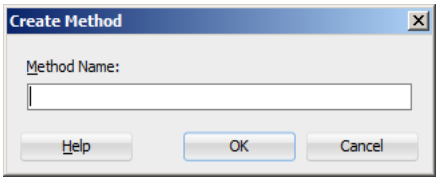
Example 5–4 New Managed Bean Class

```
<managed-bean id="__3">
   <managed-bean-name>MyBean</managed-bean-name>
   <managed-bean-class>mobile.MyBean</managed-bean-class>
   <managed-bean-scope>application</managed-bean-scope>
</managed-bean>
```

Note: If a given MAF AMX page is part of bounded as well as unbounded task flows, both of these task flows are updated with the managed bean entry.

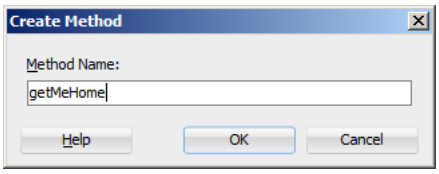
3. Click **New** next to the **Method** field (see Figure 5–15 and Figure 5–16) to open the **Create Method** dialog that Figure 5–19 shows.

Figure 5–19 Create Method Dialog



Use this dialog to provide the managed bean method name (see Figure 5–20).

Figure 5–20 Naming Managed Bean Method



Upon completion, the selected property value is updated with the appropriate EL expression, such as the following for a `commandButton`:

```
<amx:commandButton action="#{MyBean.getMeHome}"/>
```

The managed bean class is also updated to contain the newly created method, as Example 5–5 shows.

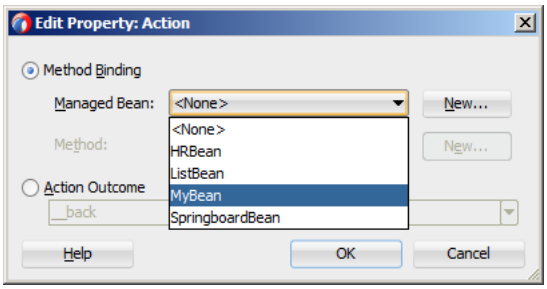
Example 5–5 New Method in Managed Bean Class

```
package mobile;

public class MyBean {
   public MyBean() {
   }

   public String getMeHome() {
      // Add event code here...
      return null;
   }
}
```

To select an existing managed bean:

1. Make a selection from the **Managed Bean** list that Figure 5–21 shows.

Figure 5–21 Selecting Managed Bean



Similar to the action outcomes, the Managed Bean list is populated with managed beans from all task flows that this MAF AMX page is part of.

Note: If the MAF AMX page is not part of any task flow, you can still create a managed bean.

For more information, see the following:

- Section 7.3.5.2, "About the Managed Beans Category"
- APIDemo, a MAF sample application located in the `PublicSamples.zip` file within the *`jdev_install`*`/jdeveloper/jdev/extensions/oracle.maf/Samples` directory on your development computer.

5.2.11 How to Specify the Page Transition Style

By defining the page transition style on the task flow, you can specify how MAF AMX pages transition from one view to another. The behavior of your MAF AMX page at transition can be as follows:

- fading in
- sliding in from left
- sliding in from right
- sliding up from bottom
- sliding down from top
- sliding in from start
- sliding in from end
- flipping up from bottom
- flipping down from top
- flipping from left
- flipping from right
- flipping from start
- flipping from end
- none

Sliding in from start and end, as well as flipping from start and end are used on the iOS platform to accommodate the right-to-left text direction. It is generally recommended to use the start and end transition style as opposed to left and right.

Note: You cannot enable flipping on the Android platform.

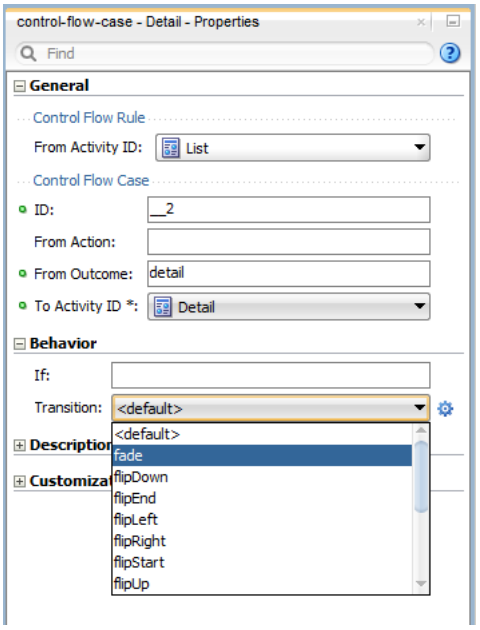
You set the transition style by modifying the `transition` attribute of the `control-flow-case` (Control Flow Case component), as Example 5–6 shows.

Example 5–6 Setting Transition Style

```
<control-flow-rule id="__1">
   <from-activity-id>products</from-activity-id>
   <control-flow-case id="__2">
      <from-outcome>details</from-outcome>
      <to-activity-id>productdetails</to-activity-id>
      <transition>fade</transition>
   </control-flow-case>
</control-flow-rule>
```

In the Properties window, the `transition` attribute is located under **Behavior**, as Figure 5–22 shows. The default transition style is `slideLeft`.

Figure 5–22 Setting Transition Style in Properties Window



Tip: When defining the task flow, you should specify the `control-flow-case`'s `transition` value such that it is logical. For example, if the transition occurs from left to right with the purpose of navigating back, then the transition should return to the previous page by sliding right.

5.2.12 What You May Need to Know About Bounded and Unbounded Task Flows

Task flows provide a modular approach for defining control flow in a MAF AMX application feature. Instead of representing an application feature as a single large page flow, you can divide it into a collection of reusable task flows. Each task flow contains a portion of the application feature's navigational graph. The nodes in the task flows represent activities. An activity node represents a simple logical operation

such as displaying a page, executing application logic, or calling another task flow. The transitions between the activities are called control flow cases.

There are two types of task flows in MAF AMX:

1. Unbounded Task Flows: a set of activities, control flow rules, and managed beans that interact to allow the end user to complete a task. The unbounded task flow consists of all activities and control flows in a MAF AMX application feature that are not included within a bounded task flow.
2. Bounded Task Flows: a specialized form of task flow that, in contrast to the unbounded task flow, has a single entry point and no exit points. It contains its own collections of activities and control-flow rules, as well as their own memory scope and managed-bean life span.

For a description of the activity types that you can add to unbounded or bounded task flows, see Section 5.2.2, "What You May Need to Know About Task Flow Activities and Control Flows."

A typical MAF AMX application feature contains a combination of one unbounded task flow created at the time when the application feature is created and one or more bounded task flows. At runtime, the MAF application can call bounded task flows from activities that you added to the unbounded task flow.

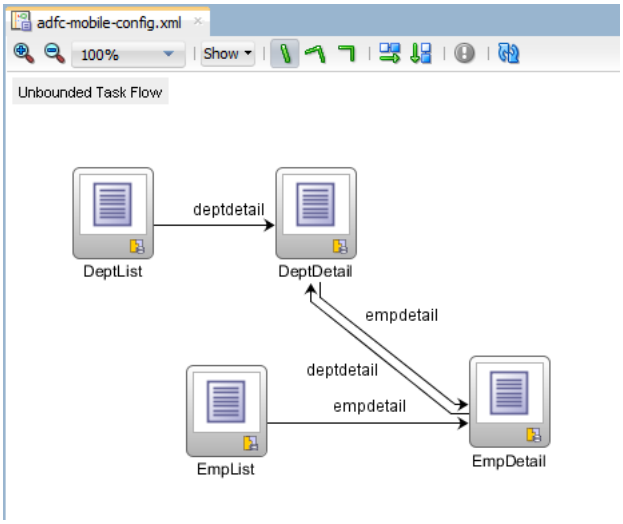
5.2.12.1 Unbounded Task Flows

A MAF AMX application feature always contains one unbounded task flow, which provides one or more entry points to that application feature. An entry point is represented by a view activity. By default, the source file for the unbounded task flow is the `adfc-mobile-config.xml` file.

> **Note:** Although it is possible create additional source files for unbounded task flows, the MAF AMX application feature combines all source files at runtime into the `adfc-mobile-config.xml` file.

Figure 5–23 displays the diagram for an unbounded task flow from a MAF AMX application feature. This task flow contains a number of view activities that are all entry points to the application feature.

Figure 5–23 Unbounded Task Flow Diagram



Consider using an unbounded task flow if the following applies:

- There is no need for the task flow to be called by another task flow.
- The MAF AMX application feature has multiple points of entry.
- There is no need for a specifically designated activity to run first in the task flow (default activity).

An unbounded task flow can call a bounded task flow, but cannot be called by another task flow.

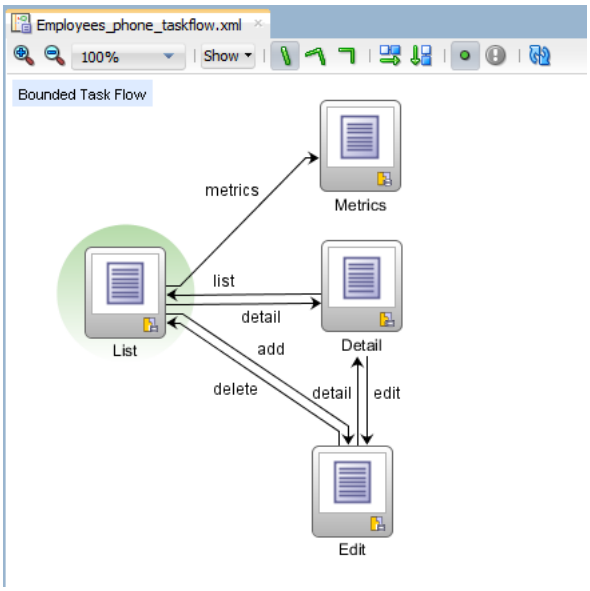
5.2.12.2 Bounded Task Flows

By default, the IDE proposes a file name for the source file of a bounded task flow (see Section 5.2.1, "How to Create a Task Flow"). You can modify this file name to reflect the purpose of the task to be performed.

A bounded task flow can call another bounded task flow, which can call another, and so on. There is no limit to the depth of the calls.

Figure 5–24 displays the diagram for a bounded task flow from a MAF AMX application feature.

Figure 5–24 Bounded Task Flow Diagram



The following are reasons for creating a bounded task flow:

- The bounded task flow always specifies a default activity, which is a single point of entry that must execute immediately upon entry of the bounded task flow.
- It is reusable within the same or other MAF AMX application features.
- Any managed beans you use within a bounded task flow can be specified in a page flow scope, making them isolated from the rest of the MAF AMX application feature. These managed beans (with page flow scope) are automatically released when the task flow completes.

The following is a summary of the main characteristics of a bounded task flow:

- Well-defined boundary: a bounded task flow consists of its own set of private control flow rules, activities, and managed beans. A caller requires no internal

knowledge of page names, method calls, child bounded task flows, managed beans, and control flow rules within the bounded task flow boundary. Data controls can be shared between task flows.

- Single point of entry: a bounded task flow has a single point of entry—a default activity that executes before all other activities in the task flow.
- Page flow memory scope: you can specify page flow scope as the memory scope for passing data between activities within the bounded task flow. Page flow scope defines a unique storage area for each instance of a bounded task flow. Its lifespan is the bounded task flow, which is longer than request scope and shorter than session scope.
- Addressable: you can access a bounded task flow by specifying its unique identifier within the XML source file for the bounded task flow and the file name of the XML source file.
- Reusable: you can identify an entire group of activities as a single entity, a bounded task flow, and reuse the bounded task flow in another MAF AMX application feature within a MAF application.

  You can also reuse an existing bounded task flow by calling it.

  In addition, you can use task flow templates to capture common behaviors for reuse across different bounded task flows.
- Parameters and return values: a caller can pass input parameters to a bounded task flow and accept return values from it (see Section 5.2.12.3.1, "Passing Parameters to a Bounded Task Flow" and Section 5.2.12.3.2, "Configuring a Return Value from a Bounded Task Flow").

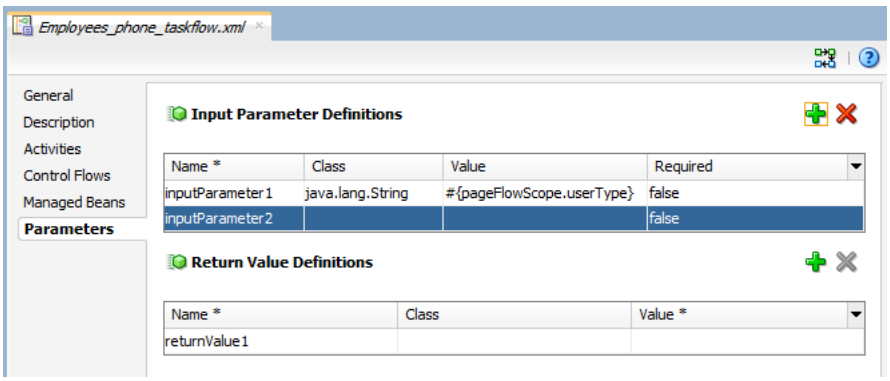
  In addition, you can share data controls between bounded task flows.
- On-demand loading of metadata: bounded task flow metadata is loaded on demand when entering a bounded task flow.

5.2.12.3 Using Parameters in Task Flows

A task flow´s ability to accept input parameters and return parameter values allows you to manipulate data in task flows and share data between task flows. Using these abilities, you can optimize the reuse of task flows in your MAF AMX application feature.

Figure 5–25 shows a task flow that specifies an input parameter definition to hold information about a user in a pageFlow scope.

Figure 5–25 Input Parameters in Task Flow



You can specify parameter values using standard EL expressions if you call a bounded task flow using a task flow call activity. For example, you can specify parameters using the following syntax for EL expressions:

```
#{bindings.bindingId.inputValue}
#{CustomerBean.zipCode}
```

Appending `inputValue` to the EL expression ensures that you assign to the parameter the value of the binding rather than the actual binding object.

5.2.12.3.1 Passing Parameters to a Bounded Task Flow

A called bounded task flow can accept input parameters from the task flow that calls it or from a task flow binding.

To pass an input parameter to a bounded task flow, you specify one or more of the following:

- Input parameters on the task flow call activity in the calling task flow: input parameters specify where the calling task flow stores parameter values.
- Input parameter definitions on the called bounded task flow: input parameter definitions specify where the called bounded task flow can retrieve parameter values at runtime.

Specify the same name for the input parameter that you define on the task flow call activity in the calling task flow and the input parameter definition on the called bounded task flow. Do this so you can map input parameter values to the called bounded task flow.

If you do not specify an EL expression to reference the value of the input parameter, the EL expression for value defaults to the following at runtime:

`#{pageFlowScope.`*`parmName`*`}`

where *`parmName`* is the value you entered for the input parameter name.

In an input parameter definition for a called bounded task flow, you can specify an input parameter as required. If the input parameter does not receive a value at runtime or design time, the task flow raises a warning in a log file of the MAF application that contains the task flow. An input parameter that you do not specify as required can be ignored during task flow call activity creation.

Task flow call activity input parameters can be passed by reference or passed by value when calling a task flow using a task flow call activity (see Section 5.2.5.4.2, "Specifying Input Parameters on a Task Flow Call Activity"). By default, primitive types (for example, `int`, `long`, or `boolean`) are passed by value (`pass-by-value`).

A called task flow can return values to the task flow that called it when it exits. For more information, see Section 5.2.12.3.2, "Configuring a Return Value from a Bounded Task Flow."

When passing an input parameter to a bounded task flow, you define values on both the calling task flow and the called task flow.

Before you begin:

- Create a calling and called task flow: the calling task flow can be bounded or unbounded. The called task flow must be bounded. For more information about creating task flows, see Section 5.2.1, "How to Create a Task Flow."
- Add a task flow call activity to the calling task flow.

Figure 5–26 shows an example where the view activity passes control to the task flow call activity.

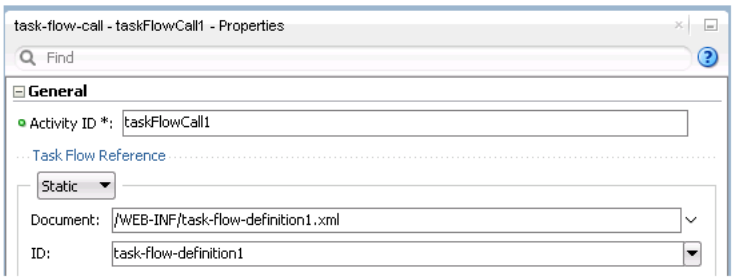
Figure 5–26 Calling Task Flow

To pass an input parameter to a bounded task flow:

1. Open a MAF AMX page that contains an input component where the end user enters a value that is passed to a bounded task flow as a parameter at runtime. Note that the MAF AMX page that you open should be referenced by a view activity in the calling task flow.
2. Select an input text component on the MAF AMX page where the end user enters a value at runtime.
3. In the Properties window, expand the Common section and enter a value for the input text component in the **Value** field.

   You can specify the value as an EL expression (for example, `#{pageFlowScope.inputValue}`), either manually or using the Expression Builder.
4. Open the task flow that is to be called by double-clicking it in the Applications window, then switch the view to the Overview tab and select the **Parameters** navigation tab.
5. In the **Input Parameter Definition** section, click Add (+) to specify a new entry (see Figure 5–25):
   - In the **Name** field, enter a name for the parameter (for example, `inputParm1)`.
   - In the **Value** field, enter an EL expression where the parameter value is stored and referenced (for example, `#{pageFlowScope.inputValue}`), either manually or using the Expression Builder.
6. In the Applications window, double-click the calling task flow that contains the task flow call activity to invoke the called bounded task flow.
7. In the Applications window, drag the called bounded task flow and drop it on top of the task flow call activity that is located in the diagram of the calling task flow. This automatically creates a task flow reference to the bounded task flow. As shown in Figure 5–27, the task flow reference contains the following:
   - The bounded task flow ID (`id`): an attribute of the bounded task flow's `task-flow-definition` element.
   - The document name that points to the source file for the task flow that contains the ID.

Figure 5–27 Task Flow Reference



8. In the Properties window for the task flow call activity, expand the **Parameters** section to view the **Input Parameters** section.
   - Enter a name that identifies the input parameter: since you dropped the bounded task flow on a task flow call activity having defined input parameters, the name should already be specified. You must keep the same input parameter name.
   - Enter a parameter value (for example, `#{pageFlowScope.param1}`): the value on the task flow call activity input parameter specifies where the calling task flow stores parameter values. The value on the input parameter definition for the called task flow specifies the location from which the value is to be retrieved for use within the called bounded task flow once it is passed.

At runtime, the called task flow can to use the input parameter. If you specified `pageFlowScope` as the value in the input parameter definition for the called task flow, you can use the parameter value anywhere in the called bounded task flow. For example, you can pass it to a view activity on the called bounded task flow.

Upon completion, JDeveloper writes entries to the source files for the calling task flow and called task flow based on the values that you select.

Example 5–7 shows an input parameter definition specified on a a bounded task flow.

Example 5–7 Input Parameter Definition

```
<task-flow-definition id="sourceTaskflow">
...
   <input-parameter-definition>
      <name>inputParameter1</name>
      <value>#{pageFlowScope.parmValue1}</value>
      <class>java.lang.String</class>
   </input-parameter-definition>
...
</task-flow-definition>
```

Example 5–8 shows the input parameter metadata for the task flow call activity that calls the bounded task flow shown in Example 5–7. At runtime, the task flow call activity calls the bounded task flow and passes it the value specified by its value element.

Example 5–8 Input Parameter on Task Flow Call Activity

```
<task-flow-call id="taskFlowCall1">
...
   <input-parameter>
      <name>inputParameter1</name>
      <value>#{pageFlowScope.newCustomer}</value>
```

```
      <pass-by-value/>
   </input-parameter>
...
</task-flow-call>
```

5.2.12.3.2 Configuring a Return Value from a Bounded Task Flow

You configure a return value definition on the called task flow and add a parameter to the task flow call activity in the calling task flow that retrieves the return value at runtime.

Before you begin:

Create a bounded or unbounded task flow (calling task flow) and a bounded task flow (called task flow). For more information, see Section 5.2.1, "How to Create a Task Flow."

To configure a return value from a called bounded task flow:

1. Open the task flow that is to be called by double-clicking it in the Applications window, then switch the view to the Overview tab and select the **Parameters** navigation tab.
2. In the **Return Value Definitions** section, click Add (+) to define a return value (see Figure 5–25):
   - In the **Name** field, enter a name to identify the return value (for example, `returnValue1`).
   - In the **Class** field, enter a Java class that defines the data type of the return value. The default value is `java.lang.String`.
   - In the **Value** field, enter an EL expression that specifies from where to read the return value (for example, `#{pageFlowScope.ReturnValueDefinition}`), either manually or using the Expression Builder.
3. In the Applications window, double-click the calling task flow.
4. With the task flow page open in the Diagram view, select **Components > Activities** from the Components window, and then drag and drop a task flow call activity onto the diagram.
5. In the Properties window for the task flow call activity, expand the **Parameters** section, click Add (+) for the Return Values entry, and then add values as follows to define a return value:
   - A name to identify the return value (for example, returnValue1). It must match the value you entered for the Name field when you defined the return value definition in step 2.
   - A value as an EL expression that specifies where to store the return value (for example, `#{pageFlowScope.ReturnValueDefinition}`). It must match the value you entered for the Value field when you defined the return value definition in step 2.

Upon completion, JDeveloper writes entries to the source files for the calling task flows that you configured.

Example 5–9 shows an example entry that JDeveloper writes to the source file for the calling task flow.

Example 5–9 Metadata in the Calling Task Flow to Configure a Return Value

```
<task-flow-call id="taskFlowCall1">
```

```
   <return-value id="__3">
      <name id="__4">returnValue1</name>
      <value id="__2">#{pageFlowScope.ReturnValueDefinition}</value>
   </return-value>
</task-flow-call>
```

Example 5–10 shows an example entry that JDeveloper writes to the source file for the called task flow.

Example 5–10 Metadata in the Called Task Flow to Configure a Return Value

```
<return-value-definition id="__2">
   <name id="__3">returnValue1</name>
   <value>#{pageFlowScope.ReturnValueDefinition}/</value>
   <class>java.lang.String</class>
</return-value-definition>
```

At runtime, the called task flow returns a value. If configured to do so, the task flow call activity in the calling task flow retrieves this value.

5.3 Creating Views

You can start creating a MAF AMX view by doing the following:

- Getting familiar with the MAF AMX page structure (see Section 5.3.1.1, "Interpreting the MAF AMX Page Structure")
- Editing and previewing a MAF AMX page (see Section 5.3.1.4, "Using UI Editors")
- Dragging and dropping components onto a MAF AMX page (see Section 5.3.2.1, "Adding UI Components")
- Adding data controls to a view (see Section 5.3.2.4, "Adding Data Controls to the View")

5.3.1 How to Work with MAF AMX Pages

A MAF AMX page is represented by an XML file.

5.3.1.1 Interpreting the MAF AMX Page Structure

The following is a basic structure of the MAF AMX file:

```
<amx:view>
   <amx:panelPage id="pp1">
      <amx:facet name="header">
         <amx:outputText id="ot1" value="Welcome"/>
      …
      </amx:facet>
   </amx:panelPage>
</amx:view>
```

With the exception of data visualization components (see Section 6.5, "Providing Data Visualization"), UI elements are declared under the `<amx>` namespace.

For more information, see Section 5.3.1.3, "What Happens When You Create a MAF AMX Page."

5.3.1.2 Creating MAF AMX Pages

MAF AMX files are contained in the View Controller project of the MAF application. You create these files using the Create MAF AMX Page dialog.

MAF offers two alternative ways of creating a MAF AMX page:

- From the New Gallery
- From an existing task flow

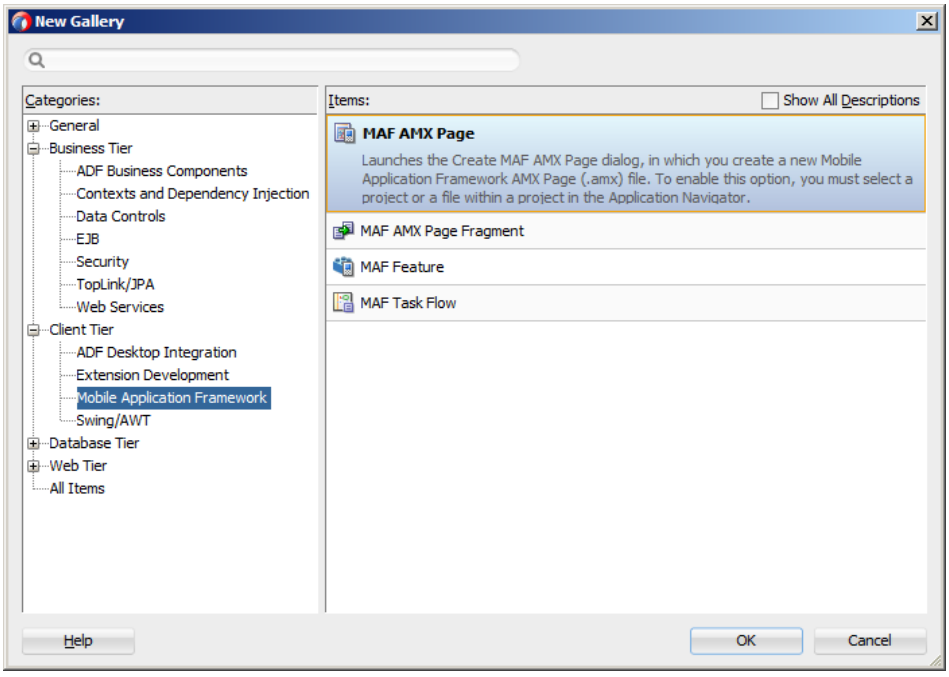
Before you begin:

To create a MAF AMX page, the MAF application must include a View Controller project file (see Chapter 3, "Getting Started with Mobile Application Development").

To create a MAF AMX page from the New Gallery:

1. From the top-level menu in JDeveloper, click **File**, and then select **New > From Gallery**.
2. In the **New Gallery**, expand the **Client Tier** node, select **Mobile Application Framework,** and then **MAF AMX Page** (see Figure 5–28). Click **OK**.

Figure 5–28 Creating MAF AMX Page

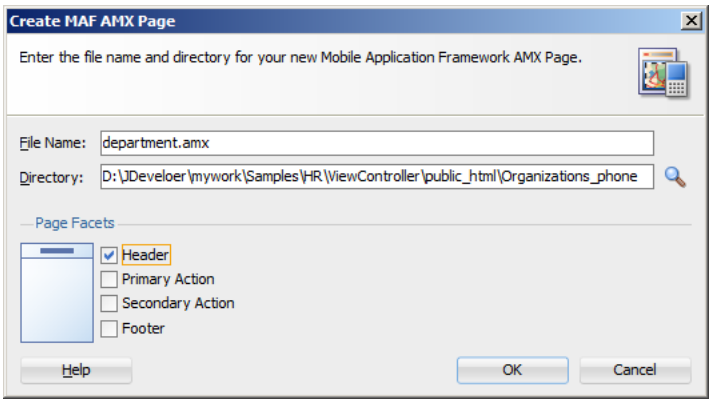


3. In the Create MAF AMX Page dialog, enter a name and, if needed, a location for your new file, as Figure 5–29 shows.
4. Optionally, you may select which facets your new MAF AMX page will include as a part of the page layout:
   - Header
   - Primary
   - Secondary
   - Footer

For more information, see Section 5.3.1.3, "What Happens When You Create a MAF AMX Page" and Section 6.2.7, "How to Use a Facet Component."

Note that when you select or deselect a facet, the image representing the page changes dynamically to reflect the changing appearance of the page.

Figure 5–29 Create MAF AMX Page Dialog



Note: MAF persists your facet selection and applies it to each subsequent invocation of the Create MAF AMX Page dialog.

5. Click **OK** on the Create MAF AMX Page dialog.

To create a MAF AMX page from a View component of the task flow:

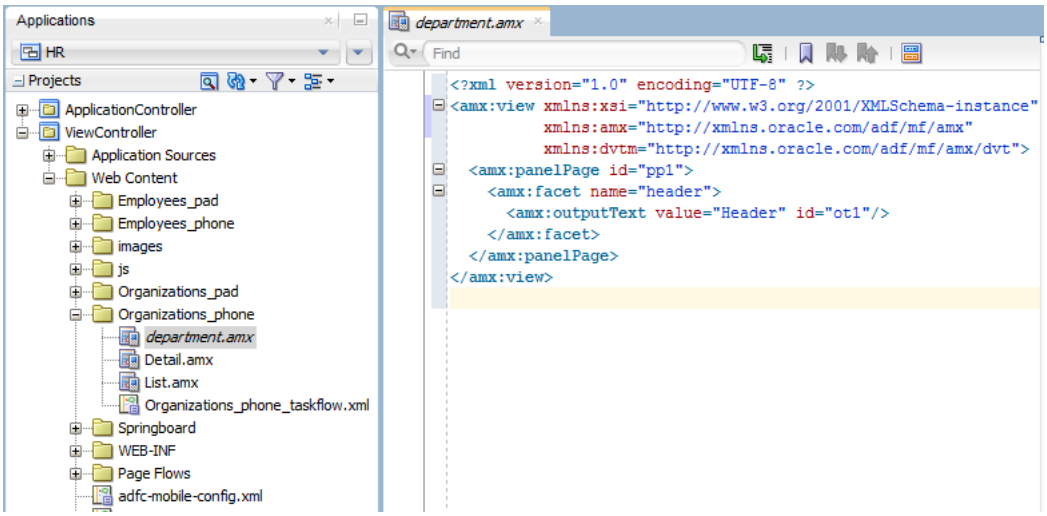
1. Open a task flow file in the diagrammer (see Figure 5–6, "The Diagrammer for the Task Flow Editor", Section 5.2.1, "How to Create a Task Flow" and Section 5.2.4, "What You May Need to Know About the MAF Task Flow Diagrammer")
2. Double-click a View component of the task flow to open the Create MAF AMX Page dialog that Figure 5–29 shows, and then enter a name and, if needed, a location for your new file. Click **OK**.

5.3.1.3 What Happens When You Create a MAF AMX Page

When you use the Create MAF AMX Page dialog to create a MAF AMX page, JDeveloper creates the physical file and adds it to the `Web Content` directory of the View Controller project.

In the Applications window that Figure 5–30 shows, the `Web Content` node contains a newly created MAF AMX file called `department.amx`.

Figure 5–30 MAF AMX File in Applications Window



JDeveloper also adds the code necessary to import the component libraries and display a page. This code is illustrated in the Source editor shown in Figure 5–30.

Figure 5–32 shows how the Preview pane and the generated MAF AMX code would look like if you selected all facet types listed in the Page Facet section of the Create MAF AMX Page dialog when creating the page (see Figure 5–31).

Figure 5–31 Creating MAF AMX Page with All Facets

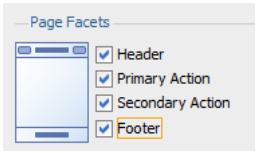
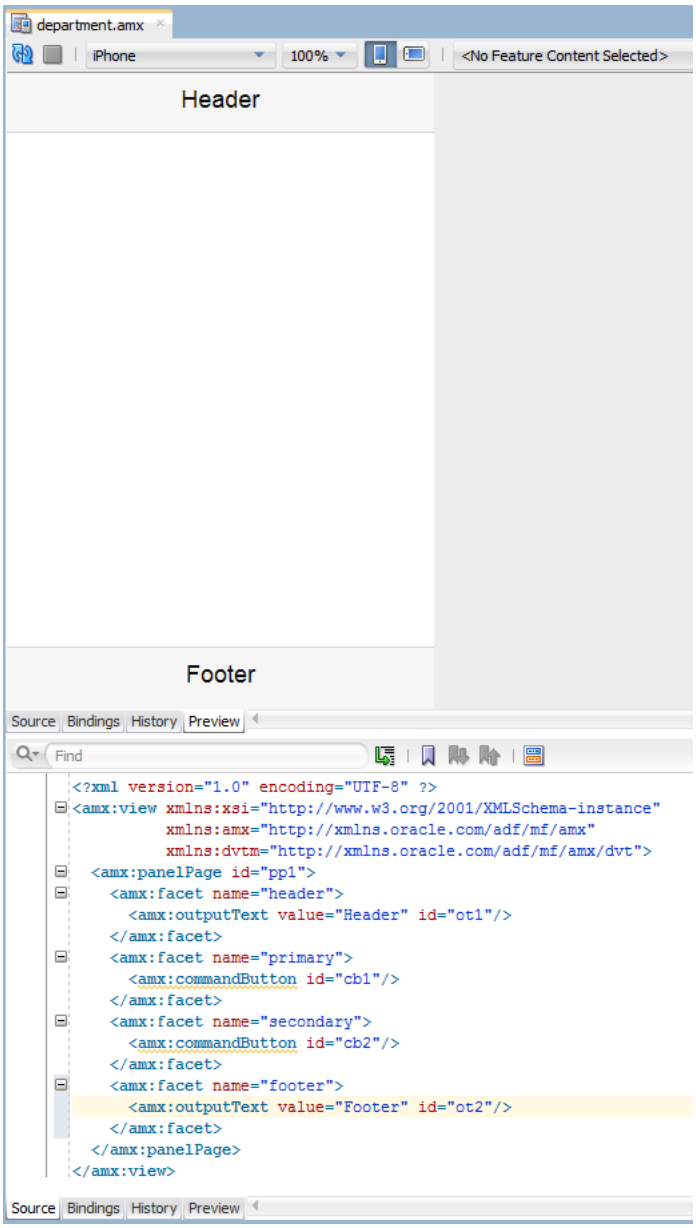


Figure 5–32 MAF AMX Page With All Facets



In the page created with all the facets selected (see Figure 5–31 and Figure 5–32), note the following:

- The header is created with an Output Text component because this component is typically used for the page title.
- The primary and secondary actions are created with Button components because it is a typical pattern.
- Since there is no single dominant pattern for the footer, it is created with an Output Text component by default because that component is used in some patterns and it prevents JDeveloper from generating the initial code with audit violation.

- Adding either the primary or secondary action without adding the header facet still causes the header section to appear in the Page Facets section of Create MAF AMX Page dialog.

Figure 5–33 shows the Page Facet section of the Create MAF AMX Page dialog without any facets selected and Figure 5–34 shows the Preview pane with the generated MAF AMX code.

Figure 5–33 Creating MAF AMX Page Without Selected Facets

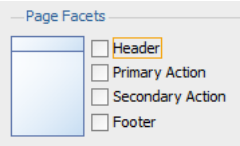
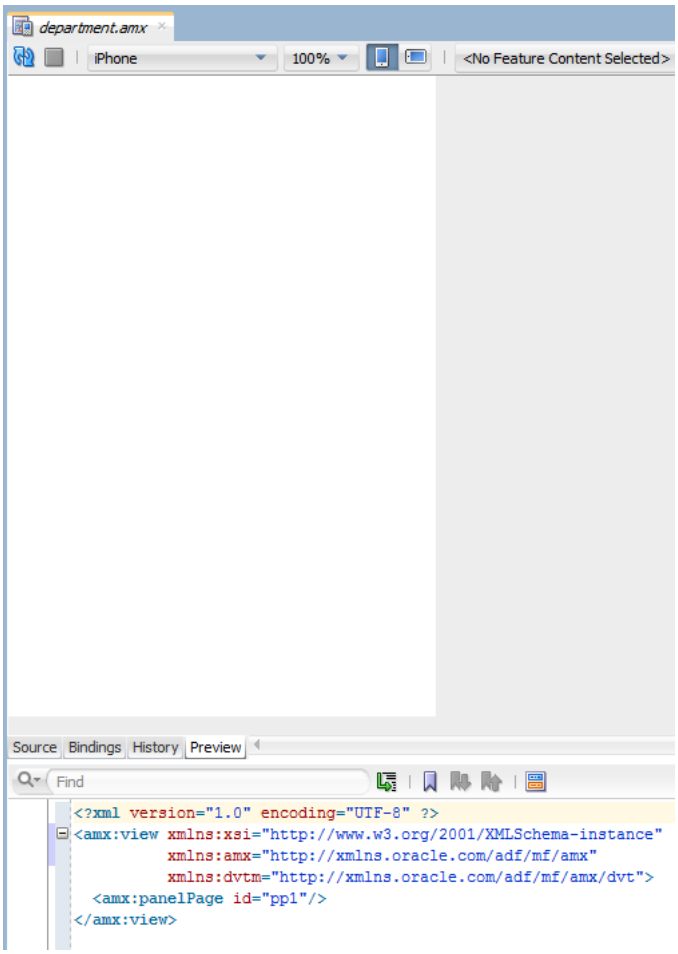


Figure 5–34 MAF AMX Page Without Facets

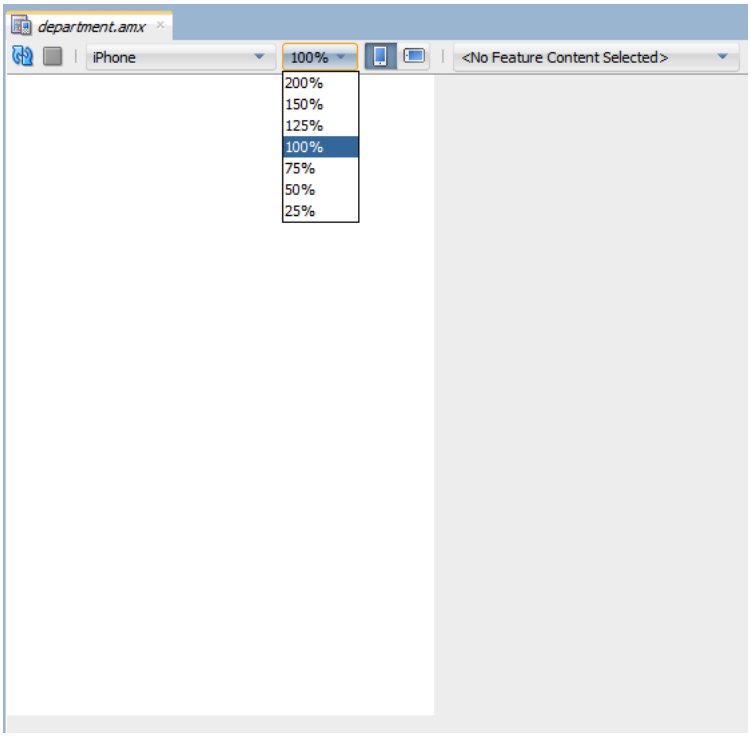


5.3.1.4 Using UI Editors

When the page is first displayed in JDeveloper, it is displayed in the Source editor. To view the page in a WYSIWYG environment, use the Preview pane (accessed by clicking the **Preview** tab).

Figure 5–35 shows the Preview tab selected for a newly created MAF AMX page called `department.amx`. This page is blank because it has not yet been populated with MAF AMX UI components or data controls.

Figure 5–35 The Preview Pane for Newly Created Page



Using the Preview pane's tool bar that Figure 5–35 shows, you can do the following:

- Refresh the display of the MAF AMX page by clicking **Refresh Page**.
- Stop loading of the page by clicking **Stop Loading Page**.
- Modify the form factor for the page by selecting a different form factor from the dropdown list. For more information on form factors, see Section 2.3.1.1, "Configuring the Environment for Form Factors."
- Modify the scaling of the display by selecting a different percentage value from the dropdown list. Since mobile device displays can be of various sizes and densities, the Preview pane allows you to see the effect of scaling on your MAF AMX pages.

> **Note:** Scaling is available for both Portrait and Landscape mode.

- Change orientation for the display to portrait and landscape by selecting **Show Portrait Orientation** or **Show Landscape Orientation** respectively.
- Select the feature content for your MAF AMX page form the dropdown list of available application features. By default, <No Feature Content Selected> is displayed.

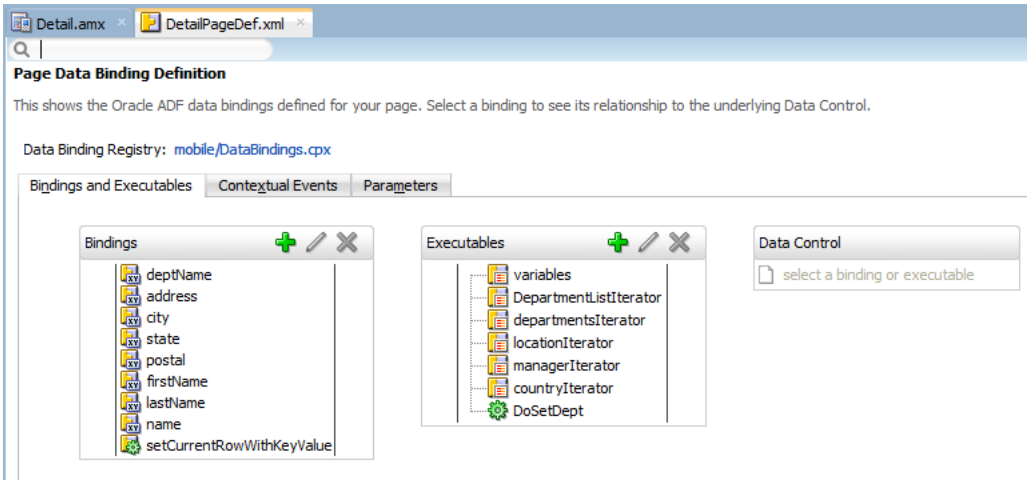
To view the source for the page in the Source editor, click the **Source** tab that Figure 5–30, "MAF AMX File in Applications Window" shows. The Structure window, located in the lower left-hand corner of JDeveloper (shown in Figure 5–30 and Figure 5–35), provides a hierarchical view of the page. For more information, see

Section 5.3.2.2, "Using the Preview."

5.3.1.5 Accessing the Page Definition File

MAF AMX supports JDeveloper's Go to Page Definition functionality that enables you to navigate to the MAF AMX page definition (see Figure 5–36 and Section 5.3.2.4.5, "What You May Need to Know About Generated Drag and Drop Artifacts") by using a context menu that allows you to locate and edit the binding information quickly.

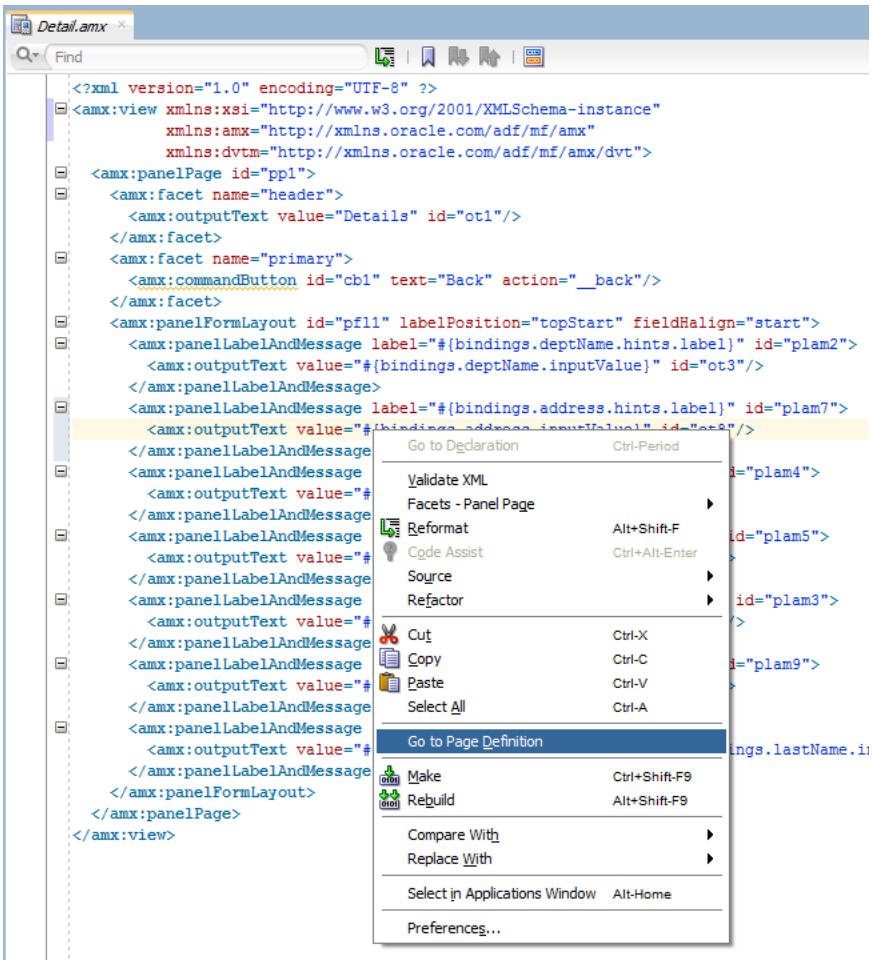
Figure 5–36 Page Definition File Accessed Through Go To Page Definition



You can invoke the context menu that contains the Go to Page Definition option from the following:

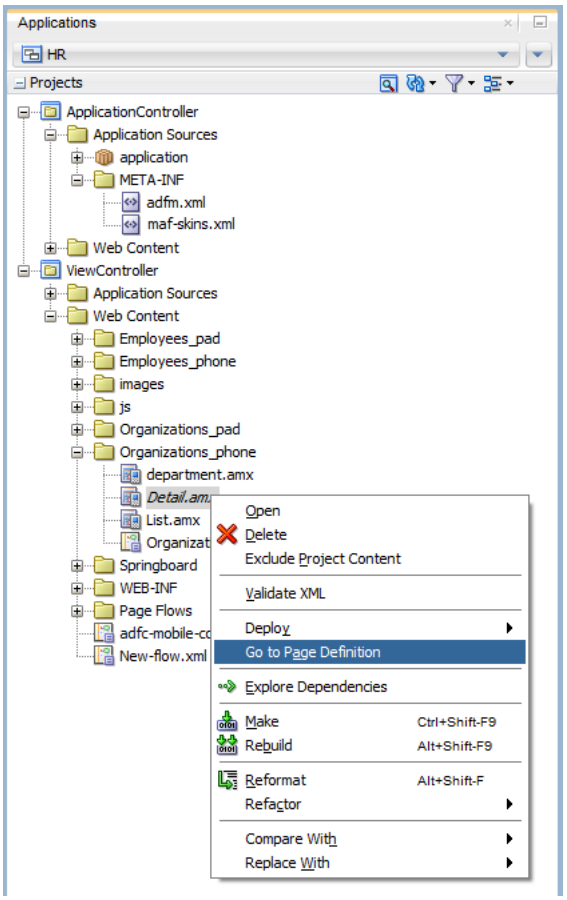
- Source editor, as Figure 5–37 shows.

Figure 5–37 Go to Page Definition from Source Editor



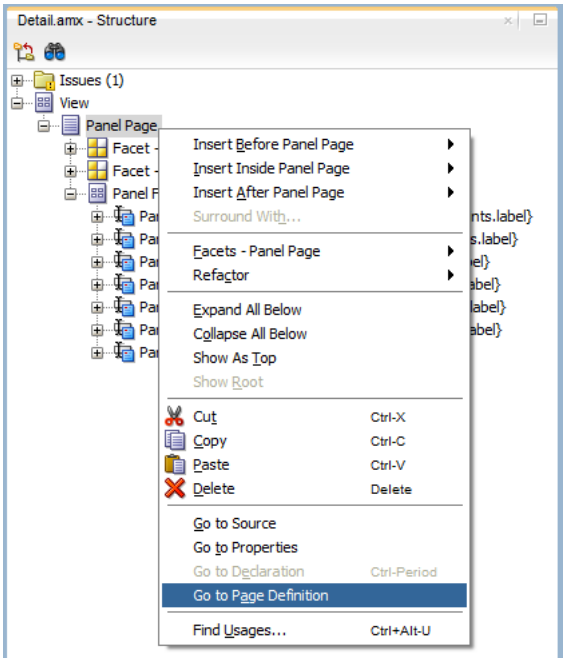
- Applications window, as Figure 5–38 shows.

Figure 5–38 Go to Page Definition from Applications Window



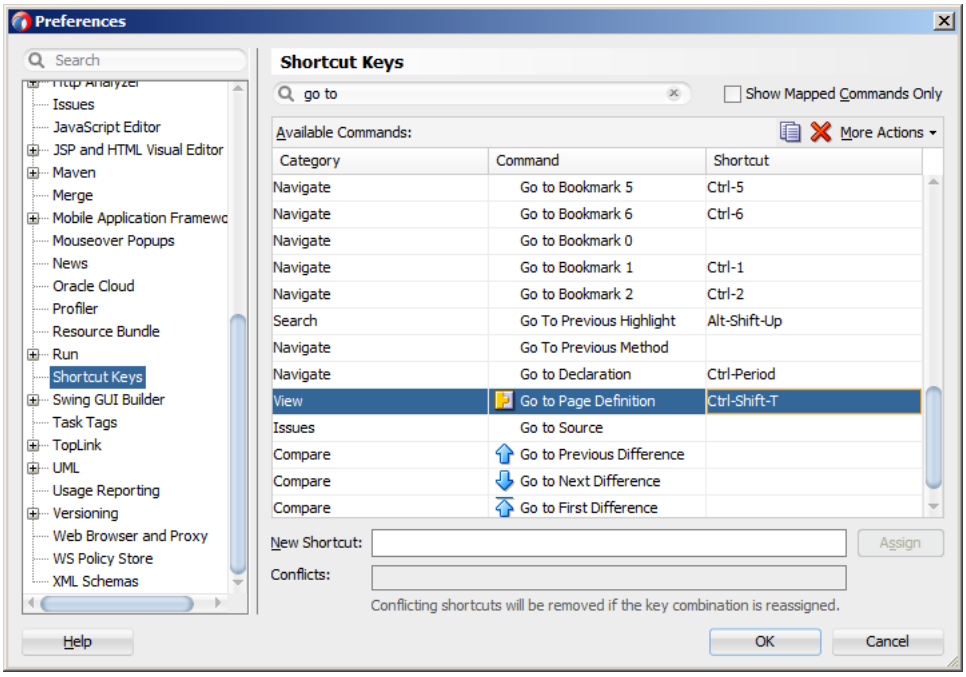
- Structure window, as Figure 5–39 shows.

Figure 5–39 Go to Page Definition from Structure Pane



In addition, you can open the Page Definition file using the **Go to Page Definition** shortcut key defined under **Tools > Preferences** on the main menu, as Figure 5–40 shows.

Figure 5–40 Opening Page Definition from Preferences



5.3.1.6 Sharing the Page Contents

You can enable sharing of contents of MAF AMX pages. Fragment (`fragment`) is a dynamic declarative component that allows for reusable parts of a MAF AMX page elements, including attributes and facets, to be inserted into the content represented by a template. This enables you to standardize the look and feel of your application by reusing the Fragment template across various pages within the application.

You can drag and drop a MAF AMX fragment file (`.amxf`) onto a MAF AMX page or another fragment file to create a reference to the fragment and to define its attributes (see Section 5.3.1.6.1, "Configuring the Fragment Content"). The fragment file resides inside your project and you can drop it from the Applications window.

Before you begin:

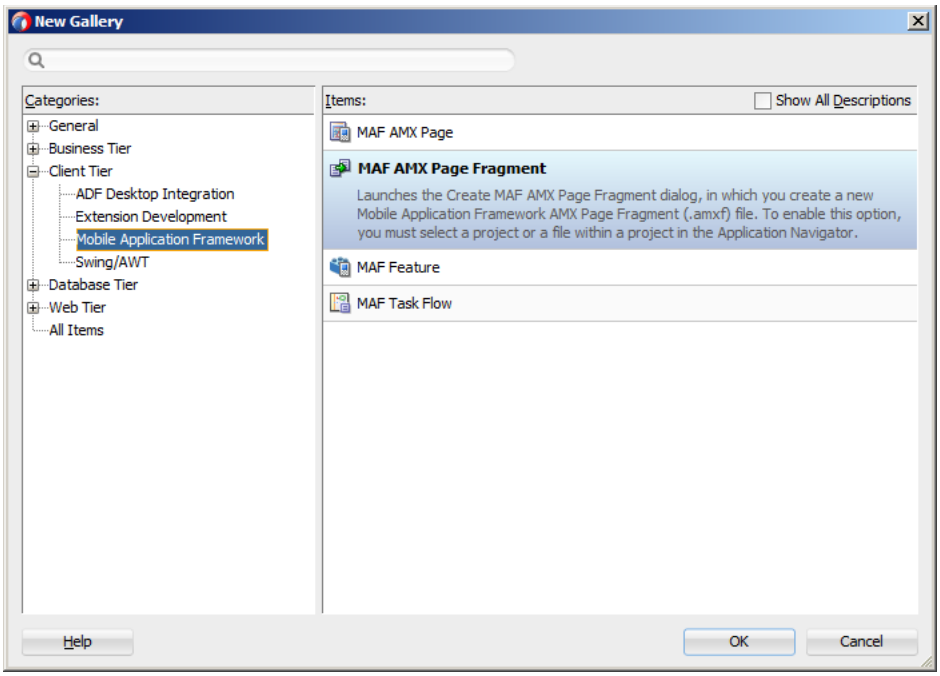
Ensure that the MAF application includes a View Controller project.

If the View Controller project does not contain a MAF AMX page or MAF AMX page task flow from which to create a page, you can invoke the Create MAF AMX Page dialog by double-clicking a view icon in a task flow diagram or by selecting **Client Tier > Mobile Application Framework > MAF AMX Page** from the New Gallery (see Section 5.3.1.2, "Creating MAF AMX Pages").

To create a Fragment from the New Gallery:

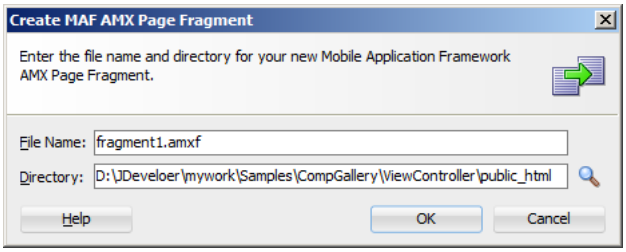
1. From the top-level menu in JDeveloper, click **File**, and then select **New > From Gallery**.
2. In the **New Gallery**, expand the **Client Tier** node, select **Mobile Application Framework**, and then **MAF AMX Page Fragment** (see Figure 5–41). Click **OK**.

Figure 5–41 Creating New Fragment



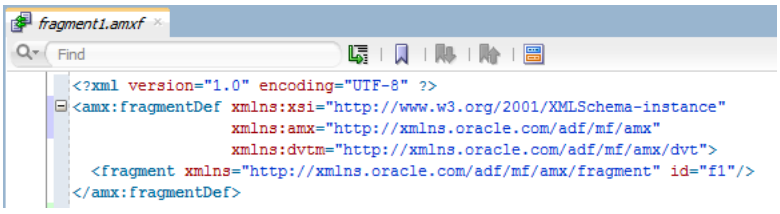
3. Complete the **Create MAF AMX Page Fragment** dialog by entering the file name and location of the new fragment, as Figure 5–42 shows. Click **OK**.

Figure 5–42 Create MAF AMX Page Fragment Dialog



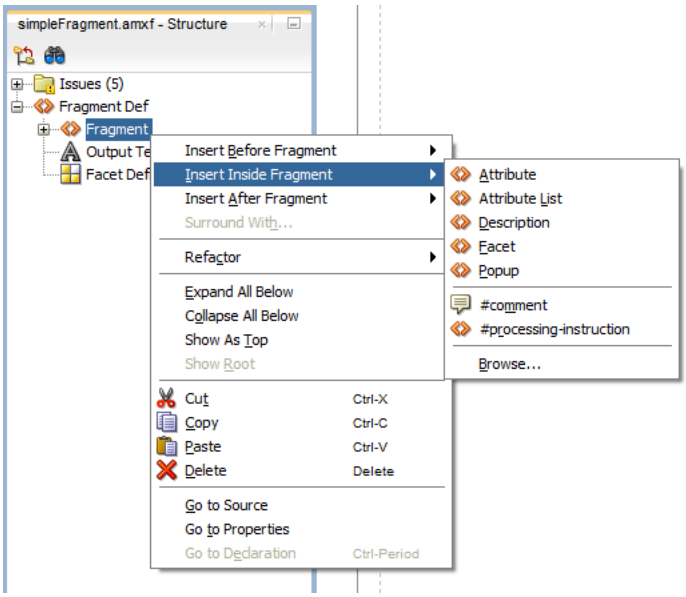
Upon completion of the dialog, a newly created file opens in the Source editor of JDeveloper (see Figure 5–43).

Figure 5–43 Fragment File



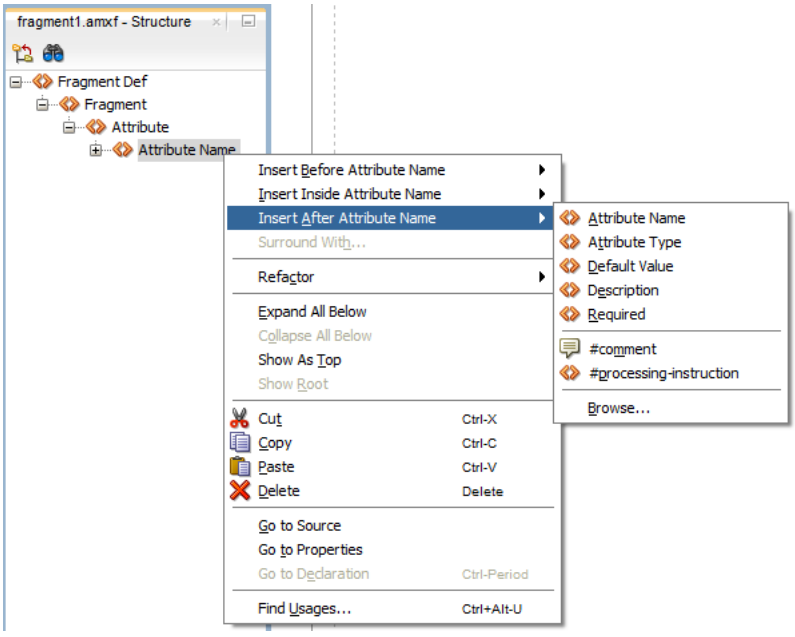
4. Right-click **Fragment** in the Structure window and select **Insert Inside Fragment**. Choose elements with which to populate the new fragment (see Figure 5–44): **Attribute**, **Attribute List**, **Description**, **Facet**, or **Popup**.

Figure 5–44 Populating Fragment



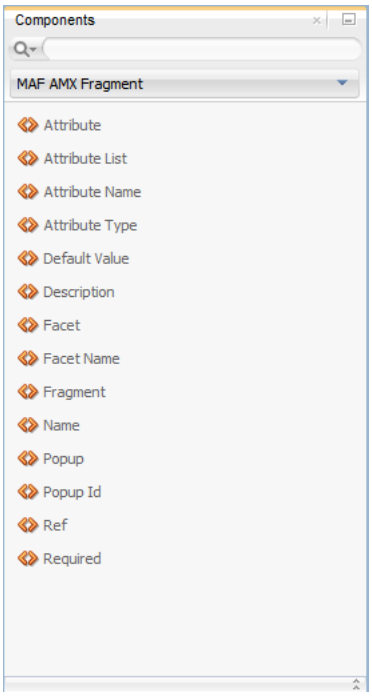
5. Proceed by defining the Fragment's **Attribute** and other children by right-clicking that child in the Structure view and selecting appropriate values (see Figure 5–45).

Figure 5–45 Defining Fragment's Attribute



You can also define the Fragment by dragging and dropping its elements onto the MAF AMX fragment file by selecting **MAF AMX Fragment** in the Components window (see Figure 5–46).

Figure 5–46 Dragging and Dropping Fragment Elements



Example 5–11 shows a MAF AMX fragment file called `fragment1.amxf`.

Example 5–11 Fragment Definition

```
<amx:fragmentDef
   xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
   xmlns:amx="http://xmlns.oracle.com/adf/mf/amx"
   xmlns:dvtm="http://xmlns.oracle.com/adf/mf/amx/dvt">
   <fragment xmlns="http://xmlns.oracle.com/adf/mf/amx/fragment" id="f1">
      <description id="d1">Description of the fragment</description>
      <facet id="f2">
         <description id="d4">Description of the facet</description>
         <facet-name id="f3">facet1</facet-name>
      </facet>
      <attribute id="a1">
         <description id="d2">Description of an attribute</description>
         <attribute-name id="a2">text</attribute-name>
         <attribute-type id="at1">String</attribute-type>
         <default-value id="d3">defaultValue</default-value>
      </attribute>
   </fragment>
   <amx:panelGroupLayout id="pgl1">
      <amx:facetRef facetName="facet1" id="fr1"/>
      <amx:outputText value="#{text}" id="ot1"/>
   </amx:panelGroupLayout>
</amx:fragmentDef>
```

To include the contents of the fragment in the MAF AMX page, you create a Fragment component (see Section 6.2.13, "How to Use the Fragment Component") and set its `src` attribute to the fragment file of your choice. Example 5–12 shows a `fragment` element added to a MAF AMX page. This element points to the `fragment1.amxf` as its page contents. At the same time, the `facetRef` element, which corresponds to the Facet Definition MAF AMX component, points to `facet1` as its `facet` (MAF AMX Facet

component). The `facetRef` element can only be specified in the `.amxf` file within the `fragmetDef`. You can pass attributes to the `facetRef` by specifying the MAF AMX `attribute` element as its child, which allows you to pass an EL variable from the Fragment to a Facet through the `attribute`'s value.

Example 5–12 Fragment in MAF AMX Page

```
<?xml version="1.0" encoding="UTF-8" ?>
<amx:view xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
          xmlns:amx="http://xmlns.oracle.com/adf/mf/amx"
          xmlns:dvtm="http://xmlns.oracle.com/adf/mf/amx/dvt">
   <amx:panelPage id="pp1">
      <amx:panelGroupLayout layout="vertical"
                            id="itemPgl"
                            styleClass="amx-style-groupbox">
         <amx:fragment id="f1"
                       src="/simpleFragment.amxf"
            <amx:attribute id="a1"
                           name="text"
                           value="defaultValue" />
            <amx:facet name="facet">
               <amx:outputText id="ot5" value="Fragment"/>
            </amx:facet>
         </amx:fragment>
      </amx:panelGroupLayout>
   </amx:panelPage>
</amx:view>
```

The Fragment receives all the information through its attributes. In addition to defining individual attributes, you can define a set of attributes to be passed to the Fragment as a list which could be iterated through in the Fragment definition. For more information, see Section 5.3.1.6.2, "Passing List of Attributes with Metadata to a Fragment."

The Fragment supports the following:

- Embedded popups (see Section 6.2.8, "How to Use a Popup Component").
- Reusable user interface that can be placed on one or more other parent pages or fragments. This allows you to create a component that is composed of other components without bindings.
- Definition of its own facets. This allows you to create a component such as a layout component that defines a header facet, summary facet, and detail facet, with each facet having its own style class as well as look and feel.
- Data model with both attributes and collections.

MAF sample applications called FragmentDemo and CompGallery demonstrate how to create and use the fragment. These sample applications are located in the `PublicSamples.zip` file within the *`jdev_install`*`/jdeveloper/jdev/extensions/oracle.maf/Samples` directory on your development computer.

5.3.1.6.1 Configuring the Fragment Content

When you drag and drop a MAF AMX fragment file (`.amxf`) onto a MAF AMX page or another fragment file, the Configure Fragment Content dialog (see Figure 5–47) appears. This dialog displays and allows you to specify all Fragment attributes that are defined as direct children of the Fragment.

Note: Facets, Popup components, Attribute Lists and their artifacts are not available through the Configure Fragment Content dialog.

Figure 5–47 Configure Fragment Content Dialog

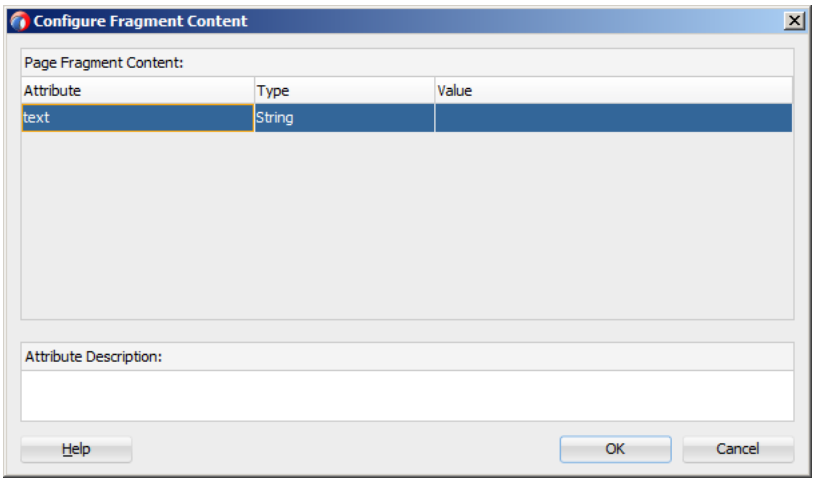
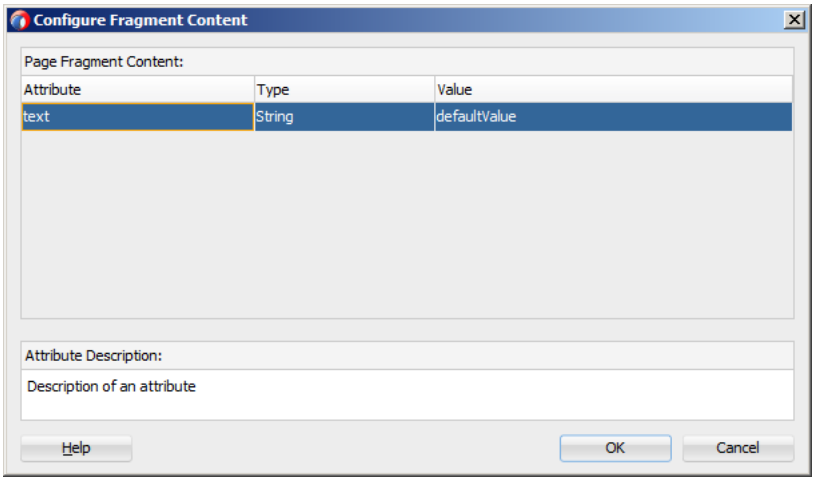


Figure 5–48 demonstrates the Configure Fragment Content dialog that appears when you drag and drop the MAF AMX fragment file whose contents is shown in Example 5–11 onto a MAF AMX file.

Figure 5–48 Configure Fragment Content Dialog with Values



When completing the dialog, consider the following:

- If you are configuring an attribute defined as required in the Fragment, an asterisks (*) is displayed at the end of the attribute name.
- The OK button of the dialog is disabled until all of the required attribute values have been defined.
- If the Fragment attribute's default value is specified and at the same time the `required` property is defined and set to `true`, this attribute is not treated as required (the default value takes precedence). In this case, the following occurs:
  - An audit warning is displayed in the Fragment.

  - The Configure Fragment Content dialog does not add the asterisk to the attribute's name and does not treat this attribute as required.

- The Type column displays the value of the `attribute-type` element from the Fragment. It is used as a description of the attribute type (as opposed to the Java class).

  Note: Even though the `attribute-type` is a required element in the Fragment, it might appear unspecified in the Fragment being dropped if you failed to define its value. In this case the dialog displays String as a default value.

- The Value column allows you to specify the value to pass to the Fragment's attribute. You can enter the value by typing it or clicking on the ellipsis (…) to invoke the EL Builder and specify an EL expression. If the `default` element is present for the given attribute in the Fragment, this default value is specified in the Value column for the attribute. You can override the default value.
- If the `description` element is present in the Fragment for this attribute, the bottom portion of the dialog displays the Attribute Description field when you switch between rows of different attributes. If the description element is not defined, the Attribute Description field is blank.
- You cannot add, remove, or reorder attributes using the Configure Fragment Content dialog.

5.3.1.6.2 Passing List of Attributes with Metadata to a Fragment

When defining the Fragment attributes, MAF allows you to do the following:

- Pass in dynamic attributes.
- Have metadata associated with each attribute (see Section 5.3.1.6.2, "Passing List of Attributes with Metadata to a Fragment").
- Loop over attributes in the Fragment definition.
- Nest dynamic attributes in an attribute.
- Pass dynamic attributes from one Fragment to an embedded Fragment.

Table 5–4 lists direct and indirect child elements of the MAF AMX `fragment` that enable you to pass lists of attributes.

Table 5–4 Attribute-Related Child Elements of the Fragment

Child Attribute Name	Description
`attributeList`	Defines an attribute list to pass to a Fragment. Can be a direct child of the MAF AMX `fragment` or `attributeSet` element. There can be any number of the child `attributeList` elements defined for a parent element. The `attributeList` element may be referenced by another `attributeList` through its `ref` attribute. An attribute list may be passed from one Fragment to another by reference, in which case both attribute lists must have the same metadata.

Table 5–4 (Cont.) Attribute-Related Child Elements of the Fragment

Child Attribute Name	Description
`attributeSet`	Can be specified as a child of the MAF AMX `attributeList`. Defines one set of attributes to be used during an iteration of the MAF AMX `attributeListIterator`. May be thought of as one item in an array. There can be any number of the child `attributeSet` elements defined for a parent `attributeList` element.
`attributeListIterator`	Consumes a MAF AMX `attributeList`. Behaves similarly to the MAF AMX Iterator in terms of stamping, but exposes attributes differently, with its `name` attribute tying the iterator to the `attributeList`. When one `attributeListIterator` is nested inside another, the `name` must point to the `attributeList` which is a child of the `attributeSet` currently being processed by the `attributeListIterator`. During the iteration, the defined attribute names are exposed as EL variables. For attributes that are not provided by the caller and in cases when the attribute has no default value, the value `adf.mf.api.OptionalFragmentArgument` is used as an EL variable. You may test for this condition by using the empty EL keyword (for example, `rendered="#{not (empty myAttribute)}"`).

For information on attributes and their values, see *Oracle Fusion Middleware Tag Reference for Oracle Mobile Application Framework*.

Example 5–13 demonstrates the basic case of passing an Attribute List to a MAF AMX Fragment.

Example 5–13 Passing Basic Attribute List

```
<amx:fragment src="something.amxf">
   <amx:attributeList name="attributeToPass" ref="nameOfAnOuterAttributeList" />
</amx:fragment>
```

Example 5–14 shows the `fragment` element with the child `attributeList` defined in the MAF AMX file.

Example 5–14 Attribute List Definition

```
<amx:fragment src="summaryView.amxf">
   <amx:attributeList name="attrs">
      <amx:attributeSet>
         <amx:attribute name="attribute" value="#{bindings.firstName}"/>
         <amx:attribute name="displayType" value="string" />
      </amx:attributeSet>
      <amx:attributeSet>
         <amx:attribute name="attribute" value="#{bindings.lastName}"/>
         <amx:attribute name="displayType" value="string" />
      </amx:attributeSet>
      <amx:attributeSet>
         <amx:attribute name="attribute" value="#{bindings.homePhone}"/>
         <amx:attribute name="displayType" value="phone" />
      </amx:attributeSet>
   </amx:attributeList>
</amx:fragment>
```

Example 5–15 shows nested `attributeList` elements defined within the `fragment` element in the MAF AMX file.

Example 5–15 Nested Attribute List Definition

```
<amx:fragment src="summaryView.amxf">
   <amx:attributeList name="attrs">
      <amx:attributeSet>
         <amx:attribute name="attribute" value="#{bindings.firstName}"/>
         <amx:attribute name="displayType" value="string" />
      </amx:attributeSet>
      <amx:attributeSet>
         <amx:attribute name="attribute" value="#{bindings.lastName}"/>
         <amx:attribute name="displayType" value="string" />
      </amx:attributeSet>
      <amx:attributeSet>
         <amx:attribute name="attribute" value="#{bindings.homePhone}"/>
         <amx:attribute name="displayType" value="phone" />
      </amx:attributeSet>
      <amx:attributeSet>
         <amx:attributeList name="subAttributes">
            <amx:attributeSet>
               <amx:attribute name="attribute"
                              value="#{bindings.spouseFirstName}"/>
               <amx:attribute name="displayType"
                              value="string" />
            </amx:attributeSet>
            <amx:attributeSet>
               <amx:attribute name="attribute"
                              value="#{bindings.spouseLastName}"/>
               <amx:attribute name="displayType"
                              value="string" />
            </amx:attributeSet>
         </amx:attributeList>
         <amx:attribute name="label" value="Spouse"/>
      </amx:attributeSet>
   </amx:attributeList>
</amx:fragment>
```

Example 5–16 shows how a Fragment with defined Attribute List components is used within the Fragment Definition. The `amxf:attribute-list` tag defines the metadata for an Attribute List. This tag must be declared as a child of the `amxf:fragment` or another `amxf:attribute-list` tag and its valid child tags are `amxf:name`, `amxf:description`, `amxf:attribute-list`, and `amxf:attribute`. The `name` child is required and must be unique within the current XML node. Even though the name could be identical to the `amxf:attribute` that is declared on the same level, such naming practice is not recommended.

Example 5–16 Attribute List Usage in Fragment Definition

```
<amx:fragmentDef
   xmlns:amx="http://xmlns.oracle.com/adf/mf/amx"
   xmlns:dvtm="http://xmlns.oracle.com/adf/mf/amx/dvt">
   <fragment xmlns="http://xmlns.oracle.com/adf/mf/amx/fragment">
      <attribute-list>
         <name>attributes</name>
         <attribute>
            <attribute-name>attribute</attribute-name>
         </attribute>
         <attribute>
```

```
            <attribute-name>displayType</attribute-name>
         </attribute>
         <attribute>
            <attribute-name>label</attribute-name>
         </attribute>
         <attribute-list>
            <name>subAttributes</name>
            <attribute>
               <attribute-name>attribute</attribute-name>
            </attribute>
            <attribute>
               <attribute-name>displayType</attribute-name>
            </attribute>
         </attribute-list>
      </attribute-list>
   </fragment>
   ...
   <amx:attributeListIterator name="attributes">
      <amx:panelLabelAndMessage label="#{attribute.hints.label}"
                                id="plam1"
                                rendered="#{not (empty attribute)}">
         <amx:outputText value="#{attribute.inputValue}" id="ot1"/>
      </amx:panelLabelAndMessage>
      <amx:outputText value="#{label}"
                      id="ot2"
                      rendered="#{not (empty label)}"/>
      <amx:attributeListIterator name="subAttributes"
                                 rendered="#{not (empty subAttributes)}">
         <amx:panelLabelAndMessage label="#{attribute.hints.label}"
                                   id="plam2"
                                   rendered="#{not (empty attribute)}">
            <amx:outputText value="#{attribute.inputValue}" id="ot3"/>
         </amx:panelLabelAndMessage>
      </amx:attributeListIterator>
   </amx:attributeListIterator>
   ...
</amx:fragmentDef>
```

The `attribute-list`, `attribute-set`, and `attribute` tags could be used in the `fragment` node to define the following:

- Attribute List components that are allowed.
- The information necessary to validate the page that is calling the Fragment.

5.3.2 How to Add UI Components and Data Controls to a MAF AMX Page

After you create a MAF AMX page, you can start adding MAF AMX UI components and data controls to your page.

5.3.2.1 Adding UI Components

You can use the Components window to drag and drop MAF AMX components and MAF AMX data visualization components onto the page. JDeveloper then adds the necessary declarative page code and sets certain values for component attributes.

The Components window displays MAF AMX components by categories (see Figure 5–49):

- General Controls

- Text and Selection
- Data Views
- Layout, with the following subcategories:
  - Interactive Containers and Headers
  - Secondary Windows
  - Core Structure
- Operations, with the following subcategories:
  - Behavior
  - Listeners
  - Validators and Converters

For information on adding and using specific components, see Section 6.3, "Creating and Using UI Components."

The Components window also displays MAF AMX data visualization components by categories (see Figure 5–49):

- Common, with the following subcategories:
  - Chart
  - Gauge
  - Map
  - Miscellaneous
- Shared Child Tags
- Other Type-Specific Child Tags, with the following subcategories:
  - Chart
  - Gauge
  - NBox
  - Thematic Map
  - Timeline
  - Sunburst and Treemap

Before you begin:

The MAF application must include a View Controller project, which may or may not contain a MAF AMX page or MAF AMX page task flow from which to create a page.

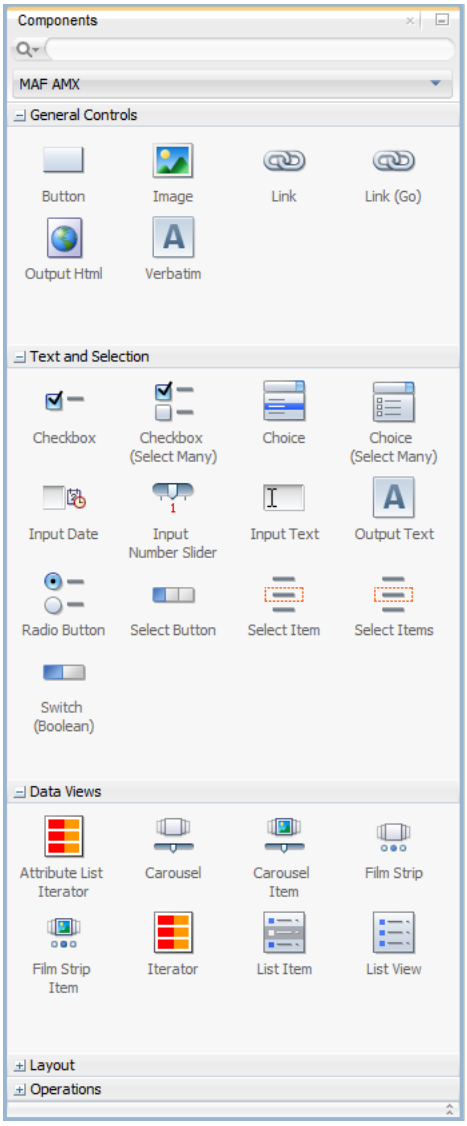
As described in Section 5.3.1.2, "Creating MAF AMX Pages," you can invoke the Create MAF AMX Page dialog by double-clicking a view icon in a task flow diagram or by selecting **Client Tier > Mobile Application Framework > MAF AMX Page** from the New Gallery.

To add UI components to a page:

1. Open a MAF AMX page in the Source editor (default).
2. In the Components window, use the menu to choose **MAF AMX**, as Figure 5–49 shows.

Tip: If the Components window is not displayed, choose **Window > Components** from the main JDeveloper menu. By default, the Components is displayed in the upper right-hand corner of JDeveloper.

Figure 5–49 MAF AMX Components Window



3. Select the component you wish to use, and then drag and drop it onto the Source editor or Structure window. You cannot drop components onto the Preview pane.

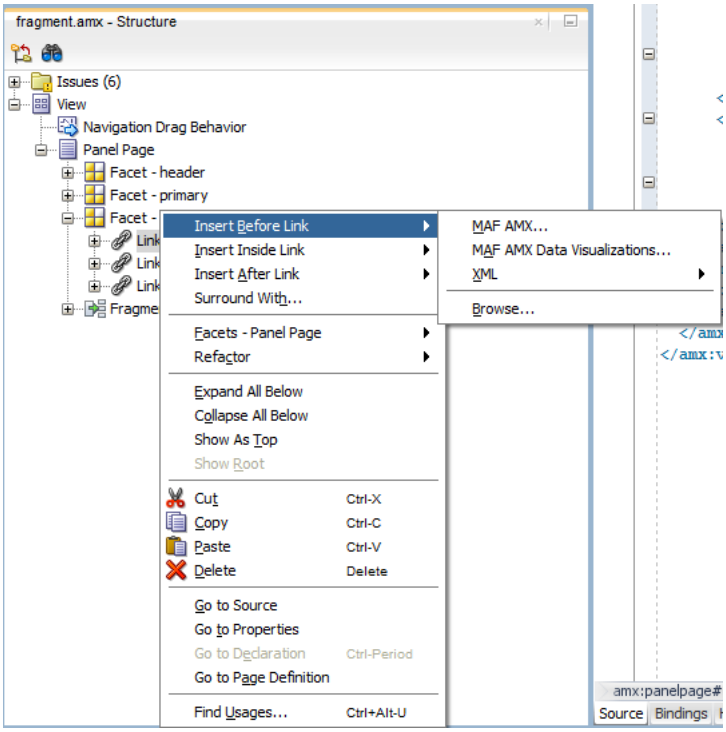
Note: When building a MAF AMX page, you can only drop UI components into UI containers such as, for example, a Panel Group Layout.

JDeveloper redraws the page in the Preview pane with the newly added component.

Alternatively, you can add UI components and data visualization components from the Structure window as follows:

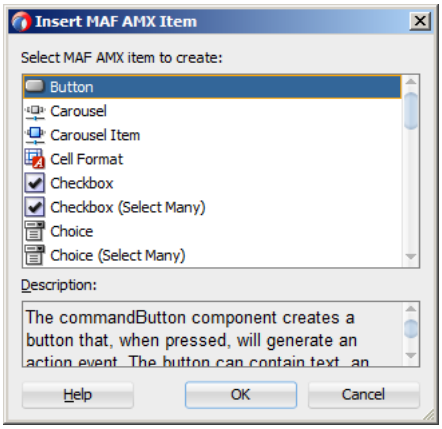
1. On the Structure window, select an existing component that you want to use as a starting point for inserting another component.
2. Right-click the selected component and choose one of the options: **Insert Before <component>**, **Insert Inside <component>**, or **Insert After <component>**, as Figure 5–50 shows.

Figure 5–50 Inserting Components from Structure Window



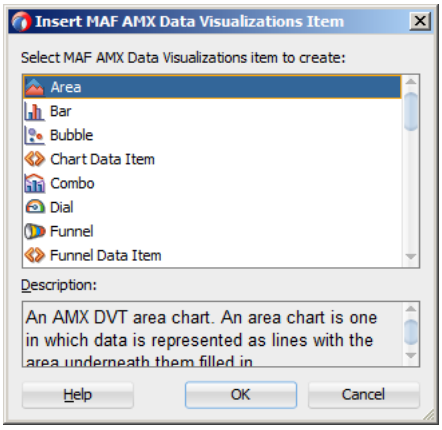
3. From the context menu, select either **MAF AMX** or **MAF AMX Data Visualizations**:
   - If you select **MAF AMX**, the **Insert MAF AMX Item** dialog opens allowing you to choose the UI component to add to the page, as Figure 5–51 shows.

Figure 5–51 Inserting MAF AMX Component



- If you select **MAF AMX Data Visualizations**, the **Insert MAF AMX Data Visualizations Item** dialog opens allowing you to choose the data visualization component to add to the page, as Figure 5–52 shows.

Figure 5–52 Inserting MAF AMX Data Visualization Component

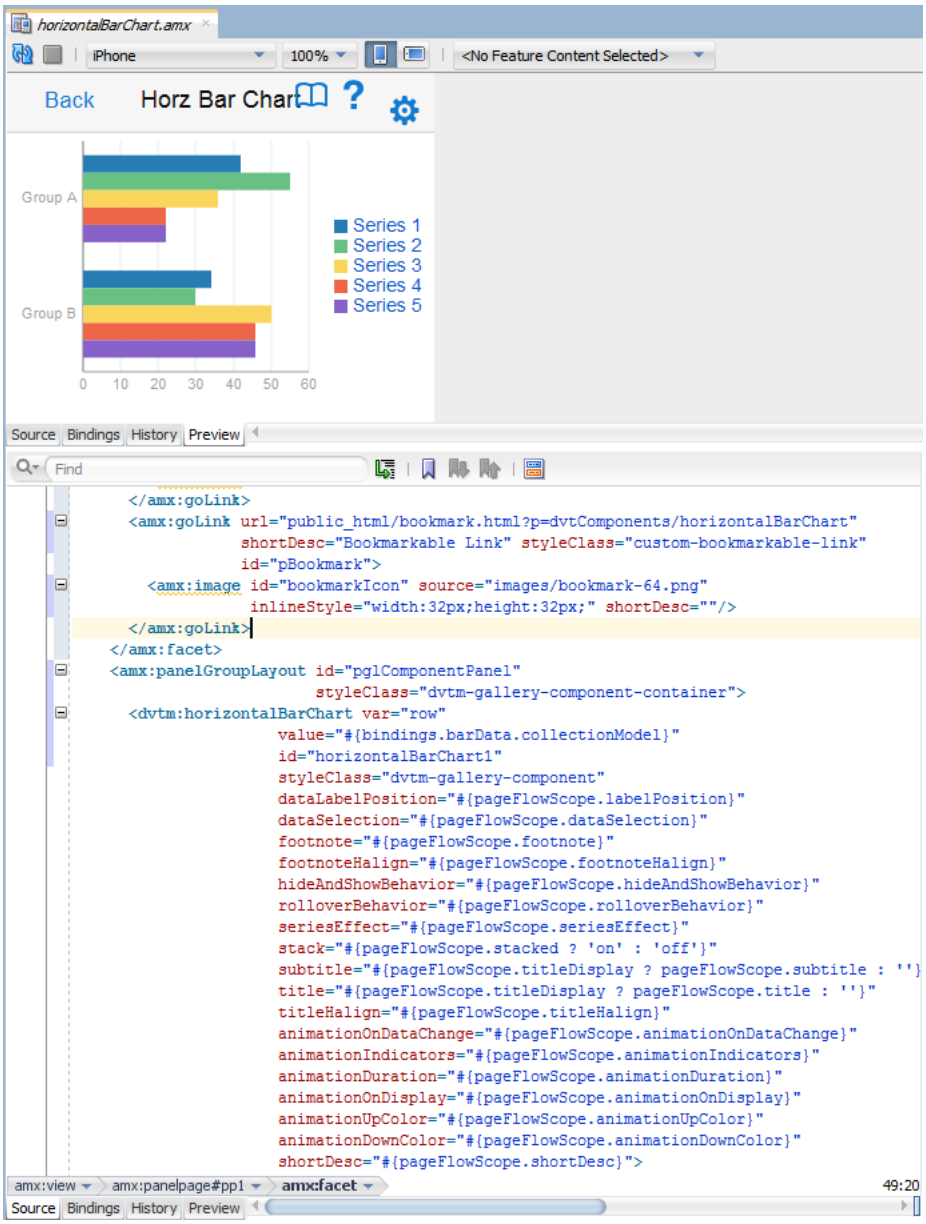


JDeveloper redraws the page in the Preview pane with the newly added component.

5.3.2.2 Using the Preview

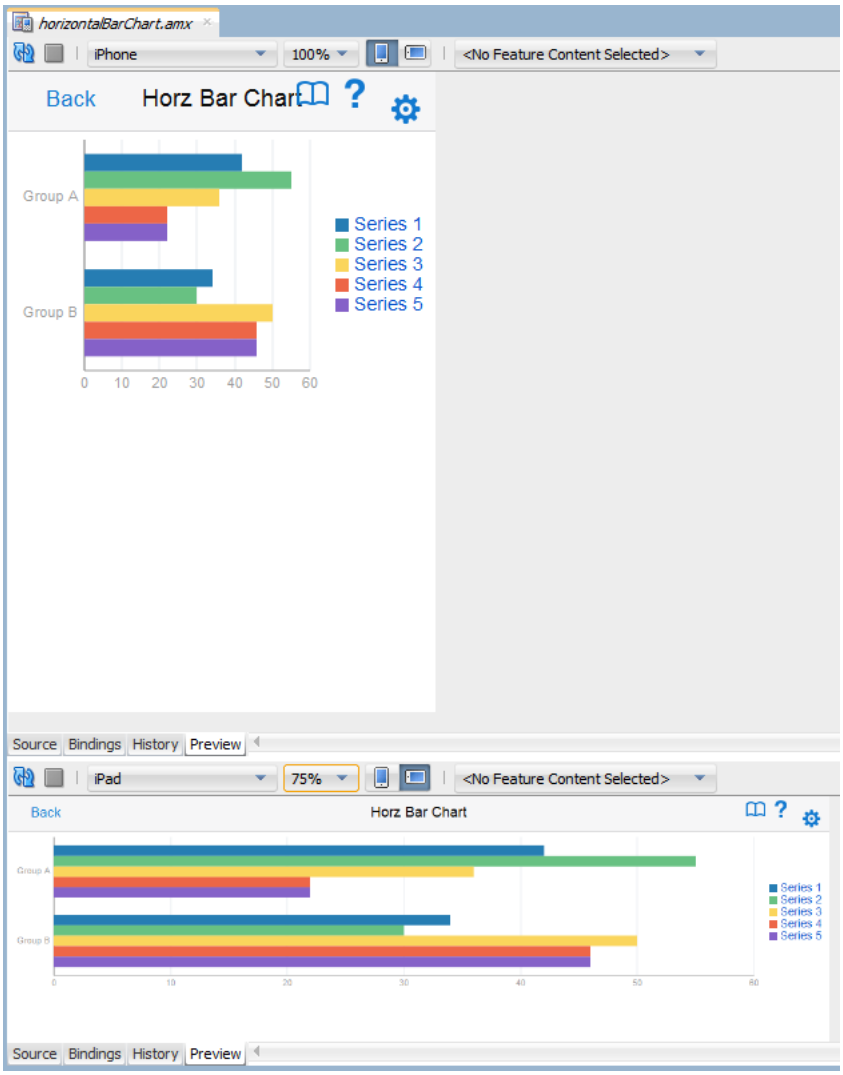
JDeveloper's Preview provides WYSIWYG support for both the iOS and Android platforms when you build the user interface using MAF AMX files. As illustrated in Figure 5–53, splitting a view while adding the MAF AMX components to the MAF AMX file enables you to see both the code view through the Source editor and a UI view through the Preview pane. As a result, you can modify the source and get instant feedback in terms of the look and feel of that application on both the iOS and Android platforms.

Figure 5–53 Splitting Design and Source Views



In addition to being able to see the design and source views simultaneously, you can also open and work with multiple design views at the same time, as well as set each one to a different platform and screen size. By opening a combination of design views for different devices, you can develop applications simultaneously for different platforms and form factors using different orientation. Figure 5–54 shows a split screen with iPhone on the top and iPad with 75% scaling on the bottom. You can split the Preview pane using the default split functionality of JDeveloper.

Figure 5–54 Multiple Design Views



Note: A MAF AMX page is rendered even for an invalid MAF AMX file. Errors are indicated by the error icon on a component. By moving the mouse over the error icon, you can view the error details.

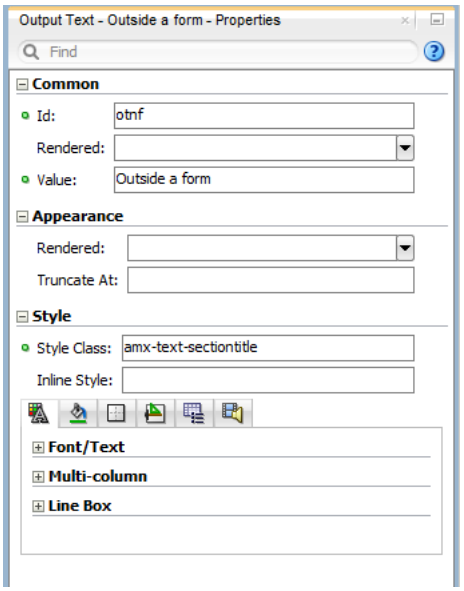
5.3.2.3 Configuring UI Components

Once you drop UI components onto a page, you can use the Properties window (displayed by default at the bottom right of JDeveloper) to set attribute values for each component.

Tip: If the Properties window is not displayed, choose **Window > Properties** from JDeveloper's main menu.

Figure 5–55 shows the Properties window displaying the attributes for an Output Text component.

Figure 5–55 The Properties Window



To set component attributes:

1. Select the component for which you want to set attributes. You can select the component in the Structure window or you can select its tag directly in the Source editor.
2. In the Properties window, expand the section that contains the attribute you wish to set.

   Tip: Some attributes are displayed in more than one section. Entering or changing the value in one section will also change it in any other sections. You can search for an attribute by entering the attribute name in the search field at the top of the Properties window.

3. In the Properties window, either enter values directly into the fields, or if the field contains a list, use that list to select a value. You can also use the list to the right of the field, which launches a popup containing tools you can use to set the value. These tools are either specific property editors (opened by choosing **Edit**) or the Expression Builder, which you can use to create EL expressions for the value (opened by choosing **Expression Builder** or **Method Expression Builder** where applicable). For more information about using the Expression Builder, see Section 7.3.2, "How to Create an EL Expression."

When you use the Properties window to set or change attribute values, JDeveloper automatically changes the page source for the attribute to match the entered value.

Tip: You can always change attribute values by directly editing the page in the Source editor. To view the page in the Source editor, click the **Source** tab at the bottom of the page.

5.3.2.4 Adding Data Controls to the View

You can create databound UI components in a MAF AMX view by dragging data control elements from the Data Controls window and dropping them into either the Structure window or the Source editor. When you drag an item from the Data Controls window to either of these places, JDeveloper invokes a context menu of default UI components available for the item that you dropped. When you select the desired UI

component, JDeveloper inserts it into a MAF AMX page. In addition, JDeveloper creates the binding information in the associated page definition file. If such file does not exist, then JDeveloper creates one. MAF provides a visual indicator for dropping data controls to inform you of the location of the new data control

> **Note:** A data control can only be dropped at a location allowed by the underlying XML schema.

Depending on the approach you take, you can insert different types of data controls into the Structure window of a MAF AMX page.

Dropping an attribute of a collection lets you create various input and output components. You can also create Button and Link components by dropping a data control operation on a page.

The respective action listener is added in the MAF AMX Button for each of these operations.

The data control attributes and operations can be dropped as one or more of the following MAF AMX UI components (see Section 6.3, "Creating and Using UI Components"):

- Button
- Link
- Input Date
- Input Date with Label
- Input Text
- Input Text with Label
- Output Text
- Output Text with Label
- Iterator
- List Item
- List View
- Select Boolean Checkbox
- Select Boolean Switch
- Select One Button
- Select One Choice
- Select One Radio
- Select Many Checkbox
- Select Many Choice
- Convert Date Time
- Convert Number
- Form
- Read Only Form
- Parameter Form

The following Date and Number types are supported:

- `java.util.Date`
- `java.sql.Timestamp`
- `java.sql.Date`
- `java.sql.Time`
- `java.lang.Number`
- `java.lang.Integer`
- `java.lang.Long`
- `java.lang.Float`
- `java.lang.Double`

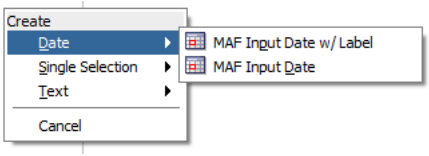
For information on how to use the Data Controls window in JDeveloper, see Section 7.6, "Creating Databound UI Components from the Data Controls Panel."

5.3.2.4.1 Dragging and Dropping Attributes If your MAF AMX page already contains a Panel Form Layout component or does not require to have all the fields added, you can drop individual attributes from a data control. Depending on the attributes types, different data binding menu options are provided as follows:

Date

This category provides options for creating MAF Input Date and MAF Input Date with Label controls. Figure 5–56 shows the context menu for adding date controls that appears when you drag an attribute from the Data Controls window onto the Source editor or Structure window of a MAF AMX page.

Figure 5–56 Context Menu for Date Controls



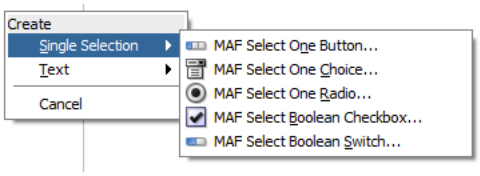
Single Selection

This category provides options for creating the following controls:

- MAF Select One Button
- MAF Select One Choice
- MAF Select One Radio
- MAF Select Boolean Checkbox
- MAF Select Boolean Switch

Figure 5–57 shows the context menu for adding selection controls that appears when you drag an attribute from the Data Controls window onto the Source editor or Structure window of a MAF AMX page.

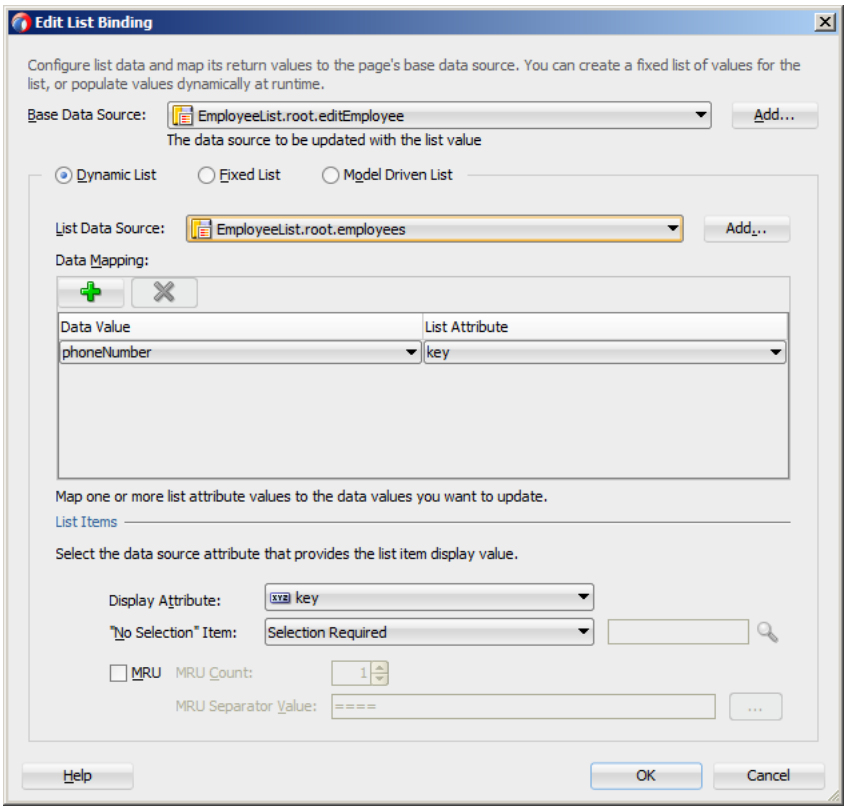
Figure 5–57 Context Menu for Selection Controls



If you are working with an existing MAF AMX page and you select **MAF Select One Button** or **MAF Select One Choice** option, an appropriate version of the Edit List Binding dialog is displayed (see Figure 5–58). If you drop a control onto a completely new MAF AMX page, the Edit Action Binding dialog opens instead. After you click OK, the Edit List Binding dialog opens.

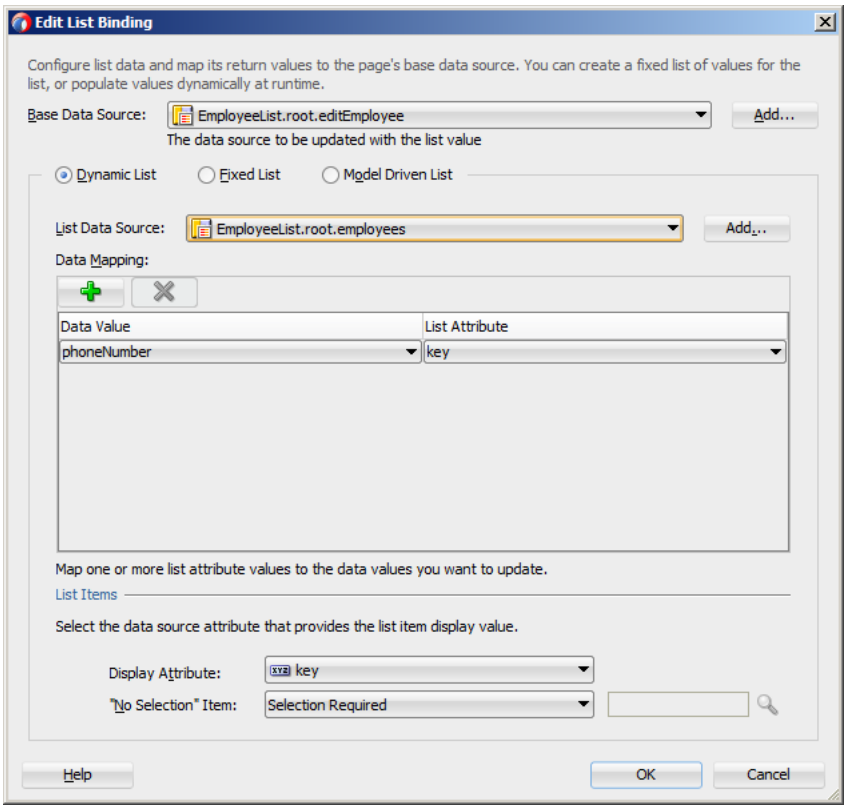
Note: The Edit List Binding or Edit Boolean Binding dialog appears every time you drop any data control attributes as any of the single selection or boolean selection components, respectively.

Figure 5–58 Edit List Binding Dialog for Select One Button and Choice Controls



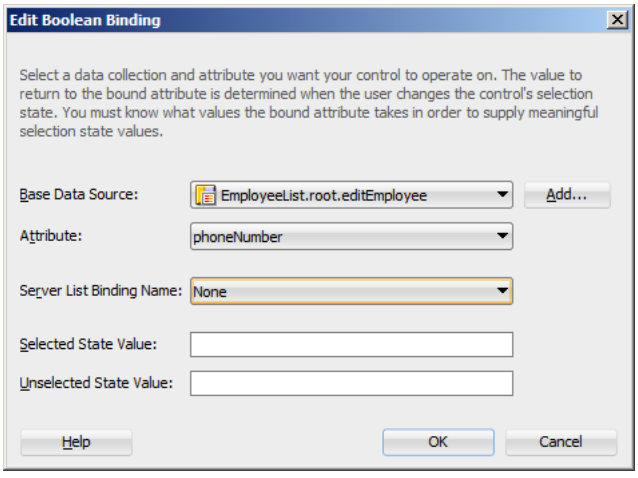
If you select **MAF Select One Radio** option, another version of the Edit List Binding dialog is displayed, as shown in Figure 5–59.

Figure 5–59 Edit List Binding Dialog for Select One Radio Control



If you select **MAF Select Boolean Checkbox** or **MAF Select Boolean Switch** option, another version of the Edit List Binding dialog is displayed, as shown in Figure 5–60.

Figure 5–60 Edit List Binding Dialog for Select Boolean Checkbox and Switch Controls



Text

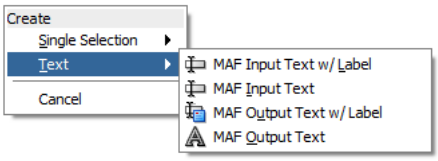
This category provides options for creating the following controls:

- MAF Input Text
- MAF Input Text with Label
- MAF Output Text

- MAF Output Text with Label

Figure 5–61 shows the context menu for adding text controls that appears when you drag an attribute from the Data Controls window onto the Source editor or Structure window of a MAF AMX page.

Figure 5–61 Context Menu for Text Controls



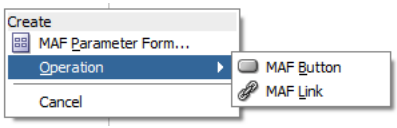
5.3.2.4.2 Dragging and Dropping Operations In addition to attributes, you can drag and drop operations and custom methods. Depending on the type of operation or method, different data binding menu options are provided, as follows:

Operation

This category is for data control operations. It provides the following options (see Figure 5–62):

- MAF Button
- MAF Link
- MAF Parameter Form

Figure 5–62 Context Menu for Operations



Note: If you drop an operation or a method as a child of the List View control, the context menu does not appear and the List Item is created automatically because no other valid control can be dropped as a direct child of the List View control. JDeveloper creates a binding similar to the following for the generated List Item:

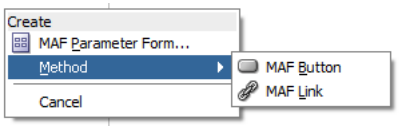
```
<amx:listItem actionListener="#{bindings.getLocation.execute}"/>
```

Method

This category is for custom methods. It provides the following options (see Figure 5–63):

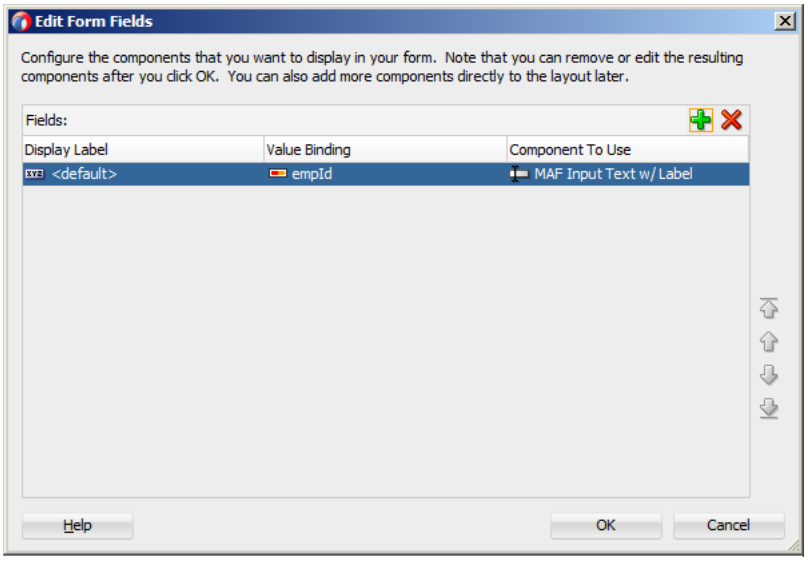
- MAF Button
- MAF Link
- MAF Parameter Form

Figure 5–63 Context Menu for Methods



The MAF Parameter Form option allows you to choose the method or operation arguments to be inserted in the form, as well as the respective controls for each of the arguments (see Figure 5–64).

Figure 5–64 Edit Form Fields Dialog



The following data bindings are generated after you select the appropriate options in the Edit Form Fields dialog:

```
<amx:panelFormLayout id="pfl1">
   <amx:inputText id="it1"
                  value="#{bindings.empId.inputValue}"
                  label="#{bindings.empId.hints.label}" />
</amx:panelFormLayout>
<amx:commandButton id="cb1"
                   actionListener="#{bindings.ExecuteWithParams1.execute}"
                   text="ExecuteWithParams1"
                   disabled="#{!bindings.ExecuteWithParams1.enabled}"/>
```

For more information about generated bindings, see Section 5.3.2.4.4, "What You May Need to Know About Generated Bindings."

The following are supported control types for the MAF Parameter Form:

- MAF Input Date
- MAF Input Date with Label
- MAF Input Text
- MAF Input Text with Label
- MAF Output Text with Label

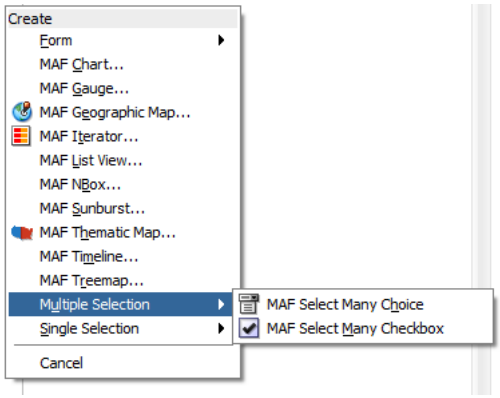
5.3.2.4.3 Dragging and Dropping Collections You can drag and drop collections. Depending on the type of collection, different data binding menu options are provided, as follows:

Multiple Selection

This category provides options for creating multiple selection controls. The following controls can be created under this category (see Figure 5–65):

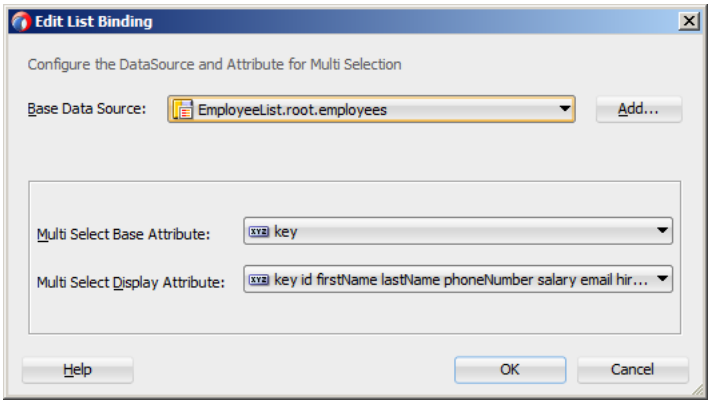
- MAF Select Many Checkbox
- MAF Select Many Choice

Figure 5–65 Context Menu for Multiple Selection Controls



If you select either **MAF Select Many Choice** or **MAF Select Many Checkbox** as the type of the control you want to create, the Edit List Binding dialog is displayed (see Figure 5–66).

Figure 5–66 Edit List Binding Dialog for Multiple Selection Controls

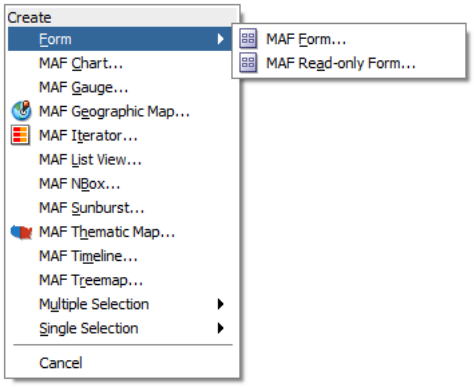


Form

This category is used to create the MAF AMX Panel Form controls. The following controls can be created under this category (see Figure 5–67):

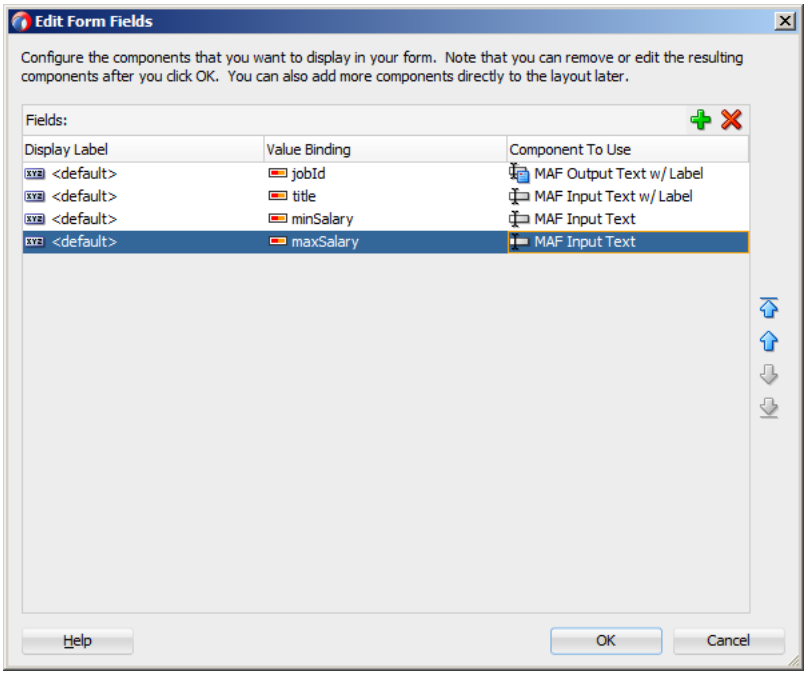
- MAF Form
- MAF Read-only Form

Figure 5–67 Context Menu for Form Controls



If you select **MAF Form** as the type of the form you want to create, a JDeveloper wizard is invoked that lets you choose the fields to be inserted in the form, as well as the respective controls for each of the fields (see Figure 5–68).

Figure 5–68 Edit Form Fields Dialog for MAF Form



The following data bindings are generated after you select the appropriate options in the Edit Form Fields dialog:

```
<amx:panelFormLayout id="pfl1">
   <amx:panelLabelAndMessage id="plam1" label="#{bindings.jobId.hints.label}">
      <amx:outputText id="ot1" value="#{bindings.jobId.inputValue}" />
   </amx:panelLabelAndMessage>
   <amx:inputText id="it4"
                  value="#{bindings.title.inputValue}"
                  label="#{bindings.title.hints.label}" />
   <amx:inputText id="it5"
                  value="#{bindings.minSalary.inputValue}"
                  simple="true" />
   <amx:inputText id="it3"
```

```
                    value="#{bindings.maxSalary.inputValue}"
                    simple="true" />
</amx:panelFormLayout>
```

For more information about generated bindings, see Section 5.3.2.4.4, "What You May Need to Know About Generated Bindings."

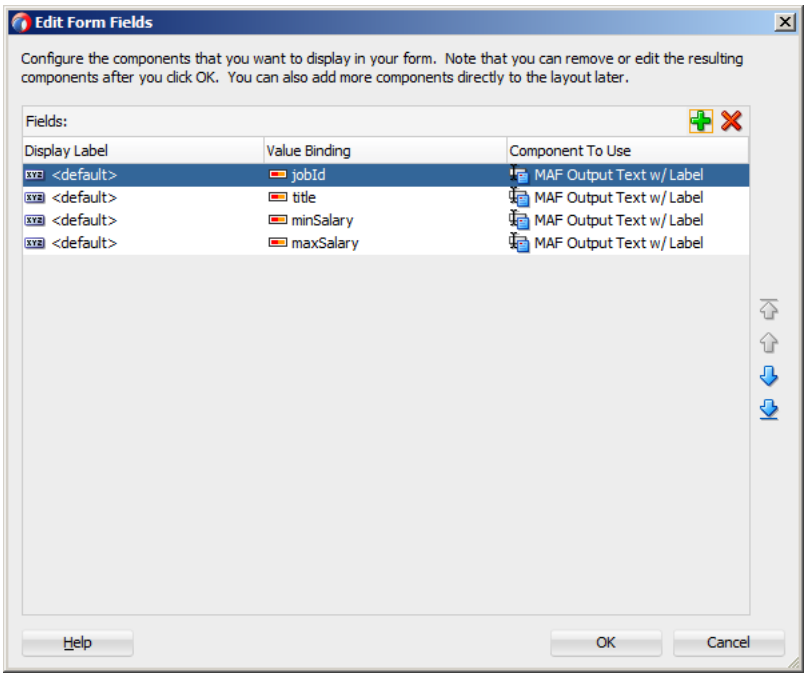
The following are supported controls for MAF Form:

- MAF Input Date
- MAF Input Date with Label
- MAF Input Text
- MAF Input Text with Label
- MAF Output Text with Label

> **Note:** Since MAF Output Text is not a valid Panel Form Layout child element as defined by the MAF schema, it is not supported.

If you select **MAF Read-only Form** as the type of the form you want to create, a JDeveloper wizard is invoked that lets you choose the fields to be inserted in the form, as well as the respective controls for each of the fields (see Figure 5–69).

Figure 5–69 Edit Form Fields Dialog for MAF Read-only Form



The following data bindings are generated after you select the appropriate options in the Edit Form Fields dialog:

```
<amx:panelFormLayout id="pfl1">
   <amx:panelLabelAndMessage id="plam4"
                             label="#{bindings.jobId.hints.label}">
      <amx:outputText id="ot4" value="#{bindings.jobId.inputValue}" />
   </amx:panelLabelAndMessage>
```

```
   <amx:panelLabelAndMessage id="plam1"
                             label="#{bindings.title.hints.label}">
      <amx:outputText id="ot1" value="#{bindings.title.inputValue}" />
   </amx:panelLabelAndMessage>
   <amx:panelLabelAndMessage id="plam3"
                             label="#{bindings.minSalary.hints.label}">
      <amx:outputText id="ot3" value="#{bindings.minSalary.inputValue}" />
   </amx:panelLabelAndMessage>
   <amx:panelLabelAndMessage  id="plam2"
                              label="#{bindings.maxSalary.hints.label}">
      <amx:outputText id="ot2" value="#{bindings.maxSalary.inputValue}" />
   </amx:panelLabelAndMessage>
</amx:panelFormLayout>
```

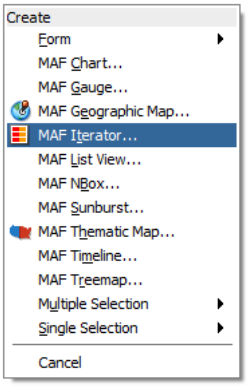
For more information about generated bindings, see Section 5.3.2.4.4, "What You May Need to Know About Generated Bindings."

The MAF Read-only Form only supports the MAF Output Text with Label control.

Iterator

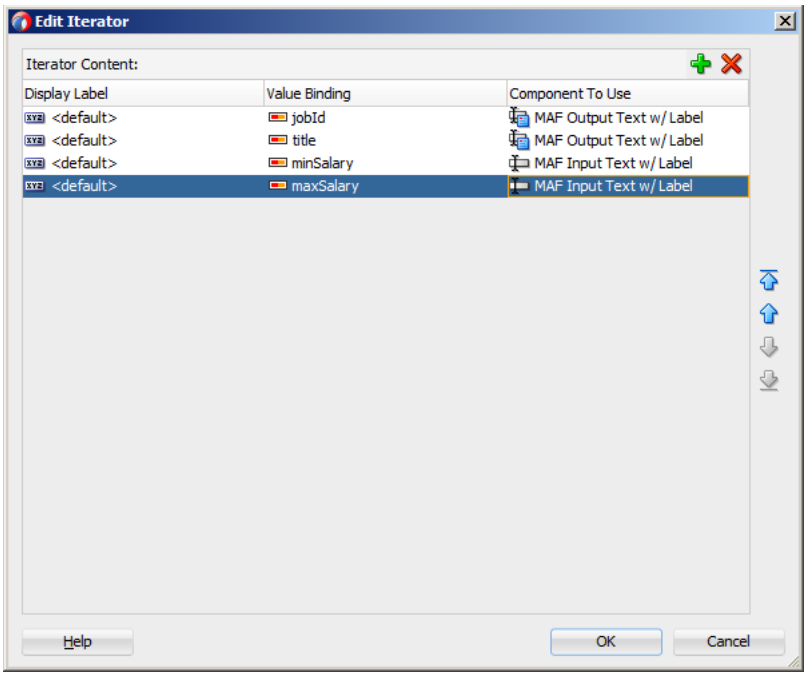
This provides an option for creating the MAF AMX Iterator with child components (see Figure 5–70).

Figure 5–70 Context Menu for Iterator Control



If you select **MAF Iterator** as the type of the control to create, a JDeveloper wizard is invoked that lets you choose the fields to be inserted in the iterator, as well as the respective controls for each of the fields, with **MAF Output Text w/Label** being a default selection (see Figure 5–71).

Figure 5–71 Edit Dialog for MAF Iterator



The following data bindings are generated after you select the appropriate options in the Edit Iterator dialog:

```
<amx:iterator id="i1"
              var="row"
              value="#{bindings.jobs.collectionModel}">
   <amx:panelLabelAndMessage id="plam6"
                             label="#{bindings.jobs.hints.jobId.label}">
      <amx:outputText id="ot6" value="#{row.jobId}" />
   </amx:panelLabelAndMessage>
   <amx:panelLabelAndMessage id="plam5"
                             label="#{bindings.jobs.hints.title.label}">
      <amx:outputText id="ot5" value="#{row.title}" />
   </amx:panelLabelAndMessage>
   <amx:inputText id="it1"
                  value="#{row.bindings.minSalary.inputValue}"
                  label="#{bindings.jobs.hints.minSalary.label}" />
   <amx:inputText id="it2"
                  value="#{row.bindings.maxSalary.inputValue}"
                  label="#{bindings.jobs.hints.maxSalary.label}" />
</amx:iterator>
```

For more information about generated bindings, see Section 5.3.2.4.4, "What You May Need to Know About Generated Bindings."

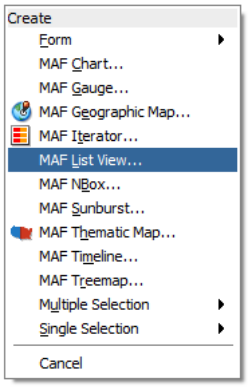
The following are supported controls for MAF Iterator:

- MAF Input Text
- MAF Input Text with Label
- MAF Output Text
- MAF Output Text with Label

List View

This provides an option for creating the MAF AMX List View with child components (see Figure 5–72).

Figure 5–72 Context Menu for List View Control



If you select **MAF List View** as the type of the control to create, the **ListView Gallery** opens that allows you to choose a specific layout for the List View, as Figure 5–73 shows.

Figure 5–73 ListView Gallery

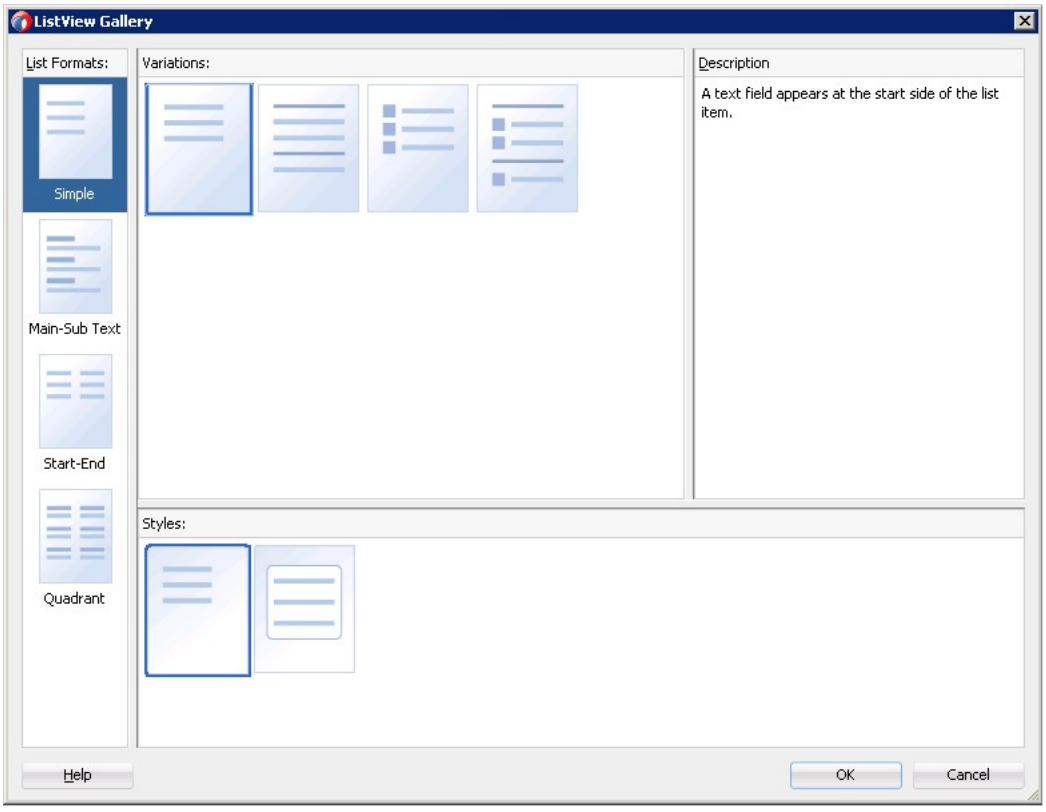


Table 5–5 lists the supported **List Formats** that are displayed in the ListView Gallery.

Table 5–5 List Formats

Format	Element Row Values
Simple	▪ Text
Main-Sub Text	▪ Main Text ▪ Subordinate Text
Start-End	▪ Start Text ▪ End Text
Quadrant	▪ Upper Start Text ▪ Upper End Text ▪ Lower Start Text ▪ Lower End Text

The **Variations** presented in the ListView Gallery (see Figure 5–73) for a selected list format consist of options to add either dividers, a leading image, or both:

- Selecting a variation with a leading image adds an Image row to the List Item Content table (see Figure 5–74).
- Selecting a variation with a divider defaults the Divider Attribute field to the first attribute in its list rather than the default No Divider value, and populates the Divider Mode field with its default value of All.

The **Styles** options presented in the ListView Gallery (see Figure 5–73) allow you to suppress chevrons, use an inset style list, or both:

- The selections do not modify any state in the Edit List View dialog (see Figure 5–74). They only affect the generated MAF AMX markup.
- Selecting a style with the inset list sets the `adfmf-listView-insetList` style class on the `listView` element in the generated MAF AMX markup.

The following is an example of the Simple format with the inset list:

```
<amx:listView var="row"
              value="#{bindings.employees.collectionModel}"
              fetchSize="#{bindings.employees.rangeSize}"
              styleClass="adfmf-listView-insetList"
              showMoreStrategy="autoScroll"
              bufferStrategy="viewport"
              id="listView2">
   <amx:listItem id="li2">
      <amx:outputText value="#{row.employeename}" id="ot3"/>
   </amx:listItem>
</amx:listView>
```

The ListView Gallery's **Description** pane is updated based on the currently selected Variation. The format will include a brief description of the main style, followed by the details of the selected variation. Four list formats with four variations on each provide sixteen unique descriptions detailed in Table 5–6.

Table 5–6 List View Formats and Variations

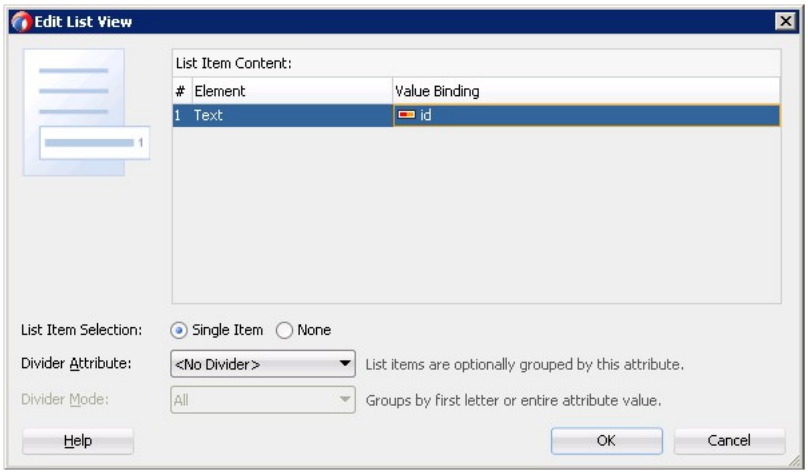
List Format	Variation	Description
Simple	Basic	A text field appears at the start side of the list item."

Table 5–6 (Cont.) List View Formats and Variations

List Format	Variation	Description
Simple	Dividers	A text field appears at the start side of the list item, with items grouped by dividers."
Simple	Images	A text field appears at the start side of the list item, following a leading image.
Simple	Dividers and Images	A text field appears at the start side of the list item, following a leading image. The list items are grouped by dividers.
Main-Sub Text	Basic	A prominent main text field appears at the start side of the list item with subordinate text below.
Main-Sub Text	Dividers	A prominent main text field appears at the start side of the list item with subordinate text below. The list items are grouped by dividers.
Main-Sub Text	Images	A prominent main text field appears at the start side of the list item with subordinate text below, following a leading image.
Main-Sub Text	Dividers and Images	A prominent main text field appears at the start side of the list item with subordinate text below, following a leading image. The list items are grouped by dividers.
Start-End	Basic	Text fields appear on each side of the list item
Start-End	Dividers	Text fields appear on each side of the list item, with the items grouped by dividers.
Start-End	Images	Text fields appear on each side of the list item, following a leading image.
Start-End	Dividers and Images	Text fields appear on each side of the list item, following a leading image. The list items are grouped by dividers.
Quadrant	Basic	Text fields appear in the four corners of the list item.
Quadrant	Dividers	Text fields appear in the four corners of the list item, with items grouped by dividers.
Quadrant	Images	Text fields appear in the four corners of the list item, following a leading image.
Quadrant	Dividers and Images	Text fields appear in the four corners of the list item, following a leading image. The list items are grouped by dividers.

After you make your selection from the ListView Gallery and click **OK**, the **Edit List View** wizard is invoked that lets you create the contents of a List Item by mapping binding attributes to the elements of the selected List View format, as Figure 5–74 shows.

Figure 5–74 Edit Dialog for MAF AMX List View



When completing the dialog that Figure 5–74 shows, consider the following:

- The image at the start reflects the main content elements from the selected List View format and provides a mapping from the schematic representation to the named elements in the underlying table.
- The read-only cells in the **Element** column derive from the selected List View format.
- The editable cells in the **Value Binding** column are based on the data control node that was dropped.
- The List Item is generated as either an Output Text or Image component, depending on whichever is appropriate for the particular element.
- Since the number of elements (rows) is predetermined by the selected List View format, rows cannot be added or removed.
- The order of elements cannot be modified.
- The **List Item Selection** indicates the selection mode, which can be either a single item selection (default) or no selection. The `showLinkIcon` attribute of the List View is updated based on the selection mode: if the selection mode is set to **None**, `showLinkIcon` attribute is set to `false`; otherwise `showLinkIcon` attribute is not modified (for example, defaulted to `true`).

  The following attributes of the `listView` enable the functioning of the selection mode:

  – `selectionListener`: defines a method reference to a selection listener.

  – `selectedRowKeys`: indicates the selection state for this component.

  If the **Single Item** option is chosen, the Edit List View dialog automatically sets these attributes as follows:

  – `selectionListener` is set to `"bindings.treebinding.collectionModel.makeCurrent"`

  – `selectedRowKeys` is set to `"bindings.treebinding.collectionModel.selectedRow"`

  The `selectionListener` attribute has the **Edit** option available from the Properties window which allows you to create a managed bean class, as well as an appropriate managed bean method, similar to any other listener attributes (see

Figure 5–75 and Figure 5–76).

Figure 5–75 Editing Selection Listener Attribute

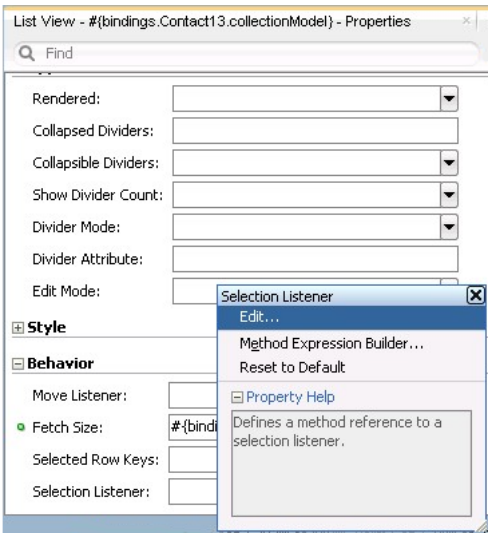
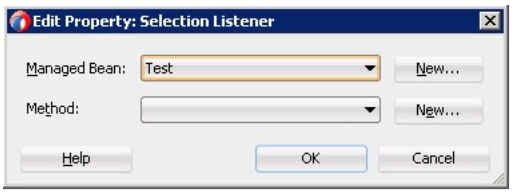


Figure 5–76 Edit Selection Listener Dialog



Example 5–17 shows the selection-related attributes of the `listView` element in the MAF AMX file. This declaration is generated when **Single Item** is chosen in the Edit List View dialog (see Figure 5–74.

Example 5–17 Selection Attributes of List View

```
<amx:listView id="listView1"
              var="row"
              value="#{bindings.employees.collectionModel}"
              fetchSize="#{bindings.employees.rangeSize}"
              showMoreStrategy="autoScroll"
              bufferStrategy="viewport"
              selectionListener=
                  "#{bindings.employees.collectionModel.makeCurrent}"
              selectedRowKeys=
                  "#{bindings.employees.collectionModel.selectedRow}">
   <amx:listItem id="listItem1">
      ...
   </amx:listItem>
</amx:listView>
```

If **None** was chosen as the **List Item Selection** option in the Edit List View dialog, then the `selectionListener` and `selectedRowKeys` attributes are not set as they do not have default values and do not appear in the MAF AMX file. At the same time, the List Item's `showLinkIcon` attribute is set to `false` (see Example 5–18).

Example 5–18 Omitting Selection Attributes in List View

```
<amx:listView id="listView1"
              var="row"
              value="#{bindings.employees.collectionModel}"
              fetchSize="#{bindings.employees.rangeSize}"
              showMoreStrategy="autoScroll"
              bufferStrategy="viewport">
   <amx:listItem id="listItem1" showLinkIcon="false">
      ...
   </amx:listItem>
</amx:listView>
```

The List View selection state is preserved when navigation occurs to or from a MAF AMX page.

Note: The selected row is respected if there is the same iterator ID across MAF AMX pages. For example, if you drag an `Employees` collection onto a page as a List View with `employeesIterator` as its iterator and then add a `Details` page, the selected row will only be respected if the `Details` page's employees iterator has its ID set to `employeesIterator`.

- The default value of the **Divider Attribute** field is No Divider, in which case the **Divider Mode** field is disabled. If you select value other than the default, then you need to specify Divider Mode parameters, as Figure 5–77 and Figure 5–78 show.

Figure 5–77 Specifying Divider Attribute

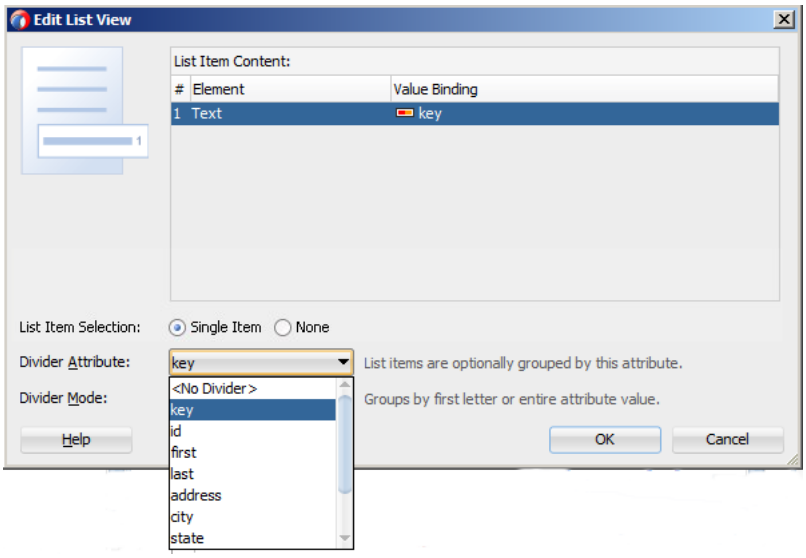
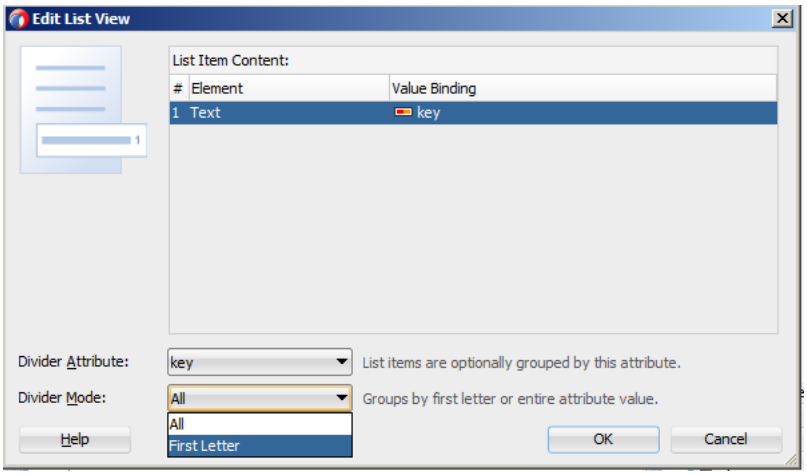


Figure 5–78 Specifying Divider Mode



For more information on List View dividers, see Section 6.3.15, "How to Use List View and List Item Components."

The following MAF AMX markup and data bindings are generated after you select the appropriate options in the Edit List View dialog:

```
<amx:listView id="listView1"
              var="row"
              value="#{bindings.employees.collectionModel}"
              fetchSize="#{bindings.employees.rangeSize}"
              showMoreStrategy="autoScroll"
              bufferStrategy="viewport"
              dividerAttribute="key"
              dividerMode="firstLetter"
              selectionListener=
                "#{bindings.employees.collectionModel.makeCurrent}"
              selectedRowKeys=
                "#{bindings.employees.collectionModel.selectedRow}">
   <amx:listItem id="listItem1" >
      <amx:outputText value="#{row.key}"
                      styleClass="adfmf-listItem-subtext"
                      id="outputText1"/>
   </amx:listItem>
</amx:listView>
```

For more information about generated bindings, see Section 5.3.2.4.4, "What You May Need to Know About Generated Bindings."

The following are supported controls for MAF List View:

- MAF Output Text
- MAF Image

5.3.2.4.4 What You May Need to Know About Generated Bindings

Table 5–7 shows sample bindings that are added to a MAF AMX page when components are dropped.

Table 5–7 Sample Data Bindings

Component	Data Bindings
Button	`<amx:commandButton id="commandButton1" actionListener="#{bindings.FindContacts.execute}" text="FindContacts" disabled="#{!bindings.FindContacts.enabled}"> </amx:commandButton>`
Link	`<amx:commandLink id="commandLink1" actionListener="#{bindings.FindContacts.execute}" text="FindContacts" disabled="#{!bindings.FindContacts.enabled}"> </amx:commandLink>`
Input Date with Label	`<amx:inputDate id="inputDate1" value="#{bindings.timeStamp.inputValue}" label="#{bindings.timeStamp.hints.label}"> </amx:inputDate>`
Input Date	`<amx:inputDate id="inputDate1" value="#{bindings.timeStamp.inputValue}"> </amx:inputDate>`
Input Text with Label	`<amx:inputText id="inputText1" value="#{bindings.contactData.inputValue}" label="#{bindings.contactData.hints.label}"> </amx:inputText>`
Input Text	`<amx:inputText id="inputText1" value="#{bindings.contactData.inputValue}" simple="true"> </amx:inputText>`
Output Text	`<amx:outputText id="outputText1" value="#{bindings.contactData.inputValue}"> </amx:outputText>`
Output Text with Label	`<amx:panelLabelAndMessage id="panelLabelAndMessage1" label="#{bindings.contactData.hints.label}"> <amx:outputText id="outputText1" value="#{bindings.contactData.inputValue}"/> </amx:panelLabelAndMessage>`
Select Boolean Checkbox	`<amx:selectBooleanCheckbox id="selectBooleanCheckbox1" value="#{bindings.contactData.inputValue}" label="#{bindings.contactData.label}"> </amx:selectBooleanCheckbox>`
Select Boolean Switch	`<amx:selectBooleanSwitch id="selectBooleanSwitch" value="#{bindings.contactData.inputValue}" label="#{bindings.contactData.label}"> </amx:selectBooleanSwitch>`
Select One Button	`<amx:selectOneButton id="selectOneButton1" value="#{bindings.contactData.inputValue}" label="#{bindings.contactData.label}" required="#{bindings.contactData.hints.mandatory}"> <amx:selectItems value="#{bindings.contactData.items}"/> </amx:selectOneButton>`

Table 5–7 (Cont.) Sample Data Bindings

Component	Data Bindings
Select One Choice	`<amx:selectOneChoice id="selectOneChoice1" value="#{bindings.contactData.inputValue}" label="#{bindings.contactData.label}"> <amx:selectItems id="selectItems1" value="#{bindings.contactData.items}"/> </amx:selectOneChoice>`
Select Many Checkbox	`<amx:selectManyCheckbox id="selectManyCheckbox1" value="#{bindings.AssetView.inputValue}" label="#{bindings.AssetView.label}"> <amx:selectItems id="selectItems1" value="#{bindings.AssetView.items}"/> </amx:selectManyCheckbox>`
Select One Radio	`<amx:selectOneRadio id="selectOneRadio1" value="#{bindings.contactData.inputValue}" label="#{bindings.contactData.label}" <amx:selectItems id="selectItems1" value="#{bindings.contactData.items}"/> </amx:selectOneRadio>`
Select Many Choice	`<amx:selectManyChoice id="selectManyChoice1" value="#{bindings.AssetView.inputValue}" label="#{bindings.AssetView.label}"> <amx:selectItems id="selectItems1" value="#{bindings.AssetView.items}"/> </amx:selectManyChoice>`

5.3.2.4.5 What You May Need to Know About Generated Drag and Drop Artifacts The first drag and drop event generates the following directories and files:

- \Application\ViewController\adfmsrc\
  - \mobile
    - \pageDefs
      - **view1PageDef.xml**
      - **view2PageDef.xml**
      - **...**
    - **DataBindings.cpx**

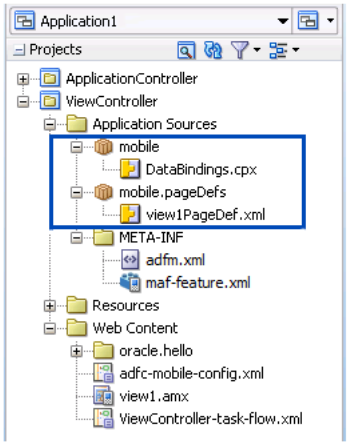


Figure 5–79 shows a sample `DataBindings.cpx` file generated upon drag and drop.

Figure 5–79 DataBindings.cpx File in Source View

The `DataBindings.cpx` files define the binding context for the entire MAF AMX application feature and provide the metadata from which the binding objects are created at runtime. A MAF AMX application feature may have more than one `DataBindings.cpx` file if a component was created outside of the project and then imported. These files map individual MAF AMX pages to page definition files and declare which data controls are being used by the MAF AMX application feature. At runtime, only the data controls listed in the `DataBindings.cpx` files are available to the current MAF AMX application feature.

JDeveloper automatically creates a `DataBindings.cpx` file in the default package of the ViewController project when you for the first time use the Data Controls window to add a component to a page or an operation to an activity. Once the `DataBindings.cpx` file is created, JDeveloper adds an entry for the first page or task flow activity. Each subsequent time you use the Data Controls window, JDeveloper adds an entry to the `DataBindings.cpx` for that page or activity, if one does not already exist.

Once JDeveloper creates a `DataBindings.cpx` file, you can open it in the Source view (see Figure 5–79) or the Overview editor.

The Page Mappings (`pageMap`) section of the file maps each MAF AMX page or task flow activity to its corresponding page definition file using an ID. The Page Definition Usages (`pageDefinitionUsages`) section maps the page definition ID to the absolute path for page definition file in the MAF AMX application feature. The Data Control Usages (`dataControlUsages`) section identifies the data controls being used by the binding objects defined in the page definition files. These mappings allow the binding container to be initialized when the page is invoked.

You can use the Overview editor to change the ID name for page definition files or data controls by double-clicking the current ID name and editing inline. Doing so will update all references in the MAF AMX application feature. Note, however, that JDeveloper updates only the ID name and not the file name. Ensure that you do not change a data control name to a reserved word.

You can also click the `DataBindings.cpx` file's element in the Structure window and then use the Properties window to change property values.

Figure 5–80 shows a sample `PageDef` file generated upon drag and drop.

Figure 5–80 PageDef File

```
<?xml version="1.0" encoding="UTF-8" ?>
<pageDefinition xmlns="http://xmlns.oracle.com/adfm/uimodel" version="12.1.1.60.73" id="view1PageDef"
                Package="mobile.pageDefs">
  <parameters/>
  <executables>
    <variableIterator id="variables"/>
    <methodIterator Binds="GetContacts.result" DataControl="DeviceDataControl" RangeSize="25"
                    BeanClass="oracle.adfmf.model.datacontrols.device.Contact" id="GetContactsIterator"/>
  </executables>
  <bindings>
    <methodAction id="GetContacts" RequiresUpdateModel="true" Action="invokeMethod" MethodName="GetContacts"
                  IsViewObjectMethod="false" DataControl="DeviceDataControl"
                  InstanceName="data.DeviceDataControl.dataProvider"
                  ReturnName="data.DeviceDataControl.methodResults.
                              GetContacts_DeviceDataControl_dataProvider_GetContacts_result"/>
    <attributeValues IterBinding="GetContactsIterator" id="contactData">
      <AttrNames>
        <Item Value="contactData"/>
      </AttrNames>
    </attributeValues>
  </bindings>
</pageDefinition>
```

Page definition files define the binding objects that populate the data in MAF AMX UI components at runtime. For every MAF AMX page that has bindings, there must be a corresponding page definition file that defines the binding objects used by that page. Page definition files provide design-time access to all the bindings. At runtime, the binding objects defined by a page definition file are instantiated in a binding container, which is the runtime instance of the page definition file.

The first time you use the Data Controls window to add a component to a page, JDeveloper automatically creates a page definition file for that page and adds definitions for each binding object referenced by the component. For each subsequent databound component you add to the page, JDeveloper automatically adds the necessary binding object definitions to the page definition file.

By default, the page definition files are located in the `mobile.PageDefs` package in the Application Sources node of the ViewController project. If the corresponding MAF AMX page is saved to a directory other than the default, or to a subdirectory of the default, then the page definition is also be saved to a package of the same name.

For information on how to open a page definition file, see Section 5.3.1.5, "Accessing the Page Definition File." When you open a page definition file in the Overview editor, you can view and configure bindings, contextual events, and parameters for a MAF AMX page using the following tabs:

- Bindings and Executables: this tab shows three different types of objects: bindings, executables, and the associated data controls. Note that data controls do not display unless you select a binding or executable.

  By default, the model binding objects are named after the data control object that was used to create them. If a data control object is used more than once on a page, JDeveloper adds a number to the default binding object names to keep them unique.

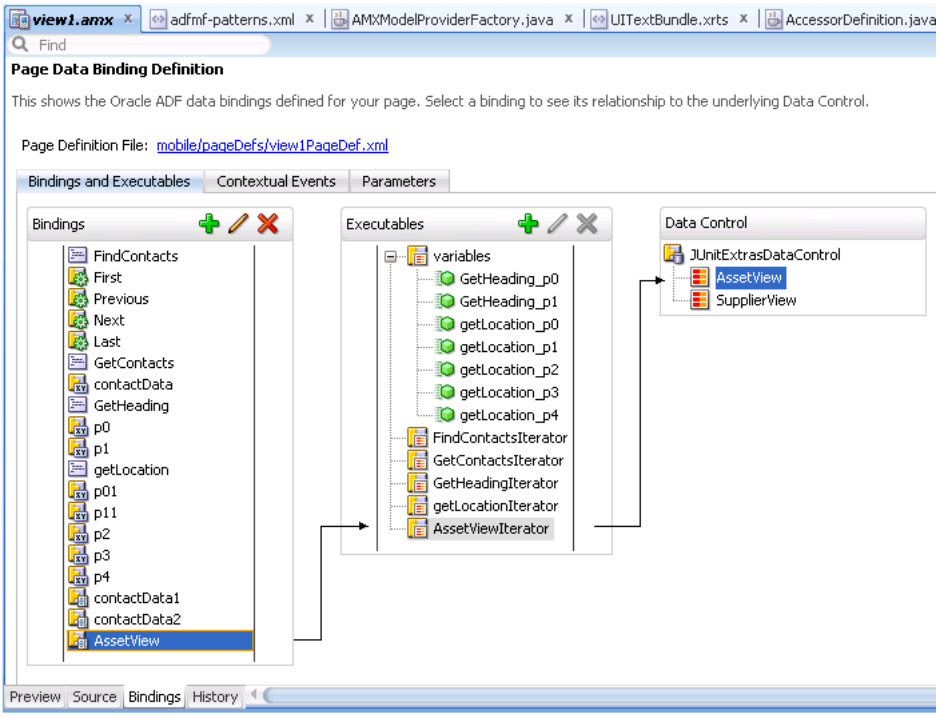
- Contextual Events: you can create contextual events to which artifacts in a MAF AMX application feature can subscribe.

- Parameters: parameter binding objects declare the parameters that the page evaluates at the beginning of a request. You can define the value of a parameter in the page definition file using static values or EL expressions that assign a static value.

When you click an item in the Overview editor (or the associated node in the Structure window), you can use the Properties window to view and edit the attribute values for the item, or you can edit the XML source directly by clicking the Source tab.

5.3.2.4.6 Using the MAF AMX Editor Bindings Tab JDeveloper's Bindings tab (see Figure 5–81) is available in the MAF AMX Editor. It displays the data bindings defined for a specific MAF AMX page. If you select a binding, its relationship to the underlying Data Control are shown and the link to the `PageDef` file is provided.

Figure 5–81 Bindings Tab



5.3.2.4.7 What You May Need to Know About Removal of Unused Bindings When you delete or cut a MAF AMX component from the Structure window, unused bindings are automatically removed from your page.

Note: Deleting a component from the Source editor does not trigger the removal of bindings.

Figure 5–82 demonstrates the deletion of a List View component that references bindings. Upon deletion, the related binding entry is automatically removed from the corresponding `PageDef.xml` file.

Figure 5–82 Deleting Bound Components from Page

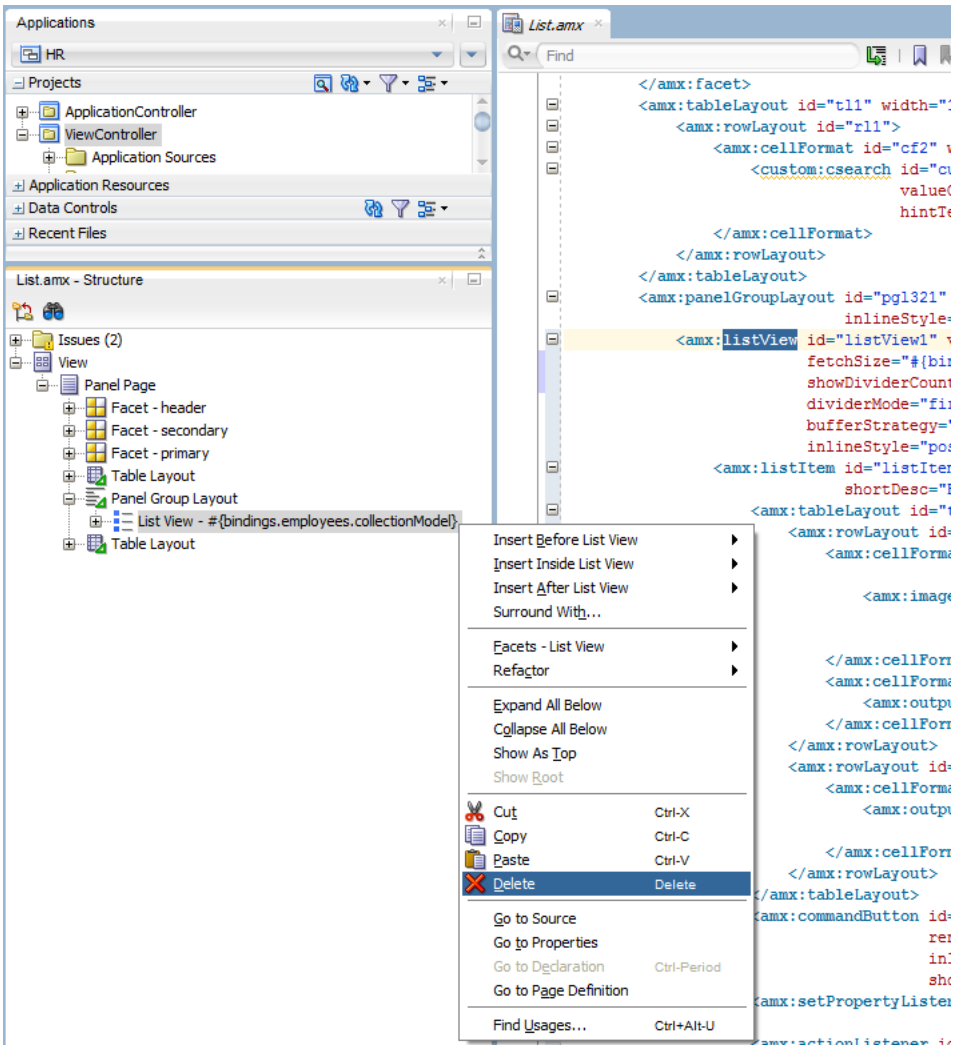
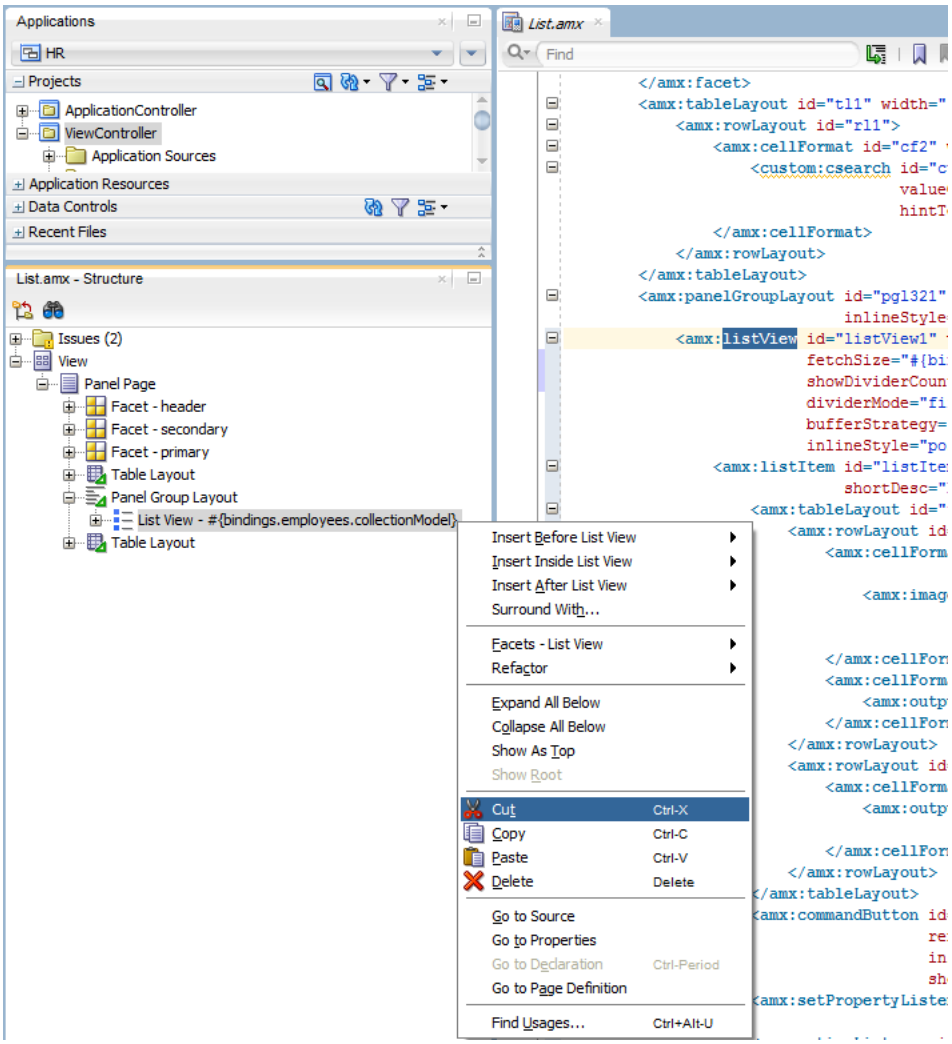


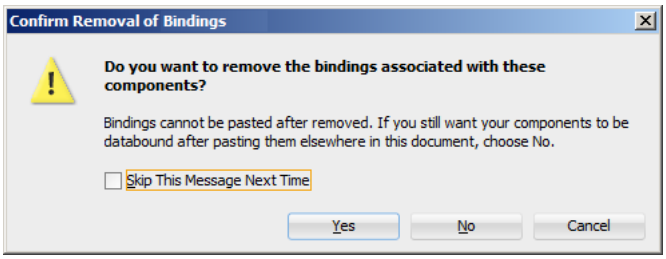
Figure 5–83 demonstrates the removal of the List View component by cutting it from the page.

Figure 5–83 Cutting Bound Components from Page



After clicking **Cut**, you are presented with the Confirm Removal of Bindings dialog that prompts you to choose whether or not to delete the corresponding bindings, as shown in Figure 5–84.

Figure 5–84 Confirm Removal of Bindings Dialog



5.3.2.5 What You May Need to Know About Element Identifiers and Their Audit

MAF generates a unique element identifier (`id`) and automatically inserts it into the MAF AMX page when an element is added by dropping a component from the Components window, or by dragging and dropping a data control. This results in a

valid identifier in the MAF AMX page that differentiates each component from others, possibly similar components within the same page.

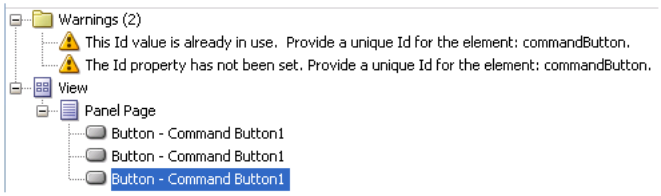
MAF provides an identifier audit utility that does the following:

- Checks the presence and uniqueness of identifiers in a MAF AMX page.
- If the identifier is not present or not unique, an error is reported for each required `id` attribute of an element.
- Provides an automatic fix to generate a unique `id` for the element when a problem with the identifier is reported.

Figure 5–85 and Figure 5–86 show the identifier error reporting in the Source editor and Structure pane respectively.

Figure 5–85 Element Identifier Audit in Source Editor

Figure 5–86 Element Identifier Audit in Structure Pane



In addition to the `id`, the audit utility checks the `popupId` and `alignId` attributes of the Show Popup Behavior operation (see Section 6.2.8, "How to Use a Popup Component").

Figure 5–87 and Figure 5–88 show the Show Popup Behavior's Popup Id and Align Id attributes error reporting in the Source Editor respectively.

Figure 5–87 Popup Id Attribute Audit in Source Editor

Figure 5–88 Align Id Attribute Audit in Source Editor

For more information, see "Auditing and Monitoring Java Projects " in *Oracle Fusion Middleware User's Guide for Oracle JDeveloper*.

5.3.3 What You May Need to Know About the Server Communication

The security architecture used by MAF guarantees that the browser hosting a MAF AMX page does not have access to the security information needed to make connections to a secure server to obtain its resources. This has a direct impact on AJAX calls made from MAF AMX pages: these calls are not supported, which poses limitations on the use of JavaScript from within MAF AMX UI components. Communication with the server must occur from the embedded Java code layer.

6

Creating the MAF AMX User Interface

This chapter describes how to create the user interface for MAF AMX pages.

This chapter includes the following sections:

6.1 Introduction to Creating the User Interface for MAF AMX Pages

MAF provides a set of UI components and operations that enable you to create MAF AMX pages which behave appropriately for both the iOS and Android user experience.

MAF AMX adheres to the typical JDeveloper development experience by allowing you to drag UI components and operations onto a Source editor or Structure window from either the Components window or the Data Controls window. In essence, MAF AMX UI components render HTML equivalents of the native components on the iOS and Android platforms, with their design-time behavior in JDeveloper being similar to components used by other technologies. In addition, the UI components are integrated with MAF's controller and model for declarative navigation and data binding.

> **Note:** When developing interfaces for mobile devices, always be aware of the fact that screen space is very limited. In addition, touchscreen support is not available on some mobile devices.

For more information, see the following:

- Chapter 5, "Creating MAF AMX Pages"
- Chapter 7, "Using Bindings and Creating Data Controls"

- Chapter 12, "Creating Custom MAF AMX UI Components"

6.2 Designing the Page Layout

MAF AMX provides layout components (listed in Table 6–1) that let you arrange UI components in a page. Usually, you begin building pages with these components, and then add other components that provide other functionality either inside these containers, or as child components to the layout components. Some of these components provide geometry management functionality, such as the capability to stretch when placed inside a component that stretches.

Table 6–1 MAF AMX Page Management, Layout, and Spacing Components

Component	Type	Description
View	Core Page Structure Component	Creates a `view` element in a MAF AMX file. Automatically inserted into the file when the file is created. For more information, see Section 6.2.1, "How to Use a View Component."
Panel Page	Core Page Structure Component	Creates a `panelPage` element in a MAF AMX file. Defines the central area in a page that scrolls vertically between the header and footer areas. For more information, see Section 6.2.2, "How to Use a Panel Page Component." For more information about MAF AMX files, see Section 5.3.1.2, "Creating MAF AMX Pages."
Facet	Core Page Structure Component	Creates a `facet` element in a MAF AMX file. Defines an arbitrarily named facet on the parent component. For more information, see Section 6.2.7, "How to Use a Facet Component."
Fragment	Core Page Structure Component	Creates a `fragment` element in a MAF AMX file. Enables sharing of the page contents. For more information, see Section 6.2.13, "How to Use the Fragment Component."
Facet Definition	Core Page Structure Component	Creates a `facetRef` element in a MAF AMX Fragment file. Used inside a page fragment definition (`fragmentDef`) to reference a facet defined in the page fragment usage. For more information, see Section 6.2.7, "How to Use a Facet Component."
Panel Group Layout	Page Layout Container	Creates a `panelGroupLayout` element in a MAF AMX file. Groups child components either vertically or horizontally. For more information, see Section 6.2.3, "How to Use a Panel Group Layout Component."
Panel Form Layout	Page Layout Container	Creates a `panelFormLayout` element in a MAF AMX file. Positions components, such as Input Text, so that their labels and fields line up horizontally or above each component. For more information, see Section 6.2.4, "How to Use a Panel Form Layout Component."
Panel Label And Message	Page Layout Container	Creates a `panelLabelAndMessage` element in a MAF AMX file. Lays out a label and its children. For more information, see Section 6.2.6, "How to Use a Panel Label And Message Component."

Table 6–1 (Cont.) MAF AMX Page Management, Layout, and Spacing Components

Component	Type	Description
Panel Stretch Layout	Page Layout Container	Creates a `panelStretchLayout` element in a MAF AMX file. Allows placement of a panel on each side of another panel. For more information, see Section 6.2.5, "How to Use a Panel Stretch Layout Component."
Popup	Secondary Window	Creates a `popup` element in a MAF AMX file. For more information, see Section 6.2.8, "How to Use a Popup Component."
Panel Splitter	Interactive Page Layout Container	Creates a `panelSplitter` element in a MAF AMX file. For more information, see Section 6.2.9, "How to Use a Panel Splitter Component."
Panel Item	Interactive Page Layout Component	Creates a `panelItem` element in a MAF AMX file. For more information, see Section 6.2.9, "How to Use a Panel Splitter Component."
Deck	Page Layout Container	Creates a `deck` element in a MAF AMX file. For more information, see Section 6.2.12, "How to Use a Deck Component."
Spacer	Spacing Component	Creates an area of blank space represented by a `spacer` element in a MAF AMX file. For more information, see Section 6.2.10, "How to Use a Spacer Component."
Table Layout	Page Layout Container	Creates a `tableLayout` element in a MAF AMX file. Represents a table consisting of rows. For more information, see Section 6.2.11, "How to Use a Table Layout Component."
Row Layout	Page Layout Container	Creates a `rowLayout` element in a MAF AMX file. Represents a row consisting of cells in a Table Layout component. For more information, see Section 6.2.11, "How to Use a Table Layout Component."
Cell Format	Page Layout Component	Creates a `cellFormat` element in a MAF AMX file. Represents a cell in a Row Layout component. For more information, see Section 6.2.11, "How to Use a Table Layout Component."

You add a layout component by dragging and dropping it onto a MAF AMX page from the Components window (see Section 5.3.2.1, "Adding UI Components"). Then you use the Properties window to set the component's attributes (see Section 5.3.2.3, "Configuring UI Components"). For information on attributes of each particular component, see *Oracle Fusion Middleware Tag Reference for Oracle Mobile Application Framework*.

Example 6–1 demonstrates several page layout elements defined in a MAF AMX file.

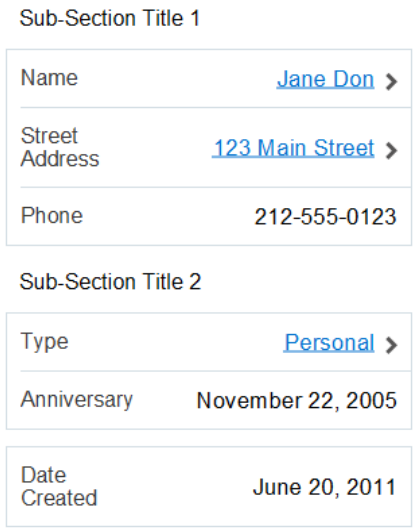
Note: You declare the page layout elements under the `<amx>` namespace.

Example 6–1 Page Layout Components Definition

```
<amx:panelPage id="pp1">
   <amx:outputText id="outputText1"
                   value="Sub-Section Title 1"
```

```
                styleClass="adfmf-text-sectiontitle"/>
   <amx:panelFormLayout id="panelFormLayout1" labelPosition="start">
      <amx:panelLabelAndMessage id="panelLabelAndMessage1" label="Name">
         <amx:commandLink id="commandLink1" text="Jane Don" action="editname" />
      </amx:panelLabelAndMessage>
      <amx:panelLabelAndMessage id="panelLabelAndMessage2" label="Street Address">
         <amx:commandLink id="commandLink2"
                          text="123 Main Street"
                          action="editaddr" />
      </amx:panelLabelAndMessage>
      <amx:panelLabelAndMessage id="panelLabelAndMessage3" label="Phone">
         <amx:outputText id="outputText2" value="212-555-0123" />
      </amx:panelLabelAndMessage>
   </amx:panelFormLayout>
   <amx:outputText id="outputText3"
                value="Sub-Section Title 2"
                styleClass="adfmf-text-sectiontitle" />
   <amx:panelFormLayout id="panelFormLayout2" labelPosition="start">
      <amx:panelLabelAndMessage id="panelLabelAndMessage4" label="Type">
         <amx:commandLink id="commandLink3" text="Personal" action="edittype" />
      </amx:panelLabelAndMessage>
      <amx:panelLabelAndMessage label="Anniversary">
         <amx:outputText id="outputText4" value="November 22, 2005" />
      </amx:panelLabelAndMessage>
   </amx:panelFormLayout>
   <amx:panelFormLayout id="panelFormLayout3" labelPosition="start">
      <amx:panelLabelAndMessage id="panelLabelAndMessage5" label="Date Created">
         <amx:outputText id="outputText5" value="June 20, 2011" />
      </amx:panelLabelAndMessage>
   </amx:panelFormLayout>
</amx:panelPage>
```

Figure 6–1 Page Layout Components at Design Time



You use the standard Cascading Style Sheets (CSS) to manage visual presentation of your layout components. CSS are located in the `Web Content/css` directory of your ViewController project, with default CSS provided by MAF. For more information, see

Section 6.6.1, "How to Use Component Attributes to Define Style."

The user interface created for iOS platform using MAF AMX displays correctly in both the left-to-right and right-to-left language environments. In the latter case, the components originate on the right-hand side of the screen instead of on the left-hand side. Some of the MAF AMX layout components, such as the Popup (see Section 6.2.8, "How to Use a Popup Component"), Panel Item, and Panel Splitter (see Section 6.2.9, "How to Use a Panel Splitter Component") can be configured to enable specific right-to-left behavior. For more information about right-to-left configuration of MAF AMX pages, see Section 6.4, "Enabling Gestures" and Section 5.2.11, "How to Specify the Page Transition Style."

Note: The right-to-left text direction is not supported on Android platform.

A MAF sample application called UIDemo demonstrates how to use layout components in conjunction with such MAF AMX UI components as a Button, to achieve some of the typical layouts that follow common patterns. In addition, this sample application shows how to work with styles to adjust the page layout to a specific pattern. The UIDemo application is located in the `PublicSamples.zip` file within the *`jdev_install`*`/jdeveloper/jdev/extensions/oracle.maf/Samples` directory on your development computer.

6.2.1 How to Use a View Component

A View (`view` element in a MAF AMX file) is a core page structure component that is automatically inserted into a MAF AMX file when the file is created. This component provides a hierarchical representation of the page and its structure and represents a single MAF AMX page.

For more information, see *Oracle Fusion Middleware Tag Reference for Oracle Mobile Application Framework*.

6.2.2 How to Use a Panel Page Component

A Panel Page (`panelPage` element in a MAF AMX file) is a component that allows you to define a scrollable area of the screen for laying out other components.

By default, when you create a MAF AMX page, JDeveloper automatically creates and inserts a Panel Page component into the page. When you add components to the page, they will be inserted inside the Panel Page component.

To prevent scrolling of certain areas (such as a header and footer of the page) and enable stretching when orientation changes, you can specify a Facet component for your Panel Page. The Panel Page's header Facet includes the title placed in the Navigation Bar of each page. For information about other types of Facet components that the Panel Page can contain, see Section 6.2.7, "How to Use a Facet Component."

Example 6–2 shows the `panelPage` element defined in a MAF AMX file. This Panel Page contains a header Facet.

Example 6–2 Panel Page Definition

```
<amx:panelPage id="pp1">
   <amx:facet name="header">
      <amx:outputText id="ot1" value="Welcome"/>
   </amx:facet>
```

```
</amx:panelPage>
```

For more information, see *Oracle Fusion Middleware Tag Reference for Oracle Mobile Application Framework*.

6.2.3 How to Use a Panel Group Layout Component

The Panel Group Layout component is a basic layout component that lays out its children horizontally or vertically. In addition, there is a wrapping layout option that enables child components to flow across and down the page.

To create the Panel Group Layout component, use the Components window.

To add the Panel Group Layout component:

1. In the Components window, drag and drop a Panel Group Layout to the MAF AMX page.
2. Insert the desired child components into the Panel Group Layout component.
3. To add spacing between adjacent child components, insert the Spacer (`spacer`) component.
4. Use the Properties window to set the component attributes. For more information, see *Oracle Fusion Middleware Tag Reference for Oracle Mobile Application Framework*.

Example 6–3 shows the `panelGroupLayout` element defined in a MAF AMX file.

Example 6–3 Panel Group Layout Definition

```
<amx:panelGroupLayout styleClass="prod" id="pgl1">
   <amx:outputText styleClass="prod-label" value="Screen Size:" id="ot1"/>
</amx:panelGroupLayout>
```

6.2.3.1 Customizing the Scrolling Behavior

Scrolling behavior of the Panel Group Layout component is defined by its `scrollPolicy` attribute which can be set to `auto` (default), `none`, or `scroll`. By default, this behavior matches the one defined in the active skin.

To disable scrolling regardless of the behavior defined in the active skin, you set the `scrollPolicy` attribute to `none`. When the Panel Group Layout component is not scrollable, its content is not constrained.

To enable scrolling regardless of the behavior defined in the active skin, you set the `scrollPolicy` attribute to `scroll`. If the Panel Group Layout component is scrollable, the scrolling is provided when the component's dimensions are constrained.

Since scrolling consumes a lot of memory and may lead to the application crashing, you should minimize its use. In the `mobileAlta` skin (see Section 6.6.2, "What You May Need to Know About Skinning"), scrolling of the Panel Group Layout, Panel Form Layout (see Section 6.2.4, "How to Use a Panel Form Layout Component"), and Table Layout (see Section 6.2.11, "How to Use a Table Layout Component") is disabled. It is recommended that you use the `mobileAlta` skin for your application and limit instances of setting the `scrollPolicy` to `scroll` to when it is necessary. To simulate the scrolling behavior for the Panel Form Layout and Table Layout, you can enclose them within a scrollable Panel Group Layout component when scrolling is required.

6.2.4 How to Use a Panel Form Layout Component

The Panel Form Layout (`panelFormLayout`) component positions components so that their labels and fields align horizontally. In general, the main content of the Panel Form Layout component is comprised of input components (such as Input Text) and selection components (such as Choice). If a child component with a `label` attribute defined is placed inside the Panel Form Layout component, the child component's label and field are aligned and sized based on the Panel Form Layout definitions. Within the Panel Form Layout, the label area can either be displayed on the start side of the field area or on a separate line above the field area. Separate lines are used if the `labelPosition` attribute of the Panel Form Layout is set to `topStart`, `topCenter`, or `topEnd`. Otherwise the label area appears on the start side of the field area. Within the label area, the `labelPosition` attribute controls where the label text can be aligned:

- to the start side (`labelPosition="start"` or `labelPosition="topStart"`)
- to the center (`labelPosition="center"` or `labelPosition="topCenter"`)
- to the end side (`labelPosition="end"` or `labelPosition="topEnd"`)

Within the field area, the `fieldHalign` attribute controls where the field content can be aligned:

- to the start side (`fieldHalign="start"`)
- to the center (`fieldHalign="center"`)
- to the end side (`fieldHalign="end"`)

Within the Panel Form Layout, the child components can be placed in one or more columns using `maxColumns` and `rows` attributes. These attributes should be used in conjunction with `labelWidth`, `fieldWidth`, `labelPosition`, and `showHorizontalDividers` attributes to obtain the optimal multi-column layout.

> **Note:** To switch from a single-column to multi-column layout, the value of the `rows` attribute must be greater than 1, regardless of the value to which the `maxColumns` attribute is set. When the `rows` attribute is specified, the `maxColumns` attribute restricts the layout to that number of columns as a maximum; however, there are as many rows as are required to lay out the child components.

To add the Panel Form Layout component:

1. In the Components window, drag and drop a Panel Form Layout component to the MAF AMX page.
2. In the Properties window, set the component's attributes. For more information, see *Oracle Fusion Middleware Tag Reference for Oracle Mobile Application Framework*.

Example 6–4 shows the `panelFormLayout` element defined in a MAF AMX file.

Example 6–4 Panel Form Layout Definition

```
<amx:panelFormLayout styleClass="prod" id="pfl1">
   <amx:panelLabelAndMessage label="Type" id="plm1">
      <amx:commandLink text="Personal" action="edittype" id="cl1"/>
   </amx:panelLabelAndMessage>
</amx:panelFormLayout>
```

6.2.5 How to Use a Panel Stretch Layout Component

The Panel Stretch Layout (`panelStretchLayout`) component manages three child Facet components: top, bottom, and center (see Example 6–5). You can use any number and combination of these facets.

Example 6–5 Basic Panel Stretch Layout Definition

```
<amx:panelStretchLayout id="psl1">
   <amx:facet name="top">
   </amx:facet>
   <amx:facet name="center">
   </amx:facet>
   <amx:facet name="bottom">
   </amx:facet>
</amx:panelStretchLayout>
```

If an attempt is made to represent the Panel Stretch Layout component as a set of three rectangles stacked one on top of another, the following would apply:

- The height of the top rectangle is defined by the natural height of the top facet.
- The height of the bottom rectangle is defined by the natural height of the bottom facet.
- The rest of the vertical space is distributed to the rectangle in the middle. If the height of this rectangle is smaller than the value defined for `Center.height` and the `scrollPolicy` attribute of the `panelStretchLayout` is set to either `scroll` or `auto`, then scroll bars are added.

To add the Panel Stretch Layout component:

1. In the Components window, drag and drop a Panel Stretch Layout onto the MAF AMX page.
2. Review the created child Facet components and, if necessary, remove some of them.
3. Use the Properties window to set the component attributes. For more information, see *Oracle Fusion Middleware Tag Reference for Oracle Mobile Application Framework*.

6.2.6 How to Use a Panel Label And Message Component

Use the Panel Label And Message (`panelLabelAndMessage`) component to place a component which does not have a `label` attribute. These components usually include an Output Text, Button, or Link.

To add the Panel Label And Message component:

1. In the Components window, drag and drop a Panel Label And Message component into a Panel Group Layout component.
2. In the Properties window, set the component's attributes. For more information, see *Oracle Fusion Middleware Tag Reference for Oracle Mobile Application Framework*.

Example 6–4 shows the `panelLabelAndMessage` element defined in a MAF AMX file. The `label` attribute is used for the child component.

Example 6–6 Panel Label and Message Definition

```
<amx:panelLabelAndMessage label="Phone" id="plm1">
   <amx:outputText value="212-555-0123" id="ot1"/>
```

```
</amx:panelLabelAndMessage>
```

6.2.7 How to Use a Facet Component

You use the Facet (`facet`) component to define an arbitrarily named facet, such as a header or footer, on the parent layout component. The position and rendering of the Facet are determined by the parent component.

The MAF AMX page header is typically represented by the Panel Page component (see Section 6.2.2, "How to Use a Panel Page Component") in combination with the Header, Primary, and Secondary facets:

- Header facet: contains the page title.
- Primary Action facet: represents an area that appears in the left corner of the header bar and typically hosts Button or Link components, but can contain any component type.
- Secondary Action facet: represents an area that appears in the right corner of the header bar and typically hosts Button or Link components, but can contain any component type.

The MAF AMX page footer is represented by the Panel Page component (see Section 6.2.2, "How to Use a Panel Page Component") in combination with the footer facet:

- Footer facet: represents an area that appears below the content area and typically hosts Button or Link components, but can contain any component type.

Example 6–7 shows the `facet` element declared inside the Panel Page container. The type of the facet is always defined by its `name` attribute (see Table 6–2).

Example 6–7 Facet Definition

```
<amx:panelPage id="pp1">
   <amx:facet name="footer">
      <amx:commandButton id="cb2" icon="folder.png"
                         text="Move (#{myBean.mailcount})"
                         action"move"/>
   </amx:facet>
</amx:panelPage>
```

Table 6–2 lists predefined Facet types that you can use with specific parent components.

Table 6–2 Facet Types and Parent Components

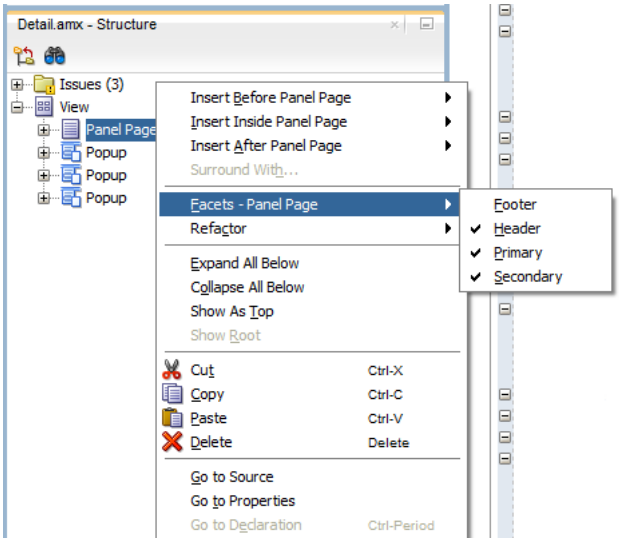
Parent Component	Facet Type (name)
Panel Page (`panelPage`)	`header`, `footer`, `primary`, `secondary`
List View (`listView`)	`header`, `footer`
Carousel (`carousel`)	`nodeStamp`
Panel Splitter (`panelSplitter`)	`navigator`
Panel Stretch Layout (`panelStretchLayout`)	`top`, `center`, `bottom`
Data Visualization Components. For more information, see Section 6.5, "Providing Data Visualization."	`dataStamp`, `seriesStamp`, `overview`, `rows` (applicable to NBox), `columns` (applicable to NBox), `cells` (applicable to NBox), `icon` (applicable to NBox Node), `indicator` (applicable to NBox Node)

To add the Facet component:

You can use the context menu displayed on the Structure window or Source editor to add a Facet component as a child of another component. The context menu displays only facets that are valid for your selected parent component. To add a Facet, first select and then right-click the parent component in the Structure window or Source editor, and then select one of the following:

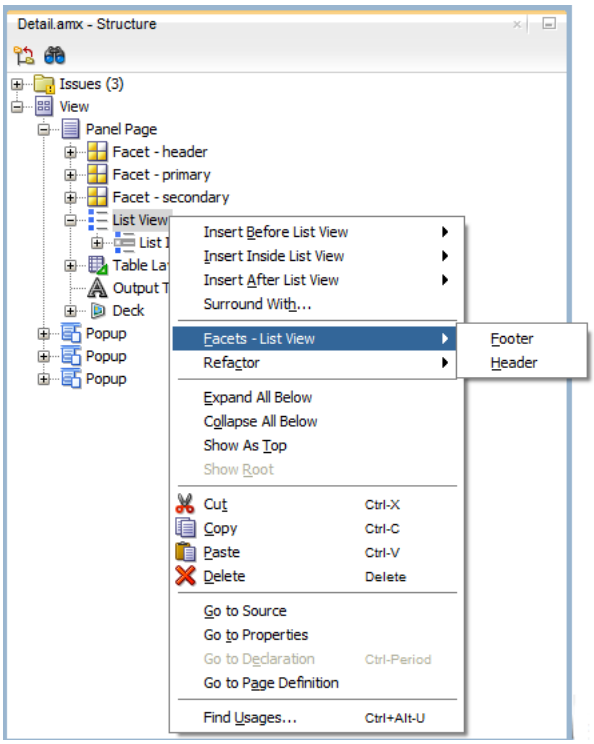
- If the parent component is a Panel Page, select **Facets - Panel Page**, and then choose the type of Facet from the list, as Figure 6–2 shows.

Figure 6–2 Using Context Menu to Add Facet to Panel Page



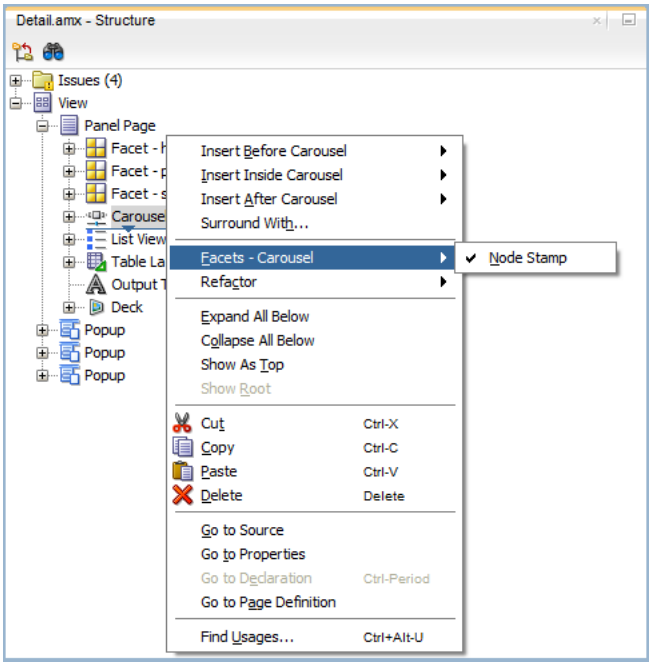
- If the parent component is a List View, select **Facets - List View**, and then choose the type of Facet from the list, as Figure 6–3 shows.

Figure 6–3 Using Context Menu to Add Facet to List View



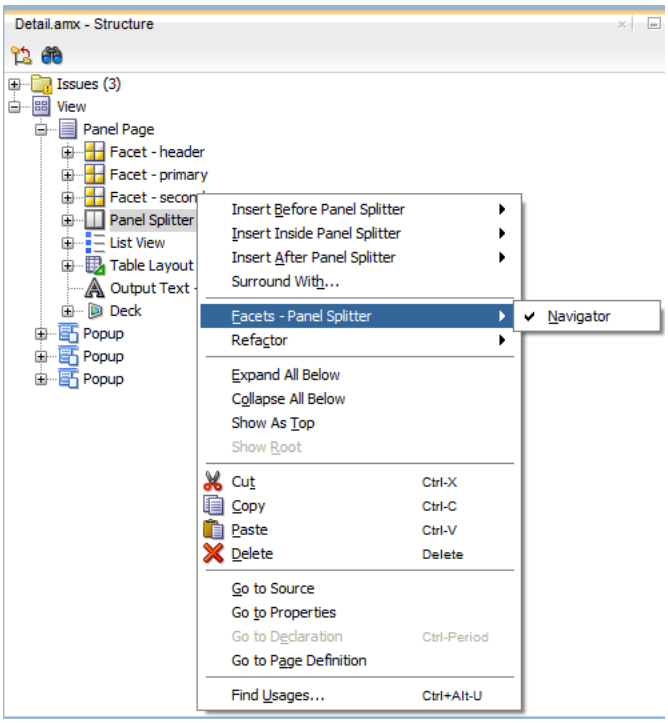
- If the parent component is a Carousel, select **Facets - Carousel > Node Stamp**, as Figure 6–4 shows.

Figure 6–4 Using Context Menu to Add Facet to Carousel



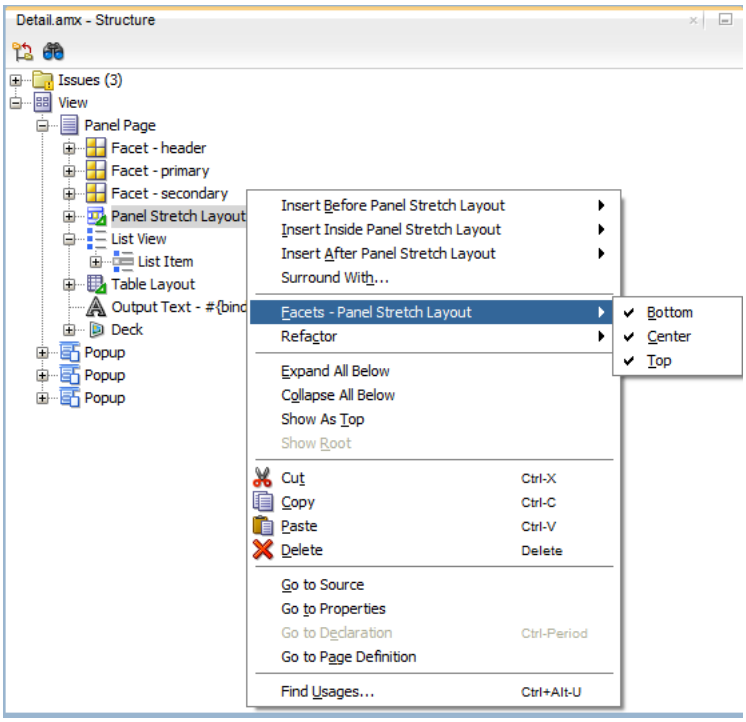
- If the parent component is a Panel Splitter, select **Facets - Panel Splitter > Navigator**, as Figure 6–5 shows.

Figure 6–5 Using Context Menu to Add Facet to Panel Splitter



- If the parent component is a Panel Stretch Layout, select **Facets - Panel Stretch Layout**, and then choose the type of Facet from the list, as Figure 6–6 shows.

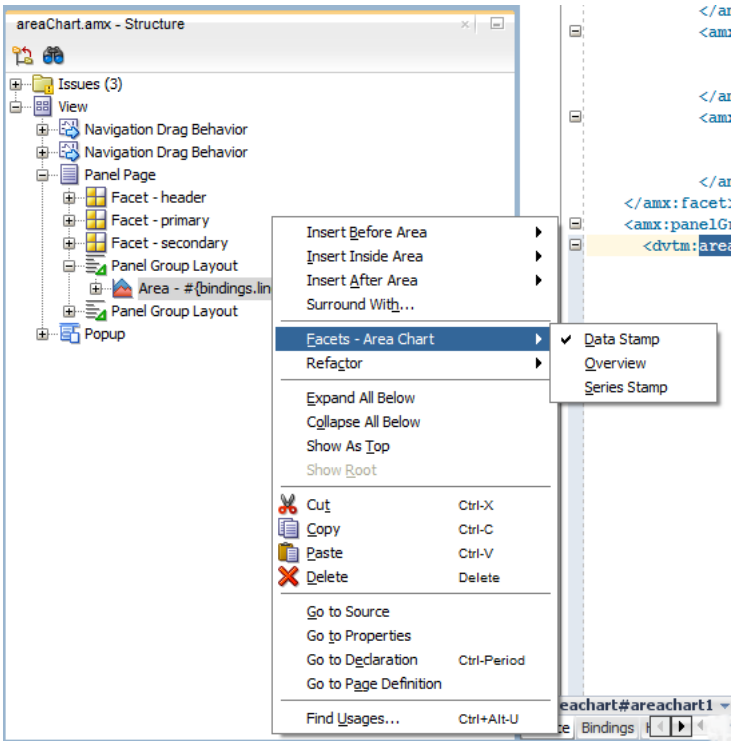
Figure 6–6 Using Context Menu to Add Facet to Panel Stretch Layout



- If the parent component is one of the data visualization components, select **Facets > <MAF AMX Data Visualizations Component Name>**, and then choose the type

of Facet from the list, as Figure 6–7 shows.

Figure 6–7 Using Context Menu to Add Facet to Data Visualization Component



For more information about data visualization components and their attributes, see Section 6.5, "Providing Data Visualization."

Alternatively:

1. In the Components window, drag and drop a Facet component into another component listed in Table 6–2.
2. In the Properties window, set the component's attributes. For more information, see *Oracle Fusion Middleware Tag Reference for Oracle Mobile Application Framework*.

6.2.8 How to Use a Popup Component

Use the Popup (`popup`) component to display a popup window. You can declare this component as a child of the View component.

You can use the following operations in conjunction with the Popup component:

- Close Popup Behavior (`closePopupBehavior`) operation represents a declarative way to close the Popup in response to a client-triggered event.
- Show Popup Behavior (`showPopupBehavior`) operation represents a declarative way to show the Popup in response to a client-triggered event specified using the `type` attribute of the Show Popup Behavior.

  The `popupId` attribute of the Show Popup Behavior specifies the unique identifier of the Popup component relative to its parent component. The `alignId` attribute of the Show Popup Behavior specifies the unique identifier of the UI component relative to which the Popup is to be aligned. Since setting identifiers manually is tedious and can lead to invalid references, you set values for these two attributes

using an editor that is integrated with the standard Properties window (see Figure 6–9). There is an Audit rule that is specifically defined to validate these identifiers (see Section 5.3.2.5, "What You May Need to Know About Element Identifiers and Their Audit").

The `decoration` attribute of the Show Popup Behavior allows you to configure the Popup to have an anchor pointing to the component that matches the specified `alignId`. You do so by setting the `decoration` attribute to `anchor` (the default value is `simple`).

Note: There is no need to define `decoration="anchor"` to use the `alignId` attribute. When using `decoration="anchor"`, if the `alignId` attribute is not specified or a match is not found for the `alignId`, the `decoration` defaults to `simple` resulting in minimal ornamentation of the Popup component.

Values you set for the `align` attribute of the Show Popup Behavior indicate where the alignment of the Popup component is to be positioned if there is enough space to satisfy that positioning. When there is not enough space, alternate positioning is chosen by MAF.

Tip: To center a Popup on the screen, you should set the `alignId` attribute of the Panel Page component, and then use the `align="center"`.

For more information on the Show Popup Behavior component's attributes and their values, see *Oracle Fusion Middleware Tag Reference for Oracle Mobile Application Framework*.

Example 6–8 shows `popup` and `showPopupBehavior` elements defined in a MAF AMX file.

Example 6–8 Popup and Show Popup Behavior Definition

```
<amx:view>
   <amx:panelPage id="panelPage1">
      <amx:commandButton id="commandButton1" text="Show Popup">
         <amx:showPopupBehavior popupId="popup1" type="action"
                                align="topStart" alignId="panelPage1"
                                decoration="anchor"/>
      </amx:commandButton>
   </amx:panelPage>
   <amx:popup id="popup1"
              animation="slideUp"
              autoDismiss="true"
              backgroundDimming="off"/>
</amx:view>
```

Popup components can display validation messages when the user input errors occur. For more information, see Section 6.9, "Validating Input."

To set a Popup Id attribute:

1. Select the `showPopupBehavior` element in the Source editor or Structure window.
2. Click the down arrow to the right of the **Popup Id** field to make a selection from a list of available Popup components (see Figure 6–8), or click on the Property Menu icon to the right of the **Popup Id** field to open the **Popup Id** property editor (see

Figure 6–9).

Figure 6–8 Selecting Popup Id from List

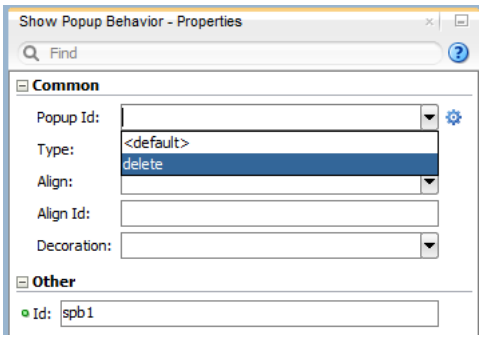
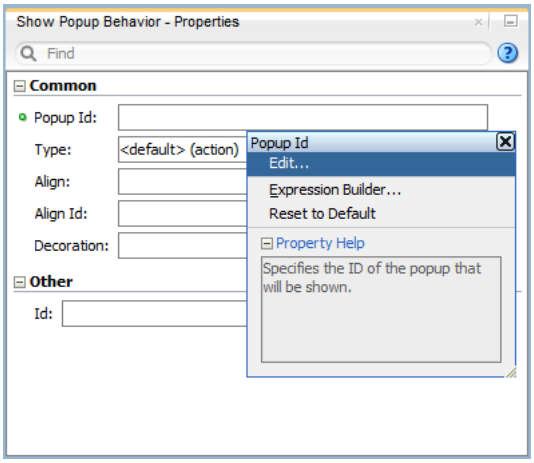
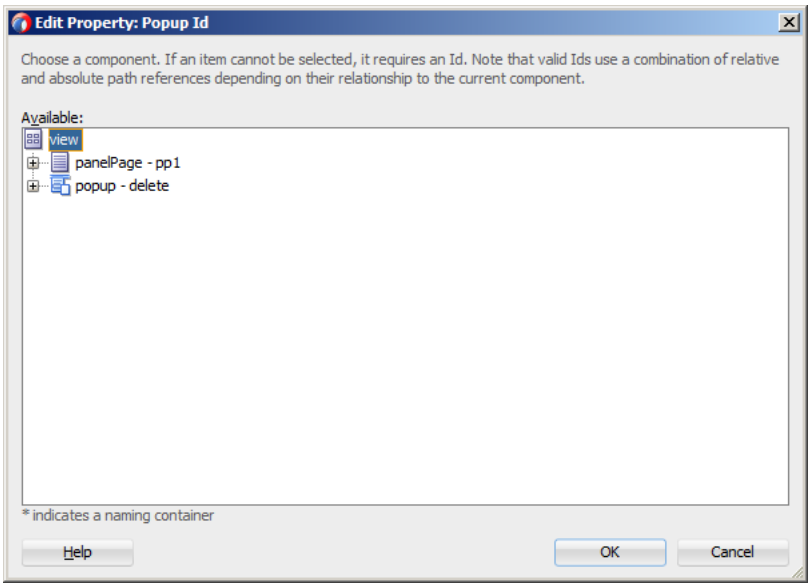


Figure 6–9 Setting Popup Id Attribute



3. If you use the property editor, select **Edit** on the **Popup Id** property editor to open the **Edit Property: Popup Id** dialog that Figure 6–10 shows.

Figure 6–10 Edit Property for Popup Id Dialog

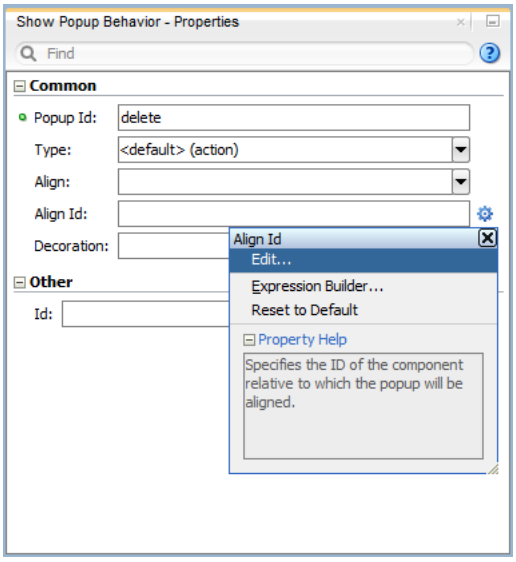


4. Select the Popup component to be displayed when this Show Popup Behavior is invoked.

To set an Align Id attribute:

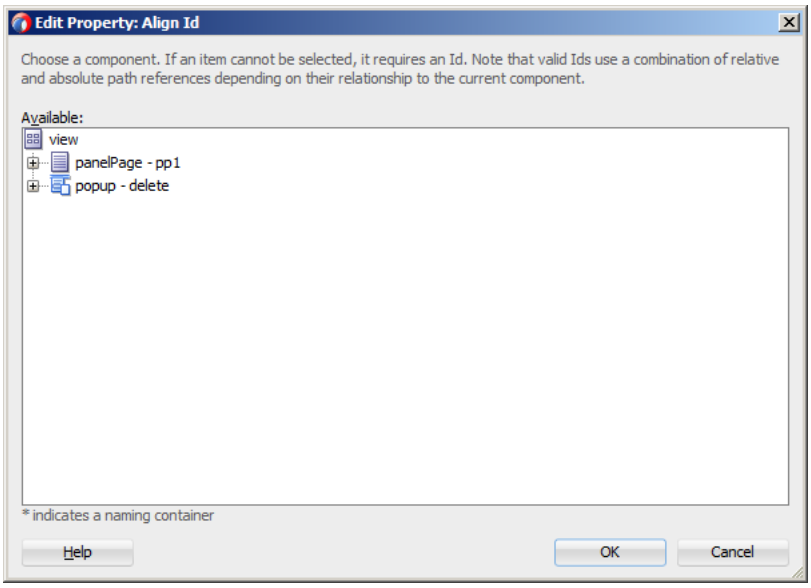
1. Select the `showPopupBehavior` element in the Source editor or Structure window.
2. Click on the Property Menu icon to the right of the **Align Id** field to open the **Align Id** property editor, as Figure 6–11 shows.

Figure 6–11 Setting Align Id Attribute



3. Select **Edit** on the **Align Id** property editor to open the **Edit Property: Align Id** dialog that Figure 6–12 shows.

Figure 6–12 Edit Property for Align Id Dialog



4. Select the parent component of the Show Popup Behavior operation.

When developing for iOS platform, you can configure the Popup to accommodate the right-to-left language environment by setting its `animation` attribute to either `slideStart` or `slideEnd`.

A MAF sample application called UIDemo demonstrates how to use the Popup component and how to apply styles to adjust the page layout to a specific pattern. The UIDemo application is located in the `PublicSamples.zip` file within the *`jdev_install`*`/jdeveloper/jdev/extensions/oracle.maf/Samples` directory on your development computer.

6.2.9 How to Use a Panel Splitter Component

Use the Panel Splitter (`panelSplitter`) component to display multiple content areas that may be controlled by a left-side navigation pane. Panel Splitter components are commonly used on tablet devices that have larger display size. These components are typically used with a list on the left and the content on the right side of the display area.

A Panel Splitter can contain a navigator Facet (see Section 6.2.7, "How to Use a Facet Component") which is generated automatically when you drag and drop the Panel Splitter onto a MAF AMX page, and a Panel Item component. The Panel Item (`panelItem`) component represents the content area of a Panel Splitter. Since each Panel Splitter component must have a least one Panel Item, the Panel Item is automatically added to the Panel Splitter when the Panel Splitter is created. Each Panel Item component can contain any component that a Panel Group Layout can contain (see Section 6.2.3, "How to Use a Panel Group Layout Component").

The left side of the Panel Splitter is represented by a navigator facet (`navigator`), which is optional in cases where only multiple content with animations is desired (for example, drawing a multicontent area with a Select Button that requires animation when selecting different buttons to switch content). When in landscape mode, this facet is rendered; in portrait mode, a button is placed above the content area and when clicked, the content of the facet is launched in a popup.

When developing for iOS platform, you can configure the Panel Splitter and Panel Item to accommodate the right-to-left language environment by setting their `animation` attribute to either `slideStart`, `slideEnd`, `flipStart`, or `flipEnd`. The `animation` attribute of the Panel Item components overrides the Panel Splitter's `animation` attribute. For more information, see *Oracle Fusion Middleware Tag Reference for Oracle Mobile Application Framework*.

Example 6–9 shows the `panelSplitter` element defined in a MAF AMX file, with the `navigator` facet used as a child component.

Example 6–9 Panel Splitter with Navigator Definition

```
<amx:panelSplitter id="ps1"
                selectedItem="#{bindings.display.inputValue}"
                animation="flipEnd">
   <amx:facet name="navigator">
      <amx:listView id="lv1"
                    value="#{bindings.data.collectionModel}"
                    var="row"
                    showMoreStrategy="autoScroll"
                    bufferStrategy="viewport>
         ...
      </listView>
   </facet>
   <amx:panelItem id="x">
      <amx:panelGroupLayout>
         ...
      </panelGroupLayout>
   </panelItem>
   <amx:panelItem id="y">
      <amx:panelGroupLayout>
         ...
      </panelGroupLayout>
   </panelItem>
</panelSplitter>
```

For more examples, see the UIDemo application located in the `PublicSamples.zip` file within the *`jdev_install`*`/jdeveloper/jdev/extensions/oracle.maf/Samples` directory on your development computer.

For more information, see *Oracle Fusion Middleware Tag Reference for Oracle Mobile Application Framework*.

6.2.10 How to Use a Spacer Component

Use the Spacer (`spacer`) component to create an area of blank space with a purpose to separate components on a MAF AMX page. You can include vertical and horizontal spaces in a page using the `height` (for vertical spacing) and `width` (for horizontal spacing) attributes of the `spacer`:

To add the Spacer component:

1. In the **Components** window, drag and drop a **Spacer** onto the MAF AMX page.
2. Use the **Properties** window to set the attributes of the component. For more information, see *Oracle Fusion Middleware Tag Reference for Oracle Mobile Application Framework*.

Example 6–10 shows the `spacer` element and its children defined in a MAF AMX file.

Example 6–10 Defining Spacer

```
<amx:outputText id="ot1" value="This is a long piece of text for this page..."/>
<amx:spacer id="s1" height="10"/>
<amx:outputText id="ot2" value="This is some more lengthy text..."/>
```

6.2.11 How to Use a Table Layout Component

Use the Table Layout (`tableLayout`) component to display data in a typical table format that consists of rows containing cells.

The Row Layout (`rowLayout`) component represents a single row in the Table Layout. The Table Layout component must contain either one or more Row Layout components or Iterator components that can produce Row Layout components.

The CellFormat (`cellFormat`) component represents a cell in the Row Layout. The Row Layout component must contain either one or more CellFormat components, Iterator components, Attribute List Iterator components, or Facet Definition components that can produce CellFormat components.

The Table Layout structure does not allow cell contents to use percentage heights nor can a height be assigned to the overall table structure as a whole. For details, see the description of the following attributes in the *Oracle Fusion Middleware Tag Reference for Oracle Mobile Application Framework*:

- `layout` and `width` attributes of the Table Layout component
- `width` and `height` attributes of the Row Layout component

To add the Table Layout component:

1. In the **Components** window, drag and drop a **Table Layout** onto the MAF AMX page.
2. Insert the desired number of Row Layout, Iterator, Attribute List Iterator, or Facet Definition child components into the Table Layout component.
3. Insert Cell Format, Iterator, Attribute List Iterator, or Facet Definition child components into each Row Layout component.
4. Use the **Properties** window to set the attributes of all added components. For more information, see *Oracle Fusion Middleware Tag Reference for Oracle Mobile Application Framework*.

Example 6–11 shows the `tableLayout` element and its children defined in a MAF AMX file.

Example 6–11 Defining Table Layout

```
<amx:tableLayout id="tableLayout1"
                 rendered="#{pageFlowScope.pRendered}"
                 styleClass="#{pageFlowScope.pStyleClass}"
                 inlineStyle="#{pageFlowScope.pInlineStyle}"
                 borderWidth="#{pageFlowScope.pBorderWidth}"
                 cellPadding="#{pageFlowScope.pCellPadding}"
                 cellSpacing="#{pageFlowScope.pCellSpacing}"
                 halign="#{pageFlowScope.pHalign}"
                 layout="#{pageFlowScope.pLayoutTL}"
                 shortDesc="#{pageFlowScope.pShortDesc}"
                 summary="#{pageFlowScope.pSummary}"
                 width="#{pageFlowScope.pWidth}">
   <amx:rowLayout id="rowLayout1">
      <amx:cellFormat id="cellFormatA" rowSpan="2" halign="center">
```

```
            <amx:outputText id="otA" value="Cell A"/>
         </amx:cellFormat>
         <amx:cellFormat id="cellFormatB" rowSpan="2" halign="center">
            <amx:outputText id="otB" value="Cell B (wide content)"/>
         </amx:cellFormat>
         <amx:cellFormat id="cellFormatC" rowSpan="2" halign="center">
            <amx:outputText id="otC" value="Cell C"/>
         </amx:cellFormat>
      </amx:rowLayout>
      <amx:rowLayout id="rowLayout2">
         <amx:cellFormat id="cellFormatD" halign="end">
            <amx:outputText id="otD" value="Cell D"/>
         </amx:cellFormat>
         <amx:cellFormat id="cellFormatE">
            <amx:outputText id="otE" value="Cell E"/>
         </amx:cellFormat>
      </amx:rowLayout>
   </amx:tableLayout>
```

6.2.12 How to Use a Deck Component

The Deck (`deck`) component represents a container that shows one of its child components at a time. The transition from one displayed child component (defined by the `displayedChild` attribute) to another is enabled by the Transition (`transition`) operation. The transition can take a form of animation. For more information about the transition, see Section 5.2.11, "How to Specify the Page Transition Style."

The Deck can be navigated forward and backwards.

To add the Deck component:

1. In the **Components** window, drag and drop a **Deck** onto the MAF AMX page.
2. Insert the desired number of Transition operations and child UI components into the Deck component.
3. Use the **Properties** window to set the attributes of all added components. For more information, see *Oracle Fusion Middleware Tag Reference for Oracle Mobile Application Framework*.

Example 6–12 shows the `deck` element and its children defined in a MAF AMX file. The Deck component's `displayedChild` attribute to define which child component ID should be displayed. Typically, this is controlled by a component such as a Select One Button or other selection component.

Example 6–12 Deck Definition

```
<amx:deck id="deck1"
            rendered="#{pageFlowScope.pRendered}"
            styleClass="#{pageFlowScope.pStyleClass}"
            inlineStyle="width:95px;height:137px;overflow:hidden;
                                 #{pageFlowScope.pInlineStyle}"
            landmark="#{pageFlowScope.pLandmark}"
            shortDesc="#{pageFlowScope.pShortDesc}"
            displayedChild="#{pageFlowScope.pDisplayedChild}">

   <amx:transition triggerType="#{pageFlowScope.pTriggerType}"
                   transition="#{pageFlowScope.pTransition}"/>
   <amx:transition triggerType="#{pageFlowScope.pTriggerType2}"
                   transition="#{pageFlowScope.pTransition2}"/>
   <amx:commandLink id="linkCardBack1" text="Card Back">>
```

```
      <amx:setPropertyListener from="linkCardA"
                               to="#{pageFlowScope.pDisplayedChild}"/>
   </amx:commandLink>
   <amx:commandLink id="linkCardA1" text="Card Front A">
   <amx:setPropertyListener id="setPL1"
                            from="linkCardB"
                            to="#{pageFlowScope.pDisplayedChild}"/>
   </amx:commandLink>
   <amx:commandLink id="linkCardB1" text="Card Front B">
      <amx:setPropertyListener id="setPL2"
                               from="linkCardC"
                               to="#{pageFlowScope.pDisplayedChild}"/>
   </amx:commandLink>
   <amx:commandLink id="linkCardC1" text="Card Front C">
      <amx:setPropertyListener id="setPL3"
                               from="linkCardD"
                               to="#{pageFlowScope.pDisplayedChild}"/>
   </amx:commandLink>
   <amx:commandLink id="linkCardD1" text="Card Front D">
      <amx:setPropertyListener id="setPL4"
                               from="linkCardE"
                               to="#{pageFlowScope.pDisplayedChild}"/>
   </amx:commandLink>
   <amx:commandLink id="linkCardE1" text="Card Front E">
      <amx:setPropertyListener id="setPL5"
                               from="linkCardBack"
                               to="#{pageFlowScope.pDisplayedChild}"/>
   </amx:commandLink>
</amx:deck>
```

For more information, see *Oracle Fusion Middleware Tag Reference for Oracle Mobile Application Framework*.

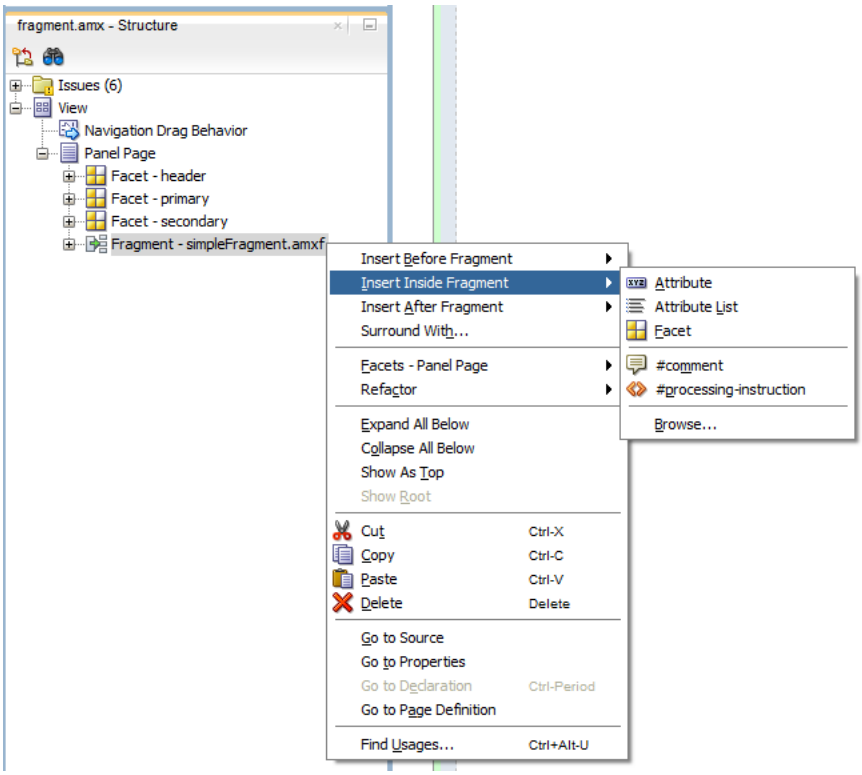
6.2.13 How to Use the Fragment Component

The Fragment (`fragment`) component enables sharing of MAF AMX page contents. This component is used in conjunction with a MAF AMX fragment file. For more information, see Section 5.3.1.6, "Sharing the Page Contents."

To add the Fragment component:

1. In the **Components** window, drag and drop a **Fragment** to the MAF AMX page.
2. Use the **Insert Fragment** dialog to set the **Src** attribute of the Fragment to a fragment file (`.amxf`).
3. Optionally, use the **Structure** view to add child components, such as an **Attribute**, **Attribute List**, or **Facet**.

Figure 6–13 Populating Fragment



4. Use the **Properties** window to set the attributes of all added components. For more information, see *Oracle Fusion Middleware Tag Reference for Oracle Mobile Application Framework*.

5. Add the **Facet Definition** (`facetRef`) to the MAF AMX fragment file whose contents is to be included in the Fragment and set the `facetRef`'s `facetName` attribute to the name of a facet.

Example 5–12, "Fragment in MAF AMX Page" shows a `fragment` element added to a MAF AMX page. Example 5–11, "Fragment Definition" shows the corresponding MAF AMX fragment file.

A MAF sample application called FragmentDemo demonstrates how to create and use the Fragment. This sample application is located in the `PublicSamples.zip` file within the *`jdev_install`*`/jdeveloper/jdev/extensions/oracle.maf/Samples` directory on your development computer.

6.3 Creating and Using UI Components

You can use the following UI components when developing your MAF AMX application feature:

- Input Text (see Section 6.3.1, "How to Use the Input Text Component")
- Input Number Slider (see Section 6.3.2, "How to Use the Input Number Slider Component")
- Input Date (see Section 6.3.3, "How to Use the Input Date Component")
- Output Text (see Section 6.3.4, "How to Use the Output Text Component")
- Button (see Section 6.3.5, "How to Use Buttons")

- Link (see Section 6.3.6, "How to Use Links")
- Image (see Section 6.3.7, "How to Display Images")
- Checkbox (see Section 6.3.8, "How to Use the Checkbox Component")
- Select Many Checkbox (see Section 6.3.9, "How to Use the Select Many Checkbox Component")
- Select Many Choice (see Section 6.3.11, "How to Use the Select Many Choice Component")
- Boolean Switch (see Section 6.3.12, "How to Use the Boolean Switch Component")
- Choice (see Section 6.3.10, "How to Use the Choice Component")
- Select Button (see Section 6.3.13, "How to Use the Select Button Component")
- Radio Button (see Section 6.3.14, "How to Use the Radio Button Component")
- List View (see Section 6.3.15, "How to Use List View and List Item Components")
- Carousel (see Section 6.3.16, "How to Use Carousel Component")
- Film Strip (see Section 6.3.17, "How to Use the Film Strip Component")
- Verbatim (see Section 6.3.18, "How to Use Verbatim Component")
- Output HTML (see Section 6.3.19, "How to Use Output HTML Component")
- Iterator (see Section 6.3.20, "How to Enable Iteration")

You can also use the following miscellaneous components that include operations, listener-type components, and converters as children of the UI components when developing your MAF AMX application feature:

- Load Bundle (see Section 6.3.21, "How to Load a Resource Bundle")
- Action Listener (see Section 6.3.22, "How to Use the Action Listener")
- Set Property Listener (see Section 6.3.23, "How to Use the Set Property Listener")
- Convert Date Time (see Section 6.3.24, "How to Convert Date and Time Values")
- Convert Number (see Section 6.3.25, "How to Convert Numerical Values")
- Navigation Drag Behavior (see Section 6.3.26, "How to Enable Drag Navigation")
- Loading Indicator Behavior (see Section 6.3.27, "How to Use the Loading Indicator")

You add a UI component by dragging and dropping it onto a MAF AMX page from the Components window (see Section 5.3.2.1, "Adding UI Components"). Then you use the Properties window to set the component's attributes (see Section 5.3.2.3, "Configuring UI Components"). For information on attributes of each particular component, see *Oracle Fusion Middleware Tag Reference for Oracle Mobile Application Framework*.

Note: On a MAF AMX page, you place UI components within layout components (see Section 6.2, "Designing the Page Layout"). UI elements are declared under the `<amx>` namespace, except data visualization components that are declared under the `<dvtm>` namespace.

You can add event listeners to some UI components. For more information, see Section 6.10, "Using Event Listeners." Event listeners are applicable to components for the MAF AMX runtime description on both iOS and Android-powered devices, but the listeners do not have any effect at design time.

For information on the UI components' support for accessibility, see Section 6.8, "Understanding MAF Support for Accessibility."

The user interface created for iOS platform using MAF AMX displays correctly in both the left-to-right and right-to-left language environments. In the latter case, the components originate on the right-hand side of the screen instead of on the left-hand side.

Note: MAF does not evaluate EL expressions at design time. If the value of a component's attribute is set to an expression, this value appears as such in JDeveloper's Preview and the component may look different at runtime.

A MAF sample application called CompGallery demonstrates how to create and configure MAF AMX UI components. Another sample application called UIDemo shows how to lay out components on a MAF AMX page. The sample applications are located in the `PublicSamples.zip` file within the *`jdev_install`*`/jdeveloper/jdev/extensions/oracle.maf/Samples` directory on your development computer.

6.3.1 How to Use the Input Text Component

The Input Text (`inputText`) component represents an editable text field. The following types of Input Text components are available:

- Standard single-line Input Text, which is declared as an `inputText` element in a MAF AMX file:

```
<amx:inputText id="text1"
                  label="Text Input:"
                  value="#{myBean.text}" />
```

- Password Input Text:

```
<amx:inputText id="text1"
               label="Password Input:"
               value="#{myBean.text}"
               secret="true" />
```

- Multiline Input Text (also known as text area):

```
<amx:inputText id="text1"
               label="Textarea:"
               value="#{myBean.text}"
               simple="true"
               rows="4" />
```

Figure 6–14 shows the Input Text component displayed in the Preview pane. This component has its parameters set as follows:

```
<amx:inputText id="inputText1"
               label="Input Text"
               value="text"/>
```

Figure 6–14 Input Text at Design Time

The `inputType` attribute lets you define how the component interprets the user input: as a text (default), email address, number, telephone number, or URL. These input types are based on the values allowed by HTML5.

To enable conversion of numbers, as well as date and time values that are entered in the Input Text component, you use the Convert Number (see Section 6.3.25, "How to Convert Numerical Values") and Convert Date Time (see Section 6.3.24, "How to Convert Date and Time Values") components.

For more information, illustrations, and examples, see the following:

- *Oracle Fusion Middleware Tag Reference for Oracle Mobile Application Framework*
- CompGallery, a MAF sample application located in the `PublicSamples.zip` file within the *`jdev_install`*`/jdeveloper/jdev/extensions/oracle.maf/Samples` directory on your development computer.

On some mobile devices, when the end user taps an Input Text field, the keyboard is displayed (slides up). If an Input Text is the only component on a MAF AMX page, the input focus is on this field and the keyboard is displayed by default when the page loads.

A multiline Input Text may be displayed on a secondary page where it is the only component, in which case the multiline Input Text receives focus when the page loads and the keyboard becomes visible.

Input Text components render and behave differently on iOS and Android-powered devices: on iPhone and iPad, Input Text components may be displayed with or without a border.

When creating an Input Text component, consider the following:

- To input or edit content, the end user has to tap in the field, which triggers a blinking insertion cursor to be displayed at the point of the tap, allowing the end user to edit the content. If the field does not contain content, the insertion cursor is positioned at the start of the field.
- Fields represented by Input Text components may contain default text, typically used as a prompt. When the end user taps a key on the keyboard in such a field, the default text clears when Edit mode is entered. This behavior is enabled and configured through the Input Text's `hintText` attribute.
- Fields represented by Input Text components do not have a selected appearance. Selection is indicated by the blinking insertion cursor within the field.
- If the end user enters more text than fits in the field, the text content shifts left one character at a time as the typing continues.
- A multiline Input Text component is rendered as a rectangle of any height. This component supports scrolling when the content is too large to fit within the boundaries of the field: rows of text scroll up as the text area fills and new rows of text are added. The end user may flick up or down to scroll rows of text if there are more rows than can be displayed in the given display space. A scroll bar is displayed within the component to indicate the area is being scrolled.
- Password field briefly echoes each typed character, and then reverts the character to a dot to protect the password.

- The appearance and behavior of the Input Text component on iOS can be customized (see Section 6.3.1.1, "Customizing the Input Text Component").

6.3.1.1 Customizing the Input Text Component

MAF AMX provides support for the input capitalization and correction on iOS-powered devices, as well as the ability to override the return button located at the bottom right of the mobile devices's soft keypad (see Figure 6–15) such that this button would appear and act as the Go or Search button (see Figure 6–16) and trigger a `DataChangeEvent` for a single-line Input Text component.

Figure 6–15 Return Button on iOS-Powered Device at Runtime

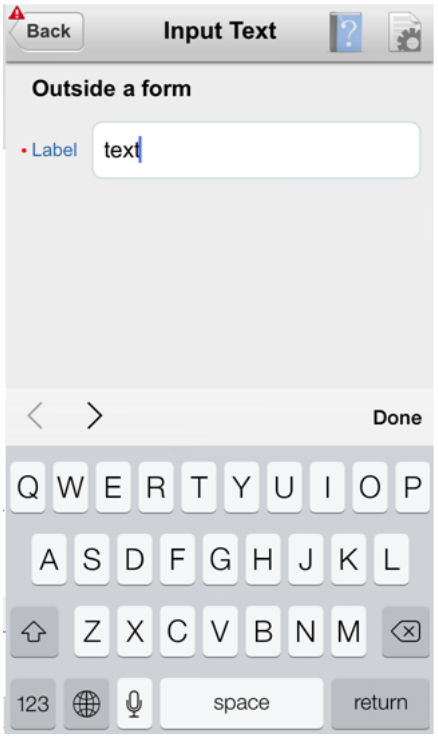
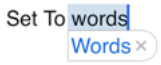
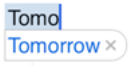


Figure 6–16 Go and Search Buttons on iOS at Runtime

Table 6–3 lists attributes of the Input Text component that allow you to customize the appearance and behavior of that component and the soft keypad that is used to enter values into fields represented by the Input Text.

Table 6–3 Input-Customizing Attributes of the Input Text Component

Attribute	Values	Description
`keyboardDismiss`	▪ `normal`: use the operating system's default. ▪ `go`: request the field to act like a trigger for behavior. ▪ `search`: request the field to act like a search field that triggers a lookup.	Indicates how the text field is to be used. If `go` or `search` is specified, dismissing the keypad causes the input to blur on both iOS and Android platforms. Even though support for Go and Search buttons on iOS is subject to change and might be terminated at any time, on some iOS-powered devices keypads are provided with the enhanced functionality. For example, instead of displaying a return button on a single-line text field, it might already replace it with a Go or Search button.
`autoCapitalize`	▪ `auto`: use the operating system's default. ▪ `sentences`: request that sentences comprising the input start with a capital letter. ▪ `none`: request that no capitalization be applied automatically to the input. ▪ `words`: request that words comprising the input start with capital letters. ▪ `characters`: request that each character typed as an input become capitalized.	Requests special treatment by iOS for capitalization of values while the field represented by the Input Text is being edited.  Note that setting this property has no impact on Android.
`autoCorrect`	▪ `auto`: use the operating system's default. ▪ `on`: request auto-correct support for the input. ▪ `off`: request auto-correct of the input be disabled.	Requests special treatment by iOS for correcting values while the field represented by the Input Text is being edited.  Note that setting this property has no impact on Android.

Since iOS provides limited support for auto-capitalization and auto-correction on its device simulator, you must test this functionality on an iOS device.

6.3.2 How to Use the Input Number Slider Component

The Input Number Slider (`inputNumberSlider`) component enables selection of numeric values from a range of values by using a slider instead of entering the value by using keys. The filled portion of the trough or track of the slider visually represents the current value.

The Input Number Slider may be used in conjunction with the Output or Input Text component to numerically show the value of the slider. The Input Text component also

allows direct entry of a slider value: when the end user taps the Input Text field, the keyboard in numeric mode slides up; the keyboard can be dismissed by either using the slide-down button or by tapping away from the slider component.

The Input Number Slider component always shows the minimum and maximum values within the defined range of the component.

> **Note:** The Input Number Slider component should not be used in cases where a precise numeric entry is required or where there is a wide range of values (for example, 0 to 1000).

Example 6–13 demonstrates the `inputNumberSlider` element defined in a MAF AMX file.

Example 6–13 Input Number Slider Definition

```
<amx:inputNumberSlider id="slider1" value="#{myBean.count}"/>
```

Figure 6–17 shows the Input Number Slider component displayed in the Preview pane. This component has its parameters set as follows:

```
<amx:inputNumberSlider id="inputNumberSlider1"
                       label="Input Number"
                       minimum="0"
                       maximum="20"
                       stepSize="1"
                       value="10"/>
```

Figure 6–17 Input Number Slider at Design Time

To enable conversion of numbers that are entered in the Input Number Slider component, you use the Convert Number component (see Section 6.3.25, "How to Convert Numerical Values").

For more information, illustrations, and examples, see the following:

- *Oracle Fusion Middleware Tag Reference for Oracle Mobile Application Framework*
- CompGallery, a MAF sample application located in the `PublicSamples.zip` file within the *`jdev_install`*`/jdeveloper/jdev/extensions/oracle.maf/Samples` directory on your development computer.

Similar to other MAF AMX UI components, the Input Number Slider component has a normal and selected state. The component is in its selected state at any time it is touched. To change the slider value, the end user touches, and then interacts with the slider button.

The Input Number Slider component has optional `imageLeft` and `imageRight` attributes which point to images that can be displayed on either side of the slider to provide the end user with additional information.

6.3.3 How to Use the Input Date Component

The Input Date (`inputDate`) component presents a popup input field for entering dates. The default date format is the short date format appropriate for the current

locale. For example, the default format in American English (ENU) is `mm/dd/yy`. The `inputType` attribute defines if the component accepts date, time, or date and time as an input. The time zone depends on the time zone configured for the mobile device, and, therefore, it is relative to the device. At runtime, the Input Date component has the device's native look and feel.

Example 6–14 demonstrates the `inputDate` element defined in a MAF AMX file. The `inputType` attribute of this component is set to the default value of `date`. If the `value` attribute is read-only, it can be set to either an EL expression or any other type of value; if `value` is not a read-only attribute, it can be specified only as an EL expression.

Example 6–14 Input Date Definition

```
<amx:inputDate id="inputDate1" label="Input Date" value="#{myBean.date}"/>
```

For more information, see the following:

- *Oracle Fusion Middleware Tag Reference for Oracle Mobile Application Framework*
- HTML5 global dates and times defined by W3C
- CompGallery, a MAF sample application located in the `PublicSamples.zip` file within the *`jdev_install`*`/jdeveloper/jdev/extensions/oracle.maf/Samples` directory on your development computer

6.3.4 How to Use the Output Text Component

MAF AMX provides the Output Text (`outputText`) component for you to use as a label to display text.

Example 6–15 demonstrates the `outputText` element defined in a MAF AMX file.

Example 6–15 Output Text Definition

```
<amx:outputText id="ot1"
                value="output"
                styleClass="#{pageFlowScope.pStyleClass}"/>
```

Figure 6–18 shows the Output Text component displayed in the Preview pane.

Figure 6–18 Output Text at Design Time

You use the Convert Number (see Section 6.3.25, "How to Convert Numerical Values") and Convert Date Time (see Section 6.3.24, "How to Convert Date and Time Values") converters to facilitate the conversion of numerical and date-and-time-related data for the Output Text components.

For more information, illustrations, and examples, see the following:

- *Oracle Fusion Middleware Tag Reference for Oracle Mobile Application Framework*
- CompGallery and UIDemo, MAF sample applications located in the `PublicSamples.zip` file within the *`jdev_install`*`/jdeveloper/jdev/extensions/oracle.maf/Samples` directory on your development computer

6.3.5 How to Use Buttons

The Button (`commandButton`) component is used to trigger actions (for example, Save, Cancel, Send) and to enable navigation to other pages within the application (for example, Back: see Section 6.3.5.7, "Enabling the Back Button Navigation" for more information).

You may use the Button in one of the following ways:

- Button with a text label.
- Button with a text label and an image icon.

> **Note:** You may define the icon image and placement as left or right of the text label.

- Button with an image icon only (for example, the " + " and " - " buttons for adding or deleting records).

MAF supports one default Button type for the following three display areas:

1. Buttons that appear in the top header bar: in MAF AMX pages, the header is represented by the Panel Page component (see Section 6.2.2, "How to Use a Panel Page Component") in combination with the header, primary, and secondary facets, which is typical on iPhones:
   - Header Facet contains the page title.
   - Primary Action Facet represents an area that appears in the left corner of the header bar and typically hosts Button or Link components, but can contain any component type.
   - Secondary Action Facet represents an area that appears in the right corner of the header bar and typically hosts Button or Link components, but can contain any component type.
2. Buttons that appear in the content area of a page.
3. Buttons that appear in the footer bar of a page. In MAF AMX pages, the footer is represented by the Panel Page component (see Section 6.2.2, "How to Use a Panel Page Component") in combination with the footer facet:
   - Footer Facet represents an area that appears below the content area and typically hosts Button or Link components, but can contain any component type.

All Button components of any type have three states:

1. Normal.
2. Activated: represents appearance when the Button is tapped or touched by the end user. When a button is tapped (touch and release), the button action is performed. Upon touch, the activated appearance is displayed; upon release, the action is performed. If the end user touches the button and then drags their finger away from the button, the action is not performed. However, for the period of time the button is touched, the activated appearance is displayed.
3. Disabled.

The appearance of a Button component is defined by its `styleClass` attribute that you set to an `adfmf-commandButton-<style>`. You can apply any of the styles detailed in Table 6–4 to a Button placed in any valid location within the MAF AMX page.

Table 6–4 Main Button Styles

Button Style Name	Description
Default	The default style of a Button placed: ■ In any of the Panel Page facets (Primary, Secondary, Header, Footer). For more information, see Section 6.3.5.1, "Displaying Default Style Buttons." ■ Anywhere in the content area of a MAF AMX page. This style is used for buttons that are to perform specific actions within a page, typically based on their location or context within the page.
Back	The back style of a Button placed in any of the Panel Page facets (Primary, Secondary, Header, Footer). This style may be applied to the default Button to give the "back to page" appearance. This button style is typical for "Back to Springboard" or any "Back to Page" buttons. For more information, see Section 6.3.5.2, "Displaying Back Style Buttons."
Highlight	The highlight style of a Button placed in any of the Panel Page facets (Primary, Secondary, Header, Footer) or the content area of a MAF AMX page. This style may be added to a Button to provide the iPhone button appearance typical of Save (or Done) buttons. For more information, see Section 6.3.5.3, "Displaying Highlight Style Buttons."
Alert	The Alert style adds the delete appearance to a button. For more information, see Section 6.3.5.4, "Displaying Alert Style Buttons."

There is a Rounded style (`adfmf-commandButton-rounded`) that you can apply to a Button to decorate it with a thick rounded border (see Figure 6–19). You can define this style in combination with any other style.

Figure 6–19 Rounded Button at Design Time

MAF AMX provides a number of additional decorative styles (see Section 6.3.5.5, "Using Additional Button Styles").

There is a particular order in which MAF AMX processes the Button component's child operations and attributes. For more information, see Section 6.3.5.8, "What You May Need to Know About the Order of Processing Operations and Attributes."

6.3.5.1 Displaying Default Style Buttons

The following are various types of default style buttons that can be placed within Panel Page facets or content area:

- Normal, activated, or disabled Button with a text label only.
- Normal, activated, or disabled Button with an image icon only.

Example 6–16 and Example 6–17 demonstrate the `commandButton` element declared in a MAF AMX file.

Example 6–16 Definition of Default Button with Text Label

```
<amx:panelPage id="pp1">
   <amx:facet name="primary">
      <amx:commandButton id="cb1"
```

```
                        text="Cancel"
                        action="cancel"
                        actionListener="#{myBean.rollback}"/>
   </amx:facet>
</amx:panelPage>
```

Example 6–17 Definition of Default Button with Image Icon

```
<amx:panelPage id="pp1">
   <amx:facet name="primary">
      <amx:commandButton id="cb1"
                        icon="plus.png"
                        action="add"
                        actionListener="#{myBean.AddItem}"/>
   </amx:facet>
</amx:panelPage>
```

Example 6–18 shows the `commandButton` element declared inside the Panel Page's footer facet.

Example 6–18 Definition of Default Button with Text Label and Image in Footer Facet

```
<amx:panelPage id="pp1">
   <amx:facet name="footer">
      <amx:commandButton id="cb2"
                        icon="folder.png"
                        text="Move (#{myBean.mailcount})"
                        action="move"/>
   </amx:facet>
</amx:panelPage>
```

Example 6–19 demonstrates the `commandButton` element declared as a part of the Panel Page content area.

Example 6–19 Definition of Default Button with Text Label in the Page Content Area

```
<amx:panelPage id="pp1">
   <amx:commandButton id="cb1"
                     text="Reply"
                     actionListener="#{myBean.share}"/>
</amx:panelPage>
```

For more information, illustrations, and examples, see the following:

- *Oracle Fusion Middleware Tag Reference for Oracle Mobile Application Framework*
- CompGallery, a MAF sample application located in the `PublicSamples.zip` file within the *`jdev_install`*`/jdeveloper/jdev/extensions/oracle.maf/Samples` directory on your development computer

6.3.5.2 Displaying Back Style Buttons

The following are various types of back style buttons that are placed within Panel Page facets or content area:

- Normal, activated, or disabled Button with a text label only.
- Normal, activated, or disabled Button with an image icon only:

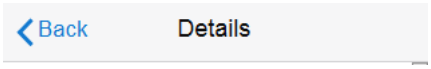
Example 6–20 demonstrates the `commandButton` element declared in a MAF AMX file.

Example 6–20 Definition of Back Button with Text Label

```
<amx:panelPage id="pp1">
   <amx:facet name="header">
      <amx:outputText value="Details" id="ot1"/>
   </amx:facet>
   <amx:facet name="primary">
      <amx:commandButton id="cb1"
                         text="Back"
                         action="__back"/>
   </amx:facet>
   ...
</amx:panelPage>
```

Every time you place a Button component within the primary facet and set its `action` attribute to `__back`, MAF AMX automatically applies the back arrow styling to it, as Figure 6–20

Figure 6–20 Back Button an Design Time



For more information, illustrations, and examples, see the following:

- *Oracle Fusion Middleware Tag Reference for Oracle Mobile Application Framework*
- CompGallery, a MAF sample application located in the `PublicSamples.zip` file within the *`jdev_install`*`/jdeveloper/jdev/extensions/oracle.maf/Samples` directory on your development computer

6.3.5.3 Displaying Highlight Style Buttons

Similar to other types of Buttons, highlight style buttons that are placed within Panel Page facets or content area can have their state as normal, activated, or disabled.

Example 6–21 demonstrates the `commandButton` element declared in a MAF AMX file.

Example 6–21 Definition of Highlight Button with Text Label

```
<amx:panelPage id="pp1">
   <amx:facet name="secondary">
      <amx:commandButton id="cb2"
                         text="Save"
                         action="save"
                         styleClass="adfmf-commandButton-highlight"/>
   </amx:facet>
</amx:panelPage>
```

Figure 6–21 Highlight Button at Design Time

For more information, illustrations, and examples, see the following:

- *Oracle Fusion Middleware Tag Reference for Oracle Mobile Application Framework*
- CompGallery, a MAF sample application located in the `PublicSamples.zip` file within the *`jdev_install`*`/jdeveloper/jdev/extensions/oracle.maf/Samples` directory on your development computer

6.3.5.4 Displaying Alert Style Buttons

Alert style buttons placed within the Panel Page can have normal, activated, or disabled state.

Example 6–22 demonstrates the `commandButton` element declared in a MAF AMX file.

Example 6–22 Definition of Alert Button with Text Label

```
<amx:commandButton id="cb1"
                   text="Delete"
                   actionListener="#{myBean.delete}"
                   styleClass="adfmf-commandButton-alert" />
```

Figure 6–22 Alert Button at Design Time

For more information, illustrations, and examples, see the following:

- *Oracle Fusion Middleware Tag Reference for Oracle Mobile Application Framework*
- CompGallery, a MAF sample application located in the `PublicSamples.zip` file within the *`jdev_install`*`/jdeveloper/jdev/extensions/oracle.maf/Samples` directory on your development computer

6.3.5.5 Using Additional Button Styles

MAF AMX provides the following additional Button styles:

- Dark style
- Bright style
- Small style
- Large style
- Highlight style
- Confirm style
- Two varieties of the Alternate style

Figure 6–23 Additional Button Styles

6.3.5.6 Using Buttons Within the Application

In your MAF application, you can use the Button component within the following contexts:

- Navigation Bar
- The Content Area to perform specific actions
- Action Sheets
- Popup-style Alert Messages

Navigation Bar

MAF lets you create standard buttons for use on a navigation bar:

- Edit button allows the end user to enter an editing or content-manipulation mode.
- Cancel button allows the end user to exit the editing or content-manipulation mode without saving changes.
- Save button allows the end user to exit the editing or content-manipulation mode by saving changes.
- Done button allows the end user to exit the current mode and save changes, if any.
- Undo button allows the end user to undo the most recent action.

- Redo button allows the end user to redo the most recent undone action.
- Back button allows the end user to navigate back to the springboard.
- Back to Page button allows the end user to navigate back to the page identified by the button text label.
- Add button allows the end user to add or create a new object.

Content Area

Buttons that are positioned within the content area of a page perform a specific action given the location and context of the button within the page. These buttons may have a different visual appearance than buttons positioned with the navigation bar:

Action Sheets

An example of buttons placed within an action sheet is a group of Delete Note and Cancel buttons.

An action sheet button expands to the width of the display.

Alert Messages

An OK button can be placed within a validation message, such as a login validation after a failed password input.

6.3.5.7 Enabling the Back Button Navigation

MAF AMX supports navigation using the back button, with the default behavior of going back to the previously visited page. For more information, see Section 5.2.9, "How to Specify Action Outcomes Using UI Components."

If any Button component is added to the primary facet of a Panel Page that is equipped with the `__back` navigation, this Button is automatically given the back arrow visual styling (see Section 6.3.5.2, "Displaying Back Style Buttons"). To disable this, set the `styleClass` attribute to `amx-commandButton-normal`.

For more information, illustrations, and examples, see the following:

- Oracle Fusion Middleware Tag Reference for Oracle Mobile Application Framework
- CompGallery, a MAF sample application located in the `PublicSamples.zip` file within the *`jdev_install`*`/jdeveloper/jdev/extensions/oracle.maf/Samples` directory on your development computer

6.3.5.8 What You May Need to Know About the Order of Processing Operations and Attributes

The following is the order in which MAF AMX processes operations and attributes when such components as a Button, Link, and List Item are activated:

1. The following child operations are processed in the order they appear in the XML file:
   - Set Property Listener
   - Action Listener
   - Show Popup Behavior
   - Close Popup Behavior

2. The Action Listener (`actionListener`) attribute is processed and the associated Java method is invoked.
3. The Action (`action`) attribute is processed and any navigation case is followed.

6.3.6 How to Use Links

You use the Link (`commandLink`) component to trigger actions and enable navigation to other views.

The Link component can have any type of component defined as its child. By using such components as Set Property Listener (see Section 6.3.23, "How to Use the Set Property Listener"), Action Listener (see Section 6.3.22, "How to Use the Action Listener"), Show Popup Behavior, Close Popup Behavior see Section 6.2.8, "How to Use a Popup Component"), and Validation Behavior (see Section 6.9, "Validating Input") as children of the Link component, you can create an actionable area within which clicks and gestures can be performed.

By placing an Image component (see Section 6.3.7, "How to Display Images") inside a Link you can create a clickable image.

Example 6–23 demonstrates the `commandLink` element declared in a MAF AMX file.

Example 6–23 Basic Link Definition

```
<amx:commandLink id="cl1"
                 text="linked"
                 action="gotolink"
                 actionListener="#{myBean.doSomething}"/>
```

Figure 6–24 shows the basic Link component displayed in the Preview pane.

Figure 6–24 Link at Design Time

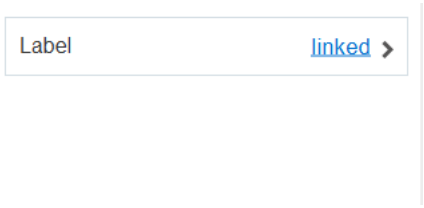
Example 6–24 demonstrates the `commandLink` element declared in a MAF AMX file. This component is placed within the `panelFormLayout` and `panelLabelAndMessage` components.

Example 6–24 Definition of Link Within Form

```
<amx:panelPage id="pp1">
   <amx:panelFormLayout id="form">
      <amx:panelLabelAndMessage id="panelLabelAndMessage1" label="Label">
         <amx:commandLink id="cl1"
                          text="linked"
                          action="gotolink"
                          actionListener="#{myBean.doSomething}"/>
      </amx:panelLabelAndMessage>
   </amx:panelFormLayout>
</amx:panelPage>
```

Figure 6–25 shows the Link component placed within a form and displayed in the Preview pane.

Figure 6–25 Link Within Form at Design Time



There is a particular order in which MAF AMX processes the Link component's child operations and attributes. For more information, see Section 6.3.5.8, "What You May Need to Know About the Order of Processing Operations and Attributes."

MAF AMX provides another component which is similar to the Link, but which does not allow for navigation between pages: Link Go (`goLink`) component. You use this component to enable linking to external pages. Figure 6–26 shows the Link Go component displayed in the Preview pane. This component has its parameters set as follows:

```
<amx:goLink id="goLink1"
            text="Go Link"
            url="http://example.com"/>
```

Figure 6–26 Link Go at Design Time

Image is the only component that you can specify as a child of the Link Go component.

For more information, illustrations, and examples, see the following:

- *Oracle Fusion Middleware Tag Reference for Oracle Mobile Application Framework*
- CompGallery, a MAF sample application located in the `PublicSamples.zip` file within the *`jdev_install`*`/jdeveloper/jdev/extensions/oracle.maf/Samples` directory on your development computer

6.3.7 How to Display Images

MAF AMX enables the display of images on iOS and Android-powered devices using the Image (`image`) component represented by a bitmap.

In addition to placing an Image in a Button and List View, you can place it inside a Link component (see Section 6.3.6, "How to Use Links") to create a clickable image.

Example 6–25 demonstrates the `image` element definition in a MAF AMX file.

Example 6–25 Image Definition

```
<amx:image id="i1"
           styleClass="prod-thumb"
           source="images/img-big-#{pageFlowScope.product.uid}.png" />
```

The following are supported formats on Android platform:

- GIF
- JPEG
- PNG

- BMP

The following are supported formats on iOS platform:

- PNG

For more information, illustrations, and examples, see the following:

- *Oracle Fusion Middleware Tag Reference for Oracle Mobile Application Framework*
- CompGallery and UIDemo, MAF sample applications located in the `PublicSamples.zip` file within the *`jdev_install`*`/jdeveloper/jdev/extensions/oracle.maf/Samples` directory on your development computer

6.3.8 How to Use the Checkbox Component

The Checkbox (`selectBooleanCheckbox`) component represents a check box that you create to enable single selection of `true` or `false` values, which allows toggling between selected and deselected states.

You can use the `label` attribute of the Checkbox component to place text to the left of the checkbox, and the `text` attribute places text on the right.

Example 6–26 demonstrates the `selectBooleanCheckbox` element declared in a MAF AMX file.

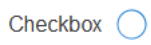
Example 6–26 Unchecked Checkbox Definition

```
<amx:selectBooleanCheckbox id="check1"
                           label="Agree to the terms:"
                           value="#{myBean.bool1}"
                           valueChangeListener=
                              "#{PropertyBean.ValueChangeHandler}"/>
```

Figure 6–27 shows the unchecked Checkbox component displayed in the Preview pane. This component has its parameters set as follows:

```
<amx:selectBooleanCheckbox id="selectBooleanCheckbox1"
                           label="Checkbox"
                           value="false"
                           valueChangeListener=
                                "#{PropertyBean.ValueChangeHandler}"/>
```

Figure 6–27 Unchecked Checkbox at Design Time

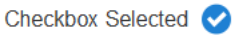


shows the checked Checkbox component displayed in the Preview pane. This component has its parameters set as follows:

Example 6–27 Checked Checkbox at Design Time

```
<amx:selectBooleanCheckbox id="selectBooleanCheckbox1"
                           label="Checkbox"
                           value="true"
                           valueChangeListener=
                                "#{PropertyBean.ValueChangeHandler}"/>
```

Figure 6–28 Checked Checkbox Definition



For more information, illustrations, and examples, see the following:

- *Oracle Fusion Middleware Tag Reference for Oracle Mobile Application Framework*
- CompGallery, a MAF sample application located in the `PublicSamples.zip` file within the *`jdev_install`*`/jdeveloper/jdev/extensions/oracle.maf/Samples` directory on your development computer

6.3.8.1 Support for Checkbox Components on iOS Platform

iOS does not support a native Checkbox component. The Boolean Switch is usually used in Properties pages to enable a boolean selection (see Section 6.3.12, "How to Use the Boolean Switch Component").

6.3.8.2 Support for Checkbox Components on Android Platform

Android provides support for a native Checkbox component. This component is used extensively on Settings pages to turn on or off individual setting values.

6.3.9 How to Use the Select Many Checkbox Component

The Select Many Checkbox (`selectManyCheckbox`) component represents a group of check boxes that you use to enable multiple selection of `true` or `false` values, which allows toggling between selected and deselected states of each check box in the group. The selection mechanism is provided by the Select Items or Select Item component (see Section 6.3.10.3, "What You May Need to Know About Differences Between Select Items and Select Item Components") contained by the Select Many Checkbox component.

> **Note:** The Select Many Checkbox component can contain more than one Select Item or Select Items components.

Example 6–28 demonstrates the `selectManyCheckbox` element declared in a MAF AMX file.

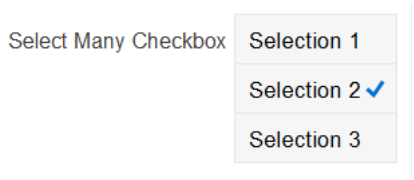
Example 6–28 Select Many Checkbox Definition

```
<amx:selectManyCheckbox id="selectManyCheckbox1"
                        label="Select shipping options"
                        value="#{myBean.shipping}"
                        valueChangeListener="#{PropertyBean.ValueChangeHandler}">
   <amx:selectItem id="selectItem1"
                   label="Air"
                   value="#{myBean.shipping.air}"/>
   <amx:selectItem id="selectItem2"
                   label="Rail"
                   value="#{myBean.shipping.rail}"/>
   <amx:selectItem id="selectItem3"
                   label="Water"
                   value="#{myBean.shipping.water}"/>
</amx:selectManyCheckbox>
```

Figure 6–29 shows the Select Many Checkbox component displayed in the Preview pane. This component has its parameters set as follows:

```
<amx:selectManyCheckbox id="selectManyCheckbox1"
                        label="Select Many Checkbox"
                        value="value2"
                        valueChangeListener="#{PropertyBean.ValueChangeHandler}">
   <amx:selectItem id="selectItem1" label="Selection 1" value="value1"/>
   <amx:selectItem id="selectItem2" label="Selection 2" value="value2"/>
   <amx:selectItem id="selectItem3" label="Selection 3" value="value3"/>
</amx:selectManyCheckbox>
```

Figure 6–29 Select Many Checkbox at Design Time



For more information, illustrations, and examples, see the following:

- *Oracle Fusion Middleware Tag Reference for Oracle Mobile Application Framework*
- CompGallery, a MAF sample application located in the `PublicSamples.zip` file within the *`jdev_install`*`/jdeveloper/jdev/extensions/oracle.maf/Samples` directory on your development computer

6.3.9.1 What You May Need to Know About the User Interaction with Select Many Checkbox Component

MAF AMX provides two alternative ways for displaying the Select Many Checkbox component: pop-up style (default) and list style that is used when the number of available choices exceeds the device screen size.

The end user interaction with a pop-up style Select Many Checkbox component on both iPhone and iPad occurs as follows: when the end user taps the component, the list of choices is displayed in a popup. To make a choice, the end user taps one or more choices. To save the selections, the end user either taps outside the popup or closes the popup using the close (" x ") button.

Upon closing of the popup, the value displayed in the component is updated with the selected value.

When the number of choices exceed the dimensions of the device, a full-page popup containing a scrollable List View (see Section 6.3.15, "How to Use List View and List Item Components") is generated.

The end user interaction with a list-style Select Many Checkbox component on both iPhone and iPad occurs as follows: when the end user taps the component, the list of choices is displayed. To make a choice, the end user scrolls up or down to browse available choices, and then taps one or more choices. To save the selections, the end user taps the close (" x ") button.

Upon closing of the list, the value displayed in the component is updated with the selected value.

> **Note:** In both cases, there is no mechanism provided to cancel the selection.

6.3.10 How to Use the Choice Component

The Choice (`selectOneChoice`) component represents a combo box that is used to enable selection of a single value from a list. The selection mechanism is provided by the Select Items or Select Item component (see Section 6.3.10.3, "What You May Need to Know About Differences Between Select Items and Select Item Components") contained by the Choice component.

> **Note:** The Choice component can contain more than one Select Items or Select Item components.

Example 6–29 demonstrates the `selectOneChoice` element definition with the `selectItems` subelement in a MAF AMX file.

Example 6–29 Choice Definition Using Select Item Component

```
<amx:selectOneChoice id="choice1"
                     label="Your state:"
                     value="#{myBean.myState}"
                     valueChangeListener="#{PropertyBean.ValueChangeHandler}">
   <amx:selectItem id="selectItem1" label="Alaska" value="AK"/>
   <amx:selectItem id="selectItem2" label="Alabama" value="AL"/>
   <amx:selectItem id="selectItem3" label="California" value="CA"/>
   <amx:selectItem id="selectItem4" label="Connecticut" value="CT"/>
</amx:selectOneChoice>
```

Example 6–30 Choice Definition Using Select Items Component

```
<amx:selectOneChoice id="choice1"
                     label="Your state:"
                     value="#{myBean.myState}"
                     valueChangeListener="#{PropertyBean.ValueChangeHandler}">
   <amx:selectItems id="selectItems1" value="myBean.allStates"/>
</amx:selectOneChoice>
```

Figure 6–30 shows the Choice component displayed in the Preview pane. This component has its parameters set as follows:

```
<amx:selectOneChoice id="selectOneChoice1"
                     label="Choice"
                     value="value1"
                     valueChangeListener="#{PropertyBean.ValueChangeHandler}">
   <amx:selectItem id="selectItem1" label="Value 1" value="value1"/>
   <amx:selectItem id="selectItem2" label="Value 2" value="value2"/>
   <amx:selectItem id="selectItem3" label="Value 3" value="value3"/>
</amx:selectOneChoice>
```

Figure 6–30 Choice at Design Time

For more information, illustrations, and examples, see the following:

- *Oracle Fusion Middleware Tag Reference for Oracle Mobile Application Framework*
- CompGallery, a MAF sample application located in the `PublicSamples.zip` file within the *`jdev_install`*`/jdeveloper/jdev/extensions/oracle.maf/Samples` directory on your development computer

6.3.10.1 What You May Need to Know About the User Interaction with Choice Component on iOS Platform

MAF AMX provides two alternative ways for displaying the Choice component: pop-up style and drop-down style.

On an iPhone, the end user interaction with a native Choice component occurs as follows: when the end user taps the components list of choices is displayed, with the first option selected by default. To make a choice, the end user scrolls up or down to browse available choices. To save the selection, the end user taps Done in the tool bar.

On an iPad, the user interaction is similar to the interaction on an iPhone, except the following:

- The list of choices is displayed in a popup dialog.
- iPad styling is implemented around the list of choices, with a notch used to indicate the source of the list.

To close the list of choices without selecting an item, the end user must tap outside the popup dialog.

> **Note:** The UI to display the list of choices and the tool bar are native to the browser and cannot be styled using CSS.

List values within the Choice component may be displayed as disabled.

When the number of choices exceeds the dimensions of the device display, a list page is generated that may be scrolled in a native way.

6.3.10.2 What You May Need to Know About the User Interaction with Choice Component on Android Platform

The end user interaction with a native Choice component on an Android-powered device occurs as follows: when the end user taps the component, the list of choices in the form of a popup dialog is displayed. A simple popup is displayed if the number of choices fits within the dimensions of the device, in which case:

- A single tap on an item from the selection list selects that item and closes the popup; the selection is reflected in the Choice component label.
- A single tap outside the popup or a click on the Back key closes the popup with no changes applied.

If the number of choices to be displayed does not fit within the device dimensions, the popup contains a scrollable list, in which case:

- A single tap on an item from the selection list selects that item and closes the popup; the selection is reflected in the Choice component label.
- A click on the Back key closes the popup with no changes applied.

6.3.10.3 What You May Need to Know About Differences Between Select Items and Select Item Components

The Select Items (`selectItems`) component provides a list of objects that can be selected in both multiple-selection and single-selection components.

The Select Item (`selectItem`) component represents a single selectable item of selection components.

6.3.11 How to Use the Select Many Choice Component

The Select Many Choice (`selectManyChoice`) component allows selection of multiple values from a list. The selection mechanism is provided by the Select Items or Select Item component (see Section 6.3.10.3, "What You May Need to Know About Differences Between Select Items and Select Item Components") contained by the Select Many Checkbox component.

> **Note:** The Select Many Checkbox component can contain more than one Select Items or Select Item components.

Example 6–31 demonstrates the `selectManyChoice` element declared in a MAF AMX file.

Example 6–31 Select Many Choice Definition Using Select Item Component

```
<amx:selectManyChoice id="check1"
                      label="Select Option:"
                      value="#{myBean.shipping}"
                      valueChangeListener="#{PropertyBean.ValueChangeHandler}">
   <amx:selectItem id="selectItem1"
                   label="Signature Required"
                   value="signature" />
   <amx:selectItem id="selectItem2"
                   label="Insurance"
                   value="insurance" />
   <amx:selectItem id="selectItem3"
                   label="Delivery Confirmation"
                   value="deliveryconfirm"/>
</amx:selectManyChoice>
```

Figure 6–31 Select Many Choice at Design Time

Example 6–32 Select Many Choice Definition Using Select Items Component

```
<amx:selectManyChoice id="check1"
                      label="Select Shipping Options:"
                      value="#{myBean.shipping}">
   <amx:selectItems id="selectItems1" value="#{myBean.shippingOptions}"/>
</amx:selectManyChoice>
```

For more information, illustrations, and examples, see the following:

- *Oracle Fusion Middleware Tag Reference for Oracle Mobile Application Framework*
- CompGallery, a MAF sample application located in the PublicSamples.zip file within the *jdev_install*`/jdeveloper/jdev/extensions/oracle.maf/Samples` directory on your development computer

The look and behavior of the Select Many Choice component on all supported devices is almost identical to the Select Many Checkbox component (see Section 6.3.9, "How to Use the Select Many Checkbox Component" for more information).

6.3.12 How to Use the Boolean Switch Component

The Boolean Switch (`selectBooleanSwitch`) component allows editing of boolean values as a switch metaphor instead of a checkbox.

Similar to other MAF AMX UI components, this component has a normal and selected state. To toggle the value, the end user taps (touches and releases) the switch once. Each tap toggles the switch.

Example 6–33 demonstrates the `selectBooleanSwitch` element defined in a MAF AMX file.

Example 6–33 Boolean Switch Definition

```
<amx:selectBooleanSwitch id="switch1"
                         label="Flip switch:"
                         onLabel="On"
                         offLabel="Off"
                         value="#{myBean.bool1}"
                         valueChangeListener=
                                "#{PropertyBean.ValueChangeHandler}"/>
```

Figure 6–32 shows the Boolean Switch component displayed in the Preview pane. This component has its parameters set as follows:

```
<amx:selectBooleanSwitch id="selectBooleanSwitch1"
                         label="Switch"
                         value="value1"
                         valueChangeListener=
                                "#{PropertyBean.ValueChangeHandler}"/>
```

Figure 6–32 Boolean Switch at Design Time

For more information, illustrations, and examples, see the following:

- *Oracle Fusion Middleware Tag Reference for Oracle Mobile Application Framework*
- CompGallery, a MAF sample application located in the `PublicSamples.zip` file within the *`jdev_install`*`/jdeveloper/jdev/extensions/oracle.maf/Samples` directory on your development computer

6.3.12.1 What You May Need to Know About Support for Boolean Switch Components on iOS Platform

On iOS, Boolean Switch components are often used on Settings pages to enable or disable an attribute value.

6.3.12.2 What You May Need to Know About Support for Boolean Switch Components on Android Platform

Android platform does not directly support a Boolean Switch component. Instead, Android provides a toggle button that allows tapping to switch between selected and deselected states.

6.3.13 How to Use the Select Button Component

The Select Button (`selectOneButton`) component represents a button group that lists actions, with a single button active at any given time. The selection mechanism is provided by the Select Items or Select Item component (see Section 6.3.10.3, "What You May Need to Know About Differences Between Select Items and Select Item Components") contained by the Select Button component.

> **Note:** The Select Button component can contain more than one Select Items or Select Item components.

Example 6–34 demonstrates the `selectOneButton` element defined in a MAF AMX file.

Example 6–34 Select Button Definition

```
<amx:selectOneButton id="bg1"
                     value="#{myBean.myState}"
                     valueChangeListener="#{PropertyBean.ValueChangeHandler}">
   <amx:selectItem id="selectItem1" label="Yes" value="yes"/>
   <amx:selectItem id="selectItem2" label="No" value="no"/>
   <amx:selectItem id="selectItem3" label="Maybe" value="maybe"/>
</amx:selectOneButton>
```

Figure 6–33 shows the Select Button component displayed in the Preview pane. This component has its parameters set as follows:

```
<amx:selectOneButton id="selectOneButton1"
                     label="Select Button"
                     value="value1"
                     valueChangeListener="#{PropertyBean.ValueChangeHandler}">
   <amx:selectItem id="selectItem1" label="Value 1" value="value1"/>
   <amx:selectItem id="selectItem2" label="Value 2" value="value2"/>
   <amx:selectItem id="selectItem3" label="Value 3" value="value3"/>
</amx:selectOneButton>
```

Figure 6–33 Select Button at Design Time

For more information, illustrations, and examples, see the following:

- *Oracle Fusion Middleware Tag Reference for Oracle Mobile Application Framework*
- CompGallery, a MAF sample application located in the `PublicSamples.zip` file within the *`jdev_install`*`/jdeveloper/jdev/extensions/oracle.maf/Samples` directory on your development computer

6.3.14 How to Use the Radio Button Component

The Radio Button (`selectOneRadio`) component represents a group of radio buttons that lists available choices. The selection mechanism is provided by the Select Items or Select Item component (see Section 6.3.10.3, "What You May Need to Know About Differences Between Select Items and Select Item Components") contained by the Radio Button component.

Note: The Radio Button component can contain more than one Select Items or Select Item components.

Example 6–35 and Example 6–36 demonstrate the `selectOneRadio` element definition in a MAF AMX file.

Example 6–35 Radio Button Definition Using Select Item Component

```
<amx:selectOneRadio id="radio1"
                    label="Choose a pet:"
                    value="#{myBean.myPet}"
                     valueChangeListener="#{PropertyBean.ValueChangeHandler}">
   <amx:selectItem id="selectItem1" label="Cat" value="cat"/>
   <amx:selectItem id="selectItem2" label="Dog" value="dog"/>
   <amx:selectItem id="selectItem3" label="Hamster" value="hamster"/>
   <amx:selectItem id="selectItem4" label="Lizard" value="lizard"/>
</amx:selectOneRadio>
```

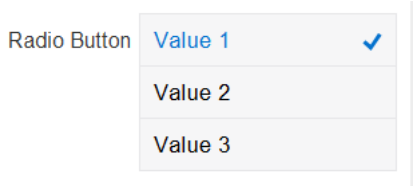
Example 6–36 Radio Button Definition Using Select Items Component

```
<amx:selectOneRadio id="radio1"
                    label="Choose a pet:"
                    value="#{myBean.myPet}"
                     valueChangeListener="#{PropertyBean.ValueChangeHandler}">
   <amx:selectItems id="selectItems1" value="myBean.allPets"/>
</amx:selectOneRadio>
```

Figure 6–34 shows the Boolean Switch component displayed in the Preview pane. This component has its parameters set as follows:

```
<amx:selectOneRadio id="selectOneRadio1"
                     label="Radio Button"
                     value="value1"
                     valueChangeListener="#{PropertyBean.ValueChangeHandler}">
   <amx:selectItem id="selectItem1" label="Value 1" value="value1"/>
   <amx:selectItem id="selectItem2" label="Value 2" value="value2"/>
   <amx:selectItem id="selectItem3" label="Value 3" value="value3"/>
</amx:selectOneRadio>
```

Figure 6–34 Radio Button at Design Time



For more information, illustrations, and examples, see the following:

- *Oracle Fusion Middleware Tag Reference for Oracle Mobile Application Framework*
- CompGallery, a MAF sample application located in the `PublicSamples.zip` file within the *`jdev_install`*`/jdeveloper/jdev/extensions/oracle.maf/Samples` directory on your development computer

6.3.15 How to Use List View and List Item Components

Use the List View (`listView`) component to display data as a list of choices where the end user can select one or more options.

The List Item (`listItem`) component represents a single row in the List View. Typically, you place a List Item component inside the List View to lay out and style a list of data items. At runtime, List Item components respond to swipe gestures (see Section 6.4, "Enabling Gestures").

The List View allows you to define one of the following:

- A row that is replicated based on the number of items in the list (collection).
- A static row that is produced by adding a child List Item component without specifying the List View's `var` and `value` attributes. You can add as many of these static items as necessary, which is useful when you know the contents of the list at design time. In this case, the list is not editable and behaves like a set of menu items.

You can create the following types of List View components:

- Basic List

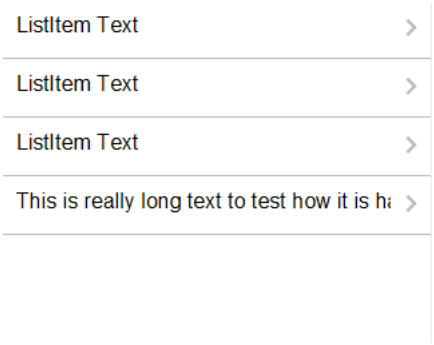
  Example 6–37 shows the `listView` element defined in a MAF AMX file. This definition corresponds to the basic component.

Example 6–37 Basic List View Definition

```
<amx:listView id="listView1"
              showMoreStrategy="autoScroll"
              bufferStrategy="viewport">
   <amx:listItem id="listItem1">
      <amx:outputText id="outputText1" value="ListItem Text"/>
   </amx:listItem>
   <amx:listItem id="listItem2">
      <amx:outputText id="outputText3" value="ListItem Text"/>
   </amx:listItem>
   <amx:listItem id="listItem3">
      <amx:outputText id="outputText5" value="ListItem Text"/>
   </amx:listItem>
   <amx:listItem id="listItem4">
      <amx:outputText id="outputText7"
                      value="This is really long text to test how it is handled"/>
   </amx:listItem>
</amx:listView>
```

Figure 6–35 demonstrates a basic List View component at design time.

Figure 6–35 Basic List View at Design Time



Example 6–38 shows another definition of the `listView` element in a MAF AMX file. This definition also corresponds to the basic component; however, the value of this List View is provided by a collection.

Example 6–38 Basic List View Definition

```
<amx:listView id="list1"
              value="#{myBean.listCollection}"
              var="row"
              showMoreStrategy="autoScroll"
              bufferStrategy="viewport">
   <amx:listItem actionListener="#{myBean.selectRow}"
                 showLinkIcon="false"
                 id="listItem1">
      <amx:outputText value="#{row.name}" id="outputText1"/>
   </amx:listItem>
</amx:listView>
```

Note: Currently, when a text string in an Output Text inside a List Item is too long to fit on one line, the text does not wrap at the end of the line. You can prevent this by adding `"white-space: normal;"` to the `inlineStyle` attribute of the subject Output Text child component.

- List with icons

  Example 6–39 shows the `listView` element defined in a MAF AMX file. This definition corresponds to the component with icons.

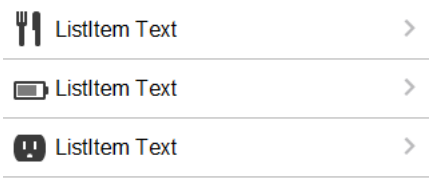
Example 6–39 List View with Icons Definition

```
<amx:listView id="list1"
              value="#{myBean.listCollection}"
              var="row"
              showMoreStrategy="autoScroll"
              bufferStrategy="viewport">
   <amx:listItem id="listItem1">
      <amx:tableLayout id="tl1" width="100%">
         <amx:rowLayout id="rl1">
            <amx:cellFormat id="cf11" width="40px" halign="center">
               <amx:image id="image1" source="#{row.image}"/>
            </amx:cellFormat>
            <amx:cellFormat id="cf12" width="100%" height="43px">
               <amx:outputText id="outputText1" value="#{row.desc}"/>
```

```
            </amx:cellFormat>
         </amx:rowLayout>
      </amx:tableLayout>
   </amx:listItem>
</amx:listView>
```

Figure 6–36 demonstrates a List View component with icons and text at design time.

Figure 6–36 List View with Icons at Design Time



- List with search
- List with dividers. This type of list allows you to group data and show order. Attributes of the List View component define characteristics of each divider. For information about attributes, see *Oracle Fusion Middleware Tag Reference for Oracle Mobile Application Framework*.

  MAF AMX provides a list divider that can do the following:

  – Collapse its contents independently.

  – Show a count of items in each divider.

  – Collapse at the same time.

  Example 6–40 shows the `listView` element defined in a MAF AMX file. This definition corresponds to the component with collapsible dividers and item counts.

Example 6–40 List View with Dividers Definition

```
<amx:listView id="list1"
          value="#{bindings.data.collectionModel}"
          var="row"
          collapsibleDividers="true"
          collapsedDividers="#{pageFlowScope.mylistDisclosedDividers}"
          dividerMode="all"
          dividerAttribute="type"
          showDividerCount="true"
          showMoreStrategy="autoScroll"
          bufferStrategy="viewport"
          fetchSize="10">
   <amx:listItem>
      <amx:outputText id="ot1" value="#{row.name}">
   </amx:listItem>
</amx:listView>
```

Note: Data in the list with dividers must be sorted by the `dividerAttribute` because this type of list does not sort the data; instead, it expects the data it receives to be already sorted.

Note: Dividers are not displayed when a List View component is in edit mode (that is, its `editMode` attribute is specified).

When dividers are visible, the end user can quickly navigate to a specific divider using the List View's localized alphabetical index utility, which is available for List View components whose `dividerMode` attribute is set to `firstLetter`. You can disable this utility by setting the `sectionIndex` attribute to `off`.

The index utility (indexer) consists of an index bar and index item and has the following characteristics:

- If the list contains unsorted data or duplicate dividers, the index item points to the first occurrence in the list.
- Only available letters are highlighted in the index, and only those highlighted become active. This is triggered by the change in the data model (for example, when the end user taps on More row item).
- The index is not case-sensitive.
- Unknown characters are hidden under the hash (#) sign.

The indexer letters can only be activated (tapped) on rows that have been loaded into the list. For example, if the List View, using its `fetchSize` attribute, has loaded rows up to the letter C, the indexer enables letters from A to C. Other letters appear on the indexer when more rows are loaded into it.

Table 6–5 describes styles that you can define for the index utility.

Table 6–5 The List View Index Styles

styleClass name	Description
`adfmf-listView-index`	Defines style of the index bar.
`adfmf-listView-indexItem`	Defines style of one item in the index bar.
`adfmf-listView-indexItem-active`	Defines style of the item in the index bar which has link to a related divider.
`adfmf-listView-indexCharacter`	Defines style of a character in the index bar.
`adfmf-listView-indexBullet`	Defines style of a bullet between two characters in index bar.
`adfmf-listView-indexOther`	Defines style of a character that represents all unknown characters in the index bar.

When the List View component with visible dividers functions as a container that provides scrolling and it becomes a subject to scrolling, the dividers are pinned at the top of the view. If this is the case, you have to explicitly set the height of the List View component. In all other cases, when the List View does not perform any scrolling itself but instead uses the scrolling of its parent container (such as the Panel Page), the List View does not have any height constraint set and its height is determined by its child components. This absence of the defined height constraint effectively disables the animated transition and pinning of dividers.

- Inset List

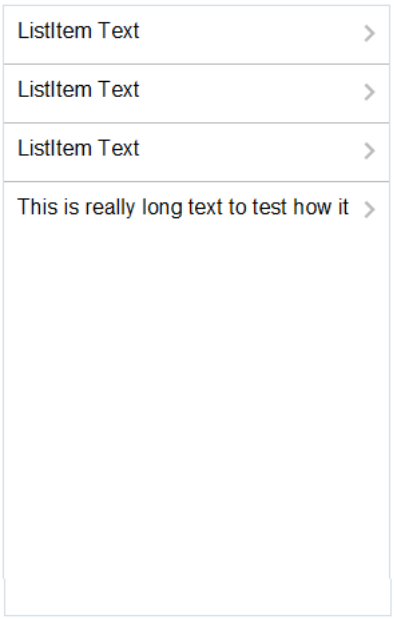
  Example 6–41 shows the `listView` element defined in a MAF AMX file. This definition corresponds to the inset component.

Example 6–41 Inset List View Definition

```
<amx:listView id="listView1"
              styleClass="adfmf-listView-insetList"
              showMoreStrategy="autoScroll"
              bufferStrategy="viewport">
   <amx:listItem id="listItem1">
      <amx:outputText id="outputText1" value="ListItem Text"/>
   </amx:listItem>
   <amx:listItem id="listItem2">
      <amx:outputText id="outputText3" value="ListItem Text"/>
   </amx:listItem>
   <amx:listItem id="listItem3">
      <amx:outputText id="outputText5" value="ListItem Text"/>
   </amx:listItem>
   <amx:listItem id="listItem4">
      <amx:outputText id="outputText7"
                      value="This is really long text to test how it is handled"/>
   </amx:listItem>
</amx:listView>
```

Figure 6–37 demonstrates an inset List View component at design time.

Figure 6–37 Inset List View at Design Time



Example 6–42 shows another definition of the `listView` element in a MAF AMX file. This definition also corresponds to the inset component, however, the value of this List View is provided by a collection.

Example 6–42 Inset List Definition

```
<amx:listView id="list1"
```

```
                value="#{CarBean.carCollection}"
                var="row"
                styleClass="adfmf-listView-insetList"
                showMoreStrategy="autoScroll"
                bufferStrategy="viewport"
                fetchSize="10">
   <amx:listItem id="li1" action="go">
      <amx:outputText id="ot1" value="#{row.name}"/>
   </amx:listItem>
</amx:listView>
```

There is a particular order in which MAF AMX processes the List Item component's child operations and attributes. For more information, see Section 6.3.5.8, "What You May Need to Know About the Order of Processing Operations and Attributes."

Unlike other MAF AMX components, when you drag and drop a List View onto a MAF AMX page, a dialog called **ListView Gallery** appears (see Figure 6–38). This dialog allows you to choose a specific layout for the List View.

Figure 6–38 ListView Gallery Dialog

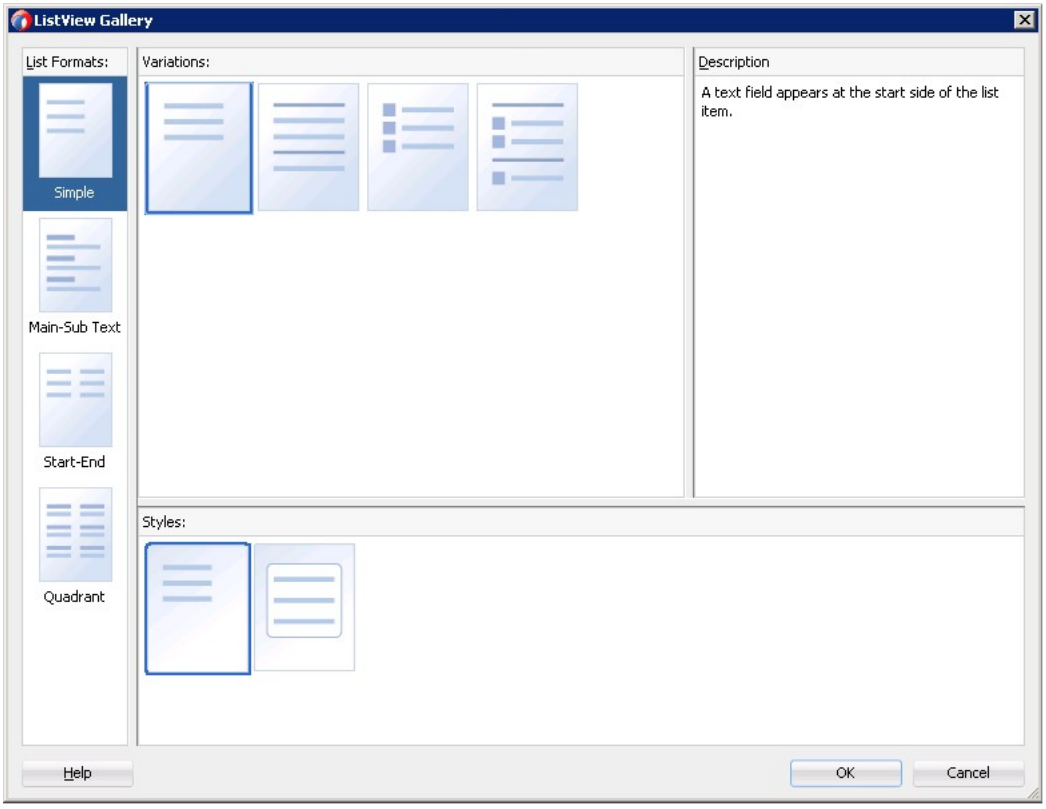


Table 6–6 lists the supported **List Formats** that are displayed in the ListView Gallery.

Table 6–6 List Formats

Format	Element Row Values
Simple	▪ Text
Main-Sub Text	▪ Main Text ▪ Subordinate Text

Table 6–6 (Cont.) List Formats

Format	Element Row Values
Start-End	▪ Start Text ▪ End Text
Quadrant	▪ Upper Start Text ▪ Upper End Text ▪ Lower Start Text ▪ Lower End Text

The **Variations** presented in the ListView Gallery (see Figure 6–38) for a selected list format consist of options to add either dividers, a leading image, or both:

- Selecting a variation with a leading image adds an Image row to the List Item Content table (see Figure 6–39).
- Selecting a variation with a divider defaults the Divider Attribute field to the first attribute in its list rather than the default No Divider value, and populates the Divider Mode field with its default value of All.

The **Styles** options presented in the ListView Gallery (see Figure 6–38) allow you to suppress chevrons, use an inset style list, or both:

- The selections do not modify any state in the Edit List View dialog (see Figure 6–39). They only affect the generated MAF AMX markup.
- Selecting a style with the inset list sets the `adfmf-listView-insetList` style class on the `listView` element in the generated MAF AMX markup.

The following is an example of the Simple format with the inset list:

```
<amx:listView var="row"
              value="#{bindings.employees.collectionModel}"
              fetchSize="#{bindings.employees.rangeSize}"
              styleClass="adfmf-listView-insetList"
              id="listView2"
              showMoreStrategy="autoScroll"
              bufferStrategy="viewport">
   <amx:listItem id="li2">
      <amx:outputText value="#{row.employeename}" id="ot3"/>
   </amx:listItem>
</amx:listView>
```

The ListView Gallery's **Description** pane is updated based on the currently selected Variation. The format includes a brief description of the main style, followed by the details of the selected variation. Four main styles with four variations on each provide sixteen unique descriptions detailed in Table 6–7.

Table 6–7 List View Variations and Styles

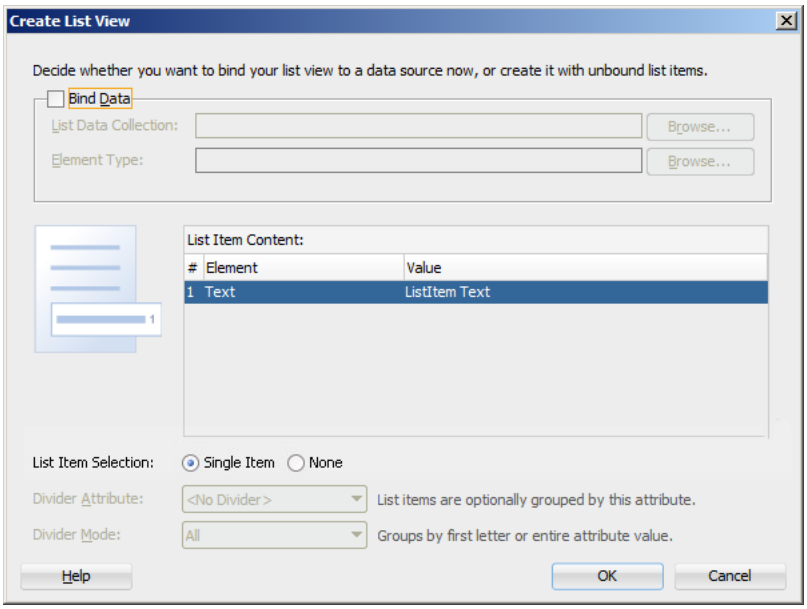
List Format	Variation	Description
Simple	Basic	A text field appears at the start side of the list item.
Simple	Dividers	A text field appears at the start side of the list item, with items grouped by dividers.
Simple	Images	A text field appears at the start side of the list item, following a leading image.

Table 6–7 (Cont.) List View Variations and Styles

List Format	Variation	Description
Simple	Dividers and Images	A text field appears at the start side of the list item, following a leading image. The list items are grouped by dividers.
Main-Sub Text	Basic	A prominent main text field appears at the start side of the list item with subordinate text below.
Main-Sub Text	Dividers	A prominent main text field appears at the start side of the list item with subordinate text below. The list items are grouped by dividers.
Main-Sub Text	Images	A prominent main text field appears at the start side of the list item with subordinate text below, following a leading image.
Main-Sub Text	Dividers and Images	A prominent main text field appears at the start side of the list item with subordinate text below, following a leading image. The list items are grouped by dividers.
Start-End	Basic	Text fields appear on each side of the list item.
Start-End	Dividers	Text fields appear on each side of the list item, with the items grouped by dividers.
Start-End	Images	Text fields appear on each side of the list item, following a leading image.
Start-End	Dividers and Images	Text fields appear on each side of the list item, following a leading image. The list items are grouped by dividers.
Quadrant	Basic	Text fields appear in the four corners of the list item.
Quadrant	Dividers	Text fields appear in the four corners of the list item, with items grouped by dividers.
Quadrant	Images	Text fields appear in the four corners of the list item, following a leading image.
Quadrant	Dividers and Images	Text fields appear in the four corners of the list item, following a leading image. The list items are grouped by dividers.

After you make your selection from the ListView Gallery and click **OK**, the **Edit List View** wizard is invoked that lets you create either an unbound List View component that displays static text in the List Item child components (see Figure 6–39), or choose a data source for the dynamic binding (see Figure 6–40).

Figure 6–39 Creating Unbound List View



When completing the dialog that Figure 6–39 shows, consider the following:

- The **List Data Collection** and **Element Type** fields are disabled when the **Bind Data** checkbox is in the deselected state.
- The image on the left reflects the main content elements from the selected List View format
- The editable cells of the **Value** column are populated with static text strings (see Table 6–8).
- If the **List Item Content** cell contains an Image, the `Value` cell is defaulted to the `<add path to your image>` string. If this is the case, you have to replace it with the path to the image.
- The **List Item Selection** indicates the selection mode. For details, see the description of this option following Figure 5–74, "Edit Dialog for MAF AMX List View".
- Since you cannot set the divider attribute when the List View contains List Item child components, rather than being data bound, both the Divider Attribute and the Divider Mode fields are disabled.

Table 6–8 Static Text Strings for List View

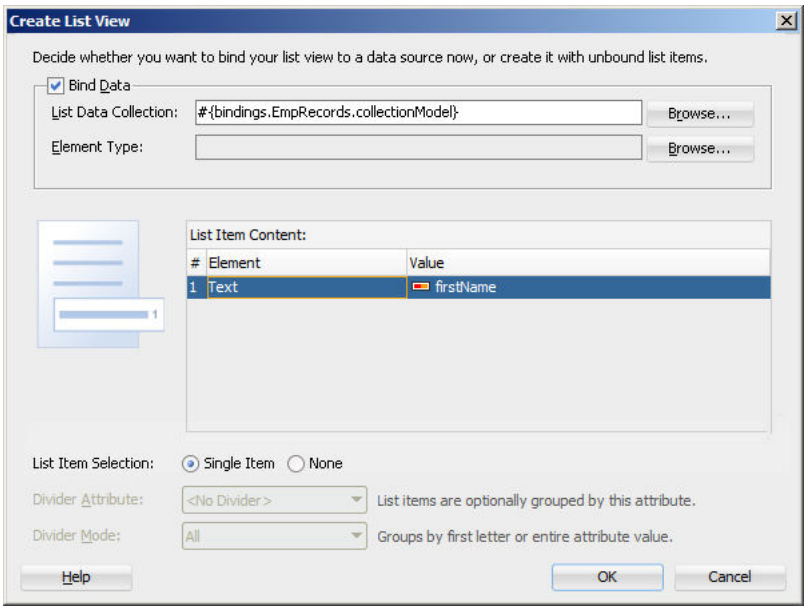
List Format	Element Row Values	Values for the Output Text
Simple	▪ Text	▪ 'ListItem Text'
Main-Sub Text	▪ Main Text ▪ Subordinate Text	▪ 'Main Text' ▪ 'This is the subordinate text.'
Start-End	▪ Start Text ▪ End Text	▪ 'Start Text' ▪ 'End Text'

Table 6–8 (Cont.) Static Text Strings for List View

List Format	Element Row Values	Values for the Output Text
Quadrant	■ Upper Start Text ■ Upper End Text ■ Lower Start Text ■ Lower End Text	■ 'Upper Start Text' ■ 'Upper End Text' ■ 'Lower Start Text' ■ 'Lower End Text'

Figure 6–40 shows the Create List View dialog when you choose to bind the List View component to data.

Figure 6–40 Creating Bound List View



When completing the dialog that Figure 6–40 shows, consider the following:

- When you select the **Bind Data** checkbox, the List Data Collection field becomes enabled. The Element Type field becomes enabled if you set the List Data Collection field to an EL expression by using the Expression Builder. If you choose a data control from the Data Control Definitions tab, the Element Type field will continue to be disabled.
- To select a data source, click Browse. This opens the Select List View Data Collection dialog that enables you to either choose a data control definition (see Figure 6–41) or to use the EL Builder to select an appropriate EL expression (see Figure 6–42).

Figure 6–41 Selecting Data Control Definition

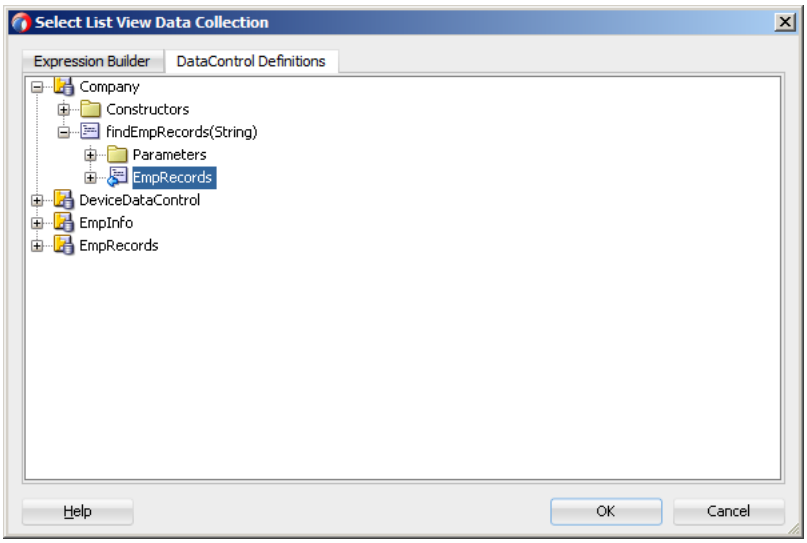
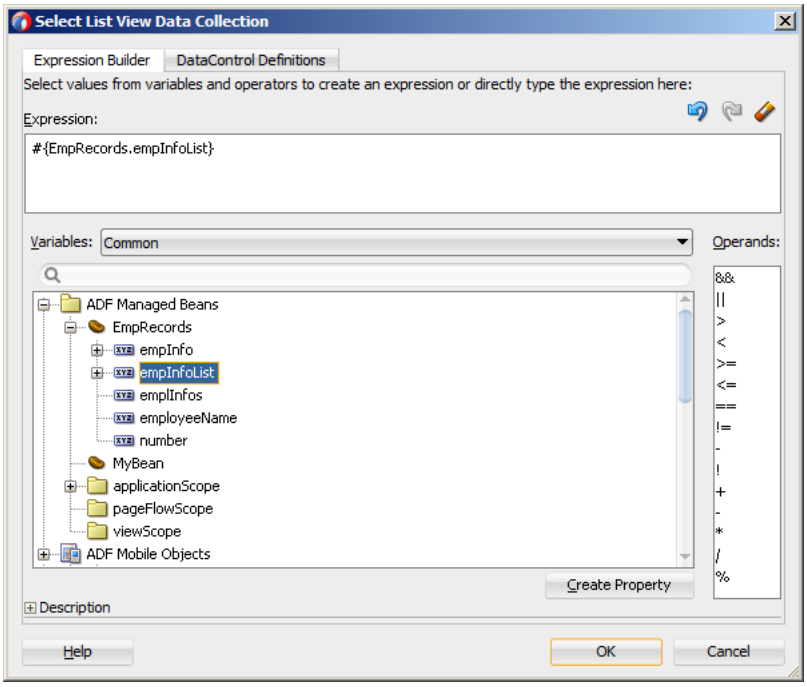


Figure 6–42 Selecting EL Expression



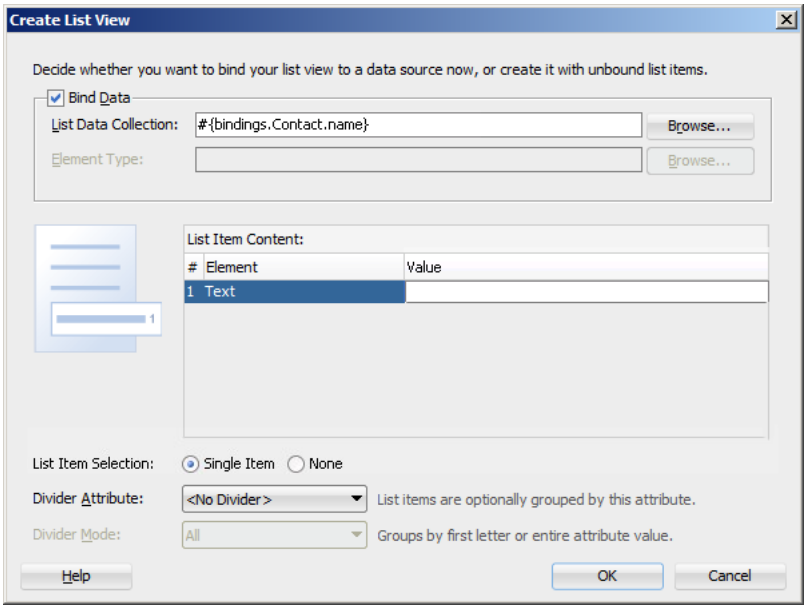
- You may declare the type of the data collection using the Element Type field (see Figure 6–40).
- After you have selected a valid data collection, the Value column in the List Item Content table changes to Value Bindings whose editable cells are populated with lists of attributes from the data collection. For a description of a special case setting, refer to Figure 6–43.
- The image on the left reflects the main content elements from the selected List View format and provides a mapping from the schematic representation to the named elements in the underlying table.

- The List Item is generated as either an Output Text or Image component, depending on whichever is appropriate for the particular element.
- Since the number of elements (rows) is predetermined by the selected List View format, rows cannot be added or removed.
- The order of elements cannot be modified.
- The default value of the Divider Attribute field is No Divider, in which case the Divider Mode field is disabled. If you select value other than the default, then you need to specify Divider Mode parameters. In addition, if you chose a Variation in the ListView Gallery that includes dividers, the default value will be set to the first attribute in the list.

The following are special cases to consider when creating a bound List View:

- If a Java bean method returns a list without generics, you should use the Element Type field to create the List Item content, as Figure 6–40 shows.
- If the list data collection value provided is not collection-based, a Value column replaces the Value Bindings column with blank values, as Figure 6–43 shows.

Figure 6–43 Providing Non-Collection-Based Values



For more information, see the following:

- *Oracle Fusion Middleware Tag Reference for Oracle Mobile Application Framework*
- Section 6.3.15.3, "Configuring Layout Using Styles"
- Section 5.3.2.4.3, "Dragging and Dropping Collections"
- UIDemo, a MAF sample application located in the `PublicSamples.zip` file within the *`jdev_install`*`/jdeveloper/jdev/extensions/oracle.maf/Samples` directory on your development computer. This sample demonstrates how to use various types of the List View component and how to apply styles to adjust the page layout to a specific pattern.
- Appendix D.6, "Limitations to the Application Usage"

6.3.15.1 Configuring Paging and Dynamic Scrolling

You can configure the List View component to display data in a list that is arbitrarily long. This is done by appending data to the bottom of the list.

The `fetchSize` attribute determines how many rows the List View component should initially load. If there are more rows available than defined by the `fetchSize`, a clickable area is displayed after the last fetched row. Clicking within this area loads another batch of rows that equals the `fetchSize`. Once there are no more rows to display, the clickable area disappears.

The `fetchSize` attribute does not represent the number of loaded rows. Instead, it represents the value by which the number of rows is incremented. When the List View component is created, the `fetchSize` attribute is by default set to use an EL expression that points to the `rangeSize` of the `PageDef` iterator. For information on the `PageDef` file, see Section 5.3.2.4.5, "What You May Need to Know About Generated Drag and Drop Artifacts" and Figure 5–80, "PageDef File". Setting the `fetchSize` to the same value as the `rangeSize` improves the application performance.

Example 6–43 shows the `listView` element that was created from a collection called `testResults` of a data control (see Section 5.3.2.4, "Adding Data Controls to the View").

Example 6–43 Setting fetchSize Attribute

```
<amx:listView var="row"
              value="#{bindings.testResults.collectionModel}"
              fetchSize="#{bindings.testResults.rangeSize}">
```

In the preceding example, the `fetchSize` attribute points to the `rangeSize` on `bindings.testResults`. Example 6–44 shows a line from the `PageDef` file for this MAF AMX page. This `PageDef` file contains an `accessorIterator` element called `testResultsIterator` to which the `testResults` is bound.

Example 6–44 accessorIterator in PageDef File

```
<accessorIterator MasterBinding="Class1Iterator"
                  Binds="testResults"
                  RangeSize="25"
                  DataControl="Class1"
                  BeanClass="mobile.Test"
                  id="testResultsIterator"/>
```

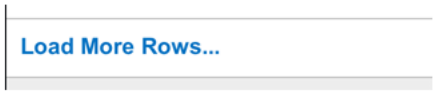
If the `fetchSize` attribute is set to -1, all records are retrieved.

The following two attributes of the List View component enable its scrolling behavior:

- `showMoreStrategy`: defines the List View component's strategy for loading more rows when required.

  When a List View component provides its own scrolling (see "To force a List View to provide its own scrolling:" on page 6-61) as opposed to being a subject to scrolling by one of its parent containers, and that List View is scrolled to the end, it automatically invokes the showMoreStrategy allowing itself to fetch the next set of records.

  At runtime, this attribute expresses itself as a Load More Rows link by default:



For information on how to configure the List View's scrolling and row-displaying behavior by setting values of the `showMoreStrategy` attribute, see *Oracle Fusion Middleware Tag Reference for Oracle Mobile Application Framework*.

- `bufferStrategy`: defines how the user interface for the rows is retained

  When the List View's height is constrained allowing it to provide its own scrolling (see "To force a List View to provide its own scrolling:" on page 6-61) as opposed to being a subject to scrolling by one of its parent containers, it fetches and displays previously hidden rows and their contents. The List View achieves this in one of the following ways:

  – By continuously adding an increasing number of hidden rows to the list.

  – By limiting the number of added rows that are available within the rendering engine and only retaining the rows that are in the List View's visible area (viewport), therefore reducing the amount of memory the MAF application uses.

  You can configure this functionality through the `listView`'s `bufferStrategy` attribute by setting it to either `additive` (if you are not concerned with the memory consumption) or `viewport` (if you are trying to reduce the memory usage). In the latter case, there may be a delay while scrolling before the contents of the new rows become visible. To minimize the number of displayed blank rows, you can set the `listView`'s `bufferSize` attribute. This attribute determines the distance (in pixels) at which the row must be located from the viewport to become hidden.

To force a List View to provide its own scrolling:

- Make the List View the only non-Facet child of a Panel Page.
- Set a fixed height for the List View. For example:

```
inlineStyle="height: 200px;"
```

The `rangeChangeListener` attribute (see Section 6.10, "Using Event Listeners") of the List View component allows you to bind a Java handler method for when the Load More Rows link is activated or when the List View is scrolled to the end. This method uses the `oracle.adfmf.amx.event.RangeChangeEvent` object as its parameter and is created when you invoke the **Edit Property: Range Change Listener** dialog from the Properties window, as Figure 6–44 and Figure 6–45 show.

Figure 6–44 Editing Range Change Listener Attribute

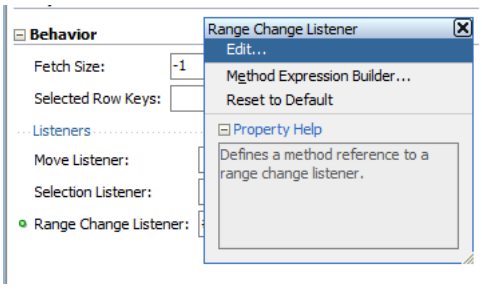
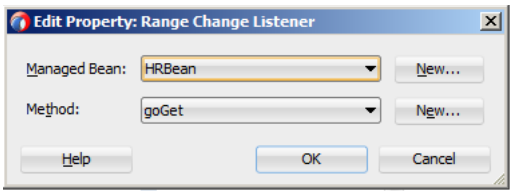


Figure 6–45 Edit Property Dialog



When you click **OK** on the dialog, the following setting is added to the `listView` element in the MAF AMX page and the Java method that Example 6–45 shows is added to a sample `HRBean` class:

```
<amx:listView id="listView1" rangeChangeListener="#{pageFlowScope.HRBean.goGet}" >
```

Example 6–45 Java Method for Triggering RangeChangeEvent

```
public void goGet(RangeChangeEvent rangeChangeEvent) {
   // Add event code here...
}
```

Note: The `rangeChangeListener` is called every time new data is being fetched by the List View. Using the `RangeChangeEvent`, you can define whether or not more data is available (see Section 6.10, "Using Event Listeners").

6.3.15.2 Rearranging List View Items

Items in a List View can be rearranged. This functionality is similar on iOS and Android platforms: both show a Rearrange icon aligned along the right margin for each list item. The Rearrange operation is initiated when the end user touches and drags a list item using the Rearrange affordance as a handle. The operation is completed when the end user lifts their finger from the display screen.

Note: If the end user touches and drags anywhere else on the list item, the list scrolls up or down.

The Rearrange Drag operation "undocks" the list item and allows the end user to move the list item up or down in the list.

For its items to be rearrangeable, the List View must not be static, must be in an edit mode, and must be able to listen to moves.

Example 6–46 shows the `listView` element defined in a MAF AMX file. This definition presents a list with an Edit and Stop Editing buttons at the top that allow switching between editable and read-only list mode.

Example 6–46 Rearrangeable List View Definition

```
<amx:panelPage id="pp1">
   <amx:commandButton id="edit"
                      text="Edit"
                      rendered="#{!bindings.inEditMode.inputValue}">
      <amx:setPropertyListener id="spl1"
                               from="true"
                               to="#{bindings.inEditMode.inputValue}"
```

```
                              type="action"/>
   </amx:commandButton>
   <amx:commandButton id="stop"
                      text="Stop Editing"
                      rendered="#{bindings.inEditMode.inputValue}">
      <amx:setPropertyListener id="spl2"
                               from="false"
                               to="#{bindings.inEditMode.inputValue}"
                               type="action"/>
   </amx:commandButton>
   <amx:listView id="lv1"
                 value="#{bindings.data.collectionModel}"
                 var="row"
                 editMode="#{bindings.inEditMode.inputValue}"
                 moveListener="#{MyBean.Reorder}">
      <amx:listItem id="li1">
         <amx:outputText id= "ot1" value="#{row.description}">
      </amx:listItem>
   </amx:listView>
</amx:panelPage>
```

For more information, see *Oracle Fusion Middleware Tag Reference for Oracle Mobile Application Framework*.

6.3.15.3 Configuring Layout Using Styles

To adjust the MAF AMX page layout to a specific pattern, you can combine the use of the various types of List View components and styles that are defined through the `styleClass` attribute (see Section 6.6, "Styling UI Components") that uses a set of predefined styles.

A MAF sample application called UIDemo demonstrates all the optional styles for each component and their associated rendering. The UIDemo application is located in the `PublicSamples.zip` file within the *`jdev_install`*`/jdeveloper/jdev/extensions/oracle.maf/Samples` directory on your development computer.

Example 6–47 shows the `listView` element and its child elements defined in a MAF AMX file. The way each `outputText` child element is laid out in the list is specified by the `tableLayout` child element of the `listItem`. Alternatively, you may use the `styleClass` attribute to lay out and style `outputText` elements: setting this attribute to `adfmf-listItem-startText` places the Output Text component to the start (left side) of the row and applies a black font to its text; setting this attribute to `adfmf-listItem-endText` places the Output Text component to the end (right side) of the row and applies a blue font to its text. Whether or not the arrow pointing to the right is visible is configured by the `showLinkIcon` attribute of the `listItem` element. Since the default value of this attribute is `true`, the example does not contain this setting.

Example 6–47 Definition of List View with Start and End Text

```
<amx:listView id="listView1" value="#{myBean.listCollection}" var="row">
   <amx:listItem id="listItem1">
      <amx:tableLayout id="tl1" width="100%">
         <amx:rowLayout id="rl1">
            <amx:cellFormat id="cf1s1" width="10px"/>
            <amx:cellFormat id="cf11" width="60%" height="43px">
               <amx:outputText id="outputText11" value="#{row.name}"/>
            </amx:cellFormat>
            <amx:cellFormat id="cf1s2" width="10px"/>
```

```
            <amx:cellFormat id="cf12" halign="end" width="40%">
               <amx:outputText id="outputText12" value="#{row.status}"
                               styleClass="adfmf-listItem-highlightText"/>
            </amx:cellFormat>
         </amx:rowLayout>
      </amx:tableLayout>
   </amx:listItem>
</amx:listView>
```

Figure 6–46 shows a List View component with differently styled text added to the start (left side) and end (right side) of each row. Besides the text, rows are equipped with a right-pointing arrow representing a link that expands each list item.

Figure 6–46 List View with Start and End Text at Design Time

Example 6–48 shows the `listView` element and its child elements defined in a MAF AMX file. The way each `outputText` child element is laid out in the list is specified by the `tableLayout` child element of the `listItem`. Alternatively, you may use the `styleClass` attribute to lay out and style `outputText` elements: setting this attribute to `adfmf-listItem-startText` places the Output Text component to the start of the row and applies a black font to its text; setting this attribute to `adfmf-listItem-endText` places the Output Text component to the end of the row and applies a blue font to its text. Whether or not the arrow pointing to the right is visible on each particular row is configured by the `showLinkIcon` attribute of the `listItem` element. Since in this example this attribute is set to `false` for every `listItem` element, arrows pointing to the right are not displayed.

Example 6–48 Definition of List View with Start and End Text Without Expansion Links

```
<amx:listView id="listView1" value="#{myBean.listCollection}" var="row">
   <amx:listItem id="listItem1" showLinkIcon="false">
      <amx:tableLayout id="tl1" width="100%">
         <amx:rowLayout id="rl1">
            <amx:cellFormat id="cf1s1" width="10px"/>
            <amx:cellFormat id="cf11" width="60%" height="43px">
               <amx:outputText id="outputText11" value="#{row.name}"/>
            </amx:cellFormat>
            <amx:cellFormat id="cf1s2" width="10px"/>
            <amx:cellFormat id="cf12" halign="end" width="40%">
               <amx:outputText id="outputText12" value="#{row.status}"
                               styleClass="adfmf-listItem-highlightText"/>
            </amx:cellFormat>
         </amx:rowLayout>
      </amx:tableLayout>
   </amx:listItem>
</amx:listView>
```

Figure 6–47 shows a List View component with differently styled text added to the start and end of each row. The rows do not contain right-pointing arrows representing links.

Figure 6–47 List View with Start and End Text Without Expansion Links at Design Time

Example 6–49 shows the `listView` element and its child elements defined in a MAF AMX file. In addition to the text displayed at the start and end of each row, this List View contains subtext placed under the end text. The way each `outputText` child element is laid out in the list is specified by the `tableLayout` child element of the `listItem`. Alternatively, you may use the `styleClass` attribute to lay out and style `outputText` elements: setting this attribute to `adfmf-listItem-upperStartText` places the Output Text component to the left side of the row and applies a black font to its text; setting this attribute to `adfmf-listItem-upperEndText` places the Output Text component to the right side of the row and applies a smaller grey font to its text; setting this attribute to `adfmf-listItem-captionText` places the Output Text component under the Output Text component whose `styleClass` attribute is set to `adfmf-listItem-upperStartText` and applies a smaller grey font to its text.

Example 6–49 Defining List View with Start and End Text and Subtext

```
<amx:listView id="listView1" value="#{myBean.listCollection}" var="row">
   <amx:listItem id="listItem1">
      <amx:tableLayout id="tl1" width="100%">
         <amx:rowLayout id="rl11">
            <amx:cellFormat id="cf1s1" width="10px" rowSpan="2"/>
            <amx:cellFormat id="cf11" width="60%" height="28px">
               <amx:outputText id="outputTexta1" value="#{row.name}"/>
            </amx:cellFormat>
            <amx:cellFormat id="cf1s2" width="10px"/>
            <amx:cellFormat id="cf12" halign="end" width="40%">
               <amx:outputText id="outputTexta2" value="#{row.status}"
                               styleClass="adfmf-listItem-highlightText"/>
            </amx:cellFormat>
         </amx:rowLayout>
         <amx:rowLayout id="rl12">
            <amx:cellFormat id="cf13" columnSpan="3" width="100%" height="12px">
               <amx:outputText id="outputTexta3"
                               value="#{row.desc}"
                               styleClass="adfmf-listItem-captionText"/>
            </amx:cellFormat>
         </amx:rowLayout>
      </amx:tableLayout>
   </amx:listItem>
</amx:listView>
```

Figure 6–48 shows a List View component with differently styled text added to the start and end of each row, and with a subtext added below the end text on the left.

Figure 6–48 List View with Start and End Text and Subtext at Design Time

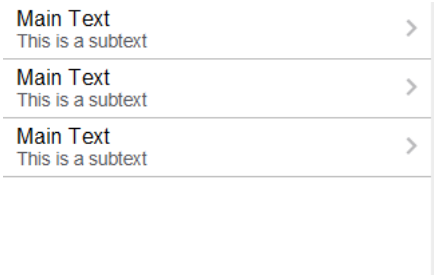
Example 6–50 shows the `listView` element and its child elements defined in a MAF AMX file. This List View is populated with rows containing a main text and subtext. The way each `outputText` child element is laid out in the list is specified by the `tableLayout` child element of the `listItem`. Alternatively, you may use the `styleClass` attribute to lay out and style `outputText` elements: setting this attribute to `adfmf-listItem-mainText` places the Output Text component to the start of the row and applies a large black font to its text; setting this attribute to `adfmf-listItem-captionText` places the Output Text component under the Output Text component whose `styleClass` attribute is set to `adfmf-listItem-mainText` and applies a smaller grey font to its text.

Example 6–50 Defining List View with Main Text and Subtext

```
<amx:listView id="listView1" value="#{myBean.listCollection}" var="row">
   <amx:listItem id="listItem1">
      <amx:tableLayout id="tla1" width="100%">
         <amx:rowLayout id="rla1">
            <amx:cellFormat id="cf1s1" width="10px" rowSpan="2"/>
            <amx:cellFormat id="cfa1" width="100%" height="28px">
               <amx:outputText id="outputTexta1" value="#{row.name}"/>
            </amx:cellFormat>
         </amx:rowLayout>
         <amx:rowLayout id="rla2">
            <amx:cellFormat id="cfa2" width="100%" height="12px" >
               <amx:outputText id="outputTexta2" value="#{row.desc}"
                               styleClass="adfmf-listItem-captionText"/>
            </amx:cellFormat>
         </amx:rowLayout>
      </amx:tableLayout>
   </amx:listItem>
</amx:listView>
```

Figure 6–49 shows a List View component with differently styled text added as a main text and subtext to each row.

Figure 6–49 List View with Main Text and Subtext at Design Time



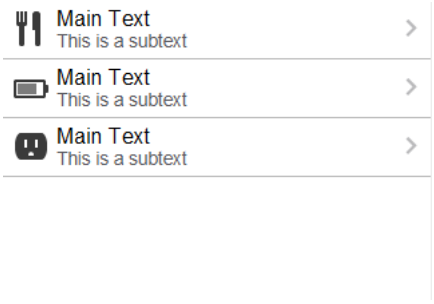
Example 6–51 shows the `listView` element and its child elements defined in a MAF AMX file. This List View is populated with cells containing an icon, main text, and subtext. The way each `outputText` child element is laid out in the list is specified by the `tableLayout` child element of the `listItem`. Alternatively, you may use the `styleClass` attribute to lay out and style `outputText` elements: setting this attribute to `adfmf-listItem-mainText` places the Output Text component to the left side of the row and applies a large black font to its text; setting this attribute to `adfmf-listItem-captionText` places the Output Text component under the Output Text component whose `styleClass` attribute is set to `adfmf-listItem-mainText` and applies a smaller grey font to its text. The position of the `image` element is defined by its enclosing `cellFormat`.

Example 6–51 Defining List View with Icons, Main Text and Subtext

```
<amx:listView id="lv1" value="#{myBean.listCollection}" var="row">
   <amx:listItem id="li1">
      <amx:tableLayout id="tl1" width="100%">
         <amx:rowLayout id="rl1">
            <amx:cellFormat id="cf1" rowSpan="2" width="40px" halign="center">
               <amx:image id="i1" source="#{row.image}"/>
            </amx:cellFormat>
            <amx:cellFormat id="cf2" width="100%" height="28px">
               <amx:outputText id="ot1" value="#{row.name}"/>
            </amx:cellFormat>
         </amx:rowLayout>
         <amx:rowLayout id="rl2">
            <amx:cellFormat id="cf3" width="100%" height="12px">
               <amx:outputText id="ot2" value="#{row.desc}"
                               styleClass="adfmf-listItem-captionText"/>
            </amx:cellFormat>
         </amx:rowLayout>
      </amx:tableLayout>
   </amx:listItem>
</amx:listView>
```

Figure 6–50 shows a List View component with icons and differently styled text added as a main text and subtext to each row.

Figure 6–50 List View with Icons, Main Text and Subtext at Design Time



Example 6–52 shows the `listView` element and its child elements defined in a MAF AMX file. In addition to the text displayed at the start and end of each row, this List View contains two different types of text placed on each side of each row. The way each `outputText` child element is laid out in the list is specified by the `tableLayout` child element of the `listItem`. Alternatively, you may use the `styleClass` attribute to lay out and style `outputText` elements: setting this attribute to `adfmf-listItem-upperStartText` places the Output Text component at the top left

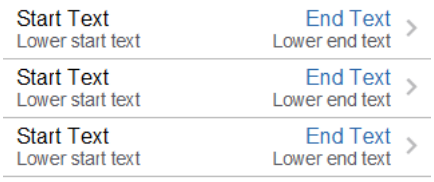
corner of the row and applies a large black font to its text; setting this attribute to `adfmf-listItem-upperEndText` places the Output Text component at the top right corner of the row and applies a large grey font to its text; setting this attribute to `adfmf-listItem-lowerStartText` places the Output Text component at the bottom left corner of the row and applies a smaller grey font to its text; setting this attribute to `adfmf-listItem-lowerEndText` places the Output Text component at the bottom right corner of the row and applies a smaller grey font to its text. Whether or not the arrow pointing to the right is visible is configured by the `showLinkIcon` attribute of the `listItem` element. Since the default value of this attribute is `true`, the example does not contain this setting.

Example 6–52 Defining List View with Four Types of Text

```
<amx:listView id="lv1" value="#{myBean.listCollection}" var="row">
   <amx:listItem id="li1">
      <amx:tableLayout id="tl1" width="100%">
         <amx:rowLayout id="rl1">
            <amx:cellFormat id="cf1" width="10px" rowSpan="2"/>
            <amx:cellFormat id="cf2" width="60%" height="28px">
               <amx:outputText id="ot1" value="#{row.name}"/>
            </amx:cellFormat>
            <amx:cellFormat id="cf3" width="10px" rowSpan="2"/>
            <amx:cellFormat id="cf4" width="40%" halign="end">
               <amx:outputText id="ot2" value="#{row.status}"
                               styleClass="adfmf-listItem-highlightText"/>
            </amx:cellFormat>
         </amx:rowLayout>
         <amx:rowLayout id="rla2">
            <amx:cellFormat id="cf5" width="60%" height="12px">
               <amx:outputText id="ot3" value="#{row.desc}"
                               styleClass="adfmf-listItem-captionText"/>
            </amx:cellFormat>
            <amx:cellFormat id="cf6" width="40%" halign="end">
               <amx:outputText id="ot4" value="#{row.priority}"
                               styleClass="adfmf-listItem-captionText"/>
            </amx:cellFormat>
         </amx:rowLayout>
      </amx:tableLayout>
   </amx:listItem>
</amx:listView>
```

Figure 6–51 shows a List View component with two types of differently styled text added to the start and end of each row. Besides the text, rows are equipped with a right-pointing arrow representing a link that expands each list item.

Figure 6–51 List View with Four Types of Text at Design Time



Example 6–53 shows the `listView` element and its child elements defined in a MAF AMX file. In addition to the text displayed at the start and end of each row, this List View contains two different types of text placed on each side of each row. The way each `outputText` child element is laid out in the list is specified by the `tableLayout` child element of the `listItem`. Alternatively, you may use the `styleClass` attribute to lay out and style `outputText` elements: setting this attribute to `adfmf-listItem-upperStartText` places the Output Text component at the top left corner of the row and applies a large black font to its text; setting this attribute to `adfmf-listItem-upperEndText` places the Output Text component at the top right corner of the row and applies a large grey font to its text; setting this attribute to `adfmf-listItem-lowerStartTextNoChevron` places the Output Text component at the bottom left corner of the row and applies a smaller grey font to its text; setting this attribute to `adfmf-listItem-lowerEndTextNoChevron` places the Output Text component at the bottom right corner of the row and applies a smaller grey font to its text. Whether or not the arrow pointing to the right is visible on each particular row is configured by the `showLinkIcon` attribute of the `listItem` element. Since in this example this attribute is set to `false` for every `listItem` element, arrows pointing to the right are not displayed.

Example 6–53 Defining List View with Four Types of Text and Without Expansion Links

```
<amx:listView id="lv1" value="#{myBean.listCollection}" var="row">
   <amx:listItem id="li1" showLinkIcon="false">
      <amx:tableLayout id="tl1" width="100%">
         <amx:rowLayout id="rl1">
            <amx:cellFormat id="cf1" width="10px" rowSpan="2"/>
            <amx:cellFormat id="cf2" width="60%" height="28px">
               <amx:outputText id="ot1" value="#{row.name}"/>
            </amx:cellFormat>
            <amx:cellFormat id="cf3" width="10px" rowSpan="2"/>
            <amx:cellFormat id="cf4" width="40%" halign="end">
               <amx:outputText id="ot2" value="#{row.status}"
                               styleClass="adfmf-listItem-highlightText"/>
            </amx:cellFormat>
         </amx:rowLayout>
         <amx:rowLayout id="rl2">
            <amx:cellFormat id="cf5" width="60%" height="12px">
               <amx:outputText id="ot3" value="#{row.desc}"
                               styleClass="adfmf-listItem-captionText"/>
            </amx:cellFormat>
            <amx:cellFormat id="cf6" width="40%" halign="end">
               <amx:outputText id="ot4" value="#{row.priority}"
                               styleClass="adfmf-listItem-captionText"/>
            </amx:cellFormat>
         </amx:rowLayout>
      </amx:tableLayout>
   </amx:listItem>
</amx:listView>
```

Figure 6–52 shows a List View component with two types of differently styled text added to the start and end of each row.

Figure 6–52 List View with Four Types of Text and Without Expansion Links at Design Time

6.3.15.4 What You May Need to Know About Using a Static List View

If you create a List View component that is not populated from the model but by hard-coded values, this List View becomes static resulting in some of its properties that you set at design time (for example, `dividerAttribute`, `dividerMode`, `fetchSize`, `moveListener`) ignored at run time.

MAF AMX treats a List View component as static if its `value` attribute is not set. Such lists cannot be editable (that is, you cannot specify its `editMode` attribute).

6.3.16 How to Use Carousel Component

You use the Carousel (`carousel`) component to display other components, such as images, in a revolving carousel. The end user can change the active item by using either the slider or by dragging another image to the front.

The Carousel component contains a Carousel Item (`carouselItem`) component, whose text represented by the `text` attribute is displayed when it is the active item of the Carousel. Although typically the Carousel Item contains an Image component, other components may be used. For example, you can use a Link as a child that surrounds an image. Instead of creating a Carousel Item component for each object to be displayed and then binding these components to the individual object, you bind the Carousel component to a complete collection. The component then repeatedly renders one Carousel Item component by stamping the value for each item. As each item is stamped, the data for the current item is copied into a property that can be addressed using an EL expression using the Carousel component's `var` attribute. Once the Carousel has completed rendering, this property is removed or reverted back to its previous value. Carousel components contain a Facet named `nodeStamp`, which is both a holder for the Carousel Item used to display the text and short description for each item, and also the parent component to the Image displayed for each item.

The Carousel Item stretches its sole child component. If you place a single Image component inside of the Carousel Item, the Image stretches to fit within the square allocated for the item (as the end user spins the carousel, these dimensions shrink or grow).

> **Tip:** To minimize any negative effect on performance of your application, you should avoid using heavy-weight components as children: a complex structure creates a multiplied effect because several Carousel Items stamps are displayed simultaneously.

By default, the Carousel displays horizontally. The objects within the horizontal orientation of the Carousel are vertically-aligned to the middle and the Carousel itself is horizontally-aligned to the center of its container. You can configure the Carousel so

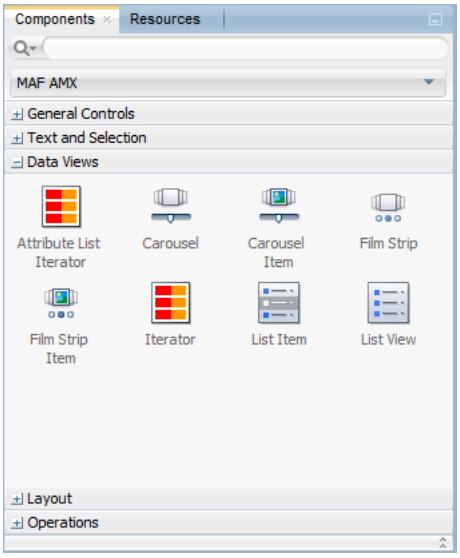
that it can be displayed vertically, as you might want for a reference rolodex. By default, the objects within the vertical orientation of the Carousel are horizontally-aligned to the center and the Carousel itself is vertically aligned middle. You can change the alignments using the Carousel's `orientation` attribute.

Instead of partially displaying the previous and next images, you can configure your Carousel to display images in a filmstrip or circular design using the `displayItems` attribute.

By default, if the Carousel is configured to display in the circular mode, when the end user hovers over an auxiliary item (that is, an item that is not the current item at the center), the item is outlined to show that it can be selected. Using the `auxiliaryPopOut` attribute, you can configure the Carousel so that instead the item pops out and displays at full size.

In JDeveloper, the Carousel is located under Data Views in the Components window (see Figure 6–53).

Figure 6–53 Carousel in Components Window



To create a Carousel component, you must first create the data model that contains images to display, then bind the Carousel to that model and insert a Carousel Item component into the `nodeStamp` facet of the Carousel. Lastly, you insert an Image component (or other components that contain an Image component) as a child to the Carousel Item component.

Example 6–54 demonstrates the `carousel` element definition in a MAF AMX file. When defining the `carousel` element, you must place the `carouselItem` element inside of a `carousel` elements's `nodeStamp` facet.

Example 6–54 Carousel Definition

```
<amx:carousel id="carousel1"
              value="#{bindings.products.collectionModel}"
              var="item"
              auxiliaryOffset="0.9"
              auxiliaryPopOut="hover"
              auxiliaryScale="0.8"
              controlArea="full"
              displayItems="circular"
```

```
                halign="center"
                valign="middle"
                disabled="false"
                shortDesc="spin"
                orientation="horizontal"
                styleClass="AMXStretchWidth"
                inlineStyle="height:250px;background-color:#EFEFEF;">
   <amx:facet name="nodeStamp">
      <amx:carouselItem id="item1" text="#{item.name}"
                        shortDesc="Product: #{item.name}">
         <amx:commandLink id="link1" action="goto-productDetails"
                          actionListener="#{someMethod()}">
            <amx:image id="image1" styleClass="prod-thumb"
                       source="images/img-big-#{item.uid}.png"/>
            <amx:setPropertyListener id="spl1"
                                     from="#{item}"
                                     to="#{pageFlowScope.product}"
                                     type="action"/>
         </amx:commandLink>
      </amx:carouselItem>
   </amx:facet>
</amx:carousel>
```

The Carousel component uses the `CollectionModel` class to access the data in the underlying collection. You may also use other model classes, such as `java.util.List` or `array`, in which case the Carousel automatically converts the instance into a `CollectionModel` class, but without any additional functionality.

A slider allows the end user to navigate through the Carousel collection. Typically, the thumb on the slider displays the current object number out of the total number of objects. When the total number of objects is too great to calculate, the thumb on the slider shows only the current object number.

For more information and examples, see the following:

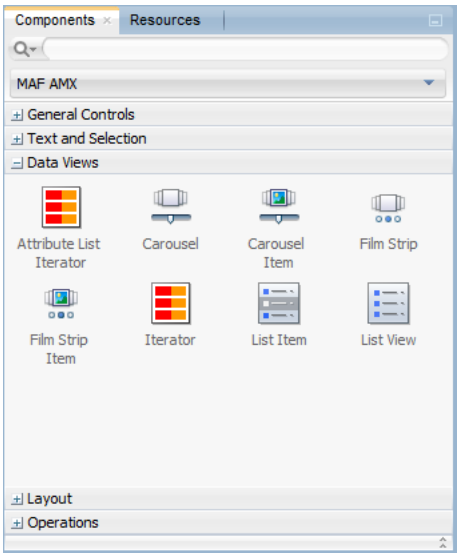
- *Oracle Fusion Middleware Tag Reference for Oracle Mobile Application Framework*
- CompGallery, a MAF sample application located in the `PublicSamples.zip` file within the *`jdev_install`*`/jdeveloper/jdev/extensions/oracle.maf/Samples` directory on your development computer

6.3.17 How to Use the Film Strip Component

A Film Strip (`filmStrip`) is a container component that visualizes data distributed among a set of groups (pages) in a form of a vertical or horizontal strip. The UI components that represent display items (`filmStripItem`) included in a group must be of the same size and type, and only one group visible at a time. The end user can navigate pages of the Film Strip, select an item and generate actions by tapping it.

In JDeveloper, the Film Strip is located under Data Views in the Components window (see Figure 6–54).

Figure 6–54 Film Strip in Components Window



Example 6–55 demonstrates the `filmStrip` element definition in a MAF AMX file.

Example 6–55 Film Strip Definition

```
<amx:filmStrip id="fs1"
               var="item"
               value="#{bindings.contacts.collectionModel}"
               rendered="#{pageFlowScope.pRendered}"
               styleClass="#{pageFlowScope.pStyleClass}"
               inlineStyle="#{pageFlowScope.pInlineStyle}"
               shortDesc="#{pageFlowScope.pShortDesc}"
               halign="#{pageFlowScope.pFsHalign}"
               valign="#{pageFlowScope.pFsValign}"
               itemsPerPage="#{pageFlowScope.pMaxItems}"
               orientation="#{pageFlowScope.pOrientation}">
   <amx:filmStripItem id="fsi1"
                      inlineStyle="text-align:center; width:200px;">
      <amx:commandLink id="ciLink"
                       action="details"
                       shortDesc="Navigate to details">
         <amx:image id="ciImage" source="images/people/#{item.first}.png"/>
         <amx:setPropertyListener id="spl1"
                                  from="#{item.rowKey}"
                                  to="#{pageFlowScope.currentContact}"
                                  type="action"/>
         <amx:setPropertyListener id="spl2"
                                  from="#{item.first}"
                                  to="#{pageFlowScope.currentContactFirst}"
                                  type="action"/>
         <amx:setPropertyListener id="spl3"
                                  from="#{item.last}"
                                  to="#{pageFlowScope.currentContactLast}"
                                  type="action"/>
      </amx:commandLink>
   </amx:filmStripItem>
</amx:filmStrip>
```

For more information and examples, see the following:

- *Oracle Fusion Middleware Tag Reference for Oracle Mobile Application Framework*
- CompGallery, a MAF sample application located in the `PublicSamples.zip` file within the *`jdev_install`*`/jdeveloper/jdev/extensions/oracle.maf/Samples` directory on your development computer

6.3.17.1 What You May Need to Know About the Film Strip Layout

In a vertically laid out Film Strip, the display items are placed in a top-down manner. Depending on the text direction, the page control is located as follows:

- For the left-to-right text direction, the page control is on the right side;
- For the right-to-left text direction, the page control is on the left side.

In a horizontally laid out Film Strip should reflect the text direction mode: in the left-to-ride mode, the first item is located on the left; in the right-to-left mode, the first item is located on the right. In both cases, the page status component is at the bottom.

6.3.17.2 What You May Need to Know About the Film Strip Navigation

The navigation of the Film Strip component is similar to the Deck (see Section 6.2.12, "How to Use a Deck Component") and Panel Splitter component (see Section 6.2.9, "How to Use a Panel Splitter Component"): one page at the time is displayed and the page change is triggered by selection of the page ID or number.

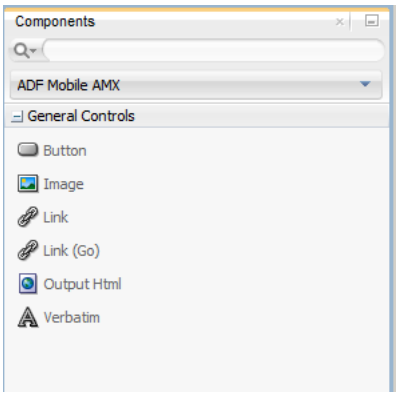
Since the child Film Strip Item component is not meant to be used for navigation to other MAF AMX pages, it does not support the `action` attribute. When required, you can enable navigation through the nested Command Link component.

6.3.18 How to Use Verbatim Component

You use the Verbatim (`verbatim`) operation to insert your own HTML into a page in cases where such a component does not exist or you prefer laying it out yourself using HTML.

In JDeveloper, Verbatim is located under **General Controls** in the Components window (see Figure 6–57).

Figure 6–55 Verbatim in Components Window



For more information and examples, see the following:

- *Oracle Fusion Middleware Tag Reference for Oracle Mobile Application Framework*

- CompGallery, a MAF sample application located in the `PublicSamples.zip` file within the *jdev_install*`/jdeveloper/jdev/extensions/oracle.maf/Samples` directory on your development computer

6.3.18.1 What You May Need to Know About Using JavaScript and AJAX with Verbatim Component

Inserting JavaScript directly into the verbatim content (within the `amx:verbatim` element) is not a recommended practice as it may not execute properly on future versions of the currently supported platforms or on other platforms that MAF might support in the future. Instead, JavaScript and CSS inclusions should be done through the existing `adfmf:include` elements in the `maf-feature.xml` file, which ensures injection of the script into the page at the startup of the MAF AMX application feature.

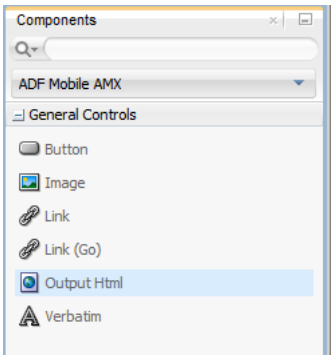
In addition, the use of JavaScript with the Verbatim component is affected by the fact that AJAX calls from an AMX page to a server are not supported. This is due to the security architecture that guarantees that the browser hosting the MAF AMX page does not have access to the security information needed to make connections to a secure server to obtain its resources. Instead, communication with the server must occur from the embedded Java code layer.

6.3.19 How to Use Output HTML Component

The Output HTML (`outputHtml`) component allows you to dynamically and securely obtain HTML content from an EL-bound property or method with the purpose of displaying it on a MAF AMX page. The Output HTML component behaves similarly to the Verbatim component (see Section 6.3.18, "How to Use Verbatim Component") and the same restrictions with regards to JavaScript and AJAX usage apply to it (see Section 6.3.18.1, "What You May Need to Know About Using JavaScript and AJAX with Verbatim Component").

In JDeveloper, Output HTML is located under **General Controls** in the Components window (see Figure 6–56).

Figure 6–56 Output HTML in Components Window



Example 6–56 demonstrates the `outputHtml` element definition in a MAF AMX file. The `value` attribute provides an EL binding to a String property that is used to obtain the HTML content to be displayed as the `outputHTML` in the final rendering of the MAF AMX page.

Example 6–56 Output HTML Definition

```
<amx:tableLayout id="t1" width="100%">
   <amx:rowLayout id="r1">
```

```
      <amx:cellFormat id="cf1" width="100%">
         <amx:outputHtml id="ReceiptView"
                         value="#{pageFlowScope.purchaseBean.htmlReceiptView}"/>
      </amx:cellFormat>
   </amx:rowLayout>
   <amx:rowLayout id="r2">
      <amx:cellFormat id="cf2" width="100%">
         <amx:outputHtml id="CheckView"
                         value="#{pageFlowScope.purchaseBean.htmlCheckView}"/>
      </amx:cellFormat>
   </amx:rowLayout>
</amx:tableLayout>
```

Example 6–57 shows the code from the Java bean called `MyPurchaseBean` that provides HTML for the Output HTML component shown in Example 6–56.

Example 6–57 Retrieving HTML

```
// The property accessor that gets the receipt view HTML
public String getHtmlReceiptView() {
   // Perform some URL remote call to get the HTML to be
   // inserted as a view of the Receipt and return that value
   return obtainReceiptHTMLFromServer();
}
// The property accessor that gets the check view HTML
public String getHtmlCheckView() {
   // Perform some URL remote call to get the HTML to be
   // inserted as a view of the Check and return that value
   return obtainCheckHTMLFromServer();
}
```

Since the Output HTML component obtains its HTML content from a Java bean property as opposed to downloading it directly from a remote source, consider using the existing MAF security features when coding the retrieval or generation of the dynamically provided HTML. For more information, see Chapter 21, "Securing Mobile Applications." In addition, ensure that the HTML being provided comes from a trusted source and is free of threats.

For more information and examples, see the following:

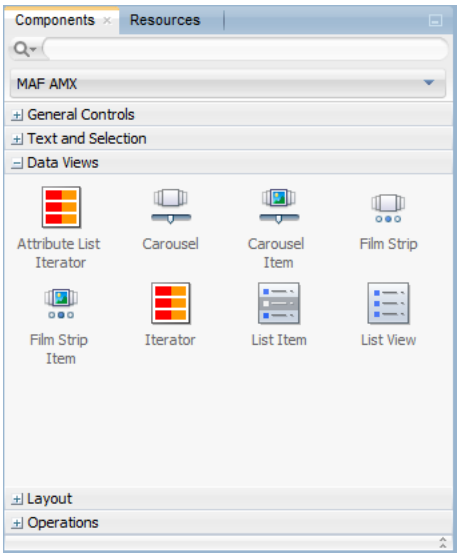
- *Oracle Fusion Middleware Tag Reference for Oracle Mobile Application Framework*
- CompGallery, a MAF sample application located in the `PublicSamples.zip` file within the *`jdev_install`*`/jdeveloper/jdev/extensions/oracle.maf/Samples` directory on your development computer

6.3.20 How to Enable Iteration

You use the Iterator (`iterator`) operation to stamp an arbitrary number of items with the same kind of data, which allows you to iterate through the data and produce UI for each element.

In JDeveloper, the Iterator is located under Data Views in the Components window (see Figure 6–57).

Figure 6–57 Iterator in Components Window



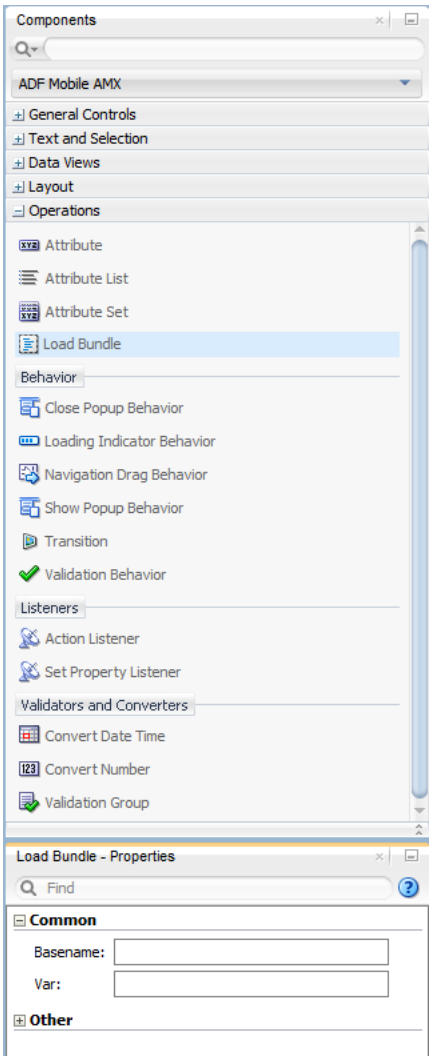
For more information, see *Oracle Fusion Middleware Tag Reference for Oracle Mobile Application Framework*.

6.3.21 How to Load a Resource Bundle

The Load Bundle (`loadBundle`) operation allows you to specify the resource bundle that provides localized text for the MAF AMX UI components on a page. For more information, see Section 6.7, "Localizing UI Components."

In JDeveloper, the Load Bundle is located under Operations in the Components window (see Figure 6–58).

Figure 6–58 Load Bundle in Components Window



In your MAF AMX file, you declare the `loadBundle` element as a child of the `view` element.

For more information, see *Oracle Fusion Middleware Tag Reference for Oracle Mobile Application Framework*.

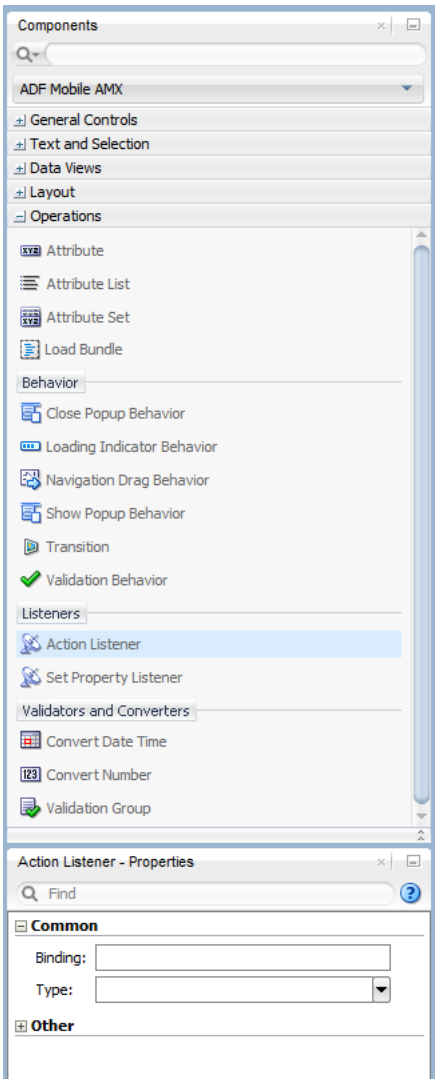
6.3.22 How to Use the Action Listener

The Action Listener (`actionListener`) component allows you to declaratively invoke commands through EL based on the type of the parent component's usage.

The predominate reason for using the Action Listener component is to add gesture-supported actions to its parent components, as well as ability to perform multiple operations for a single gesture, including tap. For more information, see Section 6.3.22.1, "What You May Need to Know About Differences Between the Action Listener Component and Attribute."

In JDeveloper, the Action Listener component is located under **Operations -> Listeners** in the Components window (see Figure 6–59).

Figure 6–59 Action Listener in Components Window



You can add zero or more Action Listener components as children of any command component (Button, Link, List Item, Film Strip Item). The `type` attribute of the Action Listener component defines which gesture, such as `swipeLeft`, `swipeRight`, `tapHold`, and so on, causes the `ActionEvent` to fire.

For more information, see the following:

- Section 6.10, "Using Event Listeners"
- Section 6.3.23, "How to Use the Set Property Listener"
- Section 6.4, "Enabling Gestures"
- Section 6.3.22.1, "What You May Need to Know About Differences Between the Action Listener Component and Attribute"
- *Oracle Fusion Middleware Tag Reference for Oracle Mobile Application Framework*

6.3.22.1 What You May Need to Know About Differences Between the Action Listener Component and Attribute

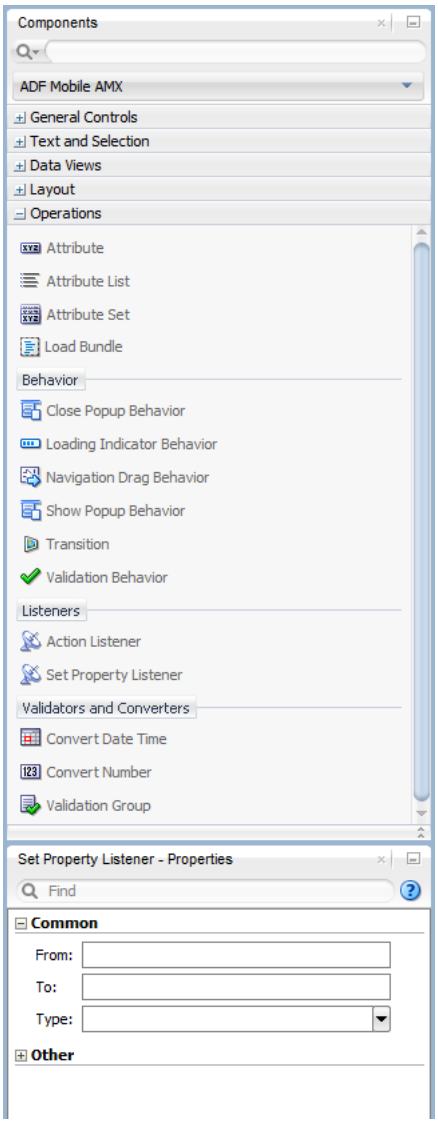
Components such as the Button, Link, and List Item have an `actionListener` attribute, which by inference seems to make the Action Listener component redundant. However, unlike the Action Listener component, these components do not have the `type` attribute that supports gestures, which is the reason MAF provides the Action Listener component in addition to the `actionListener` attribute of the parent components.

6.3.23 How to Use the Set Property Listener

The Set Property Listener (`setPropertyListener`) component allows you to declaratively copy values from one location (defined by the component's `from` attribute) to another (defined by the component's `to` attribute) as a result of an end-user action on a component, thus freeing you from the need to write Java code to achieve the same result.

In JDeveloper, the Set Property Listener component is located under **Operations -> Listeners** in the Components window (see Figure 6–60).

Figure 6–60 Set Property Listener in Components Window



Example 6–58 demonstrates the `setPropertyListener` element definition in a MAF AMX file.

Example 6–58 Set Property Listener Definition

```
<amx:listView value="#{bindings.products.collectionModel}" var="row" id="lv1">
   <amx:listItem id="li1" action="details">
      <amx:outputText value="#{row.name}" id="ot1" />
      <amx:setPropertyListener id="spl1"
                               from="#{row}"
                               to="#{pageFlowScope.product}"
                               type="action"/>
   </amx:listItem>
</amx:listView>
```

You can add zero or more Set Property Listener components as children of any command component (Button, Link, List Item, Film Strip Item, and a subset of data visualization components). The `type` attribute of the Set Property Listener component

defines which gesture, such as `swipeLeft`, `swipeRight`, `tapHold`, and so on, causes the `ActionEvent` to fire.

For more information, see the following:

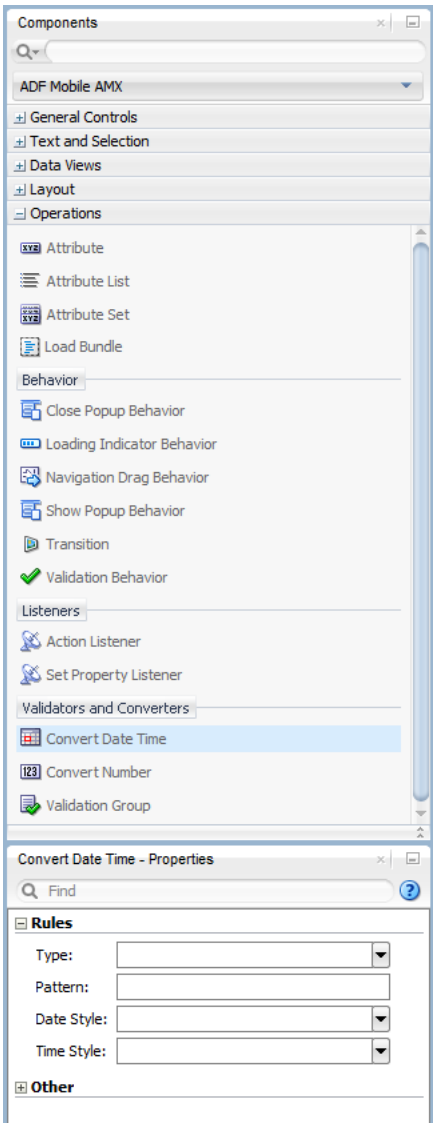
- Section 6.10, "Using Event Listeners"
- Section 6.3.22, "How to Use the Action Listener"
- Section 6.4, "Enabling Gestures"
- *Oracle Fusion Middleware Tag Reference for Oracle Mobile Application Framework*

6.3.24 How to Convert Date and Time Values

The Convert Date Time (`convertDateTime`) is not an independent UI component: it is a converter operation that you use in conjunction with an Output Text and Input Text component to display converted date, time, or a combination of date and time in a variety of formats following the specified pattern.

In JDeveloper, the Convert Date Time is located under Validators and Converters in the Components window (see Figure 6–61).

Figure 6–61 Convert Date Time in Components Window



Example 6–59 demonstrates the `convertDateTime` element declared in a MAF AMX file.

Example 6–59 Using Convert Date Time

```
<amx:panelPage id="pp1">
   <amx:inputText styleClass="ui-text" value="Order Date" id="it1" >
      <amx:convertDateTime id="cdt1" type="both"/>
   </amx:inputText>
</amx:panelPage>
```

To convert date and time values:

1. From the **Components** window, drag a **Convert Date Time** component and insert it within an Output Text or Input Text component, making it a child element of that component.
2. Open the **Properties** window for the Convert Date Time component and define its attributes. For more information, see *Oracle Fusion Middleware Tag Reference for Oracle Mobile Application Framework*.

Note: The Convert Date Time component does not produce any effect at design time.

The Convert Date Time component allows a level of leniency while converting an input value string to date:

- A converter with associated pattern `MMM` for month, when attached to any value holder, accepts values with month specified in the form `MM` or `M` as valid.
- Allows use of such separators as dash (-) or period (.) or slash (/), irrespective of the separator specified in the associated pattern.
- Leniency in pattern definition set by the `pattern` attribute.

For example, when a pattern on the converter is set to `"MMM/d/yyyy"`, the following inputs are accepted as valid by the converter:

```
Jan/4/2004
Jan-4-2004
Jan.4.2004
01/4/2004
01-4-2004
01.4.2004
1/4/2004
1-4-2004
1.4.2004
```

The converter supports the same parsing and formatting conventions as the `java.text.SimpleDateFormat` (specified using the `dateStyle`, `timeStyle`, and `pattern` attributes), except the case when the time zone is specified to have a long display, such as `timeStyle=full` or a pattern set with `zzzz`. Instead of a long descriptive string, such as "Pacific Standard Time", the time zone is displayed in the General Time zone format (GMT +/- offset) or RFC-822 time zones.

The exact result of the conversion depends on the locale, but typically the following rules apply:

- `SHORT` is completely numeric, such as 12.13.52 or 3:30pm
- `MEDIUM` is longer, such as Jan 12, 1952
- `LONG` is longer, such as January 12, 1952 or 3:30:32pm
- `FULL` is completely specified, such as Tuesday, April 12, 1952 AD or 3:30:42pm PST

6.3.24.1 What You May Need to Know About Date and Time Patterns

As per `java.text.SimpleDateFormat` definition, date and time formats are specified by date and time pattern strings. Within date and time pattern strings, unquoted letters from `A` to `Z` and from `a` to `z` are interpreted as pattern letters representing the components of a date or time string. Text can be quoted using single quotes (`'`) to avoid interpretation. `" ' ' "` represents a single quote. All other characters are not interpreted; instead, they are simply copied into the output string during formatting, or matched against the input string during parsing.

Table 6–9 lists the defined pattern letters (all other characters from `A` to `Z` and from `a` to `z` are reserved).

Table 6–9 Date and Time Pattern Letters

Letter	Date or Time Component	Presentation	Examples
G	Era designator	Text	■ AD
y	Year	Year	■ 1996 ■ 96
M	Month in year	Month	■ July ■ Jul ■ 07
w	Week in year	Number	■ 27
W	Week in month	Number	■ 2
D	Day in year	Number	■ 189
d	Day in month	Number	■ 10
F	Day of week in month	Number	■ 2
E	Day in week	Text	■ Tuesday ■ Tue
a	Am/pm marker	Text	■ PM
H	Hour in day (0-23)	Number	■ 0
k	Hour in day (1-24)	Number	■ 24
K	Hour in am/pm (0-11)	Number	■ 0
h	Hour in am/pm (1-12)	Number	■ 12
m	Minute in hour	Number	■ 30
s	Second in minute	Number	■ 55
S	Millisecond	Number	■ 978
z	Time zone	General time zone	■ Pacific Standard Time ■ PST ■ GMT-08:00
Z	Time zone	RFC 822 time zone	■ -0800

Pattern letters are usually repeated, as their number determines the exact presentation.

6.3.25 How to Convert Numerical Values

The Convert Number (`convertNumber`) is not an independent UI component: it is a converter operation that you use in conjunction with an Output Text, Input Text, and Input Number Slider components to display converted number or currency figures in a variety of formats following a specified pattern.

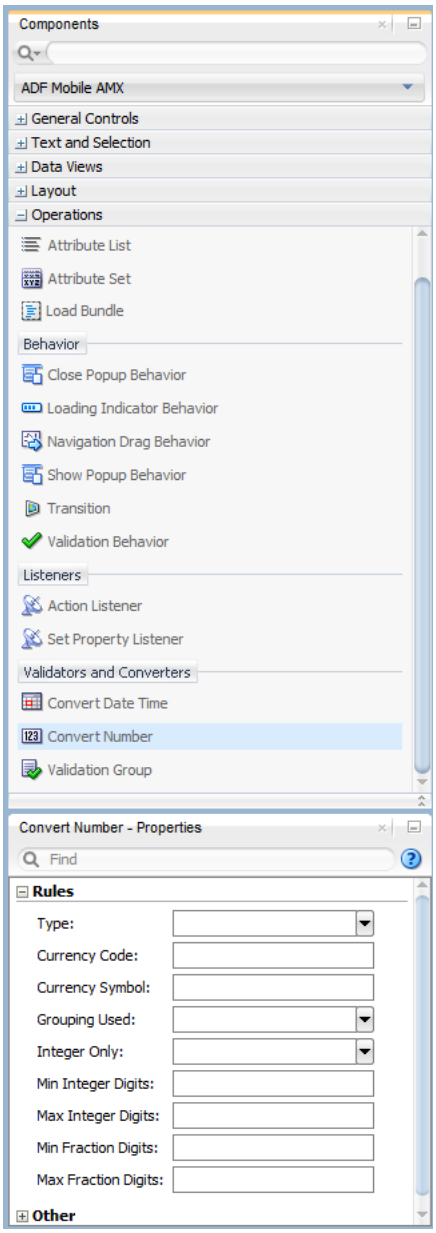
The Convert Number component provides the following types of conversion:

- From value to string, for display purposes.
- From formatted string to value, when formatted input value is parsed into its underlying value.

When the Convert Number is specified as a child of an Input Text component, the numeric keyboard is displayed on a mobile device by default.

In JDeveloper, the Convert Number is located under Validators and Converters in the Components window (see Figure 6–62).

Figure 6–62 Convert Number in Components Window



Example 6–60 demonstrates the `convertNumber` element defined in a MAF AMX file.

Example 6–60 Using Convert Number

```
<amx:panelPage id="pp1">
   <amx:inputText styleClass="ui-text" value="Product Price" id="it1" >
      <amx:convertNumber id="cn1"
                         type="percent"
                         groupingUsed="false"
                         integerOnly="true"/>
   </amx:inputText>
</amx:panelPage>
```

To convert numerical values:

1. From the **Components** window, drag a **Convert Number** component and insert it within an Output Text, Input Text, or Input Number Slider component, making it a child element of that component.
2. Open the **Properties** window for the Convert Number component and define its attributes. For more information, see *Oracle Fusion Middleware Tag Reference for Oracle Mobile Application Framework*.

> **Note:** The Convert Number component does not produce any effect at design time.

6.3.26 How to Enable Drag Navigation

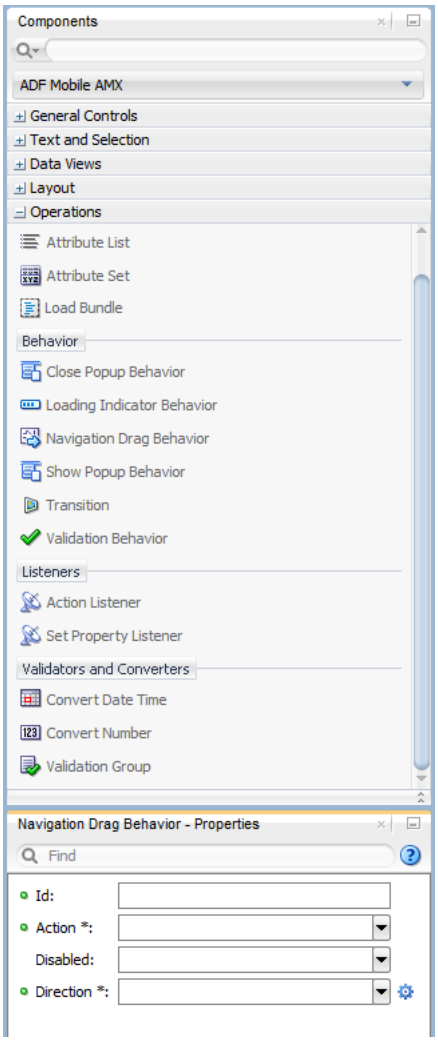
The Navigation Drag Behavior (`navigationDragBehavior`) operation allows you to invoke the action of navigating to the next or previous MAF AMX page by dragging a portion of the mobile device screen in a specified direction (left or right). As the drag in the specified direction occurs, an indicator is displayed on the appropriate side of the screen to hint that an action will be performed if the dragging continues and then stops as soon as the indicator is fully revealed. If the drag is released before the indicator is fully revealed, the indicator slides away and no action is invoked.

> **Note:** This behavior does not occur if another, closer container consumes the drag gesture.

A MAF AMX page cannot contain more than two instances of the `navigationDragBehavior` element: one with its `direction` attribute set to `back` and one set to `forward`.

In JDeveloper, the Navigation Drag Behavior is located under **Operations** in the Components window (see Figure 6–63).

Figure 6–63 Navigation Drag Behavior in Components Window



Example 6–61 demonstrates the `navigationDragBehavior` element defined in a MAF AMX file. Note that this element can only be a child of the `view` element.

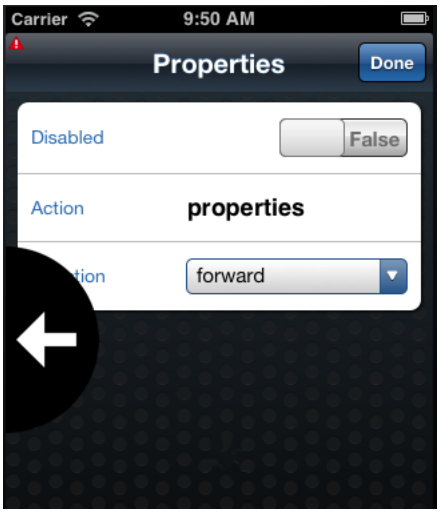
Example 6–61 Using Navigation Drag Behavior

```
<amx:view xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
          xmlns:amx="http://xmlns.oracle.com/adf/mf/amx"
          xmlns:dvtm="http://xmlns.oracle.com/adf/mf/amx/dvt">
   <amx:navigationDragBehavior id="ndb1"
                               direction="forward"
                               action="gotoDetail"/> [1]
   <amx:panelPage id="pp1">
      <amx:facet name="header">
      ...
   </amx:panelPage>
</amx:view>
```

Figure 6–64 shows the Navigation Drag Behavior at runtime (displayed using the `mobileFusionFx` skin).

[1] See Section 6.3.26.1, "What You May Need to Know About the disabled Attribute" for details.

Figure 6–64 Navigation Drag Behavior Operation at Runtime



For more information and examples, see the following:

- *Oracle Fusion Middleware Tag Reference for Oracle Mobile Application Framework*
- CompGallery, a MAF sample application located in the `PublicSamples.zip` file within the *`jdev_install`*`/jdeveloper/jdev/extensions/oracle.maf/Samples` directory on your development computer

6.3.26.1 What You May Need to Know About the disabled Attribute

The value of the `disabled` attribute (see Example 6–62 and Example 6–63) is calculated when one of the following occurs:

- A MAF AMX page is rendered
- A `PropertyChangeListener` updates the component: If you wish to dynamically enable or disable the end user's ability to invoke the Navigation Drag Behavior, you use the `PropertyChangeListener` (similarly to how it is used with other components that require updates from a bean).

Example 6–62 shows a MAF AMX page containing the `navigationDragBehavior` element with a defined disabled attribute. The functionality is driven by the Button (`commandButton`) that, when activated, changes the backing bean `boolean` value (`navDisabled` in Example 6–63) from which the `disabled` attribute reads its value. The backing bean, in turn, uses the PropertyChangeListener.

Example 6–62 Navigation Drag Behavior with disabled Attribute in MAF AMX Page

```
<amx:view xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
          xmlns:amx="http://xmlns.oracle.com/adf/mf/amx"
          xmlns:dvtm="http://xmlns.oracle.com/adf/mf/amx/dvt">
   <amx:panelPage id="pp1">
      <amx:facet name="header">
         <amx:outputText value="Header1" id="ot1"/>
      </amx:facet>
      <amx:commandButton id="cb1"
                         text="commandButton1"
                         actionListener="#{pageFlowScope.myBean.doSomething}"/>
   </amx:panelPage>
   <amx:navigationDragBehavior id="ndb1"
                               direction="forward"
```

```
                                action="goView2"
                                disabled="#{pageFlowScope.myBean.navDisabled}"/>
</amx:view>
```

Example 6–63 shows the backing bean (`myBean` in Example 6–62) that provides value for the navigationDragBehavior's `disabled` attribute.

Example 6–63 Backing Bean for Navigation Drag Behavior Disabled Functionality

```
public class MyBean {
   boolean navDisabled = true;
   private PropertyChangeSupport propertyChangeSupport =
                                    new PropertyChangeSupport(this);

   public void setNavDisabled(boolean navDisabled) {
      boolean oldNavDisabled = this.navDisabled;
      this.navDisabled = navDisabled;
      propertyChangeSupport.firePropertyChange("navDisabled",
                                               oldNavDisabled,
                                               navDisabled);
   }

   public boolean isNavDisabled() {
      return navDisabled;
   }

   public void doSomething(ActionEvent actionEvent) {
      setNavDisabled(!navDisabled);
   }

   public void addPropertyChangeListener(PropertyChangeListener l) {
      propertyChangeSupport.addPropertyChangeListener(l);
   }

   public void removePropertyChangeListener(PropertyChangeListener l) {
      propertyChangeSupport.removePropertyChangeListener(l);
   }
}
```

6.3.27 How to Use the Loading Indicator

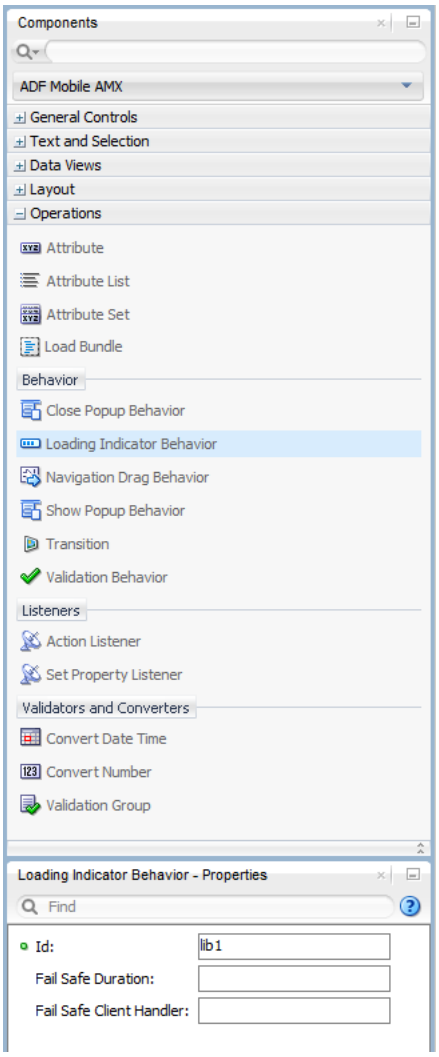
The Loading Indicator Behavior (`loadingIndicatorBehavior`) operation allows you to define the behavior of the loading indicator by overriding the following:

- The duration of the fail-safe timer (in milliseconds).
- An optional JavaScript function name that can be invoked to decide on the course of action when the fail-safe threshold is reached.

For additional information, see the `adf.mf.api.amx.showLoadingIndicator` in Table 12–1, " Static APIs".

In JDeveloper, the Loading Indicator Behavior is located under **Operations** in the Components window (see Figure 6–65).

Figure 6–65 Loading Indicator Behavior in the Components Window



Example 6–64 demonstrates the `loadingIndicatorBehavior` element defined in a MAF AMX file. Note that this element can only be a child of the `view` element.

Example 6–64 Using Loading Indicator Behavior

```
<amx:view xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
          xmlns:amx="http://xmlns.oracle.com/adf/mf/amx"
          xmlns:dvtm="http://xmlns.oracle.com/adf/mf/amx/dvt">
   <amx:loadingIndicatorBehavior id="lib1"
                        failSafeDuration="3000"
                        failSafeClientHandler="window.customFailSafeHandler"/>
   <amx:panelPage id="pp1">
      <amx:facet name="header">
      <!-- The loading indicator custom fail safe handler will appear
           if the long running operation runs longer than 3 seconds -->
      <amx:commandButton id="cb1"
                         text="longRunningOperation"
                         actionListener=
                               "#{pageFlowScope.myBean.longRunningOperation} />
   </amx:panelPage>
</amx:view>
```

In the preceding example, the `commandButton` is bound to a long-running method to illustrate that the loading indicator applies to long running operations once the page is loaded (not when the page itself takes a long time to load).

Example 6–65 demonstrates the `custom.js` file included with the application feature. It defines the client handler for the `failSafeClientHandler` in the `loadingIndicatorBehavior` page. As per the API requirement, this function returns a `String` of either `hide`, `repeat`, or `freeze`. For more information, see the `adf.mf.api.amx.showLoadingIndicator` in Table 12–1, " Static APIs".

Example 6–65 Sample custom.js File

```
window.customFailSafeHandler = function() {
   var answer =
      prompt(
         "This is taking a long time.\n\n" +
         "Use \"a\" to hide the indicator.\n" +
         "Use \"z\" to wait for it.\n" +
         "Otherwise, give it more time.");

   if (answer == "a")
      return "hide"; // don't ask again; hide the indicator
   else if (answer == "z")
      return "freeze" // don't ask again; wait for it to finish
   else
      return "repeat"; // ask again after another duration
};
```

For more information and examples, see the following:

- *Oracle Fusion Middleware Tag Reference for Oracle Mobile Application Framework*
- CompGallery, a MAF sample application located in the `PublicSamples.zip` file within the *`jdev_install`*`/jdeveloper/jdev/extensions/oracle.maf/Samples` directory on your development computer

6.4 Enabling Gestures

You can configure Button, Link, List Item, as well as a number of data visualization components to react to the following gestures:

- Swipe to the right
- Swipe to the left
- Swipe up
- Swipe down
- Tap-and-hold
- Action: as a gesture, Action represents a basic tap.
- Swipe to the start: this gesture is used on the iOS platform to accommodate the right-to-left text direction. This gesture resolves as follows:
  - Swipe to the left for the left-to-right text direction.
  - Swipe to the right for the right-to-left text direction.
- Swipe to the end: this gesture is used on the iOS platform to accommodate the right-to-left text direction. This gesture resolves as follows:
  - Swipe to the right for the left-to-right text direction.

– Swipe to the left for the right-to-left text direction.

You can define `swipeRight`, `swipeLeft`, `swipeUp`, `swipeDown`, `swipeStart`, `swipeEnd`, `action`, and `tapHold` values for the `type` attribute of the following operations:

- Set Property Listener (see Section 6.3.23, "How to Use the Set Property Listener")
- Action Listener (see Section 6.3.22, "How to Use the Action Listener")
- Show Popup Behavior (see Section 6.2.8, "How to Use a Popup Component")
- Close Popup Behavior (see Section 6.2.8, "How to Use a Popup Component")

The values of the `type` attribute are restricted based on the parent component and are supported only for Link (`commandLink`) and List Item (`listItem`) components.

Note: There is no gesture support for the Link Go (`linkGo`) component.

Swiping from start and end is used on the iOS platform to accommodate the right-to-left text direction. It is generally recommended to set the start and end swipe style as opposed to left and right.

Example 6–66 demonstrates use of the `tapHold` value of the `type` attribute in a MAF AMX file. In this example, the tap-and-hold gesture triggers the display of a Popup component.

Example 6–66 Using Tap-and-Hold Gesture

```
<amx:panelPage id="pp1">
   <amx:listView id="lv1"
                 value="#{bindings.data.collectionModel}"
                 var="row">
      <amx:listItem id="li1" action="gosomewhere">
         <amx:outputText id="ot1" value="#{row.description}"/>
         <amx:setPropertyListener id="spl1"
                                  from="#{row.rowKey}"
                                  to="#{mybean.currentRow}"
                                  type="tapHold"/>
         <amx:showPopupBehavior id="spb1"
                                type="tapHold"
                                alignid="pp1"
                                popupid="pop1"
                                align="startAfter"/>
      </amx:listItem>
   </amx:listView>>
</amx:panelPage>
<amx:popup id="pop1">
   <amx:panelGroupLayout id="pgl1" layout="horizontal">
      <amx:commandLink id="cm1" actionListener="#{mybean.doX}">
         <amx:image id="i1" source="images/x.png"/>
         <amx:closePopupBehavior id="cpb1" type="action" popupid="pop1"/>
      </amx:commandLink>
      <amx:commandLink id="cm2" actionListener="#{mybean.doY}">
         <amx:image id="i2" source="images/y.png"/>
         <amx:closePopupBehavior id="cpb2" type="action" popupid="pop1"/>
      </amx:commandLink>
      <amx:commandLink id="cm3" actionListener="#{mybean.doZ}">
         <amx:image id="i3" source="images/y.png"/>
         <amx:closePopupBehavior id="cpb3" type="action" popupid="pop1"/>
      </amx:commandLink>
```

```
   </amx:panelGroupLayout>
</amx:popup>
```

Example 6–67 demonstrates use of the `swipeRight` gesture in a MAF AMX file.

Example 6–67 Using Swipe Right Gesture

```
<amx:panelPage id="pp1">
   <amx:listView id="lv1"
                 value="#{bindings.data.collectionModel}"
                 var="row">
      <amx:listItem id="li1" action="gosomewhere">
         <amx:outputText id="ot1" value="#{row.description}"/>
         <amx:setPropertyListener id="spl1"
                                  from="#{row.rowKey}"
                                  to="#{mybean.currentRow}"
                                  type="swipeRight"/>
         <actionListener id="al1" binding="#{mybean.DoX}" type="swipeRight"/>
      </amx:listItem>
   </amx:listView>>
</amx:panelPage>
```

For more information, see *Oracle Fusion Middleware Tag Reference for Oracle Mobile Application Framework*.

A MAF sample application called GestureDemo demonstrates how to use gestures with a variety of MAF AMX UI components. This sample application is located in the `PublicSamples.zip file` within the *`jdev_install`*`/jdeveloper/jdev/extensions/oracle.maf/Samples` directory on your development computer.

6.5 Providing Data Visualization

MAF employs a set of data visualization components that you can use to create various charts, gauges, and maps to represent data in your MAF AMX application feature. You can declare the following elements under the `<dvtm>` namespace in a MAF AMX file:

- `areaChart` (see Section 6.5.1, "How to Create an Area Chart")
- `barChart` (see Section 6.5.2, "How to Create a Bar Chart")
- `horizontalBarChart` (see Section 6.5.3, "How to Create a Horizontal Bar Chart")
- `bubbleChart` (see Section 6.5.4, "How to Create a Bubble Chart")
- `comboChart` (see Section 6.5.5, "How to Create a Combo Chart")
- `lineChart` (see Section 6.5.6, "How to Create a Line Chart")
- `pieChart` (see Section 6.5.7, "How to Create a Pie Chart")
- `scatterChart` (see Section 6.5.8, "How to Create a Scatter Chart")
- `sparkChart` (see Section 6.5.9, "How to Create a Spark Chart")
- `funnelChart` (see Section 6.5.10, "How to Create a Funnel Chart")
- `ledGauge` (see Section 6.5.13, "How to Create a LED Gauge")
- `statusMeterGauge` (see Section 6.5.14, "How to Create a Status Meter Gauge")
- `dialGauge` (see Section 6.5.15, "How to Create a Dial Gauge")

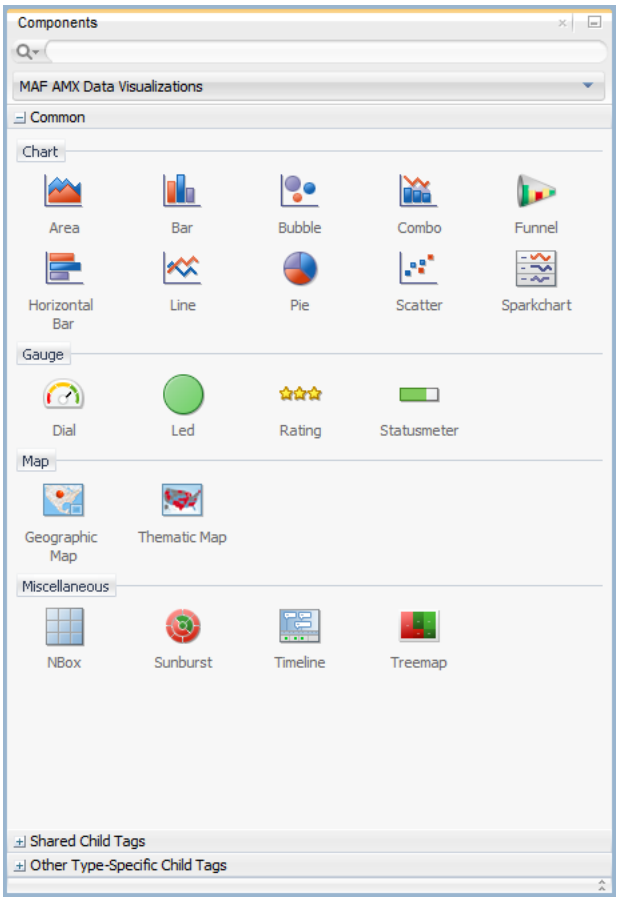
- `ratingGauge` (see Section 6.5.16, "How to Create a Rating Gauge")
- `geographicMap` (see Section 6.5.18, "How to Create a Geographic Map Component")
- `thematicMap` (see Section 6.5.19, "How to Create a Thematic Map Component")
- `treemap` (see Section 6.5.21, "How to Create a Treemap Component")
- `sunburst` (see Section 6.5.22, "How to Create a Sunburst Component")
- `timeline` (see Section 6.5.23, "How to Create a Timeline Component")
- `nBox` (see Section 6.5.24, "How to Create an NBox Component")

Chart, gauge, map, and advanced components' elements have a number of attributes that are common to all or most of them. For more information, see *Oracle Fusion Middleware Tag Reference for Oracle Mobile Application Framework*.

In JDeveloper, data visualization components are located as follows in the Components window:

- Chart components are located under **MAF AMX Data Visualizations > Common > Chart**
- Gauge components are located under **MAF AMX Data Visualizations > Common > Gauge**
- Map components are located under **MAF AMX Data Visualizations > Common > Map**
- Treemap, Sunburst, Timeline, and NBox are located under **MAF AMX Data Visualizations > Common > Miscellaneous**

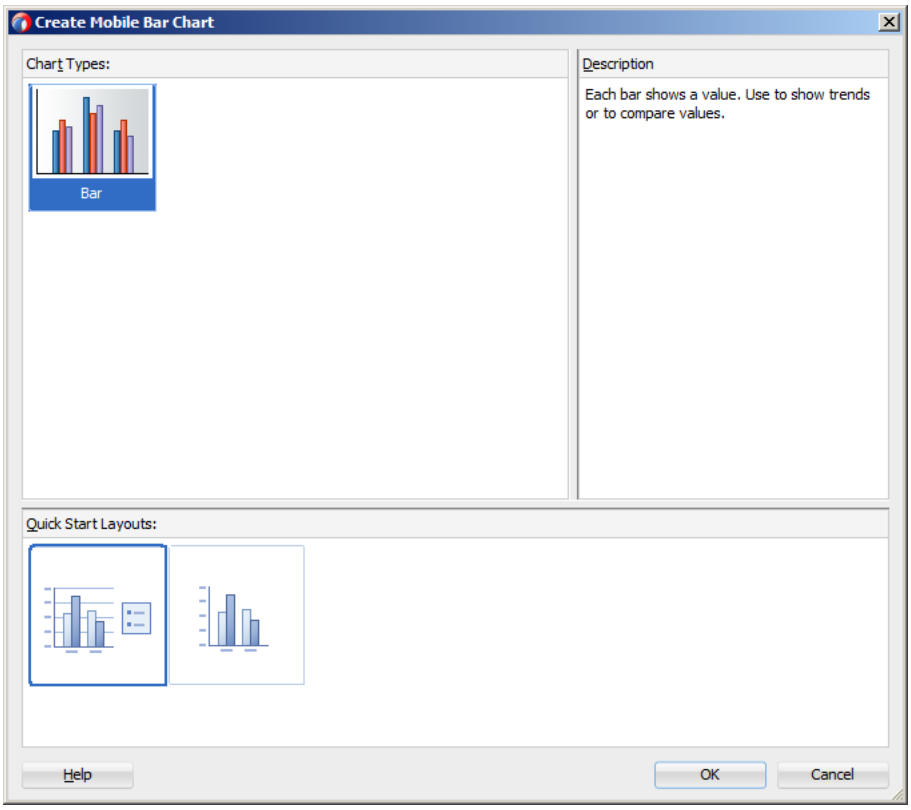
Figure 6–66 Data Visualization Components in the Components Window



When you drag and drop a data visualization component, a dialog similar to one of the following opens to display the information about the type of component you are creating:

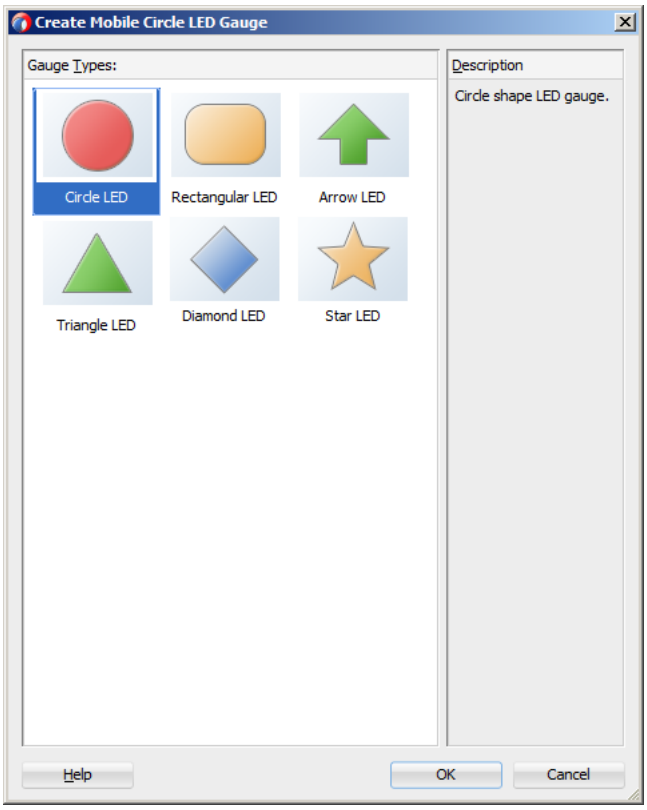
- **Create Mobile Chart** (see Figure 6–67)

Figure 6–67 Creating Chart Components



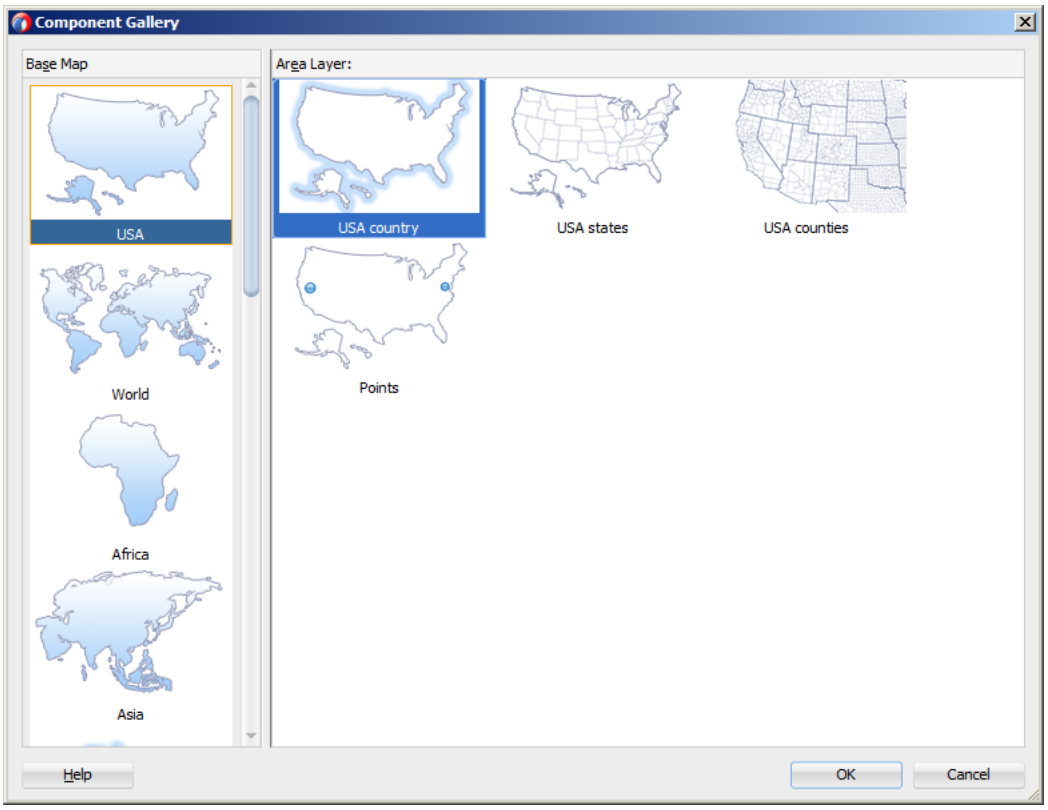
- **Create Mobile Gauge** (see Figure 6–68)

Figure 6–68 Creating Gauge Components



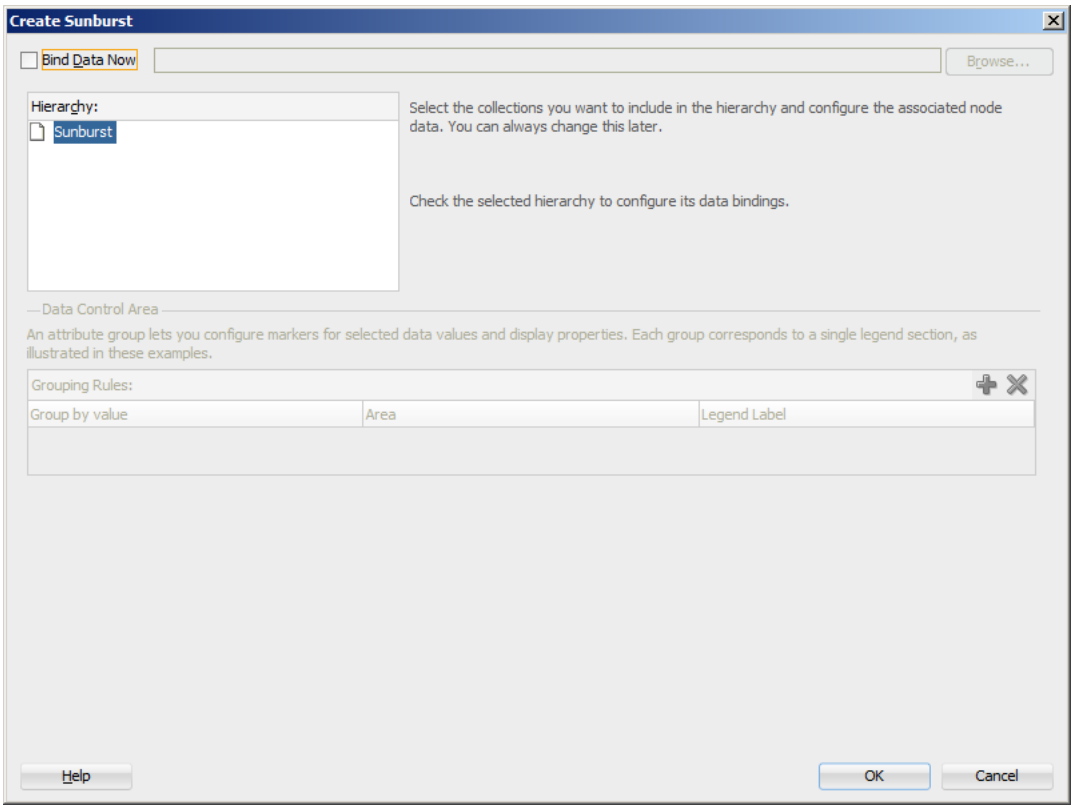
- **Component Gallery** (see Figure 6–69)

Figure 6–69 Creating Map Components



- **Create Sunburst** or **Treemap** (see Figure 6–68)

Figure 6–70 Creating Sunburst



Note: After you created the component, you can relaunch the creation dialog by selecting the component in the Source editor or Structure view, and then clicking Edit Component Definition in the Properties window.

You can use the same editing functionality available from the Properties window to edit child components (for example, the Data Point Layer) of some data visualization components.

A MAF sample application called CompGallery demonstrates how to use various data visualization components in your MAF AMX application feature. This sample application is located in the `PublicSamples.zip` file within the *`jdev_install`*`/jdeveloper/jdev/extensions/oracle.maf/Samples` directory on your development computer.

For more information on MAF AMX data visualization components, see the following:

- For information on how to add event listeners to data visualization components, see Section 6.10, "Using Event Listeners." Event listeners are applicable to components for the MAF AMX run-time description on both iOS and Android-powered devices, but the listeners do not have any effect at design time.
- For information on databound data visualization components that are created from the Data Controls window, see Section 6.5.26, "How to Create Databound Data Visualization Components."
- For information on data visualization components' support for accessibility, see Section 6.8, "Understanding MAF Support for Accessibility."

- For information on limitations to the usage of MAF AMX data visualization components, see Section D.6.2, "Data Visualization Components Limitations."

6.5.1 How to Create an Area Chart

You use the Area Chart (`areaChart`) to visually represent data where sets of data items are related and categorized into groups and series. The series are visualized using graphical elements with some common style properties (such as, for example, an area color or pattern). Those properties have to be applied at the series level instead of per each individual data item. You have an option to use the default or custom series styles. For information about defining custom series styles, see Section 6.5.6, "How to Create a Line Chart."

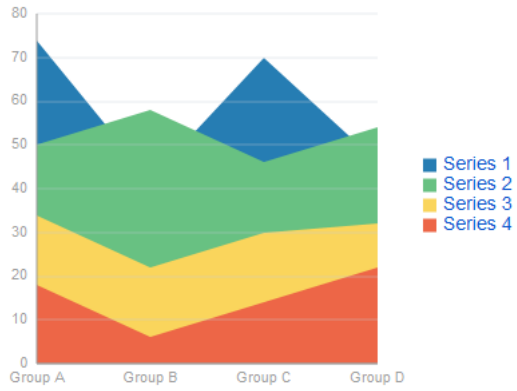
The Area Chart can be zoomed and scrolled along its X Axis. This is enabled through the use of the `zoomAndScroll` attribute.

Example 6–68 shows the `areaChart` element defined in a MAF AMX file. To create a basic area chart with default series style, you pass it a collection and specify the `dataStamp` facet with a nested `chartDataItem` element.

Example 6–68 Area Chart Definition with Default Series Styles

```
<dvtm:areaChart id="areaChart1"
                value="#{bindings.lineData.collectionModel}"
                var="row"
                inlineStyle="width: 400px; height: 300px;"
                animationOnDisplay="auto"
                animationDuration="1500" >
   <amx:facet name="dataStamp">
      <dvtm:chartDataItem id="areaChartItem1"
                          series="#{row.series}"
                          group="#{row.group}"
                          value="#{row.value}" />
   </amx:facet>
   <dvtm:yAxis id="yAxis1"
               axisMaxValue="80.0"
               majorIncrement="20.0"
               title="yAxis Title" />
   <dvtm:legend id="l1" position="end" />
</dvtm:areaChart>
```

Figure 6–71 Area Chart at Design Time



Data items are initialized in the collection model and equipped with the stamping mechanism. At a minimum, each collection `row` must include the following properties:

- `series`: name of the series to which this data item belongs;
- `group`: name of the group to which this data item belongs;
- `value`: the data item value.

The collection `row` might also include other properties, such as `color` or `shape`, applicable to individual data items.

You can use Attribute Groups (`attributeGroups` element) to set style properties for a group of data items based on some grouping criteria, as Example 6–69 shows. In this case, the data item `color` and `shape` attributes are set based on the additional grouping expression. The `attributeGroups` can have the following child elements:

- `attributeExceptionRule` from the `dvtm` namespace: replaces an attribute value with another when a particular boolean condition is met.
- `attributeMatchRule` from the `dvtm` namespace: replaces an attribute when the data matches a certain value.
- `attribute` from the `amx` namespace.

Example 6–69 Area Chart Definition with Default Series Styles and Grouping

```
<dvtm:areaChart id="areaChart1"
                value="#{bindings.lineData.collectionModel}"
                var="row"
                inlineStyle="width: 400px; height: 300px;"
                title="Chart Title"
                animationOnDisplay="auto"
                animationDuration="1500" >
   <amx:facet name="dataStamp">
      <dvtm:chartDataItem id="chartDataItem1"
                          series="#{row.series}"
                          group="#{row.group}"
                          value="#{row.value}" />
         <dvtm:attributeGroups id="ag1"
                               type="color"
                               value="#{row.brand}" />
   </amx:facet>
   <dvtm:yAxis id="yAxis1"
               axisMaxValue="80.0"
               majorIncrement="20.0"
               title="yAxis Title" />
   <dvtm:legend id="l1" position="end" />
</dvtm:areaChart>
```

Note: In Example 6–68 and Figure 6–69, since custom styles are not set at the series level, series are displayed with the colors based on the default color ramp.

For information on attributes of the `areaChart` and `dvtm` child elements that you can define for this component, see *Oracle Fusion Middleware Tag Reference for Oracle Mobile Application Framework*.

You can define a `facet` child element from the `amx` namespace. The `facet` can have a `chartDataItem` as its child (see Section 6.5.17.1, "Defining Chart Data Item").

You can style the Area Chart component's top-level element by overwriting the default CSS settings defined in the following class:

```
.dvtm-areaChart
   - supported properties: all
```

For more information on chart styling, see Section 6.5.11, "How to Style Chart Components."

For information on how to extend CSS files, see Section 6.6.3, "How to Style Data Visualization Components."

6.5.2 How to Create a Bar Chart

You use a Bar Chart (`barChart`) to visually display data as vertical bars, where sets of data items are related and categorized into groups and series. The series are visualized using graphical elements with some common style properties that you have to apply at the series level instead of per each individual data item.

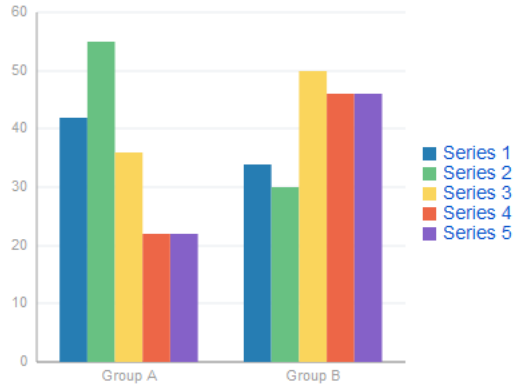
The Bar Chart can be zoomed and scrolled along its X Axis. This is enabled through the use of the `zoomAndScroll` attribute.

Example 6–70 shows the `barChart` element defined in a MAF AMX file. The `dataStamp` facet is specified with a nested `chartDataItem` element.

Example 6–70 Bar Chart Definition

```
<dvtm:barChart id="barChart1"
               value="#{bindings.barData.collectionModel}"
               var="row"
               inlineStyle="width: 400px; height: 300px;"
               animationOnDisplay="zoom"
               animationDuration="3000" >
   <amx:facet name="dataStamp">
      <dvtm:chartDataItem id="chartDataItem1"
                          series="#{row.series}"
                          group="#{row.group}"
                          value="#{row.value}" />
   </amx:facet>
   <dvtm:yAxis id="yAxis1"
               axisMaxValue="80.0"
               majorIncrement="20.0"
               title="yAxis Title" />
   <dvtm:legend id="11" position="start" />
</dvtm:barChart>
```

Figure 6–72 Bar Chart at Design Time



The data model for a bar chart is represented by a collection of items (rows) that describe individual bars. Typically, properties of each bar include the following:

- `series`: name of the series to which this bar belongs;
- `group`: name of the group to which this bar belongs;
- `value`: the data item value (required).

Data must include the same number of groups per series. If any of the series or data pairs are missing, it is passed to the API as `null`.

For information on attributes of the `barChart` and `dvtm` child elements that you can define for this component, see *Oracle Fusion Middleware Tag Reference for Oracle Mobile Application Framework*.

You can define a `facet` child element from the `amx` namespace. The `facet` can have a `chartDataItem` as its child (see Section 6.5.17.1, "Defining Chart Data Item").

You can style the Bar Chart component's top-level element by overwriting the default CSS settings defined in the following class:

```
.dvtm-barChart
   - supported properties: all
```

For more information on chart styling, see Section 6.5.11, "How to Style Chart Components."

For information on how to extend CSS files, see Section 6.6.3, "How to Style Data Visualization Components."

6.5.3 How to Create a Horizontal Bar Chart

You use a Horizontal Bar Chart (`horizontalBarChart`) to visually display data as horizontal bars, where sets of data items are related and categorized into groups and series. The series are visualized using graphical elements with some common style properties that you have to apply at the series level instead of per each individual data item.

The Bar Chart can be zoomed and scrolled along its X Axis. This is enabled through the use of the `zoomAndScroll` attribute.

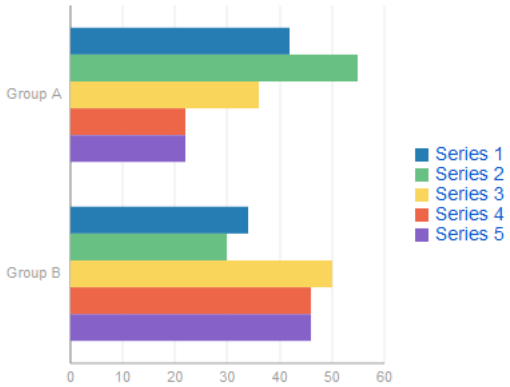
Example 6–70 shows the `horizontalBarChart` element defined in a MAF AMX file. The `dataStamp` facet is specified with a nested `chartDataItem` element.

Example 6–71 Horizontal Bar Chart Definition

```
<dvtm:horizontalBarChart id="horizBarChart1"
                  value="#{bindings.barData.collectionModel}"
                  var="row"
                  inlineStyle="width: 400px; height: 300px;"
                  dataSelection="#{pageFlowScope.dataSelection}"
                  hideAndShowBehavior="#{pageFlowScope.hideAndShowBehavior}"
                  rolloverBehavior="#{pageFlowScope.rolloverBehavior}"
                  stack="#{pageFlowScope.stack}" >
   <amx:facet name="dataStamp">
      <dvtm:chartDataItem id="chartDataItem1"
                          series="#{row.series}"
                          group="#{row.group}"
                          value="#{row.value}" />
   </amx:facet>
   <dvtm:yAxis id="yAxis1"
               axisMaxValue="80.0"
```

```
                majorIncrement="20.0"
                title="yAxis Title" />
   <dvtm:legend id="l1" position="start" />
</dvtm:horizontalBarChart>
```

Figure 6–73 Horizontal Bar Chart at Design Time



The data model for a horizontal bar chart is represented by a collection of items (rows) that describe individual bars. Typically, properties of each bar include the following:

- `series`: name of the series to which this bar belongs;
- `group`: name of the group to which this bar belongs;
- `value`: the data item value (required).

Data must include the same number of groups per series. If any of the series or data pairs are missing, it is passed to the API as `null`.

For information on attributes of the `horizontalBarChart` and `dvtm` child elements that you can define for this component, see *Oracle Fusion Middleware Tag Reference for Oracle Mobile Application Framework*.

You can define a `facet` child element from the `amx` namespace. The `facet` can have a `chartDataItem` as its child (see Section 6.5.17.1, "Defining Chart Data Item").

You can style the Horizontal Bar Chart component's top-level element by overwriting the default CSS settings defined in the following class:

```
.dvtm-horizontalBarChart
   - supported properties: all
```

For more information on chart styling, see Section 6.5.11, "How to Style Chart Components."

For information on how to extend CSS files, see Section 6.6.3, "How to Style Data Visualization Components."

6.5.4 How to Create a Bubble Chart

A Bubble Chart (`bubbleChart`) displays a set of data items where each data item has `x`, `y` coordinates and size (bubble). In addition, each data item can have various style attributes, such as `color` and `markerShape`. You can either set properties of each data item individually, or categorize the data items into groups based on various criteria. You may use multiple grouping criteria at the same time, and may also use different style attributes to visualize the relationships of the data items. However, unlike line charts (see Section 6.5.6, "How to Create a Line Chart") or area charts (see Section 6.5.1,

"How to Create an Area Chart"), bubble charts do not have a strict notion of the series and groups.

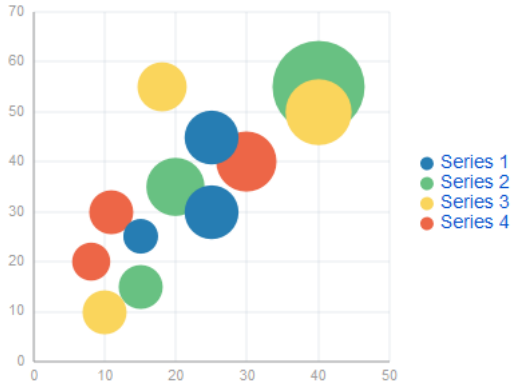
The Bubble Chart can be zoomed and scrolled along its X and Y Axis. This is enabled through the use of the `zoomAndScroll` attribute.

Example 6–72 shows the `bubbleChart` element defined in a MAF AMX file. The `dataStamp` facet is specified with a nested `chartDataItem` element. The `color` and `markerShape` attributes of each data item are set individually based on the values supplied in the data model. In addition, the underlying data control must support the respective variable references of `row.label`, `row.size`, and `row.shape`.

Example 6–72 Bubble Chart Definition with Custom Data Item Properties

```
<dvtm:bubbleChart id="bubbleChart1"
                  value="#{bindings.bubbleData.collectionModel}"
                  inlineStyle="width: 400px; height: 300px;"
                  dataSelection="multiple"
                  rolloverBehavior="dim"
                  animationOnDisplay="auto"
                  var="row">
   <amx:facet name="dataStamp">
      <dvtm:chartDataItem id="chartDataItem1"
                          group="#{row.group}"
                          x="#{row.x}"
                          y="#{row.y}"
                          markerSize="#{row.size}"
                          color="#{row.color}"
                          markerShape="#{row.shape}" />
   </amx:facet>
</dvtm:bubbleChart>
```

Figure 6–74 Bubble Chart at Design Time



In Example 6–73, the `attributeGroups` element is used to set common style attributes for a related group of data items.

Example 6–73 Bubble Chart Definition with Attribute Groups

```
<dvtm:bubbleChart id="bubbleChart1"
                  value="#{bindings.bubbleData.collectionModel}"
                  dataSelection="multiple"
                  rolloverBehavior="dim"
                  animationOnDisplay="auto"
                  title="Bubble Chart"
```

```
                  var="row">
   <amx:facet name="dataStamp">
      <dvtm:chartDataItem id="chartDataItem1"
                          group="#{row.label}"
                          x="#{row.x}"
                          y="#{row.y}" >
         <dvtm:attributeGroups id="ag1" type="color" value="#{row.category}" />
         <dvtm:attributeGroups id="ag2" type="shape" value="#{row.brand}" />
      </dvtm:chartDataItem>
   </amx:facet>
</dvtm:bubbleChart>
```

The data model for a bubble chart is represented by a collection of items (rows) that describe individual data items. Typically, properties of each bar include the following:

- `label`: data item label (optional);
- `x`, `y`: value coordinates (required);
- `z`: the size of data item (required).

The data must include the same number of groups per series. If any of the series or data pairs are missing, it is passed to the API as `null`.

For information on attributes of the `bubbleChart` and `dvtm` child elements that you can define for this component, see *Oracle Fusion Middleware Tag Reference for Oracle Mobile Application Framework*.

You can define a `facet` child element from the `amx` namespace. The `facet` can have a `chartDataItem` as its child (see Section 6.5.17.1, "Defining Chart Data Item").

You can style the Bubble Chart component's top-level element by overwriting the default CSS settings defined in the following class:

```
.dvtm-bubbleChart
   - supported properties: all
```

For more information on chart styling, see Section 6.5.11, "How to Style Chart Components."

For information on how to extend CSS files, see Section 6.6.3, "How to Style Data Visualization Components."

6.5.5 How to Create a Combo Chart

A Combo Chart (`comboChart`) represents an overlay of two or more different charts, such as a line and bar chart.

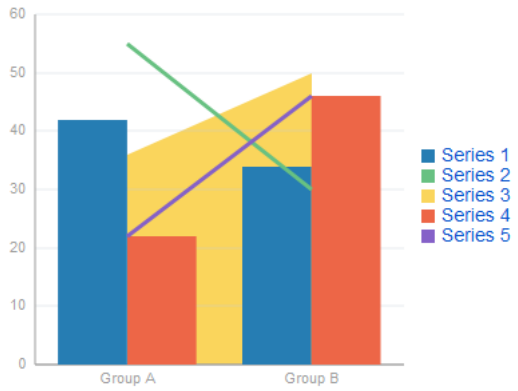
Example 6–74 shows the `comboChart` element defined in a MAF AMX file. The `dataStamp` facet is specified with a nested `chartDataItem` element. The `seriesStamp` facet overrides the default style properties for the series and sets custom series styles using the `seriesStyle` elements.

Example 6–74 Combo Chart Definition

```
<dvtm:comboChart id="comboChart1"
                 value="#{bindings.barData.collectionModel}"
                 var="row"
                 inlineStyle="width: 400px; height: 300px;"
                 animationOnDisplay="auto"
                 animationDuration="1500" >
   <amx:facet name="dataStamp">
      <dvtm:chartDataItem id="chartDataItem1"
```

```
                        series="#{row.series}"
                        group="#{row.group}"
                        value="#{row.value}" />
   </amx:facet>
   <amx:facet name="seriesStamp">
      <dvtm:seriesStyle id="seriesStyle1"
                        series="#{row.series}"
                        type="bar"
                        rendered="#{(row.series eq 'Series 1') or
                                    (row.series eq 'Series 2') or
                                    (row.series eq 'Series 3')}" />
      <dvtm:seriesStyle id="seriesStyle2"
                        series="#{row.series}"
                        type="line"
                        lineWidth="5"
                        rendered="#{(row.series eq 'Series 4') or
                                    (row.series eq 'Series 5')}" />
   </amx:facet>
   <dvtm:yAxis id="yAxis1"
               axisMaxValue="80.0"
               majorIncrement="20.0"
               title="yAxis Title" />
   <dvtm:legend position="start" id="l1" />
</dvtm:comboChart>
```

Figure 6–75 Combo Chart at Design Time



For information on attributes of the `comboChart` and `dvtm` child elements that you can define for this component, see *Oracle Fusion Middleware Tag Reference for Oracle Mobile Application Framework*.

You can define a `facet` child element from the `amx` namespace. The `facet` can have a `chartDataItem` as its child (see Section 6.5.17.1, "Defining Chart Data Item").

You can style the Combo Chart component's top-level element by overwriting the default CSS settings defined in the following class:

```
.dvtm-comboChart
   - supported properties: all
```

For more information on chart styling, see Section 6.5.11, "How to Style Chart Components."

For information on how to extend CSS files, see Section 6.6.3, "How to Style Data Visualization Components."

6.5.6 How to Create a Line Chart

You use the Line Chart (`lineChart`) to visually represent data where sets of data items are related and categorized into groups and series. The series are visualized using graphical elements with some common style properties (such as, for example, a line color, width, or style). Those properties have to be applied at the series level instead of per each individual data item. You have an option to use the default or custom series styles.

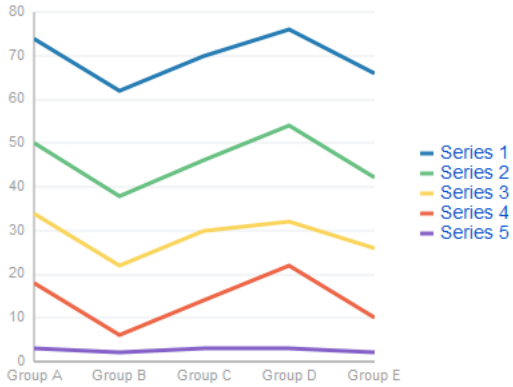
The Line Chart can be zoomed and scrolled along its X Axis. This is enabled through the use of the `zoomAndScroll` attribute.

Example 6–75 shows the `lineChart` element defined in a MAF AMX file. To create a basic line chart with default series style, you pass it a collection and specify the `dataStamp` facet with a nested `chartDataItem` element.

Example 6–75 Line Chart Definition with Default Series Styles

```
<dvtm:lineChart id="lineChart1"
                inlineStyle="width: 400px; height: 300px;"
                rolloverBehavior="dim"
                animationOnDisplay="auto"
                value="#{bindings.lineData1.collectionModel}"
                var="row" >
   <amx:facet name="dataStamp">
      <dvtm:chartDataItem id="chartDataItem1"
                          series="#{row.series}"
                          group="#{row.group}"
                          value="#{row.value}"
                          color="#{row.color}" />
   </amx:facet>
</dvtm:lineChart>
```

Figure 6–76 Line Chart at Design Time



Data items are initialized in the collection model and equipped with the stamping mechanism. At a minimum, each collection `row` must include the following properties:

- `series`: name of the series to which this line belongs;
- `group`: name of the group to which this line belongs;
- `value`: the data item value.

The collection `row` might also include other properties, such as `color` or `shape`, applicable to individual data items.

You can use attribute groups (`attributeGroups` element) to set style properties for a group of data items based on some grouping criteria, as Example 6–76 shows. In this case, the data item `color` and `shape` attributes are set based on the additional grouping expression. The `attributeGroups` can have the following child elements:

- `attributeExceptionRule` from the `dvtm` namespace: replaces an attribute value with another when a particular boolean condition is met.
- `attributeMatchRule` from the `dvtm` namespace: replaces an attribute when the data matches a certain value.
- `attribute` from the `amx` namespace.

Example 6–76 Line Chart Definition with Default Series Styles and Grouping

```
<dvtm:lineChart id="lineChart1"
                inlineStyle="width: 400px; height: 300px;"
                rolloverBehavior="dim"
                animationOnDisplay="auto"
                title="Line Chart"
                value="#{bindings.lineData1.collectionModel}"
                var="row" >
   <amx:facet name="dataStamp">
      <dvtm:chartDataItem id="chartDataItem1"
                          series="#{row.series}"
                          group="#{row.group}"
                          value="#{row.value}" />
         <dvtm:attributeGroups id="ag1"
                               type="color"
                               value="#{row.brand}" />
      </dvtm:chartDataItem>
   </amx:facet>
</dvtm:lineChart>
```

Note: In Example 6–75 and Example 6–76, since custom styles are not set at the series level, series are displayed with the colors based on the default color ramp.

To override the default style properties for the series, you can define an optional `seriesStamp` facet and set custom series styles using the `seriesStyle` elements, as Example 6–77 shows.

Example 6–77 Line Chart Definition with Custom Series Styles

```
<dvtm:lineChart id="lineChart1"
                inlineStyle="width: 400px; height: 300px;"
                rolloverBehavior="dim"
                animationOnDisplay="auto"
                title="Line Chart"
                value="#{bindings.lineData1.collectionModel}"
                var="row" >
   <amx:facet name="dataStamp">
      <dvtm:chartDataItem id="chartDataItem1"
                          series="#{row.series}"
                          group="#{row.group}"
                          value="#{row.value}" />
   </amx:facet>
   <amx:facet name="seriesStamp">
```

```
      <dvtm:seriesStyle series="#{row.series}"
                        lineStyle="#{row.lineStyle}"
                        lineWidth="#{row.lineWidth}" />
   </amx:facet>
</dvtm:lineChart>
```

In the preceding example, the `seriesStyle` elements are grouped based on the value of the `series` attribute. Series with the same name are supposed to share the same set of properties defined by other attributes of the `seriesStyle`, such as `color`, `lineStyle`, `lineWidth`, and so on. When MAF AMX encounters different attribute values for the same series name, it applies the value which was processed last.

Alternatively, you can control the series styles in a MAF AMX charts using the `rendered` attribute of the `seriesStyle` element, as Example 6–78 shows.

Example 6–78 Line Chart Definition with Filtered Series Styles

```
<dvtm:lineChart id="lineChart1"
                inlineStyle="width: 400px; height: 300px;"
                rolloverBehavior="dim"
                animationOnDisplay="auto"
                title="Line Chart"
                value="#{bindings.lineData1.collectionModel}"
                var="row" >
   <amx:facet name="dataStamp">
      <dvtm:chartDataItem id="chartDataItem1"
                          series="#{row.series}"
                          group="#{row.group}"
                          value="#{row.value}"
                          color="#{row.color}" />
   </amx:facet>
   <amx:facet name="seriesStamp">
      <dvtm:seriesStyle series="#{row.series}"
                        color="red"
                        lineWidth="3"
                        lineStyle="solid"
                        rendered="#{row.series == 'Coke'}" />
      <dvtm:seriesStyle series="#{row.series}"
                        color="blue"
                        lineWidth="2"
                        lineStyle="dotted"
                        rendered="#{row.series == 'Pepsi'}" />
   </amx:facet>
</dvtm:lineChart>
```

For information on attributes of the `lineChart` and dvtm child elements that you can define for this component, see *Oracle Fusion Middleware Tag Reference for Oracle Mobile Application Framework*.

You can define a `facet` child element from the `amx` namespace. The `facet` can have a `chartDataItem` as its child (see Section 6.5.17.1, "Defining Chart Data Item").

You can style the Line Chart component's top-level element by overwriting the default CSS settings defined in the following class:

```
.dvtm-lineChart
   - supported properties: all
```

For more information on chart styling, see Section 6.5.11, "How to Style Chart Components."

For information on how to extend CSS files, see Section 6.6.3, "How to Style Data Visualization Components."

6.5.7 How to Create a Pie Chart

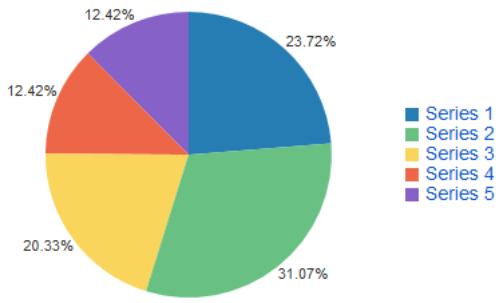
You use a Pie Chart (`pieChart`) to illustrate proportional division of data, with each data item represented by a pie segment (slice). Slices can be sorted by size (from largest to smallest), and small slices can be aggregated into a single "other" slice.

Example 6–79 shows the `pieChart` element defined in a MAF AMX file. The `dataStamp` facet is specified with a nested `pieDataItem` element.

Example 6–79 Pie Chart Definition

```
<dvtm:pieChart id="pieChart1"
               inlineStyle="width: 400px; height: 300px;"
               value="#{bindings.pieData.collectionModel}"
               var="row"
               animationOnDisplay="zoom"
               animationDuration="3000" >
   <amx:facet name="dataStamp">
      <dvtm:pieDataItem id="pieDataItem1"
                        label="#{row.name}"
                        value="#{row.data}" />
   </amx:facet>
   <dvtm:legend position="bottom" id="l1" />
</dvtm:pieChart>
```

Figure 6–77 Pie Chart at Design Time



The data model for a pie chart is represented by a collection of items that define individual pie data items. Typically, properties of each data item include the following:

- `label`: slice label;
- `value`: slice value.

The model might also define other properties of the data item, such as the following:

- `borderColor`: slice border color;
- `color`: slice color;
- `explode`: slice explosion offset.

For information on attributes of the `pieChart` and `dvtm` child elements that you can define for this component, see *Oracle Fusion Middleware Tag Reference for Oracle Mobile Application Framework*.

You can define a `facet` child element from the `amx` namespace. The `facet` can have a `pieDataItem` as its child (see Section 6.5.17.4, "Defining Pie Data Item").

You can style the Pie Chart component by overwriting the default CSS settings defined in `dvtm-pieChart` and `dvtm-chartPieLabel`, and `dvtm-chartSliceLabel` classes:

- The top-level element can be styled using

```
.dvtm-pieChart
   - supported properties: all
```

- The pie labels cal be styled using

```
.dvtm-chartPieLabel
   - supported properties:
               font-family, font-size, font-weight, color, font-style
```

- The pie slice labels can be styled using

```
.dvtm-chartSliceLabel
   - supported properties:
               font-family, font-size, font-weight, color, font-style
```

For more information on chart styling, see Section 6.5.11, "How to Style Chart Components."

For more information on how to extend CSS files, see Section 6.6.3, "How to Style Data Visualization Components."

6.5.8 How to Create a Scatter Chart

A Scatter Chart (`scatterChart`) displays data as unconnected dots that represent data items, where each item has `x`, `y` coordinates and size. In addition, each data item can have various style attributes, such as `color` and `markerShape`. You can either set properties of each data item individually, or categorize the data items into groups based on various criteria. You may use multiple grouping criteria at the same time, and may also use different style attributes to visualize the data items relationships. However, unlike line charts (see Section 6.5.6, "How to Create a Line Chart") or area charts (see Section 6.5.1, "How to Create an Area Chart"), scatter charts do not have a strict notion of the series and groups.

The Scatter Chart can be zoomed and scrolled along its X and Y Axis. This is enabled through the use of the `zoomAndScroll` attribute.

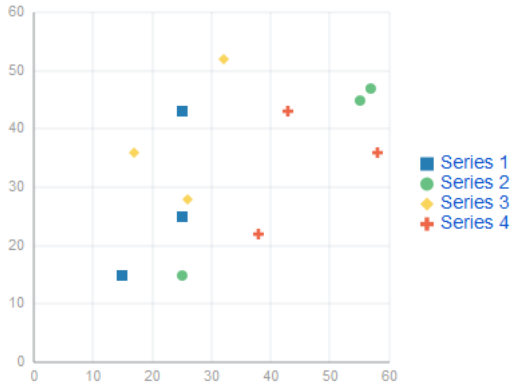
Example 6–80 shows the `scatterChart` element defined in a MAF AMX file. The `dataStamp` facet is specified with a nested `chartDataItem` element. The `color` and `markerShape` attributes of each data item are set individually based on the values supplied in the data model.

Example 6–80 Scatter Chart Definition

```
<dvtm:scatterChart id="scatterChart1"
                   inlineStyle="width: 400px; height: 300px;"
                   animationOnDisplay="zoom"
                   animationDuration="3000"
                   value="#{bindings.scatterData.collectionModel}"
                   var="row" >
   <amx:facet name="dataStamp">
      <dvtm:chartDataItem id="chartDataItem1"
                          group="#{row.group}"
                          color="#{row.color}"
```

```
                        markerShape="auto"
                        x="#{row.data.x}"
                        y="#{row.data.y}">
            <dvtm:attributeGroups type="color"
                                  value="#{row.series}"
                                  id="ag1" />
        </dvtm:chartDataItem>
    </amx:facet>
    <dvtm:xAxis id="xAxis1" title="X Axis Title" />
    <dvtm:yAxis id="xAxis2" title="Y Axis Title" />
    <dvtm:legend position="bottom" id="l1" />
</dvtm:scatterChart>
```

Figure 6–78 Scatter Chart at Design Time



The data model for a scatter chart is represented by a collection of items (rows) that describe individual data items. Attributes of each data item are defined by stamping (`dataStamp`) and usually include the following:

- `x`, `y`: value coordinates (required);
- `markerSize`: the size of the marker (optional).

The model might also define other properties of the data item, such as the following:

- `borderColor`: data item border color;
- `color`: data item color;
- `tooltip`: custom tooltip.

For information on attributes of the `scatterChart` and `dvtm` child elements that you can define for this component, see *Oracle Fusion Middleware Tag Reference for Oracle Mobile Application Framework*.

You can define a `facet` child element from the `amx` namespace. The `facet` can have a `chartDataItem` as its child (see Section 6.5.17.1, "Defining Chart Data Item").

You can style the Scatter Chart component's top-level element by overwriting the default CSS settings defined in the following class:

```
.dvtm-scatterChart
   - supported properties: all
```

For more information on chart styling, see Section 6.5.11, "How to Style Chart Components."

For information on how to extend CSS files, see Section 6.6.3, "How to Style Data Visualization Components."

6.5.9 How to Create a Spark Chart

A Spark Chart (`sparkChart`) is a simple, condensed chart that displays trends or variations, often in the column of a table. The charts are often used in a dashboard to provide additional context to a data-dense display.

Example 6–81 shows the `sparkChart` element defined in a MAF AMX file. The `dataStamp` facet is specified with a nested `sparkDataItem` element.

Example 6–81 Spark Chart Definition

```
<dvtm:sparkChart id="sparkChart1"
                 value="#{bindings.sparkData.collectionModel}"
                 var="row"
                 type="line"
                 inlineStyle="width:400px; height:300px; float:left;">
   <amx:facet name="dataStamp">
      <dvtm:sparkDataItem id="sparkDataItem1" value="#{row.value}" />
   </amx:facet>
</dvtm:sparkChart>
```

Figure 6–79 Spark Chart at Design Time

The data model for a spark chart is represented by a collection of items (rows) that describe individual spark data items. Typically, properties of each data item include the following:

- `value`: spark value.

For information on attributes and `dvtm` child elements of the `sparkChart`, see *Oracle Fusion Middleware Tag Reference for Oracle Mobile Application Framework*.

You can define a `facet` child element from the `amx` namespace. The `facet` can have a `sparkDataItem` as its child (see Section 6.5.17.5, "Defining Spark Data Item").

You can style the Spark Chart component's top-level element by overwriting the default CSS settings defined in the following class:

```
.dvtm-sparkChart
   - supported properties: all
```

For more information on chart styling, see Section 6.5.11, "How to Style Chart Components."

For information on how to extend CSS files, see Section 6.6.3, "How to Style Data Visualization Components."

6.5.10 How to Create a Funnel Chart

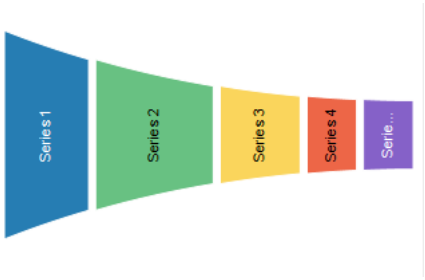
A Funnel Chart (`funnelChart`) component provides a visual representation of data related to steps in a process. The steps appear as vertical slices across a horizontal cylinder. As the actual value for a given step or slice approaches the quota for that slice, the slice fills. Typically, a Funnel Chart requires actual values and target values against a stage value, which might be time.

Example 6–82 shows the `funnelChart` element defined in a MAF AMX file. The `dataStamp` facet is specified with a nested `funnelDataItem` element.

Example 6–82 Funnel Chart Definition

```
<dvtm:funnelChart id="funnelChart1"
                  var="row"
                  value="#{bindings.funnelData.collectionModel}"
                  styleClass="dvtm-gallery-component"
                  sliceGaps="on"
                  threeDEffect="#{pageFlowScope.threeD ? 'on' : 'off'}"
                  orientation="#{pageFlowScope.orientation}"
                  dataSelection="#{pageFlowScope.dataSelection}"
                  footnote="#{pageFlowScope.footnote}"
                  footnoteHalign="#{pageFlowScope.footnoteHalign}"
                  hideAndShowBehavior="#{pageFlowScope.hideAndShowBehavior}"
                  rolloverBehavior="#{pageFlowScope.rolloverBehavior}"
                  seriesEffect="#{pageFlowScope.seriesEffect}"
                  subtitle="#{pageFlowScope.titleDisplay ?
                                          pageFlowScope.subtitle : ''}"
                  title="#{pageFlowScope.titleDisplay ? pageFlowScope.title : ''}"
                  titleHalign="#{pageFlowScope.titleHalign}"
                  animationOnDataChange="#{pageFlowScope.animationOnDataChange}"
                  animationDuration="#{pageFlowScope.animationDuration}"
                  animationOnDisplay="#{pageFlowScope.animationOnDisplay}"
                  shortDesc="#{pageFlowScope.shortDesc}">
   <amx:facet name="dataStamp">
      <dvtm:funnelDataItem id="funnelDataItem1"
                           label="#{row.label}"
                           value="#{row.value}"
                           targetValue="#{row.targetValue}"
                           color="#{row.color}"
                           shortDesc="This is a tooltip">
      </dvtm:funnelDataItem>
   </amx:facet>
   <dvtm:legend id="l1"
                position="#{pageFlowScope.legendPosition}"
                rendered="#{pageFlowScope.legendDisplay}"/>
</dvtm:funnelChart>
```

Figure 6–80 Funnel Chart at Design Time



The data model for a funnel chart is represented by a collection of items (rows) that describe individual funnel data items. Typically, properties of each data item include the following:

- `value`: funnel value
- `label`: funnel slice label

For information on attributes and `dvtm` child elements of the `funnelChart`, see *Oracle Fusion Middleware Tag Reference for Oracle Mobile Application Framework*.

You can define a `facet` child element from the `amx` namespace. The `facet` can have a `funnelDataItem` as its child (see Section 6.5.17.6, "Defining Funnel Data Item").

You can style the Funnel Chart component by overwriting the default CSS settings defined in `dvtm-funnelChart` and `dvtm-funnelDataItem` classes:

- The top-level element can be styled using

```
.dvtm-funnelChart
   - supported properties: all
```

- The Funnel Chart data items cal be styled using

```
.dvtm-funnelDataItem
   - supported properties: border-color, background-color
```

For more information on chart styling, see Section 6.5.11, "How to Style Chart Components."

For more information on how to extend CSS files, see Section 6.6.3, "How to Style Data Visualization Components."

6.5.11 How to Style Chart Components

With the exception of the Spark Chart, you can style chart components by overwriting the default CSS settings defined in the following classes:

- A chart component's legend can be styled using

```
.dvtm-legend
   - supported properties used for text styling:
               font-family, font-size, font-weight, color, font-style
   - supported properties used for background styling: background-color
   - supported properties used for border styling:
               border-color (used when border width > 0)

.dvtm-legendTitle
   - supported properties:
               font-family, font-size, font-weight, color, font-style
```

```
.dvtm-legendSectionTitle
   - supported properties:
               font-family, font-size, font-weight, color, font-style
```

- A chart component's title, subtitle, and so on, can be styled using

```
.dvtm-chartTitle
   - supported properties:
               font-family, font-size, font-weight, color, font-style

.dvtm-chartSubtitle
   - supported properties:
               font-family, font-size, font-weight, color, font-style

.dvtm-chartFootnote
   - supported properties:
               font-family, font-size, font-weight, color, font-style

.dvtm-chartTitleSeparator
   - supported properties:
               visibility (is title separator rendered),
               border-top-color, border-bottom-color
```

- A chart component's axes can be styled using

```
.dvtm-chartXAxisTitle
   - supported properties:
               font-family, font-size, font-weight, color, font-style

.dvtm-chartYAxisTitle
   - supported properties:
               font-family, font-size, font-weight, color, font-style

.dvtm-chartY2AxisTitle
   - supported properties:
               font-family, font-size, font-weight, color, font-style

.dvtm-chartXAxisTickLabel
   - supported properties:
               font-family, font-size, font-weight, color, font-style

.dvtm-chartYAxisTickLabel
   - supported properties:
               font-family, font-size, font-weight, color, font-style

.dvtm-chartY2AxisTickLabel
   - supported properties:
               font-family, font-size, font-weight, color, font-style
```

In addition to styling the chart component's top-level element, you can style specific child elements of some charts.

6.5.12 How to Use Events with Chart Components

You can use the `ViewportChangeEvent` to handle zooming and scrolling of chart components. When either zooming or scrolling occurs, the component fires an event loaded with information that defines the new viewport.

You can specify the `viewportChangeListener` as an attribute of Area Chart, Bar Chart, Horizontal Bar Chart, Combo Chart, and Line Chart components.

For more information, see the following:

- Section 6.10, "Using Event Listeners"
- *Oracle Fusion Middleware Java API Reference for Oracle Mobile Application Framework*
- *Oracle Fusion Middleware Tag Reference for Oracle Mobile Application Framework*

6.5.13 How to Create a LED Gauge

Unlike charts, gauges focus on a single data point and examine that point relative to minimum, maximum, and threshold indicators to identify problem areas. A LED (lighted electronic display) gauge (`ledGauge`) graphically depicts a measurement, such as key performance indicator (KPI). There are several styles of LED gauges. The ones with arrows are used to indicate good (up arrow), fair (left- or right-pointing arrow), or poor (down arrow). You can specify any number of thresholds for a gauge. However, some LED gauges (such as those with arrow or triangle indicators) support a limited number of thresholds because there is a limited number of meaningful directions for them to point. For arrow or triangle indicators, the threshold limit is three.

Example 6–83 shows the `ledGauge` element defined in a MAF AMX file.

Example 6–83 LED Gauge Definition

```
<dvtm:ledGauge id="ledGauge1"
               value="65"
               type="circle"
               inlineStyle="width: 100px; height: 80px; float: left;
                            border-color: navy; background-color: lightyellow;">
   <dvtm:threshold id="threshold1" text="Low" maxValue="40" />
   <dvtm:threshold id="threshold2" text="Medium" maxValue="60" />
   <dvtm:threshold id="threshold3" text="High" maxValue="80" />
</dvtm:ledGauge>
```

Figure 6–81 LED Gauge at Design Time

The data model for a LED gauge is represented by a single metric value which is specified by the `value` attribute.

For information on attributes of the `ledGauge` and `dvtm` child elements that you can define for this component, see *Oracle Fusion Middleware Tag Reference for Oracle Mobile Application Framework*.

You can define the following `amx` child elements:

- `showPopupBehavior` (see Section 6.2.8, "How to Use a Popup Component")
- `closePopupBehavior` (see Section 6.2.8, "How to Use a Popup Component")
- `validationBehavior` (see Section 6.9, "Validating Input")

6.5.14 How to Create a Status Meter Gauge

A Status Meter Gauge (`statusMeterGauge`) indicates the progress of a task or the level of some measurement along a horizontal rectangular bar or a circle. One part of the component shows the current level of a measurement against the ranges marked on

another part. In addition, thresholds can be displayed behind the indicator whose size can be changed.

MAF AMX data visualization provides support for the reference line (`referenceLine`) on its status meter gauge component. You can use this line to produce a bullet graph.

Example 6–84 shows the `statusMeterGauge` element defined in a MAF AMX file.

Example 6–84 Status Meter Gauge Definition

```
<dvtm:statusMeterGauge id="meterGauge1"
                       value="65"
                       animationOnDisplay="auto"
                       animationDuration="1000"
                       inlineStyle="width: 300px;
                                    height: 30px;
                                    float: left;
                                    border-color: black;
                                    background-color: lightyellow;"
                       minValue="0"
                       maxValue="100">
   <dvtm:metricLabel/>
   <dvtm:threshold id="threshold1" text="Low" maxValue="40" />
   <dvtm:threshold id="threshold2" text="Medium" maxValue="60" />
   <dvtm:threshold id="threshold3" text="High" maxValue="80" />
</dvtm:statusMeterGauge>
```

Figure 6–82 Rectangular Status Meter Gauge at Design Time

To create a Status Meter Gauge represented by a circle (see Figure 6–83), you set its `orientation` attribute to `circular`. By default, this attribute is set to `horizontal` resulting in a horizontal rectangle.

Figure 6–83 Circular Status Meter Gauge at Design Time

The data model for a status meter gauge is a single metric value which is specified by the `value` attribute. In addition, the minimum and maximum values can also be specified by the `minValue` and `maxValue` attributes.

For information on attributes of the `statusMeterGauge` and `dvtm` child elements that you can define for this component, see *Oracle Fusion Middleware Tag Reference for Oracle Mobile Application Framework*.

You can define the following `amx` child elements:

- `showPopupBehavior` (see Section 6.2.8, "How to Use a Popup Component")
- `closePopupBehavior` (see Section 6.2.8, "How to Use a Popup Component")
- `validationBehavior` (see Section 6.9, "Validating Input")

6.5.15 How to Create a Dial Gauge

A Dial Gauge (`dialGauge`) specifies ranges of values (thresholds) that vary from poor to excellent. The gauge indicator specifies the current value of the metric while the graphic allows for evaluation of the status of that value.

Example 6–84 shows the `dialGauge` element defined in a MAF AMX file.

Example 6–85 Dial Gauge Definition

```
<dvtm:dialGauge id="dialGauge1"
                background="#{pageFlowScope.background}"
                indicator="#{pageFlowScope.indicator}"
                value="#{pageFlowScope.value}"
                minValue="#{pageFlowScope.minValue}"
                maxValue="#{pageFlowScope.maxValue}"
                animationDuration="1000"
                animationOnDataChange="auto"
                animationOnDisplay="auto"
                shortDesc="#{pageFlowScope.shortDesc}"
                inlineStyle="#{pageFlowScope.inlineStyle}"
                styleClass="#{pageFlowScope.styleClass}"
                readOnly="true">
</dvtm:dialGauge>
```

Figure 6–84 Dial Gauge at Design Time

The data model for a dial gauge is a single metric value which is specified by the `value` attribute. In addition, the minimum and maximum values can be specified by the `minValue` and `maxValue` attributes.

For information on attributes of the `dialGauge` and `dvtm` child elements that you can define for this component, see *Oracle Fusion Middleware Tag Reference for Oracle Mobile Application Framework*.

Example 6–86 shows the definition of `dialGauge` element with the dark background theme and custom tick labels setting a range from -5000 to 5000.

Example 6–86 Defining Metric and Tick Labels

```
<dvtm:dialGauge id="dialGauge1"
                background="circleDark"
                indicator="needleDark"
                value="#{pageFlowScope.value}"
                minValue="-5000"
                maxValue="5000"
                readOnly="false">
   <dvtm:metricLabel id="metricLabel1"
                     scaling="thousand"
                     labelStyle="font-family: Arial, Helvetica;
                                 font-size: 20; color: white;"/>
   <dvtm:tickLabel id="tickLabel1"
                   scaling="thousand"
                   labelStyle="font-family: Arial, Helvetica;
```

```
                                    font-size: 18; color: white;"/>
</dvtm:dialGauge>
```

Figure 6–85 Dial Gauge with Metric and Tick Labels at Design Time

You can define the following `amx` child elements for the `dialGauge`:

- `showPopupBehavior` (see Section 6.2.8, "How to Use a Popup Component")
- `closePopupBehavior` (see Section 6.2.8, "How to Use a Popup Component")
- `validationBehavior` (see Section 6.9, "Validating Input")

6.5.16 How to Create a Rating Gauge

A Rating Gauge (`ratingGauge`) provides means to view and modify ratings on a predefined visual scale. By default, a rating unit is represented by a star. You can configure it as a circle, rectangle, star, or diamond by setting the `shape` attribute of the ratingGauge.

Example 6–87 shows the `ratingGauge` element defined in a MAF AMX file.

Example 6–87 Rating Gauge Definition

```
<dvtm:ratingGauge id="ratingGauge1"
                  value="#{pageFlowScope.value}"
                  minValue="0"
                  maxValue="5"
                  inputIncrement="full"
                  shortDesc="#{pageFlowScope.shortDesc}"
                  inlineStyle="#{pageFlowScope.inlineStyle}"
                  readOnly="true"
                  shape="circle"
                  unselectedShape="circle">
</dvtm:ratingGauge>
```

Figure 6–86 Rating Gauge at Design Time

The data model for a rating gauge is a single metric value which is specified by the `value` attribute. In addition, the minimum and maximum values can be specified by the `minValue` and `maxValue` attributes.

For information on attributes of the `ratingGauge` and `dvtm` child elements that you can define for this component, see *Oracle Fusion Middleware Tag Reference for Oracle Mobile Application Framework*.

You can define the following amx child elements for the ratingGauge:

- showPopupBehavior (see Section 6.2.8, "How to Use a Popup Component")
- closePopupBehavior (see Section 6.2.8, "How to Use a Popup Component")
- validationBehavior (see Section 6.9, "Validating Input")

6.5.16.1 Applying Custom Styling to the Rating Gauge Component

Depending on the action performed by the user on a rating gauge component, its units (images) can acquire one of the following states:

- selected: the unit is selected.
- unselected: the unit is not selected.
- hover: the unit is being hovered over.

> **Note:** On mobile devices with touch interface, the hover state is invoked through the tap-and-hold gesture.

- changed: the unit has been changed.

Each state can be represented by two attributes: color and borderColor. By default, the shape attribute of the ratingGauge determines the selection of the hover and changed states. The unselected state can be set separately using the unselectedShape attribute of the ratingGauge.

You can style the Rating Gauge component by overwriting the default CSS settings. For more information on how to extend CSS files, see Section 6.6.3, "How to Style Data Visualization Components."

Example 6–88 shows the default CSS style definitions for the color and borderColor of each state of the rating gauge unit.

Example 6–88 CSS Styling

```
.dvtm-ratingGauge {
}

.dvtm-ratingGauge .dvtm-ratingGaugeSelected {
   border-width: 1px;
   border-style: solid;
   border-color: #FFC61A;
   color: #FFBB00;
}

.dvtm-ratingGauge .dvtm-ratingGaugeUnselected {
   border-width: 1px;
   border-style: solid;
   border-color: #D3D3D3;
   color: #F4F4F4;
}

.dvtm-ratingGauge .dvtm-ratingGaugeHover {
   border-width: 1px;
   border-style: solid;
   border-color: #6F97CF;
   color: #7097CF;
}
```

```
.dvtm-ratingGauge .dvtm-ratingGaugeChanged {
   border-width: 1px;
   border-style: solid;
   border-color: #A8A8A8;
   color: #FFBB00;
}
```

6.5.17 How to Define Child Elements for Chart and Gauge Components

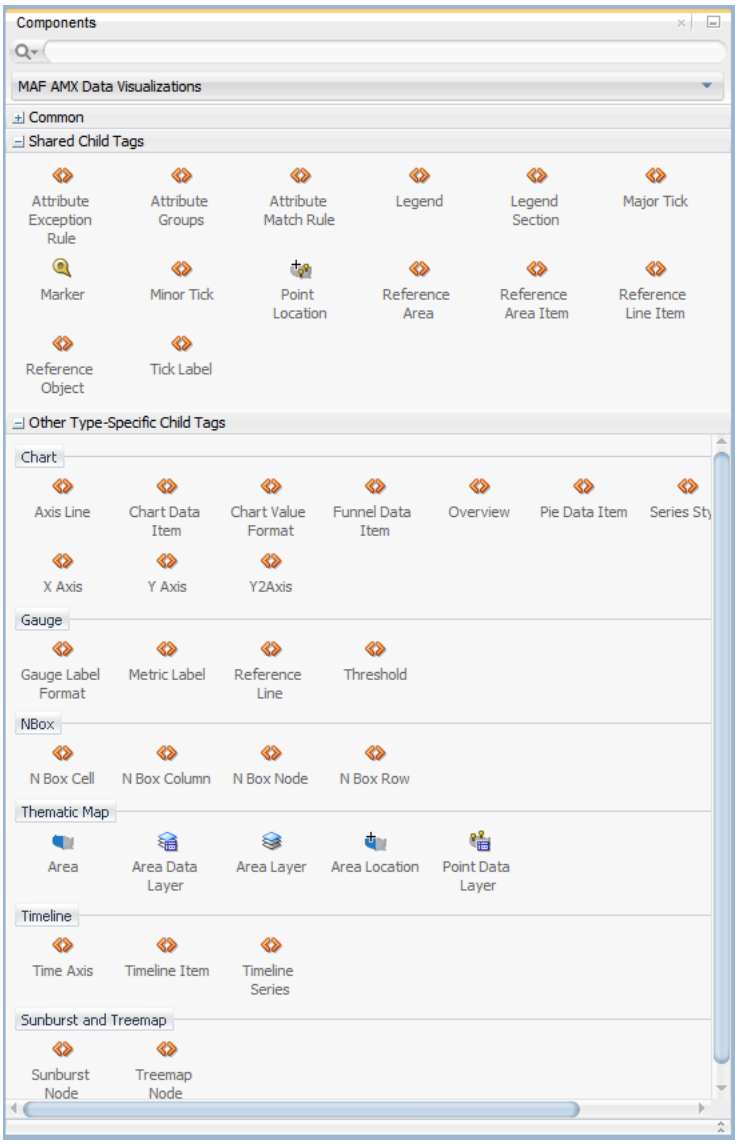
You can define a variety of child elements for charts and gauges. The following are some of these child elements:

- `chartDataItem` (see Section 6.5.17.1, "Defining Chart Data Item")
- `xAxis`, `yAxis`, and `y2Axis` (see Section 6.5.17.3, "Defining X Axis, YAxis, and Y2Axis")
- `legend` (see Section 6.5.17.2, "Defining Legend")
- `pieDataItem` (see Section 6.5.17.4, "Defining Pie Data Item")
- `sparkDataItem` (see Section 6.5.17.5, "Defining Spark Data Item")
- `threshold` (see Section 6.5.17.7, "Defining Threshold")
- `funnelDataItem`

For more information on these and other child elements, see *Oracle Fusion Middleware Tag Reference for Oracle Mobile Application Framework*.

In JDeveloper, child components of data visualization components are located under **MAF AMX Data Visualization > Shared Child Tags** and MAF AMX Data Visualization > Other Type-Specific Child Tags in the Components window (see Figure 6–66).

Figure 6–87 Creating Chart and Gauge Child Components



6.5.17.1 Defining Chart Data Item

The Chart Data Item (`chartDataItem`) element specifies the parameters that chart data items use in all supported charts, except the pie chart.

You can enable the text display on Chart Data Items and control its label, the label position, and the label style by setting relevant attributes of the `chartDataItem` element, as well as the `dataLabelPosition` attribute of the chart itself to specify the position of all data labels in a given chart.

> **Note:** The Spark Chart, Pie Chart, and Funnel Chart components do not support the `dataLabelPosition` attribute.

For information on attributes of the `chartDataItem` element, see *Oracle Fusion Middleware Tag Reference for Oracle Mobile Application Framework*.

6.5.17.2 Defining Legend

The Legend (`legend`) element specifies the legend parameters.

For information on attributes of the `legend` element, see *Oracle Fusion Middleware Tag Reference for Oracle Mobile Application Framework*.

6.5.17.3 Defining X Axis, YAxis, and Y2Axis

X Axis (`xAxis`) and Y Axis (`yAxis`) elements define the X and Y axis for a chart. Y2Axis (`y2Axis`) defines an optional Y2 axis. These elements are declared as follows in a MAF AMX file:

```
<dvtm:xAxis id="xAxis1" scrolling="on" axisMinValue="0.0" axisMaxValue="50.0" />
```

For information on attributes and child elements of `xAxis`, `yAxis`, and `y2Axis` elements, see *Oracle Fusion Middleware Tag Reference for Oracle Mobile Application Framework*.

6.5.17.4 Defining Pie Data Item

The Pie Data Item (`pieDataItem`) element specifies the parameters of the pie chart slices (see Section 6.5.7, "How to Create a Pie Chart").

For information on attributes of the `pieDataItem` element, see *Oracle Fusion Middleware Tag Reference for Oracle Mobile Application Framework*.

6.5.17.5 Defining Spark Data Item

The Spark Data Item (`sparkDataItem`) element specifies the parameters of the spark chart items (see Section 6.5.9, "How to Create a Spark Chart").

For information on attributes of the `sparkDataItem` element, see *Oracle Fusion Middleware Tag Reference for Oracle Mobile Application Framework*.

6.5.17.6 Defining Funnel Data Item

The Funnel Data Item (`funnelDataItem`) element specifies the parameters of the funnel chart items (see Section 6.5.10, "How to Create a Funnel Chart").

For information on attributes of the `funnelDataItem` element, see *Oracle Fusion Middleware Tag Reference for Oracle Mobile Application Framework*.

6.5.17.7 Defining Threshold

The Threshold (`threshold`) element specifies the threshold ranges of a gauge (see Section 6.5.13, "How to Create a LED Gauge" and Section 6.5.14, "How to Create a Status Meter Gauge").

For information on attributes of the `threshold` element, see *Oracle Fusion Middleware Tag Reference for Oracle Mobile Application Framework*.

6.5.18 How to Create a Geographic Map Component

A Geographic Map (`geographicMap`) represents business data in one or more interactive layers of information superimposed on a single map. You can configure this component to use either Google or Oracle maps as the underlying map provider (see Section 6.5.18.1, "Configuring Geographic Map Components With the Map Provider Information").

Example 6–89 shows the `geographicMap` element defined in a MAF AMX file.

Example 6–89 Geographic Map Definition

```
<dvtm:geographicMap id="g1" mapType="ROADMAP"
                    centerX="-98.57" centerY="39.82"
                    zoomLevel="2" initialZooming="auto">
   <dvtm:pointDataLayer id="pdl1"
                        var="row"
                        value="#{bindings.locationData.collectionModel}"
                        dataSelection="multiple"
                        selectionListener="#{myBean.doSomeGood}">
      <dvtm:pointLocation id="pl1" type="address" address="#{row.address}">
         <dvtm:marker shortDesc="#{row.shortDesc}" id="m1" />
      </dvtm:pointLocation>
   </dvtm:pointDataLayer>
</dvtm:geographicMap>
```

Figure 6–88 Geographic Map at Design Time

You can define a `pointDataLayer` child element for the `geographicMap`. The `pointDataLayer` allows you to display data associated with a point on the map.The `pointDataLayer` can have a `pointLocation` as a child element. The `pointLocation` specifies the columns in the data layer's model that determine the location of the data points. These locations can be represented either by address or by X and Y coordinates.

The `pointLocation` can have a `marker` as a child element. The `marker` is used to stamp out predefined or custom shapes associated with data points on the map. The `marker` supports a set of properties for specifying a URI to an image that is to be rendered as a marker. The marker can have a `convertNumber` as its child element (see Section 6.3.25, "How to Convert Numerical Values").

For information on attributes of the `geographicMap` element and its child elements, see *Oracle Fusion Middleware Tag Reference for Oracle Mobile Application Framework*.

The Geographic Map component allows for insertion of a pin (creation of a point on the map) using a touch gesture. You can configure this functionality by using the `mapInputListener`. For more information, see Section 6.5.20, "How to Use Events with Map Components."

6.5.18.1 Configuring Geographic Map Components With the Map Provider Information

To configure a Geographic Map component to use a specific provider for the underlying map (Google or Oracle), you can set the following properties as name-value pairs in the application's `adf-config.xml` file:

- `mapProvider`: specify either `oraclemaps` or `googlemaps`.
- `geoMapKey`: specify the license key if the `mapProvider` is set to `googlemaps`.
- `geoMapClientId`: if the `mapProvider` is set to `googlemaps`, specify the client ID for Google maps business license.
- `mapViewerUrl`: if the `mapProvider` is set to `oraclemaps`, specify the map viewer URL for Oracle maps.
- `baseMap`: if the `mapProvider` is set to `oraclemaps`, specify the base map to use with Oracle maps.

> **Note:** To configure the Geographic Map component to use Google maps, you must obtain an appropriate license from Google.

Example 6–90 shows the configuration for Google maps.

Example 6–90 Google Maps Configuration

```
<adf-properties-child xmlns="http://xmlns.oracle.com/adf/config/properties">
   <adf-property name="mapProvider" value="googlemaps"/>
   <adf-property name="geoMapKey" value="your key"/>
</adf-properties-child>
```

Example 6–91 shows the configuration for Oracle maps.

Example 6–91 Oracle Maps Configuration

```
<adf-properties-child xmlns="http://xmlns.oracle.com/adf/config/properties">
   <adf-property name="mapProvider" value="oraclemaps"/>
   <adf-property name="mapViewerUrl"
                 value="http://elocation.oracle.com/mapviewer"/>
   <adf-property name="baseMap" value="ELOCATION_MERCATOR.WORLD_MAP"/>
</adf-properties-child>
```

If you do not specify the map provider information, the MAF AMX Geographic Map component uses Google maps for its map, but without the license key.

For information on the `adf-config.xml` file, see the following:

- Section 3.2.2.1, "About the Application Controller Project-Level Resources"
- Table 3–1, " Mobile Application-Level Artifacts Accessed Through Application Resources"

6.5.19 How to Create a Thematic Map Component

A Thematic Map (`thematicMap`) represents business data as patterns in stylized areas or associated markers. Thematic maps focus on data without the geographic details.

Example 6–92 shows the `thematicMap` element and its children defined in a MAF AMX file.

Example 6–92 Defining Thematic Map

```
<dvtm:thematicMap id="tm1"
                  animationOnDisplay="#{pageFlowScope.animationOnDisplay}"
                  animationOnMapChange="#{pageFlowScope.animationOnMapChange}"
                  animationDuration="#{pageFlowScope.animationDuration}"
                  basemap="#{pageFlowScope.basemap}"
```

```
                        tooltipDisplay="#{pageFlowScope.tooltipDisplay}"
                  inlineStyle="#{pageFlowScope.inlineStyle}"
                  zooming="#{pageFlowScope.zooming}"
                  panning="#{pageFlowScope.panning}"
                  initialZooming="#{pageFlowScope.initialZooming}">
   <dvtm:areaLayer id="areaLayer1"
                   layer="#{pageFlowScope.layer}"
                   animationOnLayerChange=
                      "#{pageFlowScope.animationOnLayerChange}"
                   areaLabelDisplay="#{pageFlowScope.areaLabelDisplay}"
                   labelType="#{pageFlowScope.labelType}"
                   areaStyle="background-color"
                   rendered="#{pageFlowScope.rendered}">
      <dvtm:areaDataLayer id="areaDataLayer1"
                          animationOnDataChange=
                             "#{pageFlowScope.dataAnimationOnDataChange}"
                          animationDuration=
                             "#{pageFlowScope.dataAnimationDuration}"
                          dataSelection="#{pageFlowScope.dataSelection}"
                          var="row"
                          value="#{bindings.thematicMapData.collectionModel}">
         <dvtm:areaLocation id="areaLoc1" name="#{row.name}">
            <dvtm:area action="sales" id="area1" shortDesc="#{row.name}">
               <amx:setPropertyListener id="spl1"
                                        to=
                   "#{DvtProperties.areaChartProperties.dataSelection}"
                                        from="#{row.name}"
                                        type="action"/>
               <dvtm:attributeGroups id="ag1" type="color" value="#{row.cat1}" />
            </dvtm:area>
         </dvtm:areaLocation>
      </dvtm:areaDataLayer>
   </dvtm:areaLayer>
   <dvtm:legend id="l1" position="end">
      <dvtm:legendSection id="ls1" source="ag1"/>
   </dvtm:legend>
</dvtm:thematicMap>
```

Figure 6–89 Thematic Map at Design Time

Using the `markerZoomBehavior` attribute, you can enable scaling of the Thematic Map's markers when the map experiences zooming. You can enable the Marker rotation by setting its `rotation` attribute, whose value represents the angle at which the marker rotates in clockwise degrees around the center of the image.

MAF AMX Thematic Map supports the following advanced functionality:

- Custom markers (see Section 6.5.19.1, "Defining Custom Markers")
- Area isolation (see Section 6.5.19.3, "Defining Isolated Areas")

- Initial zooming (see Section 6.5.19.4, "Enabling Initial Zooming"
- Custom base maps (see Section 6.5.19.5, "Defining a Custom Base Map"

For information on attributes of the `thematicMap` element and its child elements, see *Oracle Fusion Middleware Tag Reference for Oracle Mobile Application Framework*.

6.5.19.1 Defining Custom Markers

MAF AMX Thematic Map does not support MAF AMX Image component. To use an image in the map's `pointLocation`, you can specify an image within the `pointLocation`'s `marker` child element by using its `source` attribute. If the `source` attribute is set on the Marker, its `shape` attribute is ignored by MAF AMX.

The `sourceHover`, `sourceSelected`, and `sourceHoverSelected` attributes allow you to specify images for hover and selection effects. If one of these is not specified, the image specified by the `source` attribute is used for that particular marker state. If `sourceSelected` is specified, then its value is used if `sourceHoverSelected` is not specified. The image can be of any format supported by the mobile device's browser, including PNG, JPG, SVG, and so on.

6.5.19.2 Defining Isolated Area Layers

A region outline is not always needed to convey the geographic location of data. Instead, since the Thematic Map component has the option of centering an image or marker within an area, you have the option of defining invisible area layers where region outlines are not drawn.

To define an invisible area layer, you use the `areaStyle` attribute of the `areaLayer` which accepts the CSS values of `background-color` and `border-color` as follows:

```
<dvtm:areaLayer id="areaLayer1"
                ...
                areaStyle="background-color:transparent;border-color:transparent">
```

This attribute allows you to override the default area layer color and border treatments without using the `dvtm-area` skinning key.

6.5.19.3 Defining Isolated Areas

You can configure the MAF AMX Thematic Map component to render and zoom to fit on a single isolated area of the map by using the `isolatedRowKey` attribute of the `areaDataLayer`, in which case the rest of the areas in the area or area data layers is not rendered.

Note: You can isolate only one area on a map.

6.5.19.4 Enabling Initial Zooming

The initial zooming allows the map component to be rendered as usual, and then zoom to fit on the data objects which includes both markers and areas. To enable this functionality, you use the `initialZooming` attribute of the Thematic Map.

6.5.19.5 Defining a Custom Base Map

As part of the custom base map support, MAF AMX allows you to specify the following for the Thematic Map component:

- Layers with images for different resolutions.

- Point layers with named points that can be referenced from the Point Location (`pointLocation`).
- The Thematic Map's `source` attribute that points to the custom base map metadata XML file.

> **Note:** MAF AMX does not support the following for custom base maps:
>
> - Stylized areas: since area layers cannot be defined for custom base maps, use point layers.
> - Resource bundles: if you want to add locale-specific tool tips, you can use EL in the `shortDesc` attribute of the Marker (`marker`).

To create a custom base map, you specify an area layer which points to a definition in the metadata file (see Example 6–93). To define a basic custom base map, you specify a background layer and a pointer data layer. In the metadata file, you can specify different images for different screen resolutions and display directions, similar to MAF AMX gauge components. Just like a gauge-type component, the Thematic Map chooses the correct image for the layer based on the screen resolution and direction. The display direction is left-to-right.

Example 6–93 Metadata File With List of Images

```
<basemap id="car" >
   <layer id="exterior" >
      <image source="/maps/car-800x800.png"
             width="2560"
             height="1920" />
      <image source="/maps/car-200x200.png"
             width="640"
             height="480" />
   </layer>
</basemap>
```

Example 6–94 shows a MAF AMX file that declares a custom area layer with points. The MAF AMX file points to the metadata file shown in Example 6–93 containing a list of possible images.

Example 6–94 Declaring Custom Area Layer With Points

```
<dvtm:thematicMap id="tm1" basemap="car" source="customBasemaps/map1.xml" >
   <dvtm:areaLayer id="al1" layer="exterior" >
      <dvtm:pointDataLayer id="pdl1"
                           var="row"
                           value="{bindings.thematicMapData.collectionModel}" >
         <dvtm:pointLocation id="pl1"
                             type="pointXY"
                             pointX="#{row.x}"
                             pointY="#{row.y}" >
            <dvtm:marker id="m1" fillColor="#FFFFFF" shape="circle" />
         </dvtm:pointLocation>
      </dvtm:pointDataLayer>
   </dvtm:areaLayer>
</dvtm:thematicMap>
```

In the preceding example, the base map ID is matched with the `basemap` attribute of the `thematicMap`, and the layer ID is matched with the `layer` attribute of the `areaLayer`. The points are defined through the X and Y coordinates (just like for a predefined base map) to accommodate dynamic points that can change at the time the data are updated.

Example 6–95 shows an alternative way to declare a custom area layer with points. In this example, the `pointDataLayer` is a direct child of the `thematicMap`. Despite this variation, Example 6–95 renders the same result as the declaration demonstrated in Example 6–94.

Example 6–95 Declaring Custom Area Layer With Points Using Direct Child Element

```
<dvtm:thematicMap id="demo1" basemap="car" source="customBasemaps/map1.xml" >
   <dvtm:areaLayer id="al1" layer="exterior" />
   <dvtm:pointDataLayer id="pdl1"
                        var="row"
                        value="{bindings.thematicMapData.collectionModel}" >
      <dvtm:pointLocation id="pl1"
                          type="pointXY"
                          pointX="#{row.x}"
                          pointY="#{row.y}" >
         <dvtm:marker id="m1" fillColor="#FFFFFF" shape="circle" />
      </dvtm:pointLocation>
   </dvtm:pointDataLayer>
</dvtm:thematicMap>
```

To create a custom base map with static points, you specify the points by name in the metadata file shown in Example 6–96. This process is similar to adding city markers for a predefined base map.

Example 6–96 Metadata File With List of Named Points

```
<basemap id="car" >
   <layer id="exterior" >
      <image source="/maps/car-800x800.png"
             width="2560"
             height="1920" />
      <image source="/maps/car-800x800-rtl.png"
             width="2560"
             height="1920"
             dir="rtl" />
      <image source="/maps/car-200x200.png"
             width="640"
             height="480" />
      <image source="/maps/car-200x200-rtl.png"
             width="640"
             height="480"
             dir="rtl" />
   </layer>
   <points >
      <point name="hood" x="219.911" y="329.663" />
      <point name="frontLeftTire" x="32.975" y="32.456" />
      <point name="frontRightTire" x="10.334" y="97.982" />
   </points>
</basemap>
```

The X and Y positions of the named points are assumed to be mapped to the image dimensions of the first `image` element in the `layer`.

Note: Since the points are global in scope within the base map and apply to all layers, you cannot define points for a specific layer and its images.

Example 6–97 shows a MAF AMX file that declares a custom area layer with named points. The MAF AMX file refers to the metadata file shown in Example 6–93 containing a list of points and their names.

Example 6–97 Declaring Custom Area Layer With Named Points

```
<dvtm:thematicMap id="demo1" basemap="car" source="customBasemaps/map1.xml" >
   <dvtm:areaLayer id="al1" layer="exterior" />
   <dvtm:pointDataLayer id="pdl1"
                        var="row"
                        value="#{bindings.thematicMapData.collectionModel}" >
      <dvtm:pointLocation id="pl1" type="pointName" pointName="#{row.name}" >
         <dvtm:marker id="m1" fillColor="#FFFFFF" shape="circle" />
      </dvtm:pointLocation>
   </dvtm:pointDataLayer>
</dvtm:thematicMap>
```

6.5.19.6 What You May Need to Know About the Marker Support for Event Listeners

MAF AMX data visualization does not support the `actionListener` attribute for the `marker`. Instead, the same functionality can be achieved by using the `action` attribute.

6.5.19.7 Applying Custom Styling to the Thematic Map Component

You can style the Thematic Map component by overwriting the default CSS settings or using a custom JavaScript file. For more information on how to extend these files, see Section 6.6.3, "How to Style Data Visualization Components."

Example 6–98 shows the default CSS styles for the Thematic Map component.

Example 6–98 CSS Styling

```
.dvtm-thematicMap {
   background-color: #FFFFFF;
   -webkit-user-select: none;
   -webkit-touch-callout: none;
   -webkit-tap-highlight-color: rgba(0,0,0,0);
}

.dvtm-areaLayer {
   background-color: #B8CDEC;
   border-color: #FFFFFF;
   border-width: 0.5px;
   /* border style and color must be set when setting border width */
   border-style: solid;
   color: #000000;
   font-family: tahoma, sans-serif;
   font-size: 13px;
   font-weight: bold;
   font-style: normal;
}

.dvtm-area {
```

```
   border-color: #FFFFFF;
   border-width: 0.5px;
   /* border style and color must be set when setting border width */
   border-style: solid;
}

.dvtm-marker {
   background-color: #61719F;
   opacity: 0.7;
   color: #FFFFFF;
   font-family: tahoma, sans-serif;
   font-size: 13px;
   font-weight: bold;
   font-style: normal;
   border-style: solid
   border-color: #FFCC33
   border-width: 12px
}
```

Some of the style settings cannot be specified using CSS. Instead, you must define them using a custom JavaScript file. Example 6–99 shows how to apply custom styling to the Thematic Map component without using CSS.

Example 6–99 Non-CSS Custom Styling

my-custom.js:

```
   CustomThematicMapStyle = {
      // selected area properties
      'areaSelected': {
         // selected area border color
         'borderColor': "#000000",
         // selected area border width
         'borderWidth': '1.5px'
      },

      // area properties on mouse hover
      'areaHover': {
         // area border color on hover
         'borderColor': "#FFFFFF",
         // area border width on hover
         'borderWidth': '2.0px'
      },

      // marker properties
      'marker': {
         // separator upper color
         'scaleX': 1.0,
         // separator lower color
         'scaleY': 1.0,
         // should display title separator
         'type': 'circle'
      },

      // thematic map legend properties
      'legend': {
         // legend position, such as none, auto, start, end, top, bottom
         'position': "auto"
      }
   };
```

```
})();
```

Note that you cannot change the name and the property names of the `CustomThematicMapStyle` object. Instead, you can modify specific property values to suit the needs of your application. For information on how to add custom CSS and JavaScript files to your application, see Section 4.10, "Defining the Content Types for an Application Feature."

When the `attributeGroups` attribute is defined for the Thematic Map component, you can use the `CustomThematicMapStyle` to define a default set of shapes and colors for that component. In this case, the CustomThematicMapStyle object must have the structure that Example 6–100 shows, where `styleDefaults` is a nested object containing the following fields:

- `colors`: represents a set of colors to be used for areas and markers.
- `shapes`: represents a set of shapes to be used for markers.

Example 6–100 Defining Default Custom Shapes and Colors for Thematic Map

```
window['CustomThematicMapStyle'] =
{
   // custom style values
   'styleDefaults': {
      // custom color palette
      'colors': ["#000000", "#ffffff"],
      // custom marker shapes
      'shapes' : ['circle', 'square']
   }
};
```

6.5.20 How to Use Events with Map Components

You can use the `MapBoundsChangeEvent` to handle the following map view property changes in the Geographic Map component:

- Changes to the zoom level.
- Changes to the map bounds.
- Changes to the map center.

When these changes occur, the component fires an event loaded with new map view property values.

You can define the `mapBoundsChangeListener` as an attribute of the Geographic Map.

You can use the `MapInputEvent` to handle the end user actions, such as taps and mouse clicks, in the Geographic and Thematic Map components. When these actions occur, the component fires an event loaded with the information on the latitude and longitude for the map, as well as the type of the action (for example, mouse down, mouse up, click, and so on).

You can define the `mapInputListener` as an attribute of the Geographic Map component.

For more information, see the following:

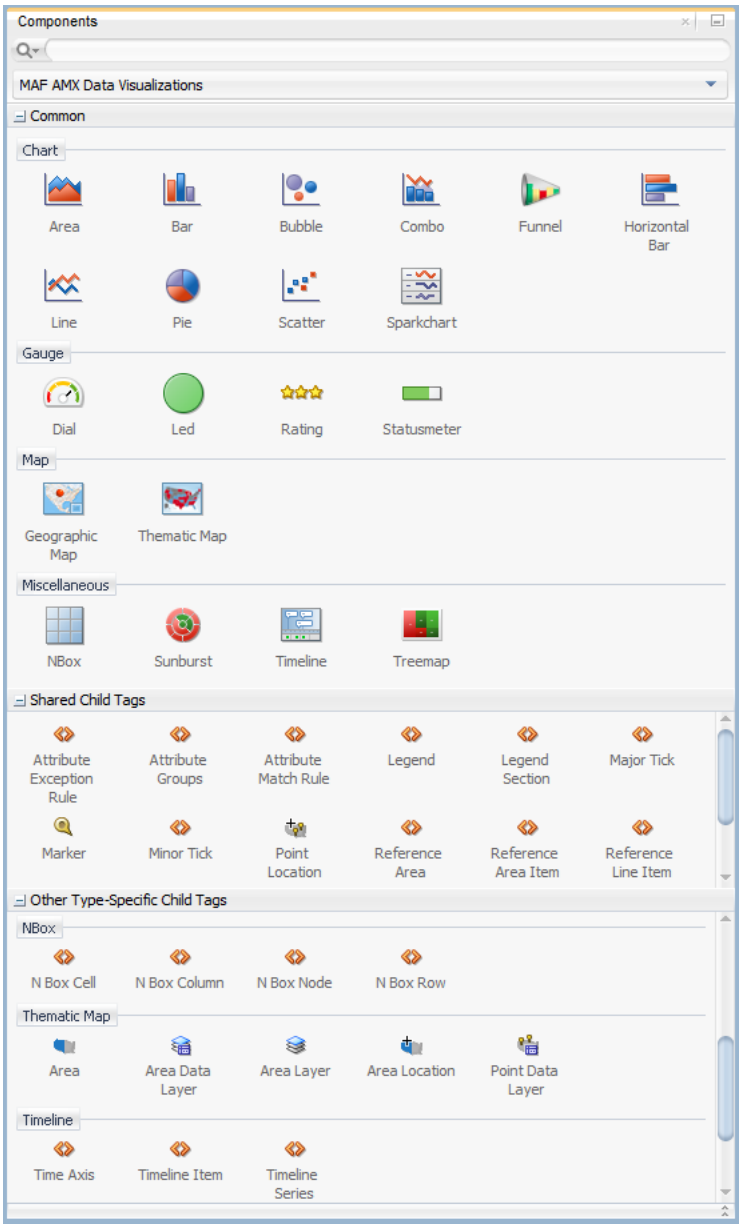
- Section 6.10, "Using Event Listeners"
- *Oracle Fusion Middleware Java API Reference for Oracle Mobile Application Framework*
- *Oracle Fusion Middleware Tag Reference for Oracle Mobile Application Framework*

6.5.21 How to Create a Treemap Component

A Treemap (`treemap`) displays hierarchical data across two dimensions represented by the size and color of its nodes (`treemapNode`).

In the Components window, the Treemap is located under **MAF AMX Data Visualizations > Common > Miscellaneous**, and its child components are located under **MAF AMX Data Visualizations > Other Type-Specific Child Tags > Sunburst and Treemap** and **MAF AMX Data Visualizations > Shared Child Tags** (see Figure 6–90).

Figure 6–90 Treemap and Other Advanced Components in Components Window

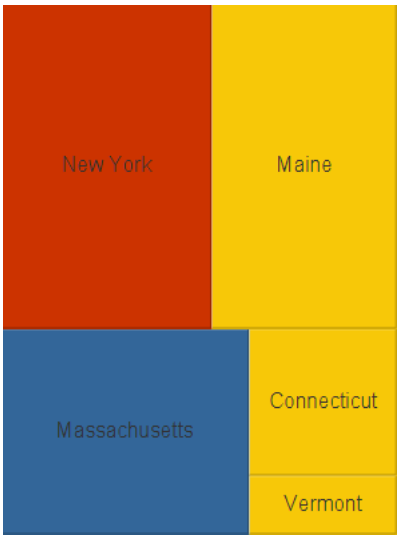


Example 6–101 shows the `treemap` element and its children defined in a MAF AMX file.

Example 6–101 Defining Treemap

```
<dvtm:treemap id="treemap1"
              value="#{bindings.treemapData.collectionModel}"
              var="row"
              animationDuration="#{pageFlowScope.animationDuration}"
              animationOnDataChange="#{pageFlowScope.animationOnDataChange}"
              animationOnDisplay="#{pageFlowScope.animationOnDisplay}"
              layout="#{pageFlowScope.layout}"
              nodeSelection="#{pageFlowScope.nodeSelection}"
              rendered="#{pageFlowScope.rendered}"
              emptyText="#{pageFlowScope.emptyText}"
              inlineStyle="#{pageFlowScope.inlineStyle}"
              sizeLabel="#{pageFlowScope.sizeLabel}"
              styleClass="dvtm-gallery-component"
              colorLabel="#{pageFlowScope.colorLabel}"
              sorting="#{pageFlowScope.sorting}"
              selectedRowKeys="#{pageFlowScope.selectedRowKeys}"
              isolatedRowKey="#{pageFlowScope.isolatedRowKey}"
              legendSource="ag1">
   <dvtm:treemapNode id="node1"
                     fillPattern="#{pageFlowScope.fillPattern}"
                     label="#{row.label}"
                     labelDisplay="#{pageFlowScope.labelDisplay}"
                     value="#{row.marketShare}"
                     labelHalign="#{pageFlowScope.labelHalign}"
                     labelValign="#{pageFlowScope.labelValign}">
      <dvtm:attributeGroups id="ag1"
                            type="color"
                            value="#{row.deltaInPosition}"
                            attributeType="continuous"
                            minLabel="-1.5%"
                            maxLabel="+1.5%"
                            minValue="-1.5"
                            maxValue="1.5" >
         <amx:attribute id="a1" name="color1" value="#ed6647" />
         <amx:attribute id="a2" name="color2" value="#f7f37b" />
         <amx:attribute id="a3" name="color3" value="#68c182" />
      </dvtm:attributeGroups>
   </dvtm:treemapNode>
</dvtm:treemap>
```

Figure 6–91 Treemap at Design Time



By setting the `attributeType` attribute of the `attributeGroups` element to `continuous`, you can enable visualization of a value associated with the Treemap item using a gradient color where the color intensity represents the relative value within a specified range.

For information on attributes of the `treemap` element and its child elements, see *Oracle Fusion Middleware Tag Reference for Oracle Mobile Application Framework*.

6.5.21.1 Applying Custom Styling to the Treemap Component

You can style the Treemap component by overwriting the default CSS settings or using a custom JavaScript file. For more information on how to extend these files, see Section 6.6.3, "How to Style Data Visualization Components."

Example 6–102 shows the Treemap component's default CSS styles that you can override.

Example 6–102 Treemap Default CSS Styling

```
.dvtm-treemap {
   border-style: solid;
   border-color: #E2E8EE;
   border-radius: 3px;
   background-color: #EDF2F7;
   ...
}
```

Example 6–103 shows the Treemap Node's default CSS styles that you can override.

Example 6–103 Treemap Node Default CSS Styling

```
.dvtm-treemapNodeSelected {
   // Selected node outer border color
   border-top-color: #E2E8EE;
   // Selected node inner border color
   border-bottom-color: #EDF2F7;
}
```

Example 6–104 shows the Treemap Node's `label` text CSS properties that you can style using custom CSS.

Example 6–104 Label CSS Styling

```
.dvtm-treemapNodeLabel {
   font-family: Helvetica, sans-serif;
   font-size: 14px;
   font-style: normal;
   font-weight: normal;
   color: #7097CF;
   ...
}
```

Some of the style settings cannot be specified using CSS. Instead, you must define them using a custom JavaScript file. Example 6–105 shows how to apply custom styling to the Treemap component without using CSS.

Example 6–105 Non-CSS Custom Styling

```
my-custom.js:

   window["CustomTreemapStyle"] = {

      // treemap properties
      "treemap" : {
         // Specifies the animation effect when the data changes - none, auto
         "animationOnDataChange": "auto",

         // Specifies the animation that is shown on initial display - none, auto
         "animationOnDisplay": "auto",

         // Specifies the animation duration in milliseconds
         "animationDuration": "500",

         // The text of the component when empty
         "emptyText": "No data to display",

         // Specifies the layout of the treemap -
         // squarified, sliceAndDiceHorizontal, sliceAndDiceVertical
         "layout": "squarified",

         // Specifies the selection mode - none, single, multiple
         "nodeSelection": "multiple",

         // Specifies whether or not the nodes are sorted by size - on, off
         "sorting": "on"
      },

      // treemap node properties
      "node" : {
         // Specifies the label display behavior for nodes - node, off
         "labelDisplay": "off",

         // Specifies the horizontal alignment for labels displayed
         // within the node - center, start, end
         "labelHalign": "end",

         // Specifies the vertical alignment for labels displayed
         // within the node - center, top, bottom
```

```
        "labelValign": "center"
      },
    }
```

6.5.22 How to Create a Sunburst Component

A Sunburst (`sunburst`) displays hierarchical data across two dimensions represented by the size and color of its nodes (`sunburstNode`).

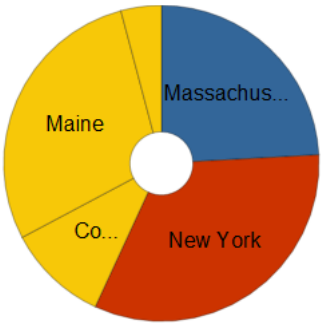
In the Components window, the Sunburst is located under **MAF AMX Data Visualizations > Common > Miscellaneous**, and its child components are located under **MAF AMX Data Visualizations > Other Type-Specific Child Tags > Sunburst and Treemap** and **MAF AMX Data Visualizations > Shared Child Tags** (see Figure 6–90, "Treemap and Other Advanced Components in Components Window").

Example 6–106 shows the `sunburst` element and its children defined in a MAF AMX file.

Example 6–106 Defining Sunburst

```
<dvtm:sunburst id="sunburst1"
               value="#{bindings.sunburstData.collectionModel}"
               var="row"
               animationDuration="#{pageFlowScope.animationDuration}"
               animationOnDataChange="#{pageFlowScope.animationOnDataChange}"
               animationOnDisplay="#{pageFlowScope.animationOnDisplay}"
               colorLabel="#{pageFlowScope.colorLabel}"
               emptyText="#{pageFlowScope.emptyText}"
               inlineStyle="#{pageFlowScope.inlineStyle}"
               nodeSelection="#{pageFlowScope.nodeSelection}"
               rendered="#{pageFlowScope.rendered}"
               rotation="#{pageFlowScope.rotation}"
               shortDesc="#{pageFlowScope.shortDesc}"
               sizeLabel="#{pageFlowScope.sizeLabel}"
               sorting="#{pageFlowScope.sorting}"
               rotationAngle="#{pageFlowScope.startAngle}"
               styleClass="#{pageFlowScope.styleClass}"
               legendSource="ag1">
   <dvtm:sunburstNode id="node1"
                      fillPattern="#{pageFlowScope.fillPattern}"
                      label="#{row.label}"
                      labelDisplay="#{pageFlowScope.labelDisplay}"
                      value="#{pageFlowScope.showRadius ? 1 : row.marketShare}"
                      labelHalign="#{pageFlowScope.labelHalign}"
                      radius="#{pageFlowScope.showRadius ? row.booksCount : 1}">
      <dvtm:attributeGroups id="ag1"
                            type="color"
                            value="#{row.deltaInPosition}"
                            attributeType="continuous"
                            minLabel="-1.5%"
                            maxLabel="+1.5%"
                            minValue="-1.5"
                            maxValue="1.5">
         <amx:attribute id="a1" name="color1" value="#ed6647" />
         <amx:attribute id="a2" name="color2" value="#f7f37b" />
         <amx:attribute id="a3" name="color3" value="#68c182" />
      </dvtm:attributeGroups>
   </dvtm:sunburstNode>
</dvtm:sunburst>
```

Figure 6–92 Sunburst at Design Time



By setting the `attributeType` attribute of the `attributeGroups` element to `continuous`, you can enable visualization of a value associated with the Sunburst item using a gradient color where the color intensity represents the relative value within a specified range.

For information on attributes of the `sunburst` element and its child elements, see *Oracle Fusion Middleware Tag Reference for Oracle Mobile Application Framework*.

6.5.22.1 Applying Custom Styling to the Sunburst Component

You can style the Sunburst component by overwriting the default CSS settings or using a custom JavaScript file. For more information on how to extend these files, see Section 6.6.3, "How to Style Data Visualization Components."

Example 6–107 shows the Sunburst component's default CSS styles that you can override.

Example 6–107 Sunburst Default CSS Styling

```
.dvtm-sunburst {
   border-style: solid;
   border-color: #E2E8EE;
   border-radius: 3px;
   background-color: #EDF2F7;
   ...
}
```

Example 6–108 shows the Sunburst Node's default CSS styles that you can override.

Example 6–108 Sunburst Node Default CSS Styling

```
.dvtm-sunburstNode {
   // Node border color
   border-color: "#000000";
}

.dvtm-sunburstNodeSelected {
   // Selected node border color
   border-color: "#000000";
}
```

Example 6–109 shows the Sunburst Node's `label` text CSS properties that you can style using custom CSS.

Example 6–109 Label CSS Styling

```
.dvtm-sunburstNodeLabel {
```

```
   font-family: Helvetica, sans-serif;
   font-size: 14px;
   font-style: normal;
   font-style: normal;
   color: #7097CF;
   ...
}
```

Some of the style settings cannot be specified using CSS. Instead, you must define them using a custom JavaScript file. Example 6–110 shows how to apply custom styling to the Sunburst component without using CSS.

Example 6–110 Non-CSS Custom Styling

```
my-custom.js:

window["CustomSunburstStyle"] = {
   // sunburst properties
   "sunburst" : {
      // Specifies whether or not the client side rotation is enabled - on, off
      "rotation": "off",

      // The text of the component when empty
      "emptyText": "No data to display",

      // Specifies the selection mode - none, single, multiple
      "nodeSelection": "multiple",

      // Animation effect when the data changes - none, auto
      "animationOnDataChange": "auto",

      // Specifies the animation that is shown on initial display - none, auto
      "animationOnDisplay": "auto",

      // Specifies the animation duration in milliseconds
      "animationDuration": "500",

      // Specifies the starting angle of the sunburst
      "startAngle": "90",

      // Specifies whether or not the nodes are sorted by size - on, off
      "sorting": "on"
   },

   // sunburst node properties
   "node" : {
      // Specifies whether or not the label is displayed - on, off
      "labelDisplay": "off"
   }
}
```

6.5.23 How to Create a Timeline Component

A Timeline (`timeline`) is an interactive component that allows viewing of events in chronological order, as well as navigating forward and backwards within a defined yet adjustable time range that can be used for zooming.

Events are represented by Timeline Item components (`timelineItem`) that include the title, description, and duration fill color. You can configure a dual timeline to display two series of events for a side-by-side comparison of related information.

Note: MAF AMX does not support the following functionality, child elements, and properties that are often available in components similar to the Timeline:

- Nested UI components
- Animation
- Attribute and time range change awareness
- Time fetching
- Custom time scales
- Time currency
- Partial triggers
- Data sorting
- Formatted time ranges
- Time zone
- Visibility

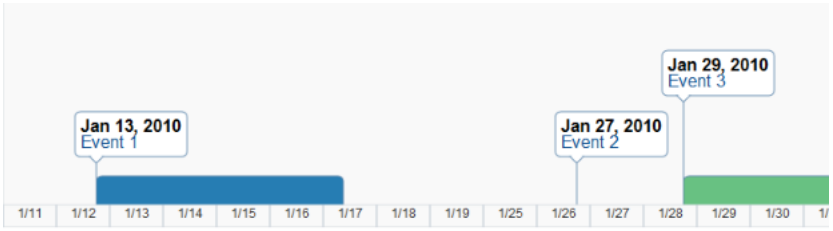
In the Components window, the Timeline is located under **MAF AMX Data Visualizations > Common > Miscellaneous**, and its child components are located under **MAF AMX Data Visualizations > Other Type-Specific Child Tags > Timeline** and **MAF AMX Data Visualizations > Shared Child Tags** (see Figure 6–90, "Treemap and Other Advanced Components in Components Window").

Example 6–111 shows the `timeline` element and its children defined in a MAF AMX file.

Example 6–111 Timeline Definition

```
<dvtm:timeline id="tl"
               itemSelection="#{pageFlowScope.itemSelection}"
               startTime="#{pageFlowScope.startTime}"
               endTime="#{pageFlowScope.endTime}">
   <dvtm:timelineSeries id="ts1"
                        label="#{pageFlowScope.s1Label}"
                        value="#{bindings.series1Data.collectionModel}"
                        var="row"
                        selectionListener=
                            "#{PropertyBean.timelineSeries1SelectionHandler}">
      <dvtm:timelineItem id="ti1"
                         startTime="#{row.startDate}"
                         endTime="#{row.endDate}"
                         title="#{row.title}"
                         description="#{row.description}"
                         durationFillColor="#AAAAAA"/>
   </dvtm:timelineSeries>
   <dvtm:timeAxis id="ta1" scale="#{pageFlowScope.scale}"/>
</dvtm:timeline>
```

Figure 6–93 Timeline at Design Time



You can control the fill color of a specific Timeline Item's duration bar using its `durationFillColor` attribute.

To display two time scales at the same time on the Timeline, use the Time Axis' `scale` attribute that determines the scale of the second axis.

The Timeline can be scrolled horizontally as well as vertically. When the component is scrollable (that is, contains data outside of the visible display area), it is indicated by arrows pointing in the direction of the scroll.

For information on attributes of the `timeline` element and its child elements, see *Oracle Fusion Middleware Tag Reference for Oracle Mobile Application Framework*.

6.5.23.1 Applying Custom Styling to the Timeline Component

You can style the Timeline component by overwriting the default CSS settings or using a custom JavaScript file. For more information on how to extend these files, see Section 6.6.3, "How to Style Data Visualization Components."

The following CSS style classes that you can override are defined for the Timeline and its child components:

- `.dvtm-timeline`

  supported properties: `all`

- `.timelineSeries-backgroundColor`

  supported properties: `color`

  `.timelineSeries-labelStyle`

  supported properties: `font-family, font-size, font-weight, color, font-style`

- `.timelineItem-backgroundColor`

  supported properties: `color`

  `.timelineItem-selectedBackgroundColor`

  supported properties: `color`

  `.timelineItem-borderColor`

  supported properties: `color`

  `.timelineItem-selectedBorderColor`

  supported properties: `color`

  `.timelineItem-borderWidth`

supported properties: `width`

`.timelineItem-feelerColor`

supported properties: `color`

`.timelineItem-selectedFeelerColor`

supported properties: `color`

`.timelineItem-feelerWidth`

supported properties: `width`

`.timelineItem-descriptionStyle`

- supported properties: `font-family, font-size, font-weight, color, font-style`

`.timelineItem-titleStyle`

- supported properties: `font-family, font-size, font-weight, color, font-style`

- `.timeAxis-separatorColor`

  supported properties: `color`

  `.timeAxis-backgroundColor`

  supported properties: `color`

  `.timeAxis-borderColor`

  supported properties: `color`

  `.timeAxis-borderWidth`

  supported properties: `width`

  `.timeAxis-labelStyle`

  - supported properties: `font-family, font-size, font-weight, color, font-style`

Example 6–112 shows a custom JavaScript file that you could use to override the default styles of the Timeline component.

Example 6–112 Custom JavaScript File

```
// Custom timeline style definition with listing
// of all properties that can be overriden
window["CustomTimelineStyle"] = {
   // Determines if items in the timeline are selectable
   "itemSelection": none

   // Timeline properties
   "timelineSeries" : {
      // Duration bars color palette
      "colors" : [comma separated list of hex colors]
   }
}
```

6.5.24 How to Create an NBox Component

An NBox (`nBox`) component presents data across two dimensions, with each dimension split into a number of ranges whose intersections form distinct cells into which each data item is placed.

In the Components window, the NBox is located under **MAF AMX Data Visualizations > Common > Miscellaneous**, and its child components are located under **MAF AMX Data Visualizations > Other Type-Specific Child Tags > NBox** and **MAF AMX Data Visualizations > Shared Child Tags** (see Figure 6–90, "Treemap and Other Advanced Components in Components Window").

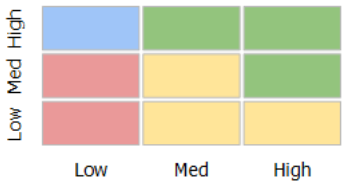
Example 6–111 shows the `nBox` element and its children defined in a MAF AMX file.

Example 6–113 NBox Definition

```
<dvtm:nBox id="nBox1"
           var="item"
           value="#{bindings.NBoxNodesDataList.collectionModel}"
           columnsTitle="#{pageFlowScope.columnsTitle}"
           emptyText="#{pageFlowScope.emptyText}"
           groupBy="#{pageFlowScope.groupBy}"
           groupBehavior="#{pageFlowScope.groupBehavior}"
           highlightedRowKeys="#{pageFlowScope.showHighlightedNodes ?
                                 pageFlowScope.highlightedRowKeys : ''}"
           inlineStyle="#{pageFlowScope.inlineStyle}"
           legendDisplay="#{pageFlowScope.legendDisplay}"
           maximizedColumn="#{pageFlowScope.maximizedColumn}"
           maximizedRow="#{pageFlowScope.maximizedRow}"
           nodeSelection="#{pageFlowScope.nodeSelection}"
           rowsTitle="#{pageFlowScope.rowsTitle}"
           selectedRowKeys="#{pageFlowScope.selectedRowKeys}"
           shortDesc="#{pageFlowScope.shortDesc}">
   <amx:facet name="rows">
      <dvtm:nBoxRow value="low" label="Low" id="nbr1"/>
       <dvtm:nBoxRow value="medium" label="Med" id="nbr2"/>
       <dvtm:nBoxRow value="high" label="High" id="nbr3"/>
   </amx:facet>
   <amx:facet name="columns">
      <dvtm:nBoxColumn value="low" label="Low" id="nbc2"/>
      <dvtm:nBoxColumn value="medium" label="Med" id="nbc1"/>
      <dvtm:nBoxColumn value="high" label="High" id="nbc3"/>
   </amx:facet>
   <amx:facet name="cells">
      <dvtm:nBoxCell row="low"
                     column="low"
                     label=""
                     background="rgb(234,153,153)"
                     id="nbc4"/>
      <dvtm:nBoxCell row="medium"
                     column="low"
                     label=""
                     background="rgb(234,153,153)"
                     id="nbc5"/>
      <dvtm:nBoxCell row="high"
                     column="low"
                     label=""
                     background="rgb(159,197,248)"
                     id="nbc6"/>
      <dvtm:nBoxCell row="low"
                     column="medium"
```

```
                    label=""
                    background="rgb(255,229,153)"
                    id="nbc7"/>
      <dvtm:nBoxCell row="medium"
                    column="medium"
                    label=""
                    background="rgb(255,229,153)"
                    id="nbc8"/>
      <dvtm:nBoxCell row="high"
                    column="medium"
                    label=""
                    background="rgb(147,196,125)"
                    id="nbc9"/>
      <dvtm:nBoxCell row="low"
                    column="high"
                    label=""
                    background="rgb(255,229,153)"
                    id="nbc10"/>
      <dvtm:nBoxCell row="medium"
                    column="high"
                    label=""
                    background="rgb(147,196,125)"
                    id="nbc11"/>
      <dvtm:nBoxCell row="high"
                    column="high"
                    label=""
                    background="rgb(147,196,125)"
                    id="nbc12"/>
   </amx:facet>
   <dvtm:nBoxNode id="nbn1"
                  row="#{item.row}"
                  column="#{item.column}"
                  label="#{item.name}"
                  labelStyle="font-style:italic"
                  secondaryLabel="#{item.job}"
                  secondaryLabelStyle="font-style:italic"
                  shortDesc="#{item.name + ': ' + item.job}">
      <dvtm:attributeGroups id="ag1"
                            type="indicatorShape"
                            value="#{item.indicator1}"
                            rendered="#{pageFlowScope.showIndicator}"/>
      <dvtm:attributeGroups id="ag2"
                            type="indicatorColor"
                            value="#{item.indicator2}"
                            rendered="#{pageFlowScope.showIndicator}"/>
      <dvtm:attributeGroups id="ag3"
                            type="color"
                            value="#{item.group}"
                            rendered="#{pageFlowScope.showColors}"/>
   </dvtm:nBoxNode>
</dvtm:nBox>
```

Figure 6–94 NBox at Design Time



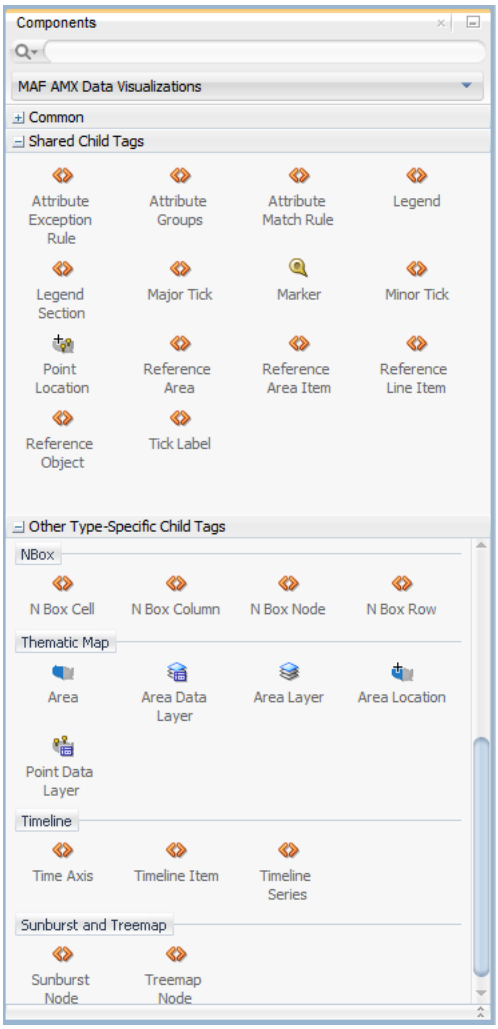
For information on attributes of the `nBox` element and its child elements, see *Oracle Fusion Middleware Tag Reference for Oracle Mobile Application Framework*.

6.5.25 How to Define Child Elements for Map Components, Sunburst, Treemap, Timeline, and NBox

You can define a variety of child elements for map components, Sunburst, Treemap, Timeline, and NBox. For information on available child elements and their attributes, see *Oracle Fusion Middleware Tag Reference for Oracle Mobile Application Framework*.

In JDeveloper, the Map, Sunburst, Treemap, Timeline, and NBox child components are located under **MAF AMX Data Visualizations > Other Type-Specific Child Tags** and **MAF AMX Data Visualizations > Shared Child Tags** in the Components window (see Figure 6–95).

Figure 6–95 Creating Map, Sunburst, Treemap, Timeline, and NBox Child Components



6.5.26 How to Create Databound Data Visualization Components

You can declaratively create a databound data visualization component using a data collection inserted from the Data Controls window (see Section 5.3.2.4, "Adding Data Controls to the View"). The **Component Gallery** dialog that Figure 6–109 shows allows you to choose from a number of data visualization component categories, types, and layout options.

Figure 6–96 Component Gallery to Create Chart Components

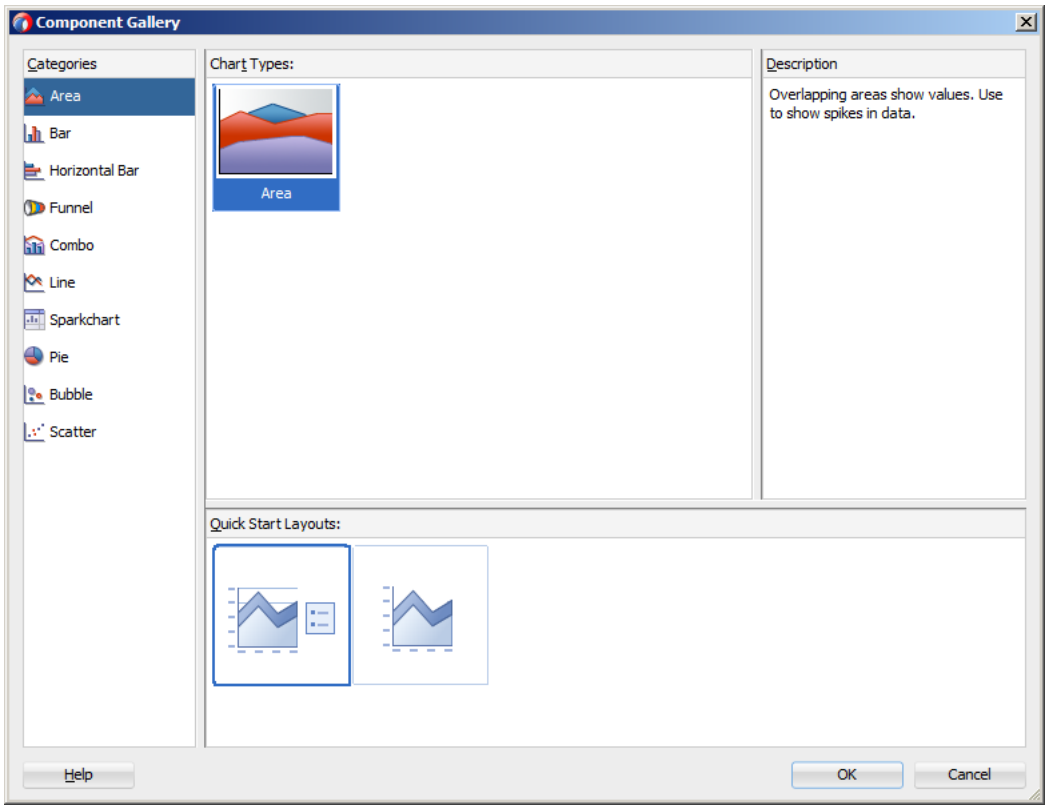


Figure 6–97 Component Gallery to Create Gauge Components

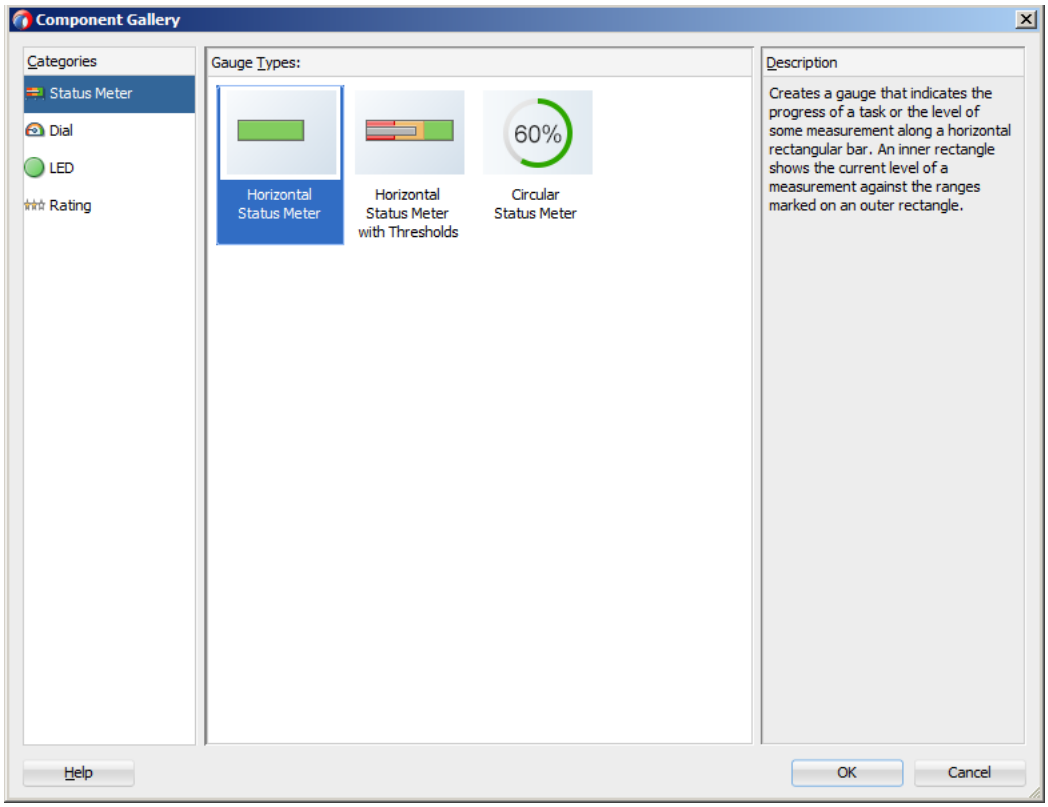
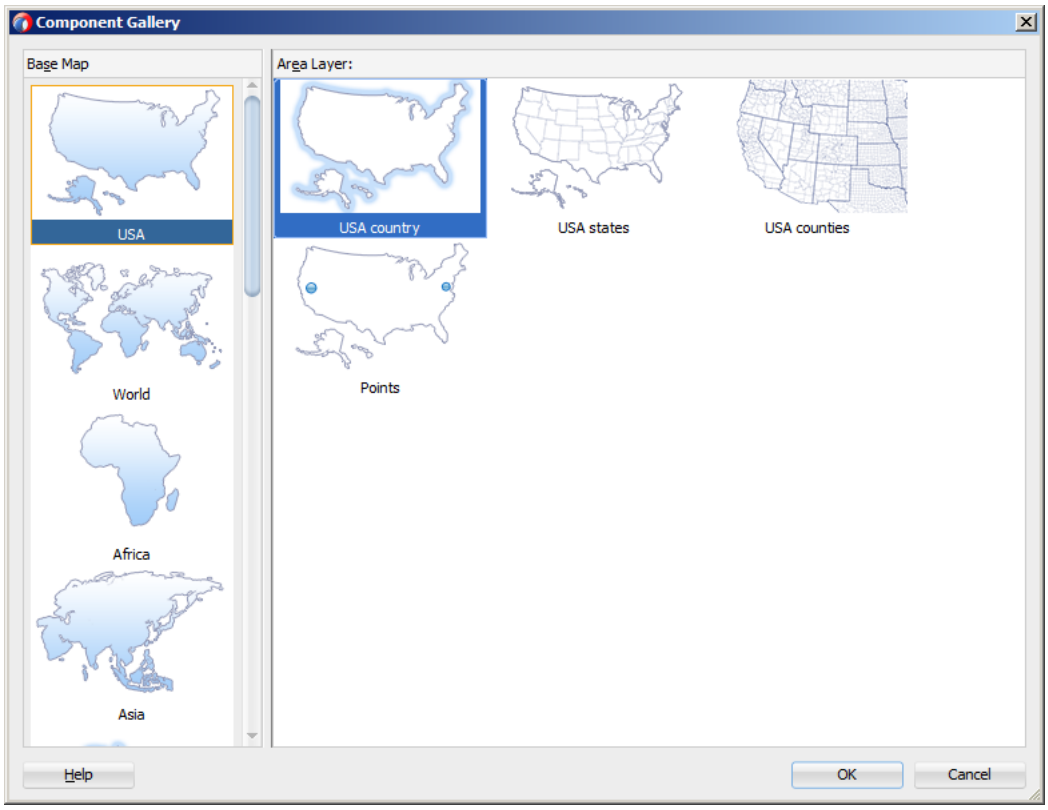


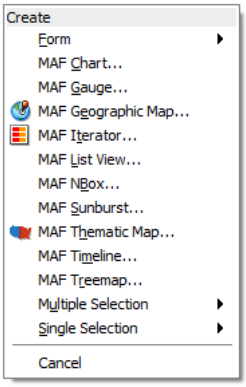
Figure 6–98 Component Gallery to Create Thematic Map Component



Note: Some data visualization component types require very specific kinds of data. If you bind a component to a data collection that does not contain sufficient data to display the component type requested, then the component is not displayed and a message about insufficient data appears.

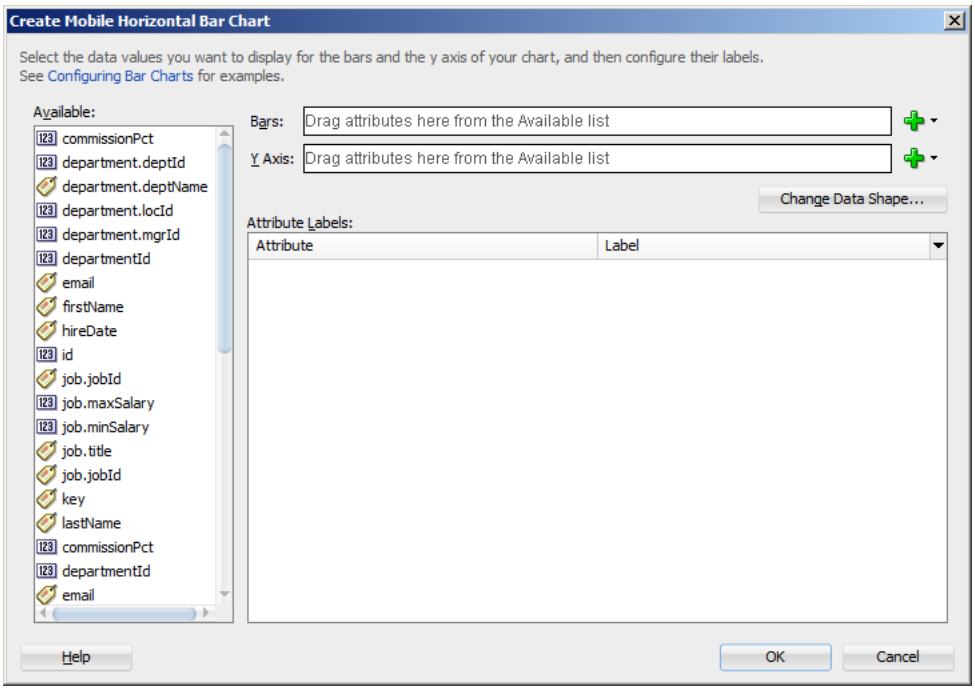
To trigger the display of the **Component Gallery**, you drag and drop a collection from the Data Controls window onto a MAF AMX page, and then select either **MAF Chart**, **MAF Gauge**, or **MAF Thematic Map** from the context menu that appears (see Figure 6–99).

Figure 6–99 Creating Databound Data Visualization Components



After you select the category, type, and layout for your new databound component from the Component Gallery and click **OK**, you can start binding the data collection attributes in the data visualization component using data binding dialogs. The name of the dialog and the input field labels depend on the category and type of the data visualization component that you selected. For example, if you select Horizontal Bar as the category and Bar as the type, then the name of the dialog that appears is Create Mobile Horizontal Bar Chart, and the input field is labeled Bars, as Figure 6–100 shows.

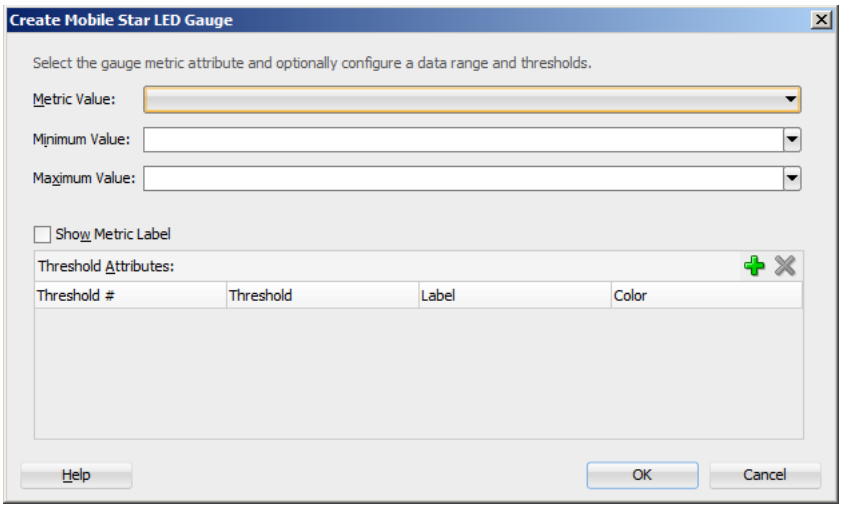
Figure 6–100 Specifying Data Values for Databound Chart



The attributes in a data collection can be data values or categories of data values. Data values are numbers represented by markers, like bar height, or points in a scatter chart. Categories of data values are members represented as axis labels. The role that an attribute plays in the bindings (either data values or identifiers) is determined by both its data type (chart requires numeric data values) and where it is mapped (for example, Bars or X Axis).

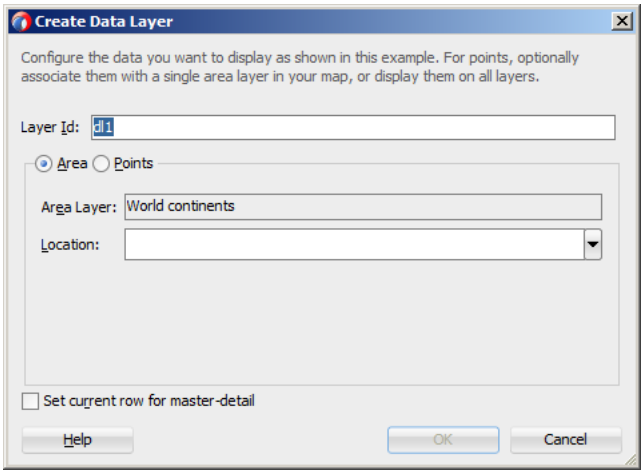
If you use the Component Gallery to create a databound gauge component, and then you select LED as the category and Star LED as the type, then the name of the dialog that appears is Create Mobile Star LED Gauge, as Figure 6–101 shows.

Figure 6–101 Specifying Data Values for Databound Gauge



If you use the Component Gallery to create a databound thematic map component, then regardless of your selection, the name of the dialog that appears is Create Data Layer, but the fields that are displayed depend on the selection you made in the Component Gallery. For example, if you select World as the base map and World continents as the area layer, the dialog show in Figure 6–101 opens.

Figure 6–102 Create Data Layer Dialog



After completing one or more data binding dialogs, you can use the Properties window to specify settings for the component attributes. You can also use the child elements associated with the component to further customize it (see Section 6.5.17, "How to Define Child Elements for Chart and Gauge Components").

When you select **MAF Geographic Map**, **MAF Sunburst**, **MAF NBox**, **MAF Timeline**, or **MAF Treemap** from the context menu upon dropping a collection onto a MAF AMX page, one of the following dialogs appear:

Figure 6–103 Creating Databound Geographic Map

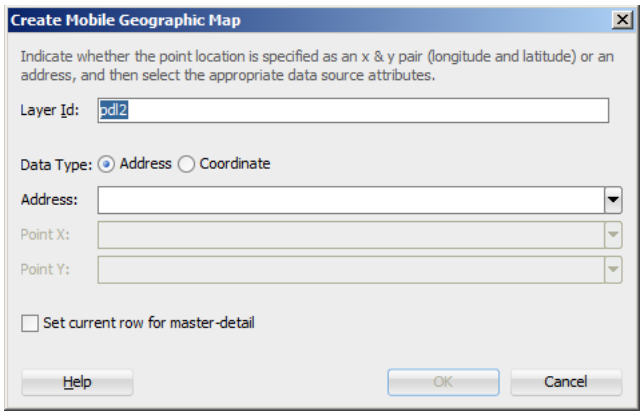


Figure 6–104 Creating Databound Sunburst

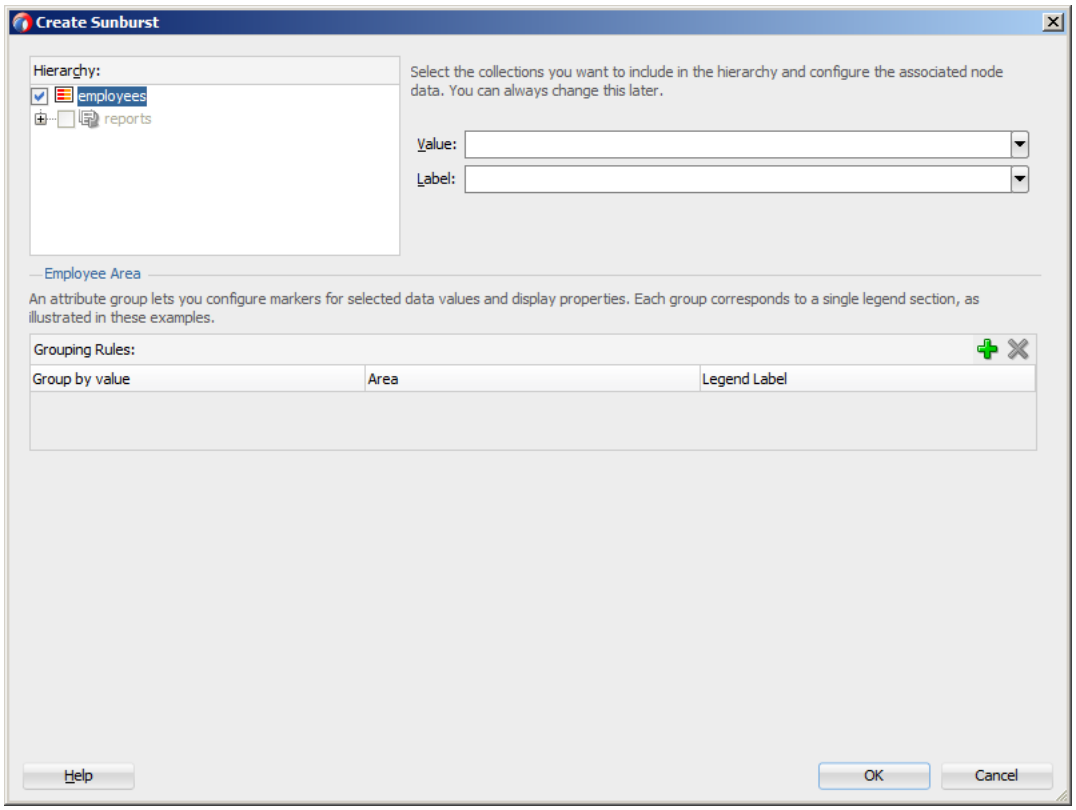


Figure 6–105 Creating Databound Timeline

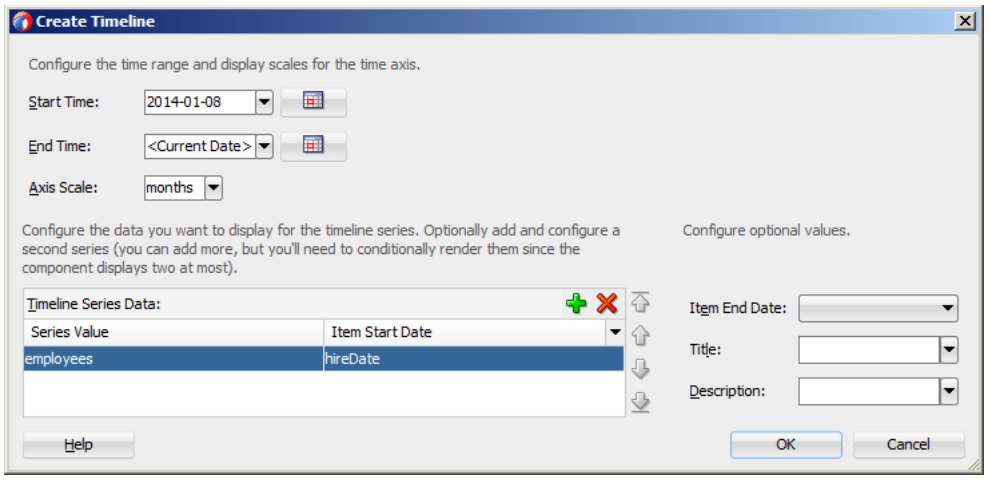


Figure 6–106 Creating Databound Treemap

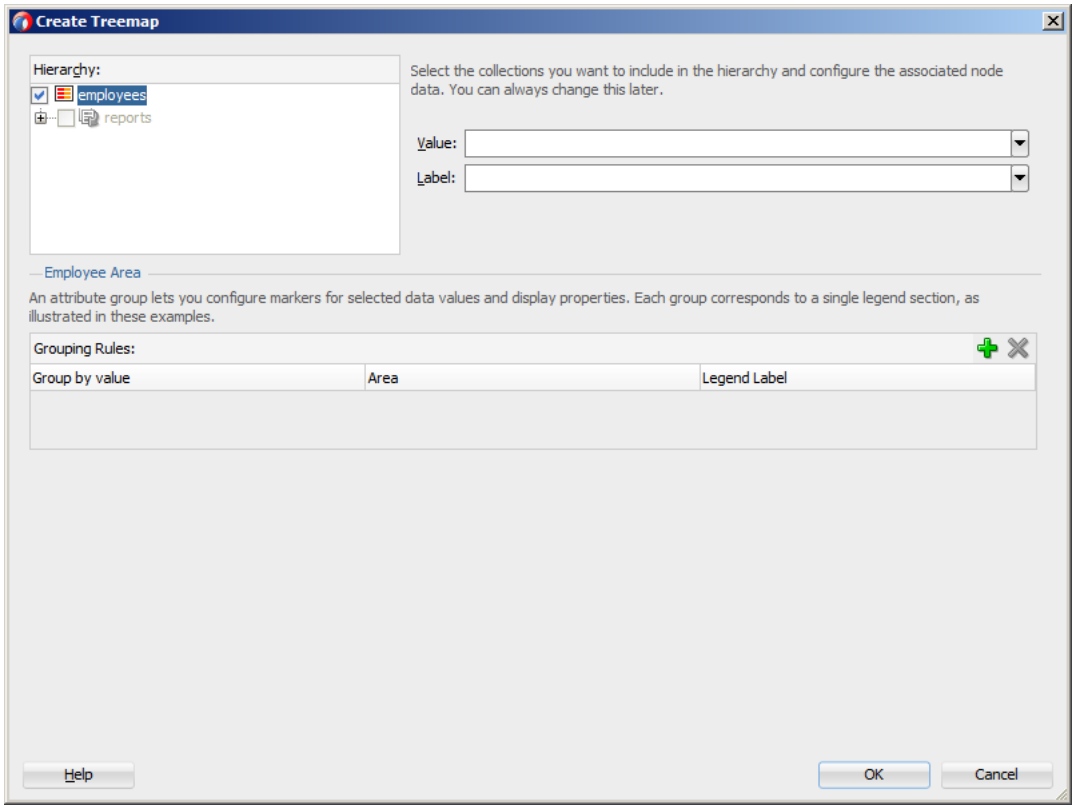
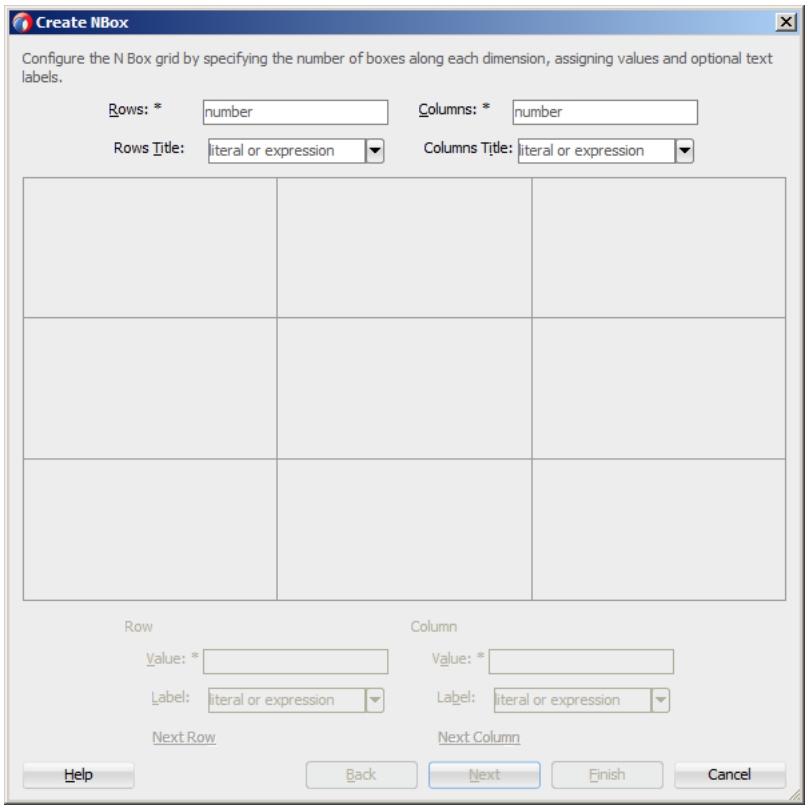


Figure 6–107 Creating Databound NBox



To complete the Create NBox dialog, you start by defining the number of rows and columns. Then you can select a cell on the box and specify values for the whole row or column in the bottom portion of the dialog, as Figure 6–108 shows.

Figure 6–108 Setting Row and Column Values for Databound NBox

The NBox component is created when you complete all pages of the series of dialogs by clicking **Next**.

For details on values for each field of each dialog, consult the online help by clicking **Help** or pressing F1.

6.5.26.1 What You May Need to Know About Setting Series Style for Databound Chart Components

When creating databound chart components from the Data Controls window, you can declaratively specify styling information for the chart series data by adding `seriesStyle` elements and then using the Properties window to open a list for the `series` attribute of the `seriesStyle` element. This list is already populated with the values o thef `series` attribute based on the values of the `chartDataItem` elements within the `dataStamp` facet.

6.6 Styling UI Components

MAF enables you to employ CSS to apply style to UI components.

6.6.1 How to Use Component Attributes to Define Style

You style your UI components by setting the following attributes:

- `styleClass` attribute defines a CSS style class to use for your layout component:

```
<amx:panelPage styleClass="#{pageFlowScope.pStyleClass}">
```

You can define the style class for layout, command, and input components in a MAF AMX page or in a skinning CSS file, in which case a certain style is applied to all components within the MAF AMX application feature (see Section 6.6.2, "What You May Need to Know About Skinning"). Alternatively, you can use the public style classes provided by MAF.

> **Note:** The CSS file is not accessible from JDeveloper. Instead, MAF injects this file into the package at build or deploy time, upon which the CSS file appears in the `css` directory under the `Web Content` root directory.

- `inlineStyle` attribute defines a CSS style to use for any UI component and represents a set of CSS styles that are applied to the root DOM element of the component:

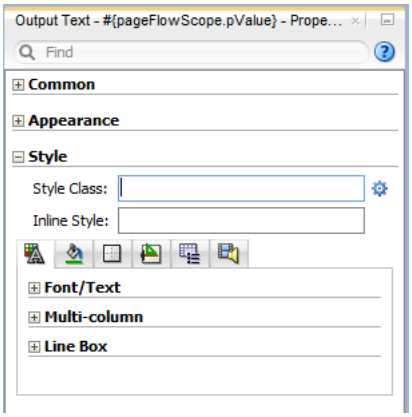
  ```
  <amx:outputText inlineStyle="color:red;">
  ```

  You should use this attribute when basic style changes are required.

  > **Note:** Some UI components are rendered with such subelements as HTML `div` elements and more complex markup. As a result, setting the `inlineStyle` attribute on the parent component may not produce the desired effect. In such cases, you should examine the generated markup and, instead of defining the `inlineStyle` attribute, apply a CSS class that would propagate the style to the subelement.
  >
  > For information on how to configure JavaScript debugging, see Section 22.3.5, "How to Enable Debugging of Java Code and JavaScript."

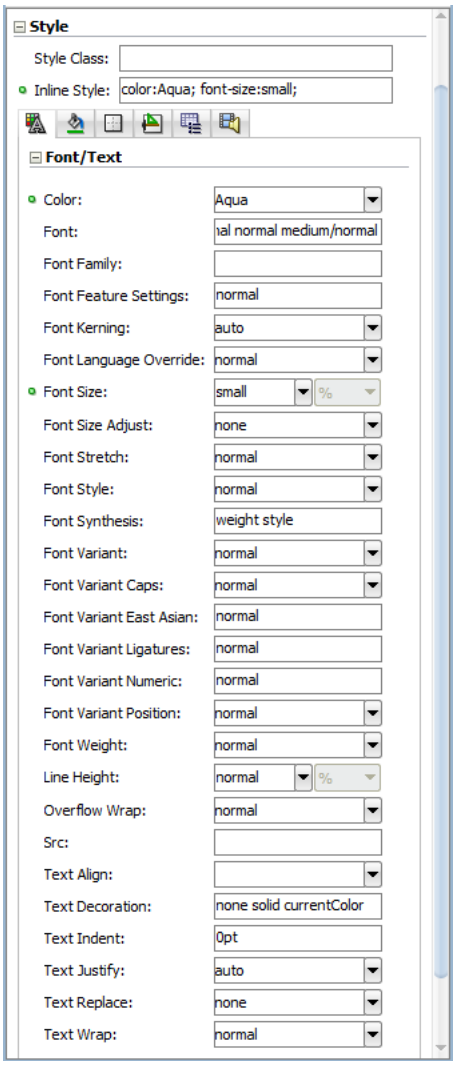
These attributes are displayed in the **Style** section in the Properties window, as Figure 6–109 shows.

Figure 6–109 Style Section of the Properties Window



Within the Properties window MAF AMX provides a drop-down editor that you can use to set various properties of the `inlineStyle` attribute (see Figure 6–110).

Figure 6–110 Inline Style Editor



For more information, see *Oracle Fusion Middleware Tag Reference for Oracle Mobile Application Framework*.

6.6.2 What You May Need to Know About Skinning

Skinning allows you to define and apply a uniform style to all UI components within a MAF AMX application feature to create a theme for the entire feature.

The default skin family for MAF is called `mobileAlta` and the default version is the latest version of that skin. For more information, see Section 4.12, "Skinning Mobile Applications."

6.6.3 How to Style Data Visualization Components

Most of the style properties of MAF AMX data visualization components are defined in the `dvtm.css` file located in the `css` directory. You can override the default values by adding a custom CSS file with custom style definitions at the application feature level (see Section 4.12.9, "Overriding the Default Skin Styles").

Some of the style properties cannot be mapped to CSS and have to be defined in custom JavaScript files. These properties include the following:

- Background and needle images for the Dial Gauge component (see Section 6.5.15, "How to Create a Dial Gauge").
- Duration bars color palette for the Timeline component (see Section 6.5.23, "How to Create a Timeline Component").
- Base maps for the Thematic Map component (see Section 6.5.19.5, "Defining a Custom Base Map").
- Style properties of the Geographic Map component (see Section 6.5.18, "How to Create a Geographic Map Component").
- Style properties of the Thematic Map component (see Section 6.5.19.7, "Applying Custom Styling to the Thematic Map Component").
- Selected and unselected states of the Rating Gauge component (see Section 6.5.16.1, "Applying Custom Styling to the Rating Gauge Component").

You should specify these custom JavaScript files in the Includes section at the application feature level (see Section 4.10.1, "How to Define the Application Content"). By doing so, you override the default style values defined in the XML style template. Example 6–114 shows a JavaScript file similar to the one you would add to your MAF project that includes the MAF AMX application feature with data visualization components which require custom styling of properties that cannot be styled using CSS.

Example 6–114 Defining Custom Style Properties

```
my-custom.js:

   CustomChartStyle = {

      // common chart properties
      'chart': {
         // text to be displayed, if no data is provided
         'emptyText': null,
         // animation effect when the data changes
         'animationOnDataChange': "none",
         // animation effect when the chart is displayed
         'animationOnDisplay': "none",
         // time axis type - disabled, enabled, mixedFrequency
         'timeAxisType': "disabled"
      },

      // chart title separator properties
      'titleSeparator': {
         // separator upper color
         'upperColor': "#74779A",
         // separator lower color
         'lowerColor': "#FFFFFF",
         // should display title separator
         'rendered': false
      },

      // chart legend properties
      'legend': {
         // legend position - none, auto, start, end, top, bottom
         'position': "auto"
      },

      // default style values
```

```
      'styleDefaults': {
         // default color palette
         'colors': ["#003366", "#CC3300", "#666699", "#006666", "#FF9900",
                    "#993366", "#99CC33", "#624390", "#669933", "#FFCC33",
                    "#006699", "#EBEA79"],
         // default shapes palette
         'shapes': ["circle", "square", "plus", "diamond",
                    "triangleUp", "triangleDown", "human"],
         // series effect
         'seriesEffect': "gradient",
         // animation duration in ms
         'animationDuration': 1000,
         // animation indicators - all, none
         'animationIndicators': "all",
         // animation up color
         'animationUpColor': "#0099FF",
         // animation down color
         'animationDownColor': "#FF3300",
         // default line width for line chart
         'lineWidth': 3,
         // default line style for line chart - solid, dotted, dashed
         'lineStyle': "solid",
         // should markers be displayed for line and area charts
         'markerDisplayed': false,
         // default marker color
         'markerColor': null,
         // default marker shape
         'markerShape': "auto",
         // default marker size
         'markerSize': 8,
         // pie feeler color for pie chart
         'pieFeelerColor': "#BAC5D6",
         // slice label position and text type for pie chart
         'sliceLabel': {
            'position': "outside",
            'textType': "percent" }
      }
   };

   CustomGaugeStyle = {
      // default animation duration in milliseconds
      'animationDuration': 1000,
      // default animation effect on data change
      'animationOnDataChange': "none",
      // default animation effect on gauge display
      'animationOnDisplay': "none",
      // default visual effect
      'visualEffects': "auto"
   };

   CustomTimelineStyle = {
      'timelineSeries' : {
      // duration bars color palette
      'colors' : ["#267db3", "#68c182", "#fad55c", "#ed6647"]
   };
...
}
```

After the JavaScript file has been defined, you can uncomment and modify any values. You add this file as an included feature in the `maf-feature.xml` file, as Example 6–115 shows.

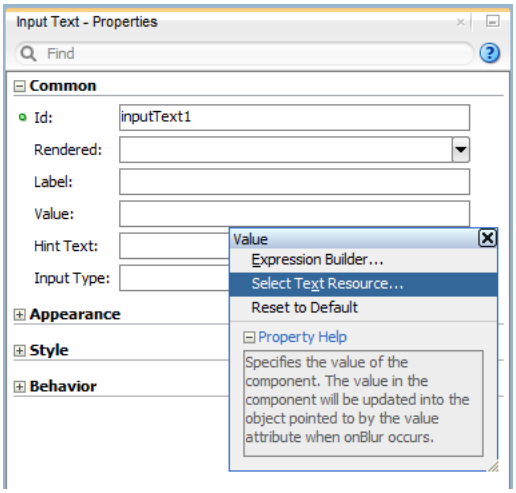
Example 6–115 Including Custom Style File in the Application Feature

```
<?xml version="1.0" encoding="UTF-8" ?>
<adfmf:features xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
                        xmlns:adfmf="http://xmlns.oracle.com/adf/mf">
   <adfmf:feature id="feature1" name="feature1">
      <adfmf:content id="feature1.1">
         <adfmf:amx file="feature1/untitled1.amx">
            <adfmf:includes>
               <adfmf:include type="StyleSheet" file="css/custom.css"/>
               <adfmf:include type="JavaScript" file="feature1/js/my-custom.js"/>
            </adfmf:includes>
         </adfmf:amx>
      </adfmf:content>
   </adfmf:feature>
</adfmf:features>
```

6.7 Localizing UI Components

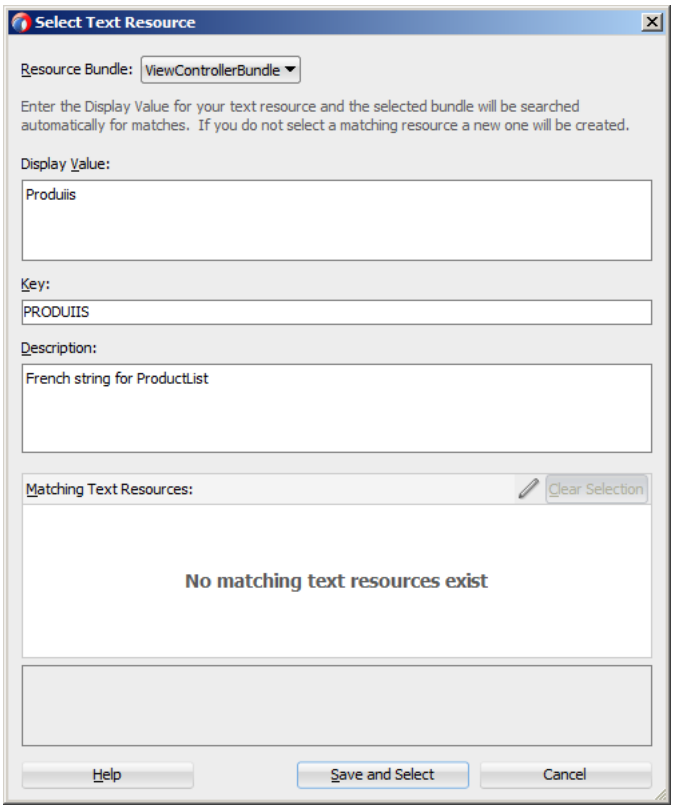
In your MAF AMX page, you can localize the text that UI components display by using the standard resource bundle provided by JDeveloper. You do so by selecting a component and one of its text-presenting properties whose value you intend to localize, and then choosing **Select Text Resource** in the appropriate box in the Properties window (see Figure 6–111).

Figure 6–111 Selecting Text Resource



This displays the standard **Select Text Resource** dialog that Figure 6–112 shows. You use this dialog to enter or find a string reference for the property you are modifying.

Figure 6–112 Select Text Resource Dialog

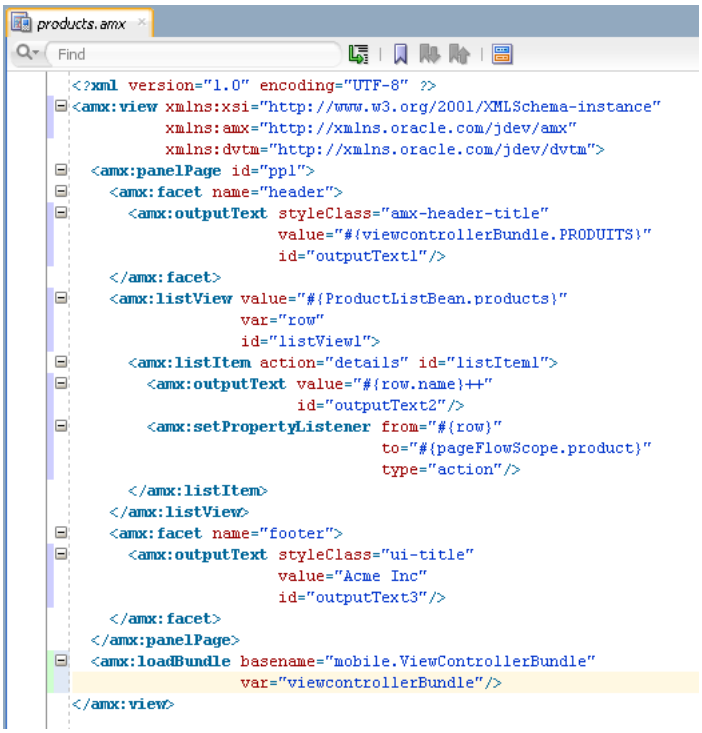


After you have defined a localized string resource, the EL for that reference is automatically placed in the property from which the Select Text Resource dialog was launched. An XLIFF (XML Localization Interchange File Format) file is created, if it is not already present. If it is present, the new entry is added to the existing XLIFF file. In addition, a corresponding Load Bundle (`loadBundle`) component is created as a child of the View component that points to the `ViewControllerBundle.xlf` file (default name, but basically it would match the name of the project).

Note: The `ViewControllerBundle.xlf` is a default file name. This name matches the name of the project.

Figure 6–113 shows the changes in the MAF AMX file.

Figure 6–113 Localized String in MAF AMX File



For more information, see Section 4.11.1, "Working with Resource Bundles."

6.8 Understanding MAF Support for Accessibility

When developing MAF applications, you may need to accommodate visually and physically impaired users by addressing accessibility issues. User agents, such as web browsers rendering to nonvisual media (for example, a screen reader) can read text descriptions of UI components to provide useful information to impaired users. MAF AMX UI and data visualization components are designed to be compliant with the following accessibility standards:

- The Accessible Rich Internet Applications (WAI-ARIA) 1.0 specification.

  For more information, see the following:

  - "Introduction" to WAI-ARIA 1.0 specification at `http://www.w3.org/TR/wai-aria/introduction`
  - "Using WAI-ARIA" at `http://www.w3.org/TR/wai-aria/usage`
  - Section 6.8.2, "What You May Need to Know About the Basic WAI-ARIA Terms"

- The Oracle Global HTML Accessibility Guidelines (OGHAG).

  For more information, see Section 6.8.3, "What You May Need to Know About the Oracle Global HTML Accessibility Guidelines."

- iOS Accessibility guidelines.

  For more information, see the *Accessibility Programming Guide for iOS*.

Accessible components do not change their appearance nor is the application logic affected by the introduction of such components.

To enable the proper functioning of the accessibility in your MAF AMX application feature, follow these guidelines:

- The navigation must not be more than three levels deep and it must be easy for the user to traverse back to the home screen.
- Keep scripting to a minimum.
- Do not provide direct interaction with the DOM.
- Do not use JavaScript time-outs.
- Avoid unnecessary focus changes
- Provide explicit popup triggers
- If needed, utilize the WAI-ARIA live region (see Section 6.8.2, "What You May Need to Know About the Basic WAI-ARIA Terms").
- Keep CSS use to a minimum.
- Try not to override the default component appearance.
- Choose scalable size units.
- Do not use CSS positioning.

For more information, see the following:

- "Mobile Accessibility" at `http://www.w3.org/WAI/mobile`
- "Web Content Accessibility and Mobile Web: Making a Web Site Accessible Both for People with Disabilities and for Mobile Devices" at `http://www.w3.org/WAI/mobile/overlap.html`

6.8.1 How to Configure UI and Data Visualization Components for Accessibility

MAF AMX UI and data visualization components have a built-in accessibility support, with most components being subject to the accessibility audit (see Figure 6–116).

Table 6–10 lists components and their attributes that you can set through the Accessibility section of the Properties window.

Table 6–10 UI Components with Configurable Accessibility Attributes

Component	Accessibility Attribute	Accessibility Audit Message
Button (`commandButton`)	Short Desc (`shortDesc`)	The `shortDesc` attribute should be present and describe the action that will take place.
Select Button (`selectOneButton`)	Short Desc (`shortDesc`)	The `shortDesc` attribute should be present and describe the action that will take place.
Link (`commandLink`)	Short Desc (`shortDesc`)	The `shortDesc` attribute should be present and describe the action that will take place.
Link Go (`goLink`)	Short Desc (`shortDesc`)	The `shortDesc` attribute should be present and describe the action that will take place.
Carousel (`carousel`)	Short Desc (`shortDesc`)	The `shortDesc` attribute should be present and describe the action that will take place.

Table 6–10 (Cont.) UI Components with Configurable Accessibility Attributes

Component	Accessibility Attribute	Accessibility Audit Message
CarouselItem (`carouselItem`)	Short Desc (`shortDesc`)	The `shortDesc` attribute should be present and describe the action that will take place.
List Item (`listItem`)	Short Desc (`shortDesc`)	The `shortDesc` attribute should be present and describe the action that will take place.
Popup (`popup`)	Short Desc (`shortDesc`)	The `shortDesc` attribute should be present and describe the action that will take place.
Image (`image`)	Short Desc (`shortDesc`)	The `shortDesc` attribute should be specified. If the image is used for decorative purposes, it can be empty.
Input Text (`inputText`)	Hint Text (`hintText`)	The `hintText` attribute should be present and describe what the field should contain.
Panel Group Layout (`panelGroupLayout`)	Landmark (`landmark`)	NA [1]
Deck (`deck`)	Landmark (`landmark`)	NA (see footnote 1)
Table Layout (`tableLayout`)	Short Desc (`shortDesc`)	The `shortDesc` attribute should be present and describe the action that will take place.
Cell Format (`cellFormat`)	Short Desc (`shortDesc`)	The `shortDesc` attribute should be present and describe the action that will take place.
Film Strip (`filmStrip`)	Short Desc (`shortDesc`)	The `shortDesc` attribute should be present and describe the action that will take place.
Film Strip Item (`filmStripItem`)	Short Desc (`shortDesc`)	The `shortDesc` attribute should be present and describe the action that will take place.
Area Chart (`areaChart`)	Short Desc (`shortDesc`)	The `shortDesc` attribute should be present and describe the action that will take place.
Bar Chart (`barChart`)	Short Desc (`shortDesc`)	The `shortDesc` attribute should be present and describe the action that will take place.
Horizontal Bar Chart (`horizontalBarChart`)	Short Desc (`shortDesc`)	The `shortDesc` attribute should be present and describe the action that will take place.
Bubble Chart (`bubbleChart`)	Short Desc (`shortDesc`)	The `shortDesc` attribute should be present and describe the action that will take place.
Combo Chart (`comboChart`)	Short Desc (`shortDesc`)	The `shortDesc` attribute should be present and describe the action that will take place.
Line Chart (`lineChart`)	Short Desc (`shortDesc`)	The `shortDesc` attribute should be present and describe the action that will take place.
Scatter Chart (`scatterChart`)	Short Desc (`shortDesc`)	The `shortDesc` attribute should be present and describe the action that will take place.

Table 6–10 (Cont.) UI Components with Configurable Accessibility Attributes

Component	Accessibility Attribute	Accessibility Audit Message
Spark Chart (`sparkChart`)	Short Desc (`shortDesc`)	The `shortDesc` attribute should be present and describe the action that will take place.
Pie Chart (`pieChart`)	Short Desc (`shortDesc`)	The `shortDesc` attribute should be present and describe the action that will take place.
NBox Node (`nBoxNode`)	Short Desc (`shortDesc`)	The `shortDesc` attribute should be present and describe the action that will take place.
Reference Object (`referenceObject`)	Short Desc (`shortDesc`)	The `shortDesc` attribute should be present and describe the action that will take place.
Reference Area (`referenceArea`)	Short Desc (`shortDesc`)	The `shortDesc` attribute should be present and describe the action that will take place.
Reference Line (`referenceLine`)	Short Desc (`shortDesc`)	The `shortDesc` attribute should be present and describe the action that will take place.
Chart Data Item (`chartDataItem`)	Short Desc (`shortDesc`)	The `shortDesc` attribute should be present and describe the action that will take place.
Pie Data Item (`pieDataItem`)	Short Desc (`shortDesc`)	The `shortDesc` attribute should be present and describe the action that will take place.
Funnel Data Item (`funnelDataItem`)	Short Desc (`shortDesc`)	The `shortDesc` attribute should be present and describe the action that will take place.
Area (`area`)	Short Desc (`shortDesc`)	The `shortDesc` attribute should be present and describe the action that will take place.
Marker (`marker`)	Short Desc (`shortDesc`)	The `shortDesc` attribute should be present and describe the action that will take place.
Treemap Node (`treemapNode`)	Short Desc (`shortDesc`)	The `shortDesc` attribute should be present and describe the action that will take place.
Sunburst Node (`sunburstNode`)	Short Desc (`shortDesc`)	The `shortDesc` attribute should be present and describe the action that will take place.
Led Gauge (`ledGauge`)	Short Desc (`shortDesc`)	The `shortDesc` attribute should be present and describe the action that will take place.
Status Meter Gauge (`statusMeterGauge`)	Short Desc (`shortDesc`)	The `shortDesc` attribute should be present and describe the action that will take place.
Dial Gauge (`dialGauge`)	Short Desc (`shortDesc`)	The `shortDesc` attribute should be present and describe the action that will take place.
Rating Gauge (`ratingGauge`)	Short Desc (`shortDesc`)	The `shortDesc` attribute should be present and describe the action that will take place.

Table 6–10 (Cont.) UI Components with Configurable Accessibility Attributes

Component	Accessibility Attribute	Accessibility Audit Message
Geographic Map (`geographicMap`)	Short Desc (`shortDesc`)	The `shortDesc` attribute should be present and describe the action that will take place.
Thematic Map (`thematicMap`)	Short Desc (`shortDesc`)	The `shortDesc` attribute should be present and describe the action that will take place.
Funnel Chart (`funnelChart`)	Short Desc (`shortDesc`)	The `shortDesc` attribute should be present and describe the action that will take place.
NBox (`nBox`)	Short Desc (`shortDesc`)	The `shortDesc` attribute should be present and describe the action that will take place.
Sunburst (`sunburst`)	Short Desc (`shortDesc`)	The `shortDesc` attribute should be present and describe the action that will take place.
Timeline (`timeline`)	Short Desc (`shortDesc`)	The `shortDesc` attribute should be present and describe the action that will take place.
Treemap (`treemap`)	Short Desc (`shortDesc`)	The `shortDesc` attribute should be present and describe the action that will take place.

[1] The landmark attribute has a default value (none) and is not subject to the accessibility audit.

You use the `shortDesc` attribute for different purposes for different components. For example, if you set the `shortDesc` attribute for the Image component, in the MAF AMX file it will appear as a value of the `alt` attribute of the `image` element.

The value of the `shortDesc` attribute can be localized.

For the Panel Group Layout and Deck components, you define the landmark role type (see Table 6–15, " Landmark Roles") that is applicable as per the context of the page. You can set one of the following values for the `landmark` attribute:

- default (none)
- application
- banner
- complementary
- contentinfo
- form
- main
- navigation
- search

Table 6–11 lists UI components whose accessible attributes defined by WAI-ARIA specification are automatically applied at run time and that you cannot modify.

Table 6–11 UI Components with Static Accessibility Attributes

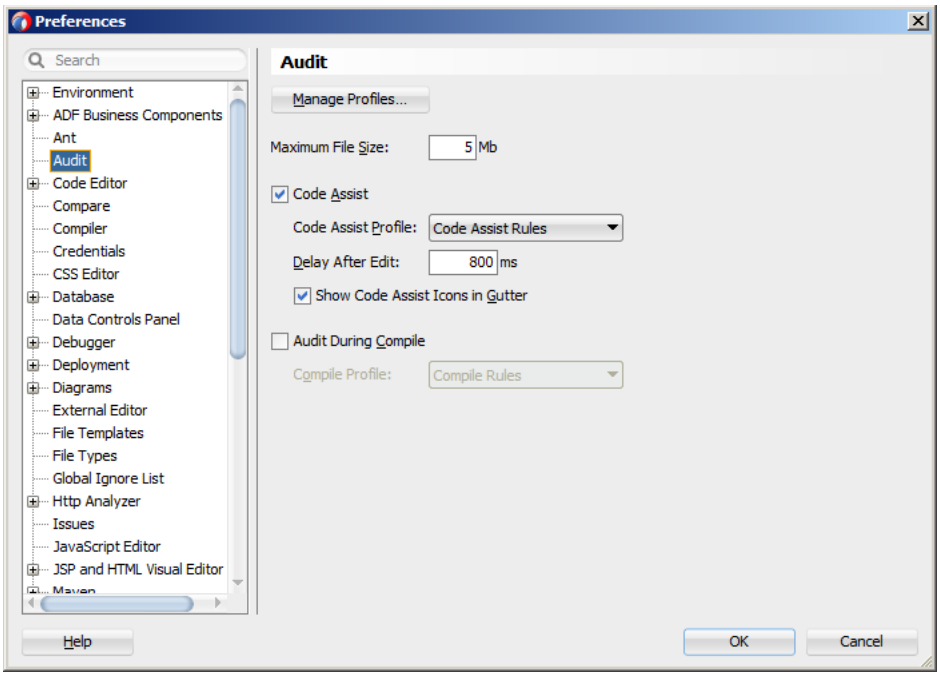
Component	Accessibility Attribute	Accessibility Audit Message
Input Date (`inputDate`)	Label (`label`)	`inputDate` is not labeled. The label attribute of `inputDate` should be specified.
Input Number Slider (`inputNumberSlider`)	Label (`label`)	`inputNumberSlider` is not labeled. The label attribute of `inputNumberSlider` should be specified.
Panel Label and Message (`panelLabelAndMessage`)	Label (`label`)	`panelLabelAndMessage` is not labeled. The label attribute of `panelLabelAndMessage` should be specified.
Select Item (`selectItem`)	Label (`label`)	`selectItem` is not labeled. The label attribute of `selectItem` should be specified.
Checkbox (`selectBooleanCheckbox`)	Label (`label`)	`selectBooleanCheckbox` is not labeled. The label attribute of `selectBooleanCheckbox` should be specified.
Boolean Switch (`selectBooleanSwitch`)	Label (`label`)	`selectBooleanSwitch` is not labeled. The label attribute of `selectBooleanSwitch` should be specified.
Radio Button (`selectOneRadio`)	Label (`label`)	`selectOneRadio` is not labeled. The label attribute of `selectOneRadio` should be specified.
Select Many Checkbox (`selectManyCheckbox`)	Label (`label`)	`selectManyCheckbox` is not labeled. The label attribute of `selectManyCheckbox` should be specified.
Select Many Choice (`selectManyChoice`)	Label (`label`)	`selectManyChoice` is not labeled. The label attribute of `selectManyChoice` should be specified.
Choice (`selectOneChoice`)	Label (`label`)	`selectOneChoice` is not labeled. The label attribute of `selectOneChoice` should be specified.
Output Text (`outputText`)	Value (`value`)	NA [1]

[1] The value attribute is not subject to the accessibility audit.

You can configure the accessibility audit rules using JDeveloper's Preferences dialog as follows:

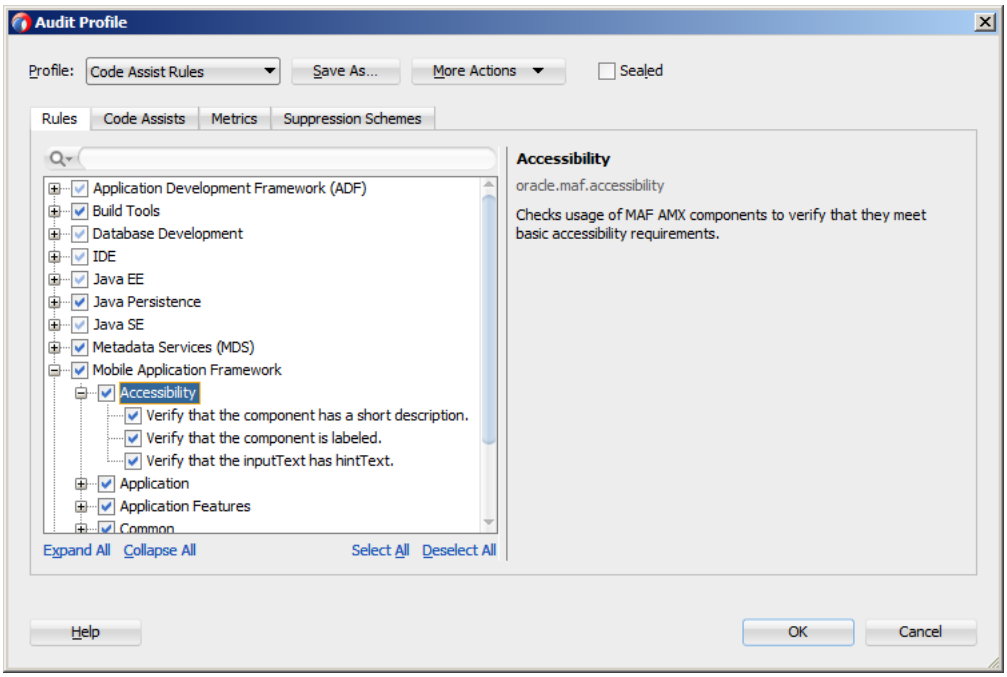
1. In JDeveloper, select **Tools > Preferences** from the main menu (on a Windows computer).
2. From the list of preferences, select **Audit** (see Figure 6–114).
3. On the **Audit** pane that Figure 6–114 shows, click **Manage Profiles** to open the **Audit Profile** dialog.

Figure 6–114 Setting Accessibility Audit Rules



4. In the **Audit Profile** dialog that Figure 6–115 shows, expand the **Mobile Application Framework** node from the tree of rules, and then expand **Accessibility**.

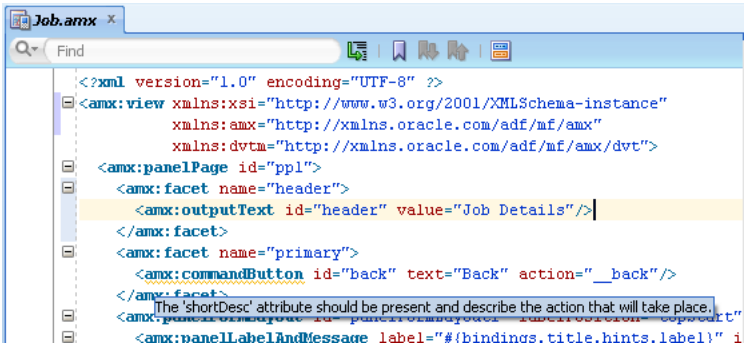
Figure 6–115 Audit Profile Dialog



5. Select the accessibility audit rules to apply to your application, as Figure 6–115 shows.

Figure 6–116 shows the accessibility audit warning displayed in JDeveloper.

Figure 6–116 Accessibility Audit Warning



For information on how to test your accessible MAF AMX application feature, see Section 22.2.1, "How to Perform Accessibility Testing on iOS-Powered Devices."

Note: WAI-ARIA accessibility functionality is not supported on Android for data visualization components.

Other MAF AMX UI components might not perform as expected when the application is run in the Android screen reader mode.

6.8.2 What You May Need to Know About the Basic WAI-ARIA Terms

As stated in the WAI-ARIA 1.0 specification, complex web applications become inaccessible when assistive technologies cannot determine the semantics behind portions of a document or when the user is unable to effectively navigate to all parts of it in a usable way. WAI-ARIA divides the semantics into roles (the type defining a user interface element), and states and properties supported by the roles. The following semantic associations form the base for the WAI-ARIA terms:

- Role
- Landmark
- Live region

For more information, see "Important Terms" at `http://www.w3.org/TR/wai-aria/terms`.

The following tables list role categories (as defined in the WAI-ARIA 1.0 specification) that are applicable to MAF.

Table 6–12 lists abstract roles that are used to support the WAI-ARIA role taxonomy for the purpose of defining general role concepts.

Table 6–12 Abstract Roles

Abstract Role	Description
input	A generic type of widget that allows the user input.
landmark	A region of the page intended as a navigational landmark.
select	A form widget that allows the user to make selections from a set of choices.
widget	An interactive component of a graphical user interface.

Table 6–13 lists widget roles that act as standalone user interface widgets or as part of larger, composite widgets.

Table 6–13 Widget Roles

Widget Role	Description	Widget Required States
alertdialog	A type of dialog that contains an alert message, where initial focus moves to an element within the dialog.	aria-labelledby, aria-describedby
button	An input that allows for user-triggered actions when clicked or pressed.	aria-expanded (state), aria-pressed (state)
checkbox	A checkable input that has three possible values: `true`, `false`, or `mixed`.	aria-checked (state)
dialog	A dialog represented by an application window that is designed to interrupt the current processing of an application in order to prompt the user to enter information or require a response.	aria-labelledby, aria-describedby
link	An interactive reference to an internal or external resource that, when activated, causes the user agent to navigate to that resource.	aria-disabled (state), aria-describedby
option	A selectable item in a select list.	aria-labelledby, aria-checked (state), aria-selected (state)
radio	A checkable input in a group of radio roles, only one of which can be checked at a time.	aria-checked (state), aria-disabled (state)
slider	A user input where the user selects a value from within a given range.	aria-valuemax, aria-valuemin, aria-valuenow, aria-disabled (state)
listbox	A widget that allows the user to select one or more items from a list of choices.	aria-live
radiogroup	A group of radio buttons.	aria-disabled (state)
listitem	A single item in a list or directory.	aria-describedby
textbox	Input that allows free-form text as its value.	aria-labelledby, aria-readonly, aria-required, aria-multiline, aria-disabled (state)

Table 6–14 lists document structure roles that describe structures that organize content in a page. Typically, document structures are not interactive.

Table 6–14 Document Structure Roles

Document Structure Role	Description
img	A container for a collection of elements that form an image.
list	A group of non-interactive list items.
listitem	A single item in a list or directory.

Table 6–15 lists landmark roles that represent regions of the page intended as navigational landmarks.

Table 6–15 Landmark Roles

Landmark Role	Description
application	A region declared as a web application (as opposed to a web document).
banner	A region that contains mostly site-oriented content (rather than page-specific content).
complementary	A supporting section of a document designed to be complementary to the main content at a similar level in the DOM hierarchy, but that remains meaningful when separated from the main content.
contentinfo	A large perceivable region that contains information about the parent document.
form	A region that contains a collection of items and objects that, as a whole, combine to create a form.
main	The main content of a document.
navigation	A collection of navigational elements (usually links) for navigating the document or related documents.
search	A region that contains a collection of items and objects that, as a whole, combine to create a search facility.

For the majority of MAF UI components, you cannot modify accessible WAI-ARIA attributes. For some components, you can set special accessible attributes at design time, and for the Panel Group Layout and Deck, you can use the WAI-ARIA landmark role type. For more information, see Section 6.8.1, "How to Configure UI and Data Visualization Components for Accessibility."

6.8.3 What You May Need to Know About the Oracle Global HTML Accessibility Guidelines

The Oracle Global HTML Accessibility Guidelines (OGHAG) is a set of scripting standards for HTML that Oracle follows. These standards represent a combination of Section 508 (see `http://www.section508.gov`) and Web Content Accessibility Guidelines (WCAG) 1.0 level AA (see `http://www.w3.org/TR/WCAG10`), with improved wording and checkpoint measurements.

For more information, see *Oracle's Accessibility Philosophy and Policies* at `http://www.oracle.com/us/corporate/accessibility/policies/index.html`.

6.9 Validating Input

MAF allows you to inform the end user about data input errors and other conditions that occur during data input. Depending on their type (error or warning), validation messages have a different look and feel.

The user input validation is triggered when an input is submitted: Input Text components are automatically validated when the end user leaves the field; for selection components, such as a Checkbox or Choice, the validation occurs when the end user makes a selection. For validation purposes, UI components on a MAF AMX page are grouped together within a Validation Group operation (`validationGroup`) to define components whose input is to be validated when the submit operation takes place. A Validation Behavior (`validationBehavior`) component defines which Validation Group is to be validated before a command component's action is taken. A

command component can have multiple child Validation Behavior components. Validation does not occur if a component does not have a Validation Behavior defined for it.

Note: You cannot define nested Validation Group operations.

The following is an invalid definition of a Validation Group:

```
<amx:view>
   <amx:panelPage>
      <amx:validationGroup>
         <amx:panelGroupLayout>
            <amx:validationGroup/>
         <amx:panelGroupLayout/>
      </amx:validationGroup>
   </amx:panelPage>
</amx:view>
```

The following is a valid definition:

```
<amx:view>
   <amx:panelPage>
      <amx:validationGroup>
   </amx:panelPage>
   <amx:popup>
      <amx:validationGroup>
   </amx:popup>
</amx:view>
```

If a MAF AMX page contains any validation error messages, you can use command components, such as List Item, Link, and Button, to prevent the end user from navigating off the page. Messages containing warnings do not halt the navigation.

Example 6–116 shows how to define validation elements, including multiple Validation Group and Validation Behavior operations, in a MAF AMX file.

Example 6–116 Defining Input Validation

```
<amx:panelPage id="pp1">
   <amx:facet name="header">
      <amx:outputText id="outputText1" value="Validate"/>
   </amx:facet>
   <amx:facet name="secondary">
      <amx:commandButton id="commandButton2" action="go" text="Save">
         <amx:validationBehavior id="vb1"
                                 disabled="#{pageFlowScope.myPanel ne 'panel1'}"
                                 group="group1"/>
         <amx:validationBehavior id="vb2"
                                 disabled="#{pageFlowScope.myPanel ne 'panel2'}"
                                 group="group2"/>
         <!-- invalid, should be caught by audit rule but for any reason
         if group not found at run time, this validate is ignored -->
         <amx:validationBehavior id="vb3" disabled="false" group="groupxxx"/>
         <!-- group is not found at run time, this validate is ignored -->
         <amx:validationBehavior id="vb4" disabled="false" group="group3"/>
      </amx:commandButton>
   </amx:facet>
   <amx:panelSplitter id="ps1" selectedItem="#{pageFlowScope.myPanel}">
      <amx:panelItem id="pi1">
```

```
            <amx:validationGroup id="group1">
               <amx:panelFormLayout id="pfl1">
                  <amx:inputText value="#{bindings.first.inputValue}"
                                 required="true"
                                 label="#{bindings.first.hints.label}"
                                 id="inputText1"/>
                  <amx:inputText value="#{bindings.last.inputValue}"
                                 label="#{bindings.last.hints.label}"
                                 id="inputText2"/>
               </amx:panelFormLayout>
            </amx:validationGroup>
         </amx:panelItem>
         <amx:panelItem id="pi2">
            <amx:validationGroup id="group2">
               <amx:panelFormLayout id="pfl2">
                  <amx:inputText value="#{bindings.salary.inputValue}"
                                 label="#{bindings.first.hints.label}"
                                 id="inputText3"/>
                  <amx:inputText value="#{bindings.last.inputValue}"
                                 label="#{bindings.last.hints.label}"
                                 id="inputText4"/>
               </amx:panelFormLayout>
            </amx:validationGroup>
         </amx:panelItem>
      </amx:panelSplitter>
      <amx:panelGroupLayout id="pgl1" rendered="false">
         <amx:validationGroup id="group3">
            <amx:panelFormLayout id="pfl4">
               <amx:inputText value="#{bindings.salary.inputValue}"
                              label="#{bindings.first.hints.label}"
                              id="inputText5"/>
               <amx:inputText value="#{bindings.last.inputValue}"
                              label="#{bindings.last.hints.label}"
                              id="inputText6"/>
            </amx:panelFormLayout>
         </amx:validationGroup>
      </amx:panelGroupLayout>
</amx:panelPage>
```

Example 6–117 shows how to define a validation message displayed in a popup in a MAF AMX file.

Example 6–117 Defining Input Validation with Popup Message

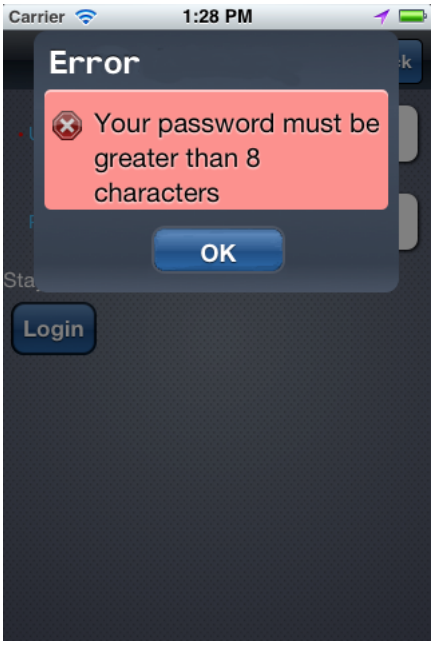
```
<amx:panelPage id="pp1">
   <amx:facet name="header">
      <amx:outputText id="outputText1" value="Login Demo"/>
   </amx:facet>
   <amx:facet name="secondary">
      <amx:commandButton id="btnBack" action="__back" text="Back"/>
   </amx:facet>
   <amx:panelGroupLayout id="panelGroupLayout1">
      <amx:validationGroup id="group1">
         <amx:panelGroupLayout id="panelGroupLayout2">
            <amx:inputText value="#{bindings.userName.inputValue}"
                           label="#{bindings.userName.hints.label}"
                           id="inputText1"
                           showRequired="true"
                           required="true"/>
            <amx:inputText value="#{bindings.password.inputValue}"
```

```
                            label="#{bindings.password.hints.label}"
                            id="inputText2"
                            required="true"
                            showRequired="true"
                            secret="true"/>
                <amx:outputText id="outputText2"
                                value="#{bindings.timeToStayLoggedIn.hints.label}:
                                #{bindings.timeToStayLoggedIn.inputValue} minutes"/>
            </amx:panelGroupLayout>
        </amx:validationGroup>
        <amx:commandButton id="commandButton2"
                           text="Login"
                           action="navigationSuccess">
            <amx:validationBehavior id="validationBehavior2" group="group1"/>
        </amx:commandButton>
    </amx:panelGroupLayout>
</amx:panelPage>
```

Validation messages are displayed in a Popup component (see Section 6.2.8, "How to Use a Popup Component"). You cannot configure the title of a validation popup, which is automatically determined by the relative message severity: the most severe of all of the current messages becomes the title of the validation popup. That is, if all validation messages are of type `WARNING`, then the title is "Warning"; if some of the messages are of type `WARNING` and others are of type `ERROR`, then the title is set to "Error".

Figure 6–117 shows a popup validation message produced at runtime.

Figure 6–117 Validation Message on iPhone



6.10 Using Event Listeners

To invoke Java code from your MAF AMX pages and perform the application logic, you define listeners as attributes of UI components in one of the following ways:

- Manually in the source of your MAF AMX file.

- From the **Properties** window for the selected component. For more information, see *Oracle Fusion Middleware Tag Reference for Oracle Mobile Application Framework*

You may use the following listeners to add awareness of the UI-triggered events to your MAF AMX page:

- `valueChangeListener`: listens to `ValueChangeEvent` that is constructed with the following parameters:
  - `java.lang.Object` representing an old value
  - `java.lang.Object` representing a new changed value
- `actionListener`: listens to `ActionEvent` that is constructed without parameters;
- `selectionListener`: listens to `SelectionEvent` that is constructed with the following parameters:
  - `java.lang.Object` representing an old row key
  - `java.lang.String[]` representing selected row keys
- `moveListener`: listens to `MoveEvent` that is constructed with the following parameters: of the `RowKey` type representing an old row key;
  - `java.lang.Object` representing the moved row key
  - `java.lang.String[]` representing the row key before which the moved row key was inserted
- `rangeChangeListener`: listens to `RangeChangeEvent` that is constructed without parameters.
- `mapBoundsChangeListener`: listens to `MapBoundsChangeEvent` that is constructed with the following parameters:
  - `java.lang.Object` representing the X coordinate (longitude) of minimum map bounds
  - `java.lang.Object` representing the Y coordinate (latitude) of minimum map bounds
  - `java.lang.Object` representing the X coordinate (longitude) of maximum map bounds
  - `java.lang.Object` representing the Y coordinate (latitude) of maximum map bounds
  - `java.lang.Object` representing the X coordinate (longitude) of the map center
  - `java.lang.Object` representing the Y coordinate (latitude) of the map center
  - `int` representing the current zoom level
- `mapInputListener`: listens to `MapInputEvent` that is constructed with the following parameters:
  - `java.lang.String` representing the event type
  - `java.lang.Object` representing the X coordinate of the event point
  - `java.lang.Object` representing the Y coordinate of the event point
- `viewportChangeListener`: listens to `ViewportChangeEvent` that is constructed with the following parameters:
  - `java.lang.Object` representing the minimum X coordinate
  - `java.lang.Object` representing the maximum X coordinate

- `java.lang.Object` representing the minimum Y coordinate
- `java.lang.Object` representing the maximum Y coordinate
- `java.lang.Object` representing the first visible group
- `java.lang.Object` representing the last visible group

The value for your listener must match the pattern `#{*}` and conform to the following requirements:

- Type name: EL Expression
- Base type: string
- Primitive type: string

For information on EL events, see Section 7.3.6, "About EL Events."

Most MAF AMX event classes extend the `oracle.adfmf.amx.event.AMXEvent` class. When defining event listeners in your Java code, you need to pass the `oracle.adfmf.amx.event.AMXEvent` class.

For more information, see the following:

- *Oracle Fusion Middleware Java API Reference for Oracle Mobile Application Framework*
- *Oracle Fusion Middleware Tag Reference for Oracle Mobile Application Framework*
- Section 12.2.2, "How to Use AmxEvent Classes"

MAF allows you to create managed bean methods for listeners so that your managed bean methods use MAF AMX-specific event classes. Example 6–118, Example 6–119, and Example 6–120 demonstrate a Button and a Link component calling the same managed bean method. The source value of the `AMXEvent` determines which object invoked the event by showing a message box with the component's ID.

Example 6–118 Calling a Bean Method from MAF AMX File

```
<amx:commandButton text="commandButton1"
                   id="commandButton1"
                   actionListener="#{applicationScope.Bean.actionListenerMethod}">
</amx:commandButton>
<amx:commandLink text="commandLink1"
                 id="commandLink1"
                 actionListener="#{applicationScope.Bean.actionListenerMethod}">
</amx:commandLink>
```

Example 6–119 Using AMXEvent

```
private void actionListenerMethod(AMXEvent amxEvent) {
   // Some Java handling
}
```

Example 6–120 Invoking the Event Method

```
public Object invokeMethod(String methodName, Object[] params) {
   if (methodName.equals("actionListenerMethod")) {
      actionListenerMethod((AMXEvent) params[0]);
   }
   return null;
}
```

For additional examples, see a MAF sample application called APIDemo located in the `PublicSamples.zip` file within the *jdev_*

install/jdeveloper/jdev/extensions/oracle.maf/Samples directory on your development computer. This sample demonstrates how to call listeners from Java beans.

6.10.1 What You May Need to Know About Constrained Type Attributes for Event Listeners

You can define event listeners as children of some MAF AMX UI components. The listeners' `type` attribute identifies which event they are to be registered to handle. Since each parent UI component supports only a subset of the events (suitable for that particular component), these supported events are presented in a constrained list of types that you can select for a listener.

Table 6–16 lists parent UI components, event listeners they can have as children, and event types they support.

Table 6–16 Supported Event Listeners and Event Types

UI Component (parent)	ActionListener (child)	SetPropertyListener (child)	ShowPopupBehavior (child)	ClosePopupBehavior (child)	actionListener (attribute)	valueChangeListener (attribute)	moveListener (attribute)	selectionListener (attribute)	mapBoundsChangeListener (attribute)	mapInputListener (attribute)	viewportChangeListener (attribute)	rangeChangeListener (attribute)
Button	Supported	Supported	Supported	Supported	Supported	Not supported	Not supported	Not supported	Not supported	Not supported	Not supported	Not supported
Link	Supported	Supported	Supported	Supported	Supported	Not supported	Not supported	Not supported	Not supported	Not supported	Not supported	Not supported
List Item	Supported	Supported	Supported	Supported	Supported	Not supported	Not supported	Not supported	Not supported	Not supported	Not supported	Not supported
Input Date	Not supported	Not supported	Not supported	Not supported	Not supported	Supported	Not supported	Not supported	Not supported	Not supported	Not supported	Not supported
Input Number Slider	Not supported	Not supported	Not supported	Not supported	Not supported	Supported	Not supported	Not supported	Not supported	Not supported	Not supported	Not supported
Input Text	Not supported	Not supported	Not supported	Not supported	Not supported	Supported	Not supported	Not supported	Not supported	Not supported	Not supported	Not supported
List View	Not supported	Not supported	Not supported	Not supported	Not supported	Not supported	Supported	Supported	Not supported	Not supported	Not supported	Supported
Checkbox	Not supported	Not supported	Not supported	Not supported	Not supported	Supported	Not supported	Not supported	Not supported	Not supported	Not supported	Not supported
Switch	Not supported	Not supported	Not supported	Not supported	Not supported	Supported	Not supported	Not supported	Not supported	Not supported	Not supported	Not supported

Table 6–16 (Cont.) Supported Event Listeners and Event Types

UI Component (parent)	Action Listener (child)	Set Property Listener (child)	Show Popup Behavior (child)	Close Popup Behavior (child)	actionListener (attribute)	valueChangeListener (attribute)	moveListener (attribute)	selectionListener (attribute)	mapBoundsChangeListener (attribute)	mapInputListener (attribute)	viewportChangeListener (attribute)	rangeChangeListener (attribute)
Checkbox (Select Many)	Not supported	Not supported	Not supported	Not supported	Not supported	Supported	Not supported	Not supported	Not supported	Not supported	Not supported	Not supported
Choice (Select Many)	Not supported	Not supported	Not supported	Not supported	Not supported	Supported	Not supported	Not supported	Not supported	Not supported	Not supported	Not supported
Choice	Not supported	Not supported	Not supported	Not supported	Not supported	Supported	Not supported	Not supported	Not supported	Not supported	Not supported	Not supported
Select Button	Not supported	Not supported	Not supported	Not supported	Not supported	Supported	Not supported	Not supported	Not supported	Not supported	Not supported	Not supported
Radio Button	Not supported	Not supported	Not supported	Not supported	Not supported	Supported	Not supported	Not supported	Not supported	Not supported	Not supported	Not supported
Link (Go)	Not supported	Not supported	Not supported	Not supported	Not supported	Not supported	Not supported	Not supported	Not supported	Not supported	Not supported	Not supported
Carousel	Not supported	Not supported	Not supported	Not supported	Not supported	Not supported	Not supported	Not supported	Not supported	Not supported	Not supported	Not supported
Carousel Item	Not supported	Not supported	Not supported	Not supported	Not supported	Not supported	Not supported	Not supported	Not supported	Not supported	Not supported	Not supported
Image	Not supported	Not supported	Not supported	Not supported	Not supported	Not supported	Not supported	Not supported	Not supported	Not supported	Not supported	Not supported
Area Chart	Not supported	Not supported	Not supported	Not supported	Not supported	Not supported	Not supported	Supported	Not supported	Not supported	Supported	Not supported
Bar Chart	Not supported	Not supported	Not supported	Not supported	Not supported	Not supported	Not supported	Supported	Not supported	Not supported	Supported	Not supported
Bubble Chart	Not supported	Not supported	Not supported	Not supported	Not supported	Not supported	Not supported	Supported	Not supported	Not supported	Not supported	Not supported
Combo Chart	Not supported	Not supported	Not supported	Not supported	Not supported	Not supported	Not supported	Supported	Not supported	Not supported	Supported	Not supported
Horizontal Bar Chart	Not supported	Not supported	Not supported	Not supported	Not supported	Not supported	Not supported	Supported	Not supported	Not supported	Supported	Not supported
Led Gauge	Not supported	Not supported	Supported	Supported	Not supported	Not supported	Not supported	Not supported	Not supported	Not supported	Not supported	Not supported

Table 6–16 (Cont.) Supported Event Listeners and Event Types

UI Component (parent)	Action Listener (child)	Set Property Listener (child)	Show Popup Behavior (child)	Close Popup Behavior (child)	actionListener (attribute)	valueChangeListener (attribute)	moveListener (attribute)	selectionListener (attribute)	mapBoundsChangeListener (attribute)	mapInputListener (attribute)	viewportChangeListener (attribute)	rangeChangeListener (attribute)
Dial Gauge	Not supported	Not supported	Supported	Supported	Not supported	Supported	Not supported	Not supported	Not supported	Not supported	Not supported	Not supported
Rating Gauge	Not supported	Not supported	Supported	Supported	Not supported	Supported	Not supported	Not supported	Not supported	Not supported	Not supported	Not supported
Line Chart	Not supported	Not supported	Not supported	Not supported	Not supported	Not supported	Not supported	Supported	Not supported	Not supported	Supported	Not supported
Pie Chart	Not supported	Not supported	Not supported	Not supported	Not supported	Not supported	Not supported	Supported	Not supported	Not supported	Not supported	Not supported
Scatter Chart	Not supported	Not supported	Not supported	Not supported	Not supported	Not supported	Not supported	Supported	Not supported	Not supported	Not supported	Not supported
Spark Chart	Not supported	Not supported	Not supported	Not supported	Not supported	Not supported	Not supported	Not supported	Not supported	Not supported	Not supported	Not supported
Status Meter Gauge	Not supported	Not supported	Supported	Supported	Not supported	Supported	Not supported	Not supported	Not supported	Not supported	Not supported	Not supported
Geographic Map	Not supported	Supported[1]	Not supported	Not supported	Not supported	Not supported	Not supported	Supported[2]	Supported	Supported	Not supported	Not supported
Thematic Map	Not supported	Supported[3]	Not supported	Not supported	Not supported	Not supported	Not supported	Supported[4]	Not supported	Not supported	Not supported	Not supported
Sunburst	Not supported	Not supported	Not supported	Not supported	Not supported	Not supported	Not supported	Supported	Not supported	Not supported	Not supported	Not supported
Treemap	Not supported	Not supported	Not supported	Not supported	Not supported	Not supported	Not supported	Supported	Not supported	Not supported	Not supported	Not supported
Timeline	Not supported	Not supported	Not supported	Not supported	Not supported	Not supported	Not supported	Not supported	Not supported	Not supported	Not supported	Not supported
NBox	Not supported	Not supported	Not supported	Not supported	Not supported	Not supported	Not supported	Supported	Not supported	Not supported	Not supported	Not supported

[1] The Set Property Listener can be specified as a child of the Geographic Map's Marker of Area.

[2] The selectionListener attribute can be set on the Geographic Map's Area Data Layer or Point Data Layer.

[3] The Set Property Listener can be specified as a child of the Thematic Map's Marker of Area.

[4] The selectionListener attribute can be set on the Thematic Map's Area Data Layer or Point Data Layer.

The `type` attribute (see Figure 6–118) of each of the child event listeners has a base set of values that match the listener events. These values are filtered based on the

information presented in Table 6–16 such that when the child event listener is within the context of the identified parent UI component, only the events that the parent supports are shown. For example, under a Button component, the Action Listener or Set Property Listener child would show only the `action` Type value, as well as gestures.

Figure 6–118 shows values available in the constrained Type list of the Set Property Listener for a parent List Item component.

Figure 6–118 Selecting Event Type

7

Using Bindings and Creating Data Controls

This chapter describes how to use data bindings, data controls, and the data binding expression language (EL) with the Mobile Application Framework (MAF). In addition, object scope lifecycles, managed beans, UI hints, validation, and data change events are also discussed.

This chapter includes the following sections:

7.1 Introduction to Bindings and Data Controls

Mobile Application Framework implements two concepts that enable the decoupling of the user interface (UI) technology from the business service implementation: *data controls* and *declarative bindings*. Data controls abstract the implementation technology of a business service by using standard metadata interfaces to describe the service's operations and data collections, including information about the properties, methods, and types involved. Using JDeveloper, you can view that information as icons that you can drag and drop onto a page. Declarative bindings abstract the details of accessing data from data collections in a data control and invoking its operations. At runtime, the model layer reads the information describing the data controls and bindings from the appropriate XML files and then implements the two-way connection between the user interface and the business service.

The group of bindings supporting the user interface components on a page are described in a page-specific XML file called the page definition file. The model layer

uses this file at runtime to instantiate the page's bindings. These bindings are held in a request-scoped map called the binding container, accessible during each page request using the EL expression `#{bindings}`. This expression always evaluates to the binding container for the current page. You can design a databound user interface by dragging an item from the Data Controls panel and dropping it on a page as a specific UI component. When you use data controls to create a UI component, JDeveloper automatically creates the code and objects needed to bind the component to the data control you selected.

The Mobile Application Framework comes with two out-of-the box data controls: the DeviceFeatures data control and the ApplicationFeatures data control. The DeviceFeatures data control appears within the Data Controls panel in JDeveloper, enabling you to drag and drop the primary data attributes of data controls to your application as (text) fields, and the operations of data controls as command objects (buttons). These drag and drop actions will generate EL bindings in your application and the appropriate properties for the controls that are created. The bindings are represented in a `DataControls.dcx` file, which points at the data control source, and the page bindings link the specific page's reference to the data control. For information about the ApplicationFeatures data control, see Section 4.5.5, "What You May Need to Know About Custom Springboard Application Features with MAF AMX Content."

For more information about data controls and bindings, see the following:

- Section 7.5, "Exposing Business Services with Data Controls"
- Section 7.6, "Creating Databound UI Components from the Data Controls Panel"
- Section 7.7, "What Happens at Runtime: How the Binding Context Works"
- Section 7.8, "Configuring Data Controls"
- Section 7.9, "Working with Attributes"
- Section 7.10, "Creating and Using Bean Data Controls"
- Section 7.11, "Using the DeviceFeatures Data Control"

7.2 About Object Scope Lifecycles

At runtime, you pass data to pages by storing the needed data in an object scope where the page can access it. The scope determines the lifespan of an object. Once you place an object in a scope, it can be accessed from the scope using an EL expression. For example, you might create a managed bean named `foo`, and define the bean to live in the view scope. To access that bean, you would use the expression `#{viewScope.foo}`.

Mobile Application Framework variables and managed bean references are defined within different object scopes that determine the variable's lifetime and visibility. MAF supports the following scopes, listed in order of decreasing visibility:

- Application scope—The object is available for the duration of the application (across features).
- Page flow scope—The object is available for the duration of a feature (single feature boundary).
- View scope—The object is available for the duration of the view (single page of a feature).

Object scopes are analogous to global and local variable scopes in programming languages. The wider the scope, the higher the availability of an object. During their lifespan, these objects may expose certain interfaces, hold information, or pass

variables and parameters to other objects. For example, a managed bean defined in application scope will be available for use during multiple page requests for the duration of the application. However, a managed bean defined in view scope will be available only for the duration of one page request within a feature.

EL expressions defined in the application scope namespace are available for the life of the application, across feature boundaries. You can define an application scope in one view of an application, and then reference it in another. EL expressions defined in the page flow scope namespace are available for the duration of a feature, within the bounds of a single feature. EL expressions defined in the view scope namespace are available for the duration of the view, within the bounds of a single page of a feature. In addition to these variable-containing scopes, MAF defines scopes that can expose information about device properties and application preferences. These scopes have application-level lifetime and visibility. For more information, see Section 7.3.5.2, "About the Managed Beans Category" and Section 7.3.5.3, "About the Mobile Application Framework Objects Category."

When determining what scope to register a managed bean with or to store a value in, always try to use the narrowest scope possible. Use the application scope only for information that is relevant to the whole application, such as user or context information. Avoid using the application scope to pass values from one page to another.

Note: Every object you put in a memory scope is serialized to a JSON `DataChangeEvent`, and objects returned by any getter method inside this object are also serialized. This can lead to deeply nested object trees that are serialized, which will decrease performance. To avoid serialization of a chain of nested objects, you should define them as transient. See Section 7.10.1, "What You May Need to Know About Serialization of Bean Class Variables" for more information.

7.2.1 What You May Need to Know About Object Scopes and Task Flows

When determining what scope to use for variables within a task flow, you should use only view or page flow scopes. The application scope will persist objects in memory beyond the life of the task flow and therefore compromise the encapsulation and reusable aspects of a task flow. In addition, application scope may keep objects in memory longer than needed, causing unneeded overhead.

When you need to pass data values between activities within a task flow, you should use page flow scope. View scope should be used for variables that are needed only within the current view activity, not across view activities.

7.3 Creating EL Expressions

You use EL expressions in MAF applications to bind attributes to object values determined at runtime. For example, `#{UserList.selectedUsers}` might reference a set of selected users, `#{user.name}` might reference a particular user's name, while `#{user.role == 'manager'}` would evaluate whether a user is a manager or not. At runtime, a generic expression evaluator returns the `List`, `String`, and `boolean` values of these respective expressions, automating access to the individual objects and their properties without requiring code.

Expressions are not evaluated until they are needed for rendering a value. Because MAF AMX supports only deferred evaluation, an expression using the immediate construction expression (`"${}"`) still parses, but behaves the same as a deferred

expression ("#{}"). At runtime, the value of certain UI components (such as an inputText component or an outputText component) is determined by its value attribute. While a component can have static text as its value, typically the value attribute will contain an EL expression that the runtime infrastructure evaluates to determine what data to display. For example, an outputText component that displays the name of the currently logged-in user might have its value attribute set to the expression #{UserInfo.name}. Since any attribute of a component (and not just the value attribute) can be assigned a value using an EL expression, it's easy to build dynamic, data-driven user interfaces. For example, you could hide a component when a set of objects you need to display is empty by using a boolean-valued expression like #{not empty UserList.selectedUsers} in the UI component's rendered attribute. If the list of selected users in the object named UserList is empty, the rendered attribute evaluates to false and the component disappears from the page.

In a typical application, you would create objects like UserList as a managed bean. The runtime manages instantiating these beans on demand when any EL expression references them for the first time. When displaying a value, the runtime evaluates the EL expression and pulls the value from the managed bean to populate the component with data when the page is displayed. If the user updates data in the UI component, the runtime pushes the value back into the corresponding managed bean based on the same EL expression. For more information about creating and using managed beans, see Section 7.4, "Creating and Using Managed Beans." For more information about EL expressions, see the Java EE tutorial at http://www.oracle.com/technetwork/java/index.html.

Note: When using an EL expression for the value attribute of an editable component, you must have a corresponding set method for that component, or else the EL expression will evaluate to read-only, and no updates to the value will be allowed.

For example, say you have an inputText component (whose ID is it1) on a page, and you have its value set to #{myBean.inputValue}. The myBean managed bean would have to have get and set methods as follows, in order for the inputText value to be updated:

```
public void setIt1(RichInputText it1) {
    this.it1 = it1;
}

public RichInputText getIt1() {
    return it1;
}
```

7.3.1 About Data Binding EL Expressions

When you use the Data Controls panel to create a component, the MAF data binding expressions are created for you. The expressions are added to every component attribute that will either display data from or reference properties of a binding object. Each prebuilt expression references the appropriate binding objects defined in the page definition file. You can edit these binding expressions or create your own, as long as you adhere to the basic MAF binding expression syntax. MAF data binding expressions can be added to any component attribute that you want to populate with data from a binding object, if the attribute supports EL.

A typical MAF data binding EL expression uses the following syntax to reference any of the different types of binding objects in the binding container:

```
#{bindings.BindingObject.propertyName}
```

where:

- `bindings` is a variable that identifies that the binding object being referenced by the expression is located in the binding container of the current page. All MAF data binding EL expressions must start with the `bindings` variable.
- *`BindingObject`* is the ID, or for attributes the name, of the binding object as it is defined in the page definition file. The binding `objectID` or name is unique to that page definition file. An EL expression can reference any binding object in the page definition file, including parameters, executables, or value bindings.
- *`propertyName`* is a variable that determines the default display characteristics of each databound UI component and sets properties for the binding object at runtime. There are different binding properties for each type of binding object. For more information about binding properties, see Section 7.3.3, "What You May Need to Know About MAF Binding Properties."

For example, in the following expression:

```
#{bindings.ProductName.inputValue}
```

the `bindings` variable references a bound value in the current page's binding container. The binding object being referenced is `ProductName`, which is an attribute binding object. The binding property is `inputValue`, which returns the value of the first `ProductName` attribute.

> **Tip:** While the binding expressions in the page definition file can use either a dollar sign (`$`) or hash sign (`#`) prefix, the EL expressions in MAF pages can only use the hash sign (`#`) prefix.

As stated previously, when you use the Data Controls panel to create UI components, these expressions are built for you. However, you can also manually create them if you need to. The JDeveloper Expression Builder is a dialog that helps you build EL expressions by providing lists of binding objects defined in the page definition files, as well as other valid objects to which a UI component may be bound. It is particularly useful when creating or editing MAF databound expressions because it provides a hierarchical list of MAF binding objects and their most commonly used properties. For information about binding properties, see Section 7.3.3, "What You May Need to Know About MAF Binding Properties."

7.3.2 How to Create an EL Expression

You can create EL expressions declaratively using the JDeveloper Expression Builder. You can access the Expression Builder from the Properties window.

Before you begin

It may be helpful to have an understanding of EL expressions. For more information, see Section 7.3, "Creating EL Expressions."

To use the Expression Builder:

1. In the Properties window, locate the attribute you wish to modify and use the rightmost dropdown menu to choose **Expression Builder**.
2. Create expressions using the following features:

- Use the **Variables** dropdown to select items that you want to include in the expression. These items are displayed in a tree that is a hierarchical representation of the binding objects. Each icon in the tree represents various types of binding objects that you can use in an expression.

  To narrow down the tree, you can either use the dropdown filter or enter search criteria in the search field. The EL accessible objects exposed by MAF are located under the **Mobile Application Framework Objects** node, which is under the **ADF Managed Beans** node.

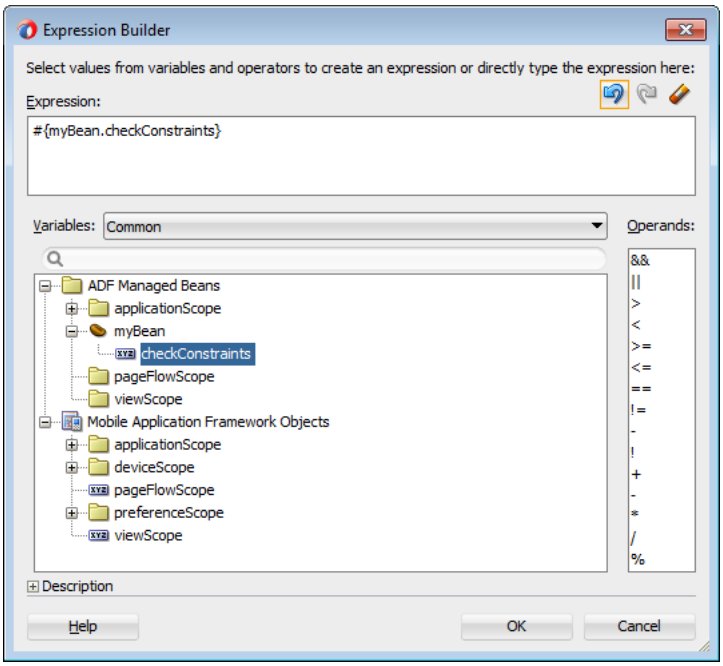
  Tip: For more information about these objects, see the MAF Javadoc. See also Section 7.3.5, "About the Categories in the Expression Builder."

  Selecting an item in the tree causes it to be moved to the **Expression** box within an EL expression. You can also type the expression directly in the **Expression** box.

- Use the operator buttons to add logical or mathematical operators to the expression.

Figure 7–1 shows an example of how to create an EL expression from the ADF Managed Beans category. However, you can create EL expressions from any of the categories described in Section 7.3.5, "About the Categories in the Expression Builder."

Figure 7–1 The Expression Builder Dialog



Tip: For information about using proper syntax to create EL expressions, see the Java EE tutorial at `http://download.oracle.com/javaee/index.html`.

Table 7–1 Icons Under the Bindings Node of the Expression Builder

Icon	Description
	Represents the `bindings` container variable, which references the binding container of the current page. Opening the `bindings` node exposes all the binding objects for the current page.
	Represents the `data` binding variable, which references the entire binding context (created from all the `.cpx` files in the application). Opening the `data` node exposes all the page definition files in the application.
	Represents an action binding object. Opening a node that uses this icon exposes a list of valid action binding properties.
	Represents an iterator binding object. Opening a node that uses this icon exposes a list of valid iterator binding properties.
	Represents an attribute binding object. Opening a node that uses this icon exposes a list of valid attribute binding properties.
	Represents a list binding object. Opening a node that uses this icon exposes a list of valid list binding properties.
	Represents a table or tree binding object. Opening a node that uses this icon exposes a list of valid table and tree binding properties.
	Represents a MAF binding object property. For more information about MAF properties, see Section 7.3.3, "What You May Need to Know About MAF Binding Properties."
	Represents a parameter binding object.
	Represents a bean class.
	Represents a method.

7.3.2.1 About the Method Expression Builder

Table 7–2 shows properties that have the Method Expression Builder option available in the Properties window instead of the Expression Builder option. The only difference between them is that the Method Expression Builder filters out the managed beans depending on the selected property.

Table 7–2 Properties for the Method Expression Builder

Property	Element
`action`	`amx:commandButton`
`action`	`amx:commandLink`
`action`	`amx:listItem`
`action`	`amx:navigationDragBehavior`
`action`	`dvtm:chartDataItem`
`action`	`dvtm:ieDataItem`
`action`	`dvtm:timelineItem`
`action`	`dvtm:area`

Table 7–2 (Cont.) Properties for the Method Expression Builder

Property	Element
action	dvtm:marker
actionListener	amx:listItem
actionListener	amx:commandButton
actionListener	amx:commandLink
binding	amx:actionListener
mapBoundsChangeListener	dvtm:geographicMap
mapInputListener	dvtm:geographicMap
moveListener	amx:listView
rangeChangeListener	amx:listView
selectionListener	amx:listView
selectionListener	amx:filmStrip
selectionListener	dvtm:areaDataLayer
selectionListener	dvtm:pointDataLayer
selectionListener	dvtm:treemap
selectionListener	dvtm:sunburst
selectionListener	dvtm:timelineSeries
selectionListener	dvtm:nBox
selectionListener	dvtm:areaChart
selectionListener	dvtm:barChart
selectionListener	dvtm:bubbleChart
selectionListener	dvtm:comboChart
selectionListener	dvtm:horizontalBarChart
selectionListener	dvtm:lineChart
selectionListener	dvtm:funnelChart
selectionListener	dvtm:pieChart
selectionListener	dvtm:scatterChart
valueChangeListener	amx:inputDate
valueChangeListener	amx:inputNumberSlider
valueChangeListener	amx:inputText
valueChangeListener	amx:selectBooleanCheckbox
valueChangeListener	amx:selectBooleanSwitch
valueChangeListener	amx:selectManyCheckbox
valueChangeListener	amx:selectManyChoice
valueChangeListener	amx:selectOneButton
valueChangeListener	amx:selectOneChoice
valueChangeListener	amx:selectOneRadio
valueChangeListener	dvtm:statusMeterGauge

Table 7–2 (Cont.) Properties for the Method Expression Builder

Property	Element
valueChangeListener	dvtm:dialGauge
valueChangeListener	dvtm:ratingGauge
viewportChangeListener	dvtm:areaChart
viewportChangeListener	dvtm:barChart
viewportChangeListener	dvtm:comboChart
viewportChangeListener	dvtm:horizontalBarChart
viewportChangeListener	dvtm:lineChart

7.3.2.2 About Non EL-Properties

Table 7–3 shows the properties that do not have the EL Expression Builder option available in the Properties window, because they are not EL-enabled.

Table 7–3 Non EL-Properties

Property	Element
id	all elements
facetName	amx:facetRef
failSafeClientHandler	amx:loadingIndicatorBehavior
failSafeDuration	amx:loadingIndicatorBehavior
group	amx:validationBehavior
name	amx:attribute
name	amx:attributeList
name	amx:attributeListIterator
name	amx:facet
ref	amx:attributeList
type	dvtm:attributeGroups
var	amx:carousel
var	amx:filmStrip
var	amx:iterator
var	amx:listView
var	amx:loadBundle
var	dvtm:areaChart
var	dvtm:barChart
var	dvtm:bubbleChart
var	dvtm:comboChart
var	dvtm:funnelChart
var	dvtm:horizontalBarChart
var	dvtm:lineChart
var	dvtm:pieChart

Table 7–3 (Cont.) Non EL-Properties

Property	Element
var	dvtm:scatterChart
var	dvtm:sparkChart
var	dvtm:geographicMap
varStatus	amx:attributeListIterator

7.3.3 What You May Need to Know About MAF Binding Properties

When you create a databound component using the Expression Builder, the EL expression might reference specific MAF binding properties. At runtime, these binding properties can define such things as the default display characteristics of a databound UI component or specific parameters for iterator bindings. The ADF binding properties are defined by Oracle APIs. For a full list of the available properties for each binding type, see Table 7–4, " Runtime EL Properties of MAF Bindings"

Values assigned to certain properties are defined in the page definition file. For example, iterator bindings have a property called `RangeSize`, which specifies the number of rows the iterator should display at one time. The value assigned to `RangeSize` is specified in the page definition file, as shown in Example 7–1.

Example 7–1 Iterator Binding Object with the RangeSize Property

```
<iterator Binds="ItemsForOrder" RangeSize="25"
              DataControl="BackOfficeAppModuleDataControl"
              id="ItemsForOrderIterator" ChangeEventPolicy="ppr"/>
```

7.3.4 How to Reference Binding Containers

You can reference the active screen's binding container by the root EL expression `"#{bindings}"` and you can reference another screen's binding container through the expression `"#{data.PageDefName}"`. The Mobile Application Framework AMX binding objects are referenced by name from the binding container `"#{bindings.Name}"`.

Table 7–4 shows a partial list of the properties that you can use in EL expressions to access values of the Mobile Application Framework AMX binding objects at runtime. The properties appear in alphabetical order.

Table 7–4 Runtime EL Properties of MAF Bindings

Runtime Property	Description	Iterator	Action	attributeValues	Tree
`class`	Returns the Java class object for the runtime binding.	Yes	Yes	Yes	Yes
`collectionModel`	Exposes a collection of data. EL expressions used within a component that is bound to a `collectionModel` can be referenced with a `row` variable [1], which will resolve the expression for each element in the collection.	No	No	No	Yes
`collectionModel.makeCurrent`	Causes the selected row to become the current row in the iterator for this binding.	No	No	No	Yes

Table 7–4 (Cont.) Runtime EL Properties of MAF Bindings

Runtime Property	Description	Iterator	Action	attributeValues	Tree
`collectionModel.selectedRow`	Returns a reference to the selected row.	No	No	No	Yes
`currentRow`	Returns a reference to the current row or data object pointed to by the iterator (for example, built-in navigation actions).	Yes	No	No	No
`currentRow.dataprovider`	Returns a reference to the current row or data object pointed to by the iterator. (This is the same object returned by `currentRow`, just with a different syntax).	Yes	No	No	No
`enabled`	Returns `true` or `false`, depending on the state of the action binding. For example, the action binding may be enabled (`true`) or disabled (`false`) based on the currency (as determined, for example, when the user clicks the First, Next, Previous, or Last navigation buttons).	No	Yes	No	No
`execute`	Invokes the named action or `methodAction` binding when resolved.	No	Yes	No	No
`format`	This is a shortcut for `hints.format`.	No	No	Yes	Yes
`hints`	Returns a list of name-value pairs for UI hints for all display attributes to which the binding is associated.	No	No	Yes	Yes
`inputValue`	Returns the value of the first attribute to which the binding is associated.	No	No	Yes	No
`items`	Returns the list of values associated with the current list-enabled attribute.	No	No	Yes	No
`label`	Available as a child of `hints` or direct child of an attribute. Returns the label (if supplied by control `hints`) for the first attribute of the binding.	No	No	Yes	Yes
`name`	Returns the `id` of the binding as declared in the `PageDef.xml` file.	Yes	Yes	Yes	Yes
`rangeSize`	Returns the range size of the iterator binding's row set. This allows you to determine the number of data objects to bind from the data source.	Yes	No	No	Yes

Table 7–4 (Cont.) Runtime EL Properties of MAF Bindings

Runtime Property	Description	Iterator	Action	attributeValues	Tree
`result`	Returns the result of a method that is bound and invoked by a method action binding.	No	Yes	No	No
`updateable`	Available as a child of `hints` or direct child of an attribute. Returns `true` if the first attribute to which the binding is associated is updateable. Otherwise, returns `false`.	No	No	Yes	Yes
`viewable`	Available as a child of `Tree`. Resolves at runtime whether this binding and the associated component should be rendered or not.	No	No	No	Yes

[1] The EL term *`row`* is used within the context of a collection component; `row` simply acts as an iteration variable over each element in the collection whose attributes can be accessed by a MAF AMX binding object when the collection is rendered. Attribute and list bindings can be accessed through the `row` variable. The syntax for such expressions will be the same as those used for accessing binding objects outside of a collection, with the `row` variable prepended as the first term: `#{row.bindings.Name.property}`.

7.3.5 About the Categories in the Expression Builder

The following categories are available in the Expression Builder for MAF AMX pages:

- About the Bindings Category
- About the Managed Beans Category
- About the Mobile Application Framework Objects Category

7.3.5.1 About the Bindings Category

This section lists the options available under the Bindings category. The `bindings` and `data` nodes display the same set of supported bindings and properties. Table 7–5 lists available binding types along with the properties that are supported for each binding type. The `securityContext` node supports the following properties:

- `authenticated`
- `userGrantedPrivilege`
- `userInRole`
- `userName`

For example:

```
#{securityContext.authenticated}
#{securityContext.userGrantedPrivilege['submit_privilege']}
#{securityContext.userInRole['manager_role']}
#{securityContext.userName}
```

Table 7–5 Supported Binding Types

Binding Type	Properties
accessorIterator	class
	currentRow: dataProvider
	name
	rangeSize
action	class
	enabled
	execute
	name
attributeValues	autoSubmit
	category
	class
	controlType
	displayHeight
	displayHint
	displayWidth
	filedorder
	format
	hints: allows.read, allows.update, autoSubmit, category, controlType, displayHeight, displayHint, displayWidth, filedorder, format, label, mandatory, precision, tooltip, updateable
	inputValue
	items
	iteratorBinding
	label
	mandatory
	name
	precision
	tooltip
	updateable

Table 7–5 (Cont.) Supported Binding Types

Binding Type	Properties
button	autoSubmit
	category
	class
	controlType
	displayHeight
	displayHint
	displayWidth
	filedorder
	format
	hints: allows.read, allows.update, autoSubmit, category, controlType, displayHeight, displayHint, displayWidth, filedorder, format, label, mandatory, precision, tooltip, updateable
	inputValue
	items
	iteratorBinding
	label
	mandatory
	name
	precision
	tooltip
	updateable
invokeAction	always
	deferred
iterator	class
	currentRow: dataProvider
	name
	rangeSize

Table 7–5 (Cont.) Supported Binding Types

Binding Type	Properties
list	autoSubmit
	category
	class
	controlType
	displayHeight
	displayHint
	displayWidth
	filedorder
	format
	hints: format, allows.read, allows.update, autoSubmit, category, controlType, displayHeight, displayHint, displayWidth, filedorder, format, label, mandatory, precision, tooltip, updateable
	inputValue
	items
	iteratorBinding
	label
	mandatory
	name
	precision
	tooltip
	updateable
methodAction	class
	enabled
	execute
	name
	operationEnabled
	operationInfo
	paramsMap
	result
methodIterator	class
	currentRow: dataProvider
	name
	rangeSize
searchAction	class
	enabled
	execute
	name
	operationEnabled
	operationInfo
	paramsMap
	result

Table 7–5 (Cont.) Supported Binding Types

Binding Type	Properties
tree	category
	class
	collectionModel: bindings, makeCurrent, selectedRow, <AttrName>
	displayHeight
	displayHint
	displayWidth
	filedorder
	format
	hints: category, displayHeight, displayHint, displayWidth, filedorder, format, label, mandatory, precision, tooltip, updateable, <AttrName>
	iteratorBinding
	label
	mandatory
	name
	precision
	rangeSize
	tooltip
	updateable
	viewable
variable	class
	currentRow: dataProvider
	name
variableIterator	class
	currentRow: dataProvider
	name

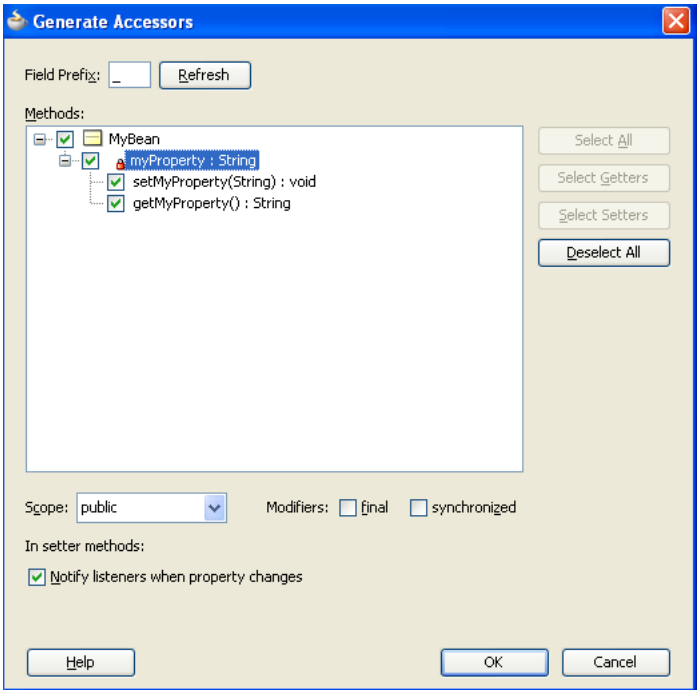
7.3.5.2 About the Managed Beans Category

This section lists the options available under the Managed Beans category.

- applicationScope: Managed Beans > applicationScope node contains everything that is defined at the application level (for example, application-scoped managed beans).
- pageFlowScope: Managed Beans > pageFlowScope node contains everything that is defined at the page flow level (for example, page flow-scoped managed beans).
- viewScope: Managed Beans > viewScope node contains everything that is defined at the view level (for example, view-scoped managed beans).

The MAF runtime will register itself as a listener on managed bean property change notifications so that EL expressions bound to UI components that reference bean properties will update automatically if the value of the property changes. Sourcing these notifications requires some additional code in the beans' property accessors. To automatically generate the necessary code to source notifications from your beans' property accessors, select the **Notify listeners when property changes** checkbox in the Generate Accessors dialog (see Figure 7–2).

Figure 7–2 Notify Listeners When Property Changes



It is not necessary to add this code to simply reference bean methods or properties through EL, but it is necessary to keep the rendering of any EL expressions in the active form that depend on values stored in the bean current if those values change, especially if the change is indirect, such as a side effect of executing a bean method that changes one or more property values. For information about property changes and the `PropertyChangeSupport` class, see Section 7.13, "About Data Change Events."

Example 7–2 illustrates how to retrieve a value bound to another managed bean attribute programmatically.

Example 7–2 Object Value Retrieved Programmatically from a Managed Bean

```
public void someMethod()
{
  Object value =
AdfmfJavaUtilities.evaluateELExpression("#{applicationScope.MyManagedBean.someProp
erty}");
```

Example 7–3 illustrates how to execute bindings programmatically from a managed bean.

Example 7–3 Bindings Executed Programmatically from a Managed Bean

```
public void someMethod()
{
  Object value =
AdfmfJavaUtilities.evaluateELExpression("#{bindings.someDataControlMethod.execute}
");
```

Note: If you declare a managed bean within the `applicationScope` of a feature but then try to reference that bean through EL in another feature at design time, you will see a warning in the design time about invalid EL. This warning is due to the fact that the design time cannot find a reference in the current project for that bean. You can reference that bean at runtime only if you first visit the initial feature where you declared the bean and the bean is instantiated before you access it through EL in another feature. This is not the case for the `PreferenceValue` element as it uses the `Name` attribute value as the node label.

7.3.5.3 About the Mobile Application Framework Objects Category

The Mobile Application Framework Objects category lists various objects defined in the Mobile Application Framework that can be referenced using EL, such as object scopes.

MAF variables and managed bean references are defined within different object scopes that determine the variable's lifetime and visibility. In order of decreasing visibility, they are application scope, page flow scope, and view scope. For more information about the different object scopes, see Section 7.2, "About Object Scope Lifecycles.".

In addition to these variable-containing scopes, MAF defines scopes that can expose information about device properties and application preferences. These scopes have application-level lifetime and visibility.

The following are available under the Mobile Application Framework Objects category:

- `applicationScope`: The `applicationScope` node contains everything that is defined at the application level (for example, application-scoped managed beans). EL variables defined in the application scope are available for the life of the application, across feature boundaries.
- `pageFlowScope`: The `pageFlowScope` node contains everything that is defined at the page flow level (for example, page flow-scoped managed beans). EL variables defined in the page flow scope namespace are available for the duration of a feature, within the bounds of a single feature.
- `preferenceScope`: The `preferenceScope` node contains all the application and feature preferences.

  Preference elements use the `Id` attribute value as the node label in the Expression Builder, except for the `PreferenceValue` element. The `PreferenceValue` element uses the `Name` attribute value as the node label in the Expression Builder.

  Note: Where string tokens in EL expressions contain a dot (".") or any special character, or a reserved word like `default`, the Expression Builder surrounds such string tokens with a single quote and bracket. When the feature ID or preference component ID contains a dot, the Expression Builder displays each part of the ID that is separated by a dot as a separate property in the `preferenceScope` hierarchy. The expression generated also takes each part of the ID separated by a dot as a separate property.

  Following are some sample `preferenceScope` EL expressions:

Example 7–4 Feature ID Containing "."

```
"#{preferenceScope.feature.oracle.hello.SampleGroup1.label}"
```

Example 7–5 Attribute Name Is a Reserved Word

```
"#{preferenceScope.application.OracleMobileApp.Edition['default']}"
```

- `viewScope`: This node contains everything that is defined at the view level (for example, view-scoped managed beans). EL variables defined in the view scope namespace are available for the duration of the view, within the bounds of a single page of a feature.
- `row`: The `row` object is an intermediate variable that is a shortcut to a single provider in the `collectionModel`. Its name is the value of the `var` attribute of the parent component (such as List View or Carousel).

  Note: It is not possible to evaluate `#{row}` or properties of `row` using `AdfmfJavaUtilities.evaluateELExpression`. These expressions will return a null value.

- `viewControllerBundle`

  This is the name of the resource bundle variable that points to a resource bundle defined at the project level. This node is shown only after the `amx:loadBundle` element has been dropped and a resource bundle has been created. The name of this node will vary as it depends on the variable name of `amx:loadBundle`. This node will display all strings declared in the bundle.

  Example 7–6 shows an example of AMX code for `viewControllerBundle`.

Example 7–6 AMX Code Sample of the loadBundle Element

```
<amx:loadBundle basename="mobile.ViewControllerBundle"
var="viewcontrollerBundle"/>
```

7.3.6 About EL Events

EL events play a significant role in the functioning of the MAF AMX UI, enabling expressions with common terms to update in sync with each other.

EL expressions can refer to values in various contexts. Example 7–7 shows the creation of two Input Number Slider components, with each component tied to an `applicationScope` value. The output text then uses EL to display a simple addition equation along with the calculated results. When the framework parses the EL expression in the output text labels, it determines that the expression contains references to two values and creates event listeners (see Section 6.10, "Using Event Listeners") for the output text on those two values. When the value of the underlying expression changes, an event is generated to all listeners for that value.

Note: If you are referencing properties on a managed bean (as opposed to scope objects) you have to add the listeners. For more information, see Section 7.3.5.2, "About the Managed Beans Category."

Example 7–7 Generating EL Events with Two Components

```
<amx:inputNumberSlider id="slider1" label="X" value="#{applicationScope.X}"/>
<amx:inputNumberSlider id="slider2" label="Y" value="#{applicationScope.Y}"/>
```

```
<amx:outputText id="ot1" value="#{applicationScope.X} +
       #{applicationScope.Y} = #{applicationScope.X + applicationScope.Y}"/>
```

In Example 7–7 two components are updating one value each, and one component is consuming both values. Example 7–8 shows that the behavior would be identical if a third Input Number Slider component is added that references one of the existing values.

Example 7–8 Generating EL Events with Three Components

```
<amx:inputNumberSlider id="slider1" label="X" value="#{applicationScope.X}"/>
<amx:inputNumberSlider id="slider2" label="Y" value="#{applicationScope.Y}"/>
<amx:outputText id="ot1" value="#{applicationScope.X} +
       #{applicationScope.Y} = #{applicationScope.X + applicationScope.Y}"/>
<amx:inputNumberSlider id="slider3" label="X" value="#{applicationScope.X}"/>
```

In Example 7–8, when either Input Number Slider component updates `#{applicationScope.X}`, the other is automatically updated along with the Output Text.

7.3.7 How to Use EL Expressions Within Managed Beans

While JDeveloper creates many needed EL expressions for you, and you can use the Expression Builder to create those not built for you, there may be times when you need to access, set, or invoke EL expressions within a managed bean.

Example 7–9 shows how you can get a reference to an EL expression and return (or create) the matching object.

Example 7–9 Resolving an EL Expression from a Managed Bean

```
public static Object resolveExpression(String expression) {
  return AdfmfJavaUtilities.evaluateELExpression(expression);
}
```

Example 7–10 shows how you can resolve a method expression.

Example 7–10 Resolving a Method Expression from a Managed Bean

```
public static Object resloveMethodExpression(String expression,
                                             Class returnType,
                                             Class[] argTypes,
                                             Object[] argValues) {
  MethodExpression methodExpression = AdfmfJavaUtilities.getMethodExpression(expression,
    returnType, argTypes);
  return methodExpression.invoke(AdfmfJavaUtilities.getAdfELContext(), argValues);
}
```

Example 7–11 shows how you can set a new object on a managed bean.

Example 7–11 Setting a New Object on a Managed Bean

```
public static void setObject(String expression, Object newValue) {
  AdfmfJavaUtilities.setELValue(expression, newValue);
}
```

7.4 Creating and Using Managed Beans

Managed beans are Java classes that you register with the application using various configuration files. When the MAF application starts up, it parses these configuration files and the beans are made available and can be referenced in an EL expression, allowing access to the beans' properties and methods. Whenever a managed bean is referenced for the first time and it does not already exist, the Managed Bean Creation Facility instantiates the bean by calling the default constructor method on the bean. If any properties are also declared, they are populated with the declared default values.

Often, managed beans handle events or some manipulation of data that is best handled at the front end. For a more complete description of how to use managed beans, see the Java EE tutorial at `http://www.oracle.com/technetwork/java/index.html`.

> **Best Practice:** Use managed beans to store only bookkeeping information, for example the current user. All application data and processing should be handled by logic in the business layer of the application.

Note: EL expressions must explicitly include the scope to reference the bean. For example, to reference the `MyBean` managed bean from the `pageFlowScope` scope, your expression would be `#{pageFlowScope.MyBean}`.

7.4.1 How to Create a Managed Bean in JDeveloper

You can create a managed bean and register it with the MAF application at the same time using the overview editor for the `adfc-mobile-config.xml` file.

Before you begin

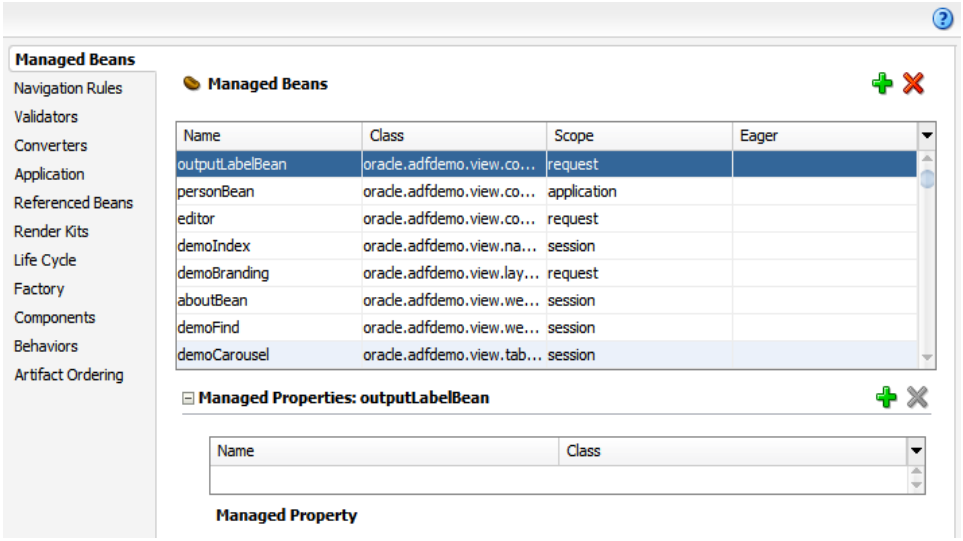
It may be helpful to have an understanding of managed beans. For more information, see Section 7.4, "Creating and Using Managed Beans."

To create and register a managed bean:

1. In the Applications window, double-click **adfc-mobile-config.xml**.
2. In the editor window, click the **Overview** tab.
3. In the overview editor, click the **Managed Beans** navigation tab.

   Figure 7–3 shows the editor for the `adfc-mobile-config.xml` file.

Figure 7–3 Managed Beans in the adfc-mobile-config.xml File



4. Click the **Add** icon to add a row to the Managed Bean table.
5. In the Create Managed Bean dialog, enter values. Click **Help** for more information about using the dialog. Select the **Generate Class If It Does Not Exist** option if you want JDeveloper to create the class file for you. You can also open the Create Managed Bean dialog from the Properties window, by selecting one of the listener properties and clicking the Edit button. From there you can create a new managed bean and corresponding method.

> **Note:** When determining what scope to register a managed bean with or to store a value in, always try to use the narrowest scope possible. For more information about the different object scopes, see Section 7.2, "About Object Scope Lifecycles."

6. You can optionally add managed properties for the bean. When the bean is instantiated, any managed properties will be set with the provided value. With the bean selected in the Managed Bean table, click the **New** icon to add a row to the Managed Properties table. In the Properties window, enter a property name (other fields are optional).

> **Note:** While you can declare managed properties using this editor, the corresponding code is not generated on the Java class. You must add that code by creating private member fields of the appropriate type, and then by choosing the **Generate Accessors** menu item on the context menu of the code editor to generate the corresponding `get` and `set` methods for these bean properties.

7.4.2 What Happens When You Use JDeveloper to Create a Managed Bean

When you create a managed bean and elect to generate the Java file, JDeveloper creates a stub class with the given name and a default constructor. Example 7–12 shows the code added to the `MyBean` class stored in the view package.

Example 7–12 Generated Code for a Managed Bean

```
package view;

public class MyBean {
    public MyBean() {
    }
}
```

You now must add the logic required by your page. You can then refer to that logic using an EL expression that refers to the `managed-bean-name` given to the managed bean. For example, to access the `myInfo` property on the `my_bean` managed bean, the EL expression would be:

```
#{my_bean.myInfo}
```

JDeveloper also adds a `managed-bean` element to the `adfc-mobile-config.xml` file. Example 7–13 shows the `managed-bean` element created for the `MyBean` class.

Example 7–13 Managed Bean Configuration on the adfc-mobile-config.xml File

```
<managed-bean>
  <managed-bean-name>my_bean</managed-bean-name>
  <managed-bean-class>view.MyBean</managed-bean-class>
  <managed-bean-scope>application</managed-bean-scope>
</managed-bean>
```

7.5 Exposing Business Services with Data Controls

Once you have your application's services in place, you can use JDeveloper to create data controls that provide the information needed to declaratively bind UI components to those services.

You generate data controls with the Create Data Control menu item. Data controls consist of one or more XML metadata files that define the capabilities of the services that the bindings can work with at runtime. The data controls work in conjunction with the underlying services.

7.5.1 How to Create Data Controls

You create adapter-based data controls from within the Applications window of JDeveloper.

Before you begin:

It may be helpful to have a general understanding of using data controls. For more information, see Section 7.5, "Exposing Business Services with Data Controls."

You will need to complete this task:

Create an application workspace and add the business services on which you want to base your data control. For information on creating an application workspace, see Section 3.2, "Creating an Application Workspace."

To create a data control:

1. Right-click the top-level node for the data model project in the application workspace and choose **New** and then **From Gallery**.

2. In the New Gallery, expand **Business Tier**, select **Data Controls**, select the type of data control that you want to create, and click **OK**.
3. Complete the remaining steps of the wizard.

> **Note:** In some cases, you can create a data control by right-clicking the class or object on which the data control will be based and choosing Create Data Control.

7.5.2 What Happens in Your Project When You Create a Data Control

When you create a data control, JDeveloper creates the data control definition file (`DataControls.dcx`), opens the file in the overview editor, and displays the file's hierarchy in the Data Controls panel. This file enables the data control to work directly with the services and the bindings.

You can see the code from the corresponding XML file by clicking the Source tab in the editor window.

7.5.2.1 DataControls.dcx Overview Editor

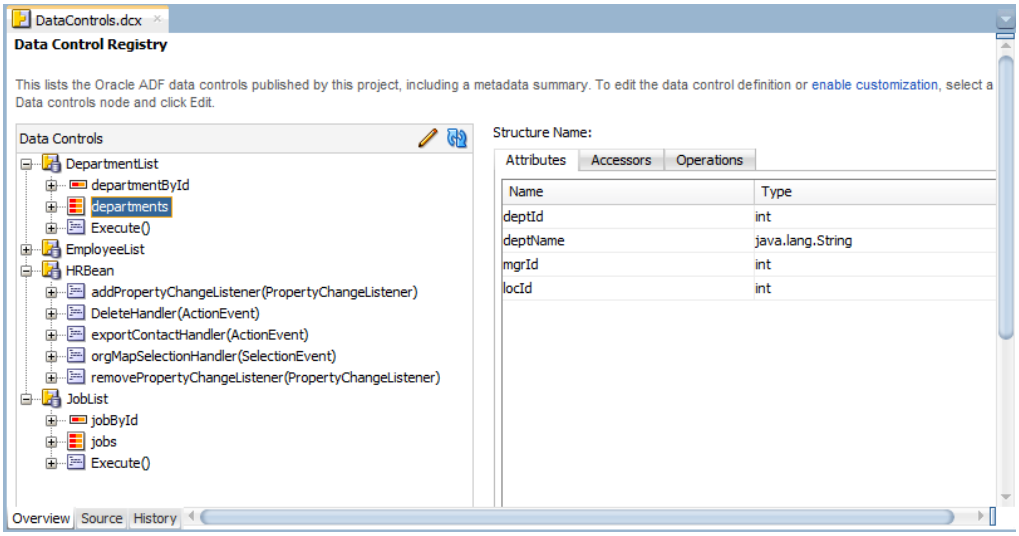
The overview editor for the `DataControls.dcx` file provides a view of the hierarchies of data control objects and exposed methods of your data model.

See Table 7–6 for a description of the icons that are used in the overview editor and Data Controls panel.

You can change the settings for a data control object by selecting the object and clicking the **Edit** icon. For more information about editing a data control, see Section 7.8.1, "How to Edit a Data Control."

Figure 7–4 shows the `DataControls.dcx` file in the overview editor.

Figure 7–4 DataControls.dcx File in the Overview Editor

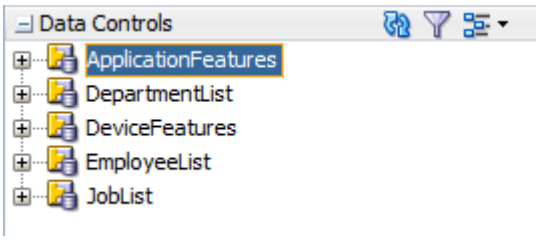


7.5.2.2 Data Controls Panel

The Data Controls panel serves as a palette, from which you can create databound UI components by dragging nodes from the Data Controls panel to the design editor for a page. The Data Controls panel appears in the Applications window once you have

created a data control. Figure 7–5 shows the Data Controls panel for a sample application.

Figure 7–5 Data Controls Panel



7.5.3 Data Control Built-in Operations

The data control framework defines a standard set of operations for data controls. These operations are implemented using functionality of the underlying business service. At runtime, when one of these data collection operations is invoked by name by the data binding layer, the data control delegates the call to an appropriate service method to handle the built-in functionality. For example, in bean data controls, the `Next` operation relies on the bean collection's iterator.

Most of the built-in operations affect the current row. However, the `execute` operation refreshes the data control itself.

The operations available vary by data control type and the functionality of the underlying business service. Here is the full list of built-in operations:

- `Create`: Creates a new row that becomes the current row. This new row is also added to the row set.
- `CreateInsert`: Creates a new row that becomes the current row and inserts it into the row set.
- `Create With Parameters`: Uses named parameters to create a new row that becomes the current row and inserts it into the row set.
- `Delete`: Deletes the current row.
- `Execute`: Refreshes the data collection by executing or reexecuting the accessor method.

  `ExecuteWithParams`: Refreshes the data collection by first assigning new values to variables that passed as parameters, then executing or reexecuting the associated query. This operation is only available for data control collection objects that are based on parameterized queries.
- `First`: Sets the first row in the row set to be the current row.
- `Last`: Sets the last row in the row set to be the current row.
- `Next`: Sets the next row in the row set to be the current row.
- `Next Set`: Navigates forward one full set of rows.
- `Previous`: Sets the previous row in the row set to be the current row.
- `Previous Set`: Navigates backward one full set of rows.
- `removeRowWithKey`: Tries to find a row using the serialized string representation of the row key passed as a parameter. If found, the row is removed.

- `setCurrentRowWithKey`: Tries to find a row using the serialized string representation of the row key passed as a parameter. If found, that row becomes the current row.
- `setCurrentRowWithKeyValue`: Tries to find a row using the primary key attribute value passed as a parameter. If found, that row becomes the current row.

7.6 Creating Databound UI Components from the Data Controls Panel

You can design a databound user interface by dragging an item from the Data Controls panel and dropping it on a page as a specific UI component. When you use data controls to create a UI component, JDeveloper automatically creates the various code and objects needed to bind the component to the data control you selected.

In the Data Controls panel, each data control object is represented by a specific icon. Table 7–6 describes what each icon represents, where it appears in the Data Controls panel hierarchy, and what components it can be used to create.

Table 7–6 Data Controls Panel Icons and Object Hierarchy

Icon	Name	Description	Used to Create...
	Data Control	Represents a data control.	Serves as a container for the other objects and is not used to create anything.
	Collection	Represents a named data collection returned by an accessor method or operation.	Forms, tables, graphs, trees, range navigation components, master-detail components, and selection list components
	Structured Attribute	Represents a returned object that is neither a Java primitive type (represented as an attribute) nor a collection of any type.	Forms, label, text field, date, list of values, and selection list components.
	Attribute	Represents a discrete data element in an object (for example, an attribute in a row).	Label, text field, date, list of values, and selection list components.
	Key Attribute	Represents an object attribute that has been declared as a primary key attribute, either in data control structure file or in the business service itself.	Label, text field, date, list of values, and selection list components.
	Method	Represents a method or operation in the data control or one of its exposed structures that may accept parameters, perform some business logic and optionally return single value, a structure, or a collection.	Command components. For methods that accept parameters: command components and parameterized forms.

Table 7–6 (Cont.) Data Controls Panel Icons and Object Hierarchy

Icon	Name	Description	Used to Create...
	Method Return	Represents an object that is returned by a method or other operation. The returned object can be a single value or a collection. A method return appears as a child under the method that returns it. The objects that appear as children under a method return can be attributes of the collection, other methods that perform actions related to the parent collection, or operations that can be performed on the parent collection.	For single values: text fields and selection lists. For collections: forms, tables, trees, and range navigation components. When a single-value method return is dropped, the method is not invoked automatically by the framework. To invoke the method, you can drop the corresponding method as a button. If the form is part of a task flow, you can create a method activity to invoke the method.
	Operation	Represents a built-in data control operation that performs actions on the parent object.	UI command components, such as buttons and links.
	Parameter	Represents a parameter value that is declared by the method or operation under which it appears.	Label, text, and selection list components.

7.6.1 How to Use the Data Controls Panel

JDeveloper provides you with a predefined set of UI components from which to choose for each data control item you can drop.

Before you begin:

It may be helpful to have an understanding of the different objects in the Data Controls panel. For more information, see Section 7.6, "Creating Databound UI Components from the Data Controls Panel."

You will need to complete these tasks:

- Create a data control as described in Section 7.5.1, "How to Create Data Controls."
- Create a a MAF AMX page as described in Section 5.3.1.2, "Creating MAF AMX Pages."

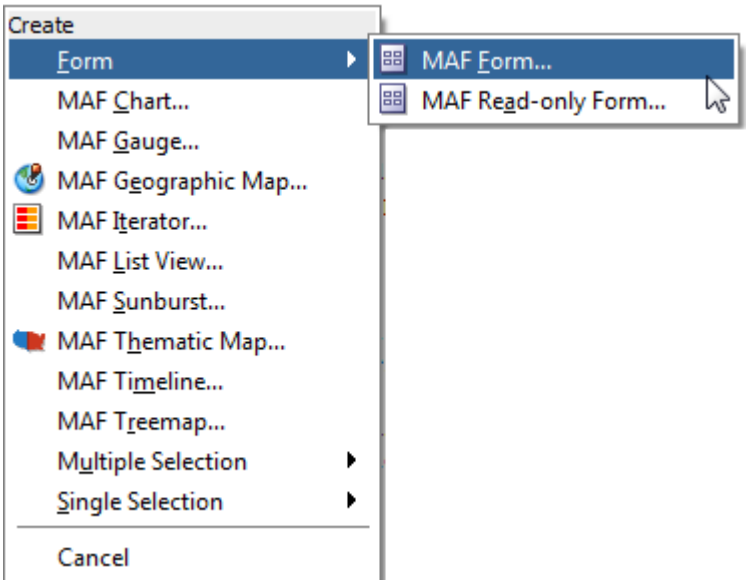
To use the Data Controls panel to create UI components:

1. Select an item in the Data Controls panel and drag it onto the visual editor for your page. For a definition of each item in the panel, see Table 7–6, " Data Controls Panel Icons and Object Hierarchy".
2. From the ensuing context menu, choose a UI component.

   When you drag an item from the Data Controls panel and drop it on a page, JDeveloper displays a context menu of all the default UI components available for the item you dropped. The components displayed are based on the libraries in your project.

Figure 7–6 shows the context menu displayed when a data collection from the Data Controls panel is dropped on a page.

Figure 7–6 Dropping Component From Data Controls Panel



Depending on the component you select from the context menu, JDeveloper may display a dialog that enables you to define how you want the component to look. For example, if you select **Form** from the context menu, the Edit Form Fields dialog opens. Once you select a component, JDeveloper inserts the UI component on the page in the visual editor.

The UI components selected by default are determined first by any UI hints set on the corresponding business object. If no UI hints have been set, then JDeveloper uses input components for standard forms and tables, and output components for read-only forms and tables. Components for lists are determined based on the type of list you chose when dropping the data control object.

By default, the UI components created when you use the Data Controls are bound to attributes in the MAF data control and may have built-in features, such as:

- Databound labels
- Tooltips
- Formatting
- Basic navigation buttons
- Validation, if validation rules are attached to a particular attribute.

The default components are fully functional without any further modifications. However, you can modify them to suit your particular needs.

Tip: If you want to change the type of MAF databound component used on a page, the easiest method is to use either the visual editor or the structure window to delete the component, and then drag and drop a new one from the Data Controls panel. When you use the visual editor or the structure window to delete a databound component from a page, if the related binding objects in the page definition file are not referenced by any other component, JDeveloper automatically deletes those binding objects for you (automatic deletion of binding objects will not happen if you use the source editor).

7.6.2 What Happens When You Use the Data Controls Panel

When an application is built using the Data Controls panel, JDeveloper does the following:

- Creates a `DataBindings.cpx` file in the default package for the project (if one does not already exist), and adds an entry for the page.

  A `DataBindings.cpx` files defines the *binding context* for the application. The binding context is a container object that holds a list of available data controls and data binding objects. The `DataBindings.cpx` file maps individual pages to the binding definitions in the page definition file and registers the data controls used by those pages. For more information, see Section 5.3.2.4.5, "What You May Need to Know About Generated Drag and Drop Artifacts."

- Creates the `adfm.xml` file in the META-INF directory. This file creates a registry for the `DataBindings.cpx` file, which allows the application to locate it at runtime so that the binding context can be created.

- Adds a page definition file (if one does not already exist for the page) to the page definition subpackage. The default subpackage is `mobile.pageDefs` in the `adfmsrc` directory.

  Tip: You can set the package configuration (such as name and location) in the ADF Model settings page of the Project Properties dialog (accessible by double-clicking the project node).

  The page definition file (*pageName*`PageDef.xml`) defines the binding container for each page in an application's view layer. The binding container provides runtime access to all the binding objects for a page. For more information about the page definition file, see Section 5.3.2.4.5, "What You May Need to Know About Generated Drag and Drop Artifacts."

  Tip: The current binding container is also available from `AdfContext` for programmatic access.

- Configures the page definition file, which includes adding definitions of the binding objects referenced by the page.

- Adds the given component to the page.

  These prebuilt components include the data binding expression language (EL) expressions that reference the binding objects in the page definition file. For more information, see Section 7.3.1, "About Data Binding EL Expressions."

- Adds all the libraries, files, and configuration elements required by the UI components. For more information on the artifacts required for databound

components, see Section 3.2.2, "What Happens When You Create a MAF Application."

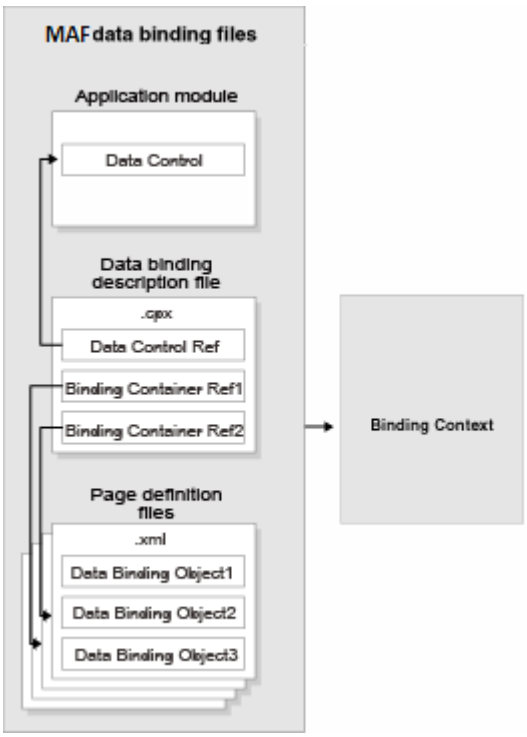
7.7 What Happens at Runtime: How the Binding Context Works

When a page contains MAF bindings, at runtime the interaction with the business services initiated from the client or controller is managed by the application through a single object known as the **binding context**. The binding context is a runtime map (named *data* and accessible through the EL expression `#{data}`) of all data controls and page definitions within the application.

The MAF creates the binding context from the application, `DataBindings.cpx`, and page definition files, as shown in Figure 7–7. The union of all the `DataControls.dcx` files and any application modules in the workspace define the available data controls at design time, but the `DataBindings.cpx` file defines what data controls are available to the application at runtime. The `DataBindings.cpx` file lists all the data controls that are being used by pages in the application and maps the binding containers, which contain the binding objects defined in the page definition files, to web page URLs. The page definition files define the binding objects used by the application pages. There is one page definition file for each page.

The binding context does not contain live instances of these objects. Instead, it is a map that contains references that become data control or binding container objects on demand. When the object (such as a page definition) is released from the application (for example when a task flow ends or when the binding container or data control is released at the end of the request), data controls and binding containers turn back into reference objects. For more information about the `DataBindings.cpx` file, see Section 5.3.2.4.5, "What You May Need to Know About Generated Drag and Drop Artifacts."

Figure 7–7 File Binding Context Runtime Usage



Note: Carefully consider the binding styles you use when configuring components. More specifically, combining standard bindings with managed bean bindings will frequently result in misunderstood behaviors because the class instances are unlikely to be the same between the binding infrastructure and the managed bean infrastructure. If you mix bindings, you may end up calling behavior on an instance that isn't directly linked to the UI.

For more information on working with bindings in MAF, see the following:

- Section 5.3.2.4.4, "What You May Need to Know About Generated Bindings"
- Section 5.3.2.4.6, "Using the MAF AMX Editor Bindings Tab"
- Section 5.3.2.4.7, "What You May Need to Know About Removal of Unused Bindings"

7.8 Configuring Data Controls

When you create a data control, a standard set of values and behaviors are assumed for the data control. For example, the data control determines how the label for an attribute will display in a client. You can configure these values and behaviors by creating and modifying data control structure files that correspond to the elements of the data control. You first generate a data control structure file using the overview editor for the `.dcx` file.

7.8.1 How to Edit a Data Control

You can make a data control configurable by using the overview editor for the `DataControls.dcx` file to create data control structure files that correspond to objects encompassed by the data control. You can then edit the individual data control structure files.

Before you begin:

It may be helpful to have a general understanding of data control configuration. For more information, see Section 7.8, "Configuring Data Controls."

You will need to complete this task:

Create a data control, as described in Section 7.5.1, "How to Create Data Controls."

To edit a data control:

1. In the Applications window, double-click **DataControls.dcx**.
2. In the overview editor, select the object that you would like to configure and click the **Edit** icon to generate a data control structure file, as shown in Figure 7–8.

Figure 7–8 Edit Button in Data Controls Registry

3. In the overview editor of the data control structure file, make the desired modifications.

7.8.2 What Happens When You Edit a Data Control

When you edit a data control, JDeveloper creates a data control structure file that contains metadata for the affected collection and opens that file in the overview editor. This file stores configuration data for the data control that is specific to that collection, such as any UI hints or validators that you have specified for the data object.

A data control structure file has the same base name as the data object with which it corresponds. For example, if you click the **Edit** icon when you have a collection node selected that corresponds with the `Customer.java` entity bean, the data control structure file is named `Customer.xml`. The data control structure file is generated in a package that corresponds to the package of the bean class, but with `persdef` prepended to the package name. For example, if the `Customer.java` bean is in the `model` package, the `Customer.xml` data control definition file is generated in the `persdef.model` package. Once a data control structure file has been generated, you can use the overview editor for that file to make further configurations.

A data control structure file contains the following information:

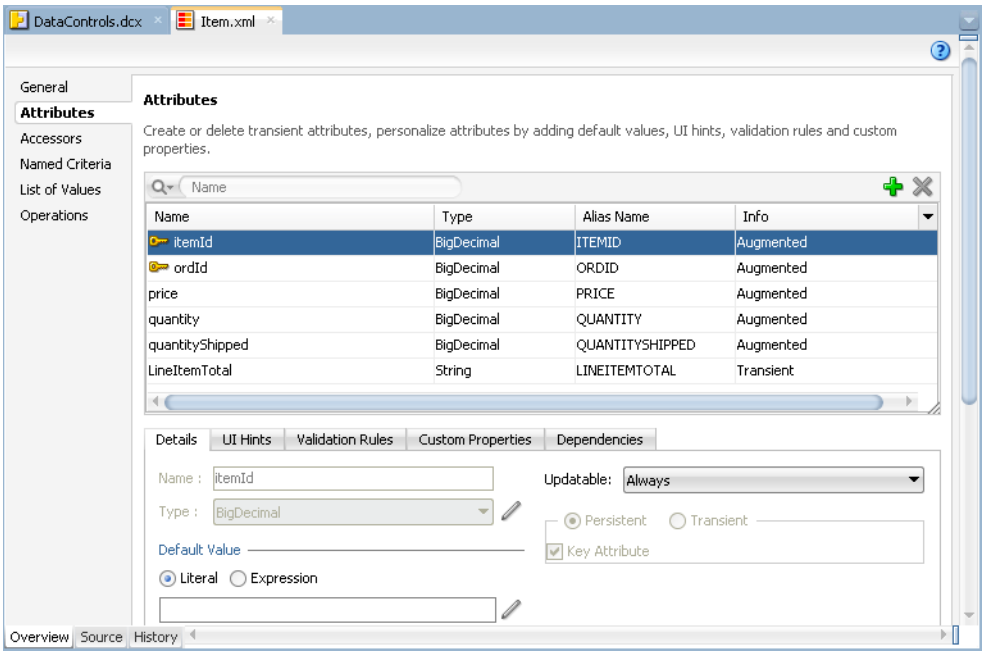
- Attributes: Describes all of the attributes on the service. For example, for entity beans, there is an attribute for each bean property that is mapped to a database column. You can also add transient attributes. You can set UI hints that define how these attributes will display in the UI. You can also set other properties, such as whether the attribute value is required, whether it must be unique, and whether it is visible. For more information, see Section 7.9, "Working with Attributes."

  You can also set validation for an attribute and create custom properties. For more information on validation, see Section 7.12, "Validating Attributes."

- Accessors: Describes data control elements that return result sets.
- Operations: Describes methods on the data object that are used by the data control's built-in operations, such as `add` and `remove` methods, which are used by the Create and Delete built-in operations, respectively.

Figure 7–9 shows the data control structure file for the `Item` bean.

Figure 7–9 Data Control Structure File in the Overview Editor



Note: The overview editor of a data control structure file shows all of the attributes, accessors, and operations that are associated with the data object. However, the data control structure file's XML source only contains definitions for elements that you have edited. The base elements are introspected from the data object. Also, when you make changes to the underlying data object, the data control inherits those changes.

7.8.3 What You May Need to Know About MDS Customization of Data Controls

If you wish for all of the objects that are encompassed by the data control to be available for Oracle Metadata Services (MDS) customization, the packaged application must contain data control structure files for those objects.

When you create a data control based on the adapter framework, data control structure files are not generated by default, since they are not needed by the data control if you do not add metadata to a given object. Typically, a data control structure file is only generated for a data control object once you edit the data control to add declarative metadata (such as UI hints or validators) to that object, as described in Section 7.8.1, "How to Edit a Data Control." To create data control structure files for each data control object, you need to repeat that procedure for each data control object.

For more information on MDS, see Section 4.14, "Customizing MAF Files Using Oracle Metadata Services."

7.9 Working with Attributes

When you create a data control for your business services, you can create a data control structure file for an individual data object in which you can declaratively augment the functionality of the data object's persistent attributes. For example, you can create validation rules and set UI hints to control the default presentation of attributes in UI components.

You set these properties on the Attributes page of the overview editor of the data control structure file. For information on creating a data control structure file, see Section 7.8.1, "How to Edit a Data Control."

7.9.1 How to Designate an Attribute as Primary Key

In the overview editor for a data object's data control structure file, you can designate an attribute as a primary key for that data object if you have not already done so in the data object's underlying class.

Before you begin:

It may be helpful to have an understanding of how you set attribute properties. For more information, see Section 7.9, "Working with Attributes."

You will need to complete this task:

Create the desired data control structure files as described in Section 7.8.1, "How to Edit a Data Control."

To set an attribute as a primary key:

1. In the Applications window, double-click the desired data control structure file.
2. In the overview editor, click the **Attributes** navigation tab.
3. On the Attributes page, select the attribute you want to designate as the primary key and then click the **Details** tab.
4. On the Details page, set the **Key Attribute** property.

Note: If the attribute has already been designated as the primary key in the class, the data control inherits that setting and the **Key Attribute** checkbox will be selected. However, in this case, you can not deselect the **Key Attribute** option.

7.9.2 How to Define a Static Default Value for an Attribute

The **Value** field in the **Details** section allows you to specify a static default value for the attribute when the value type is set to **Literal**. For example, you might set the default value of a `ServiceRequest` entity bean's `Status` attribute to `Open`, or set the default value of a `User` bean's `UserRole` attribute to `user`.

Before you begin:

It may be helpful to have an understanding of how you set attribute properties. For more information, see Section 7.9, "Working with Attributes."

To define a static default value for an attribute:

1. In the Applications window, double-click the desired data control structure file.
2. In the overview editor, click the **Attributes** navigation tab.
3. On the Attributes page, select the attribute you want to edit, and then click the **Details** tab.
4. On the Details page, select the **Literal** option.
5. In the text field below the **Literal** option, enter the default value for the attribute.

7.9.3 How to Set UI Hints on Attributes

You can set UI hints on attributes so that those attributes are displayed and labeled in a consistent and localizable way by any UI components that use those attributes. UI hints determine things such as the type of UI component to use to display the attribute, the label, the tooltip, and whether the field should be automatically submitted. You can also determine whether a given attribute is displayed or hidden. To create UI hints for attributes, use the overview editor for the data object's data control structure file, which is accessible from the Applications window.

Before you begin:

It may be helpful to have an understanding of how you set attribute properties. For more information, see Section 7.9, "Working with Attributes."

You will need to complete this task:

Create the desired data control structure files as described in Section 7.8.1, "How to Edit a Data Control."

To set a UI hint:

1. In the Applications window, double-click the desired data control structure file.
2. In the overview editor, click the **Attributes** navigation tab.
3. On the Attributes page, select the attribute you want to edit, and then click the **UI Hints** tab.
4. In the **UI Hints** section, set the desired UI hints.

7.9.4 What Happens When You Set UI Hints on Attributes

When you set UI hints on an attribute, those hints are stored as properties. Tags for the properties are added to the data object's data control structure file and the values for the properties are stored in a resource bundle file. If the resource bundle file does not already exist, it is generated in the data control's package and named according to the project name when you first set a UI hint.

Example 7–14 shows the code for the `price` attribute in the `Item.xml` data control structure file, including tags for the Label and Format Type hints which have been set for the attribute.

Example 7–14 XML Code for UI Hints

```
<PDefAttribute
  Name="price">
  <Properties>
    <SchemaBasedProperties>
      <LABEL
        ResId="${adfBundle['model.ModelBundle']['model.Item.price_LABEL']}"/>
      <FMT_FORMATTER
        ResId="${adfBundle['model.ModelBundle']['model.Item.price_FMT_
                                                FORMATTER']}"/>
    </SchemaBasedProperties>
  </Properties>
</PDefAttribute>
```

Example 7–15 shows the corresponding entries for the Label and Format Type hints in the `ModelBundle.properties` resource bundle file, which contains the values for all of the project's localizable properties.

Example 7–15 Resource Bundle Code for UI Hints

```
model.Item.price_LABEL=Price
. . .
model.Item.price_FMT_FORMATTER=oracle.jbo.format.DefaultCurrencyFormatter
```

7.9.5 How to Access UI Hints Using EL Expressions

You can access UI hints using EL expressions to display the hint values as data in a page. You access UI hints through the binding instances that you create after dropping databound components onto your pages.

Example 7–16 was produced using the DeviceFeatures data control. It shows the EL expression that is produced by dragging and dropping Contact as a MAF form and only keeping the `displayName` and `nickname` fields. The labels in bold are examples of the retrieval of UI hints using EL.

Example 7–16 Using EL to Access UI HInts

```
<amx:panelFormLayout id="pfl2">
      <amx:inputText value="#{row.bindings.displayName.inputValue}"
                     label="#{bindings.Contact.hints.displayName.label}" id="it9"/>
      <amx:inputText value="#{row.bindings.nickname.inputValue}"
                     label="#{bindings.Contact.hints.nickname.label}"
                     id="it10"/>
</amx:panelFormLayout>af:panelHeader id="ph1"
```

7.10 Creating and Using Bean Data Controls

Java bean data controls obtain their data structure from POJOs (plain old Java objects). To create a Java bean data control, right-click a Java class file (in the Applications window), and choose Create Data Control.

Note: If the Java bean is using a background thread to update data in the UI, you need to manually call `oracle.adfmf.framework.api.AdfmfJavaUtilities.flushDataChangeEvent`. For information about the `flushDataChangeEvent` method, see Section 7.13, "About Data Change Events."

7.10.1 What You May Need to Know About Serialization of Bean Class Variables

MAF does not serialize to JavaScript Object Notation (JSON) data bean class variables that are declared as transient. To avoid serialization of a chain of nested objects, you should define them as transient. This strategy also helps to prevent the creation of cyclic objects due to object nesting.

Consider the following scenario: you have an `Employee` object that has a child `Employee` object representing the employee's manager. If you do not declare the child object transient, a chain of serialized nested objects will be created when you attempt to calculate the child `Employee` object at runtime.

To serialize and deserialize Java objects into JSON objects, use the `JSONBeanSerializationHelper` class. The `JSONBeanSerializationHelper` class enables you to implement your own custom JSON serialization and deserialization, and it provides a hook to alter the JSON object after the JSON serialization (and deserialization) process. The `JSONBeanSerializationHelper` class is similar to the

`GenericTypeSerializationHelper` class, which you can use to serialize and deserialize `GenericType` objects in REST and SOAP-based web services. For details, see the `oracle.adfmf.framework.api.JSONBeanSerializationHelper` class in the MAF Javadoc.

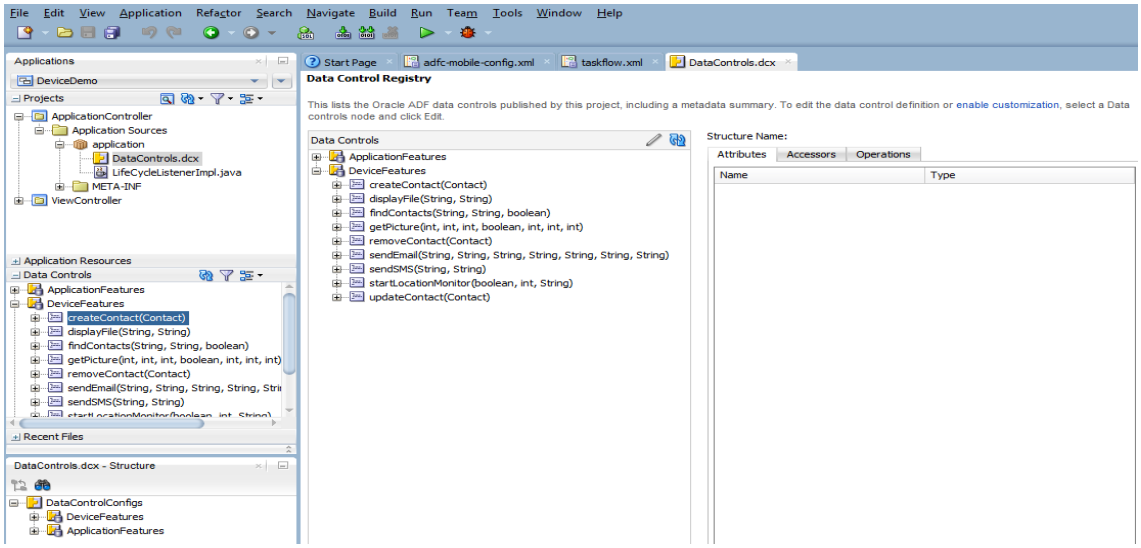
MAF does not support serializing objects of the `GregorianCalendar` class. The `JSONBeanSerializationHelper` class cannot serialize objects of the `GregorianCalendar` class because the `GregorianCalendar` class has cyclical references in it. Instead, use `java.util.Date or java.sql.Date` for date manipulation. The following example shows how to convert a `GregorianCalendar` object using `java.util.Date`:

```
Calendar calDate = new GregorianCalendar();
calDate.set(1985, 12, 1); // "January 1, 1986"
Date date = calDate.getTime();
```

7.11 Using the DeviceFeatures Data Control

MAF exposes device-specific features that you can use in your application through the DeviceFeatures data control, a component that appears in the Data Controls panel when you create a new MAF application. The Cordova Java API is abstracted through this data control, enabling the application features implemented as MAF AMX to access various services embedded on a device. By dragging and dropping the operations provided by the DeviceFeatures data control into a MAF AMX page, you can add functions to manage the user contacts stored on a device, create and send both email and SMS text messages, ascertain the location of a device, use a device's camera, and retrieve images stored in a device's file system. The following sections describe each of these operations in detail, including how to use them declaratively and how to implement them with Java code and JavaScript.

Figure 7–10 MAF DeviceFeatures Data Control in the Overview Editor



The DeviceFeatures data control appears in the Data Controls panel automatically when you create an application using the MAF application template. Figure 7–10 shows the DeviceFeatures data control in the overview editor. The following methods are available:

- createContact
- findContacts
- getPicture
- removeContact
- sendEmail
- sendSMS
- startLocationMonitor
- updateContact
- displayFile

After you create a page, you can drag DeviceFeatures data control methods (or other objects nested within those methods) from the Data Controls panel to a MAF AMX view to create command buttons and other components that are bound to the associated functionality. You can accept the default bindings or modify the bindings using EL. You can also use JavaScript or Java to implement or configure functionality.

The `DeviceManager` is the object that enables you to access device functionality. You can get a handle on this object by calling `DeviceManagerFactory.getDeviceManager`. The following sections describe how you can invoke methods like `getPicture` or `createContact` using the `DeviceManager` object.

For information on how to include data controls in your MAF application, see Section 5.3.2.4, "Adding Data Controls to the View." Access to all of the Apache Cordova-enabled device capabilities is not enabled by default for MAF applications. For more information, see Section 21.6, "Allowing Access to Device Capabilities."

7.11.1 How to Use the getPicture Method to Enable Taking Pictures

The DeviceFeatures data control includes the `getPicture` method, which enables MAF applications to leverage a device's camera and photo library so end users can take a photo or retrieve an existing image. Example 7–17 shows JavaScript code that enables an end user to take a picture with a device's camera. Example 7–18 and Example 7–19 show Java code that will enable an end user to take a picture or retrieve a saved image. For information about the `getPicture` method, see the `DeviceDataControl` class in the MAF Javadoc and refer to the Cordova documentation (`http://cordova.apache.org/docs/en/2.2.0/index.html`).

The following parameters control where the image is taken from and how it is returned:

> **Note:** If you do not specify a `targetWidth`, `targetHeight`, and `quality` for the picture being taken, the default values used are maximum values, and this can cause memory failures.

- `quality`: Set the quality of the saved image. Range is 0 to 100, inclusive. A higher number indicates higher quality, but also increases the file size. Only applicable to JPEG images (specified by `encodingType`).
- `destinationType`: Choose the format of the return value:
  - `DeviceManager.CAMERA_DESTINATIONTYPE_DATA_URL (0)`—Returns the image as a Base64-encoded string. This value is also specified as an `enum` using `DeviceManager.CAMERA_DESTINATION_DATA_URL` when used programmatically.

You need to prefix the value returned with `""` in order to see the image in an image component.

  - `DeviceManager.CAMERA_DESTINATIONTYPE_FILE_URI (1)`—Returns the image file path. This value is also specified as an enum using DeviceManager.`CAMERA_DESTINATION_FILE_URI` when used programmatically.

Note: If a file URI is returned by the `getPicture` method, it should be stripped of any query parameters before being used to determine the size of the file. For example:

```
String fileURI = ...getPicture(...);

fileURI = fileURI.substring(0, result.lastIndexOf("?"));
```

- `sourceType`: Set the source of the picture:
  - `DeviceManager.CAMERA_SOURCETYPE_PHOTOLIBRARY (0)`—Enables the user to choose from a previously saved image. This value is also specified as an enum using `DeviceManager.CAMERA_SOURCETYPE_PHOTOLIBRARY` when used programmatically.
  - `DeviceManager.CAMERA_SOURCETYPE_CAMERA (1)`—Enables the user to take a picture with device's camera. This value is also specified as an enum using `DeviceManager.CAMERA_SOURCETYPE_CAMERA` when used programmatically.
  - `DeviceManager.CAMERA_SOURCETYPE_SAVEDPHOTOALBUM (2)`—Allows the user to choose from an existing photo album. This value is also specified as an enum using `DeviceManager.CAMERA_SOURCETYPE_SAVEDPHOTOALBUM` when used programmatically.
- `allowEdit`: Choose whether to allow simple editing of the image before selection (boolean).
- `encodingType`: Choose the encoding of the returned image file:
  - `DeviceManager.CAMERA_ENCODINGTYPE_JPEG` (0)—Encodes the returned image as a JPEG file. This value is also specified as an enum using `DeviceManager.CAMERA_ENCODINGTYPE_JPEG` when used programmatically.
  - `DeviceManager.CAMERA_ENCODINGTYPE_PNG` (1)—Encodes the returned image as a PNG file. This value is also specified as an enum using `DeviceManager.CAMERA_ENCODINGTYPE_PNG` when used programmatically.
- `targetWidth`: Set the width in pixels to scale the image. Aspect ratio is maintained. A negative or zero value indicates that the original dimensions of the image will be used.
- `targetHeight`: Set the height in pixels to scale the image. Aspect ratio is maintained. A negative or zero value indicates that the original dimensions of the image will be used.

To customize a getPicture operation using the DeviceFeatures data control:

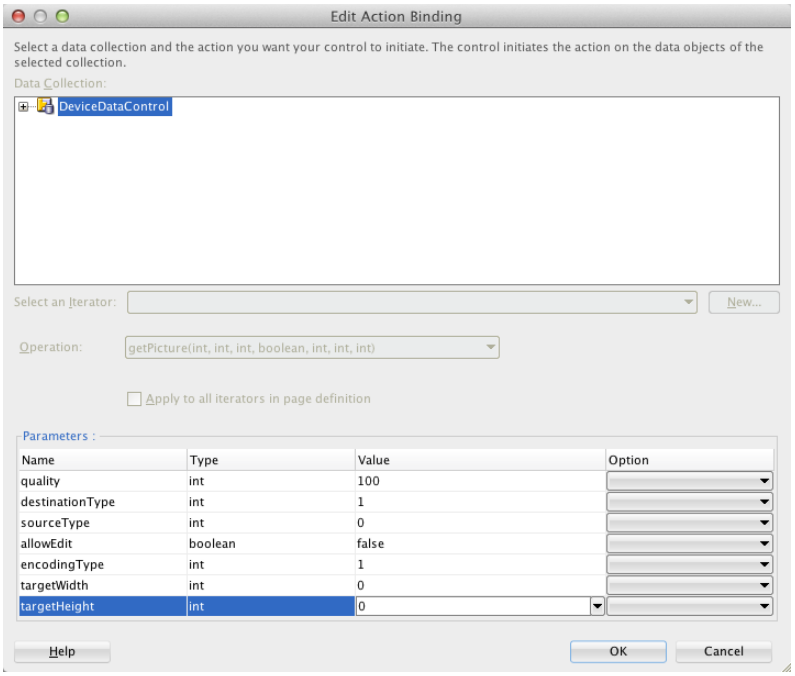
1. Drag the **getPicture** operation from the DeviceFeatures data control in the Data Controls panel and drop it on the page as a **Button**.

   If you want to provide more control to the user, drop the **getPicture** operation as a **Parameter Form**. This allows the end user to specify settings before taking a picture or choosing an existing image.

2. In the Edit Action dialog, set the values for all parameters described above. Be sure to specify `destinationType = 1` so that the image is returned as a filename.
3. Drag the return value of **getPicture** and drop it on the page as an **Output Text**.
4. From the Common Components panel, drag an **Image** from the Component Palette and drop it on the page.
5. Set the `source` attribute of the Image to the return value of the `getPicture` operation. The bindings expression should be: `#{bindings.Return.inputValue}`.

Figure 7–11 shows the bindings for displaying an image from the end user's photo library:

Figure 7–11 Bindings for Displaying an Image from the Photo Library at Design Time



When this application is run, the image chooser will automatically be displayed and the end user can select an image to display. The image chooser is displayed automatically because the Image control is bound to the return value of the `getPicture` operation, which in turn causes the `getPicture` operation to be invoked.

> **Note:** The timeout value for the `getPicture` method is set to 5 minutes. If the device operation takes longer than the timeout allowed, a timeout error is displayed.

Keep in mind the following platform-specific issues:

- iOS
  - Set quality below 50 to avoid memory error on some devices.
  - When `destinationType FILE_URI` is used, photos are saved in the application's temporary directory.

  - The contents of the application's temporary directory are deleted when the application ends. You may also delete the contents of this directory using the `navigator.fileMgr` APIs if storage space is a concern.
  - `targetWidth` and `targetHeight` must both be specified to be used. If one or both parameters have a negative or zero value, the original dimensions of the image will be used.

- Android
  - Ignores the `allowEdit` parameter.
  - `Camera.PictureSourceType.PHOTOLIBRARY` and `Camera.PictureSourceType.SAVEDPHOTOALBUM` both display the same photo album.
  - `Camera.EncodingType` is not supported. The parameter is ignored, and will always produce JPEG images.
  - `targetWidth` and `targetHeight` can be specified independently. If one parameter has a positive value and the other uses a negative or zero value to represent the original size, the positive value will be used for that dimension, and the other dimension will be scaled to maintain the original aspect ratio.
  - When `destinationType DATA_URL` is used, large images can exhaust available memory, producing an out-of-memory error, and will typically do so if the default image size is used. Set the `targetWidth` and `targetHeight` to constrain the image size.

Example 7–17 shows JavaScript code that allows the user to take a picture with a device's camera. The result will be the full path to the saved image.

Example 7–17 JavaScript Code Example for getPicture

```
// The camera, like many other device-specific features, is accessed
// from the global 'navigator' object in JavaScript.
// Note that in the Cordova JavaScript APIs, the parameters are passed
// in as a dictionary, so it is only necessary to provide key-value pairs
// for the parameters you want to specify.

navigator.camera.getPicture(onSuccess, onFail, { quality: 50 });

function onSuccess(imageURI) {
    var image = document.getElementById('myImage');
    image.src = imageURI;
}
function onFail(message) {
    alert('Failed because: ' + message);
}
```

Example 7–18 shows Java code that allows the user to take a picture with a device's camera. The result will be the full path to the saved image.

Example 7–18 Java Code Example for Taking a Picture with getPicture

```
import oracle.adf.model.datacontrols.device;

// Access device features in Java code by acquiring an instance of the
// DeviceManager from the DeviceManagerFactory.
// Take a picture with the device's camera.
// The result will be the full path to the saved PNG image.
```

```
String imageFilename = DeviceManagerFactory.getDeviceManager().getPicture(100,
    DeviceManager.CAMERA_DESTINATIONTYPE_FILE_URI,
    DeviceManager.CAMERA_SOURCETYPE_CAMERA, false,
    DeviceManager.CAMERA_ENCODINGTYPE_PNG, 0, 0);
```

Example 7–19 shows Java code that allows the user to retrieve a previously-saved image. The result will be a base64-encoded JPEG.

Example 7–19 Java Code Example for Retrieving an Image with getPicture

```
import oracle.adf.model.datacontrols.device;

// Retrieve a previously-saved image. The result will be a base64-encoded JPEG.
String imageData = DeviceManagerFactory.getDeviceManager().getPicture(100,
  DeviceManager.CAMERA_DESTINATIONTYPE_FILE_URL,
  DeviceManager.CAMERA_SOURCETYPE__PHOTOLIBRARY, false,
  DeviceManager.CAMERA_ENCODINGTYPE_JPEG, 0, 0);
```

7.11.2 How to Use the SendSMS Method to Enable Text Messaging

The DeviceFeatures data control includes the `sendSMS` method, which enables MAF applications to leverage a device's Short Message Service (SMS) text messaging interface so end users can send and receive SMS messages. MAF enables you to display a device's SMS interface and optionally pre-populate the following fields:

- `to`: List recipients (comma-separated).
- `body`: Add message body.

After the SMS text messaging interface is displayed, the end user can choose to either send the SMS or discard it. It is not possible to automatically send the SMS due to device and carrier restrictions; only the end user can actually send the SMS.

Note: The timeout value for the `sendSMS` method is set to 5 minutes. If the device's operation takes longer than the timeout allowed, a timeout error is displayed.

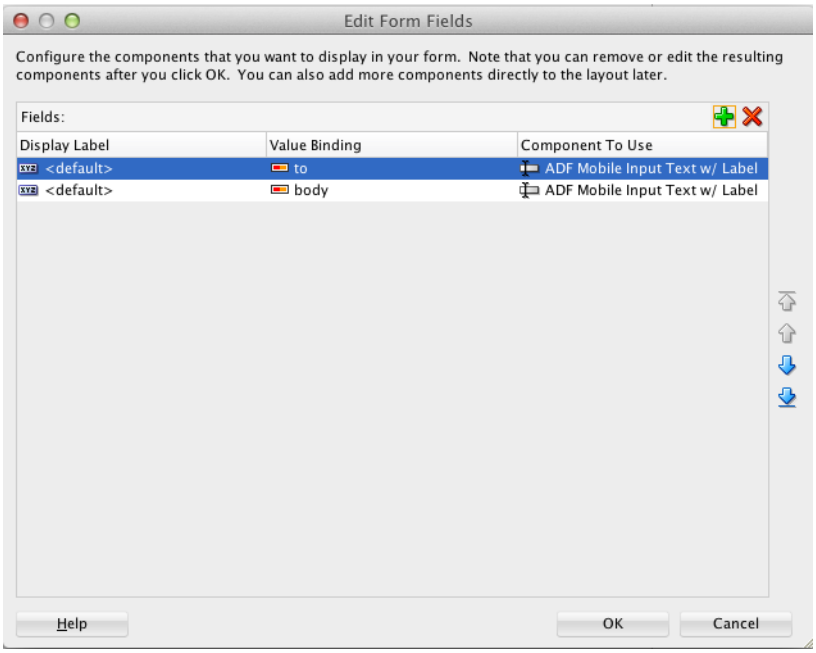
Note: In Android, if an end user switches away from their application while editing an SMS message and then subsequently returns to it, they will no longer be in the SMS editing screen. Instead, that message will have been saved as a draft that can then manually be selected for continued editing.

To customize a sendSMS operation using the DeviceFeatures data control:

To display an interactive form on the page for sending SMS, drag the `sendSMS` operation from the DeviceFeatures data control in the Data Controls panel and drop it on the page designer as a **Parameter Form**. You can then customize the form in the **Edit Form Fields** dialog. At runtime, an editable form will be displayed on the page, which enables the application user to enter values for the various fields described above. Below this form will be a button to display the device's SMS interface, which will display an SMS that is ready to send with all of the specified fields pre-populated.

Figure 7–12 shows the bindings for sending an SMS using an editable form on the page.

Figure 7–12 Bindings for Sending an SMS Using an Editable Form at Design Time



Example 7–20 and Example 7–21 show code examples that allow the end user to send an SMS message with a device's text messaging interface.

For information about the `sendSMS` method, see the `DeviceDataControl` class in the MAF Javadoc and refer to the Cordova documentation (`http://cordova.apache.org/docs/en/2.2.0/index.html`).

Example 7–20 JavaScript Code Example for sendSMS

```
adf.mf.api.sendSMS({to: "5551234567", body: "This is a test message"});
```

Example 7–21 Java Code Example for sendSMS

```
import oracle.adf.model.datacontrols.device.DeviceManagerFactory;

// Access device features in Java code by acquiring an instance of the
// DeviceManager from the DeviceManagerFactory.
// Send an SMS to the phone number "5551234567"
DeviceManagerFactory.getDeviceManager().sendSMS("5551234567", "This is a test message");
```

7.11.3 How to Use the sendEmail Method to Enable Email

The DeviceFeatures data control includes the `sendEmail` method, which enables MAF applications to leverage a device's email messaging interface so end users can send and receive email messages. MAF enables you to display a device's email interface and optionally pre-populate the following fields:

- `to`: List recipients (comma-separated).
- `cc`: List CC recipients (comma-separated).
- `subject`: Add message subject.
- `body`: Add message body.
- `bcc`: List BCC recipients (comma-separated).

- `attachments`: List file names to attach to the email (comma-separated).
- `mimeTypes`: List MIME types to use for the attachments (comma-separated). Specify null to let MAF automatically determine the MIME types. It is also possible to specify only the MIME types for selected attachments as shown in Example 7–22 and Example 7–23.

After the device's email interface is displayed, the user can choose to either send the email or discard it. It is not possible to automatically send the email due to device and carrier restrictions; only the end user can actually send the email. The device must also have at least one email account configured to send email or an error will be displayed indicating that no email accounts could be found.

Note: The timeout value for the `sendEmail` method is set to 5 minutes. If the device's operation takes longer than the timeout allowed, a timeout error is displayed.

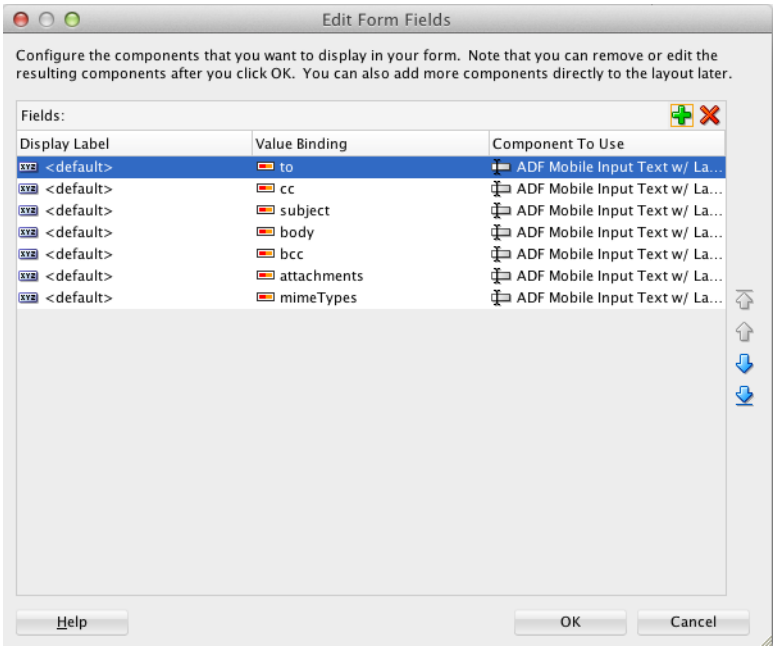
Note: In Android, if an end user switches away from their application while editing an email and then subsequently returns to it, they will no longer be in the email editing screen. Instead, the message will be saved as a draft that can then be manually selected for continued editing.

To customize a sendEmail operation using the DeviceFeatures data control:

In JDeveloper, drag the `sendEmail` operation from the DeviceFeatures data control in the Data Controls panel to the page designer and drop it as a **Parameter Form**. You can then customize the form in the **Edit Form Fields** dialog. At runtime, an editable form will be displayed on the page, which enables the application user to enter values for the various fields described above. Below this form will be a button to display the device's email interface, which will display an email ready to send with all of the specified fields pre-populated.

Figure 7–13 shows the bindings for sending an email using an editable form on the page.

Figure 7–13 Bindings for Sending an Email Using an Editable Form at Design Time



Example 7–22 and Example 7–23 show code examples that allow the end user to send an email message with the device's email interface.

For information about the `sendEmail` method, see the `DeviceDataControl` class in the MAF Javadoc and refer to the Cordova documentation (`http://cordova.apache.org/docs/en/2.2.0/index.html`).

Example 7–22 JavaScript Code Example for sendEmail

```
// Populate an email to 'ann.li@example.com',
// copy 'joe.jones@example.com', with the
// subject 'Test message', and the body 'This is a test message'
// No BCC recipients or attachments
adf.mf.api.sendEmail({to: "ann.li@example.com",
                          cc: "joe.jones@example.com",
                          subject: "Test message",
                          body: "This is a test message"});

// Populate the same email as before, but this time, also BCC
// 'john.smith@example.com' & 'jane.smith@example.com' and attach two files.
// By not specifying a value for the mimeTypes parameter, you are telling
// ADFMobile to automatically determine the MIME type for each of the attachments.
adf.mf.api.sendEmail({to: "ann.li@example.com",
                          cc: "joe.jones@example.com",
                          subject: "Test message",
                          body: "This is a test message"});
                          bcc: "john.smith@example.com,jane.smith@example.com",
                          attachments: "path/to/file1.txt,path/to/file2.png"});

// For iOS only: Same as previous email, but this time, explicitly specify
// all the MIME types.
adf.mf.api.sendEmail({to: "ann.li@example.com",
                          cc: "joe.jones@example.com",
                          subject: "Test message",
                          body: "This is a test message"});
```

```
                            bcc: "john.smith@example.com,jane.smith@example.com",
                            attachments: "path/to/file1.txt,path/to/file2.png"});
                            mimeTypes: "text/plain,image/png"});

// For iOS only: Same as previous email, but this time, only specify
// the MIME type for the second attachment and let the system determine
// the MIME type for the first one.
adf.mf.api.sendEmail({to: "ann.li@example.com",
                            cc: "joe.jones@example.com",
                            subject: "Test message",
                            body: "This is a test message"});
                            bcc: "john.smith@example.com,jane.smith@example.com",
                            attachments: "path/to/file1.txt,path/to/file2.png"});
                            mimeTypes: ",image/png"});

// For Android only: Same as previous e-mail, but this time, explicitly specify
// the MIME type.
adf.mf.api.sendEmail({to: "ann.li@example.com",
                            cc: "joe.jones@example.com",
                            subject: "Test message",
                            body: "This is a test message"});
                            bcc: "john.smith@example.com,jane.smith@example.com",
                            attachments: "path/to/file1.txt,path/to/file2.png"});
                            mimeTypes: "image/*"});
// You can also use "plain/text" as the MIME type as it just determines the type
// of applications to be filtered in the application chooser dialog.
```

Example 7–23 Java Code Example for sendEmail

```
import oracle.adf.model.datacontrols.device.DeviceManagerFactory;

// Access device features in Java code by acquiring an instance of the
// DeviceManager from the DeviceManagerFactory.
// Populate an email to 'ann.li@example.com', copy 'joe.jones@example.com', with the
// subject 'Test message', and the body 'This is a test message'.
// No BCC recipients or attachments.
DeviceManagerFactory.getDeviceManager().sendEmail(
                                        "ann.li@example.com",
                                        "joe.jones@example.com",
                                        "Test message",
                                        "This is a test message",
                                        null,
                                        null,
                                        null);

// Populate the same email as before, but this time, also BCC
// 'john.smith@example.com' & 'jane.smith@example.com' and attach two files.
// By specifying null for the mimeTypes parameter, you are telling
// ADFMobile to automatically determine the MIME type for each of the attachments.
DeviceManagerFactory.getDeviceManager().sendEmail(
                                        "ann.li@example.com",
                                        "joe.jones@example.com",
                                        "Test message",
                                        "This is a test message",
                                        "john.smith@example.com,jane.smith@example.com",
                                        "path/to/file1.txt,path/to/file2.png",
                                        null);

// Same as previous email, but this time, explicitly specify all the MIME types.
```

```
DeviceManagerFactory.getDeviceManager().sendEmail(
                                        "ann.li@example.com",
                                        "joe.jones@example.com",
                                        "Test message",
                                        "This is a test message",
                                        "john.smith@example.com,jane.smith@example.com",
                                        "path/to/file1.txt,path/to/file2.png",
                                        "text/plain,image/png");


// Same as previous email, but this time, only specify the MIME type for the
// second attachment and let the system determine the MIME type for the first one.
DeviceManagerFactory.getDeviceManager().sendEmail(
                                        "ann.li@example.com",
                                        "joe.jones@example.com",
                                        "Test message",
                                        "This is a test message",
                                        "john.smith@example.com,jane.smith@example.com",
                                        "path/to/file1.txt,path/to/file2.png",
                                        ",image/png");
```

7.11.4 How to Use the createContact Method to Enable Creating Contacts

The DeviceFeatures data control includes the `createContact` method, which enables MAF applications to leverage a device's interface and file system for managing contacts so end users can create new contacts to save in the device's address book. MAF enables you to display the device's interface and optionally pre-populate the `Contact` fields. The `createContact` method takes in a `Contact` object as a parameter and returns the created `Contact` object, as shown in Example 7–25.

For more information about the `createContact` method and the `Contact` object, see the `DeviceDataControl` class in the MAF Javadoc and refer to the Cordova documentation (`http://cordova.apache.org/docs/en/2.2.0/index.html`). Also see Section 7.11.5, "How to Use the findContacts Method to Enable Finding Contacts" for a description of `Contact` properties.

Note: The timeout value for the `createContact` method is set to 1 minute. If the device's operation takes longer than the timeout allowed, a timeout error is displayed.

Note: If a null `Contact` object is passed in to the method, an exception is thrown.

To customize a createContact operation using the DeviceFeatures data control:

1. In JDeveloper, drag the `createContact` operation from the DeviceFeatures data control in the Data Controls panel and drop it on the page designer as a **Link** or **Button**.

   Link or Button: You will be prompted with the Edit Action Binding dialog to enter the `Contact` object parameter to the `createContact` operation. This parameter must be an EL expression that refers to the property of a managed bean that is used to return the `Contact` from a Java bean class. Assuming a managed bean already exists with a getter for a `Contact` object, you can use the EL Expression Builder to set the value of the parameter. At runtime, a button or link will be

displayed on the page, which will use the entered values to perform a `createContact` operation when pressed. Example 7–24 shows an example of managed bean code for creating a `Contact` object.

2. You can also drag a `Contact` return object from under the `createContact` operation in the Data Controls panel and drop it on to the page as a **Form**. You can then customize the form in the **Edit Form Fields** dialog. When the `createContact` operation is performed, the results will be displayed in this form.

Example 7–24 Managed Bean Code for Creating a Contact Object

```
private Contact contactToBeCreated;

public void setContactToBeCreated(Contact contactToBeCreated)
{
   this.contactToBeCreated = contactToBeCreated;
}

public Contact getContactToBeCreated()
{
   String givenName = "Mary";
   String familyName = "Jones";
   String note = "Just a Note";
   String phoneNumberType = "mobile";
   String phoneNumberValue = "650-555-0111";
   String phoneNumberNewValue = "650-555-0199";
   String emailType = "home";
   String emailTypeNew = "work";
   String emailValue = "Mary.Jones@example.com";
   String addressType = "home";
   String addressStreet = "500 Barnacle Pkwy";
   String addressLocality = "Redwood Shores";
   String addressCountry = "USA";
   String addressPostalCode = "94065";
   ContactField[] phoneNumbers = null;
   ContactField[] emails = null;
   ContactAddresses[] addresses = null;

   /*
    * Create contact
    */
   this.contactToBeCreated = new Contact();

   ContactName name = new ContactName();
   name.setFamilyName(familyName);
   name.setGivenName(givenName);
   this.contactToBeCreated.setName(name);

   ContactField phoneNumber = new ContactField();
   phoneNumber.setType(phoneNumberType);
   phoneNumber.setValue(phoneNumberValue);

   phoneNumbers = new ContactField[] { phoneNumber };

   ContactField email = new ContactField();
   email.setType(emailType);
   email.setValue(emailValue);

   emails = new ContactField[] { email };
```

```
   ContactAddresses address = new ContactAddresses();
   address.setType(addressType);
   address.setStreetAddress(addressStreet);
   address.setLocality(addressLocality);
   address.setCountry(addressCountry);

   addresses = new ContactAddresses[] { address };

   this.contactToBeCreated.setNote(note);
   this.contactToBeCreated.setPhoneNumbers(phoneNumbers);
   this.contactToBeCreated.setEmails(emails);
   this.contactToBeCreated.setAddresses(addresses);

   return this.contactToBeCreated;
}
```

Example 7–25 and Example 7–26 show code examples that allow the end user to create contacts on devices.

Example 7–25 JavaScript Code Example for createContact

```
// Contacts, like many other device-specific features, are accessed from the
global 'navigator' object in JavaScript.
var contact = navigator.contacts.create();

var name = new ContactName();
name.givenName = "Mary";
name.familyName = "Jones";

contact.name = name;

// Store contact phone numbers in ContactField[]
var phoneNumbers = [1];
phoneNumbers[0] = new ContactField('home', '650-555-0123', true);

contact.phoneNumbers = phoneNumbers;

// Store contact email addresses in ContactField[]
var emails = [1];
emails[0] = new ContactField('work', 'Mary.Jones@example.com');

contact.emails = emails;

// Save
contact.save(onSuccess, onFailure);

function onSuccess()
{
  alert("Create Contact successful.");
}

function onFailure(Error)
{
  alert("Create Contact failed: " + Error.code);
}
```

Example 7–26 Java Code Example for createContact

```
import oracle.adf.model.datacontrols.device.DeviceManagerFactory;
```

```
import oracle.adf.model.datacontrols.device.ContactAddresses;
import oracle.adf.model.datacontrols.device.ContactField;
import oracle.adf.model.datacontrols.device.ContactName;

String givenName = "Mary";
String familyName = "Jones";
String note = "Just a Note";
String phoneNumberType = "mobile";
String phoneNumberValue = "650-555-0111";
String phoneNumberNewValue = "650-555-0199";
String emailType = "home";
String emailTypeNew = "work";
String emailValue = "Mary.Jones@example.com";
String addressType = "home";
String addressStreet = "500 Barnacle Pkwy";
String addressLocality = "Redwood Shores";
String addressCountry = "USA";
String addressPostalCode = "91234";
ContactField[] phoneNumbers = null;
ContactField[] emails = null;
ContactAddresses[] addresses = null;
ContactField[] emails = null;

/*
* Create contact
*/
Contact aContact = new Contact();

ContactName name = new ContactName();
name.setFamilyName(familyName);
name.setGivenName(givenName);
aContact.setName(name);

ContactField phoneNumber = new ContactField();
phoneNumber.setType(phoneNumberType);
phoneNumber.setValue(phoneNumberValue);

phoneNumbers = new ContactField[] { phoneNumber };

ContactField email = new ContactField();
email.setType(emailType);
email.setValue(emailValue);

emails = new ContactField[] { email };

ContactAddresses address = new ContactAddresses();
address.setType(addressType);
address.setStreetAddress(addressStreet);
address.setLocality(addressLocality);
address.setCountry(addressCountry);

addresses = new ContactAddresses[] { address };

aContact.setNote(note);
aContact.setPhoneNumbers(phoneNumbers);
aContact.setEmails(emails);
aContact.setAddresses(addresses);

// Access device features in Java code by acquiring an instance of the
```

```
// DeviceManager from the DeviceManagerFactory.
// Invoking the createContact method, using the DeviceDataControl object.
Contact createdContact = DeviceManagerFactory.getDeviceManager()
    .findContacts.createContact(aContact);
```

7.11.5 How to Use the findContacts Method to Enable Finding Contacts

The DeviceFeatures data control includes the `findContacts` method, which enables MAF applications to leverage a device's interface and file system for managing contacts so end users can find one or more contacts from the device's address book. MAF enables you to display the device's interface and optionally pre-populate the `findContacts` fields. The `findContacts` method takes in a filter string and a list of field names to look through (and return as part of the found contacts). The filter string can be anything to look for in the contacts. For more information about the `findContacts` method, see the `DeviceDataControl` class in the MAF Javadoc and refer to the Cordova documentation (http://cordova.apache.org/docs/en/2.2.0/index.html).

The `findContacts` operation takes the following arguments:

- `contactFields`: *Required parameter*. Use this parameter to specify which fields should be included in the `Contact` objects resulting from a `findContacts` operation. Separate fields with a comma (spacing does not matter).
- `filter`: The search string used to filter contacts. (String) (Default: `""`)
- `multiple`: Determines if the `findContacts` operation should return multiple contacts. (Boolean) (Default: `false`)

> **Note:** Passing in a field name that is not in the following list may result in a `null` return value for the `findContacts` operation. Also, only the fields specified in the `Contact` fields argument will be returned as part of the `Contact` object.

The following list shows the possible `Contact` properties that can be passed in to look through and be returned as part of the found contacts:

- `id`: A globally unique identifier
- `displayName`: The name of this contact, suitable for display to end-users
- `name`: An object containing all components of a person's name
- `nickname`: A casual name for the contact. If you set this field to null, it will be stored as an empty string.
- `phoneNumbers`: An array of all the contact's phone numbers
- `emails`: An array of all the contact's email addresses
- `addresses`: An array of all the contact's addresses
- `ims`: An array of all the contact's instant messaging (IM) addresses (The `ims` property is not supported in this release.)

> **Note:** MAF does not support the `Contact` property `ims` in this release. If you create a contact with the `ims` property, MAF will save the contact without the `ims` property. As a result, if a user tries to perform a search based on `ims`, the user will not be able to find the contact. Also, if a user tries to enter `ims` in a search field, the `ims` will be returned as `null`.

- `organizations`: An array of all the contact's organizations
- `birthday`: The birthday of the contact. Although you cannot programmatically set a contact's birthday field and persist it to the address book, you can still use the operating system's address book application to manually set this field.
- `note`: A note about the contact. If you set this field to null, it will be stored as an empty string.
- `photos`: An array of the contact's photos
- `categories`: An array of all the contact's user-defined categories.
- `urls`: An array of web pages associated to the contact

> **Note:** The timeout value for the `findContacts` method is set to 1 minute. If the device's operation takes longer than the timeout allowed, a timeout error is displayed.

To customize a findContacts operation using the DeviceFeatures data control:

1. In JDeveloper, drag the `findContacts` operation from the DeviceFeatures data control in the Data Controls panel and drop it on the page designer as a **Link**, **Button**, or **Parameter Form**.

   Link or Button: You will be prompted with the Edit Action Binding dialog to enter values for arguments to the `findContacts` operation. At runtime, a button or link will be displayed on the page, which will use the entered values to perform a `findContacts` operation when pressed.

   Parameter Form: Customize the form in the Edit Form Fields dialog. At runtime, an editable form will be displayed on the page, which enables the application user to enter values for the various Contact fields described above. Below this form will be a button, which will use the entered values to perform a `findContacts` operation when pressed.

2. You can also drag a `Contact` return object from under the `findContacts` operation in the Data Controls panel and drop it on to the page as a **Form**. You can then customize the form in the Edit Form Fields dialog. When the `findContacts` operation is performed, the results will be displayed in this form.

Example 7–27 shows possible argument values for the `findContacts` method. Example 7–28 and Example 7–29 show how to find a contact by family name and get the contact's name, phone numbers, email, addresses, and note.

Example 7–27 Possible Argument Values for findContacts

```
// This will return just one contact with only the ID field:
Contact[] foundContacts = DeviceManagerFactory.getDeviceManager().findContacts("", "", false);

// This will return all contacts with only ID fields:
Contact[] foundContacts = DeviceManagerFactory.getDeviceManager().findContacts("", "", true);
```

```
// This will return just one contact with all fields:
Contact[] foundContacts = DeviceManagerFactory.getDeviceManager().findContacts("*", "", false);

// This will return all contacts with all fields:
Contact[] foundContacts = DeviceManagerFactory.getDeviceManager().findContacts("*", "", true);

// These will throw an exception as contactFields is a required argument and cannot be null:
DeviceManagerFactory.getDeviceManager().findContacts(null, "", false);
DeviceManagerFactory.getDeviceManager().findContacts(null, "", true);

// These will throw an exception as the filter argument cannot be null:
DeviceManagerFactory.getDeviceManager().findContacts("", null, false);
DeviceManagerFactory.getDeviceManager().findContacts("", null, true);
```

Note: The `Contact` fields passed are strings (containing the comma-delimited fields). If any arguments are passed as `null` to the method, an exception is thrown.

Example 7–28 JavaScript Code Example for findContacts

```
var filter = ["name", "phoneNumbers", "emails", "addresses", "note"];

var options = new ContactFindOptions();
options.filter="FamilyName";

// Contacts, like many other device-specific features, are accessed from
// the global 'navigator' object in JavaScript.
navigator.contacts.find(filter, onSuccess, onFail, options);

function onSuccess(contacts)
{
  alert ("Find Contact call succeeded! Number of contacts found = " + contacts.length);
}

function onFail(Error)
{
  alert("Find Contact failed: " + Error.code);
}
```

Example 7–29 Java Code Example for findContacts

```
import oracle.adf.model.datacontrols.device.DeviceManagerFactory;

/*
 * Find Contact - Find contact by family name.
 *
 * See if we can find the contact that we just created.
 */

String familyName = "FamilyName"

// Access device features in Java code by acquiring an instance of the
// DeviceManager from the DeviceManagerFactory.
Contact[] foundContacts = DeviceManagerFactory.getDeviceManager().findContacts(
    "name,phoneNumbers,emails,addresses,note", familyName, true);
```

7.11.6 How to Use the updateContact Method to Enable Updating Contacts

The DeviceFeatures data control includes the `updateContact` method, which enables MAF applications to leverage a device's interface and file system for managing contacts so end users can update contacts in the device's address book. MAF enables you to display the device's interface and optionally pre-populate the `updateContact` fields. The `updateContact` method takes in a `Contact` object as a parameter and returns the updated `Contact` object, as shown in Example 7–30.

For more information about the `updateContact` method and the `Contact` object, see the `DeviceDataControl` class in the MAF Javadoc and refer to the Cordova documentation (`http://cordova.apache.org/docs/en/2.2.0/index.html`). Also see Section 7.11.5, "How to Use the findContacts Method to Enable Finding Contacts" for a description of `Contact` properties.

> **Note:** The `Contact` object that is needed as the input parameter can be found using the `findContacts` method as described in Section 7.11.5, "How to Use the findContacts Method to Enable Finding Contacts." If a null `Contact` object is passed in to the method, an exception is thrown.

To customize an updateContact operation using the DeviceFeatures data control:

1. In JDeveloper, drag the **updateContact** operation from the DeviceFeatures data control in the Data Controls panel and drop it on the page designer as a **Link** or **Button**.

   Link or Button: You will be prompted with the Edit Action Binding dialog to enter the `Contact` object parameter to the `updateContact` operation. This parameter must be an EL expression that refers to the property of a managed bean that is used to return the `Contact` from a Java bean class. Assuming a managed bean already exists with a getter for a `Contact` object, you can use the EL Expression Builder to set the value of the parameter. At runtime, a button or link will be displayed on the page, which will use the entered values to perform a `updateContact` operation when pressed. Example 7–24 shows an example of managed bean code for creating a `Contact` object.

2. You can also drag a **Contact** return object from under the `updateContact` operation in the Data Controls panel and drop it on to the page as a **Form**. You can then customize the form in the Edit Form Fields dialog. When the `updateContact` operation is performed, the results will be displayed in this form.

Example 7–30 and Example 7–32 show how to update a contact's phone number. Example 7–31 and Example 7–33 show how to add another phone number to a contact.

Example 7–30 JavaScript Code Example for updateContact

```
function updateContact(contact)
{
  try
  {
    if (null != contact.phoneNumbers)
    {
      alert("Number of phone numbers = " + contact.phoneNumbers.length);
      var numPhoneNumbers = contact.phoneNumbers.length;
```

```
      for (var j = 0; j < numPhoneNumbers; j++)
      {
        alert("Type: " + contact.phoneNumbers[j].type + "\n" +
              "Value: "  + contact.phoneNumbers[j].value + "\n" +
              "Preferred: "  + contact.phoneNumbers[j].pref);

        contact.phoneNumbers[j].type = "mobile";
        contact.phoneNumbers[j].value = "408-555-0100";
      }

      // save
      contact.save(onSuccess, onFailure);
    }
    else
    {
      //alert ("No phone numbers found in the contact.");
    }
  }
  catch(e)
  {
    alert("updateContact - ERROR: " + e.description);
  }
}

function onSuccess()
{
  alert("Update Contact successful.");
}

function onFailure(Error)
{
  alert("Update Contact failed: " + Error.code);
```

Example 7–31 shows you how to add another phone number to the already existing phone numbers.

Example 7–31 JavaScript Code Example for Adding a Phone Number with updateContact

```
function updateContact(contact)
{
  try
  {
    var phoneNumbers = [1];
    phoneNumbers[0] = new ContactField('home', '650-555-0123', true);
    contact.phoneNumbers = phoneNumbers;

    // save
    contact.save(onSuccess, onFailure);
  }
  catch(e)
  {
    alert("updateContact - ERROR: " + e.description);
  }
}

function onSuccess()
{
  alert("Update Contact successful.");
}
```

```
function onFailure(Error)
{
  alert("Update Contact failed: " + Error.code);
}
```

Example 7–32 shows how to update a contact's phone number, email type, and postal code.

Example 7–32 Java Code Example for updateContact

```
import oracle.adf.model.datacontrols.device.DeviceManagerFactory;

/*
 * Update Contact - Updating phone number, email type, and adding address postal code
 */
String familyName = "FamilyName";
String phoneNumberNewValue = "650-555-0123";
String emailTypeNew = "work";
String addressPostalCode = "91234";

Contact[] foundContacts = DeviceManagerFactory.getDeviceManager().findContacts(
    "name,phoneNumbers,emails,addresses,note", familyName, true);

// Assuming there was only one contact returned, we can use the first contact in the array.
// If more than one contact is returned then we have to filter more to find the exact contact
// we need to update.

foundContacts[0].getPhoneNumbers()[0].setValue(phoneNumberNewValue);
foundContacts[0].getEmails()[0].setType(emailTypeNew);
foundContacts[0].getAddresses()[0].setPostalCode(addressPostalCode);

Contact updatedContact = DeviceManagerFactory.getDeviceManager().updateContact(foundContacts[0]);
```

Example 7–33 shows you how to add another phone number to the already existing phone numbers.

Example 7–33 Java Code Example for Adding a Phone Number with updateContact

```
import oracle.adf.model.datacontrols.device.DeviceManagerFactory;

String additionalPhoneNumberValue = "408-555-0123";
String additionalPhoneNumberType = "mobile";
// Create a new phoneNumber that will be appended to the previous one.
ContactField additionalPhoneNumber = new ContactField();
additionalPhoneNumber.setType(additionalPhoneNumberType);
additionalPhoneNumber.setValue(additionalPhoneNumberValue);

foundContacts[0].setPhoneNumbers(new ContactField[] { additionalPhoneNumber });

// Access device features in Java code by acquiring an instance of the DeviceManager
// from the DeviceManagerFactory.
Contact updatedContact = DeviceManagerFactory.getDeviceManager().updateContact(foundContacts[0]);
```

Note: The timeout value for the `updateContact` method is set to 1 minute. If the device's operation takes longer than the timeout allowed, a timeout error is displayed.

7.11.7 How to Use the removeContact Method to Enable Removing Contacts

The DeviceFeatures data control includes the `removeContact` method, which enables MAF applications to leverage a device's interface and file system for managing contacts so end users can remove contacts from the device's address book. MAF enables you to display the device's interface and optionally pre-populate the `removeContact` fields. The `removeContact` method takes in a `Contact` object as a parameter, as shown in Example 7–34.

Note: The `Contact` object that is needed as the input parameter can be found using the `findContacts` method as described in Section 7.11.5, "How to Use the findContacts Method to Enable Finding Contacts."

To customize a removeContact operation using the DeviceFeatures data control:

1. In JDeveloper, drag the **removeContact** operation from the DeviceFeatures data control in the Data Controls panel and drop it on the page designer as a **Link**, **Button**, or **Parameter Form**.

   Link or Button: You will be prompted with the Edit Action Binding dialog to enter values for arguments to the `removeContact` operation. At runtime, a button or link will be displayed on the page, which will use the entered values to perform a `removeContact` operation when pressed.

   Parameter Form: Customize the form in the Edit Form Fields dialog. At runtime, an editable form will be displayed on the page, which enables the application user to enter values for the various Contact fields. Below this form will be a button, which will use the entered values to perform a `removeContact` operation when pressed.

2. You can also drag a `Contact` return object from under the `removeContact` operation in the Data Controls panel and drop it on to the page as a **Form**. You can then customize the form in the Edit Form Fields dialog. When the `removeContact` operation is performed, the results will be displayed in this form.

Example 7–34 and Example 7–35 show you how to delete a contact that you found using `findContacts`. For information about the `removeContact` method and the Contact object, see the `DeviceDataControl` class in the MAF Javadoc and refer to the Cordova documentation (`http://cordova.apache.org/docs/en/2.2.0/index.html`).

Note: In Android, the `removeContact` operation does not remove the contact fully. After a contact is removed by calling the `removeContact` method, a contact with the "(Unknown)" display name shows in the contacts list in the application.

Example 7–34 JavaScript Code Example for removeContact

```
// Remove the contact from the device
contact.remove(onSuccess,onError);
```

```
function onSuccess()
{
  alert("Removal Success");
}

function onError(contactError)'
{
  alert("Error = " + contactError.code);
}
```

Example 7–35 Java Code Example for removeContact

```
import oracle.adf.model.datacontrols.device.DeviceManagerFactory;

/*
 * Remove the contact from the device
 */
Contact[] foundContacts = DeviceManagerFactory.getDeviceManager().findContacts(
    "name,phoneNumbers,emails,addresses", familyName, true);

// Assuming there is only one contact returned, we can use the first contact in the array.
// If more than one contact is returned we will have to filter more to find the
// exact contact we want to remove.

// Access device features in Java code by acquiring an instance of the DeviceManager
// from the DeviceManagerFactory.
DeviceManagerFactory.getDeviceManager().removeContact(foundContacts[0]);
```

Note: The timeout value for the `removeContact` method is set to 1 minute. If the device's operation takes longer than the timeout allowed, a timeout error is displayed.

7.11.8 How to Use the startLocationMonitor Method to Enable Geolocation

The DeviceFeatures data control includes the `startLocationMonitor` method, which enables MAF applications to leverage a device's geolocation services in order to obtain and track the device's location. MAF enables you to display a device's interface and optionally pre-populate the `startLocationMonitor` fields.

MAF exposes APIs that enable you to acquire a device's current position, allowing you to retrieve the device's current location for one instant in time or to subscribe to it on a periodic basis. Example 7–36 and Example 7–37 show code examples that will allow your application to obtain the device's location. For information about the `startLocationMonitor` method, see the `DeviceDataControl` class in the MAF Javadoc and refer to the Cordova documentation (`http://cordova.apache.org/docs/en/2.2.0/index.html`).

Note: The Android 2.*n* simulators will not return a geolocation result unless the `enableHighAccuracy` option is set to `true`.

The `altitudeAccuracy` property is not supported by Android devices.

Updates do not occur as frequently on the Android platform as on iOS.

To listen for changes in a device's location using the DeviceFeatures data control:

In JDeveloper, drag the `startLocationMonitor` operation from the DeviceFeatures data control in the Data Controls panel to the page designer and drop it as a **Link** or **Button**. When prompted by the **Edit Action Dialog**, populate the fields as follows:

- `enableHighAccuracy`: If `true`, use the most accurate possible method of obtaining a location fix. This is just a hint; the operating system may not respect it. Devices often have several different mechanisms for obtaining a location fix, including cell tower triangulation, Wi-Fi hotspot lookup, and true GPS. Specifying `false` indicates that you are willing to accept a less accurate location, which may result in a faster response or consume less power.
- `updateInterval`: Defines how often, in milliseconds, to receive updates. Location updates may not be delivered as frequently as specified; the operating system may wait until a significant change in the device's position has been detected before triggering another location update.
- `locationListener`: EL expression that resolves to a bean method with the following signature:

  ```
  void methodName(Location newLocation)
  ```

  This EL expression will be evaluated every time a location update is received. For example, enter `viewScope.LocationListenerBean.locationUpdated` (without the surrounding`#{}`), then define a bean named `LocationListenerBean` in `viewScope` and implement a method with the following signature:

  ```
  public void locationUpdated(Location currentLocation)
  {
    System.out.println(currentLocation);
    // To stop subscribing to location updates, invoke the following:
    // DeviceManagerFactory.getDeviceManager().clearWatchPosition(
    //     currentLocation.getWatchId());
  }
  ```

  Note: Do not use the EL syntax `#{LocationListenerBean.locationUpdate}` to specify the `locationListener`, unless you truly want the result of evaluating that expression to be the name of the `locationListener`.

Example 7–36 shows how to subscribe to changes in the device's location periodically. The example uses the `DeviceManager.startUpdatingPosition` method, which takes the following parameters:

- `int updateInterval`: Defines how often to deliver location updates, in milliseconds. Location updates may not be delivered as frequently as specified; the operating system may wait until a significant change in the device's position has been detected before triggering another location update. Conversely, location updates may also be delivered at the specified frequency, but may be identical until the device's position has changed significantly.
- `boolean enableHighAccuracy`: If set to `true`, use the most accurate possible method of obtaining a location fix.
- `String watchID`: Defines a unique ID that can be subsequently used to stop subscribing to location updates

- `GeolocationCallback`: An implementation of the GeolocationCallback interface. This implementation's `locationUpdated` method is invoked each time the location is updated, as shown in Example 7–36.

For an example of how to subscribe to changes in the device's position using JavaScript, refer to the Cordova documentation (`http://cordova.apache.org/docs/en/2.2.0/index.html`).

Parameters returned in the callback function specified by the `locationListener` are as follows:

- `double getAccuracy`—Accuracy level of the latitude and longitude coordinates in meters
- `double getAltitude`—Height of the position in meters above the ellipsoid
- `double getLatitude`—Latitude in decimal degrees
- `double getLongitude`—Longitude in decimal degrees
- `double getAltitudeAccuracy`—Accuracy level of the altitude coordinate in meters
- `double getHeading`—Direction of travel, specified in degrees counting clockwise relative to the true north
- `double getSpeed`—Current ground speed of the device, specified in meters per second
- `long getTimestamp`—Creation of a timestamp in milliseconds since the Unix epoch
- `String getWatchId`—Only used when subscribing to periodic location updates. A unique ID that can be subsequently used to stop subscribing to location updates

For more information about the `startLocationMonitor` and `startHeadingMonitor` methods, see the `DeviceDataControl` class in the MAF Javadoc and refer to the Cordova documentation (`http://cordova.apache.org/docs/en/2.2.0/index.html`).

Note: The timeout value for the `startLocationMonitor` and `startHeadingMonitor` methods is set to 1 minute. If the device's operation takes longer than the timeout allowed, a timeout error is displayed.

Example 7–36 Using Geolocation to Subscribe to Changes in a Device's Location

```
import oracle.adf.model.datacontrols.device.DeviceManagerFactory;
import oracle.adf.model.datacontrols.device.GeolocationCallback;
import oracle.adf.model.datacontrols.device.Location;

// Subscribe to location updates that will be delivered every 20 seconds, with high accuracy.
// As you can have multiple subscribers, let's identify this one as 'MyGPSSubscriptionID'.
// Notice that this call returns the watchID, which is usually the same as the watchID passed in.
// However, it may be different if the specified watchID conflicts with an existing watchID,
// so be sure to always use the returned watchID.
String watchID = DeviceManagerFactory.getDeviceManager().startUpdatingPosition(20000, true, "
       "MyGPSSubscriptionID", new GeolocationCallback() {
    public void locationUpdated(Location position) {
        System.out.println("Location updated to: " + position);
    }
});
```

```
// The previous call returns immediately so that you can continue processing.
// When the device's location changes, the locationUpdated() method specified in
// the previous call will be invoked in the context of the current feature.

// When you wish to stop being notified of location changes, call the following method:
DeviceManagerFactory().getDeviceManager().clearWatchPosition(watchID);
```

To obtain a device's location using the DeviceFeatures data control:

In JDeveloper, drag the **startLocationMonitor** operation from the DeviceFeatures data control in the Data Controls panel to the page designer and drop it as a **Link** or **Button**. Follow Example 7–36, but stop listening after the first location update is received.

Example 7–37 shows how to get a device's location one time. The example uses `DeviceManager.getCurrentPosition`, which takes the following parameters:

- `int maximumAge`: Accept a cached value no older than this value, in milliseconds. If a location fix has been obtained within this window of time, then it will be returned immediately; otherwise, the call will block until a new location fix can be determined. The value of the `maximumAge` parameter must be at least 1000 ms; values less than this will be set to 1000 ms automatically.
- `boolean: enableHighAccuracy` If set to true, use the most accurate possible method of obtaining a location fix.

Example 7–37 Using Geolocation to Get a Device's Current Location (One Time)

```
import oracle.adf.model.datacontrols.device.DeviceManagerFactory;
import oracle.adf.model.datacontrols.device.Location;

// Get the device's current position, with highest accuracy, and accept a cached location that is
// no older than 60 seconds.
Location currentPosition = DeviceManagerFactory.getDeviceManager().getCurrentPosition(60000, true);
System.out.println("The device's current location is: latitude=" + currentPosition.getLatitude() +
    ", longitude=" + currentPosition.getLongitude());
```

7.11.9 How to Use the displayFile Method to Enable Displaying Files

The DeviceFeatures data control includes the `displayFile` method, which enables MAF applications to display files that are local to the device. Depending on the platform, application users can view PDFs, image files, Microsoft Office documents, and various other file types. On iOS, the application user has the option to preview supported files within the MAF application. Users can also open those files with third-party applications, email them, or send them to a printer. On Android, all files are opened in third-party applications. In other words, the application user leaves the MAF application while viewing the file. The user may return to the MAF application by pressing the Android Back button. If the device does not have an application capable of opening the given file, an error is displayed. For an example of how the `displayFile` method opens files on both iOS- and Android-powered devices, see the DeviceDemo sample application. This application is available in the `PublicSamples.zip` file at the following location within the JDeveloper installation directory of your development computer:

jdev_install`/jdeveloper/jdev/extensions/oracle.maf/Samples`

The `displayFile` method is only able to display files that are local to the device. This means that remote files first have to be downloaded. Use the call `AdfmfJavaUtilities.getDirectoryPathRoot(AdfmfJavaUtilities.`*`DownloadDirectory`*) to return the directory root where downloaded files should be stored. Note that on iOS, this location is specific to the application, but on Android this location refers to the external storage directory. The external storage directory is publicly accessible and allows third-party applications to read files stored there.

Table 7–7 Supported File Types

iOS	Android
For more information about supported file types, see the Quick Look preview controller documentation at the Apple iOS development site (http://developer.apple.com/library/ios/navigation/).	The framework will start the viewer associated with the given MIME type if it is installed on the device. There is no built-in framework for viewing specific file types. If the device does not have an application installed that handles the file type, the MAF application displays an error.
iWork documents	
Microsoft Office documents (Office '97 and newer)	
Rich Text Format (RTF) documents	
PDF files	
Images	
Text files whose uniform type identifier (UTI) conforms to the public.text type	
Comma-separated value (csv) files	

To customize a displayFile operation using the DeviceFeatures data control:

1. In JDeveloper, drag the **displayFile** operation from the DeviceFeatures data control in the Data Controls panel and drop it on the page designer as a **Link**, **Button**, or **Parameter Form**.

   Link or Button: You will be prompted with the Edit Action Binding dialog to enter values for arguments to the `displayFile` operation. At runtime, a button or link will be displayed on the page, which will use the entered values to perform a `displayFile` operation when pressed.

   Parameter Form: Customize the form in the Edit Form Fields dialog. At runtime, an editable form will be displayed on the page, which enables the application user to enter values for the various fields. Below this form will be a button, which will use the entered values to perform a `displayFile` operation when pressed.

Example 7–38 shows you how to view files using `the displayFile` method. For information about the `displayFile` method, see the `DeviceDataControl` class in the MAF Javadoc).

Example 7–38 Java Code Example for displayFile

```
import oracle.adf.model.datacontrols.device.DeviceManagerFactory;

 URL remoteFileUrl;
        InputStream is;
        BufferedOutputStream fos;
        try {
```

```
            // Open connection to remote file; fileUrl here is a String containing the URL to the
remote file.
            remoteFileUrl = new URL(fileUrl);
            URLConnection connection = remoteFileUrl.openConnection();
            is = new BufferedInputStream(connection.getInputStream());
            // Saving the file locally as 'previewTempFile.<extension>'
            String fileExt = fileUrl.substring(fileUrl.lastIndexOf('.'), fileUrl.length());
            String tempFile = "/previewTempFile" + fileExt;
            File localFile = null;
            // Save the file in the DownloadDirectory location
            localFile = new
File(AdfmfJavaUtilities.getDirectoryPathRoot(AdfmfJavaUtilities.DownloadDirectory) + tempFile);
            if (localFile.exists()) {
                localFile.delete();
            }
            // Use buffered streams to download the file.
            fos = new BufferedOutputStream(new FileOutputStream(localFile));
            byte[] data = new byte[1024];
            int read = 0;
            while ((read = is.read(data)) != -1) {
                fos.write(data, 0, read);
            }
            is.close();
            fos.close();

            // displayFile takes a URL string which has to be encoded on iOS.
            // iOS does not handle "+" as an encoding for space (" ") but
            // expects "%20" instead.  Also, the leading slash MUST NOT be
            // encoded to "%2F".  We will revert it to a slash after the
            // URLEncoder converts it to "%2F".
            StringBuffer buffer = new StringBuffer();
            String path = URLEncoder.encode(localFile.getPath(), "UTF-8");
            // replace "+" with "%20"
            String replacedString = "+";
            String replacement = "%20";
            int index = 0, previousIndex = 0;
            index = path.indexOf(replacedString, index);
            while (index != -1) {
                buffer.append(path.substring(previousIndex, index)).append(replacement);
                previousIndex = index + 1;
                index = path.indexOf(replacedString, index + replacedString.length());
            }
            buffer.append(path.substring(previousIndex, path.length()));
            // Revert the leading encoded slash ("%2F") to a literal slash ("/").
            if (buffer.indexOf("%2F") == 0) {
                buffer.replace(0, 3, "/");
            }

            // Create URL and invoke displayFile with its String representation.
            URL localURL = null;
            if (Utility.getOSFamily() == Utility.OSFAMILY_ANDROID) {
                localURL = new URL("file", "localhost", localFile.getAbsolutePath());
            }
            else if (Utility.getOSFamily() == Utility.OSFAMILY_IOS)
            {
                localURL = new URL("file", "localhost", buffer.toString());
            }
            DeviceManagerFactory.getDeviceManager().displayFile(localURL.toString(), "remote
file");
```

```
} catch (Throwable t) {
    System.out.println("Exception caught: " + t.toString());
}
```

7.11.10 Device Properties

There may be features of your application that rely on specific device characteristics or capabilities. For example, you may want to present a different user interface depending on the device's screen orientation, or there may be a mapping feature that you want to enable only if the device supports geolocation. MAF provides a number of properties that you can access from Java, JavaScript, and EL in order to support this type of dynamic behavior. Table 7–8 lists these properties, along with information about how to query them, what values to expect in return, and whether the property can change during the application's lifecycle. Example 7–39 shows an example of how you can access these properties using JavaScript.

Note: The timeout value for device properties is set to 1 minute. If the device's operation takes longer than the timeout allowed, a timeout error is displayed.

Table 7–8 Device Properties and Corresponding EL Expressions

Property	Static/ Dynamic	EL Expression	Sample Value	Java API
device.name	Static	#{deviceScope.device.name}	"iPhone Simulator", "Joe Smith's iPhone"	DeviceManager.getName()
device.platform	Static	#{deviceScope.device.platform}	"iPhone Simulator", "iPhone"	DeviceManager.getPlatform()
device.version	Static	#{deviceScope.device.version}	"4.3.2", "5.0.1"	DeviceManager.getVersion()
device.os	Static	#{deviceScope.device.os}	"iOS"	DeviceManager.getOs()
device.model	Static	#{deviceScope.device.model}	"x86_64", "i386", "iPhone3,1"	DeviceManager.getModel()
device.phonegap	Static	#{deviceScope.device.phonegap}	"1.0.0"	DeviceManager.getPhonegap()
hardware.hasCamera	Static	#{deviceScope.hardware.hasCamera}	"true", "false"	DeviceManager.hasCamera()
hardware.hasContacts	Static	#{deviceScope.hardware.hasContacts}	"true", "false"	DeviceManager.hasContacts()
hardware.hasTouchScreen	Static	#{deviceScope.hardware.hasTouchScreen}	"true", "false"	DeviceManager.hasTouchScreen()
hardware.hasGeolocation	Static	#{deviceScope.hardware.hasGeolocation}	"true", "false"	DeviceManager.hasGeolocation()
hardware.hasAccelerometer	Static	#{deviceScope.hardware.hasAccelerometer}	"true", "false"	DeviceManager.hasAccelerometer()
hardware.hasCompass	Static	#{deviceScope.hardware.hasCompass}	"true", "false"	DeviceManager.hasCompass()

Table 7–8 (Cont.) Device Properties and Corresponding EL Expressions

Property	Static/ Dynamic	EL Expression	Sample Value	Java API
hardware.hasFileAccess	Static	#{deviceScope.hardware.hasFileAccess}	"true", "false"	DeviceManager.hasFileAccess()
hardware.hasLocalStorage	Static	#{deviceScope.hardware.hasLocalStorage}	"true", "false"	DeviceManager.hasLocalStorage()
hardware.hasMediaPlayer	Static	#{deviceScope.hardware.hasMediaPlayer}	"true", "false"	DeviceManager.hasMediaPlayer()
hardware.hasMediaRecorder	Static	#{deviceScope.hardware.hasMediaRecorder}	"true", "false"	DeviceManager.hasMediaRecorder()
hardware.networkStatus	Dynamic	#{deviceScope.hardware.networkStatus}	"wifi", "2g", "unknown", "none"[1]	DeviceManager.getNetworkStatus()
hardware.screen.width	Dynamic	#{deviceScope.hardware.screen.width}	320, 480	DeviceManager.getScreenWidth()
hardware.screen.height	Dynamic	#{deviceScope.hardware.screen.height}	480, 320	DeviceManager.getScreenHeight()
hardware.availableWidth	Dynamic	#{deviceScope.hardware.screen.availableWidth}	<= 320, <= 480	DeviceManager.getAvailableScreenWidth()
hardware.availableHeight	Dynamic	#{deviceScope.hardware.screen.availableHeight}	<= 480, <= 320	DeviceManager.getAvailableScreenHeight()
hardware.screen.dpi	Static	#{deviceScope.hardware.screen.dpi}	160, 326	DeviceManager.getScreenDpi()
hardware.screen.diagonalSize	Static	#{deviceScope.hardware.screen.diagonalSize}	9.7, 6.78	DeviceManager.getScreenDiagonalSize()
hardware.screen.scaleFactor	Static	#{deviceScope.hardware.screen.scaleFactor}	1.0, 2.0	DeviceManager.getScreenScaleFactor()

[1] If both `wifi` and `2G` are turned on, network status will be `wifi`, as `wifi` takes precedence over `2G`.

Example 7–39 illustrates how you can access device properties using JavaScript.

Example 7–39 Using JavaScript to Access Device Properties

```
<!DOCTYPE html>
<html>
  <head>
    <title>Device Properties Example</title>

    <script type="text/javascript" charset="utf-8" src="cordova-2.2.0.js"></script>
    <script type="text/javascript" charset="utf-8">

    // Wait for Cordova to load
    //
    //document.addEventListener("deviceready", onDeviceReady, false);
    document.addEventListener("showpagecomplete",onDeviceReady,false);

    // Cordova is ready
    //
    function onDeviceReady() {
```

```
        adf.mf.api.getDeviceProperties(properties_success, properties_fail);
    }

    function properties_success(response) {
      try {
        var element = document.getElementById('deviceProperties');
        var device = response.device;
        var hardware = response.hardware;
        element.innerHTML = 'Device Name:              ' + device.name            + '<br />' +
                            'Device Platform:          ' + device.platform        + '<br />' +
                            'Device Version:           ' + device.version         + '<br />' +
                            'Device OS:                ' + device.os              + '<br />' +
                            'Device Model:             ' + device.model           + '<br />' +
                            'Hardware Screen Width:    ' + hardware.screen.width  + '<br />' +
                            'Hardware Screen Height:   ' + hardware.screen.height + '<br />' +
      } catch (e) {alert("Exception: " + e);}
    }

    function properties_fail(error) {
        alert("getDeviceProperties failed");
    }

    </script>
  </head>
  <body>
    <p id="deviceProperties">Loading device properties...</p>
  </body>
</html>
```

7.12 Validating Attributes

In the Mobile Application Framework, validation occurs in the data control layer, with validation rules set on binding attributes. Attribute validation takes place at a single point in the system, during the `setValue` operation on the bindings.

You can define the following validators for attributes exposed by the data controls:

- Compare validator
- Length validator
- List validator
- Range validator

All validators for a given attribute are executed, and nested exceptions are thrown for every validator that does not pass. You can define a validation message for attributes, which is displayed when a validation rule is fired at runtime. For more information, see Section 6.9, "Validating Input" and Section 7.12.1, "How to Add Validation Rules."

> **Note:** Due to a JSON limitation, the value that a `BigDecimal` can hold is within the range of a `Double`, and the value that a `BigInteger` can hold is within the range of a `Long`. If you want to use numbers greater than those allowed, you can call `toString` on `BigDecimal` or `BigInteger` to (de)serialize values as `String`.

Table 7–9 lists supported validation combinations for the length validator.

Table 7–9 Length Validation

Compare type	Byte	Character
Equals	Supported	Supported
Not Equals	Supported	Supported
Less Than	Supported	Supported
Greater Than	Supported	Supported
Less Than Equal To	Supported	Supported
Greater Than Equal To	Supported	Supported
Between	Supported	Supported

Table 7–10 and Table 7–11 list supported validation combinations for the range validator.

Table 7–10 Range Validation

Compare type	Byte	Char	Double	Float	Integer	Long	Short
Between	Supported	Supported	Supported	Supported	Supported	Supported	Supported
Not Between	Supported	Supported	Supported	Supported	Supported	Supported	Supported

Table 7–11 Range Validation - math, sql, and util Packages

Compare type	java.math.BigDecimal	java.math. BigInteger	java.sql.Date	java.sql.Time	java.sql.Time stamp	java.util.Date
Between	Supported	Supported	Not supported	Not supported	Not supported	Not supported
Not Between	Supported	Supported	Not supported	Not supported	Not supported	Not supported

Table 7–12 lists supported validation combinations for the list validator.

Table 7–12 List Validation

Compare type	String
In	Supported
Not In	Supported

Table 7–13 and Table 7–14 lists supported validation combinations for the compare validator.

Table 7–13 Compare Validation

Compare type	Byte	Char	Double	Float	Integer	Long	Short	String
Equals	Supported	Supported	Supported	Supported	Supported	Supported	Supported	Supported
Not Equals	Supported	Supported	Supported	Supported	Supported	Supported	Supported	Supported
Less Than	Not supported	Supported	Supported	Supported	Supported	Supported	Supported	Not supported

Table 7–13 (Cont.) Compare Validation

Compare type	Byte	Char	Double	Float	Integer	Long	Short	String
`Greater Than`	Not supported	Supported	Supported	Supported	Supported	Supported	Supported	Not supported
`Less Than Equal To`	Not supported	Supported	Supported	Supported	Supported	Supported	Supported	Not supported
`Greater Than Equal To`	Not supported	Supported	Supported	Supported	Supported	Supported	Supported	Not supported

Table 7–14 Compare Validation - java.math, java.sql, and java.util Packages

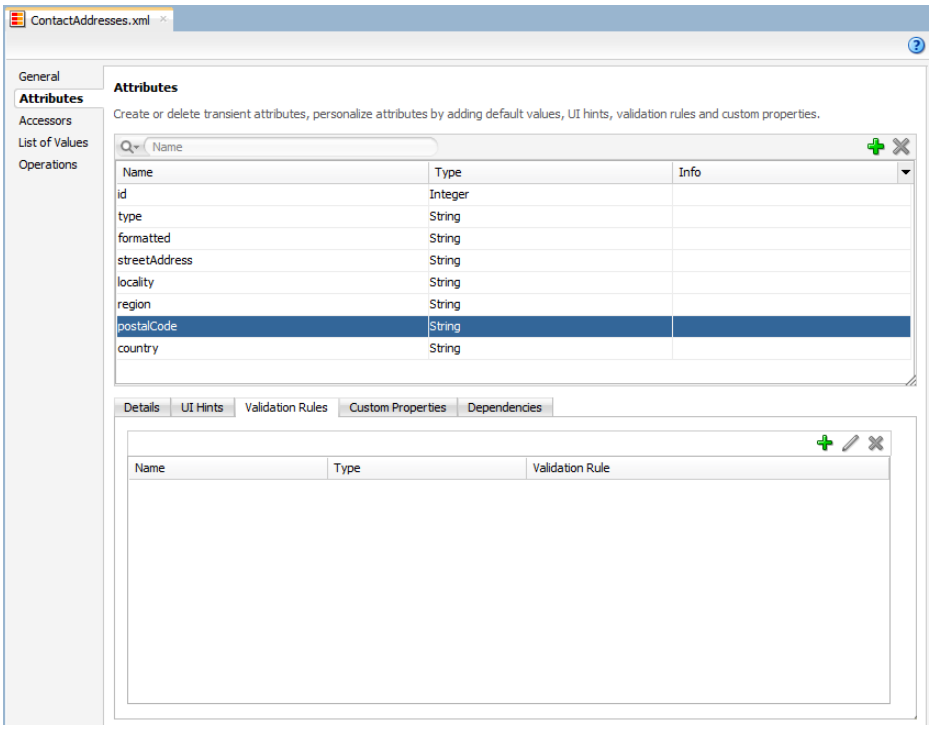
Compare type	java.math. BigDecimal	java.math. BigInteger	java.sql.Date	java.sql.Time	java.sql.Timestamp	java.util.Date
`Equals`	Supported	Supported	Not supported	Not supported	Not supported	Not supported
`Not Equals`	Supported	Supported	Not supported	Not supported	Not supported	Not supported
`Less Than`	Supported	Supported	Not supported	Not supported	Not supported	Not supported
`Greater Than`	Supported	Supported	Not supported	Not supported	Not supported	Not supported
`Less Than Equal To`	Supported	Supported	Not supported	Not supported	Not supported	Not supported
`Greater Than Equal To`	Supported	Supported	Not supported	Not supported	Not supported	Not supported

7.12.1 How to Add Validation Rules

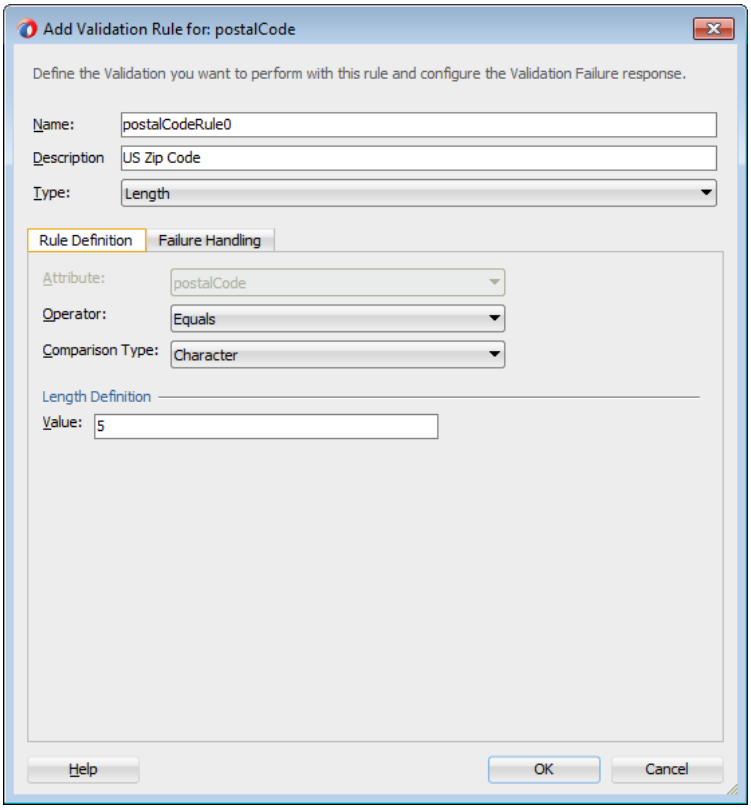
You can define validation rules for a variety of use cases. To add a declarative validation rule to an entity object, use the Overview Editor for Data Control Structure Files - Attributes Page.

To add a validation rule:

1. From the Data Controls panel, right-click on a data controls object and choose **Edit Definition**.
2. In the Overview Editor for Data Control Structure Files, select the **Attributes** page.



3. Select the **Validation Rules** tab in the lower part of the page and then click **Add**. In the resulting **Add Validation Rule** dialog, define the validation rule and the failure handling.



7.12.2 What You May Need to Know About the Validator Metadata

The validator metadata is placed into the data control structure metadata XML files at design time. Example 7–40 shows a sample length validator.

Example 7–40 Length Validator Declared in Metadata File

```
<?xml version="1.0" encoding="windows-1252" ?>
<!DOCTYPE PDefViewObject SYSTEM "jbo_03_01.dtd">
<PDefViewObject
   xmlns="http://xmlns.oracle.com/bc4j"
   Name="Product"
   Version="12.1.1.61.36"
   xmlns:validation="http://xmlns.oracle.com/adfm/validation">
   <DesignTime>
      <Attr Name="_DCName" Value="DataControls.ProductListBean"/>
      <Attr Name="_SDName" Value="mobile.Product"/>
   </DesignTime>
   <PDefAttribute
      Name="name">
      <validation:LengthValidationBean
         Name="nameRule0"
         OnAttribute="name"
         CompareType="GREATERTHAN"
         DataType="BYTE"
         CompareLength="5"
         Inverse="false"/>
   </PDefAttribute>
</PDefViewObject>
```

7.13 About Data Change Events

To simplify data change events, JDeveloper uses the property change listener pattern. In most cases you can use JDeveloper to generate the necessary code to source notifications from your beans' property accessors by selecting the **Notify listeners when property changes** checkbox in the Generate Accessors dialog (see Section 7.3.5.2, "About the Managed Beans Category" for details). The `PropertyChangeSupport` object is generated automatically, with the calls to `firePropertyChange` in the newly-generated setter method. Additionally, the `addPropertyChangeListener` and `removePropertyChangeListener` methods are added so property change listeners can register and unregister themselves with this object. This is what the framework uses to capture changes to be pushed to the client cache and to notify the user interface layer that data has been changed.

> **Note:** If you are manually adding a `PropertyChangeSupport` object to a class, you must also include the `addPropertyChangeListener` and `removePropertyChangeListener` methods (using these explicit method names).

Property changes alone will not solve all the data change notifications, as in the case where you have a bean wrapped by a data control and you want to expose a collection of items. While a property change is sufficient when individual items of the list change, it is not sufficient for *cardinality* changes. In this case, rather than fire a property change for the entire collection, which would cause a degradation of performance, you can instead refresh just the collection delta. To do this you need to

expose more data than is required for a simple property change, which you can do using the `ProviderChangeSupport` class.

> **Note:** The `ProviderChangeSupport` object is *not* generated automatically—you must manually add it to your class—along with the `addProviderChangeListener` and `removeProviderChangeListener` methods (using these explicit method names).

Since the provider change is required only when you have a dynamic collection exposed by a data control wrapped bean, there are only a few types of provider change events to fire:

- `fireProviderCreate`—when a new element is added to the collection
- `fireProviderDelete`—when an element is removed from the collection
- `fireProviderRefresh`—when multiple changes are done to the collection at one time and you decide it is better to simply ask for the client to refresh the entire collection (this should only be used in bulk operations)

The `ProviderChangeSupport` class is used for sending notifications relating to collection elements, so that components update properly when a change occurs in a Java bean data control. It follows a similar pattern to the automatically-generated `PropertyChangeSupport` class, but the event objects used with `ProviderChangeSupport` send more information, including the type of operation as well as the key and position of the element that changed. `ProviderChangeSupport` captures structural changes to a collection, such as adding or removing an element (or provider) from a collection. `PropertyChangeSupport` captures changes to the individual items in the collection.

Example 7–41 shows how to use `ProviderChangeSupport` for sending notifications relating to structural changes to collection elements (such as when adding or removing a child). For more information on the `ProviderChangeListener` interface and the `ProviderChangeEvent` class, see the MAF Javadoc.

Example 7–41 ProviderChangeSupport Code Example

```
public class NotePad {
   private   static    List
                       s_notes              = null;

/* manually adding property change listener as well as provider change listener. */
   protected transient PropertyChangeSupport
                       propertyChangeSupport = new PropertyChangeSupport(this);
   protected transient ProviderChangeSupport
                       providerChangeSupport = new ProviderChangeSupport(this);

    public NotePad() {
        …
    }

    public  mobile.Note[] getNotes() {
        mobile.Note n[] = null;

        synchronized (this)
        {
            if(s_notes.size() > 0) {
                n = (mobile.Note[])
                    s_notes.toArray(new mobile.Note[s_notes.size()]);
```

```
        }
        else {
            n = new mobile.Note[0];
        }
    }

    return n;
}

public void addNote() {
    System.out.println("Adding a note ....");
    Note  n = new Note();
    int   s = 0;

    synchronized (this)
    {
        s_notes.add(n);
        s = s_notes.size();
    }

    System.out.println("firing the events");
    providerChangeSupport.fireProviderCreate("notes", n.getUid(), n);
}

public void removeNote() {
    System.out.println("Removng a note ....");
    if(s_notes.size() > 0) {
        int     end = -1;
        Note    n   = null;

        synchronized (this)
        {
            end   = s_notes.size() - 1;
            n     = (Note)s_notes.remove(end);
        }

        System.out.println("firing the events");
    providerChangeSupport.fireProviderDelete("notes", n.getUid());
    }
}

public void RefreshNotes() {
    System.out.println("Refreshing the notes ....");

    providerChangeSupport.fireProviderRefresh("notes");
}

public void addProviderChangeListener(ProviderChangeListener l) {
    providerChangeSupport.addProviderChangeListener(l);
}

public void removeProviderChangeListener(ProviderChangeListener l) {
    providerChangeSupport.removeProviderChangeListener(l);
}

protected String   status;

/* --- JDeveloper generated accessors --- */

public void addPropertyChangeListener(PropertyChangeListener l) {
```

```
        propertyChangeSupport.addPropertyChangeListener(l);
    }

    public void removePropertyChangeListener(PropertyChangeListener l) {
        propertyChangeSupport.removePropertyChangeListener(l);
    }

    public void setStatus(String status) {
        String oldStatus = this.status;
        this.status = status;
        propertyChangeSupport.firePropertyChange("status", oldStatus, status);
    }

    public String getStatus() {
        return status;
    }
}
```

Data changes are passed back to the client (to be cached) with any response message or return value from the JVM layer. This allows JDeveloper to compress and reduce the number of events and updates to refresh to the user interface, allowing the framework to be as efficient as possible.

However, there are times where you may need to have a background thread handle a long-running process (such as web-service interactions, database interactions, or expensive computations) and notify the user interface independent of a user action. To update data on an AMX page to reflect the current values of data fields whose values have changed, you can avoid the performance hit associated with reloading the whole AMX page by calling `AdfmfJavaUtilities.flushDataChangeEvent` to force the currently queued data changes to the client.

Note: The `flushDataChangeEvent` method can only be executed from a background thread.

Example 7–42 shows how the `flushDataChangeEvent` method can be used to force pending data changes to the client. For more information about `oracle.adfmf.framework.api.AdfmfJavaUtilities.flushDataChangeEvent`, see *Oracle Fusion Middleware Java API Reference for Oracle Mobile Application Framework*.

Example 7–42 Data Change Event Example

```
/* Note - Simple POJO used by the NotePad managed bean or data control wrapped bean */

package mobile;

import oracle.adfmf.amx.event.ActionEvent;
import oracle.adfmf.framework.api.AdfmfJavaUtilities;
import oracle.adfmf.java.beans.PropertyChangeListener;
import oracle.adfmf.java.beans.PropertyChangeSupport;


/**
 * Simple note object
 * uid   - unique id - generated and not mutable
 * title - title for the note - mutable
 * note  - note comment - mutable
 */
```

```
public class Note {
    /* standard JDeveloper generated property change support */
    protected transient PropertyChangeSupport
                      propertyChangeSupport = new PropertyChangeSupport(this);


    private static boolean s_backgroundFlushTestRunning = false;


    public Note() {
        this("" + (System.currentTimeMillis() % 10000));
    }

    public Note(String id) {
        this("UID-"+id, "Title-"+id, "");
    }

    public Note(String uid, String title, String note) {
        this.uid     = uid;
        this.title   = title;
        this.note    = note;
    }


    /* update the current note with the values passed in */
    public void updateNote(Note n) {
        if (this.getUid().compareTo(n.getUid()) == 0) {
            this.setTitle(n.getTitle());
            this.setNote(n.getNote());
        } else {
            throw new IllegalArgumentException("note");
        }
    }


    /* background thread to simulate some background process that make changes */
    public void startNodeBackgroundThread(ActionEvent actionEvent) {
        Thread backgroundThread   = new Thread() {
            public void run() {
                System.out.println("startBackgroundThread enter - " +
                                                    s_backgroundFlushTestRunning);

                s_backgroundFlushTestRunning = true;
                for(int i = 0; i <= iterations; ++i) {
                    try
                    {
                        System.out.println("executing " + i + " of " + iterations + "
                                " iterations.");

                        /* update a property value */
                        if(i == 0) {
                            setNote("thread starting");
                        }
                        else if( i == iterations) {
                            setNote("thread complete");
                            s_backgroundFlushTestRunning = false;
                        }
                        else {
                            setNote("executing " + i + " of " + iterations + " iterations.");
                        }
```

```
                    setVersion(getVersion() + 1);
                    setTitle("Thread Test v" + getVersion());
                    AdfmfJavaUtilities.flushDataChangeEvent();  /* key line */
                }
                catch(Throwable t)
                {
                    System.err.println("Error in the background thread: " + t);
                }

                try {
                    Thread.sleep(delay);  /* sleep for 6 seconds */
                } catch (InterruptedException ex) {
                    ex.printStackTrace();
                }
            }
        }
    };

    backgroundThread.start();
}

protected String uid;
protected String title;
protected String note;
protected int    version;

protected int    iterations =  10;
protected int    delay      = 500;


/* --- JDeveloper generated accessors --- */

public void addPropertyChangeListener(PropertyChangeListener l) {
    propertyChangeSupport.addPropertyChangeListener(l);
}

public void removePropertyChangeListener(PropertyChangeListener l) {
    propertyChangeSupport.removePropertyChangeListener(l);
}

public String getUid() {
    return uid;
}

public void setTitle(String title) {
    String oldTitle = this.title;
    this.title = title;
    propertyChangeSupport.firePropertyChange("title", oldTitle, title);
}

public String getTitle() {
    return title;
}

public void setNote(String note) {
    String oldNote = this.note;
    this.note = note;
    propertyChangeSupport.firePropertyChange("note", oldNote, note);
}
```

```
    public String getNote() {
        return note;
    }

    public void setVersion(int version) {
        int oldVersion = this.version;
        this.version = version;
        propertyChangeSupport.firePropertyChange("version", oldVersion, version);
    }

    public int getVersion() {
        return version;
    }

    public void setIterations(int iterations) {
        int oldIterations = this.iterations;
        this.iterations = iterations;
        propertyChangeSupport.
                 firePropertyChange("iterations", oldIterations, iterations);
    }

    public int getIterations() {
        return iterations;
    }

    public void setDelay(int delay) {
        int oldDelay = this.delay;
        this.delay = delay;
        propertyChangeSupport.
                firePropertyChange("delay", oldDelay, delay);
    }

    public int getDelay() {
        return delay;
    }
}
```

```
/* NotePad - Can be used as a managed bean or wrapped as a data control */

package mobile;

import java.util.ArrayList;
import java.util.List;

import oracle.adfmf.amx.event.ActionEvent;
import oracle.adfmf.framework.api.AdfmfJavaUtilities;
import oracle.adfmf.java.beans.PropertyChangeListener;
import oracle.adfmf.java.beans.PropertyChangeSupport;
import oracle.adfmf.java.beans.ProviderChangeListener;
import oracle.adfmf.java.beans.ProviderChangeSupport;


public class NotePad {
    private static List     s_notes                      = null;
    private static boolean  s_backgroundFlushTestRunning = false;

    protected transient     PropertyChangeSupport
```

```
    propertyChangeSupport = new PropertyChangeSupport(this);

protected transient     ProviderChangeSupport
    providerChangeSupport = new ProviderChangeSupport(this);

public NotePad() {
    if (s_notes == null) {
        s_notes = new ArrayList();

        for(int i = 1000; i < 1003; ++i) {
            s_notes.add(new Note(""+i));
        }
    }
}

public  mobile.Note[] getNotes() {
    mobile.Note n[] = null;

    synchronized (this)
    {
        if(s_notes.size() > 0) {
            n = (mobile.Note[])s_notes.
                 toArray(new mobile.Note[s_notes.size()]);
        }
        else {
            n = new mobile.Note[0];
        }
    }

    return n;
}

public void addNote() {
    System.out.println("Adding a note ....");
    Note  n = new Note();
    int   s = 0;

    synchronized (this)
    {
        s_notes.add(n);
        s = s_notes.size();
    }

    System.out.println("firing the events");

    /* update the note count property on the screen */
    propertyChangeSupport.
         firePropertyChange("noteCount", s-1, s);

    /* update the notes collection model with the new note */
    providerChangeSupport.
         fireProviderCreate("notes", n.getUid(), n);

    /* to update the client side model layer */
    AdfmfJavaUtilities.flushDataChangeEvent();
}

public void removeNote() {
    System.out.println("Removing a note ....");
    if(s_notes.size() > 0) {
```

```
            int     end = -1;
            Note    n   = null;

            synchronized (this)
            {
                end   = s_notes.size() - 1;
                n     = (Note)s_notes.remove(end);
            }

            System.out.println("firing the events");

            /* update the client side model layer */
            providerChangeSupport.
                fireProviderDelete("notes", n.getUid());

           /* update the note count property on the screen */
           propertyChangeSupport.
                firePropertyChange("noteCount", -1, end);
        }
    }

    public void RefreshNotes() {
        System.out.println("Refreshing the notes ....");

        /* update the entire notes collection on the client */
        providerChangeSupport.fireProviderRefresh("notes");
    }

    public int getNoteCount() {
        int size = 0;

        synchronized (this)
        {
            size = s_notes.size();
        }
       return size;
    }

    public void
    addProviderChangeListener(ProviderChangeListener l) {
        providerChangeSupport.addProviderChangeListener(l);
    }

    public void
    removeProviderChangeListener(ProviderChangeListener l) {
        providerChangeSupport.removeProviderChangeListener(l);
    }

    public void
    startListBackgroundThread(ActionEvent actionEvent) {
        for(int i = 0; i < 10; ++i) {
            _startListBackgroundThread(actionEvent);
            try {
                Thread.currentThread().sleep(i * 1234);
            } catch (InterruptedException e) {
            }
        }
    }

    public void
```

```
_startListBackgroundThread(ActionEvent actionEvent) {
    Thread backgroundThread   = new Thread() {
        public void run() {
            s_backgroundFlushTestRunning = true;

            for(int i = 0; i <= iterations; ++i) {
                System.out.println("executing " + i +
                      " of " + iterations + " iterations.");

                try
                {
                    /* update a property value */
                    if(i == 0) {
                        setStatus("thread starting");
                        addNote();  // add a note
                    }
                    else if( i == iterations) {
                        setStatus("thread complete");
                        removeNote();  // remove a note
                        s_backgroundFlushTestRunning = false;
                    }
                    else {
                        setStatus("executing " + i + " of " +
                                iterations + " iterations.");

                        synchronized (this)
                        {
                            if(s_notes.size() > 0) {
                                Note n =(Note)s_notes.get(0);

                                n.setTitle("Updated-" +
                                      n.getUid() + " v" + i);
                            }
                        }
                    }
                    AdfmfJavaUtilities.
                             flushDataChangeEvent();
                }
                catch(Throwable t)
                {
                    System.err.
                    println("Error in bg thread - " + t);
                }

                try {
                     Thread.sleep(delay);
                } catch (InterruptedException ex) {
                    setStatus("inturrpted " + ex);
                    ex.printStackTrace();
                }
            }
        }
    };

    backgroundThread.start();
}


protected int iterations = 100;
protected int delay      = 750;
```

```
    protected String   status;

    /* --- JDeveloper generated accessors --- */

    public void
    addPropertyChangeListener(PropertyChangeListener l) {
        propertyChangeSupport.addPropertyChangeListener(l);
    }

    public void
    removePropertyChangeListener(PropertyChangeListener l) {
        propertyChangeSupport.removePropertyChangeListener(l);
    }

    public void setStatus(String status) {
        String oldStatus = this.status;
        this.status = status;
        propertyChangeSupport.
                firePropertyChange("status", oldStatus, status);
    }

    public String getStatus() {
        return status;
    }

    public void setIterations(int iterations) {
        int oldIterations = this.iterations;
        this.iterations = iterations;
        propertyChangeSupport.
                firePropertyChange("iterations",
                                   oldIterations, iterations);
    }

    public int getIterations() {
        return iterations;
    }

    public void setDelay(int delay) {
        int oldDelay = this.delay;
        this.delay = delay;
        propertyChangeSupport.
                firePropertyChange("delay", oldDelay, delay);
    }

    public int getDelay() {
        return delay;
    }
}
```

The StockTracker sample application provides an example of how data change events use Java to enable data changes to be reflected in the user interface. This sample application is in the `PublicSamples.zip` file at the following location within the JDeveloper installation directory of your development computer:

jdev_install`/jdeveloper/jdev/extensions/oracle.maf/Samples`

For more information about sample applications, see Appendix F, "Mobile Application Framework Sample Applications."

8 Using Web Services

This chapter describes how to integrate a third-party web service into the MAF AMX application feature implementation.

This chapter includes the following sections:

8.1 Introduction to Using Web Services in MAF Applications

Web services allow applications and their features to exchange data and information through defined application programming interfaces. Using web services you can expose business functionality irrespective of the platform or language of the originating application because the business functionality is exposed in such a way that it is abstracted to a message composed of standard XML constructs that can be recognized and used by other applications.

Some of the most typical reasons for using web services in MAF applications are:

- To add functionality that is readily available as a web service, but which would be time-consuming to develop within the application.
- To provide access to an application that runs on a different architecture.

MAF supports both SOAP and REST web services and allows you to integrate a third-party web service into your MAF AMX application feature.

Using web services in your MAF application enables you to do the following:

- Provide either all of the data or a subset of data from a larger (enterprise) data store in which the end user of the mobile application is interested.
- Provide functionality that is too computationally intensive for the mobile device's resources. This could be due to either the actual amount of work the device would need to perform, or the fact that the functionality is based on a much larger data set than the one that is locally available on the device.

The following web service scenarios usage demonstrate the data access (scenario 1) as well as computational and data-driven functionality (scenarios 2 and 3):

- Fetch a set of Opportunity data from the enterprise data store to enable the end user to manipulate it on the device, and then post changes back to the enterprise data store through the web service.
- Request a report be generated on some enterprise data, and then fetch the report.
- Obtain a map image of a route to a customer site.

8.2 Creating Web Service Data Controls

The most common way of using web services in an application feature developed with MAF is to create a data control for an external web service. For more information, see Section 7.1, "Introduction to Bindings and Data Controls."

8.2.1 How to Create a Web Service Data Control Using SOAP

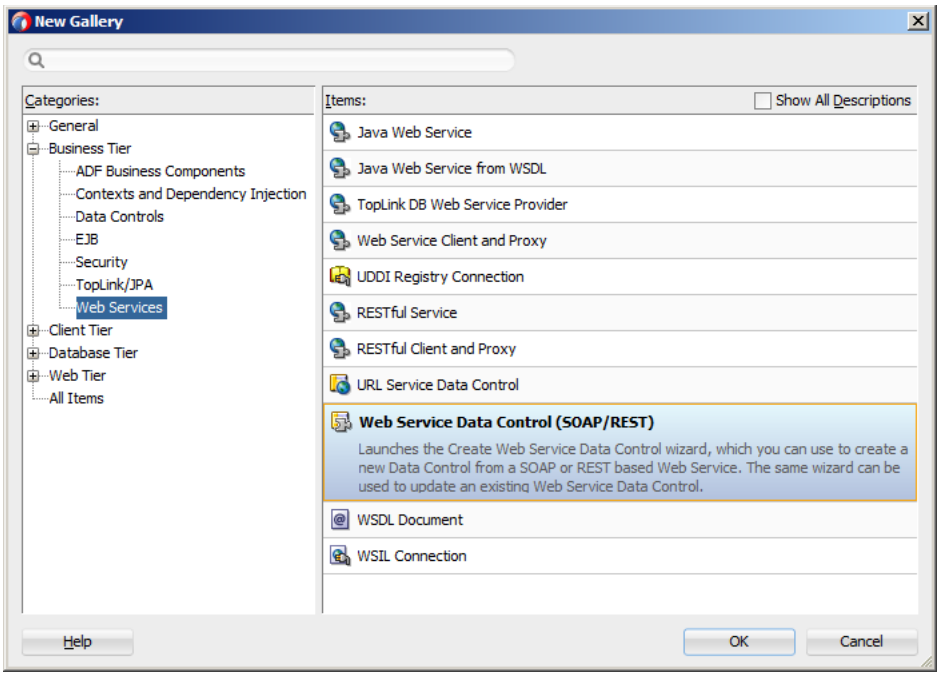
JDeveloper lets you create a data control for an existing SOAP web service using only the Web Services Description Language (WSDL) file for the service. You can either browse to a WSDL file on the local file system, locate one in a Universal Description, Discovery and Integration (UDDI) registry, or enter the WSDL URL directly.

Note: If you are working behind a firewall and you want to use a web service that is outside the firewall, you must configure the Web Browser and Proxy settings in JDeveloper. For more information, see Section 8.7, "Configuring the Browser Proxy Information."

To create a SOAP web service data control:

1. In the Applications window, right-click the application name, and then select **File > New > From Gallery** from the main JDeveloper menu.
2. In the **New Gallery** dialog, expand the **Business Tier** node on the left and select **Web Services**. From the **Items** list on the right select **Web Service Data Control (SOAP/REST)** (see Figure 8–1), and then click **OK**.

Figure 8–1 Creating a New SOAP Web Service Data Control



3. On the **Data Source** page of the **Create Web Service Data Control** wizard, select **SOAP**.
4. Follow the wizard instructions to complete creation of the data control.

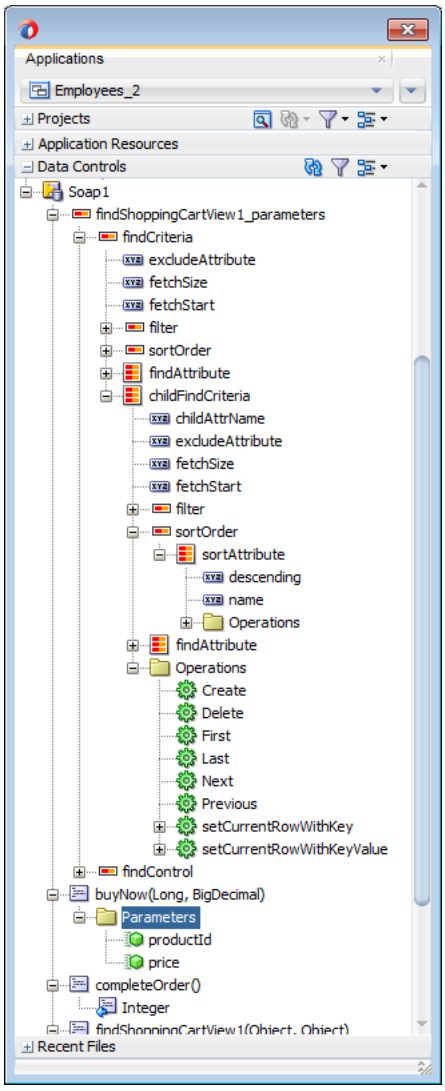
Note: MAF supports the following encoding styles for both SOAP 1.1 and 1.2 versions:

- Document/literal
- Document/wrapped
- RPC

8.2.2 What You May Need to Know About Web Service Data Controls

After the web service data control has been created, the web service operations and return values of the operations are displayed in the Data Controls window, illustrated in Figure 8–2.

Figure 8–2 Web Service Data Control



Like other data controls, you can drag and drop the objects returned by the web service operations to create user interface components in a MAF AMX page. For more information, see Section 5.3.2.4, "Adding Data Controls to the View." When data returned from a web service operation is displayed, the following object types are handled:

- Collections
- Complex objects returned by a web service operation
- Nested complex objects returned by a web service operation

Using a web service operation, both standard and complex data types can be updated and deleted.

As illustrated by Figure 8–2, each data control object is represented by an icon. Table 8–1 describes what each icon represents, where it appears in the Data Controls panel hierarchy, and what components it can be used to create. For more information see Section 7.6, "Creating Databound UI Components from the Data Controls Panel."

Table 8–1 Data Controls Panel Icons and Object Hierarchy for Web Services

Icon	Name	Description	Used to Create...
	Data Control	Represents a data control. You cannot use the data control itself to create UI components, but you can use any of the child objects listed under it. Typically, there is one data control for each web service.	Serves as a container for other objects and is not used to create anything.
	Collection	Represents a data collection returned by an operation on the service. Collections also appear as children under method returns, other collections, or structured attributes. The children under a collection may be attributes, other collections, custom methods, and built-in operations that can be performed on the collection.	Forms, tables, graphs, trees, range navigation components, and master-detail components. See also Section 6.5, "Providing Data Visualization."
	Attribute	Represents a discrete data element in an object (for example, an attribute in a row). Attributes appear as children under the collections or method returns to which they belong.	Label, text field, date, list of values, and selection list components. See also Section 6.2, "Designing the Page Layout."
	Structured Attribute	Represents a returned object that is a complex type but not a collection. For example, a structured attribute might represent a single user assigned to the current service request.	Label, text field, date, list of values, and selection list components. See also Section 6.2, "Designing the Page Layout."
	Method	Represents an operation in the data control or one of its exposed structures that may accept parameters, perform some business logic and optionally return single value, a structure or a collection of those.	Command components. For methods that accept parameters: command components and parameterized forms. See also Section 6.3, "Creating and Using UI Components."

Table 8–1 (Cont.) Data Controls Panel Icons and Object Hierarchy for Web Services

Icon	Name	Description	Used to Create...
	Method Return	Represents an object that is returned by a web service method. The returned object can be a single value or a collection. A method return appears as a child under the method that returns it. The objects that appear as children under a method return can be attributes of the collection, other methods that perform actions related to the parent collection, and operations that can be performed on the parent collection. When a single-value method return is dropped, the method is not invoked automatically by the framework. You should either drop the corresponding method as a button to invoke the method, or if working with task flows you can create a method activity for it.	The same components as for collections and attributes and for query forms.
	Operation	Represents a built-in data control operation that performs actions on the parent object. Data control operations are located in an **Operations** node under collections. If an operation requires one or more parameters, they are listed in a **Parameters** node under the operation. The following operations for navigation and setting the current row are supported: `First`, `Last`, `Next`, `Previous`, `setCurrentRowWithKey`, and `SetCurrentRowWithKeyValue`. `Execute` is supported for refreshing queries. `Create` and `Delete` are available as applicable, depending on the web service operation. Because the web service data controls are not transactional, `Commit` and `Rollback` are not supported.	User interface command components, such as buttons, links, and menus. For more information, see Section 6.3, "Creating and Using UI Components."

Table 8–1 (Cont.) Data Controls Panel Icons and Object Hierarchy for Web Services

Icon	Name	Description	Used to Create...
	Parameter	Represents a parameter value that is declared by the method or operation under which it appears. Parameters appear in the **Parameters** node under a method or operation. Array and structured parameters are exposed as updatable structured attributes and collections under the data control, which can be dropped as an ADF form or an updatable table on the UI. You can use the UI to build a parameter that is an array or a complex object (not a standard Java type).	Label, text, and selection list components. For more information, see Section 6.3.15, "How to Use List View and List Item Components."

8.2.3 How to Customize SOAP Headers in Web Service Data Controls

MAF allows you to specify a custom provider class in your `DataControls.dcx` file (see Example 8–3). This custom class extends `oracle.adfinternal.model.adapter.webservice.provider.soap.SOAPProvider`. You can use it to specify an implementation of the `SoapHeader[] getAdditionalSoapHeaders()` method

Example 8–1 shows how to extend the `SOAPProvider` and create a custom header demonstrated in Example 8–2.

Example 8–1 Defining Custom SOAP Headers

```
package provider.ebs.soap;

import oracle.adfinternal.model.adapter.webservice.provider.soap.SOAPProvider;
import oracle.adfinternal.model.adapter.webservice.provider.soap.SoapHeader;

public class EBSSOAPProvider extends SOAPProvider {

public SoapHeader[] getAdditionalSoapHeaders() {
   SoapHeader header[] = new SoapHeader[2];
   SoapHeader token = null;
   SoapHeader user = null;
   SoapHeader pass = null;

   header[0] = new SoapHeader("http://xmlns.oracle.com/apps/fnd/soaprovider/plsql/fnd_user_pkg/",
                              "SOAHeader");
   header[0].addChild(new SoapHeader(
                              "http://xmlns.oracle.com/apps/fnd/soaprovider/plsql/fnd_user_pkg/",
                              "Responsibility",
                              "SYSTEM_ADMINISTRATOR"));
   header[0].addChild(new SoapHeader(
                              "http://xmlns.oracle.com/apps/fnd/soaprovider/plsql/fnd_user_pkg/",
                              "RespApplication",
                              "SYSADMIN"));
   header[0].addChild(new SoapHeader(
                              "http://xmlns.oracle.com/apps/fnd/soaprovider/plsql/fnd_user_pkg/",
```

```
                              "SecurityGroup",
                              "STANDARD"));
   header[0].addChild(new SoapHeader(
                              "http://xmlns.oracle.com/apps/fnd/soaprovider/plsql/fnd_user_pkg/",
                              "NLSLanguage",
                              "AMERICAN"));
   header[0].addChild(new SoapHeader(
                              "http://xmlns.oracle.com/apps/fnd/soaprovider/plsql/fnd_user_pkg/",
                              "Org_Id",
                              "0"));

   header[1] = new SoapHeader(
               "http://docs.oasis-open.org/wss/2004/01/oasis-200401-wss-wssecurity-secext-1.0.xsd",
               "Security");
   token = new SoapHeader(
              "http://docs.oasis-open.org/wss/2004/01/oasis-200401-wss-wssecurity-secext-1.0.xsd",
              "UsernameToken");
   user = new SoapHeader(
              "http://docs.oasis-open.org/wss/2004/01/oasis-200401-wss-wssecurity-secext-1.0.xsd",
              "Username",
              "sysadmin");
   pass = new SoapHeader(
              "http://docs.oasis-open.org/wss/2004/01/oasis-200401-wss-wssecurity-secext-1.0.xsd",
              "Password",
              "sysadmin");

   header[1].addChild(token);
   token.addChild(user);
   token.addChild(pass);

   return header;
   }
}
```

Example 8–2 shows the new custom header.

Example 8–2 SOAP Header

```
<soap:Header xmlns:ns1="http://xmlns.oracle.com/apps/fnd/soaprovider/plsql/fnd_user_pkg/">
   <ns1:SOAHeader>
      <ns1:Responsibility>SYSTEM_ADMINISTRATOR</ns1:Responsibility>
      <ns1:RespApplication>SYSADMIN</ns1:RespApplication>
      <ns1:SecurityGroup>STANDARD</ns1:SecurityGroup>
      <ns1:NLSLanguage>AMERICAN</ns1:NLSLanguage>
      <ns1:Org_Id>0</ns1:Org_Id>
   </ns1:SOAHeader>
   <wsse:Security xmlns:wsse=
      "http://docs.oasis-open.org/wss/2004/01/oasis-200401-wss-wssecurity-secext-1.0.xsd"
      xmlns="http://docs.oasis-open.org/wss/2004/01/oasis-200401-wss-wssecurity-secext-1.0.xsd"
      xmlns:env="http://schemas.xmlsoap.org/soap/envelope/"
      soap:mustUnderstand="1">
      <wsse:UsernameToken xmlns:wsse=
      "http://docs.oasis-open.org/wss/2004/01/oasis-200401-wss-wssecurity-secext-1.0.xsd"
      xmlns="http://docs.oasis-open.org/wss/2004/01/oasis-200401-wss-wssecurity-secext-1.0.xsd">
         <wsse:Username>sysadmin</wsse:Username>
         <wsse:Password Type=
          http://docs.oasis-open.org/wss/2004/01/
          oasis-200401-wss-username-token-profile-1.0#PasswordText">sysadmin</wsse:Password>
      </wsse:UsernameToken>
   </wsse:Security>
```

```
</soap:Header>

@return
```

Example 8–3 demonstrates a sample `DataControls.dcx` file entry with the `SOAPProvider` registration.

Example 8–3 Registering SOAPProvider in DataControls.dcx File

```
<definition xmlns="http://xmlns.oracle.com/adfm/adapter/webservice"
                  name="SoapService" version="1.0"
                  provider="oracle.adf.model.adapter.webservice.SOAPMessageHandler"
                  wsdl="http://@SRG_WS_HOST@:@SRG_WS_PORT@/SoapService/SoapServicePort?wsdl" >
   <service name="SoapService" namespace="http://model/"
            connection="SoapService">
      <port name="SoapServicePort">
         <operation name="echoSoapHeader"/>
      </port>
   </service>
</definition>
```

Note: You cannot specify dynamic SOAP headers using MAF.

8.2.4 How to Create a Web Service Data Control Using REST

JDeveloper lets you create a data control for an existing REST web service.

Note: If you are working behind a firewall and you want to use a web service that is outside the firewall, you must configure the Web Browser and Proxy settings in JDeveloper. For more information, see Section 8.7, "Configuring the Browser Proxy Information."

You can associate a REST web service data control with one or more HTTP methods using the same connection. You should be able to access custom operations exposed by a REST service. These custom operations map to one of the HTTP methods and allow you to create a data control to expose these custom operations on the client.

To use security and notifications functionality on mobile devices, you can add custom headers and custom values to standard HTTP headers for use with specific operations exposed by the REST data control.

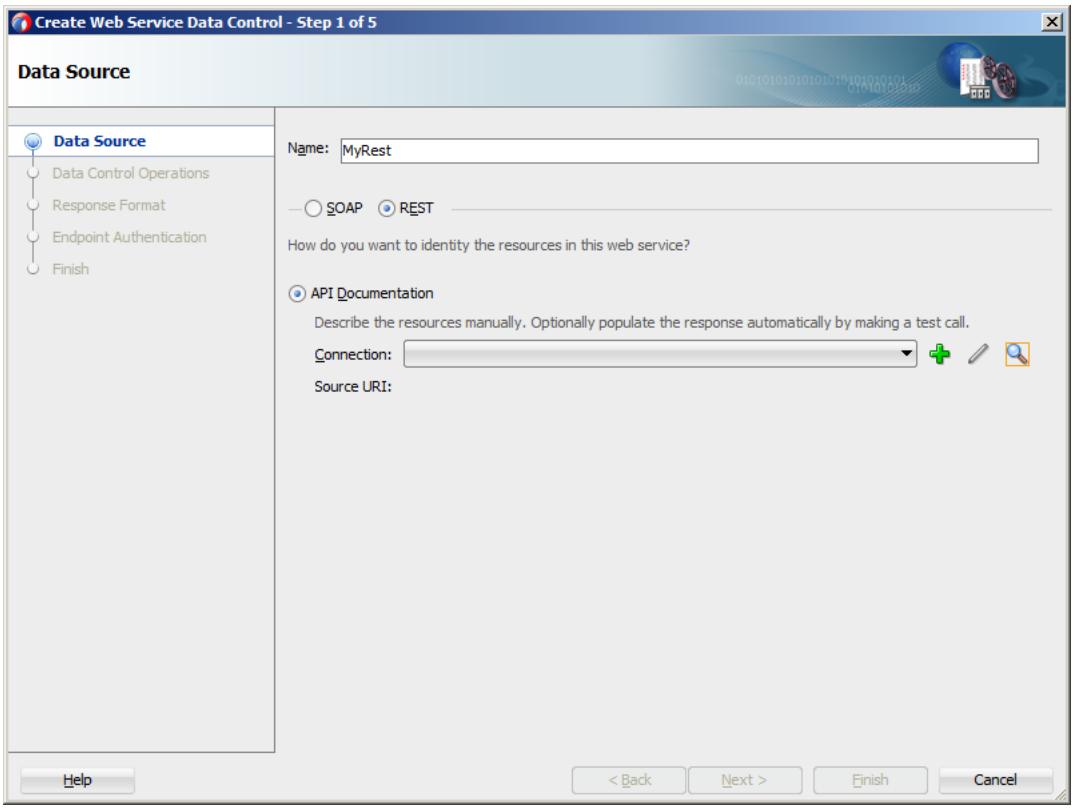
Before you begin:

Ensure that you have access to the REST web service that the data control is to access.

To create a REST web service data control:

1. In the Applications window, right-click the application name, and then select **File > New > From Gallery** from the main JDeveloper menu.
2. In the **New Gallery** dialog, expand the **Business Tier** node on the left and select **Web Services**. From the **Items** list on the right select **Web Service Data Control (SOAP/REST)** (see Figure 8–1), and then click **OK**.
3. On the **Data Source** page of the **Create Web Service Data Control** wizard, select **REST**, as Figure 8–3 shows.

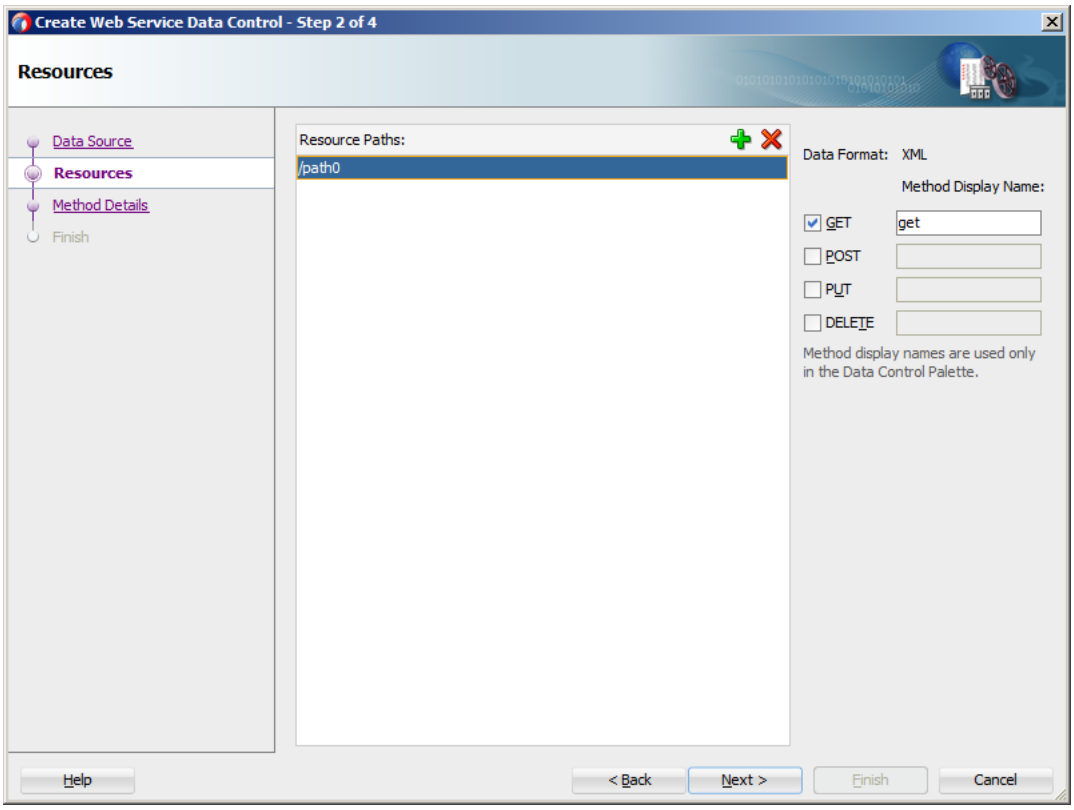
Figure 8–3 Defining Data Source for REST Web Service Data Control



4. Follow the Create Web Service Data Control wizard instructions to complete creation of the data control, keeping in mind the following:
   - MAF supports only basic authentication for web services (see Section 8.5, "Accessing Secure Web Services"). When creating a new connection, select **Basic** in the **Authentication Type** field on the **Create URL Connection** dialog.
   - MAF supports all HTTP method types: `GET`, `POST`, `PUT`, and `DELETE`. You can select any of these method types when completing the **Method Display Name** fields on the **Resources** page, as Figure 8–4 shows.

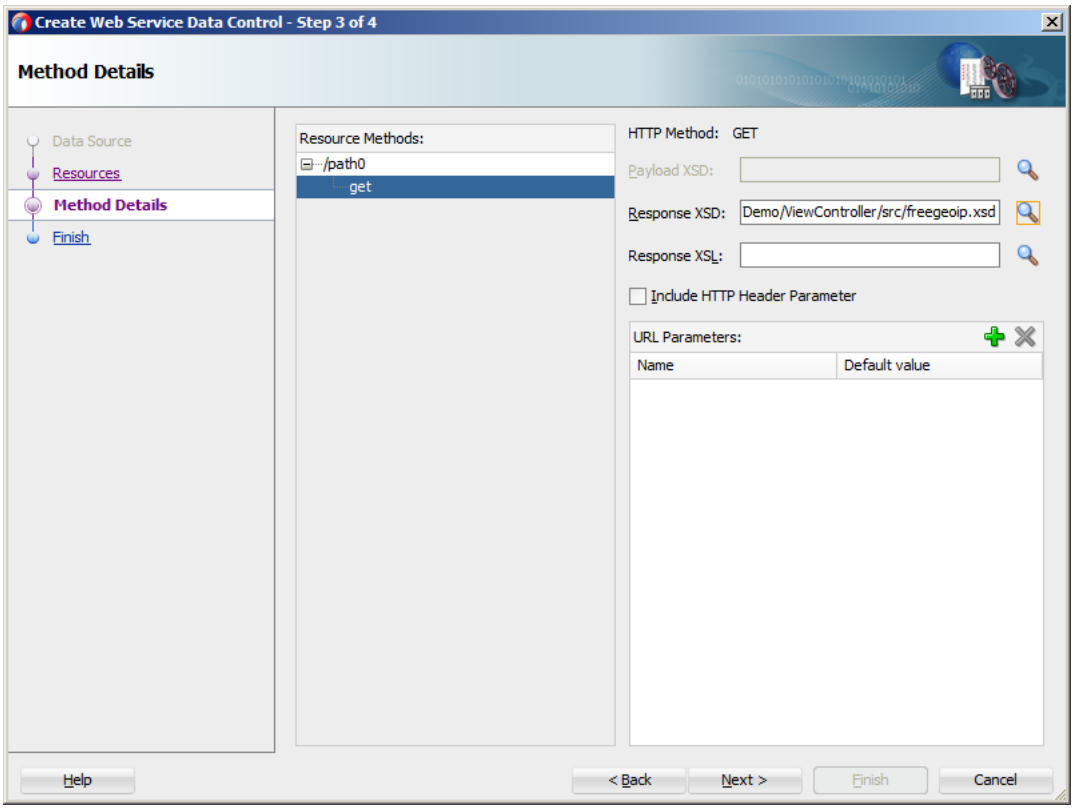
   Note: You can include all four methods using the same connection and the same REST web service data control.

Figure 8–4 Defining Resources for REST Web Service Data Control



- MAF does not support the delimiter separated values in the spread sheet data and the XSL for the XML data formats.
- By specifying a local XSD file for the REST web service data control definition, you create a file URI reference for the fields that identify schema on the **Method Details** page, as Figure 8–5 shows.

Figure 8–5 Defining Method Details for REST Web Service Data Control



Note: Since MAF creates internal definitions for the XSD structures at compile time, the XSD should not change after the application has been compiled. Therefore, it is recommended to reference the XSD file locally. Using the remote XSD negatively affects performance because MAF retrieves the XSD with each run of the application.

After the REST web services data control has been created by following the preceding steps, it behaves identically to its counterparts provided by other technologies available through JDeveloper.

A MAF sample application called RESTDemo (located in the `PublicSamples.zip` file within the *`jdev_install`*`/jdeveloper/jdev/extensions/oracle.maf/Samples` directory on your development computer) demonstrates how to use REST web services in a MAF application.

For information on how to use REST web services through Java bypassing data controls, see Section 8.6.2, "How to Use REST Web Services Adapter."

8.3 Creating a New Web Service Connection

The connection information for the web service is stored in the `connections.xml` file along with the other connections in your application. You do not need to explicitly create this file, as it is generated in the `.adf/META-INF` directory by the New Web Service Data Control wizard at the time when the web service data control is created (see Section 8.2, "Creating Web Service Data Controls").

You modify the connection settings by editing the `connections.xml` file.

8.4 Adjusting the Endpoint for a Web Service Data Control

After creating a web service data control, you can modify the endpoint of the URI. This is useful in such cases as when you migrate an application feature from a test to production environment.

You modify the endpoint by editing the `connections.xml` file.

8.5 Accessing Secure Web Services

MAF supports both secured and unsecured web services. For more information, see Chapter 21, "Securing Mobile Applications."

To access secured web services from your MAF application, you may need to configure web service data controls included in the application.

8.5.1 How to Enable Access to SOAP-Based Web Services

The following predefined security policies are supported for SOAP-based web services:

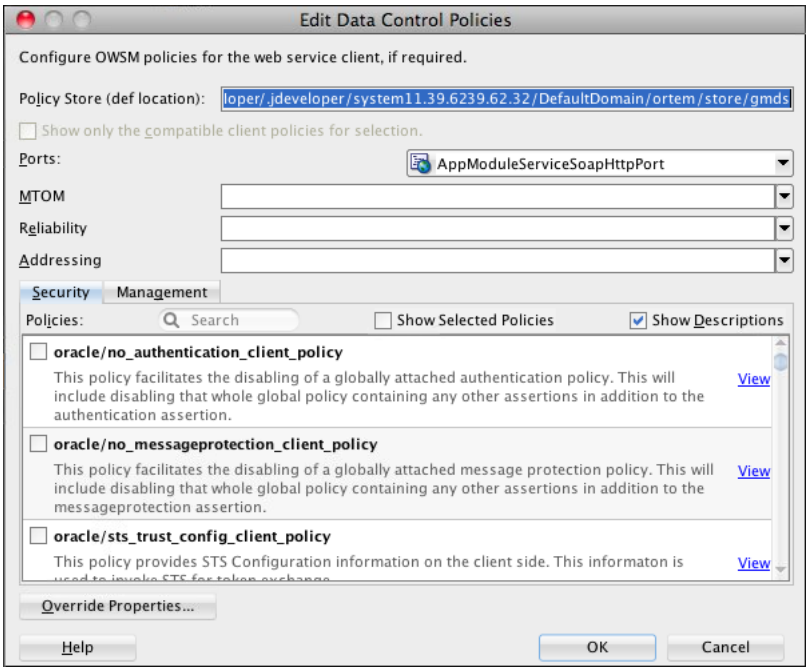
- `oracle/wss_http_token_client_policy`
- `oracle/wss_http_token_over_ssl_client_policy`
- `oracle/http_basic_auth_over_ssl_client_policy`
- `oracle/wss_username_token_client_policy`
- `oracle/wss_username_token_over_ssl_client_policy`

For descriptions of these policies and their usage, see the "Determining Which Predefined Policies to Use" and "Predefined Policies" chapters in *Oracle Fusion Middleware Securing Web Services and Managing Policies with Oracle Web Services Manager*.

If a SOAP web service is secured, you can access it by configuring the web service data control with either `oracle/wss_http_token_over_ssl_client_policy` or `oracle/wss_http_token_client_policy`. To do so, use the Edit Data Control Policies dialog that Figure 8–6 shows. You can open this dialog as follows:

- In the Applications window, select the `.dcx` file located in the application's view controller project.
- In the Structure window, right-click the web service data control that you would like to configure, and then select Define Web Service Security from the context menu.

Figure 8–6 Editing Web Service Data Control Policies



Note: JDeveloper stores the web service policy definitions in the `wsm-assembly.xml` file (located in `META-INF` directory of the application workspace).

8.5.2 How to Enable Access to REST-Based Web Services

Each time a mobile application requests a REST web service for cookie-based authorization, MAF's security framework enables the transport layer of the REST web service to check if cookie injection is enabled for the login connection associated with the URL endpoint of the REST web service. That is, the `connections.xml` file must include `<injectCookiesToRESTHttpHeader value="true"/>`. For details about configuring MAF application login to enable the login server cookie in REST web service calls, see Section 21.4.3, "How to Configure Authentication Using Oracle Mobile and Social Identity Management."

This is also true for an Oracle Access Management Mobile and Social (OAMMS) authentication context and the web resource is protected by an Oracle Access Manager server 10g WebGate, where the access token is injected as the encrypted cookie called the ObSSOCookie. For more information, see Section 21.4.11, "What Happens When You Enable Cookie Injection into REST Web Service Calls."

When a REST web service is expecting an OAuth access token, you must associate the REST connection with the predefined security policy that supports REST web services: `oracle/oauth2_config_client_policy`. Currently, the design time in JDeveloper does not support associating the policy. You must edit the REST connection to manually attach the policy set to the web service, where URI is set to `oracle/oauth2_config_client_policy` and `someapi` is the connection name, as illustrated in Example 8–4.

Example 8–4 Associating a Policy Set to a REST Connection

```
<sca11:policySet xmlns:sca11="http://docs.oasis-open.org/ns/opencsa/sca/200912"
                 name="policySet"
```

```
                attachTo="MODULE('someapi')"
   <wsp:PolicyReference xmlns:wsp="http://www.w3.org/ns/ws-policy"
                        DigestAlgorithm="http://www.w3.org/ns/ws-policy/Sha1Exc"
                        URI="oracle/oauth2_config_client_policy"
                        orawsp:status="enabled" orawsp:id="1"/>
</sca11:policySet>
```

For example, you would configure this policy when an OAMMS server is configured to authenticate against a social authentication server and the MAF application needs to invoke social service provider's REST API.

8.5.3 What You May Need to Know About Credential Injection

For secured web services, the user credentials are dynamically injected into a web service request at the time when the request is invoked. This process is similar for SOAP and REST web services.

MAF uses Oracle Web Services Manager (OWSM) Mobile Agent to propagate user identity through web service requests.

Before web services are invoked, the user must respond to an authentication prompt triggered by the user trying to invoke a secured MAF application feature or to start the application controlled by the access control service (ACS). In the latter case, the application must define a default login server with ACS URL, as well as to have at least one feature with a constraint that depends on the `user.roles` setting. The user credentials are stored in a credential store—a device-native and local repository used for storing credentials associated with the authentication provider's server URL and the user. At runtime, MAF assumes that all credentials have already been stored in the IDM Mobile credential store before the time of their usage.

In the `connections.xml` file, you have to specify the login server connection's `adfCredentialStoreKey` attribute value in the `adfCredentialStoreKey` attribute of the web service connection reference in order to associate the login server to the web service security (see Example 8–5 and Example 8–6).

> **Note:** Since JDeveloper does not provide an Overview editor for the `connections.xml` file, you can use the Properties window to update the `<Reference>` element's `adfcredentialStoreKey` attribute with the name configured for the `adfCredentialStoreKey` attribute of the login server connection. Alternatively, you can add or update the attribute using the Source editor.

Example 8–5 shows the definition of the web service connection referenced as `adfCredentialStoreKey="MyAuth"`, where `MyAuth` is the name of the login connection reference.

Example 8–5 Defining the Web Service Connection

```
<Reference name="URLConnection1"
           className="oracle.adf.model.connection.url.HttpURLConnection"
           adfCredentialStoreKey="MyAuth"
           xmlns="">
   <Factory className="oracle.adf.model.connection.url.URLConnectionFactory"/>
   <RefAddresses>
      <XmlRefAddr addrType="URLConnection1">
         <Contents>
            <urlconnection name="URLConnection1"
```

```
                        url="http://myhost.us.example.com:7777/
                             SecureRESTWebService1/Echo">
                <authentication style="challange">
                   <type>basic</type>
                   <realm>myrealm</realm>
                </authentication>
             </urlconnection>
          </Contents>
       </XmlRefAddr>
       <SecureRefAddr addrType="username"/>
       <SecureRefAddr addrType="password"/>
   </RefAddresses>
</Reference>
```

Example 8–6 shows the definition of the login connection, where `MyAuth` is used as the credential store key value in the login server connection.

Example 8–6 Defining the Login Connection

```
<Reference name="MyAuthName"
           className="oracle.adf.model.connection.adfmf.LoginConnection"
           adfCredentialStoreKey="MyAuth"
           partial="false"
           manageInOracleEnterpriseManager="true"
           deployable="true"
           xmlns="">
   <Factory className="oracle.adf.model.connection.adfmf.LoginConnectionFactory"/>
   <RefAddresses>
      <XmlRefAddr addrType="adfmfLogin">
         <Contents>
            <login url="http://172.31.255.255:7777/
                        SecuredWeb1-ViewController-context-root/faces/view1.jsf"/>
            <logout url="http://172.31.255.255:7777/
                    /SecuredWeb1-ViewController-context-root/faces/view1.jsf"/>
            <accessControl url="http://myhost.us.example.com:7777/
                          UserObjects/jersey/getUserObjects" />
            <idleTimeout value="10"/>
            <sessionTimeout value="36000"/>
            <userObjectFilter>
               <role name="testuser1_role1"/>
               <role name="testuser2_role1"/>
               <privilege name="testuser1_priv1"/>
               <privilege name="testuser2_priv1"/>
               <privilege name="testuser2_priv2"/>
            </userObjectFilter>
         </Contents>
      </XmlRefAddr>
   </RefAddresses>
</Reference>
```

If a web service request is rejected due to the authentication failure, MAF returns an appropriate exception and invokes an appropriate action (see Section 22.4, "Using and Configuring Logging"). If none of the existing exceptions correctly represent the condition, a new exception is added.

The `connections.xml` file is deployed and managed under the Configuration Service. For more information, see Chapter 9, "Configuring End Points Used in MAF Applications."

connections.xml files in FARs are aggregated when the MAF application is deployed. The credentials represent deployment-specific data and are not expected to be stored in FARs.

8.5.4 Limitations of Secure WSDL File Usage

Since a MAF application must make a WSDL file accessible at run time without authentication, you cannot use a secure WSDL file with a SOAP web service secured by the basic authentication.

If your intention is to secure the WSDL, consider the following: since the WSDL file is fetched by the GET method of the web service, if you secure each web service method, except the GET method, you can use a secure WSDL. If you secure the GET method, you should not secure the WSDL.

8.6 Invoking Web Services From Java

In your MAF application, you can invoke the web services layer (both REST and SOAP) from the Java code and use the results in Java methods.

MAF provides the GenericTypeBeanSerializationHelper utility class that you can use to perform conversions between POJOs (JavaBeans objects) and MAF's GenericType objects based on the following set of conversion rules:

1. When converting from POJO to GenericType objects:
   - Standard JavaBeans reflection rules are used for determining properties.
   - Transient properties are ignored in the conversion process.
   - Readable properties are converted into a GenericType attribute.
   - Array properties are represented as repeated attributes in the GenericType.
   - Map properties are represented as individual attributes in the GenericType.
   - Non-primitive properties are represented as nested GenericType objects.
2. When converting from GenericType objects to POJO:
   - Standard JavaBeans reflection rules are used for determining properties.
   - Transient properties are ignored in the conversion process.
   - Writable properties are converted from GenericType attributes.
   - Repeated attributes in the GenericType are converted into an array object.
   - If the POJO implements the Map interface, then any properties that cannot be set through standard accessors are set in the POJO through the set method of the Map.
   - Non-primitive attributes are represented as nested POJO objects.

The advantage of using this helper API is that it allows you to take the response received from a web service and convert it to a JavaBean in a single call.

For example, a web service passes back and forth an Employee object that needs to be reused throughout the business logic. This object has the following set of properties:

- name of type String
- address: a complex object with street, city, state, and zipcode attributes
- id of type long

- `salary` of type `float`
- `phone` of type `String`, and there could be more than one phone
- `password` of type `String`, and the password should never be transmitted to the back-end web service

Example 8–7 shows a potential code for the `Employee` object.

Example 8–7 Employee Object

```
public class Employee {

   protected String name;
   protected Address address;
   protected long id;
   protected float salary;
   protected String[] phone;
   protected transient String password;

   public String getName() {
      return name;
   }

   public void setName(String name) {
      this.name = name;
   }

   public Address getAddress() {
      return address;
   }

   public void setAddress(Address address) {
      this.address = address;
   }

   public long getId() {
      return id;
   }

   public void setId(long id) {
      this.id = id;
   }

   public float getSalary() {
      return salary;
   }

   public void setSalary(float salary) {
      this.salary = salary;
   }

   public String getPassword() {
      return password;
   }

   public void setPassword(String password) {
      this.password = password;
   }

   public void setPassword(String password) {
```

```
      this.password = password;
   }

   public String[] getPhone() {
      return phone;
   }

   public void setPhone(String phone) {
      this.phone = phone;
   }
```

Example 8–8 shows the potential code for the `Address` object of the `Employee` class.

Example 8–8 Address Object

```
public class Address {

   protected String street;
   protected String city;
   protected String state;
   protected String zipcode;

   public String getStreet() {
      return street;
   }

   public void setStreet(String street) {
      this.street = street;
   }

   public String getCity() {
      return city;
   }

   public void setCity(String city)  {
      this.city = city;
   }

   public String getState() {
      return state;
   }

   public void setState(String state) {
      this.state = state;
   }

   public String getZipcode() {
      return zipcode;
   }

   public void setZipcode(String zipcode)  {
      this.zipcode = zipcode;
   }
```

Keeping in mind the conversion rules, note the following:

1. Since the `password` is defined as transient, it is ignored with respect to the conversion algorithm.
2. Since `name`, `address`, `id`, and `salary` all have `get` and `set` methods, they will all be converted to and from the `GenericType`.

3. Based on the property type, properties can be coerced between types, as defined in the `coerceToType(Object, Class)` method of the `oracle.adfmf.misc.Converter` class.
4. Complex objects, such as `address`, are recursed by the conversion algorithm to either build the child `GenericType` or to create and populate the POJO complex object depending on the direction of the conversion.
5. Since `phone` is an array of `String` objects each representing a unique phone number and since the cardinality of this element is greater than one, the conversion algorithm will find all matches of the `phone` attribute in the `GenericType` object, present them as an array, and invoke the `setPhone` method on the bean. The `toGenericType` method of the `GenericTypeBeanSerializationHandler` will take each array element and append it to the `toGenericType` as an individual `phone` attribute.

With the following defined:

```
final String EMPLOYEE_VIRTUAL_BEAN_NAME = "EmployeeDC.Types.Employee";
Employee emp = getEmployee();
GenericType gt = null;
```

- The `Employee` object is converted to the `GenericType` as:

```
gt = GenericTypeBeanSerializationHelper.toGenericType
                                    (EMPLOYEE_VIRTUAL_BEAN_NAME, emp);
```

- The `GenericType` is converted to the `Employee` object as:

```
emp = GenericTypeBeanSerializationHelper.fromGenericType
                                     (Employee.class, gt, null);
```

For successful conversion, consider the following:

- Typically, POJOs closely follow their associated `GenericType` structure.
- When deviating from the `GenericType` structure, one of the following strategies should be followed:
  1. Additional bean properties should be declared transient.
  2. Optional properties can be excluded from the POJO, provided that the backing service can handle the missing data if used as an operation parameter.
- The `GenericType` is only exposed in SOAP data controls. The virtual types have an associated virtual bean name that is passed into the `toGenericType` method. You can access the virtual bean name by hovering over the virtual type in the Data Controls window of JDeveloper. The typical name format is *`<DCName>.Types.<methodName>.<argName>`*.

For more information, see *Oracle Fusion Middleware Java API Reference for Oracle Mobile Application Framework*.

8.6.1 How to Add and Delete Rows on Web Services Objects

MAF allows you to insert and delete rows from a web services object programmatically by accessing the iterator on that object. To do so, you use the `createRow` and `deleteRow` methods of the `oracle.adfmf.bindings.iterator.BasicIterator` class.

Example 8–9 shows how to add a row to a web services object.

Example 8–9 Inserting a Row

```
String keyFieldNames[] = {"EMPLID","ACAD_CAREER","INSTITUTION"};
String keyFieldValues[] = {"SR12030","UGRD","PSUNV"};
AmxAccessorIteratorBinding  acIter =
   (AmxAccessorIteratorBinding)((AdfmfJavaUtilities.getValueExpression
                                ("#{bindings.KEYIterator}", Object.class))
                                .getValue(AdfmfJavaUtilities.getAdfELContext()));

BasicIterator iter = acIter.getIterator();
GenericType key = (GenericType)iter.getDataProvider();
key.setAttribute("FIELDNAME", keyFieldNames[0]);
key.setAttribute("FIELDVALUE", keyFieldValues[0]);

int totalRowCount = 0;
int currIndex = 0;

for (int i = 1; i < keyFieldNames.length; i++) {
   totalRowCount = iter.getTotalRowCount();
   currIndex = iter.getCurrentIndex();

   System.out.println("Starting to add rows.. \n\t Total Row Count: " +
                      totalRowCount + "\n\t Current Row Index: " + currIndex);

   // Create rows for key iterator
   iter.createRow();

   totalRowCount = iter.getTotalRowCount();
   System.out.println("\t Total Row Count after creating row: " + totalRowCount);

   if (iter.hasNext()) {
      iter.next();
   }

   currIndex = iter.getCurrentIndex();
   System.out.println("\t Current Row Index after setting current
                      index to newly added row: " + currIndex);

   GenericType key1 = (GenericType)iter.getDataProvider();
   key1.setAttribute("FIELDNAME", keyFieldNames[i]);
   key1.setAttribute("FIELDVALUE", keyFieldValues[i]);
}

// Execute method

// Add call to execute the action binding to execute the action.
// If this is a web service call, the modified GenericType object
// will be sent to the server and the server will respond appropriately
```

Note: The `createRow` method signatures are available with and without a boolean input parameter. When this method is used without parameters, it produces the result identical to using the `createRow` with its boolean parameter value set to `true`: both `createRow()` and `createRow(true)` create a new row and insert it in the iterator.

8.6.2 How to Use REST Web Services Adapter

You can use the `oracle.adfmf.dc.ws.rest.RestServiceAdapter` interface to access data (that could be presented as JavaScript Object Notation, for example) sent across a

REST call. The `RestServiceAdapter` interface lets you trigger execution of web service operations without the need to create a web service data control or interact with it directly.

To use the `RestServiceAdapter` interface in your MAF application, ensure that the connection exists in the `connections.xml` file (see Section 8.3, "Creating a New Web Service Connection"), and then add your code to the bean class, as the following examples show.

Example 8–10 demonstrates the use of the `RestServiceAdapter` for the `GET` request.

Example 8–10 Using RestServiceAdapter for GET Request

```
RestServiceAdapter restServiceAdapter = Model.createRestServiceAdapter();

// Clear any previously set request properties, if any
restServiceAdapter.clearRequestProperties();

// Set the connection name
restServiceAdapter.setConnectionName("RestServerEndpoint");

// Specify the type of request
restServiceAdapter.setRequestType(RestServiceAdapter.REQUEST_TYPE_GET);

// Specify the number of retries
restServiceAdapter.setRetryLimit(0);

// Set the URI which is defined after the endpoint in the connections.xml.
// The request is the endpoint + the URI being set
restServiceAdapter.setRequestURI("/WebService/Departments/100");

String response = "";

// Execute SEND and RECEIVE operation
try {
   // For GET request, there is no payload
   response = restServiceAdapter.send("");
}
catch (Exception e) {
   e.printStackTrace();
}
```

Example 8–11 demonstrates the use of the `RestServiceAdapter` for the `POST` request.

Example 8–11 Using RestServiceAdapter for POST Request

```
String id = "111";
String name = "TestName111";
String location = "TestLocation111";
RestServiceAdapter restServiceAdapter = Model.createRestServiceAdapter();

restServiceAdapter.clearRequestProperties();
restServiceAdapter.setConnectionName("RestServerEndpoint");
restServiceAdapter.setRequestType(RestServiceAdapter.REQUEST_TYPE_POST);
restServiceAdapter.setRetryLimit(0);
restServiceAdapter.setRequestURI("/WebService/Departments");

String response = "";

// Execute SEND and RECEIVE operation
try {
```

```
   String postData = makeDepartmentPost("DEPT", id, name, location);
   response = restServiceAdapter.send(postData);
}
catch (Exception e) {
   e.printStackTrace();
}
System.out.println("The response is:  " + response);

private String makeDepartmentPost(String rootName, String id,
                                  String name, String location) {
   String ret = "<" + rootName + ">";
   ret += "<DEPTID>" + id + "</DEPTID>";
   ret += "<NAME>" + name + "</NAME>";
   ret += "<LOCATION>" + location + "</LOCATION>";
   ret += "</" + rootName + ">";
   return ret;
}
```

Example 8–12 demonstrates the use of the `RestServiceAdapter` for the `PUT` request.

Example 8–12 Using RestServiceAdapter for PUT Request

```
String id = "111";
String name = "TestName111";
String location = "TestLocation111";
RestServiceAdapter restServiceAdapter = Model.createRestServiceAdapter();

restServiceAdapter.clearRequestProperties();
restServiceAdapter.setConnectionName("RestServerEndpoint");
restServiceAdapter.setRequestType(RestServiceAdapter.REQUEST_TYPE_PUT);
restServiceAdapter.setRetryLimit(0);
restServiceAdapter.setRequestURI("/WebService/Departments");

String response = "";

// Execute SEND and RECEIVE operation
try {
   String putData = makeDepartmentPut("DEPT", id, name, location);
   response = restServiceAdapter.send(putData);
}
catch (Exception e) {
   e.printStackTrace();
}
System.out.println("The response is:  " + response);

private String makeDepartmentPut(String rootName, String id,
                                 String name, String location) {
   String ret = "<" + rootName + ">";
   ret += "<DEPTID>" + id + "</DEPTID>";
   ret += "<NAME>" + name + "</NAME>";
   ret += "<LOCATION>" + location + "</LOCATION>";
   ret += "</" + rootName + ">";
   return ret;
}
```

Example 8–13 demonstrates the use of the `RestServiceAdapter` for the `DELETE` request.

Example 8–13 Using RestServiceAdapter for DELETE Request

```
RestServiceAdapter restServiceAdapter = Model.createRestServiceAdapter();
```

```
restServiceAdapter.clearRequestProperties();
restServiceAdapter.setConnectionName("RestServerEndpoint");
restServiceAdapter.setRequestType(RestServiceAdapter.REQUEST_TYPE_DELETE);
restServiceAdapter.setRetryLimit(0);
restServiceAdapter.setRequestURI("/WebService/Departments/44");

String response = "";

// Execute SEND and RECEIVE operation
try {
   // For DELETE request, there is no payload
   response = restServiceAdapter.send("");
}
catch (Exception e) {
   e.printStackTrace();
}

System.out.println("The response is:  " + response);
```

When you use the `RestServiceAdapter`, you should set the `Accept` and `Content-Type` headers to ensure that your request and response payloads are not deemed invalid due to mismatched MIME type.

> **Note:** The REST web service adapter only supports UTF-8 character set on mobile applications. UTF-8 is embedded in the adapter program.

8.6.2.1 Accessing Input and Output Stream

You can use the following `RestServiceAdapter` methods to obtain and customize the `javax.microedition.io.HttpConnection`, as well as access and interact with the connection's input and output streams which allows you to read data from the `HttpConnection` and write to it for further upload to the server:

- Get an `HttpConnection`:

  ```
  HttpConnection getHttpConnection(String requestMethod,
                                   String request,
                                   Object httpHeadersValue)
  ```

- Get the `HttpConnection`'s `OutputStream`:

  ```
  OutputStream getOutputStream(HttpConnection connection)
  ```

- Get the `HttpConnection`'s `InputStream`:

  ```
  InputStream getInputStream(HttpConnection connection)
  ```

- Close the `HttpConnection`:

  ```
  void close (HttpConnection connection)
  ```

- Look up a connection name in the `connections.xml` file and return the connection's end point:

  ```
  String getConnectionEndPoint(String connecionName)
  ```

These methods, while accomplishing the same functionality as the `RestServiceAdaper`'s `send` and `sendReceive` methods, provide opportunity for

customization of the connection and the process of sending requests and receiving responses.

Example 8–14 initializes and returns an `HttpConnection` using the provided request method, request, and HTTP headers value. In addition, it injects basic authentication into the request headers from the credential store, obtains the input stream and closes the connection.

Example 8–14 Obtaining HttpConnection and Using Its Methods

```
RestServiceAdapter restServiceAdapter = Model.createRestServiceAdapter();

restServiceAdapter.clearRequestProperties();

// Specify the type of request
String requestMethod = RestServiceAdapter.REQUEST_TYPE_GET;

// Get the connection end point from connections.xml
String requestEndPoint = restServiceAdapter.getConnectionEndPoint("GeoIP");

// Get the URI which is defined after the end point
String requestURI = "/xml/" + someIpAddress;

// The request is the end point + the URI being set
String request = requestEndPoint + requestURI;

// Specify some custom request headers
HashMap httpHeadersValue = new HashMap();
httpHeadersValue.put("Accept-Language", "en-US");
httpHeadersValue.put("My-Custom-Header-Item", "CustomItem1");

// Get the connection
HttpConnection connection =
                  restServiceAdapter.getHttpConnection(requestMethod,
                                                       request,
                                                       httpHeadersValue);

// Get the input stream
InputStream inputStream = restServiceAdapter.getInputStream(connection);

// Define data
ByteArrayOutputStream byStream = new ByteArrayOutputStream();

int res = 0;
int bufsize = 0, bufread = 0;

byte[] data = (bufsize > 0) ? new byte[bufsize] : new byte[1024];

// Use the input stream to read data
while ((res = inputStream.read(data)) > 0) {
   byStream.write(data, 0, res);
   bufread = bufread + res;
}
data = byStream.toByteArray();

// Use data
...

restServiceAdapter.close(connection);
...
```

8.6.2.2 Support for Non-Text Responses

You can use the `RestServiceAdapter` to handle binary (non-text) responses received from web service calls. These responses can include any type of binary data, such as PDF or video files. The `RestServiceAdapter` method to use is `sendReceive`.

Example 8–15 shows how to send a request for a file to a REST server, and then save the file to a disk (see Example 8–16).

Example 8–15 Sending Request for File

```
RestServiceAdapter restServiceAdapter = Model.createRestServiceAdapter();

restServiceAdapter.clearRequestProperties();
restServiceAdapter.setConnectionName("JagRestServerEndpoint");
restServiceAdapter.setRequestType(RestServiceAdapter.REQUEST_TYPE_GET);
restServiceAdapter.setRetryLimit(0);
restServiceAdapter.setRequestURI("/ftaServer/v1/kpis/123/related/1");

// Set credentials needed to access the REST server
String theUsername = "hr_spec_all";
String thePassword = "Welcome1";
String userPassword = theUsername + ":" + thePassword;
String encoding = new sun.misc.BASE64Encoder().encode(userPassword.getBytes());

restServiceAdapter.addRequestProperty("Authorization", "Basic " + encoding);

// Execute the SEND / RECEIVE operation.
// Since it is a GET request, there is no payload.
try {
   this.responseRaw = restServiceAdapter.sendReceive("");
}
catch (Exception e) {
   e.printStackTrace();
}
System.out.println("The response is:  " + this.responseRaw);

// Write the response to a file
writeByteArrayToFile(this.responseRaw);
```

Example 8–16 demonstrates a method that is called by the code from Example 8–15. This method saves a `byte[]` response to a file on disk:

Example 8–16 Saving File to Disk

```
public void writeByteArrayToFile(byte[] fileContent) {
   BufferedOutputStream bos = null;
try {
   FileOutputStream fos = new FileOutputStream(new File(fileToSavePath));
   bos = new BufferedOutputStream(fos);

   // Write the byte [] to a file
   System.out.println("Writing byte array to file");
   bos.write(fileContent);
   System.out.println("File written");
}
catch(FileNotFoundException fnfe) {
   System.out.println("Specified file not found" + fnfe);
}
catch (IOException ioe) {
   System.out.println("Error while writing file" + ioe);
```

```
}
finally {
   if(bos != null) {
      try {
         // Flush the BufferedOutputStream
         bos.flush();

         // Close the BufferedOutputStream
         bos.close();
      }
      catch (Exception e) {
      }
   }
}
```

8.6.3 How to Enable Strict Validation of REST Responses

Using the `maf-config.xml` file, you can specify how MAF is to behave when a REST response contains a child or attribute that is not expected or defined in the XSD:

- If the strict validation is enabled, MAF throws an exception.
- If the strict validation is disabled, the condition is logged and the execution continues without exceptions thrown.

Example 8–17 shows how to set the `validated` parameter. If you define the value of this parameter as `true`, the validation proceeds as strict. The value of `false` (default) means that the validation is not strict.

Example 8–17 Enabling Strict Validation of REST Response

```
<generic-type>
   <conversion>
      <validated>true</validated>
   </conversion>
</generic-type>
```

8.6.4 What You May Need to Know About Invoking Data Control Operations

You can use the `invokeDataControlMethod` method of the `AdfmfJavaUtilities` to invoke a data control operation which does not have to be explicitly added as a `methodAction` in a `PageDef` file.

For more information and examples, see *Oracle Fusion Middleware Java API Reference for Oracle Mobile Application Framework*.

8.7 Configuring the Browser Proxy Information

If the web service you are to call resides outside your corporate firewall, you need to ensure that you have set the appropriate Java system properties to configure the use of an HTTP proxy server.

By default, MAF determines the proxy information using the system settings on iOS and Android platforms. For example, if the proxy information is set using the Settings utility on an iOS-powered device, then CVM automatically absorbs it.

Note: It is possible to define a different proxy for each MAF application.

If you do not want to obtain the proxy information from the device settings, first you need to add the `-Dcom.oracle.net.httpProxySource` system property. The default value of this property is `native`, which means that the proxy information is to be obtained from the device settings. You need to disable it by specifying a different value, such as `user`, for example: `-Dcom.oracle.net.httpProxySource=user`

CVM uses two different mechanisms for enabling the network connection:

1. The generic connection framework (GCF). If this mechanism is used, the proxy is defined through the system property `-Dcom.sun.cdc.io.http.proxy=<host>:<port>`
2. `java.net` API. If this mechanism is used, the proxy is defined through the standard `http.proxyHost` and `http.proxyPort`.

In either case, it is recommended to define all three properties in the `cvm.properties` file, which would look similar to the following:

```
java.commandline.argument=-Dcom.oracle.net.httpProxySource=user
java.commandline.argument=-Dcom.sun.cdc.io.http.proxy=www-proxy.us.mycompany.com:80
java.commandline.argument=-Dhttp.proxyHost=www-proxy.us.mycompany.com
java.commandline.argument=-Dhttp.proxyPort=80
```

Note: These properties affect only the CVM side of network calls.

9

Configuring End Points Used in MAF Applications

This chapter describes how to use the Configuration Service to configure end points used in a MAF application.

This chapter includes the following sections:

9.1 Introduction to Configuring End Points

The Configuration Service is a tool that allows you to configure end points used by web services, login utilities, and any other parts of a MAF application.

9.2 Defining the Configuration Service End Point

The end point (or seed) URL is defined in the `connections.xml` file and a new connection entry must be added to that file. This new connection should be of type `HttpURLConnection`, with its `url` value pointing to the configuration server end point (or seed) URL and its `name` set to an arbitrary value which will eventually be referenced in a Java bean code.

Example 9–1 shows how to define the Configuration Service end point in the `connections.xml` file.

Example 9–1 Setting End Point in the connections.xml File

```
<Reference name="ConfigServiceConnection"
               className="oracle.adf.model.connection.url.HttpURLConnection"
               credentialStoreKey="ConfigServiceConnection"
               adfCredentialStoreKey="ConfigServerLogin"
               xmlns="">
   <Factory className="oracle.adf.model.connection.url.URLConnectionFactory"/>
   <RefAddresses>
      <XmlRefAddr addrType="ADFMFSecuredConfigServer">
         <Contents>
```

```
            <urlconnection name="ADFMFSecuredConfigServer"
                           url="http://127.0.0.1"/>
               <authentication style="challange">
                 <type>basic</type>
                 <realm>myrealm</realm>
               </authentication>
            </urlconnection>
         </Contents>
      </XmlRefAddr>
      <SecureRefAddr addrType="username"/>
      <SecureRefAddr addrType="password"/>
   </RefAddresses>
</Reference>
<Reference name="ConfigServerLogin"
           className="oracle.adf.model.connection.adfmf.LoginConnection"
           adfCredentialStoreKey="ConfigServerLogin"
           partial="false"
           manageInOracleEnterpriseManager="true"
           deployable="true"
           xmlns="">
   <Factory className="oracle.adf.model.connection.adfmf.LoginConnectionFactory"/>
   <RefAddresses>
      <XmlRefAddr addrType="adfmfLogin">
         <Contents>
            <login url="http://127.0.0.1"/>
            <logout url="http://127.0.0.1"/>
            <accessControl url=""/>
            <idleTimeout value="300"/>
            <sessionTimeout value="28800"/>
            <authenticationMode value="remote"/>
            <rememberCredentials>
               <enableRememberUserName value="true"/>
               <rememberUserNameDefault value="true"/>
               <enableRememberPassword value="false"/>
               <enableStayLoggedIn value="true"/>
               <stayLoggedInDefault value="true"/>
            </rememberCredentials>
            <userObjectFilter/>
         </Contents>
      </XmlRefAddr>
   </RefAddresses>
</Reference>
```

If security is enabled for the configuration server, the `connections.xml` file would have to include the following additional definition:

- There should be a login connection that points to the same end point (or seed) URL as the URL connection. The login connection and `HttpURLConnection` should share the same `adfCredentialStoreKey`.

Sometimes the end point URL needs to be retrieved from the end user and cannot be set in the `connections.xml` file. If this is the case, a user interface can be created to obtain the value of the end point URL and set it into an application preference whose value can then be used in the Java bean method to override the connection URL value, as Example 9–2 shows.

Example 9–2 Overriding the Connection Definition

```
AdfmfJavaUtilities.overrideConnectionProperty("ConfigServerConnection",
                                              "login",
```

```
                                                    "url",
                                                    <Endpoint_URL>);
```

9.3 Creating the User Interface for the Configuration Service

If there is a requirement for the Configuration Service user interface, you should create it in a new or existing application feature.

MAF provides a set of APIs within the `oracle.adfmf.config.client.ConfigurationService` class that allow to check for new changes on the server and download the updates. You can use these APIs in a Java bean to activate the respective methods through the Configuration Service application feature.

In the following list of APIs and their sample usage, the `_configservice` variable represents an instance of the `oracle.adfmf.config.client.ConfigurationService` class:

- `setDeliveryMechanism` method sets the delivery mechanism for the Configuration Service. Since the communication with the previous release's configuration server is enabled through HTTP, `http` is passed in as an argument to this method:

  ```
  _configservice.setDeliveryMechanism("http");
  ```

  Note: The method argument refers to the web transport that is to be used for the Configuration Service and should not be confused with HTTP or HTTPS: if the end point is an HTTPS URL, setting the transport to `http` is still valid.

- `setDeliveryMechanismConfiguration` method sets additional attributes on the Configuration Service allowing to associate the configuration server connection and the end point URL:

  ```
  _configservice.setDeliveryMechanismConfiguration("connectionName",
                                                   "ConfigServerConnection");
  _configservice.setDeliveryMechanismConfiguration("root", <Endpoint_URL);
  ```

- `isThereAnyNewConfigurationChanges` method checks whether or not there are any changes on the server that are available for download, and if there are, this method returns `true`:

  ```
  _configservice.isThereAnyNewConfigurationChanges(<APPLICATION_ID>, <VERSION>);
  ```

- `stageAndActivateVersion` method triggers download of updates by the Configuration Service. The application version is passed in as an argument to this method, either as a hard-coded value or obtained through the `Application.getApplicationVersion` API:

  ```
  _configservice.stageAndActivateVersion("1.0");

  _configservice.stageAndActivateVersion(Application.getApplicationVersion);
  ```

- `addProgressListener` method registers an update progress listener on the Configuration Service to receive update messages and progress status. The underlying class should implement the `ProgressListener` interface and the `updateProgress` method which is to be called from the Configuration Service. The

`updateProgress` method receives the progress update message and the update percentage complete:

```
_configservice.addProgressListener(this);
```

- `removeProgressListener` method unregisters the update progress listener:

```
_configservice.removeProgressListener(this);
```

A MAF sample application called ConfigService demonstrates how to use these APIs to communicate with the Configuration Server. The ConfigService application is located in the `PublicSamples.zip` file within the *`jdev_install`*`/jdeveloper/jdev/extensions/oracle.maf/Samples` directory on your development computer.

For more information, see *Oracle Fusion Middleware Java API Reference for Oracle Mobile Application Framework*.

9.4 About the URL Construction

The URL to each of the Configuration Service-managed resources is constructed. It contains the application ID and the file name as follows:

If the user provides the URL of `http://my.server.com:port/SomeLocation` and the application ID of `com.mycompany.appname`, the following t URLs will be used to download the configuration files:

```
http://my.server.com:port/SomeLocation/com.mycompany.appname/connections.xml
http://my.server.com:port/SomeLocation/com.mycompany.appname/adf-config.xml
http://my.server.com:port/SomeLocation/com.mycompany.appname/maf-config.xml
```

9.5 Setting Up the Configuration Service on the Server

The Configuration Service can be implemented as a service that accepts HTTP `GET` request and returns the `connections.xml` file.

The URL used by the Configuration Service client is of the following format:

`url configured in adf-config.xml/application bundle id``/connections.xml`

The Configuration Service end point may be secured using basic authentication (`BASIC_AUTH`) over HTTP and HTTPS.

9.6 Migrating the Configuration Service API

If an application was created using the previous release of MAF and that application utilizes the Configuration Service, you have to perform manual migration.

The main reason for the migration is that in the current release, MAF removed support for the following APIs, properties, and utilities that played an essential role in enabling functionality of the Configuration Service:

- MAF used to provide means to manipulate the Configuration Service from the `adf-config.xml` file by setting the `use-configuration-service-at-startup` property to enable the service and `adfmf-configuration-service-seed-url` property to provide the end point URL.
- The `checkForUpdates` API provided means to check for the Configuration Service updates.
- The Configuration Service was initiated from a UI provided by MAF.

To start the migration, the end point (or seed) URL must be moved from the `adf-config.xml` file to the `connections.xml` file and a new connection element must be added to the `connections.xml` file, as described in Section 9.2, "Defining the Configuration Service End Point."

Since in the current release MAF does not provide a user interface for the Configuration Service, you have to create it in a new or existing application feature assuming there is a requirement for the user interface. For more information, see Section 9.3, "Creating the User Interface for the Configuration Service."

A MAF sample application called ConfigService demonstrates how to use the APIs to communicate with the configuration server included in the previous release of MAF. The ConfigService application is located in the `PublicSamples.zip` file within the *`jdev_install`*`/jdeveloper/jdev/extensions/oracle.maf/Samples` directory on your development computer.

10 Using the Local Database

This chapter describes how to use the local SQLite database with a MAF application.

This chapter includes the following sections:

- Section 10.1, "Introduction to the Local SQLite Database Usage"
- Section 10.2, "Using the Local SQLite Database"

10.1 Introduction to the Local SQLite Database Usage

SQLite is a relational database management system (RDBMS) specifically designed for embedded applications.

SQLite has the following characteristics:

- It is ACID-compliant: like other traditional database systems, it has the properties of atomicity, consistency, isolation, and durability.
- It is lightweight: the entire database consists of a small C library designed to be embedded directly within an application.
- It is portable: the database is self-contained in a single file that is binary-compatible across a diverse range of computer architectures and operating systems

For more information, see the SQLite website at `http://www.sqlite.org`.

For a sample usage of the local SQLite database, see the MAF sample application called StockTracker located in the `PublicSamples.zip` file within the *`jdev_install`*`/jdeveloper/jdev/extensions/oracle.maf/Samples` directory on your development computer. For more information, see Section 10.2.8, "What You May Need to Know About the StockTracker Sample Application."

10.1.1 Differences Between SQLite and Other Relational Databases

SQLite is designed for use as an embedded database system, one typically used by a single user and often linked directly into the application. Enterprise databases, on the other hand, are designed for high concurrency in a distributed client-server environment. Because of these differences, there is a number of limitations compared to Oracle databases. Some of the most important differences are:

- Concurrency
- SQL Support and Interpretation
- Data Types
- Foreign Keys

- Database Transactions
- Authentication

For more information, see the following:

- Documentation section of the SQLite website at http://www.sqlite.org/docs.html
- "Limits In SQLite" available from the Documentation section of the SQLite website at http://www.sqlite.org/limits.html

10.1.1.1 Concurrency

At any given time, a single instance of the SQLite database may have either a single read-write connection or multiple read-only connections.

Due to its coarse-grained locking mechanism, SQLite does not support multiple read-write connections to the same database instance. For more information, see "File Locking And Concurrency In SQLite Version 3" available from the Documentation section of the SQLite website at http://www.sqlite.org/lockingv3.html.

10.1.1.2 SQL Support and Interpretation

Although SQLite complies with the SQL92 standard, there are a few unsupported constructs, including the following:

- `RIGHT OUTER JOIN`
- `FULL OUTER JOIN`
- `GRANT`
- `REVOKE`

For more information, see "SQL Features That SQLite Does Not Implement" available from the Documentation section of the SQLite website at http://www.sqlite.org/omitted.html.

For information on how SQLite interprets SQL, see "SQL As Understood by SQLite" available from the Documentation section of the SQLite website at http://www.sqlite.org/lang_createtable.html.

10.1.1.3 Data Types

While most database systems are strongly typed, SQLite is dynamically typed and therefore any value can be stored in any column, regardless of its declared type. SQLite does not return an error if, for instance, a string value is mistakenly stored in a numeric column. For more information, see "Datatypes In SQLite Version 3" available from the Documentation section of the SQLite website at http://www.sqlite.org/datatype3.html.

10.1.1.4 Foreign Keys

SQLite supports foreign keys. It parses and enforces foreign key constraints. For more information, see the *SQLite Foreign Key Support* available from the Documentation section of the SQLite site at http://www.sqlite.org/foreignkeys.html.

10.1.1.5 Database Transactions

Although SQLite is ACID-compliant and hence supports transactions, there are some fundamental differences between its transaction support and Oracle's:

- Nested transactions: SQLite does not support nested transactions. Only a single transaction may be active at any given time.
- Commit: SQLite permits either multiple read-only connections **or** a single read-write connection to any given database. Therefore, if you have multiple connections to the same database, only the first connection that attempts to modify the database can succeed.
- Rollback: SQLite does not permit a transaction to be rolled back until all open `ResultSets` have been closed first.

For more information, see "Distinctive Features of SQLite" available from the Documentation section of the SQLite website at `http://www.sqlite.org/different.html`.

10.1.1.6 Authentication

SQLite does not support any form of role-based or user-based authentication. By default, anyone can access all of the data in the file. However, MAF provides encryption routines that you can use to secure the data and prevent access by users without the valid set of credentials. For more information, see Section 10.2.7, "How to Encrypt and Decrypt the Database."

10.2 Using the Local SQLite Database

MAF contains an encrypted SQLite 3.7.9 database.

A typical SQLite usage requires you to know the following:

- How to Connect to the Database
- How to Use SQL Script to Initialize the Database or How to Initialize the Database on a Desktop
- How to Encrypt and Decrypt the Database
- How to Use the VACUUM Command

10.2.1 How to Connect to the Database

Connecting to the SQLite database is somewhat different from opening a connection to an Oracle database. That said, once you have acquired the initial connection, you can use most of the same JDBC APIs and SQL syntax to query and modify the database.

You use the `java.sql.Connection` object associated with your application to connect to the SQLite database. When creating the connection, ensure that every SQLite JDBC URL begins with the text `jdbc:sqlite:`.

Example 10–1 shows how to open a connection to an unencrypted database.

Example 10–1 Connecting to Unencrypted Database

```
java.sql.Connection connection = new SQLite.JDBCDataSource
            ("jdbc:sqlite:/path/to/database").getConnection();
```

Example 10–2 shows how to open a connection to an encrypted database.

Example 10–2 Connecting to Encrypted Database

```
java.sql.Connection connection = new SQLite.JDBCDataSource
            ("jdbc:sqlite:/path/to/database").getConnection(null,"password");
```

In the preceding example, the first parameter of the `getConnection` method is the user name, but since SQLite does not support user-based security, this value is ignored.

> **Note:** SQLite does not display any error messages if you open an encrypted database with an incorrect password. Likewise, you are not alerted if you mistakenly open an unencrypted database with a password. Instead, when you attempt to read or modify the data, an `SQLException` is thrown with the message "Error: file is encrypted or is not a database".

10.2.2 How to Use SQL Script to Initialize the Database

Typically, you can use an SQL script to initialize the database when the application starts. Example 10–3 shows the SQL initialization script that demonstrates some of the supported SQL syntax (described in Section 10.1.1.2, "SQL Support and Interpretation") through its use of the `DROP TABLE`, `CREATE TABLE`, and `INSERT` commands and the `NUMBER` and `VARCHAR2` data types.

Example 10–3 SQL Initialization Script

```
DROP TABLE IF EXISTS PERSONS;

CREATE TABLE PERSONS
(
PERSON_ID NUMBER(15) NOT NULL,
FIRST_NAME VARCHAR2(30),
LAST_NAME VARCHAR2(30),
EMAIL VARCHAR2(25) NOT NULL
);

INSERT INTO PERSONS (PERSON_ID, FIRST_NAME, LAST_NAME, EMAIL) VALUES ( 100,
'David', 'King', 'steven@king.net');
INSERT INTO PERSONS (PERSON_ID, FIRST_NAME, LAST_NAME, EMAIL) VALUES ( 101,
'Neena', 'Kochhar', 'neena@kochhar.net');
INSERT INTO PERSONS (PERSON_ID, FIRST_NAME, LAST_NAME, EMAIL) VALUES ( 102, 'Lex',
'De Haan', 'lex@dehaan.net');
INSERT INTO PERSONS (PERSON_ID, FIRST_NAME, LAST_NAME, EMAIL) VALUES ( 103,
'Alexander', 'Hunold', 'alexander@hunold.net');
INSERT INTO PERSONS (PERSON_ID, FIRST_NAME, LAST_NAME, EMAIL) VALUES ( 104,
'Bruce', 'Ernst', 'bruce@ernst.net');
```

To use the SQL script, add it to the ApplicationController project of your MAF application as a resource. Suppose a sample script has been saved as `initialize.sql` in the `META-INF` directory. Example 10–4 shows the code that you should add to parse the SQL script and execute the statements.

Example 10–4 Initializing Database from SQL Script

```
private static void initializeDatabaseFromScript() throws Exception {
   InputStream scriptStream = null;
   Connection conn = null;
   try {
      // ApplicationDirectory returns the private read-write sandbox area
      // of the mobile device's file system that this application can access.
      // This is where the database is created
      String docRoot = AdfmfJavaUtilities.getDirectoryPathRoot
                               (AdfmfJavaUtilities.ApplicationDirectory);
      String dbName = docRoot + "/sample.db";
```

```
      // Verify whether or not the database exists.
      // If it does, then it has already been initialized
      // and no furher actions are required
      File dbFile = new File(dbName);
      if (dbFile.exists())
         return;

      // If the database does not exist, a new database is automatically
      // created when the SQLite JDBC connection is created
      conn = new SQLite.JDBCDataSource("jdbc:sqlite:" + docRoot +
                                       "/sample.db").getConnection();

      // To improve performance, the statements are executed
      // one at a time in the context of a single transaction
      conn.setAutoCommit(false);

      // Since the SQL script has been packaged as a resource within
      // the application, the getResourceAsStream method is used
      scriptStream = Thread.currentThread().getContextClassLoader().
                           getResourceAsStream("META-INF/initialize.sql");
      BufferedReader scriptReader = new BufferedReader
                                       (new InputStreamReader(scriptStream));
      String nextLine;
      StringBuffer nextStatement = new StringBuffer();

      // The while loop iterates over all the lines in the SQL script,
      // assembling them into valid SQL statements and executing them as
      // a terminating semicolon is encountered
      Statement stmt = conn.createStatement();
      while ((nextLine = scriptReader.readLine()) != null) {
         // Skipping blank lines, comments, and COMMIT statements
         if (nextLine.startsWith("REM") ||
             nextLine.startsWith("COMMIT") ||
             nextLine.length() < 1)
            continue;
         nextStatement.append(nextLine);
         if (nextLine.endsWith(";")) {
            stmt.execute(nextStatement.toString());
            nextStatement = new StringBuffer();
         }
      }
      conn.commit();
   }
   finally {
      if (conn != null)
         conn.close();
   }
}
```

Note: In Example 10–4, the error handling was omitted for simplicity.

You invoke the database initialization code (see Example 10–4) from the `start` method of the `LifeCycleListenerImpl`, as Example 10–5 shows.

Example 10–5 Invoking Database Initialization Code

```
public void start() {
   try {
      initializeDatabaseFromScript();
   }
   catch (Exception e) {
      Trace.log(Utility.FrameworkLogger,
                Level.SEVERE,
                LifeCycleListenerImpl.class,
                "start",
                e);
   }
}
```

10.2.3 How to Initialize the Database on a Desktop

Because SQLite databases are self-contained and binary-compatible across platforms, you can use the same database file on iOS, Android, Windows, Linux, and Mac OS platforms. In complex cases, you can initialize the database on a desktop using third-party tools (such as MesaSQLite, SQLiteManager, and SQLite Database Browser), and then package the resulting file as a resource in your application.

To use the database, add it to the ApplicationController project of your MAF application as a resource. Suppose a database has been saved as `sample.db` in the `META-INF` directory. Example 10–6 shows the code that you should add to copy the database from your application to the mobile device's file system to enable access to the database.

Example 10–6 Initializing Database on Desktop

```
private static void initializeDatabase() throws Exception {
   InputStream sourceStream = null;
   FileOutputStream destinationStream = null;
   try {
      // ApplicationDirectory returns the private read-write sandbox area
      // of the mobile device's file system that this application can access.
      // This is where the database is created
      String docRoot = AdfmfJavaUtilities.getDirectoryPathRoot
                               (AdfmfJavaUtilities.ApplicationDirectory);
      String dbName = docRoot + "/sample.db";

      // Verify whether or not the database exists.
      // If it does, then it has already been initialized
      // and no furher actions are required
      File dbFile = new File(dbName);
      if (dbFile.exists())
         return;

      // Since the database has been packaged as a resource within
      // the application, the getResourceAsStream method is used
      sourceStream = Thread.currentThread().getContextClassLoader().
                           getResourceAsStream("META-INF/sample.db");
      destinationStream = new FileOutputStream(dbName);
      byte[] buffer = new byte[1000];
      int bytesRead;
      while ((bytesRead = sourceStream.read(buffer)) != -1) {
         destinationStream.write(buffer, 0, bytesRead);
      }
   }
```

```
   finally {
      if (sourceStream != null)
         sourceStream.close();
      if (destinationStream != null)
         destinationStream.close();
   }
}
```

Note: In Example 10–6, the error handling was omitted for simplicity.

You invoke the database initialization code (see Example 10–6) from the `start` method of the `LifeCycleListenerImpl`, as Example 10–7 shows.

Example 10–7 Invoking Database Initialization Code

```
public void start() {
   try {
      initializeDatabase();
   }
   catch (Exception e) {
      Trace.log(Utility.FrameworkLogger,
                Level.SEVERE,
                LifeCycleListenerImpl.class,
                "start",
                e);
   }
}
```

10.2.4 What You May Need to Know About Commit Handling

`Commit` statements are ignored when encountered. Each statement is committed as it is read from the SQL script. This auto-commit functionality is provided by the SQLite database by default. To improve your application's performance, you can disable the auto-commit to allow a regular execution of `commit` statements by using the `Connection`'s `setAutoCommit(false)` method.

10.2.5 Limitations of the MAF's SQLite JDBC Driver

The following methods from the `java.sql` package have limited or no support in MAF:

- The `getByte` method of the `ResultSet` is not supported. If used, this method will throw an `SQLException` when executed.
- The `execute` method of the `Statement` always returns `true` (as opposed to returning `true` only for statements that return a `ResultSet`).

10.2.6 How to Use the VACUUM Command

When records are deleted from an SQLite database, its size does not change. This leads to fragmentation and, ultimately, results in degraded performance. You can avoid this by periodically running the `VACUUM` command.

> **Note:** The `VACUUM` can take a significant amount of time when run on large databases (approximately 0.5 seconds per megabyte on the Linux computer on which SQLite is developed). In addition, it can use up to twice as much temporary disk space as the original file while it is running.

Typically, the `VACUUM` command should be run from a properly registered `LifeCycleListener` implementation (see Section 4.7, "About Lifecycle Event Listeners").

10.2.7 How to Encrypt and Decrypt the Database

MAF allows you to provide the SQLite database with an initial or subsequent encryption through the use of various APIs. Some of these APIs enable you to specify your own password for encrypting the database. Others are used when you prefer MAF to generate and, optionally, manage the password.

To encrypt the database with your own password:

1. Establish the database connection (see Section 10.2.1, "How to Connect to the Database").
2. Use the following utility method to encrypt the database with a new key:

```
AdfmfJavaUtilities.encryptDatabase(connection, "newPassword");
```

To permanently decrypt the database encrypted with your own password:

1. Open the encrypted database with the correct password.
2. Use the following utility method:

```
AdfmfJavaUtilities.decryptDatabase(connection);
```

> **Caution:** If you open a database incorrectly (for example, use an invalid password to open an encrypted database), and then encrypt it again, neither the old correct password, the invalid password, nor the new password can unlock the database resulting in the irretrievable loss of data.

To encrypt the database using the MAF-generated password:

1. Generate a password using the following method:

```
GeneratedPassword.setPassword("databasePasswordID", "initialSeedValue");
```

   This method requires both a unique identifier and an initial seed value to aid the cryptographic functions in generating a strong password.

2. Retrieve the created password using the previously-specified ID as follows:

```
char[] password = GeneratedPassword.getPassword("databasePasswordID");
```

3. Establish the database connection (see Section 10.2.1, "How to Connect to the Database").
4. Encrypt the database as follows:

```
AdfmfJavaUtilities.encryptDatabase(connection, new String(password));
```

To decrypt the database and delete the MAF-generated password:

1. Obtain the correct password as follows:

```
char[] password = GeneratedPassword.getPassword("databasePasswordID");
```

2. Establish the database connection and decrypt the database as follows:

```
java.sql.Connection connection =
                    SQLite.JDBCDataSource("jdbc:sqlite:/path/to/database").
                    getConnection(null, new String(password));
```

3. Optionally, delete the generated password using the following method:

```
GeneratedPassword.clearPassword("databasePasswordID");
```

10.2.8 What You May Need to Know About the StockTracker Sample Application

The StockTracker sample application uses a custom SQLite database file that is packaged within this application. The database file contains a table with four records which include information on four stocks. When the application is activated, it reads data from the table and displays the four stocks. The information about the stocks can be subject to CRUD operations: the stocks can be created, reordered, updated, and deleted through the user interface. All the CRUD operations, including reordering of stocks, are updated in the SQLite database.

11

Customizing MAF AMX Application Feature Artifacts

This chapter describes how to preform customization of existing MAF AMX pages, task flows, and page definition files.

This chapter includes the following sections:

11.1 Introduction to Customizing MAF AMX Pages and Artifacts

You can use the standard customization mechanism provided by JDeveloper and Oracle Metadata Service (MDS) to customize your existing MAF AMX application feature artifacts and metadata files, including the following:

- MAF AMX files (`.amx`)
- Task flow files, such as `ViewController-task-flow.xml`
- Page definition files (`<page name>.PageDef.xml`)
- Data control XML file—a package file that contains a data control structure file (that is, a package file named for a data control and prepended with `persdef.`). For more information, see Section 7.8, "Configuring Data Controls."

The customization changes that you make at design time are applied to your files during deployment and become visible at runtime. MAF AMX supports the static seeded customization, where the final version for a specific customization context is seeded during deployment and work statically at runtime for that customization context. For each customization context you have to deploy a separate MAF application.

Note: MAF AMX does not support the user customization that both creates and applies customization at runtime.

11.2 Customizing MAF AMX Pages and Artifacts

You customize your MAF AMX pages and artifacts as follows:

1. Define customization layers and layer values by modifying the *jdev_install*/jdeveloper/jdev/CustomizationLayerValues.xml file, as Example 11–1 shows.

Example 11–1 Defining Customization Layers

```
<cust-layers xmlns="http://xmlns.oracle.com/mds/dt">
   <cust-layer name="site" id-prefix="s">
      <!-- Generated id-prefix would be "s1" and "s2"
       for values "site1" and "site2" -->
      <cust-layer-value value="headquarter"
                        display-name="Headquarter"
                        id-prefix="1" />
      <cust-layer-value value="remoteoffices"
                        display-name="Remote Office"
                        id-prefix="2" />
   </cust-layer>
</cust-layers>
```

   For more information, see Section 11.4, "Configuring Customization Layers."

2. Create a customization class—a POJO class that extends oracle.mds.cust.CustomizationClass. For more information, see Section 11.3, "What You May Need to Know About Customization Classes."

   Note: The customization class can be created with a separate Java application.

3. Enable the JDeveloper design time to access the customization as follows:

   a. Package the customization class (a .java file) as a JAR file.

   b. Add the JAR file to one of the projects of the MAF application.

      For more information, see Section 11.5.1, "How to Make Customization Classes Available to JDeveloper at Design Time."

4. Register the customization class with the MAF application's adf-config.xml file by adding that class to the cust-config section, as Example 11–2 shows.

Example 11–2 Registering the Customization Class

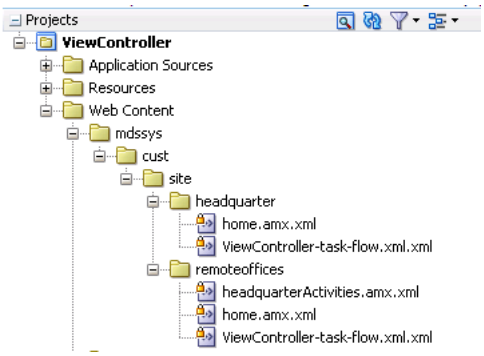
```
<?xml version="1.0" encoding="windows-1252" ?>
<adf-config xmlns="http://xmlns.oracle.com/adf/config">
   <adf-mds-config xmlns="http://xmlns.oracle.com/adf/mds/config">
      <mds-config xmlns="http://xmlns.oracle.com/mds/config" version="11.1.1.000">
         <cust-config>
            <match path="/">
               <customization-class name="customclass.SiteCC"/>
            </match>
         </cust-config>
      </mds-config>
   </adf-mds-config>
</adf-config>
```

   For information, see Section 11.6, "Configuring the adf-config.xml File."

5. Restart JDeveloper in the Customization Developer role. For more information, see the "Working with JDeveloper Roles" section in *Oracle Fusion Middleware User's Guide for Oracle JDeveloper* and Section 11.7, "What You May Need to Know About the Customization Developer Role."

   Note: The Customization Developer role enables you to change files, but not add them.

6. Perform the required modifications to the files. Your changes are recorded by MDS in the `mdssys` directory of the ViewController project:



7. Deploy the application to a mobile device, emulator, or as a platform-specific application package.

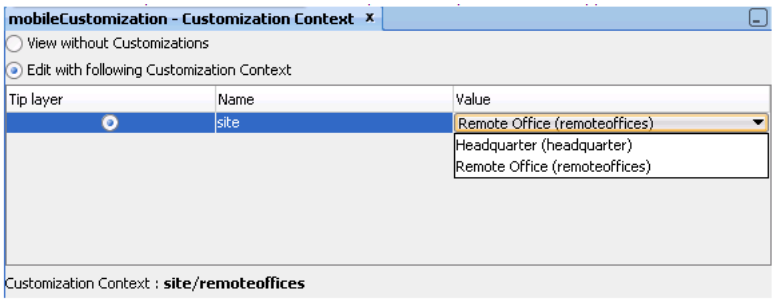
   Note: During deployment, the current customization context is picked up and the customized content that you declared in your MAF AMX pages in the deployed application is included in the new deployment artifacts. The customized content is grouped by the deployment profile name and may extend across multiple pages within the MAF AMX application feature.

   You can deploy a customized application in the Studio Developer role or in Customization Developer role. To deploy in the Customization Developer role:

   a. Launch the application the application in the Customization Developer role.

   b. In the Customization Context window, shown in Figure 11–1, select the layer and value for which you want to implement customizations.

Figure 11–1 Selecting a Customization Context for Deployment



c. Select from among the deployment options (accessed by choosing **Application > Deploy**, and then by selecting the deployment profile). For more information, see Chapter 19, "Deploying Mobile Applications."

d. Perform a separate deployment for each customization context.

During deployment, the base file and the delta files are merged to create the customized version of the application at runtime. The deployed application has no MDS dependencies.

> **Tip:** You can deploy the customized application as a MAF Application Archive (`.maa`) file and then import it into an application to perform additional customization and upgrades. The delta files included in the `.maa` file are merged with the base files after deployment. For more information, see Section 4.14.7, "Upgrading a Mobile Application with Customizations."

When the customization process is complete, JDeveloper creates a metadata file for the customizations and a subpackage for storing them. The metadata file contains the customizations for the customized object, which are applied over the base metadata at runtime. JDeveloper gives the new metadata file the same name as the base file for the object, but includes an additional `.xml` extension, as Figure 11–2, Figure 11–3, Figure 11–4, and Figure 11–5 show.

Figure 11–2 Customization File for MAF AMX Page

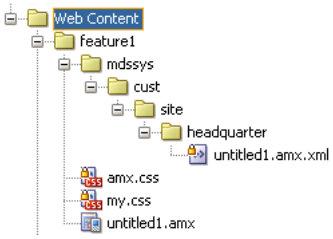


Figure 11–3 Customization File for Task Flow

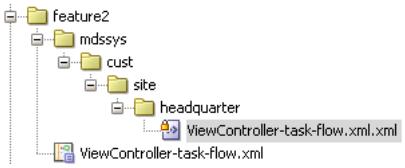


Figure 11–4 Customization File for Page Definition

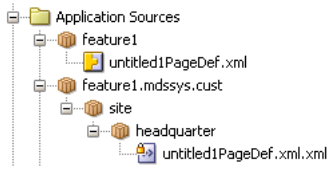
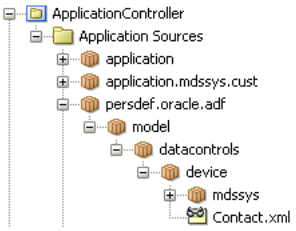


Figure 11–5 Customization File for Data Control XML File



For additional information about customizing web service data controls, see Section 4.14.4, "What You May Need to Know About Web Service Data Controls and Customized Application Deployments."

For information about customizing MAF application-level artifacts, see Section 4.14, "Customizing MAF Files Using Oracle Metadata Services."

11.3 What You May Need to Know About Customization Classes

A customization class evaluates the current context and returns a String result. This String result is used to locate the customization layer.

The customization class provides the following information:

- A name that represents the name of the layer.
- An IDPrefix, for objects created in the layer. When new objects are created in a customization layer, they need a unique ID. The IDPrefix is added to the autogenerated identifier for the object to create an ID for the newly added object. Each layer needs a unique IDPrefix so that objects created at different customization layers have unique IDs.
- A cache hint (`CacheHint`), for the layer defined by the customization class. In MAF, the cache hint defines a static customization layer and the `getCacheHint` method always returns `ALL_USERS` which means the customization is applied globally (unconditionally) for a given deployment.

> **Note:** Since customization classes are likely to be executed frequently, once for each document being accessed to get the layer name and layer value, you should ensure their efficiency.

Customizations can be used to tailor MAF AMX application feature to suit a specific industry domain (verticalization). Each such domain denotes a customization layer and is depicted using a customization class.

11.3.1 What You May Need to Know About the Static Customization Content

Static customizations have only one layer value in effect for all executions of the application. A static customization has the same value for all users executing the application.

In the customization class used in a MAF application, the `getCacheHint` method always returns `ALL_USERS` meaning that the customization layer is always static. For more information about `CacheHint` values, see Section 11.3, "What You May Need to Know About Customization Classes."

All objects could have a static customization layer, depending on how the customization classes are implemented.

11.4 Configuring Customization Layers

To customize an application, you must specify the customization layers and their values in the `CustomizationLayerValues.xml` file so that they are recognized by JDeveloper.

When you open a customizable application in the Customization Developer role, JDeveloper reads the `adf-config.xml` file to determine the customization classes to use and their order of precedence. JDeveloper also reads the `CustomizationLayerValues.xml` file to determine the layer values to make available in the Customization Context window. If there are layer values defined in the `CustomizationLayerValues.xml` file that are not defined in the customization classes listed in the `adf-config.xml` file, they are not displayed in the Customization Context window.

Therefore, you can have a comprehensive list of layer values for all of your customization projects in the `CustomizationLayerValues.xml` file, and only those appropriate for the current application are available in the Customization Context window. Conversely, you could have a comprehensive list of customization classes for a MAF AMX application feature in the `adf-config.xml` file, and only the subset of layer values on which you would work in your `CustomizationLayerValues.xml` file.

Note: At design time, JDeveloper retrieves customization layer values from the `CustomizationLayerValues.xml` file. However, at runtime the layer values are retrieved from the customization class.

The names of the layers and layer values that you enter in the `CustomizationLayerValues.xml` file must be consistent with those specified in your customization classes. Example 11–3 shows the contents of a sample `CustomizationLayerValues.xml` file.

Example 11–3 Layers and Layer Values Defined in CustomizationLayerValues.xml

```
<cust-layers  xmlns="http://xmlns.oracle.com/mds/dt">
   <cust-layer name="industry" id-prefix="i">
      <cust-layer-value value="financial"
                        display-name="Financial"
                        id-prefix="f"/>
      <cust-layer-value value="healthcare"
                        display-name="Healthcare"
                        id-prefix="h"/>
   </cust-layer>
   <cust-layer name="site" id-prefix="s">
      <cust-layer-value value="headquarters"
                        display-name="HQ"
                        id-prefix="hq"/>
      <cust-layer-value value="remoteoffices"
                        display-name="Remote"
                        id-prefix="rm"/>
   </cust-layer>
</cust-layers>
```

For each layer and layer value, you can add an `id-prefix` token. This helps to ensure the uniqueness of the `id`, so that customizations are applied accurately. When you add

a new element (such as a `commandButton`) to a MAF AMX page during customization, JDeveloper adds the `id-prefix` of the layer and layer value (determined by the selected tip layer) to the autogenerated identifier for the element to create an `id` for the newly added element in the customization metadata file. In the preceding example, the site layer has an `id-prefix` of " `s` " and the headquarters layer value has an `id-prefix` of " `hq` ". So, when you select `site/headquarters` as the tip layer and add a Button component to a page, the `commandButton` element will have an `id` of " `shqcb1` " in the metadata customization file.

For each layer value, you can also add a `display-name` token to provide a human-readable name for the layer value. When you are working in the Customization Developer role, the value of the `display-name` token is shown in the Customization Context window for that layer value.

For each layer, you can optionally provide a `value-set-size` token that defines the size of the value set for the customization layer. This can be useful, for example, when using a design-time, application-specific `CustomizationLayerValues.xml` file. By setting `value-set-size` to `no_values` you can exclude runtime-only layers at design time.

```
<cust-layer name="runtime_only_layer" value-set-size="no_values"/>
```

You can define the customization layer values either globally for JDeveloper or in an application-specific file. If you use an application-specific file, it takes precedence over the global file. For more information on configuring layer values globally for JDeveloper, see Section 11.4.1, "How to Configure Layer Values Globally." For more information on configuring application-specific layer values, see Section 11.4.2.1, "Using the Studio Developer Role."

11.4.1 How to Configure Layer Values Globally

Before you begin:

- Create your customization classes, as described in Section 11.3, "What You May Need to Know About Customization Classes"
- Make your classes available to JDeveloper, as described in Section 11.5.1, "How to Make Customization Classes Available to JDeveloper at Design Time"

To configure design time customization layer values globally for JDeveloper:

1. Open the `CustomizationLayerValues.xml` file located in the `jdev` subdirectory of your JDeveloper installation directory (`jdev_install\jdev\CustomizationLayerValues.xml`).
2. For each layer, enter a `cust-layer` element, as shown in Example 11–3, "Layers and Layer Values Defined in CustomizationLayerValues.xml".
3. For each layer value, enter a `cust-layer-value` element, as shown in Example 11–3, "Layers and Layer Values Defined in CustomizationLayerValues.xml".
4. Save and close the `CustomizationLayerValues.xml`file.
5. After you have made changes to the global `CustomizationLayerValues.xml` file, restart JDeveloper.

11.4.2 How to Configure Workspace-Level Layer Values

When configuring layer values for an application, you can use either the Studio Developer role (see Section 11.4.2.1, "Using the Studio Developer Role") or the Customization Developer role (see Section 11.4.2.2, "Using the Customization Developer Role"). Note that when you configure an application-specific `CustomizationLayerValues.xml` file, you can create and modify layer values, but you cannot create additional customization layers. It is not necessary to restart JDeveloper to pick up changes made to the application-specific layer values.

When you create an application-specific `CustomizationLayerValues.xml` file, JDeveloper stores it in an application-level directory (for example, `workspace-directory\.mds\dt\customizationLayerValues\CustomizationLayerValues.xml`). You can access this file in the Application Resources window of the Applications window, under the **MDS DT** node.

11.4.2.1 Using the Studio Developer Role

The following procedure describes how to configure the `CustomizationLayerValues.xml` file for a specific application from the Studio Developer role.

Before you begin:

- Create your customization classes, as described in Section 11.3, "What You May Need to Know About Customization Classes"
- Make your classes available to JDeveloper, as described in Section 11.5.1, "How to Make Customization Classes Available to JDeveloper at Design Time"

To configure design-time customization layer values at the workspace level from the Studio Developer role:

1. In the Application Resources window, expand the **Descriptors > ADF META-INF** node, and then double-click **adf-config.xml**.
2. In the Overview editor, click the **MDS Configuration** navigation tab.
3. On the MDS Configuration page, below the table of customization classes, click **Configure Design Time Customization Layer Values** to open the workspace-level `CustomizationLayerValues.xml` file in the Source editor.

   Note: If the override file does not exist, JDeveloper displays a confirmation dialog. Click **Yes** to create and open a copy of the global file.

4. In the file, specify layer values as necessary, as described in Section 11.4, "Configuring Customization Layers."
5. Save your changes.

11.4.2.2 Using the Customization Developer Role

The following procedure describes how to configure the `CustomizationLayerValues.xml` file for a specific application from the Customization Developer role.

Before you begin:

- Create your customization classes, as described in Section 11.3, "What You May Need to Know About Customization Classes"
- Make your classes available to JDeveloper, as described in Section 11.5.1, "How to Make Customization Classes Available to JDeveloper at Design Time"

To configure design-time customization layer values at the workspace level from the Customization Developer role:

1. In the Customization Context window, click **Configure application layer values** to open the `CustomizationLayerValues.xml` file in the Source editor.

   Note: If the override file does not exist, JDeveloper displays a confirmation dialog. Click **Yes** to create and open a copy of the global file.

2. In the file, specify layer values as necessary, as described in Section 11.4, "Configuring Customization Layers."
3. Save your changes.

After you make changes to the application-specific `CustomizationLayerValues.xml` file while you are in the Customization Developer role, any tip layer you have selected in the Customization Context window is deselected. You can then select the desired tip layer.

11.5 Consuming Customization Classes

After you have created your customization classes, you can use them at design time in the Customization Developer role, as well as at runtime in the application. To be consumed in an application or in JDeveloper, the classes must be packaged appropriately.

11.5.1 How to Make Customization Classes Available to JDeveloper at Design Time

After you create the customization classes, you must make them available to JDeveloper so that you can use them when implementing customizations while working in the Customization Developer role.

Because the customization classes are reusable components, you can create a separate project to contain them and package them into their own JAR file. You can then import the JAR into the consuming application, which makes the customization classes available to JDeveloper.

Note: This procedure is not required if you created your customization classes in the data model project of the consuming application.

Use the following procedure to make the customization classes visible to the application, and then add the customization classes to the `cust-config` section of the `adf-config.xml` file, as described in Section 11.6, "Configuring the adf-config.xml File."

Before you begin:

- Create your customization classes in an external project, as described in Section 11.2, "Customizing MAF AMX Pages and Artifacts."
- Create a JAR file that includes the customization classes.
- Launch JDeveloper using the Studio Developer role, and open the application that you want to customize.

To use customization classes from an external project:

1. In the Applications window, click the Application Menu icon and select **Application Properties.**
2. In the Application Properties dialog, select **Libraries and Classpath**, and click **Add JAR/Directory**.
3. In the **Add Archive or Directory** dialog, select the JAR file you created that contains the customization classes, and click Open.
4. Click OK.

Upon completion, the customization classes are available to JDeveloper for customization and for running your project locally in JDeveloper. They will also be packaged to the EAR class path when you package the application.

11.6 Configuring the adf-config.xml File

The application's `adf-config.xml` file must have an appropriate `cust-config` element in the `mds-config` section. The `cust-config` element allows clients to define an ordered and named list of customization classes. You use the Overview editor for the `adf-config.xml` file to add customization classes (see Figure 11–6).

Before you begin:

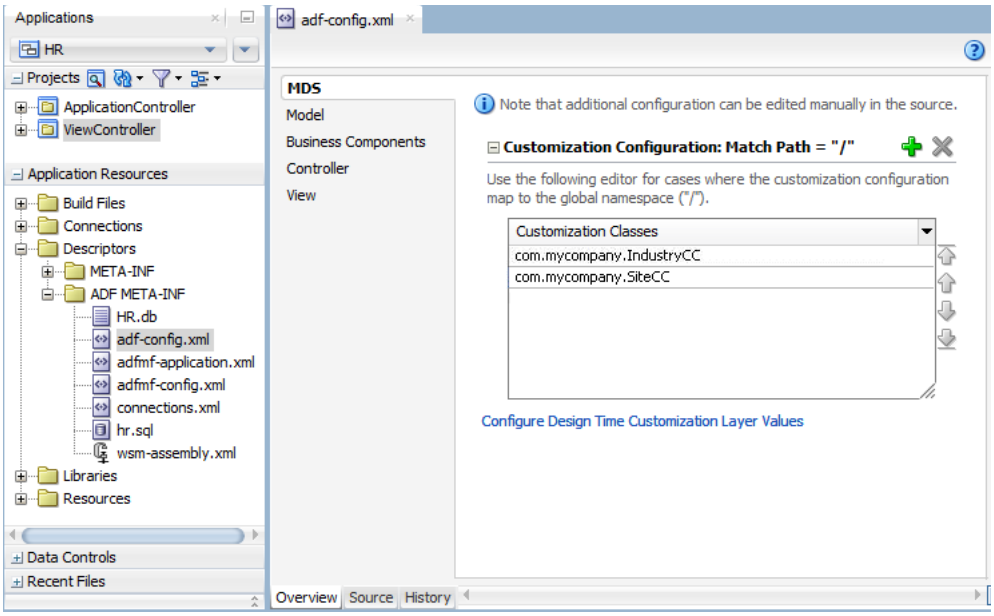
- Create your customization classes in an external project, as described in Section 11.2, "Customizing MAF AMX Pages and Artifacts."
- Create a JAR file that contains the customization classes.
- Make your classes available to JDeveloper, as described in Section 11.5.1, "How to Make Customization Classes Available to JDeveloper at Design Time."
- Launch JDeveloper using the Studio Developer role, and open the application that you want to customize.

To identify customization classes in the adf-config.xml file:

1. In the Application Resources window, expand the **Descriptors > ADF META-INF** nodes, and then double-click **adf-config.xml.**
2. In the Overview editor, select **MDS** navigation tab and then click the **Add** (+).
3. In the Edit Customization Class dialog, search for or navigate to the customization classes you have already created.
4. Select the appropriate classes and click OK.
5. After you have added all of the customization classes, you can use the arrow icons to arrange them in the appropriate order.

Figure 11–6 shows the Overview editor for the `adf-config.xml` file with two customization classes added.

Figure 11–6 adf-config.xml Overview Editor



The order of the `customization-class` elements defines the precedence of customization layers. For example, in the code shown in Example 11–4, the `IndustryCC` class is listed before the `SiteCC` class. This means that customizations at the industry layer are applied to the base application, and then customizations at the site layer are applied.

Example 11–4 Customization Class Order in the adf-config.xml File

```
<adf-config xmlns="http://xmlns.oracle.com/adf/config">
   <adf-mds-config xmlns="http://xmlns.oracle.com/adf/mds/config">
      <mds-config xmlns="http://xmlns.oracle.com/mds/config" version="11.1.1.000">
         <cust-config>
            <match path="/">
               <customization-class name="com.mycompany.IndustryCC"/>
               <customization-class name="com.mycompany.SiteCC"/>
            </match>
         </cust-config>
      </mds-config>
   </adf-mds-config>
</adf-config>
```

11.7 What You May Need to Know About the Customization Developer Role

In JDeveloper, the Customization Developer role is used to customize the metadata in a project. Customization features are available only in this role. When working in a Customization Developer role, you can do the following:

- Create and update customizations.
- Select and edit the tip layer of a customized application.
- Remove existing customizations.

When you use JDeveloper in the Customization Developer role, the Source editor is read-only and the following JDeveloper features are disabled:

- Workspace migration.
- Creation, deletion, and modification of application and IDE connections. You must configure connections in Default role before opening an application in Customization Developer role.

When working with an application in the Customization Developer role, new objects cannot be created, and noncustomizable objects cannot be modified. In addition, you cannot edit noncustomizable files, such as Java classes, resource bundles, security policies, deployment descriptors, and configuration files.

> **Note:** Noncustomizable files are indicated by a lock icon when you are working in the Customization Developer role.

You are also restricted from modifying project settings and customizing certain ADF Business Components features, including service interfaces and business event definitions. Additionally, you cannot refactor, or make changes to customizable files that would, in turn, necessitate changes in noncustomizable files.

11.7.1 How to Switch to the Customization Developer Role in JDeveloper

The customization features of JDeveloper are available to you in the Customization Developer role. To work in this role, you can either choose it when you start JDeveloper or, if JDeveloper is already running, you can use the Switch Roles menu to switch to the Customization Developer role.

To switch to the Customization Developer role in JDeveloper:

From the main menu in JDeveloper, choose **Tools > Switch Roles > Customization Developer**.

Optionally, you can toggle the **Tools > Switch Roles > Always Prompt for Role Selection at Startup** menu to specify whether or not you want to choose the role when JDeveloper is launched. If deselected, JDeveloper launches in the role in which it was when you last closed it.

11.7.2 What You May Need to Know About the Tip Layer

When working in the Customization Developer role, the layer and layer value combination that is selected in the Customization Context window is called the tip layer. The changes you make while in the Customization Developer role are applied to this layer.

> **Note:** When working in the Customization Developer role, if the Customization Context window is not displayed, you can access it from JDeveloper's Window menu.

The metadata displayed in the JDeveloper editors is a combination of the base metadata and the customization layers up to and including the tip layer, according to the precedence set in `adf-config.xml`, with the values specified in the Customization Context window for each layer.

When working in the Customization Developer role, you can also see the noncustomized state of the application. When you select **View without Customizations** in the Customization Context window, there is no current tip layer.

Therefore, what you see is the noncustomized state. While you are in this view, all customizable files show the lock icon (in the Applications window), indicating that these files are read-only.

When you make customizations in a tip layer, these customizations are indicated by an orange icon in the Properties window. A green icon indicates non-tip layer customizations. When you see an orange icon beside a property, you have the option of deleting that customization by choosing Remove Customization from the dropdown menu for that property.

12

Creating Custom MAF AMX UI Components

This chapter describes how to create custom MAF AMX UI components and specify them as part of the development environment.

This chapter includes the following sections:

- Section 12.1, "Introduction to Creating Custom UI Components"
- Section 12.2, "Using MAF APIs to Create Custom Components"
- Section 12.3, "Creating Custom Components"

12.1 Introduction to Creating Custom UI Components

Using a combination of JavaScript and APIs provided by MAF, you can create new, fully functional interactive UI components and add them to a tag library to be used in your MAF AMX application feature.

12.2 Using MAF APIs to Create Custom Components

MAF provides the following APIs for creating custom components:

- Static APIs (see Section 12.2.1, "How to Use Static APIs")
- `AmxEvent` Classes (see Section 12.2.2, "How to Use AmxEvent Classes")
- `TypeHandler` (see Section 12.2.3, "How to Use the TypeHandler")
- `AmxNode` (see Section 12.2.4, "How to Use the AmxNode")
- `AmxTag` (see Section 12.2.5, "How to Use the AmxTag")
- `VisitContext` (see Section 12.2.6, "How to Use the VisitContext")
- `AmxAttributeChange` (see Section 12.2.7, "How to Use the AmxAttributeChange")
- `AmxDescendentChanges` (see Section 12.2.8, "How to Use the AmxDescendentChanges")
- `AmxCollectionChange` (see Section 12.2.9, "How to Use the AmxCollectionChange")
- `AmxNodeChangeResult` (see Section 12.2.10, "How to Use the AmxNodeChangeResult")
- `AmxNodeStates` (see Section 12.2.11, "How to Use the AmxNodeStates")
- `AmxNodeUpdateArguments` (see Section 12.2.12, "How to Use the AmxNodeUpdateArguments")

12.2.1 How to Use Static APIs

Table 12–1 lists static APIs that you can use to create custom UI components.

Table 12–1 Static APIs

Return Type	Function Name	Parameters	Description

`Function`	`adf.mf.api.amx.TypeHandler.register`	`String namespaceUrl,`
		`String tagName,`
		`adf.mf.api.amx.TypeHandler precreatedClass`
			Registers a `TypeHandler` class with a tag namespace and name.
			Returns the registered `adf.mf.api.amx.TypeHandler` subclass so that prototype functions can be added.
			The `precreatedClass` is optional but can be used if you first create a class that inherits from `adf.mf.api.amx.TypeHandler`.

`void`	`adf.mf.api.amx.addBubbleEventListener`	`Node domNode,`
		`String eventType,`
		`Function listener,`
		`Object eventData`
			Registers a bubble event listener (such as tap, taphold, keydown, touchstart, touchmove, touchend, focus, blur, resize, and so on).
			Note that web browsers do not support all event types on all DOM nodes (see the browser documentation for details).
			The `eventData` is optional and serves as extra data to be made available to the listener function.

`void`	`adf.mf.api.amx.removeBubbleEventListener`	`Node domNode,`
		`String eventType,`
		`Function listener`
			Unregisters a bubble event listener that was added through `adf.mf.api.amx.addBubbleEventListener`.
			Note that the removal of the meta events tap and taphold will cause all touchstart and touchend listeners, including those of other meta events, to become removed from the element as opposed to only the specified listener being removed.

Table 12–1 (Cont.) Static APIs

Return Type	Function Name	Parameters	Description

`void`	`adf.mf.api.amx.addDragListener`	`Node domNode,`
		`Object payload,`
		`Object eventData`
			Allows an element to trigger MAF AMX drag events.
			The `Object payload` defines three member functions: `start`, `drag`, `end`. The first parameter of each function is the DOM event, the second parameter is a `dragExtra Object` with the following members:
			■ `eventSource`: the DOM event source.
			■ `pageX`: the `x` coordinate of the event.
			■ `pageY`: the `y` coordinate of the event.
			■ `startPageX`: the original `pageX`.
			■ `startPageY`: the original `pageY`.
			■ `deltaPageX`: the change in `pageX`.
			■ `deltaPageY`: the change in `pageY`.
			■ `originalAngle`: if defined, it is the original angle of the drag in degrees where 0 degrees is East, 90 is North, -90 is South, 180 is West.
			and the following modifiable member flags:
			■ `preventDefault`
			■ `stopPropagation`
			The `eventData` is optional and serves as extra data to be made available to the listener functions.

`void`	`adf.mf.api.amx.removeDomNode`	`Node domNode`	Removes a DOM node and its children, but prior to that removes event listeners added through `adf.mf.api.amx.addBubbleEventListener`.
void	`adf.mf.api.amx.emptyHtmlElement`	`Node domNode`	Empties an HTML element by removing children DOM nodes and calling `adf.mf.api.amx.removeDomNode` on each of the children nodes.

Table 12–1 (Cont.) Static APIs

Return Type	Function Name	Parameters	Description
void	adf.mf.api.amx.processAmxEvent	adf.mf.api.amx.AmxNode amxNode, String amxEventType, String attributeValueName, String newValue, AmxEvent amxEvent, Function finishedCallback	Processes an AmxEvent. Change the value if attributeValueName is defined, process the appropriate setPropertyListener and actionListener subtags, and then process the [amxEventType]Listener attribute. If a finished callback is provided, it will be invoked once the event is processed.
void	adf.mf.api.amx.acceptEvent	None	Determines whether it is safe to proceed with invoking adf.mf.api.amx.processAmxEvent in order to avoid preparing anything you might need to pass into that function (for example, when in the middle of a page transition or in an environment such as a design-time preview).
void	adf.mf.api.amx.invokeEl	String expression, Array<String> params, String returnType, Array<String> paramTypes, Function successCallback, Function failureCallback	Represents a utility similar to adf.mf.el.invoke() for invoking an EL method, with a difference that it refrains from execution in environments such as design-time previews.
void	adf.mf.api.amx.enableAmxEvent	adf.mf.api.amx.AmxNode amxNode, Node domNode, String eventType	Allows a DOM node to trigger custom MAF AMX events such as tapHold and swipe for amx:showPopupBehavior, amx:setPropertyListener, and so on.
void	adf.mf.api.amx.doNavigation	String outcome	Tells the controller that there is an intention to perform navigation for a given outcome.
void	adf.mf.api.amx.validate	Node domNode, Function successCallback	Prevents an operation, such as navigation, when there are unsatisfied validators (required or amx:validationBehavior). The successCallback is invoked if allowed to proceed.

Table 12–1 (Cont.) Static APIs

Return Type	Function Name	Parameters	Description
`void`	`adf.mf.api.amx.showLoadingIndicator`	`Number failSafeDuration`, Function failSafeClientHandler	Shows the busy indicator. The parameters: ■ failSafeDuration: The approximate duration (non-negative integer in milliseconds) that MAF waits between showing and hiding the loading indicator (assuming some other trigger has not already shown the indicator). If this parameter is not specified or is set to `null`, then MAF uses the value of 10000 (10 seconds). ■ failSafeClientHandler: The optional JavaScript function that is invoked when the `failSafeDuration` has been reached. This function can be used to decide how to proceed. This function must return a `String` defined by one of the following values: - `hide`: to hide the indicator as in the default fail-safe. - `repeat`: to restart the timer for another duration where the function may get invoked again. - `freeze`: to keep the indicator up and wait indefinitely; the page may become stuck in a frozen state until restarted. To prevent the indicator from being displayed for longer than necessary, hide it.
`void`	`adf.mf.api.amx.hideLoadingIndicator`	None	Hides one instance of the loading indicator.
`Object`	`adf.mf.api.amx.createIterator`	`Object dataItems`	Creates an iterator that supports either a JavaScript array of objects or iterator over a tree node iterator (collection model). Returns an iterator `Object` with `next`, `hasNext`, and `isTreeNodeIterator` functions where `next` returns undefined if no more objects are available.

Table 12–1 (Cont.) Static APIs

Return Type	Function Name	Parameters	Description

`void`	`adf.mf.api.amx.bulkLoadProviders`	`Object treeNodeIterator,`
		`Number startingPoint,`
		`Number maximumNumberOfRowsToLoad,`
		`Function successCallback,`
		`Function failCallback`
			Bulk-loads a set of data providers so they are cached and are locally accessible.

`String`	`adf.mf.api.amx.buildRelativePath`	`String url`	Builds the relative path based on the specified resource assuming it is relative to the current MAF AMX page. If there is a protocol on the resource, then it is assumed to be an absolute path and left unmodified.
`void`	`adf.mf.api.amx.markNodeForUpdate`	`adf.mf.api.amx.AmxNodeUpdateArguments args`	Function for `TypeHandler` instances to notify MAF of a state change to an `AmxNode` that requires the `AmxNode` hierarchy to be updated at that node and below. If a custom `createChildrenNodes` method exists on the `TypeHandler`, it is called again for these `AmxNode` instances. This allows `AmxNode` instances that stamp their children to add new stamps due to a user change. The `refresh` method is called on the `AmxNode` with the provided properties if the `AmxNode` is ready to render. If the `AmxNode` is not ready to render, MAF waits for any EL to be resolved and the `refresh` method is called once all the data are available.

Note: Other public APIs are available in the `adf.mf.el` package for logging, translation, and data channel.

12.2.2 How to Use AmxEvent Classes

Table 12–2 lists `AMXEvent` classes that you can use when creating custom UI components.

Table 12–2 AMXEvent Classes

Class Name	Parameters	Description
`adf.mf.api.amx.ActionEvent`	None	An event triggering an outcome-based navigation. See also `oracle.adfmf.amx.event.ActionEvent` in *Oracle Fusion Middleware Java API Reference for Oracle Mobile Application Framework*.
`adf.mf.api.amx.MoveEvent`	`Object rowKeyMoved,` `Object rowKeyInsertedBefore`	An event for notifying that a specified row has been moved. It contains the key for the row that was moved along with the key for the row before which it was inserted. See also `oracle.adfmf.amx.event.MoveEvent` in *Oracle Fusion Middleware Java API Reference for Oracle Mobile Application Framework*.
`adf.mf.api.amx.SelectionEvent`	`Object oldRowKey,` `Array<Object> selectedRowKeys`	An event for changes of selection for a component. See also `oracle.adfmf.amx.event.SelectionEvent` in *Oracle Fusion Middleware Java API Reference for Oracle Mobile Application Framework*.
`adf.mf.api.amx.ValueChangeEvent`	`Object oldValue,` `Object newValue`	An event for changes of value for a component. See also `oracle.adfmf.amx.event.ValueChangeEvent` in *Oracle Fusion Middleware Java API Reference for Oracle Mobile Application Framework*.

12.2.3 How to Use the TypeHandler

Table 12–3 lists `TypeHandler` APIs that you can use to create custom UI components.

Table 12–3 TypeHandler APIs

Return Type	Function Name	Parameters	Description
`HTMLElement`	`render`	`adf.mf.api.amx.AmxNode amxNode,` `String id`	Creates an initial DOM structure and returns the root element of the structure. This member function is required and must be defined.
`void`	`init`	`HTMLElement rootElement,` `adf.mf.api.amx.AmxNode amxNode`	Represents the handler invoked after all `create` functions that belong to the set of components created with this component are invoked.
`void`	`postDisplay`	`HTMLElement rootElement,` `adf.mf.api.amx.AmxNode amxNode`	Represents the handler invoked after all `init` functions that belong to the set of components created with this component are invoked.

Table 12–3 (Cont.) TypeHandler APIs

Return Type	Function Name	Parameters	Description
`Boolean`	`createChildrenNodes`	`adf.mf.api.amx.AmxNode amxNode`	Selectively adds `AmxNode` children for processing. Note that if one of the children is shown, the use of this function prevents processing of the other children. Should return `false` if MAF is to create the children nodes instead of the custom implementation. This function is optional.
`adf.mf.api.amx.AmxNodeChangeResult`	`updateChildren`	`adf.mf.api.amx.AmxNode amxNode,` `adf.mf.api.amx.AmxAttributeChange attributeChanges`	Represents a handler for one of the following: ■ removing any old children and creating and adding any new children to the `AmxNode`. ■ through the return value, declaring what `adf.mf.api.amx.AmxNodeChangeResult` action should be taken. This function is optional.
`adf.mf.api.amx.AmxNodeChangeResult`	`getDescendentChangeAction`	`adf.mf.api.amx.AmxNode amxNode,` `adf.mf.api.amx.AmxDescendentChanges descendentChanges`	Allows a type handler to customize the handling of changes to descendent `AmxNode` instances.
`void`	`refresh`	`adf.mf.api.amx.AmxAttributeChange attributeChanges,` `adf.mf.api.amx.AmxDescendentChanges descendentChanges`	Allows a type handler to selectively refresh the HTML in response to a change. This method is called after the `updateChildren` method. The `attributeChanges` defines the changed attributes. If `descendentChanges` is not `null`, it defines the changes for any descendent nodes that need to be refreshed.
`Boolean`	`isFlattenable`	None	Declares whether or not the `AmxNode` is flattenable. Note that a flattened AmxNode might not have any behavior related to rendering: a type handler for a flattened AmxNode can only control child node creation and visiting, but cannot influence rendering.

Table 12–3 (Cont.) TypeHandler APIs

Return Type	Function Name	Parameters	Description
Boolean	visit	adf.mf.api.amx.VisitContext visitContext, Function visitCallback	Handles an AmxNode tree visitation starting from this AmxNode. The visitCallback function to invoke when visiting uses parameters visitContext and AmxNode. Returns whether or not the visitation is complete and should not continue.
Boolean	visitChildren	adf.mf.api.amx.AmxNode amxNode, adf.mf.api.amx.VisitContext visitContext, Function visitCallback	Handles an AmxNode tree visitation starting from the children of this AmxNode. The visitCallback function to invoke when visiting uses parameters visitContext and AmxNode. Returns whether or not the visitation is complete and should not continue.
void	preDestroy	HTMLElement rootElement, adf.mf.api.amx.AmxNode amxNode	Handles anything just before the current view is destroyed; when about to navigate to a new view. Typically used to save client state such as scroll positions (see adf.mf.api.amx.setClientState).
void	destroy	HTMLElement rootElement, adf.mf.api.amx.AmxNode amxNode	Handles anything after the new view is displayed and the old view is being removed.

12.2.4 How to Use the AmxNode

Table 12–4 lists AmxNode APIs that you can use to create custom UI components.

Table 12–4 AmxNode APIs

String	Function Name	Parameters	Description
String	getId	None	Gets the unique identifier for this AmxNode. This value contributes to the ID on the root DOM element.
adf.mf.api.amx.AmxTag	getTag	None	Gets the AmxTag that created this AmxNode.
adf.mf.api.amx.TypeHandler	getTypeHandler	None	Gets the TypeHandler object associated with this AmxNode.

Table 12–4 (Cont.) AmxNode APIs

String	Function Name	Parameters	Description
`void`	`setClientState`	`Object payloadJsonObject`	Stores or replaces the client state for the specified `AmxNode` ID. Type handlers should call this function whenever a state change happens (for example, something that should be cached so that when the user navigates to a new page and then comes back, it would be restored like a scroll position). That said, it is not always feasible to detect when a state change happens so you may need to update the state for your component just before the view is going to be discarded. There are two possible scenarios for which you need to account: 1. `refresh`: for redrawing pieces of the DOM structure (within the same view). 2. `preDestroy`: for navigating to a new view and later navigating back. The `payloadJsonObject` is the client state data to store for the lifetime of this view instance.
`Object`	`getClientState`	None	Gets the `payloadJsonObject` that was previously stored through the `setClientState` function during this view instance (undefined if not available).
`void`	`setVolatileState`	`Object payloadJsonObject`	Stores or replaces the client state for the specified `AmxNode` ID. Type handlers should call this function whenever a volatile state change happens (for example, something that should be forgotten when navigating to a new MAF AMX page but should be kept in case a component is redrawn). The `payloadJsonObject` is the volatile state data to store until navigation occurs.
`Object`	`getVolatileState`	None	Gets the `payloadJsonObject` that was previously stored through the `setVolatileState` function since the last navigation (undefined if not available).
`Object`	`getConverter`	None	Get the converter, if applicable, for this `AmxNode`.
`void`	`setConverter`	`Object converter`	Set the converter for this `AmxNode`.

Table 12–4 (Cont.) AmxNode APIs

String	Function Name	Parameters	Description
`String`	`storeModifyableEl`	`String nameOfTheAttribute`	For an attribute, creates and stores an EL expression that may be used to set EL values into the model. The value is context-insensitive and may be used to set a value at any time. Common use is to set a value based on user interaction. This function may be called by type handlers. Returns `null` if the subject attribute is not bound to an EL value.
`Object`	`getStampKey`	None	Gets the stamp key for the `AmxNode`. The stamp key identifies `AmxNode` instances that are produced inside of iterating containers. This is provided by the parent `AmxNode`. An example tag that uses stamp keys is the `amx:iterator` tag. Returns `null` if the `AmxNode` is not stamped.
`Array<String>`	`getDefinedAttributeNames`	None	Gets a list of the attribute names that have been defined for this node.
`Object`	`getAttribute`	`String name`	Gets an attribute value for the attribute of the given name. Return value may be `null`. Returns undefined if the attribute is not set or is not yet loaded.
`void`	`setAttributeResolvedValue`	`String name,` `Object value`	Used by the type handler or MAF to store the attribute value for an attribute onto the `AmxNode`. This function does not update the model.
`void`	`setAttribute`	`String name,` `String value`	Sets the value of an attribute on the model. This value is sent to the Java side to update the EL value. The value on the `AmxNode` is not updated by this call. Instead, it is expected that a data change event will update the `AmxNode`.
`Boolean`	`isAttributeDefined`	`String name`	Checks whether the attribute was defined by the user.
`adf.mf.api.amx.AmxNode`	`getParent`	None	Gets either the parent `AmxNode` or `null` if at the top level.

Table 12–4 (Cont.) AmxNode APIs

String	Function Name	Parameters	Description
`void`	`addChild`	`adf.mf.api.amx.AmxNode child,` `String facetName`	Adds a child `AmxNode` to this `AmxNode`. The `facetName` should be `null` if the child does not belong in a facet.
`Boolean`	`removeChild`	`adf.mf.api.amx.AmxNode child`	Removes a child `AmxNode` from this `AmxNode`. Note that the child is removed from the hierarchy, but not the DOM for it. It is up to the caller to remove the DOM. This is to allow type handlers to handle animation and other transitions when DOM is replaced. Returns whether or not the child was found and removed.
`Boolean`	`replaceChild`	`adf.mf.api.amx.AmxNode oldChild,` `adf.mf.api.amx.AmxNode newChild`	Replaces an existing child with another child. Returns whether or not the old one was found and replaced.
`Array<adf.mf.api.amx.AmxNode>`	`getChildren`	`String facetName,` `Object stampKey`	Gets children `AmxNodes`. The two parameters are optional. The `facetName` can be `null` to get the non-facet children. Returns an empty array if no children exist or if there are no children for the given qualifiers.
`Map<String, Array<adf.mf.api.amx.AmxNode>>`	`getFacets`	`Object stampKey`	Gets all of the facets of the `AmxNode`. The `stampKey` is optional; if provided, it retrieves the facet `AmxNode` instances for a given stamp key.
`Boolean`	`visit`	`adf.mf.api.amx.VisitContext visitContext,` `Function visitCallback`	Performs a tree visitation starting from this `AmxNode`. The `visitCallback` function should accept the `visitContext` and the `AmxNode` as arguments. Returns whether or not the visitation is complete and should not continue.
`Boolean`	`visitChildren`	`adf.mf.api.amx.VisitContext visitContext,` `Function visitCallback`	Performs a tree visitation starting from the children of this `AmxNode`. The `visitCallback` function should accept the `visitContext` and the `AmxNode` as arguments. Returns whether the visitation is complete and should not continue.

Table 12–4 (Cont.) AmxNode APIs

String	Function Name	Parameters	Description

`Boolean`	`visitStampedChildren`	`Object stampKey,`
		`Array<String> facetNamesToInclude,`
		`Function filterCallback,`
		`adf.mf.api.amx.VisitContext visitContext,`
		`Function visitCallback`
			Convenience function for type handlers that stamp their children to visit the children `AmxNode` from inside of a custom `visitChildren` function.
			When `facetNamesToInclude` is empty, no facets are processed for this stamp. When `facetNamesToInclude` is `null`, all facets are processed for this stamp.
			The `filterCallback` may be `null`. The `filterCallback` must return a `Boolean` of `true`, meaning the tag will be used to create children, or `false`, meaning the tag will not be processed.
			The `visitCallback` should accept the `visitContext` and `AmxNode` as arguments.
			Returns whether or not the visitation is complete and should not continue.

`Array<adf.mf.api.amx.AmxNode>`	`getRenderedChildren`	`String facetName,` `Object stampKey`	Gets the rendered children of the `AmxNode`. The `facetName` indicates from which facet to retrieve the rendered children, or `null` for the non-facet children. If the `stampKey` is provided, it retrieves the children `AmxNode` instances for a given stamp key. Returns the children that should be rendered for the given stamp key. It flattens any components that can be flattened (flattenable) and does not return any non-rendered ones.
`Boolean`	`isFlattenable`	None	Determines whether or not the `AmxNode` is flattenable. Note that a flattened AmxNode might not have any behavior related to rendering: a type handler for a flattened AmxNode can only control child node creation and visiting, but cannot influence rendering.
`adf.mf.api.amx.AmxNodeStates`	`getState`	None	Gets the current state of the `AmxNode` (as a constant value from `adf.mf.api.amx.AmxNodeStates`).

Table 12–4 (Cont.) AmxNode APIs

String	Function Name	Parameters	Description
`void`	`setState`	`state`	Moves the `adf.mf.api.amx.AmxNodeStates` state of the `AmxNode`. Should only be called by MAF or the `AmxNode`'s type handler.
`HTMLElement`	`render`	None	Renders the `AmxNode`. Returns the root element rendered or `null` if the child is not rendered or if there is no type handler for this `AmxNode`.
`Array<HTMLElement>`	`renderDescendants`	`String facetName,` `Object key`	Renders the subnodes of this `AmxNode` (if applicable, it flattens to the nearest descendant). If `facetName` is not `null`, it renders the children of that facet. If facetName is `null`, the non-facet children are rendered. The optional key is used for rendering the children `AmxNode` instances for that stamping key. Returns an array of the root elements for each `subNode`.
`void`	`rerender`	None	Rerenders the `AmxNode`.

Table 12–4 (Cont.) AmxNode APIs

String	Function Name	Parameters	Description
Boolean	isRendered	None	Checks the state of the AmxNode to see whether or not it should be rendered. The AmxNode is considered to be renderable if it is in the ABLE_TO_RENDER, RENDERED or PARTIALLY_RENDERED state.
void	refresh	adf.mf.api.amx.AmxAttributeChange attributeChanges, adf.mf.api.amx.AmxDescendentChanges descendentChanges	Refreshes the DOM of an AmxNode. This method is called after the updateChildren method and should be implemented by type handlers that wish to update their DOM in response to a change.
void	createStampedChildren	Object stampKey, Array<String> facetNamesToInclude, Function filterCallback	Convenience function for type handlers that stamp their children to create child AmxNode instances from inside of a custom createChildrenNodes function. This function creates children for any UI tags. If facetNamesToInclude is empty, the facets are not processed for this stamp. If facetNamesToInclude is null, all the facets are processed. If the facetNamesToInclude includes a null value inside the array, children for non-facet tags are created. The filterCallback is an optional function to filter the children that are created. The filterCallback function is invoked with the AmxNode, the stampKey, the child tag, and the facet name (or null for non-facets). The filterCallback function must return a boolean. If true, the tag is used to create children; if false, the tag is not processed.

12.2.5 How to Use the AmxTag

Table 12–5 lists AmxTag APIs that you can use to create custom UI components.

Table 12–5

Return Type	Function Name	Parameters	Description
`String`	`getNamespace`	None	Gets the XML namespace URI for the tag.
`String`	`getNsPrefixedName`	None	Returns the tag name including the namespace as its prefix (not the local `xmlns` prefix). This is the full XML name such as `"http://xmlns.example.com/custom:custom"`.
`String`	`getName`	None	Gets the tag name. This is the local XML tag name without the prefix.
`adf.mf.api.amx.AmxTag`	`getParent`	None	Gets the parent tag or `null` if it is the top-level tag.
`String`	`getTextContent`	None	Returns the text content of the tag.
`Array<adf.mf.api.amx.AmxTag>`	`findTags`	`String namespace,` `String tagName`	Recursively searches the tag hierarchy for tags with the given namespace and tag name. Returns the current tag if it matches.
`Array<adf.mf.api.amx.AmxTag>`	`getChildren`	`String namespace,` `String tagName`	Gets the children of the tag. Provides for optional filtering of the children namespaces and tag names. If a namespace is `null`, all the children are returned. If `tagName` is `null`, the children are not filtered by tag name.
`Array<adf.mf.api.amx.AmxTag>`	`getChildrenFacetTags`	None	Get all of the children facet tags. This function is meant to assist the creation of the `AmxNode` process.

Table 12–5 (Cont.)

Return Type	Function Name	Parameters	Description
`adf.mf.api.amx.AmxTag`	`getChildFacetTag`	`String name`	Gets the facet tag with the given name. This function is meant to assist the code if the presence of a facet changes the behavior of a type handler. Returns `null` if the facet is not found.
`Array<adf.mf.api.amx.AmxTag>`	`getChildrenUITags`	None	Gets all children tags that are UI tags. This function is meant to assist in creation of the `AmxNode` process. This function not return any facet tags.
`Array<String>`	`getAttributeNames`	None	Gets all of the attribute names for the attributes that are specified on the tag.
`Boolean`	`isAttributeElBound`	`String name`	Determines whether or not the given attribute is bound to an EL expression (as opposed to a static value).
`String`	`getAttribute`	`String name`	Gets the attribute value (may be an EL string) for the attribute of the given name. Returns undefined if the attribute is not specified.
`Map<String, String>`	`getAttributes`	None	Gets a key-value pair map of the attributes and their values.
`Boolean`	`isUITag`	None	Determines whether or not the node is a UI tag with a type handler and renders content.

Table 12–5 (Cont.)

Return Type	Function Name	Parameters	Description
`Object{name:string, children:Array<adf.mf.api.amx.AmxTag>}`	`getFacet`	None	Gets the tags for the children of this facet and the name of the facet if this tag is a facet tag. This is a convenience function for building the `AmxNode` tree. Returns an object with the name of the facet and the children tags of the facet. Returns `null` if the tag is not an `amx:facet` tag.
`adf.mf.api.amx.AmxNode`	`buildAmxNode`	`adf.mf.api.amx.AmxNode parentNode,` `Object stampKey`	Creates a new instance of an `AmxNode` for this tag given the stamp ID. If the tag is a facet tag, the tag creates an `AmxNode` for the child tag. This function does not initialize the `AmxNode`. Instead, it returns either an uninitialized `AmxNode` or `null` for non-UI tags.
`adf.mf.api.amx.TypeHandler`	`getTypeHandler`	None	Gets the type handler for this tag.

12.2.6 How to Use the VisitContext

Table 12–6 lists `VisitContext` APIs that you can use when creating custom UI components.

Table 12–6 VisitContext APIs

Return Type	Function Name	Parameters	Description
`Boolean`	`isVisitAll`	None	Determines whether or not all nodes should be visited.
`Array<adf.mf.api.amx.AmxNode>`	`getNodesToWalk`	None	Gets the nodes that should be walked during visitation. This list does not necessarily include the nodes that should be visited (callback invoked).
`Array<adf.mf.api.amx.AmxNode>`	`getNodesToVisit`	None	Get the list of nodes to visit.
`Array<adf.mf.api.amx.AmxNode>`	`getChildrenToWalk`	`adf.mf.api.amx.AmxNode parentAmxNode`	Determine which child AmxNode instances, including facets (if any), should be walked of the given parent `AmxNode`. Allows for type handlers to optimize how to walk the children if not all are being walked. May return `null`.

12.2.7 How to Use the AmxAttributeChange

Table 12–7 lists `AmxAttributeChange` APIs that you can use when creating custom UI components.

Table 12–7 AmxAttributeChange APIs

Return Type	Function Name	Parameters	Description
`Array<String>`	`getChangedAttributeNames`	None	Gets the names of the attributes that have been affected during the current change.
`Boolean`	`isCollectionChange`	`String name`	Determines whether the attribute change is a collection change.
`adf.mf.api.amx.AmxCollectionChange`	`getCollectionChange`	`String name`	Gets the collection model change information for an attribute. Returns null if no change object is available.
`String`	`getOldValue`	`String name`	Gets the value of the attribute before the change was made.
`Boolean`	`hasChanged`	`String name`	Determines whether the attribute with the given name has changed.
`Number`	`getSize`	None	Gets the number of attribute changes.

12.2.8 How to Use the AmxDescendentChanges

Table 12–8 lists `AmxAttributeChange` APIs that you can use when creating custom UI components.

Table 12–8 AmxDescendentChanges APIs

Return Type	Function Name	Parameters	Description
`Array<adf.mf.api.amx.AmxNode>`	`getAffectedNodes`	None	Gets the unrendered changed descendent `AmxNode` instances.
`adf.mf.api.amx.AmxAttributeChange`	`getChanges`	`adf.mf.api.amx.AmxNode amxNode`	Gets the changes for a given AmxNode.
`adf.mf.api.amx.AmxNodeStates`	`getPreviousNodeState`	`adf.mf.api.amx.AmxNode amxNode`	Gets the state of the descendent AmxNode before the changes were applied.

12.2.9 How to Use the AmxCollectionChange

Table 12–9 lists `AmxCollectionChange` APIs that you can use when creating custom UI components.

Table 12–9 AmxCollectionChange APIs

Return Type	Function Name	Parameters	Description
`Boolean`	`isItemized`	None	Determines whether or not the change to the collection may be itemized: the keys and elements on that collection were identified, so the `TypeHandler` can update just the appropriate items as opposed to rerendering the entire list from scratch.
`Array<String>`	`getCreatedKeys`	None	Gets either an array of keys that were created, or `null` if the change cannot be itemized.
`Array<String>`	`getDeletedKeys`	None	Gets either an array of the keys that were removed, or null if the change cannot be itemized.
`Array<String>`	`getUpdatedKeys`	None	Gets either an array of the keys that were updated, or null if the change cannot be itemized.
`Array<String>`	`getDirtiedKeys`	None	Gets either an array of the keys that were dirtied, or null if the change cannot be itemized.

12.2.10 How to Use the AmxNodeChangeResult

Table 12–10 lists `AmxNodeChangeResult` APIs that you can use when creating custom UI components.

Table 12–10 AmxNodeChangeResult APIs

Members	Description
adf.mf.api.amx.AmxNodeChangeResult["NONE"]	Takes no action in response to an attribute change on a non-rendered descendent AmxNode.
adf.mf.api.amx.AmxNodeChangeResult["REFRESH"]	The attribute and its child AmxNode instances have been updated by the type handler and the DOM will be updated by the type handler's refresh function.
adf.mf.api.amx.AmxNodeChangeResult["RERENDER"]	The AmxNode and its child AmxNode instances been updated by the type handler, but the DOM should only be recreated as there is no need to modify the AmxNode hierarchy so the refresh function will not be called on the type handler.
adf.mf.api.amx.AmxNodeChangeResult["REPLACE"]	The type handler cannot handle the change. The DOM, as well as the AmxNode hierarchy should be recreated. This value may only be returned from the updateChildren method on a type handler and cannot be returned from the getDescendentChangeAction method.

12.2.11 How to Use the AmxNodeStates

Table 12–11 lists AmxNodeStates APIs that you can use when creating custom UI components.

Table 12–11 AmxNodeStates APIs

Members	Description
adf.mf.api.amx.AmxNodeStates["INITIAL"]	Initial state. The AmxNode has been created but not populated.
adf.mf.api.amx.AmxNodeStates["WAITING_ON_EL_EVALUATION"]	EL-based attributes needed for rendering have not been fully loaded yet.
adf.mf.api.amx.AmxNodeStates["ABLE_TO_RENDER"]	EL attributes have been loaded, but the AmxNode has not yet been rendered.
adf.mf.api.amx.AmxNodeStates["PARTIALLY_RENDERED"]	The EL is not fully loaded, but the AmxNode has partially rendered itself (reserved for future use).
adf.mf.api.amx.AmxNodeStates["RENDERED"]	The AmxNode has been fully rendered.
adf.mf.api.amx.AmxNodeStates["UNRENDERED"]	The AmxNode is not to be rendered.

12.2.12 How to Use the AmxNodeUpdateArguments

Table 12–12 lists AmxNodeUpdateArguments APIs that you can use when creating custom UI components.

Table 12–12 AmxNodeUpdateArguments APIs

Return Type	Function Name	Parameters	Description
`Array<adf.mf.api.amx.AmxNode>`	`getAffectedNodes`	None	Gets an array of affected `AmxNode` instances.
`Map<String,Boolean>`	`getAffectedAttributes`	`String amxNodeId`	Gets an object representing the affected attributes for a given AmxNode ID.
`Map<String,adf.mf.api.amx.AmxCollectionChange>`	`getCollectionChanges`	`String amxNodeId`	Gets the collection changes for a given AmxNode and property. The returned map is keyed by attribute name. Returns undefined if there are no changes for the `AmxNode`.
`void`	`setAffectedAttribute`	`adf.mf.api.amx.AmxNode amxNode,` `String attributeName`	Marks an attribute of an AmxNode as affected.

`void`	`setCollectionChanges`	`String amxNodeId,`
		`String attributeName,`
		`adf.mf.api.amx.AmxCollectionChange collectionChanges`
			Sets the collection changes for a given `AmxNode`'s attribute.

12.3 Creating Custom Components

You can create a custom UI component through the use of JavaScript and MAF APIs. This component's JavaScript file can be added to your project through the application feature-level includes. When you add your custom tag library, it is entered into the Components window's list of tag libraries and, when this library is selected, your custom component becomes available in the Components window, with its attributes displayed in the Properties window.

Before you begin:

Familiarize yourself with APIs described in Section 12.2, "Using MAF APIs to Create Custom Components."

To create a custom component:

1. Produce a JavaScript file that registers a tag namespace and series of one or more type handlers using the `adf.mf.api.amx.TypeHandler.register` API (see Table 12–1, " Static APIs" and Example 12–1, "JavaScript File for Custom Components").
2. For each type handler, implement a rendering member function.
3. Optionally, implement other functions.
4. Attach one or more of your JavaScript and CSS files to the MAF AMX application feature. For examples, see the following sample applications located in the `PublicSamples.zip` file within the *`jdev_install`*`/jdeveloper/jdev/extensions/oracle.maf/Samples` directory on your development computer:
   - `custom.js` and `custom.css` files included in the MAF sample application called CompGallery.

- WorkBetter sample application contains a custom search component.

Alternatively, you can perfrom a design-time packaging.

5. For each MAF AMX page that uses one of the customs components, add an `xmlns` entry in the `view` element:

```
xmlns:custom="http://xmlns.example.com/custom"
```

Example 12–1 shows a JavaScript file that declares custom components.

Example 12–1 JavaScript File for Custom Components

```
(function() {
   // TypeHandler for custom "x" elements
   var x = adf.mf.api.amx.TypeHandler.register("http://xmlns.example.com/custom",
                                               "x");
   x.prototype.render = function(amxNode) {
      var rootElement = document.createElement("div");
      rootElement.appendChild(document.createTextNode("Hello World"));
      return rootElement;
   };

   // TypeHandler for custom "y" elements
   var y = adf.mf.api.amx.TypeHandler.register("http://xmlns.example.com/custom",
                                               "y");

   y.prototype.render = function(amxNode) {
      var rootElement = document.createElement("div");
      rootElement.appendChild(document.createTextNode("Goodbye World"));
      return rootElement;
   };

})();
```

For examples of how to create custom UI components, see the `custom.amx`, `customOther.amx`, `exampleEvents.amx`, and `exampleList.amx` files included in the MAF sample application called CompGallery. The sample applications are located in the `PublicSamples.zip` file within the *`jdev_install`*`/jdeveloper/jdev/extensions/oracle.maf/Samples` directory on your development computer.

Part V

Advanced Topics

Describes how to enable the content derived from remote URLs to access native device controls, how to augment MAF applications with user preference pages, and how setting constraints can determine how MAF applications show or hide content. This part also describes how to enable push notifications.

Part V contains the following chapters:

13

Implementing Application Feature Content Using Remote URLs

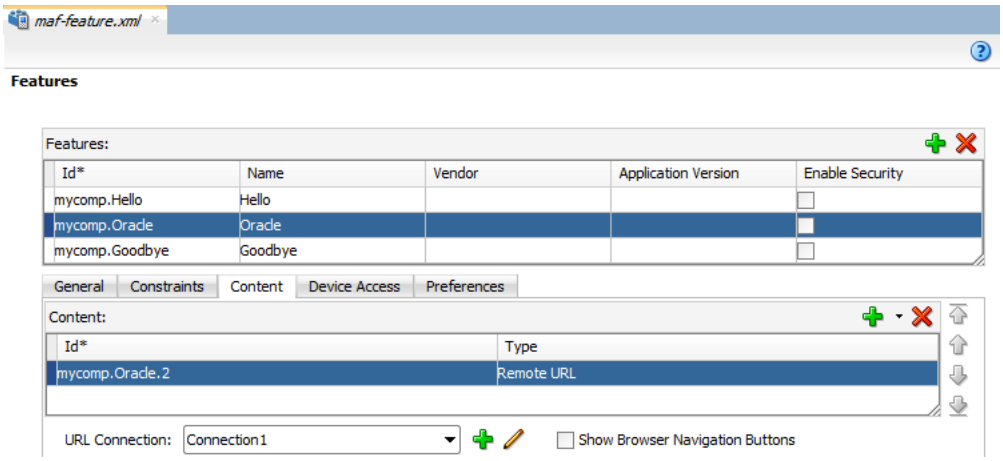
This chapter describes how application features with content from remote URLs can access (or be restricted from) device services.

This chapter includes the following sections:

13.1 Overview of Remote URL Applications

By configuring the content type for an application feature in the overview editor for the `maf-feature.xml` file as **Remote URL**, as shown in Figure 13–1, you create a browser-based application that is served from the configured URL. Such server-hosted applications differ from the client applications written in MAF AMX, local HTML, or a platform-specific language such as Objective-C in that they are intended for occasional use and cannot directly access the device's memory or services (such as the camera, contacts, or GPS). These interactions are instead contingent upon the capabilities of the device's browser. Remote applications that open within the MAF web view, however, access device features using Apache Cordova JavaScript APIs (and the MAF JavaScript API to access the MAF container services). The Apache Cordova JavaScript API libraries are platform-specific, which means you must ensure that the content used for a remote URL application references the Apache Cordova library appropriate to the target platform. See Section B.1, "Using MAF APIs to Create a Custom HTML Springboard Application Feature."

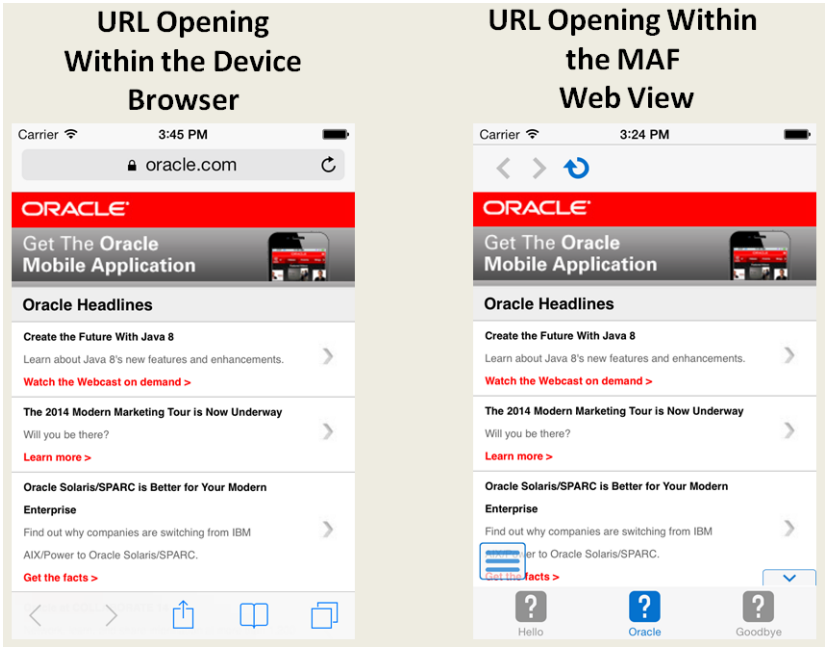
Figure 13–1 Configuring Remote URL Content



13.1.1 Enabling Remote Applications to Access Device Services through Whitelists

To ensure security for remotely served content, MAF supports the concept of whitelists, a registry of URLs that opens within the application web view to access various device services, such as GPS, a camera, or a file system. If a web page is not included on a whitelist (that is, it is not whitelisted), then MAF's Apache Cordova implementation opens a web page in the device browser (such as Safari) instead. Without whitelisting, a remote web page cannot open within the MAF web view, thereby limiting its access to the embedded device capabilities. As illustrated in Figure 13–2, a URL that opens within the MAF web view is presented as an application feature.

Figure 13–2 URLs in the Device Browser and MAF Web View



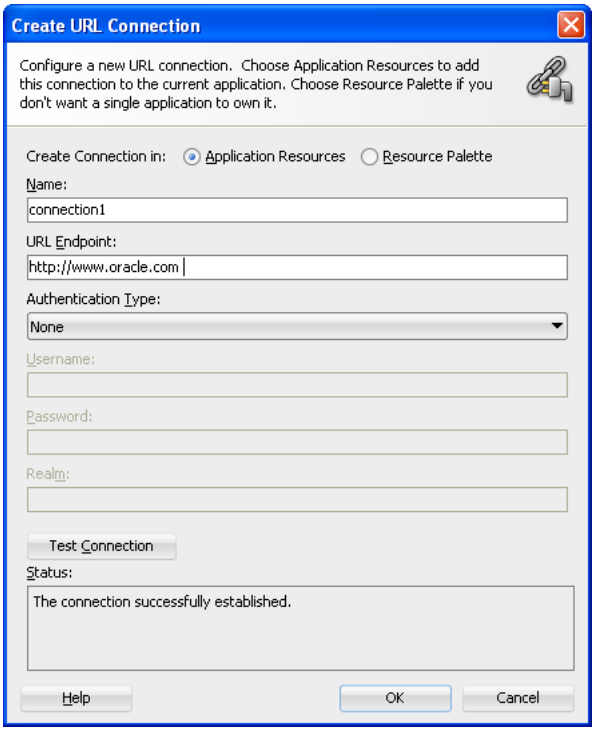
13.1.2 Enabling Remote URL Implementations to Access Apache Cordova

Remote URL implementations use Apache Cordova JavaScript APIs to access device features and the MAF JavaScript API to access the MAF container services. As described in Appendix B, "Local HTML and Application Container APIs," a JavaScript `<script>` tag that references the `www/js/base.js` libraries enables this access. These libraries are platform-specific, meaning that you must ensure that the content used for a remote URL application references the Apache Cordova library appropriate to the target platform. The Apache Cordova JavaScript API libraries are platform-specific, which means you must ensure that the content used for a remote URL application references the Apache Cordova library appropriate to the target platform. See Section B.1, "Using MAF APIs to Create a Custom HTML Springboard Application Feature."

13.1.3 How Whitelisted Domains Access Device Capabilities

By default, the domains defined in the `connections.xml` file (the repository for all of the connections defined in the mobile application) are whitelisted automatically. These domains for the Remote URL content are created using the Create URL Connection dialog, shown in Figure 13–3. MAF parses the domain from each of the connection strings and adds these domains to the whitelist.

Figure 13–3 Creating the Connection to Retrieve the Content of the Remote URL Application Feature



JDeveloper then populates the `connections.xml` file, located in the Application Resources panel, with the connections information and also creates the connection resources.

In addition to the domains that MAF includes from the `connections.xml` file, you can enable (or restrict) remote URL content to open with the MAF web view by configuring the following in the `maf-application.xml` file:

- One or more whitelisted domains
- Device access permissions—As described in Section 21.6, "Allowing Access to Device Capabilities," an application feature only accesses the device capabilities that have been granted at the application level; by default, MAF applications do not allow any access to the Apache Cordova APIs. If an application's user interface is implemented using remotely hosted content, then it can only open within the MAF web view to access device features and services if the `maf-application.xml` file's configuration includes the `access="true"` definition for the requested API.

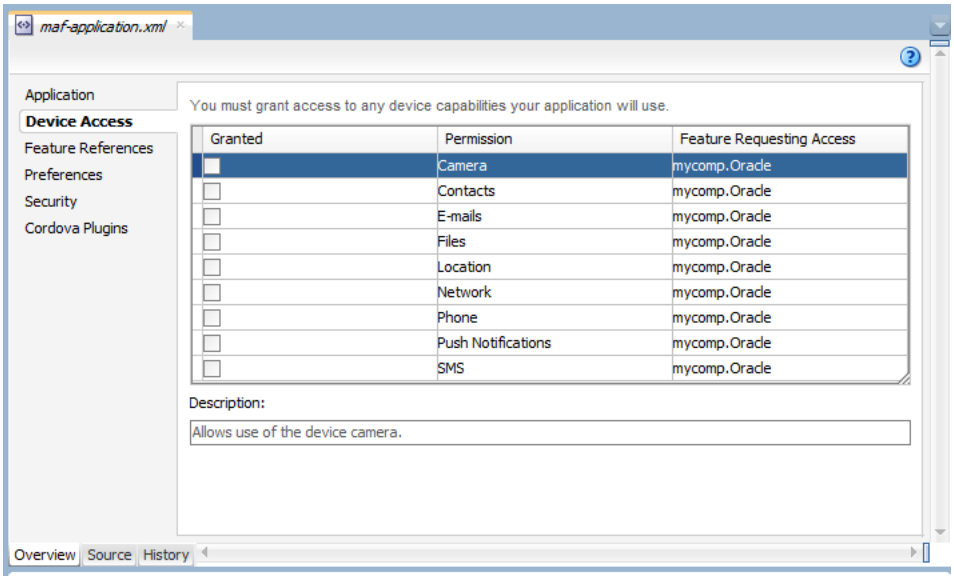
Before you begin:

Using the overview editor for the `maf-feature.xml` file, designate the content for an application as Remote URL and then create the connection as described in Section 4.6.1, "How to Designate the Content for a Mobile Application."

To restrict access to device services:

1. Open the Device Access page in the overview editor for the `maf-application.xml` file.
2. Clear the Granted option, as shown in Figure 13–4, or update the maf-application.xml with `access=false` (for example, `<adfmf:deviceCamera id="dc1" access="false"/>`).

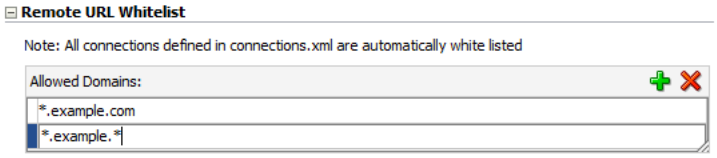
Figure 13–4 Preventing Domains from Accessing Device Services



13.1.4 How to Create a Whitelist (or Restrict a Domain)

You configure the whitelist in the Security page of `maf-application.xml`, as shown in Figure 13–5.

Figure 13–5 Configuring a Whitelist



Before you begin:

Be aware that some URLs configured in the mobile application may open to other domains.

To create whitelists:

1. Open the `maf-application.xml` file and then select the Security page.
2. Click **Add** and then enter the domains that can be called from within the web view of the application feature. These domains can include a wildcard (*). For example, `*.example.com` is a valid domain entry as is `*.example.*`. You cannot enter a fully qualified path.

> **Caution:** Entering only the wildcard allows the web view to request all domains and can pose a security risk; adding all domains to the whitelist not only enables all of them to open within the web view, but also enables all of them to access the device (whether or not it is intended for them to do so).

13.1.5 What Happens When You Add Domains to a Whitelist

When you add a domain, JDeveloper updates `<adfmf:remoteURLWhiteList>` element as illustrated in Example 13–1.

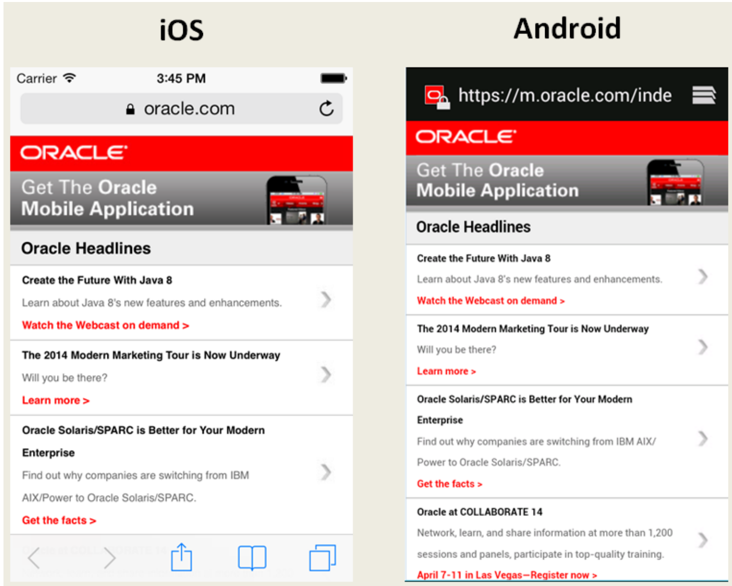
Example 13–1 Configuring the Whitelist

```
...
<adfmf:remoteURLWhiteList>
  <adfmf:domain id="domain_1">*.oracle.*</adfmf:domain>
  <adfmf:domain id="domain_2">www.oracle.*</adfmf:domain>
  </adfmf:remoteURLWhiteList>
...
```

13.1.6 What You May Need to Know About Remote URLs

Some URLs are redirected to a URL that may not be part of the whitelist domain. These URLs may open in the device browser rather than the application web view. For example, if you whitelist `www.oracle.com` (`<adfmf:domain>www.oracle.com<adfmf:domain>`), MAF opens the mobile version of this site (`www.m.oracle.com`) in the device browser, because it does not pass the whitelist. Figure 13–6 shows a web page that has not been whitelisted and has opened within the device browser.

Figure 13–6   A Web Page Opening in the Device Browser, Not the MAF Web View



To enable `www.oracle.com` to open within the application web view, you must specify `*.oracle.*` or `www.oracle.*` as shown in Example 13–1.

Because the MAF whitelist is at the domain-level, you cannot restrict an individual page within a whitelisted domain from opening with an application feature web view; all pages are allowed.

13.2 Creating Whitelists for Application Components

Use a whitelist for pages that contain links to URLs that point to another domain. Such pages would otherwise open in the device browser instead of the MAF web view. In such a case, you can create an anchor tag or an `<amx:goLink>` component with a `url` attribute for the `<amx:goLink>` component that points outside of the application, such as the `url` attribute in `<goLink2>` in Example 13–2.

Example 13–2   <amx:goLink> with a url Parameter

```
<?xml version="1.0" encoding="UTF-8" ?>
<amx:view xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
          xmlns:amx="http://xmlns.oracle.com/adf/mf/amx"
          xmlns:dvtm="http://xmlns.oracle.com/adf/mf/amx/dvt">
  <amx:panelPage id="pp1">
    <amx:panelGroupLayout id="panelGroupLayout1">
      <amx:goLink text="This opens in the device browser"
                  id="golink1"
                  url="http://www.example.com"
                  shortDesc="Opens in device browser"/>
      <amx:goLink text="This opens in the web view"
                  id="golink2"
                  url="http://www.example2.com"
                  shortDesc="Accesses device services"/>
    </amx:panelGroupLayout>
  </amx:panelPage>
</amx:view>
```

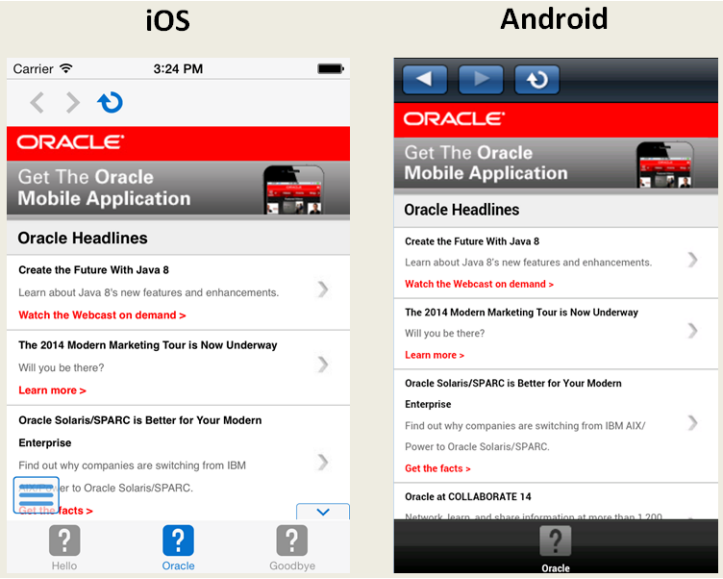
See also Section 6.3, "Creating and Using UI Components."

13.3 Enabling the Browser Navigation Bar on Remote URL Pages

MAF enables you to add a navigation bar with buttons for back, forward, and refresh actions for application features implemented as remotely served web content that open within the MAF web view, as shown in Figure 13–7. The forward and back buttons are disabled when either navigation forward or back is not possible.

Note: The back button is disabled on Android-powered devices.

Figure 13–7 A Remote Web Page Displaying the Navigation and Refresh Buttons



13.3.1 How to Add the Navigation Bar to a Remote URL Application Feature

You enable users to navigate through, or refresh remote content through the Content tab of the overview editor for the `maf-feature.xml` file.

Before you begin:

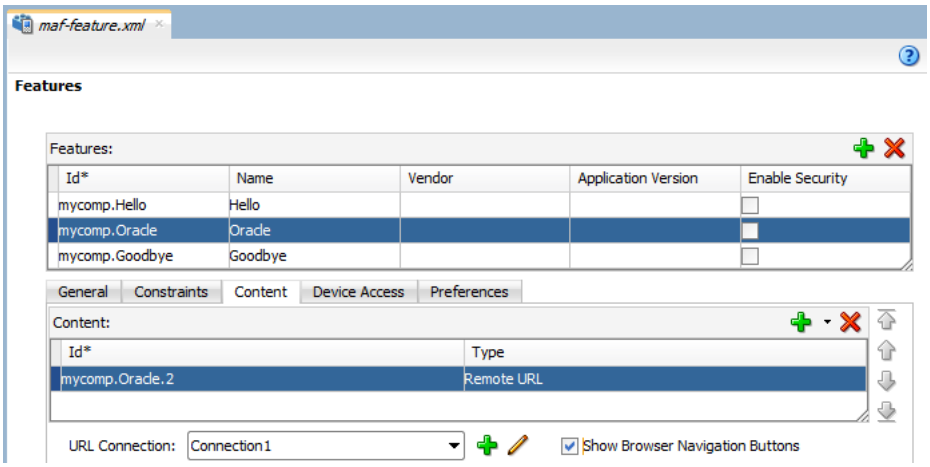
Designate an application feature's content be delivered from a remotely hosted application by first selecting **Remote URL** and then by creating the connection to the host server, as described in Section 4.10, "Defining the Content Types for an Application Feature."

Ensure that the domain is whitelisted.

To enable a navigation bar:

1. Select the Remote URL application feature listed in the Features table in the `maf-feature.xml` file.
2. Click **Content**.
3. Select **Show Browser Navigation Buttons**, as shown in Figure 13–8.

Figure 13–8 Selecting Navigation Options



13.3.2 What Happens When You Enable the Browser Navigation Buttons for a Remote URL Application Feature

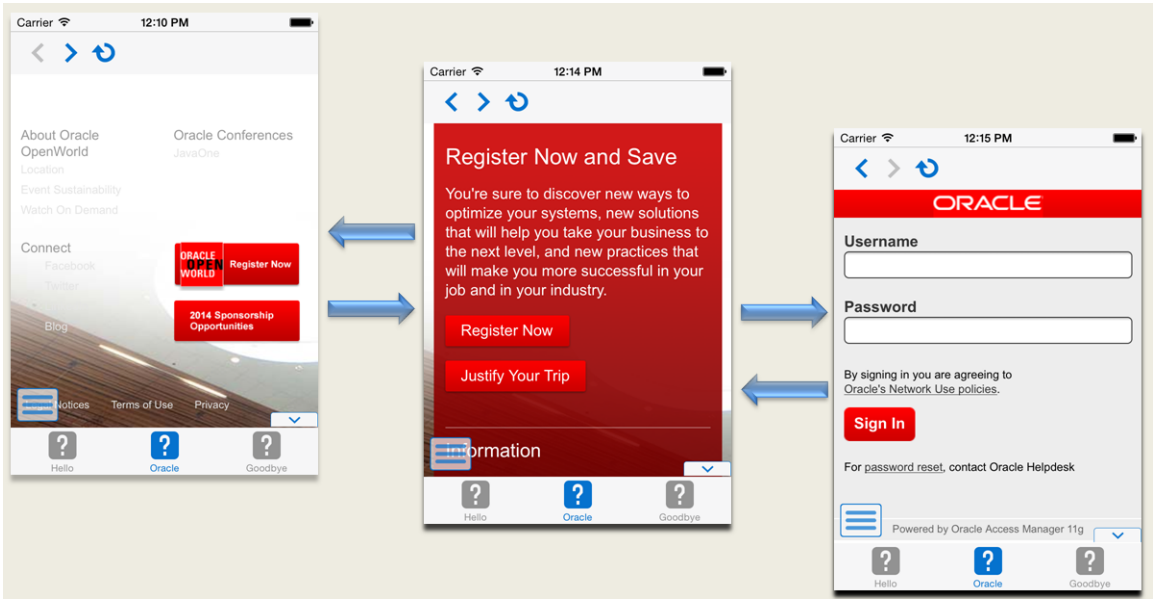
JDeveloper updates the `adfmf:remoteURL` element with an attribute called `showNavButtons`, which is set to `true`, as shown in Example 13–3.

Example 13–3 The showNavButtons Attribute

```
<?xml version="1.0" encoding="UTF-8" ?>
<adfmf:features xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
                xmlns:adfmf="http://xmlns.oracle.com/adf/mf">
  <adfmf:feature id="oraclemobile" name="oraclemobile">
    <adfmf:content id="oraclemobile.1">
      <adfmf:remoteURL connection="connection1"
                       showNavButtons="true"/>
    </adfmf:content>
  </adfmf:feature>
</adfmf:features>
```

After you deploy the application, MAF applies the forward, back, and refresh buttons to the web pages that are traversed from the home page of the Remote URL application feature, as shown in Figure 13–9.

Figure 13–9 Traversing Through a Remote URL Application Feature



13.4 About Authoring Remote Content

The Browser-based user interface may be authored using Apache Trinidad components (described at `http://myfaces.apache.org/trinidad/`) because they display equally well within the browsers of either smartphones or feature phones. To accommodate recent smartphones and tablet devices, web applications may also be authored using ADF Rich Faces components as described in *Oracle Fusion Middleware Developing Web User Interfaces with Oracle ADF Faces*.

Note: Oracle recommends using ADF Mobile browser for application features that derive their content from remote URLs. ADF Mobile browser applications are comprised of JSF pages populated with Apache Trinidad components. For more information, see *Oracle Fusion Middleware Developing Oracle ADF Mobile Browser Applications*.

14

Enabling User Preferences

This chapter describes how to create both application-level and application feature-level user preference pages.

This chapter includes the following sections:

14.1 Creating User Preference Pages for a Mobile Application

Preferences enable you to add settings that can be configured by end users. Within both the `maf-application.xml` and `maf-feature.xml` files, the user preference pages are defined with the `<adfmf:preferences>` element. As shown in Example 14–1, the child element of `<adfmf:preferences>` called `<adfmf:preferenceGroup>` and its child elements define the user preferences by creating pages that present options in various forms, such as text strings, dropdown menus, or in the case of Example 14–1, as a child page that can present the user with additional options for application settings.

You also use the `<adfmf:preferences>` element to create the preferences that users manage within each application feature.

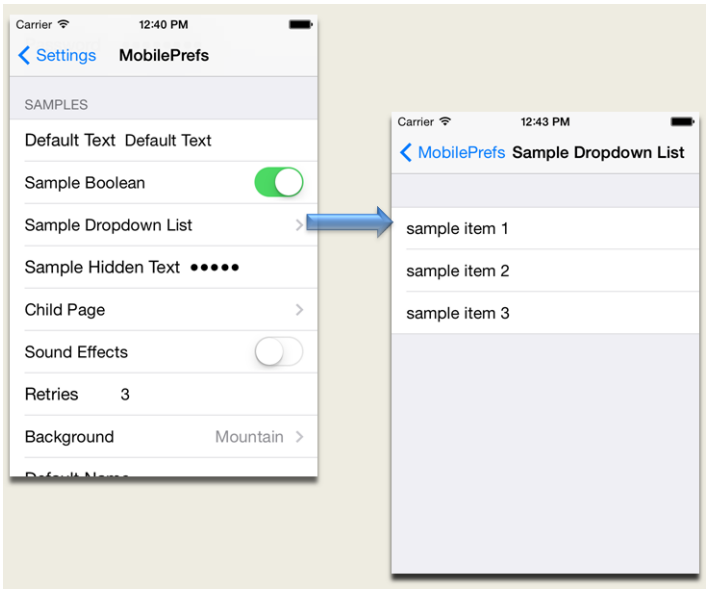
Example 14–1 Defining Application-Level Preferences with the <adfmf:preferences> Element

```
<?xml version="1.0" encoding="UTF-8" ?>
<adfmf:application xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
                   xmlns:adfmf="http://xmlns.oracle.com/adf/mf"
                   name="MobileApplication"
                   id="com.company.MobileApplication"
                   appControllerFolder="ApplicationController"
                   version="1"
                   vendor="oracle"
                   listener-class="application.LifeCycleListenerImpl">
  <adfmf:description>This app created by Mobile Application Framework</adfmf:description>
  <adfmf:featureReference id="PROD"/>
  <adfmf:featureReference id="HCM"/>
  <adfmf:featureReference id="Customers"/>
      <adfmf:preferences>
<adfmf:preferenceGroup id="a" label="Prefs Group A">
        <adfmf:preferenceBoolean id="a1_sound" label="Sound Effects"/>
        <adfmf:preferenceNumber id="a2_retries" label="Retries" default="3"/>
```

```
        <adfmf:preferenceList id="a3_background" label="Background" default="3">
          <adfmf:preferenceValue name="None" value="0" id="pv4"/>
          <adfmf:preferenceValue name="Field" value="1" id="pv1"/>
          <adfmf:preferenceValue name="Galaxy" value="2" id="pv5"/>
          <adfmf:preferenceValue name="Mountain" value="3" id="pv6"/>
        </adfmf:preferenceList>
        <adfmf:preferenceText id="a4_name" label="Default Name"/>
        <adfmf:preferencePage id="aa" label="Prefs SubGroup AA">
          <adfmf:preferenceGroup id="aa_sec" label="Security">
            <adfmf:preferenceBoolean id="aa_sec_useSec" label="Use Security"/>
            <adfmf:preferenceNumber id="aa_sec_timeout" label="Timeout (secs)" default="120"/>
          </adfmf:preferenceGroup>
        </adfmf:preferencePage>
      </adfmf:preferenceGroup>
      <adfmf:preferenceGroup id="b" label="Prefs Group B">
        <adfmf:preferenceBoolean id="b_cloudSync" label="Cloud Sync"/>
        <adfmf:preferenceList id="b_dispUsage" label="Display Usage As" default="1">
          <adfmf:preferenceValue name="Percent" value="1" id="pv2"/>
          <adfmf:preferenceValue name="Minutes" value="2" id="pv3"/>
        </adfmf:preferenceList>
      </adfmf:preferenceGroup>
    </adfmf:preferences>
</adfmf:application>
```

Figure 14–1 shows an example of how opening child user preferences page can offer subsequent options.

Figure 14–1 User Preferences Pages



Preference pages are defined within the `<adfmf:preferenceGroup>` element and have the following child elements:

- `<adfmf:preferencePage>`—Specifies a new page in the user interface.
- `<adfmf:preferenceList>`—Provides users with a specific set of options.
  - `<adfmf:preferenceValue>`—A child element that defines a list element.
- `<adfmf:preferenceBoolean>`—A boolean setting.

- `<adfmf:preferenceText>`—A text preference setting.

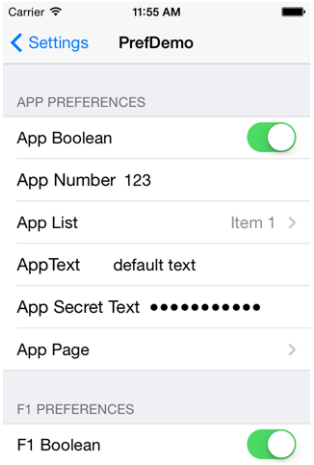
See Oracle Fusion Middleware Tag Reference for Oracle Mobile Application Framework for more information on these elements and their attributes.

For an example of creating preference pages at both the application and application-feature levels, refer to the PrefDemo sample application. This sample application is located in the `PublicSamples.zip` file at the following location within the JDeveloper installation directory of your development computer:

jdev_install`/jdeveloper/jdev/extensions/oracle.maf/Samples`

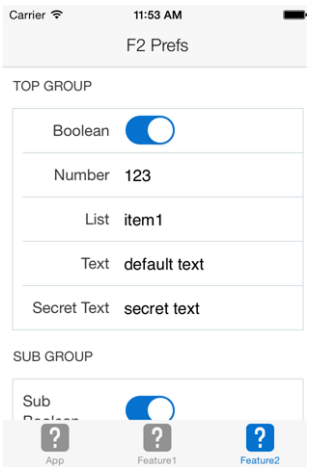
The PrefDemo application is comprised of an application-level settings page as well as three application feature preference pages, which are implemented as MAF AMX. Figure 14–2 shows the PrefDemo application settings page, which you invoke from the general settings page. In this illustration, the preference settings page is invoked from the iOS Settings application.

Figure 14–2 The PrefDemo Application Settings Page



The application feature preference pages, illustrated by *App*, *Feature1* (which is selected), and *Feature 2* in Figure 14–3, provide examples of preferences pages constructed from the MAF AMX Boolean Switch, Input Text, and Output Text components that use EL (Expression Language) to access the application feature and the various `<adfmf:preferences>` components configured within it. For more information, see Section 14.3, "Using EL Expressions to Retrieve Stored Values for User Preference Pages."

Figure 14–3 An Application Feature Preference Page from the PrefDemo Application

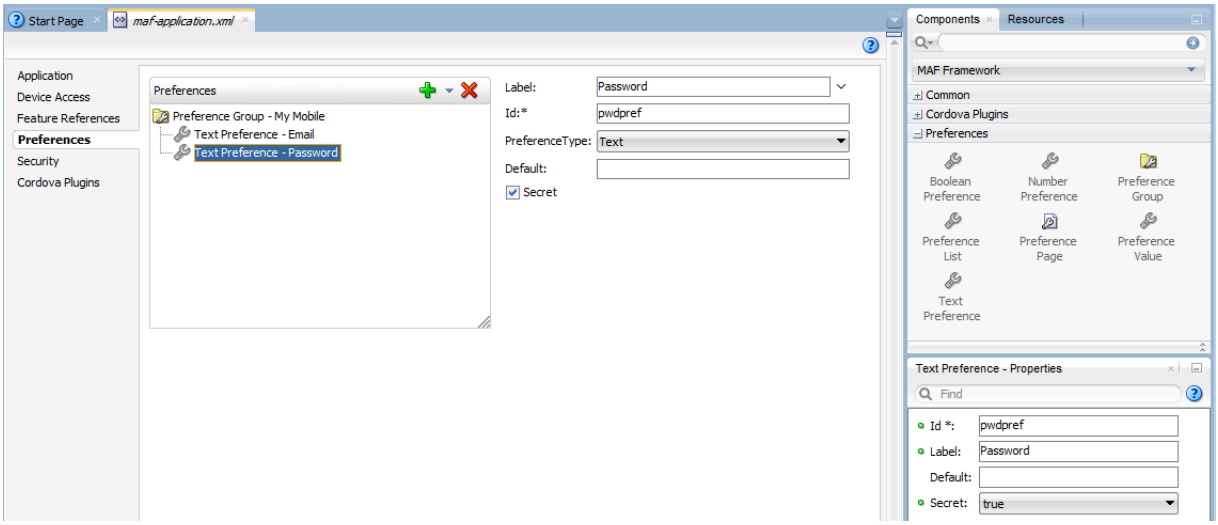


In the PrefDemo application, each MAF AMX preference page is referenced by a single bounded task flow comprised of a view activity and a control flow case that enables the page refresh.

14.1.1 How to Create Mobile Application-Level Preferences Pages

The Preferences page of the `maf-application.xml` overview editor, shown in Figure 14–4, enables you to build sets of application-level preference pages by nesting the child preference page elements within `<adfmf:preferenceGroup>`. The page presents the `<adfmf:preferencesGroup>` and its child elements as similarly named options (that is, Preference Group, Preference Page, Preference List, and so on), which you assemble into a hierarchy (or tree), similar to the Structure window in JDeveloper.

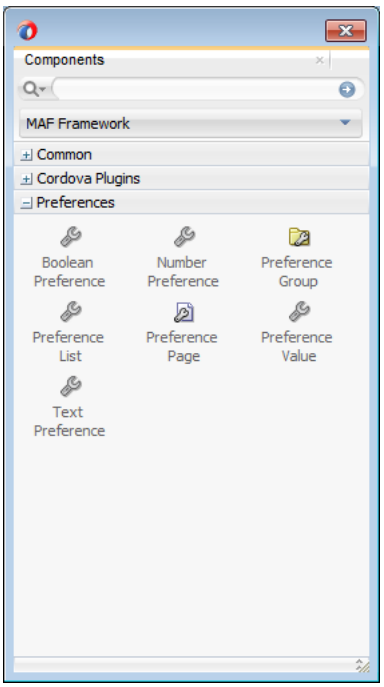
Figure 14–4 Adding Mobile Application-Level Preferences Using the Preference Page



To ensure that the `maf-application.xml` file is well-formed, use the Preferences page's **Add** dropdown list, shown in Figure 14–4 to construct the user preferences pages. While you can also drag components from the Preferences palette, shown in Figure 14–5, into either the editor, the Source window, or the Structure window, the page's dropdown list presents only the elements that can have the appropriate parent, child, or sibling relationship to a selected preferences element. For example,

Figure 14–4 shows only the components that can be inserted within the Preference Group element, *Oracle Mobile App*. The editor also enables you to enter the values for the attributes specific to each preference element.

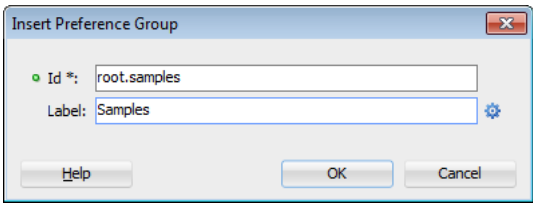
Figure 14–5 Preferences in the Component Palette



To create preferences pages:

1. Click **Preferences**.
2. Click **Add** to create the parent `<adfmf:preferenceGroup>` element.
3. Enter the following information in to the Insert Preference Group dialog, shown in Figure 14–6.

Figure 14–6 Defining the Parent Preference Group Element



   - Enter a unique identifier for the Preference Group element.
   - Enter the descriptive text that displays in the user interface. For an example of how this text displays in the user interface, see *Sample* in Figure 14–1.
4. Click **Add** to further define the preference pages using the **Insert Before**, **Insert Inside**, **Insert After** options to ensure that the XML document is well formed.

14.1.1.1 How to Create a New User Preference Page

The Preference Page component enables you to create a new user interface page. You create a Preference Page using the **Insert Before**, **Insert Inside**, **Insert After** options.

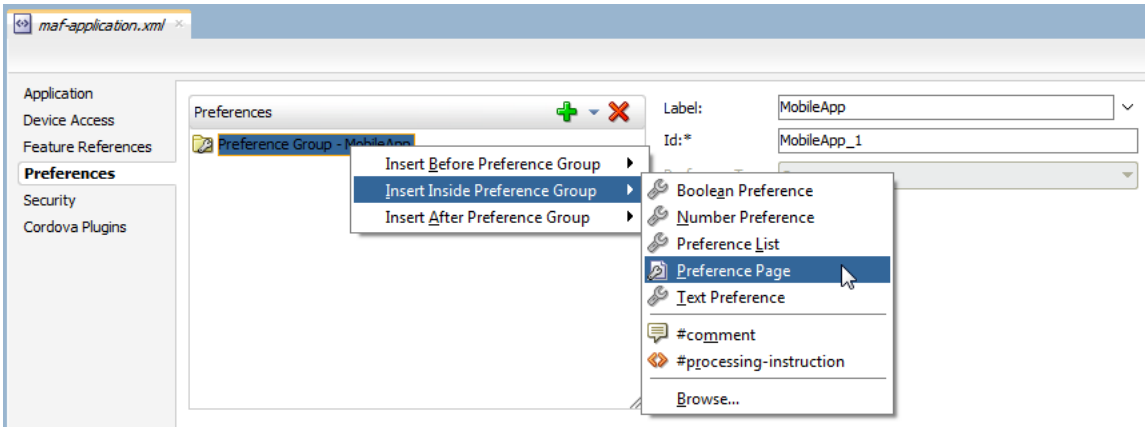
Before you begin:

You must create a Preferences Group element.

To create a new user preference page:

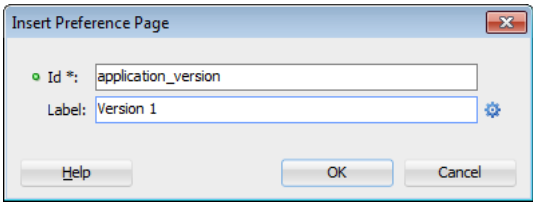
1. Select the Preference Group element.
2. Click **Add**, choose **Insert Inside** (Preference Group), then select **Preference Page**. As shown in Figure 14–7, the Preference Group is called *MobileApp*.

Figure 14–7 Selecting the Preference Page Component



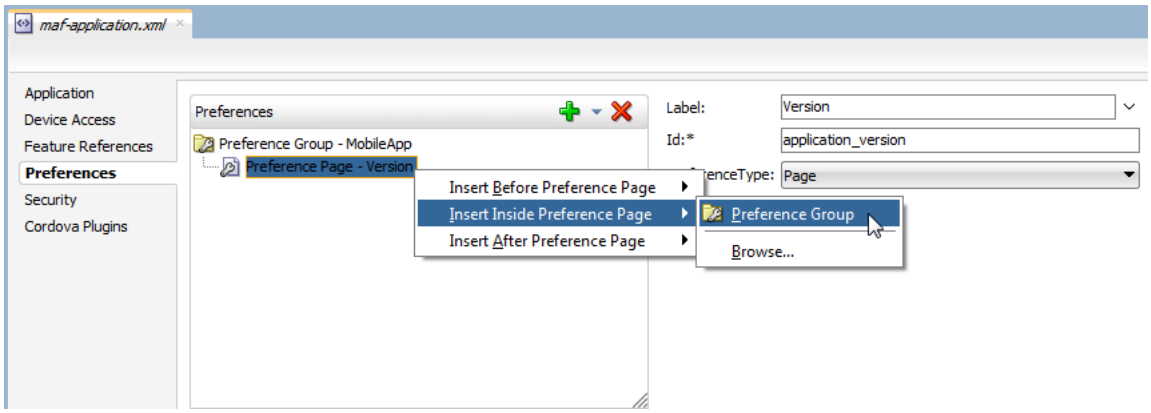
3. Define the following Preference Page attributes in the Insert Preference Page dialog, shown in Figure 14–8:
   - Enter a unique identifier for the Preference Page element.
   - Enter the descriptive text that displays in the user interface.

Figure 14–8 The Insert Preference Page Dialog



4. Create the body of the preference page by inserting a child Preference Group element by selecting the Preference Page, and then first choosing **Insert Inside** (Preference Page) and then **Preference Group**, as shown in Figure 14–9. After you define a unique identifier and display name for the child Preference Group, you can populate it with other elements, such as a Preference List element, as shown in Example 14–2.

Figure 14–9 Adding a Preference Group to a Preference Page



14.1.1.2 What Happens When You Add a Preference Page

After you define the Preference Page and its child Preference Group components in the overview editor, JDeveloper generates an `<adfmf:preferencePage>` with attributes similar to Example 14–2. The `<adfmf:preferencePage>` is nested within a parent `<adfmf:preferenceGroup>` element.

Example 14–2 Adding an <adfmf:PreferencePage element>

```
<adfmf:preferences>
          <adfmf:preferenceGroup id="gen"
                                 label="Oracle Mobile App">
                    <adfmf:preferencePage id="application_version"
                                          label="Version">
                   <adfmf:preferenceGroup id="version_select"
                                          label="Select Your Version">
                        <adfmf:preferenceList id="edition"
                                              label="Edition"
                                              default="PERSONAL">
                             adfmf:preferenceValue name="Enterprise"
                                                   id="pv2"/>
                             <adfmf:preferenceValue name="Personal"
                                                    value="PERSONAL"
                                                    id="pv1"/>
                        </adfmf:preferenceList>
                   </adfmf:preferenceGroup>
                    </adfmf:preferencePage>
</adfmf:preferences>
```

14.1.1.3 How to Create User Preference Lists

Add a Preference List component to create a list of options.

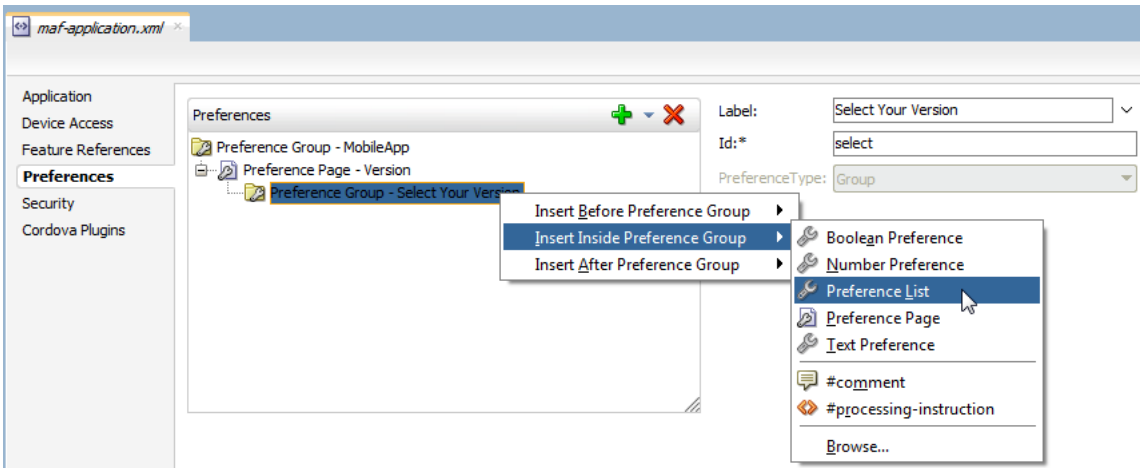
Before you begin:

You must create Preference Group as the parent to the Preference List or any other list-related component.

To create a user preference list:

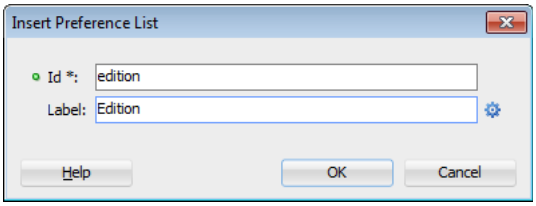
1. Select a Preference Group or Preference Page and then click **Add**, then Insert Inside, and then **Preference List**. Example 14–10 shows adding a Preference List as a child of a Preference Group component called *Select Your Version*.

Figure 14–10 Adding a Preference List Component to a Preference Group



2. Define the following attributes using the Insert Preference List dialog, shown in Example 14–11, and then click **OK**.
   - Enter a unique identifier.
   - Enter the descriptive text that displays in the user interface.

Figure 14–11 The Insert Preference List Dialog

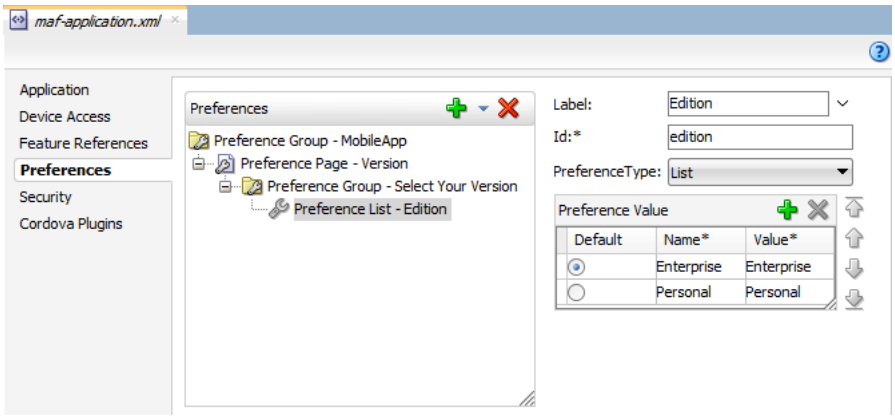


3. Define a list of items by clicking **Add** in the Preference Value table, shown in Figure 14–12. You can also remove a preference value by selecting it and then clicking **Delete**. You can change the order in which the preference values display by selecting the preference value and then using the up- and down-arrows.

   You can present the user with a default setting by choosing **Default**. As illustrated in Example 14–2, the default status is defined within the `<adfmf:preferenceList>` element as `default="ENTERPIRSE"`.

   Tip: In addition to clicking **Add**, you can add Preference Value components by dragging them either into the Structure window or the Source window.

Figure 14–12 Adding Preference Values



14.1.1.4 What Happens When You Create a Preference List

After you add Preference List component to a Preference Group and then define a series of Preference Values, JDeveloper updates the `<adfmf:preferences>` section with an `<adfmf:preferenceList>` element, as shown in Example 14–2.

14.1.1.5 How to Create a Boolean Preference List

See, for example, Example 14–1.

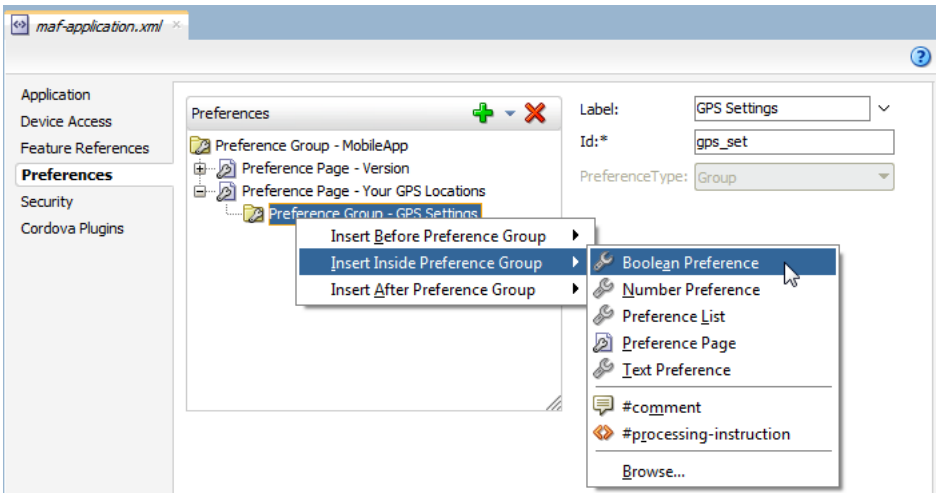
Before you begin:

Because an `<adfmf:preferenceBoolean>` element must be nested within an `<adfmf:preferenceGroup>` element, you must first insert a Preference Group component to the hierarchy.

To create a boolean preference list:

1. Select a Preference Group element, such as GPS Settings in Figure 14–13.

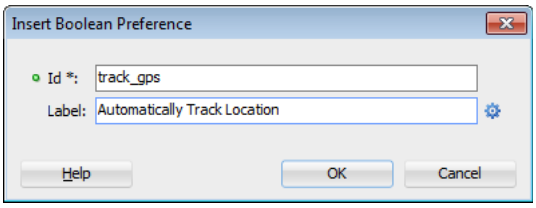
Figure 14–13 Adding a Boolean Preference to a Preference Group



2. Define the following attributes using the Insert Boolean Preference dialog, shown in Figure 14–14, and then click **OK**.
   - Enter a unique identifier.

- Enter the descriptive text that displays in the user interface.

Figure 14–14 The Insert Boolean Preference Dialog



3. Accept the default value of `false`, or select `true`.

14.1.1.6 What Happens When You Add a Boolean Preference

When you add a Boolean Preference and designate its default value, JDeveloper updates the `<adfmf:preferences>` section of the `maf-application.xml` file with a `<adfmf:preferenceBoolean>` element, as illustrated in Example 14–3.

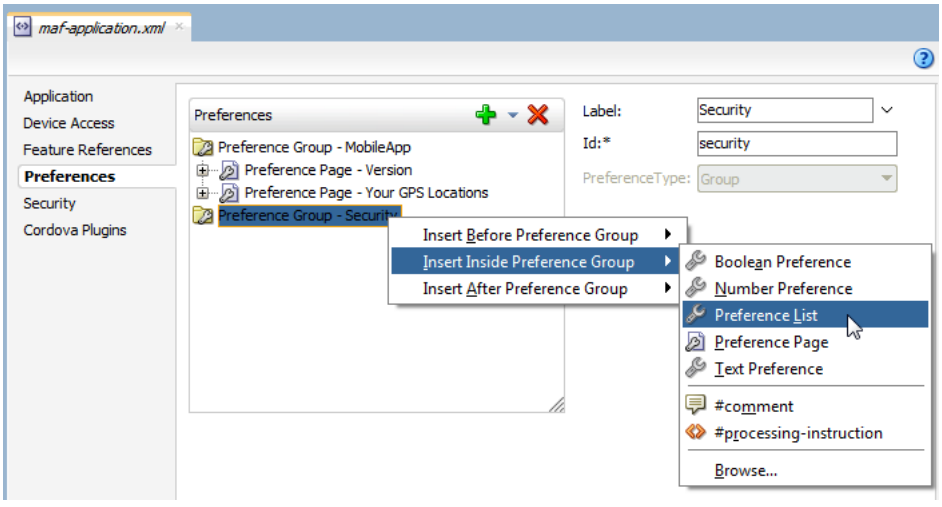
Example 14–3 Adding an <adfmf:preferenceBoolean> Element

```
<adfmf:preferencePage id="gps_tracking"
                      label="Your_GPS_Locations">
   <adfmf:preferenceGroup id="gps"
                          label="GPS Settings">
      <adfmf:preferenceBoolean id="track_gps"
                               label="Automatically Track Location"
                               default="true"/>
</adfmf:preferencePage>
```

14.1.1.7 How to Add a Text Preference

Use the insert options, shown in Figure 14–15, to create a Text Preference, a dialog that enables users to store information or view default text. Figure 14–15 shows creating a text preference within a Preference Group called *Security*.

Figure 14–15 Inserting a Text Preference



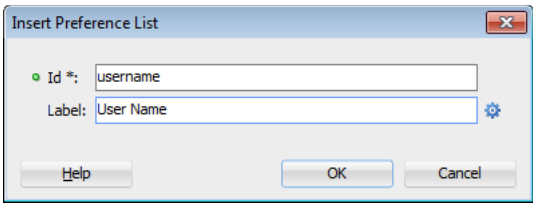
Before you begin:

Create a Preference Group element.

To create a text preference:

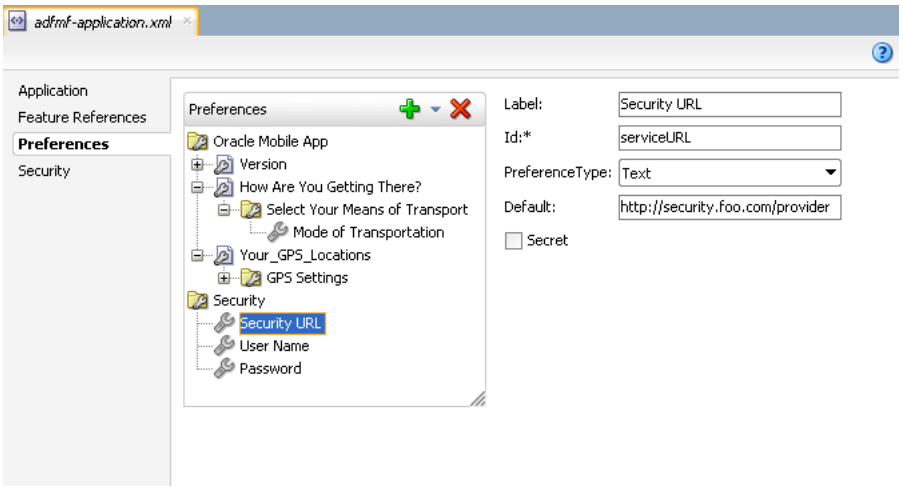
1. Select a Preference Group element.
2. Select **Insert Inside** and then **Text Preference**.
3. Enter the following information into the Insert Text Preference dialog, shown in Figure 14–16, and then click **OK**.
   - Enter a unique identifier.
   - Enter the descriptive text that displays in the user interface.

Figure 14–16 The Insert Text Preference Dialog



4. Define the following for the preference text dialog:
   - Enter the default text value.
   - Select **Secret** to hide the text preference.

Figure 14–17 Defining the Text Preference



14.1.1.8 What Happens When You Define a Text Preference

When you add a Text Preference and designate its default value, JDeveloper updates the `<adfmf:preferences>` section of the `maf-application.xml` file with a `<adfmf:preferenceText>` element, as illustrated in Example 14–4.

Example 14–4 Adding the <adfmf:preferenceText> Element

```
<adfmf:preferenceGroup id="security" label="Security">
   <adfmf:preferenceText id="serviceURL"
                         label="Security URL"
                         default="http://security.example.com/provider"/>
   <adfmf:preferenceText  id="username"
                          label="User Name"/>
```

```
    <adfmf:preferenceText  id="password"
                           label="Password"
                           secret="true"/>
</adfmf:preferenceGroup>
```

The Preference Group elements that define a security URL, user name, and password preference setting display similarly to Figure 14–18.

Figure 14–18 Text Preferences

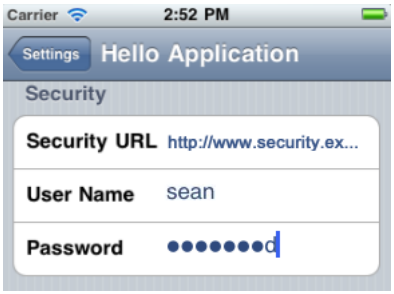


Figure 14–18 illustrates `<adfmf:preferenceText>` elements with a seeded value for the Security URL and an input value for the User Name. Because the MAF preferences are integrated with the iOS Settings application, the `secret="true"` attribute for the Password input text results in the application following the iOS convention of obscuring the user input with bullet points. For more information, see the description for the `isSecure` text field element in *Settings Application Schema Reference*, available from the iOS Developer Library (`http://developer.apple.com/library/ios/navigation/`) and Section 14.4, "Platform-Dependent Display Differences."

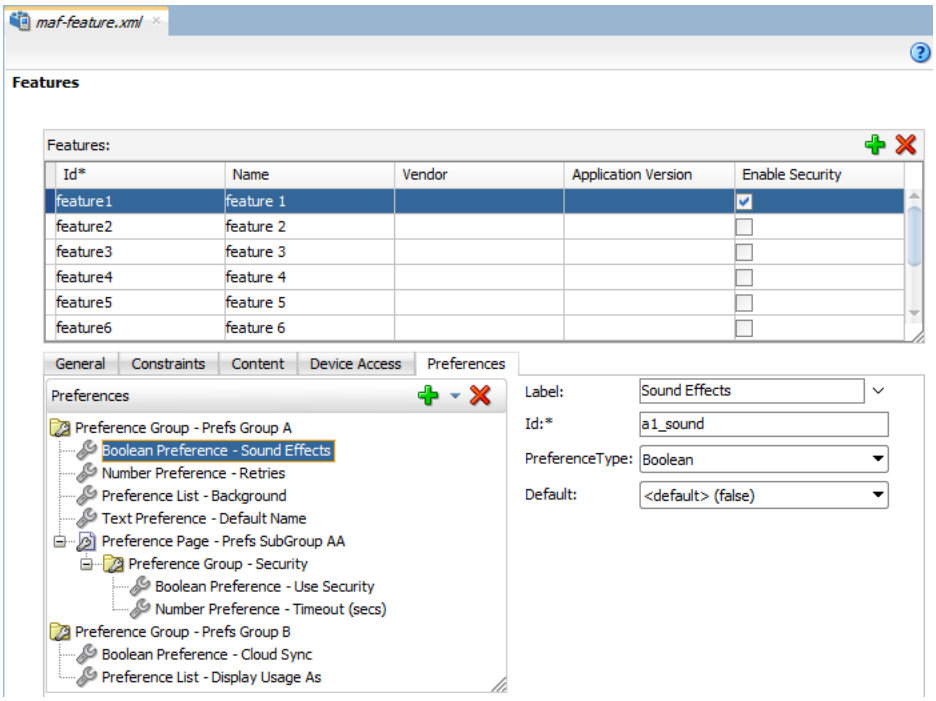
14.1.2 What Happens When You Create an Application-Level Preference Page

After you deploy the mobile application, the application-wide preference settings page is propagated to the device's global settings application, such as the Settings application on iOS-powered devices. For more information, see Appendix C, "Converting Preferences for Deployment."

14.2 Creating User Preference Pages for Application Features

As described in Section 4.13, "Working with Feature Archive Files," you can distribute an application feature independently of its mobile application by adding a Feature Application Archive (FAR) `.jar` file containing the application feature to the library of another mobile application. You then reference the application feature in the application's `maf-application.xml` file. If an application feature requires a specific set of user preferences in addition to the general preferences defined for the consuming application, you can define them using the Preferences tab of the `maf-feature.xml` overview editor, shown in Figure 14–19. You build application feature preferences in the same manner as the application-level preferences, which are described in Section 14.1, "Creating User Preference Pages for a Mobile Application." After you define the preferences in the `maf-feature.xml` file, you then create the actual preference page by creating an application feature that references a MAF AMX page that is embedded with the Boolean Switch, Input, and Output components described in Section 6.3, "Creating and Using UI Components."

Figure 14–19 Setting Application Feature-Level Preferences



14.3 Using EL Expressions to Retrieve Stored Values for User Preference Pages

When creating an application feature-level preference page, you add EL expressions to the MAF AMX components, such as the Input Text component in Example 14–5.

Example 14–5 Referencing Preference Values Using EL in MAF AMX Components

```
<amx:inputText label="Number" id="it1" inputType="number"
               value="#{preferenceScope.feature.Feature1.f1top.f1Number}"/>
```

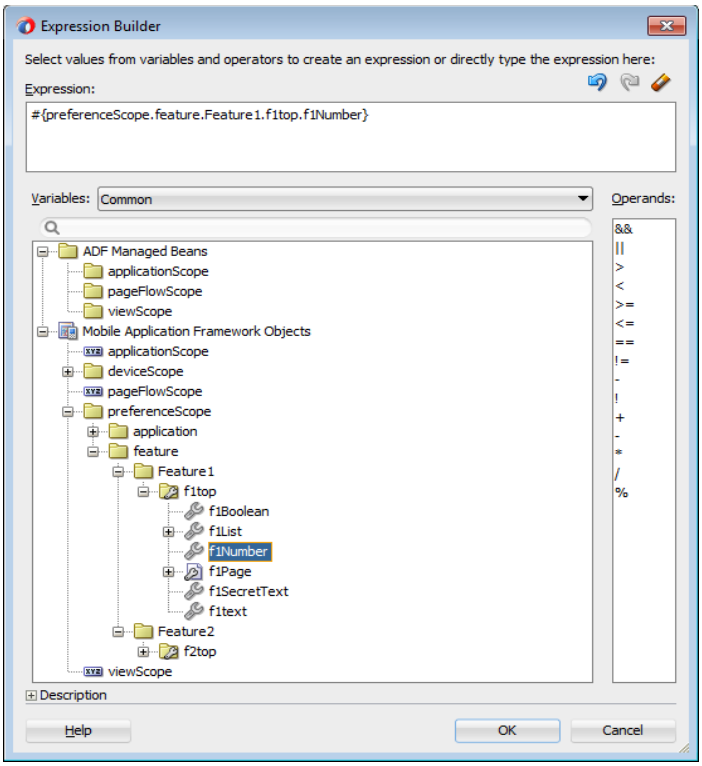
As illustrated in Example 14–5, EL expressions use the `preferenceScope` object to enable applications to access an application feature-level preference. These EL expressions are in the following format:

`preferenceScope.feature.`*`feature-id.group-id.property-id`*

Figure 14–20 illustrates using the Expression Builder to create the EL expression.The preference itself is designated by the IDs configured for various components in `maf-feature.xml`, such as the ID of the application feature `<adfmf:feature id="Feature1">`), the ID of a Preference Group (`<adfmf:preferenceGroup id="f1top">`), and the ID of a preference property (`<adfmf:preferenceNumber id="f1Number">`).

The EL expression may include zero or more `group-id` and `property-id` elements.

Figure 14–20 Building an EL Expression for a Preference



14.3.1 What You May Need to Know About preferenceScope

An EL expression has the following resolution pattern:

- From the JavaScript layer, EL value expressions are resolved using the following JavaScript function:

  ```
  adf.mf.el.getValue(expression, success, failed)
  ```

  The resolution of `adf.mf.el.getValue` begins with an attempt to resolve the expression locally using the JS-EL parser and JavaScript Context Cache. If the expression cannot be resolved locally, the expression is passed to the embedded Java layer for evaluation where it is resolved by the Java EL parser. This is done through the `GenericInvokeRequest` to the Model's `getValue` method.

- At the Java layer, an EL value expression is resolved using the following approach:

  ```
  String val =
  AdfmfJavaUtilities.evaluateELExpression("#{preferenceScope.feature.f0.vendor}")
  ;
  ```

  For a `setValue` method, the expression is resolved as follows:

  ```
  ValueExpression ve =
  AdfmfJavaUtilities.getValueExpression("#{preferenceScope.feature.f0.vendor}");
  ve.setValue(AdfmfJavaUtilities.getADFELContext(), value);
  ```

  Evaluation of the EL expression involves looking up the `preferenceScope` object. The evaluation is from left to right, where each token is resolved independently. After a token is resolved, it is used to resolve the next token (which is on its right).

Preferences cannot be exposed without the `preferenceScope` object. For more information about the `preferenceScope` object, see Section 7.3.5.3, "About the Mobile Application Framework Objects Category."

14.3.2 Reading Preference Values in iOS Native Views

MAF integrates APIs provided for a native UI (such as `UIView` or `UIViewController`) to allow certain configurations on iOS platform.

When the native UI is initialized, an instance of the `ADFSession` object becomes available. You can use its `getPreferences` method to instruct MAF to provide a listing of the available preferences for the application as defined in the `maf-application.xml` file. As shown in Example 14–6, this method returns a `NSArray*` of preference property objects that can include the `id`, `value`, and `label` for the preference. This API call ensures that either the end user provided the value for a particular preference, or that the default value of the preference is returned.

Example 14–6 Getting Preferences

```
//...
-(id) initWithADFSession:(id<ADFSession>) providedSession
{
   id me = [self init];
   session = providedSession;
   //...
   // Dump the preferences to the data display
   NSArray* prefsArray = [session getPreferences];
   NSString* prefs = [prefsArray JSONRepresentation];
   self.theData.text = [[NSString alloc ] initWithFormat:
        :@"%@\nUser Preferences = --> %@ <--", self.theData.text, prefs];
   //...
   return me;
}
```

14.4 Platform-Dependent Display Differences

The MAF preference pages maintain the native look-and-feel for both the iOS and Android platforms. Consequently, the MAF preference pages display differently on the two platforms. As shown in Table 14–1, preferences display inline on the iOS platform, meaning that the system does not invoke dialog pages. With a few exceptions, the Android platform presents these components as dialogs.

Table 14–1 Preference Component Comparison by Platform

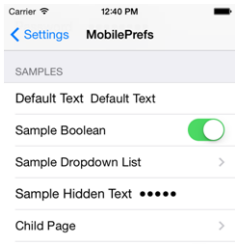
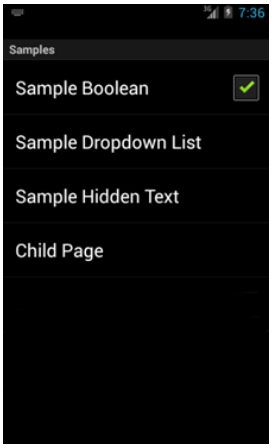
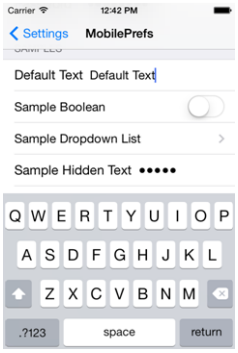
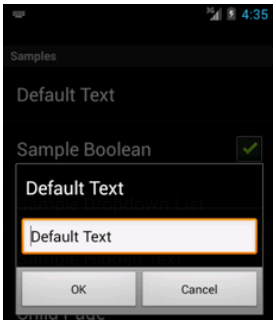
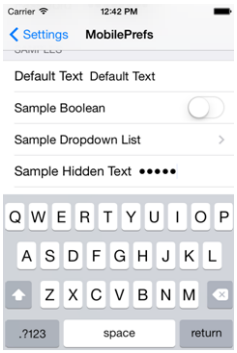
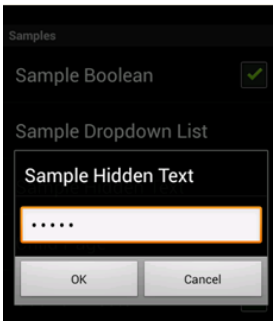
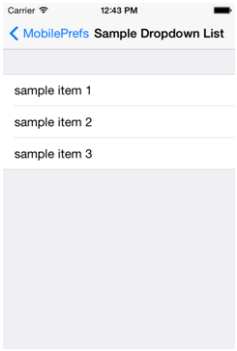
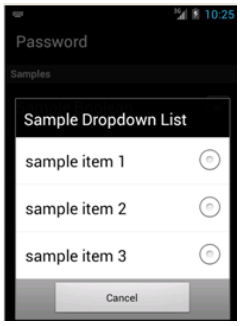
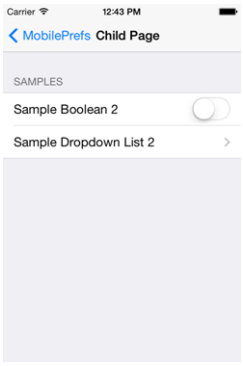
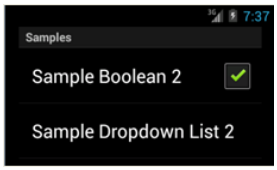
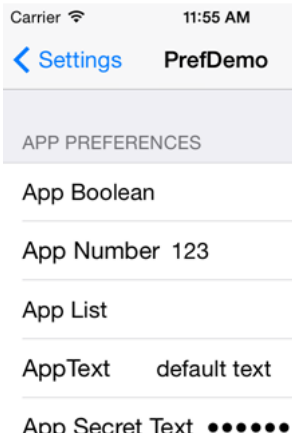
Component	iOS	iOS Display Examples	Android	Android Display Examples
Preference Groups (Category Selection)	The iOS platform displays the preference elements within their parent preference group.		The Android platform displays the preference elements within their parent preference group.	
Boolean Preference List	The Boolean preference is represented as value pair, such as *on* and *off*.		Android presents the Boolean preference as a check box.	
Text Preference	iOS displays the text inline.		Android displays the default text within an input field.	

Table 14–1 (Cont.) Preference Component Comparison by Platform

Component	iOS	iOS Display Examples	Android	Android Display Examples
Text Preference (as secret input text)	On iOS platforms, users enter text inline, with each character obscured by a bullet point after it has been entered. For more information, see Section 14.1.1.8, "What Happens When You Define a Text Preference."		Android launches an input text dialog and obscures each character with a bullet point after it has been entered.	
Single Item Selection List (from a Preference List)	iOS platforms display the single item selection list in a separate preferences page.		Android displays the single item selection list in a dialog.	
Preference Page	iOS launches a child preference page from a preference group.		Android launches a child preference page from a preference group.	

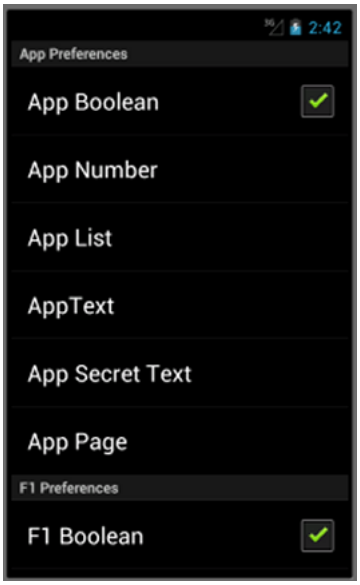
Although iOS and Android platforms have a Settings application, only the iOS platform supports integrating application-level preferences into the Settings application, as shown by the preferences in Figure 14–21.

Figure 14–21 Oracle Mobile Preferences in the iOS Settings Application



On Android-powered devices, users access application-specific preferences pages similar to the one shown in Figure 14–22 only when the application is running.

Figure 14–22 The Preferences Menu on an Android-Powered Device



15

Setting Constraints on Application Features

This chapter describes how to set constraints that can restrict an application feature based on user access privileges or device requirements.

This chapter includes the following sections:

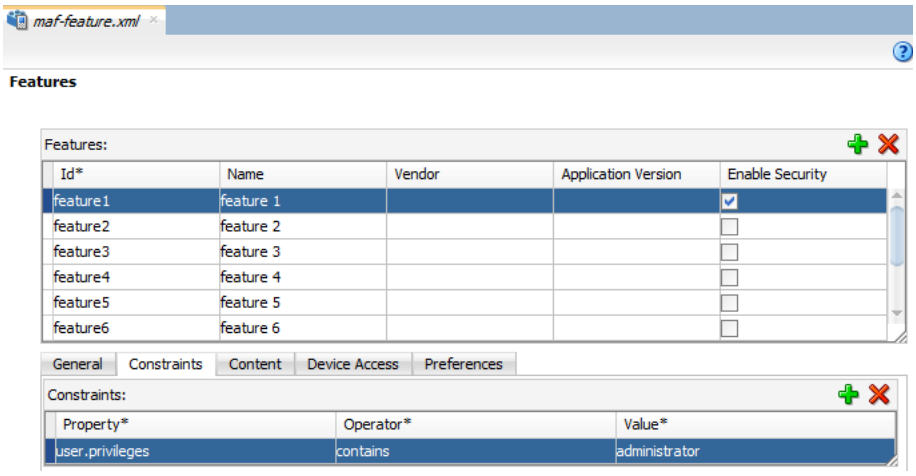
15.1 Introduction to Constraints

A constraint describes when an application feature or application content should be used. Constraints can restrict access based on users and user roles, the characteristics of the device on which the mobile application is targeted to run, and the hardware available on the device. You can set constraints at two levels: at the application feature level, where you control the visibility of an application feature on a user's device, and at the content level, where you can specify which type of MAF content can be delivered for an application feature. The overview editor for the `maf-feature.xml` file enables you to set both of these types of constraints. Constraints are evaluated by the MAF runtime and must evaluate to `true` to enable the end user to view or use specific content, or even access the application feature itself.

15.1.1 Using Constraints to Show or Hide an Application Feature

The Constraints tab, shown in Figure 15–1, enables you to set the application feature-level constraints. For example, an application feature that uses the device's camera displays within the mobile application's navigation bar or springboard only if the MAF runtime determines that the device actually has a camera function. You can also use feature level constraints to secure an application based on user roles and privileges. Figure 15–1 illustrates creating constraints that would allow only a user with administrator privileges to access the application feature, should the MAF runtime evaluate the constraint to `true`. If the runtime evaluates the constraint to `false`, then it prevents an end user from accessing the application feature, because it does not appear on the navigation bar or within the springboard.

Figure 15–1 Setting Application Feature-Level Constraints



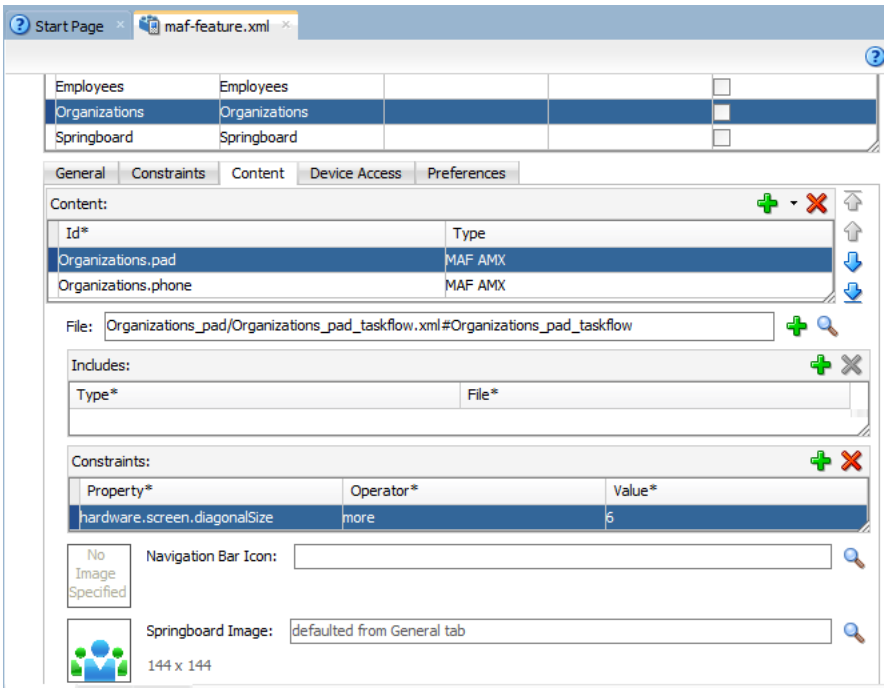
15.1.2 Using Constraints to Deliver Specific Content Types

To accommodate such factors as device hardware properties or user privileges, a single application feature can have more than one type of content to deliver different versions of the user interface. By setting constraints on the content of an application feature, you designate the conditions for determining what end users can see or how application pages can be used.

Using the Content tab, shown in Figure 15–2, you can, for example, specify content that delivers one type of user interface for users who have been granted administrative privileges and a separate user interface for those who have basic user privileges. In addition, content-level constraints can accommodate the layout considerations of a device. Figure 15–2 illustrates how a sample application performs this using a constraint based on the screen width of a device to deliver AMX Mobile task flows that call pages tailored to the layout of the iPhone and the iPad. When an end user launches the sample application, the MAF runtime evaluates the constraint that is set for the Employees application feature. If the runtime ascertains that the diagonal width of the device's screen exceeds six inches, it selects the `Employees_pad_taskflow.xml` file, which calls the MAF AMX pages designed for the iPad. If this constraint evaluates to `false` (that is, the diagonal width of the screen is less than six inches), then the runtime selects the MAF taskflow that calls iPhone-specific pages, `Employees_phone_taskflow.xml`. In addition, the Content tab enables you to select navigation bar and springboard images that display when the runtime selects specific content. If you do not select content-specific images, then MAF instead uses the application feature-level images that are designated in the General tab.

Note: Images must adhere to the platform-specific guidelines, as described in Section 4.9.1, "How to Define the Basic Information for an Application Feature."

Figure 15–2 Setting Content-Level Constraints



For more information on the sample applications, see Appendix F, "Mobile Application Framework Sample Applications."

15.2 Defining Constraints for Application Features

When setting application feature-level constraints, the `property`, `operator`, and `value` attributes of the `<adfmf:constraint>` element (a child element of `<adfmf:constraints>`) enable you to restrict application usage based on a user, a device, or hardware. An example of defining these attributes, shown in Example 15–1, illustrates defining these attributes to restrict access to an application feature to a Field Rep and to also restrict the application to run only on an iOS-powered device.

Example 15–1 The <adfmf:constraint> Element

```
<adfmf:constraints>
      <adfmf:constraint property="user.roles"
                        operator="contains"
                        value="Field Rep"/>
      <adfmf:constraint property="device.model"
                        operator="contains"
                        value="ios"/>
</adfmf:constraints>
```

15.2.1 How to Define the Constraints for an Application Feature

You declaratively configure the constraints for a selected application feature using the Constraints tab in the Features page, shown in Figure 15–1.

Defining the constraints for an application feature:

1. Click the **Constraints** tab.
2. Click **Add**.

3. Select a property and an appropriate operator and then enter a value. For more information on using properties, see Section 15.2.3, "About the property Attribute."

15.2.2 What Happens When You Define a Constraint

Entering the values in the Constraints tab updates the descriptor file's `<adfmf:constraints>` element with defined `<adfmf:constraint>` elements, similar to Example 15–1.

15.2.3 About the property Attribute

MAF provides a set of `property` attributes that reflect users, devices, and hardware properties. Using these properties in conjunction with the following operators and an appropriate value determines how an application feature can be used.

- `contains`
- `equal`
- `less`
- `more`
- `not`

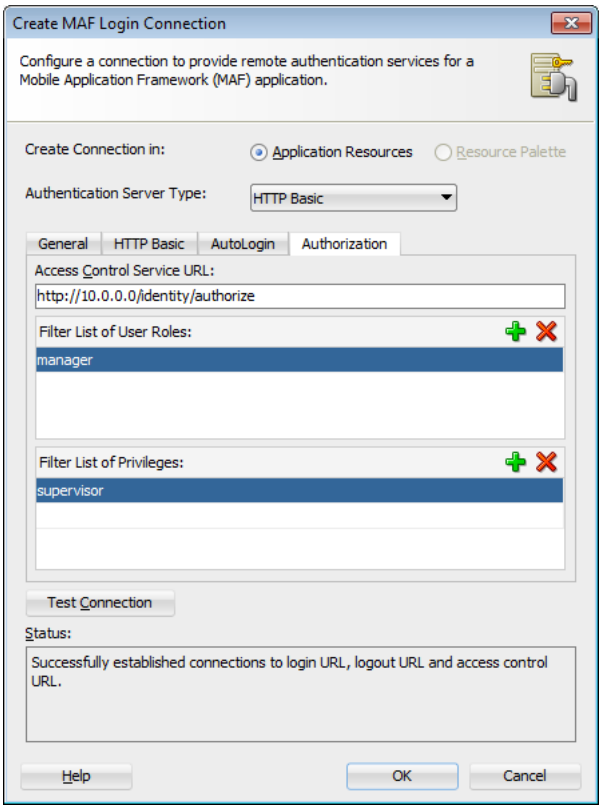
15.2.4 About User Constraints and Access Control

After a user logs into a mobile application, the MAF runtime reconciles the user role-based constraints configured for each application feature against the user roles and privileges retrieved by the Access Control Service (ACS). MAF then presents only the application feature (or application feature content) to end users whose privileges satisfy the constraints. In addition to setting these user privilege and role constraints, you create access control for the mobile application by entering the following in the Create MAF Login Connection dialog, shown in Figure 15–3 (and described in Section 21.5.2, "How to Designate the Login Page"):

- The URL of the REST Web service that transmits a list of user roles and privileges.
- A list the user roles checked by the application feature.
- A list of privileges.

See also Section 21.4.17, "What You May Need to Know About the Access Control Service."

Figure 15–3 Configuring Retrieval of User Roles and Privileges



You control access to application features using constraints based on `user.roles` and `user.privileges`. For example, to allow only a user with the *manager* role to access an application feature, you must add a constraint of `user.roles contains manager` to the definition of the application feature.

The `user.roles` and `user.privileges` use the `contains` and `not` operators as follows:

- `contains`—If the collection of roles or privileges contains the named role or privilege, then the runtime evaluates the constraint to `true`. Example 15–2 shows an example of using the `user.roles` property with the `contains` operator. The application feature will appear in the mobile application if the user's roles include the role of employee.

Example 15–2 Using the contains Operator for a User Role Collection

```
<feature ...>
   ...
   <constraints>
      <constraint property="user.roles"
                  operator="contains"
                  value="employee" />
   </constraints>
   ...
</feature>
```

- `not`—If the collection of roles or privileges does not contain the named role or privilege, then the runtime evaluates the constraint to `true`. In Example 15–3, the application feature is not included if the user's privileges contain the manager privilege.

Example 15–3 Using the not Operator with the user.privileges Property to Restrict Access to an Application Feature

```
<feature ...>
   ...
   <constraints>
      <constraint property="user.privileges"
                  operator="not"
                  value="manager" />
   </constraints>
   ...
</feature>
```

15.2.5 About Hardware-Related Constraints

The hardware object references the hardware available on the device, such as the presence of a camera, the ability to provide compass heading information, or to store files. These properties use the `equal` operator.

- `hardware.networkStatus`—Indicates the state of the network at the startup of the application. This property can be modified with three attribute values: `NotReachable`, `CarrierDataConnection`, and `WiFiConnection`. Example 15–4 illustrates the latter value. As illustrated in this example, setting this value means that this mobile application feature only displays in the mobile application if the device hardware indicates that there is a Wi-Fi connection. In other words, if the device does not have a Wi-Fi connection when the mobile application loads, then this application feature will not display.

Example 15–4 Defining the hardware.networkStatus Property

```
<feature ...>
...
   <constraints>
      <constraint property="hardware.networkStatus"
                  operator="equal"
                  value="WiFiConnection" />
   </constraints>
...
</feature>
```

> **Note:** This constraint is evaluated at startup on iOS-powered devices. If a device does not have a Wi-Fi connection at startup but subsequently attains one (for example, when a user enters a Wi-Fi hotspot), then the application feature remains unaffected and does not become available until the user stops and then restarts the mobile application.

- `hardware.hasAccelerometer`—Indicates whether or not the device has an accelerometer. This property is defined by a `true` or `false` value. Example 15–5 shows a `true` value, indicating that this application feature is only available if the hardware has an accelerometer.

Example 15–5 Using the hardware.hasAccelerometer Property

```
<feature ...>
...
```

```
   <constraints>
      <constraint property="hardware.hasAccelerometer"
                  operator="equal"
                  value="true" />
</constraints>
...
</feature>
```

> **Note:** Because all iOS-based hardware have accelerometers, this property must always have a value of `true` for the application feature to be available on iOS-powered devices.

- `hardware.hasCamera`—Indicates whether or not the device has a camera. This constraint is defined using a value attribute of `true` or `false`. In Example 15–6, the value is set to `true`, indicating that the application feature is only available if the device includes a camera.

Example 15–6 Using the hardware.hasCamera Property

```
<feature ...>
...
   <constraints>
      <constraint property="hardware.hasCamera"
                  operator="equal"
                  value="true" />
</constraints>
...
</feature>
```

> **Note:** Not all iOS-based hardware have cameras. This value is dynamically evaluated at the startup of mobile applications on an iOS-powered device. At this time, the mobile application removes the application features that do not evaluate to `true`.

- `hardware.hasCompass`—Indicates whether the device has a compass. You define this constraint with the attribute value of `true` or `false`, as shown in Example 15–7.

Example 15–7 Using the hardware.hasCompass Property

```
<feature ...>
   ...
   <constraints>
      <constraint property="hardware.hasCompass"
                  operator="equal"
                  value="true" />
   </constraints>
   ...
</feature>
```

> **Note:** Not every iOS-powered device has a compass. This value is dynamically evaluated at the startup of mobile applications on an iOS-powered device. At this time, the mobile application removes the application features that do not evaluate to `true`.

- `hardware.hasContacts`—Indicates whether the device has an address book or contacts. You define this constraint with the attribute value of `true` or `false`, as shown in Example 15–8.

Example 15–8 Using the hardware.hasContacts Property

```
<feature ...>
   ...
   <constraints>
      <constraint property="hardware.hasContacts"
                  operator="equal"
                  value"=true" />
      </constraints>
   ...
</feature>
```

> **Note:** Because contacts on iOS-based hardware are accessed through Apache Cordova, the `value` attribute is always set to `true` for iOS-powered devices.

- `hardware.hasFileAccess`—Indicates whether the device provides file access. You define this constraint with the attribute value of `true` or `false`, as shown in Example 15–9. The application feature is only available if the runtime evaluates this constraint to `true`.

Example 15–9 Using the hardware.hasFileAccess Property

```
<feature ...>
   ...
   <constraints>
      <constraint property="hardware.hasFileAccess"
                  operator="equal"
                  value="true" />
   </constraints>
   ...
</feature>
```

> **Note:** Because file access on iOS-based hardware is accessed through Apache Cordova, the `value` attribute is always `true` for iOS-powered devices.

- `hardware.hasGeoLocation`—Indicates whether or not the device provides geolocation services. You define this constraint with the attribute value of `true` or `false`, as shown in Example 15–10. The application feature is only available if the device supports geolocation.

Example 15–10 Using the hardware.hasGeoLocation Property

```
<feature ...>
   ...
   <constraints>
      <constraint property="hardware.hasGeoLocation"
                  operator="equal"
                  value="true"/>
   </constraints>
   ...
</feature>
```

> **Note:** Apache Cordova does not provide access to the gelocation service for all iOS-powered devices. Depending on the device, the application feature may not be available when the constraint is evaluated by the runtime.

- `hardware.hasLocalStorage`—Indicates whether the device provides local storage of files. You define this constraint with the `value` attribute of `true` or `false`, as shown in Example 15–11. The application feature only displays if the device supports storing files locally.

Example 15–11 Using the hasLocalStorage Property

```
<feature ...>
   ...
   <constraints>
      <constraint property="hardware.hasLocalStorage"
                  operator="equal"
                  value="true" />
   </constraints>
   ...
</feature>
```

> **Note:** Because Apache Cordova provides access to local file storage on all iOS hardware, the `value` attribute is always `true` for iOS-powered devices.

- `hardware.hasMediaPlayer`—Indicates whether or not the device has a media player. You define this constraint with the `value` attribute of `true` or `false`, as shown in Example 15–12. The application feature only displays if the device has a media player.

Example 15–12 Using the hardware.hasMediaPlayer Property

```
<feature ...>
   ...
   <constraints>
      <constraint property="hardware.hasMediaPlayer"
                  operator="equal"
                  value="true" />
   </constraints>
   ...
</feature>
```

Note: For iOS-powered devices, the `value` attribute is always `true`, because Apache Cordova provides access to media players on iOS-based hardware.

- `hardware.hasMediaRecorder`—Indicates whether or not the device has a media recorder. You define this constraint with the `value` of `true` or `false`, as shown in Example 15–13. The application feature is only included if the device hardware supports a media recorder.

Example 15–13 Using the hardware.hasMediaRecorder Property

```
<feature ...>
   ...
   <constraints>
      <constraint property="hardware.hasMediaRecorder"
                  operator="equal"
                  value="true" />
   </constraints>
   ...
</feature>
```

Note: Set this value to `true` for all iOS-powered devices because all iOS-based hardware have media recorders which can be accessed through Apache Cordova. Some devices, such as the Apple iTouch, do not have a microphone but can allow end users to make recordings by attaching an external microphone.

- `hardware.hasTouchScreen`—Indicates whether or not the hardware provides a touch screen. You define this constraint with the `value` attribute of `true` or `false`, as shown in Example 15–14. The application feature is only included if the device hardware supports a touch screen.

Example 15–14 Using the hardware.hasTouchScreen Property

```
<feature ...>
   ...
   <constraints>
      <constraint property="hardware.hasTouchScreen"
                  operator="equal"
                  value="true" />
   </constraints>
   ...
</feature>
```

Note: Set the `value` attribute to `true` for iOS-powered devices, because all iOS-based hardware provides touch screens.

- `hardware.screen.width`—Indicates the width of the screen for the device in its current orientation. Enter a numerical value that reflects the screen's width in terms of logical device pixels (such as such as 320 in Example 15–15), not physical device pixels, which represent the actual pixels that appear on a device. The value depends on the orientation of the device.

Example 15–15 Using the hardware.screen.width Property

```
<feature ...>
   ...
   <constraints>
      <constraint property="hardware.screen.width"
                  operator="equal"
                  value="320" />
   </constraints>
   ...
</feature>
```

> **Note:** This value is evaluated at the startup of the mobile application when the runtime evaluates constraints and dismisses application features with constraints that do not evaluate to `true`. If a user rotates the device after the mobile application starts, MAF's runtime does not re-evaluate this constraint because the set of application features is fixed after the mobile application starts.

- `hardware.screen.height`—Indicates the height of screen for the device in its current position. Enter a numerical value that reflects the screen's height in terms of logical pixels, such as 320 or 480, as shown in Example 15–16. The value depends on the orientation of the device.

Example 15–16 Using the hardware screen.height Property

```
<feature ...>
   ...
   <constraints>
      <constraint property="hardware.screen.height"
                  operator="equal"
                  value="480" />
   </constraints>
   ...
</feature>
```

> **Note:** When the mobile application starts, the MAF runtime evaluates the screen height value for this constraint as part of the process of dismissing application features with constraints that do not evaluate to `true`. If a user changes the orientation of the device after the mobile application starts, the runtime does not re-evaluate this constraint, because the set of application features is fixed after the mobile application starts.

- `hardware.screen.availableWidth`—Indicates the available width of the device's screen in its current orientation. Enter a numerical value that reflects the screen's width in terms of logical pixels, such as 320 or 480, as shown in Example 15–17. The value depends on the orientation of the device.

Example 15–17 Using the hardware.screen.availableWidth Property

```
<feature ...>
   ...
   <constraints>
```

```
      <constraint property="hardware.screen.availableWidth"
                  operator="equal"
                  value"320" />
   </constraints>
   ...
</feature>
```

- `hardware.screen.availableHeight`—Indicates the available height of the screen for the device in its current position. Enter a numerical value that reflects the screen's width in terms of logical pixels, such as 320 or 480, as shown in Example 15–18. The value depends on the orientation of the device.

Example 15–18 Using the hardware.screen.availableHeight Property

```
<feature ...>
   ...
   <constraints>
      <constraint property="hardware.screen.availableHeight"
                  operator="equal"
                  value"480" />
   </constraints>
   ...
</feature>
```

15.2.6 Creating Dynamic Constraints on Application Features and Content

In addition to displaying or hiding an application feature or user interface content based on the static constraints that are defined by the `name`, `operator`, and `value` attributes, you can enable a mobile application to render its application features and content dynamically by defining constraints with EL expressions. The dynamic evaluation of constraints based on EL expressions enables you to write expressions that can call your own bean logic, write complex EL expressions, or even write logic-accessing application preferences. Defining constraints as EL expressions provides flexibility in that the MAF runtime may initially hide an application feature if it evaluates an EL expression as `false`, but may display it at a later point when it evaluates the same EL expression as `true`. The `<adfmf:constraintExpression>` element enables you to define constraints on an application feature using EL expressions, as illustrated by the deferred method expression in Example 15–19.

Example 15–19 Defining a Dynamic Constraint with EL Expressions

```
<adfmf:constraints>
   <adfmf:constraint id="c1" property="hardware.screen.dpi" operator="more" value="120"/>
   <adfmf:constraint id="c2" property="device.model" operator="equal" value="iPad"/>
   <adfmf:constraintExpression id="c3" value="#{myBean.checkConstraint}"/>
</adfmf:constraints>
```

As also illustrated by Example 15–19, you can nest this element among the static constraints defined within the `<adfmf:constraints>` element of the `maf-feature.xml` file. For more information, see *Oracle Fusion Middleware Tag Reference for Oracle Mobile Application Framework*.

15.2.6.1 About Combining Static and EL-Defined Constraints

The MAF runtime must evaluate all the criteria of a static constraint to `true` to enable it to display. It displays application features and content when it evaluates the

constraint EL expressions as `true`, but hides them when it evaluates the expressions as `false`.

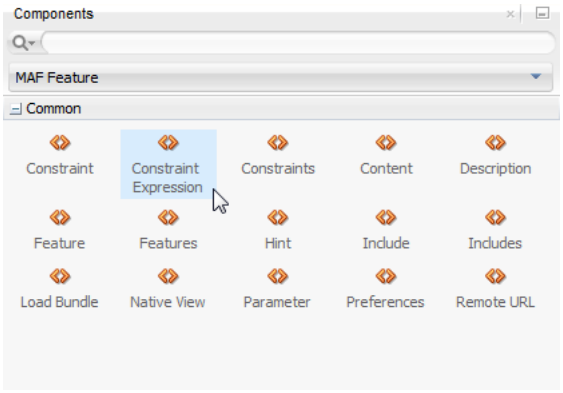
15.2.6.2 How to Define a Dynamic Constraint

Unlike static constraints, you do not create (or update) a dynamic constraint using the `maf-feature.xml` overview editor. Instead, you create an `<adfmf:constraintExpression>` by dragging the Constraint Expression component into either the Source editor or the Structure window and then use the Expression Builder to populate this component with the EL expression.

To define an Constraint Expression component:

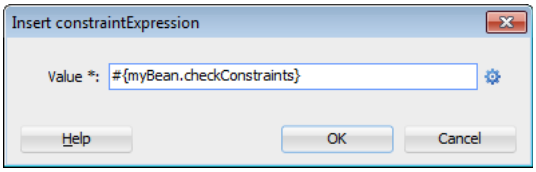
1. Choose the Source editor for the `maf-feature.xml` file.
2. Navigate to the `<adfmf-constraints>` element.
3. In the Components window, select the Common components, as illustrated in Figure 15–4.

Figure 15–4 The Constraint Expression Component



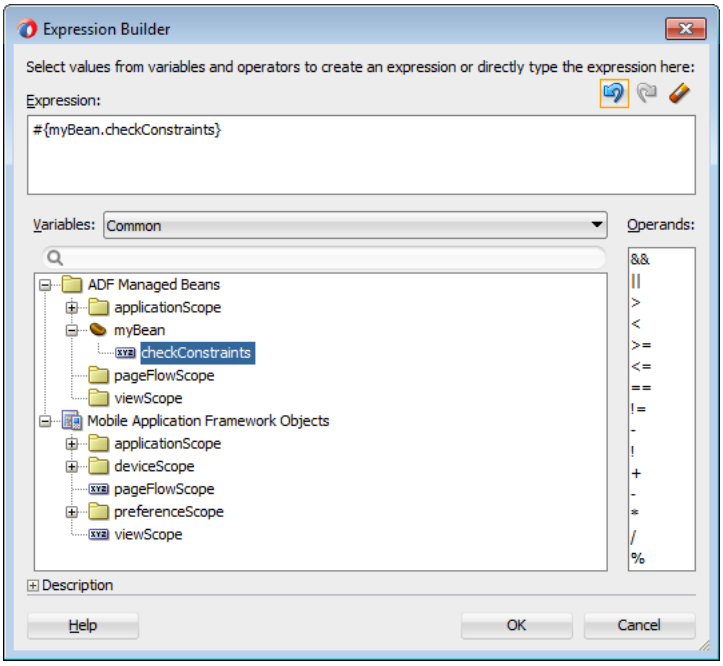
4. Choose the Constraint Expression component and add it to the `<adfmf-constraints>` element using any of the following methods:
   - Double-click the Constraint Expression component in the Components window.
   - Drag the Constraint Expression component into the `<adfmf-constraints>` element in the Source editor.
   - Drag the Constraint Expression component into the Constraints node of the Structure window.
5. Enter the EL expression in the Insert constraintExpression dialog, shown in Figure 15–5, or create an EL expression with the Expression Builder, which you access by clicking the Property Menu icon (the gear) in this dialog.

Figure 15–5 Defining an EL Constraint Using the InsertconstraintExpession Dialog



Example 15–6 illustrates creating an EL expression from the ADF Managed Bean category. However, you can create an constraint's EL expression from any of the categories described in Section 7.3.5, "About the Categories in the Expression Builder."

Figure 15–6 Building a Constraint's EL Expression



6. Click **OK**.

16 Accessing Data on Oracle Cloud

This chapter describes how a mobile application can access data hosted on Oracle Java Cloud Service.

This chapter includes the following section:

- Section 16.1, "Enabling Mobile Applications to Access Data Hosted on Oracle Cloud"

16.1 Enabling Mobile Applications to Access Data Hosted on Oracle Cloud

Mobile applications can access both SOAP and REST web services hosted on Oracle Cloud. To enable access to the hosted SOAP web services, create a web service data control as described in Section 8.2, "Creating Web Service Data Controls." You can enable access to RESTful web services by creating a web service data control. Depending on the content type, mobile applications can access cloud data by dragging and dropping a data control into a MAF AMX user interface component, as described in Section 5.3.2, "How to Add UI Components and Data Controls to a MAF AMX Page," or programmatically, for applications whose content is delivered from a either a remote web server, or from locally stored HTML files.

16.1.1 How to Authenticate Against Oracle Cloud

You use the MAF Login Server Connection dialog to create a login server connection to authenticate against Oracle Cloud.

Before you begin:

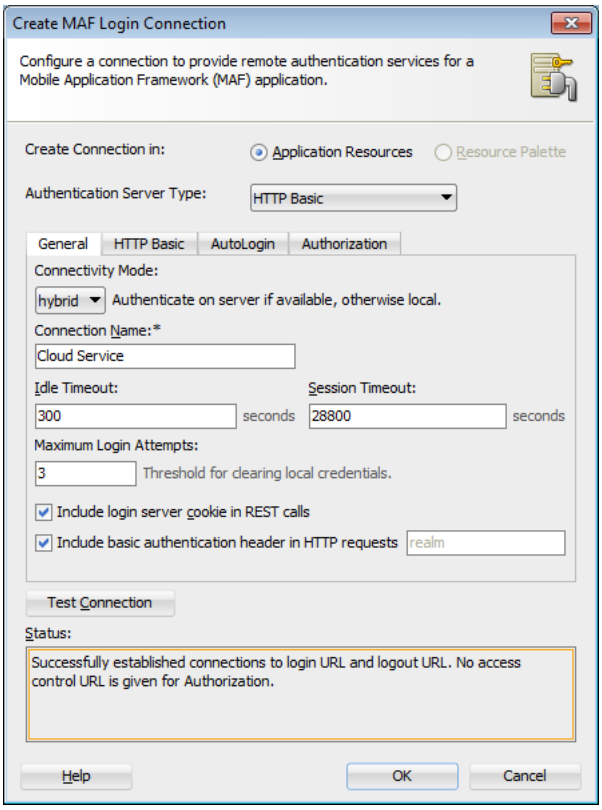
Obtain the Oracle Cloud URL that is used for the login server connection.

To create a login URL with an Oracle Cloud endpoint:

1. Select **Application**, then **New**, and then **Connections**.
2. Select **MAF Server Login Connection**.
3. Complete the Connect MAF Login Connection dialog, shown in Figure 16–1, by entering the following:
   - A name for the connection in the **Name** field.
   - The URL for Oracle Cloud in the **Login URL** field.

   For more information, refer to the Oracle JDeveloper online help and Section 21.5.2, "How to Designate the Login Page."

Figure 16–1 Creating the Login to Oracle Cloud



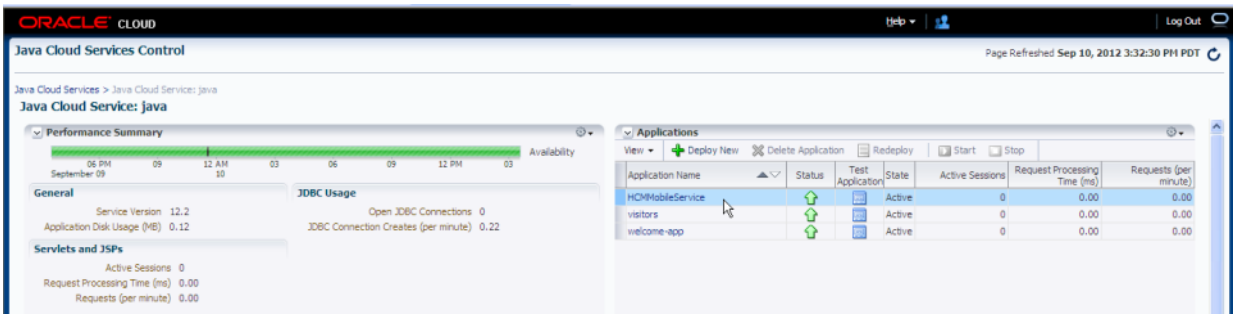
16.1.2 How to Create a Web Service Data Control to Access Oracle Java Cloud

The Create Data Service Control Wizard enables you to create the data control that accesses the hosted data. You use the WSDL URL of the SOAP web service deployed to Oracle Java Cloud to create this data control. If you do not know this URL, then you must create the URL to the WSDL document by appending the web service port name and `?wsdl` to the application context root.

Before you begin:

You must have access to a SOAP web service application that has been deployed to Oracle Java Cloud Service. This application must be available through the Applications pane of the Oracle Java Cloud Service Control home page. In addition, its Status and State must be noted as both Up and Active, respectively, as illustrated by the HCMMobileService application shown in Figure 16–2.

Figure 16–2 The Java Cloud Services Control Home Page



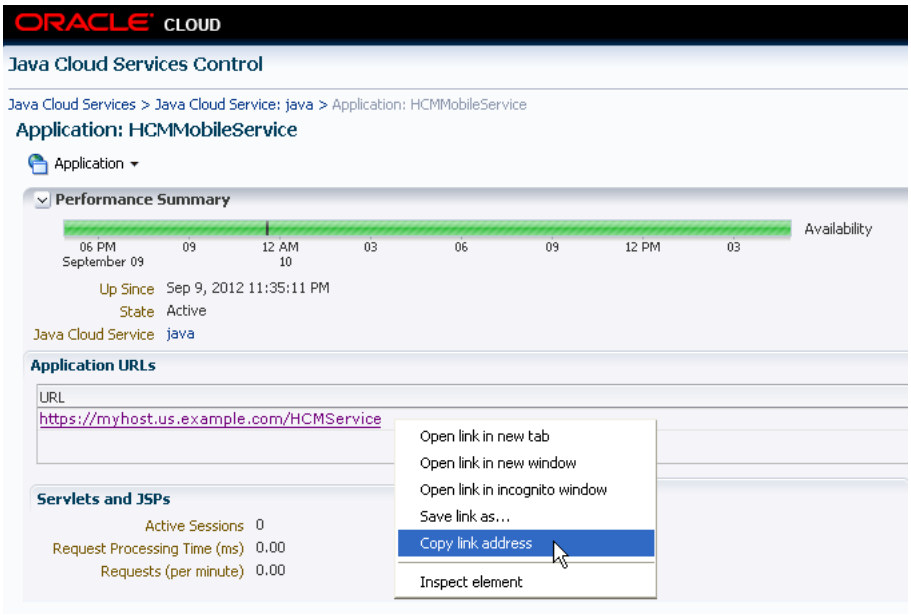
To create a web service data control:

1. Obtain the application context root of the web service hosted on Oracle Cloud as follows:

   a. Traverse to the application home page, shown in Figure 16–3, by clicking the application in the Applications pane (shown in Figure 16–2).

   b. Copy the URL, as shown in Figure 16–3. This URL is the application context root of the WSDL document.

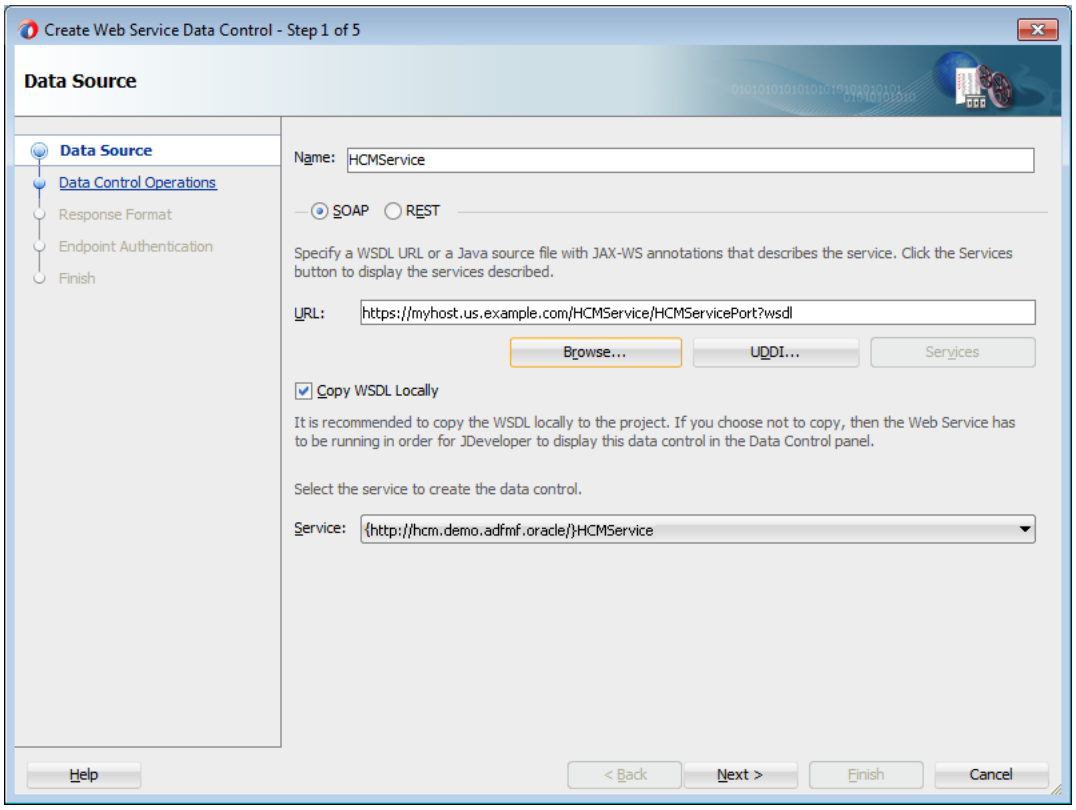
Figure 16–3 Copying the Web Service Application Context Root



2. In JDeveloper, right-click the view controller project in the Application Navigator and then open the Create Web Service Data Control Wizard, as described in Section 8.2, "Creating Web Service Data Controls."

3. In the Data Source page, shown in Figure 16–4, enter the name of the data control.

Figure 16–4 Entering the URL for the WSDL Document



4. In the **URL** field, paste the URL of the SOAP-based web service that is deployed to (and currently running on) Oracle Cloud Java Service.
5. Enable the data control to access the WSDL by appending a web service port name and `?wsdl` to the application context root, such as `HCMServicePort?wsdl` in Figure 16–4.
6. In the Data Controls Operations page, shown in Figure 16–5, select from among the web service operations that can be used by the application feature to retrieve data. Click **Finish**.

Figure 16–5 Selecting the Web Service Operations

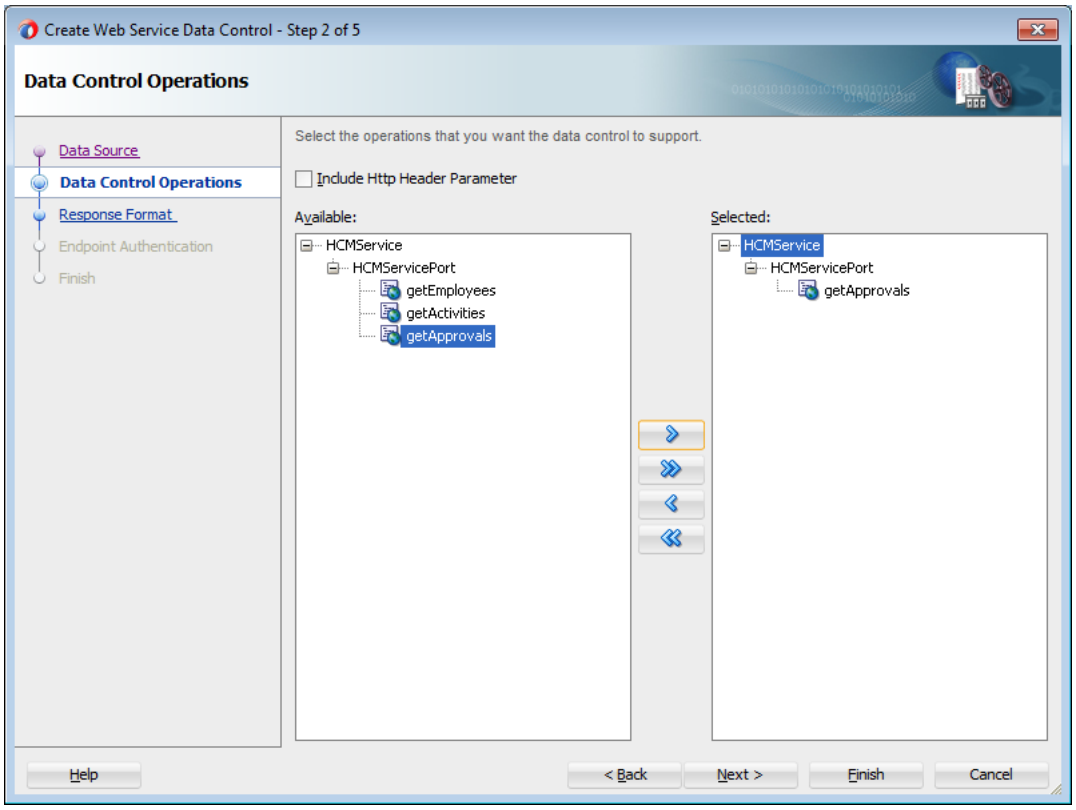


Figure 16–5 shows the web service operations returned by the MAF design time that can be made available to the mobile application. In this example, the design time has queried a web service that hosts human resources data and has returned operations to retrieve employee data, including expense approvals.

16.1.2.1 Configuring the Policy for SOAP-Based Web Services

You must configure a policy for a SOAP-based web service that is secured on Oracle Cloud. Using the Edit Data Service Control Policies dialog, described at Section 8.5, "Accessing Secure Web Services," you can select the `oracle/wss_http_token_over_ssl_client_policy`. For descriptions of this (and other) policies, see "Determining Which Predefined Policies to Use" and "Predefined Policies" chapters in *Oracle Fusion Middleware Securing Web Services and Managing Policies with Oracle Web Services Manager*.

Note: Only the `oracle/wss_http_token_over_ssl_client_policy` is supported for SOAP-based web services. For RESTful web services, MAF supports both basic authentication and SSL policies.

16.1.3 What Happens When You Deploy a Mobile Application that Accesses Oracle Java Cloud Service

After you deploy the application, the operations of the web service data control retrieve the data from a web service running on the Oracle Java Cloud Service instance.

17 Enabling Push Notifications

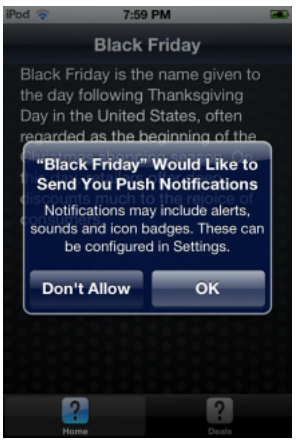
This chapter describes how to enable mobile applications to register for, and handle, push notification messages.

This chapter includes the following sections:

17.1 Introduction to Push Notifications

Push notifications are notifications sent from an external source, such as a server, to an application on a mobile device. These may appear as messages in the form of an alert, or as a banner, depending on the state of the application and user settings. Figure 17–1 shows a push notification alert on an iOS-powered device.

Figure 17–1 A Push Notification



When users are notified, they can launch the application, or they can choose to ignore the notification. In this case, the application is not activated. Notifications may also accompany an alert message with a brief, distinctive sound.

17.1.1 How Push Notifications Work

Applications must register with a notification service to receive push notifications. If the registration succeeds, then the notification service issues a token to the application. The application shares this token with its provider (located on a remote server), and in doing so, enables the provider to send notifications to the application through the notification service. MAF registers on behalf of the application using application-provided registration configuration, described in Section 17.2, "Enabling Push Notifications for a Mobile Application." Registration occurs upon every start of the mobile application to ensure a valid token. After a successful registration, MAF shares the token obtained from the platform-specific notification service with the provider. On iOS, the notification service is Apple Push Notification Service (APNs). Google Cloud Messaging (GCM) for Android provides the notification service for applications installed on Android-powered devices.

17.1.2 How Mobile Applications Display Notifications Depending on Application State

A mobile application can receive push notifications regardless of its state; the display of these messages, which can appear even when the application is not in the foreground, depends on the state of the mobile application and the user settings. Table 17–1 describes how the iOS operating system handles push notifications depending on the state of the mobile application.

Table 17–1 Handling Push Notifications on an iOS-Powered Device

State	Action
The mobile application is installed, but not running.	The notification message displays with the registered notification style (none, banner, or alert). When the user taps the message (if its a banner-style notification) or touches the action button (if the message appears as an alert), the mobile application launches, invoking the application notification handlers.
The mobile application is running in the background.	The notification message displays with the registered notification style (none, banner, alert). When the user taps the message (if it is a banner-style notification), or touches the action button (if the message appears as an alert), the mobile application launches, invoking the application notification handlers.
The mobile application is running in the foreground.	No notification message displays. The application notification handlers are invoked.

On the iOS and Android platforms, if the application is not running in the foreground, then any push notification messages associated with it are queued in a specific location, such as the iOS Notification Center or the notification drawer on Android-powered devices.

17.2 Enabling Push Notifications for a Mobile Application

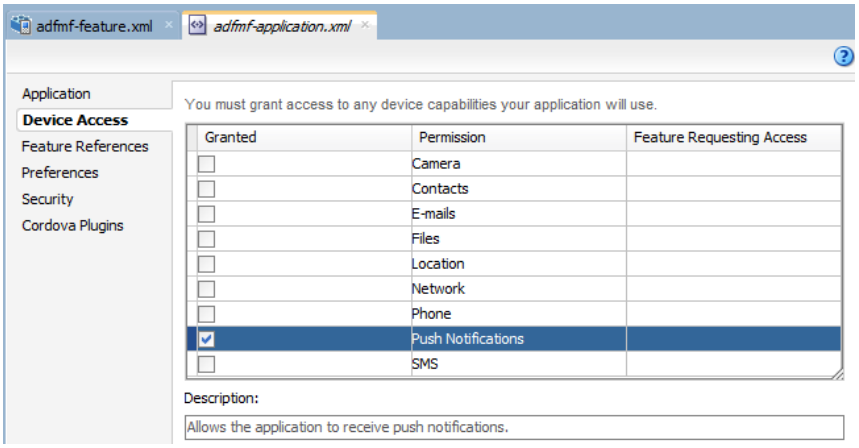
You can enable push notifications by performing the following tasks:

1. Allow the mobile application to receive push notifications by choosing **Push Notifications** in the Device Access page of the `maf-application.xml` overview

editor, as shown in Figure 17–2. For more information, see Section 21.6.1, "How to Enable Access to Device Capabilities."

Note: By default, a mobile application does not allow push notifications (nor any other device type of device access).

Figure 17–2 Allowing Push Notifications



2. In the application controller project, register an application lifecycle event listener (ALCL) class. For more information, see Section 4.3, "Setting the Basic Information for a Mobile Application" and Section 4.7, "About Lifecycle Event Listeners."

3. Implement the `oracle.adfmf.application.PushNotificationConfig` interface in the ALCL. This interface provides the configuration required to successfully register with the push notification service.

   Override and implement the `getNotificationStyle` and `getSourceAuthorizationId` methods of the `PushNotificationConfig` interface. The `getNotificationStyle` method enables you to specify the notification styles for which the application registers. The `getSourceAuthorizationId` method enables you to enter the Google Project Number of the accounts authorized to send messages to the mobile application. For more information, see *Oracle Fusion Middleware Java API Reference for Oracle Mobile Application Framework*.

4. In the application controller project, create a push notification event listener class (for example, `NativePushNotificationListener`) that handles push notification events. This class must implement the `oracle.adfmf.framework.event.EventListener` interface that defines an event listener. For more information on the `oracle.adfmf.framework.event.EventListener` interface, see *Oracle Fusion Middleware Java API Reference for Oracle Mobile Application Framework*.

   Override and implement the `onOpen`, `onMessage`, and `onError` methods to register for and receive notification events. After a successful registration with the push notification service, MAF calls the `onOpen` method with the registration token that must be shared with the provider by the application developer. The `onError` method is invoked if there is an error when registering with the notification service, with the error returned by the push notification service encapsulated as an `AdfException`.

   MAF calls the `onMessage(Event e)` method with the notification payload whenever the application receives a notification. The `Event` object can be used to

retrieve useful information about notification payload and the application state. To get the notification payload, use the `Event.getPayload` method. To get the application state at the time of notification, use the `Event.getApplicationState` method. For more information, see the `Event` class in *Oracle Fusion Middleware Java API Reference for Oracle Mobile Application Framework*.

5. Get an `EventSource` object in the `start` method of the ALCL class that represents the source of a native push notification event:

```
EventSource evtSource =
EventSourceFactory.getEventSource(EventSourceFactory.NATIVE_PUSH_NOTIFICATION_
                                                                  REMOTE_EVENT
                                                                 _SOURCE_NAME);
```

6. Create and add an object of the push notification events listener class to the event source:

```
evtSource.addListener(new NativePushNotificationListener());
```

17.3 About the Push Notification Payload

MAF respects the following keys for a JSON-formatted payload:

- `alert`: the text message shown in the notification prompt.
- `sound`: a sound that is played when the notification is received.
- `badge`: the number to badge the application icon on iOS.

Note: On Android, the payload can be a JSON object with key-value pairs. The value is always stringified, because the GCM server converts non-string values to strings before sending them to an application. This is not the case with the APNs, which preserves the value types. For more information, refer to the description of the "data" message parameter in the "Implementing GCM Server" section of *Google Cloud Messaging*. This document is available from the Android Developers website (`http://developer.android.com/index.html`) or the Android SDK documentation.

18

Handling Errors in MAF Applications

This chapter describes how to use the `AdfException` class to handle errors and how to localize error messages.

This chapter includes the following sections:

- Section 18.1, "About Error Handling for MAF"
- Section 18.3, "Localizing Error Messages"
- Section 18.2, "Displaying Error Messages and Stopping Background Threads"

18.1 About Error Handling for MAF

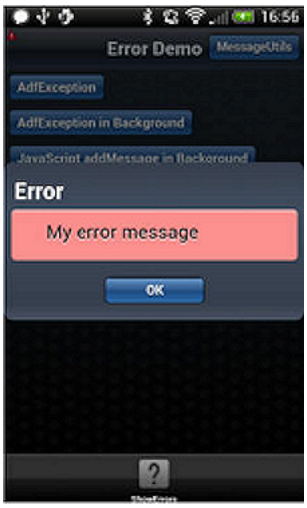
Errors arising from mobile applications might be unexpected, such as a failed connection to a remote server, or expected, such as a violation of an application business rule. Errors or exceptions might occur in the primary request thread or in a secondary thread that runs a background task. If the application supports multiple languages, then it must display the error message in the user's language.

To enable a mobile application to throw an exception, use `oracle.adfmf.framework.exception.AdfException` class. For more information, see *Oracle Fusion Middleware Java API Reference for Oracle Mobile Application Framework*.

The following code enables MAF to handle an exception gracefully. A popup message, similar to the one illustrated in Figure 18–1displays within the application and shows the message severity and explanatory text.

```
throw new AdfException("My error message",AdfException.ERROR);
```

Figure 18–1 An Error Message



Note: Similar error messages display within application when the exception is thrown within a managed bean or a data control bean.

18.2 Displaying Error Messages and Stopping Background Threads

The `MessageUtils` class, illustrated in Example 18–1, enables an application to stop a thread and display an error by first making a JavaScript call (`invokeContainerJavaScriptFunction`) and then throwing an exception. The `addMessage` method enables the error to display. For more information, see Section 18.2.1, "How Applications Display Error Message for Background Thread Exceptions." See also Section B.2.14, "invokeContainerJavaScriptFunction."

The `MessageUtils` class uses the `BundleFactory` and `Utility` methods for retrieving the resource bundle and the error message and dynamically checks if a thread is running in the background. Using this class, you can move code from the main thread to the background thread.

Example 18–1 A MessageUtils Class

```
package oracle.errorhandling.demo.mobile;

import java.util.ResourceBundle;

import oracle.adfmf.framework.api.AdfmfContainerUtilities;
import oracle.adfmf.framework.api.AdfmfJavaUtilities;
import oracle.adfmf.framework.exception.AdfException;
import oracle.adfmf.util.BundleFactory;
import oracle.adfmf.util.Utility;

public class MessageUtils {

   public static void handleError(AdfException ex) {
      handleMessage(ex.getSeverity(), ex.getMessage());
   }

   public static void handleError(String message) {
      handleMessage(AdfException.ERROR, message);
   }
```

```
   public static void handleError(Exception ex) {
      handleMessage(AdfException.ERROR, ex.getLocalizedMessage());
   }

   public static void handleMessage(String severity, String message) {
      if (AdfmfJavaUtilities.isBackgroundThread()) {
         AdfmfContainerUtilities.invokeContainerJavaScriptFunction(AdfmfJavaUtilities.
                                                                   getFeatureName(),
                                                                   "adf.mf.api.amx.addMessage",
                                                                   new Object[] {severity,
                                                                                 null,
                                                                                 null});
         if (AdfException.ERROR.equals(severity)) {
            // we still need to throw execption to stop background thread processing
            throw new AdfException(message,severity);
         }
      }
      else {
         throw new AdfException(message,severity);
      }
   }

   public static void addJavaScriptMessage(String severity, String message) {
      AdfmfContainerUtilities.invokeContainerJavaScriptFunction(AdfmfJavaUtilities.
                                                                getFeatureName(),
                                                                "adf.mf.api.amx.addMessage",
                                                                new Object[] {severity,
                                                                              message,
                                                                              null,
                                                                              null });
   }

}
```

18.2.1 How Applications Display Error Message for Background Thread Exceptions

Applications do not display error messages when exceptions are thrown for background threads. To enable error messages to display under these circumstances, applications call the `addMessage` method. The `addMessage` method takes the following parameters:

- The severity of the error
- The summary message
- The detail message
- a `clientComponentId`.

Example 18–2 illustrates how you can enable the application to alert the user when an error occurs in the background by using the `addMessage` method.

Example 18–2 Allowing the Display of an Error Message for Background Threads

```
Runnable runnable = new Runnable()
{
  public void run() {
    AdfmfContainerUtilities.invokeContainerJavaScriptFunction(AdfmfJavaUtilities.getFeatureName(),
      "adf.mf.api.amx.addMessage", new Object[] {AdfException.ERROR,
                                                 "My error message for background thread",
```

```
                                                  null,
                                                  null });
  }
};
Thread thread = new Thread(runnable);
thread.start();
```

Because the `adf.mf.api.amx.addMessage` JavaScript function is the same method that is used when the application throws `AdfException` in the primary request thread, users receive the same popup error message whether the error message is referring to exceptions in the main thread or from a background thread.

Note: As illustrated in Example 18–2, the detail message and the `clientComponentId` can be a `Null` value. A detail message displays on a new line in the same font size as the summary message.

18.3 Localizing Error Messages

MAF uses standard Java resource bundles to display an exception error message in the language of the application user. As illustrated in Example 18–3, the resource bundle name (the `.xlf` file) and bundle message key is passed to the `AdfException` constructor method to enable the error message to be read from a resource bundle.

Example 18–3 Passing the Resource Bundle Name and Message Key to the AdfException Constructor Method

```
private static final String XLF_BUNDLE_NAME="oracle.errorhandling..mobile.ViewControllerBundle";
   throw new AdfException(AdfException.ERROR, XLF_BUNDLE_NAME,
                                            "MY_ERROR_MESSAGE",
                                             null);
```

To ensure that the application does not throw an `MissingResourceException` error, use the `oracle.adfmf.util.BundleFactory` method to retrieve the resource bundle and then use the `oracle.adfmf.util.Utility` method to retrieve the error message, as illustrated in Example 18–4.

Example 18–4 Using the BundleFactory and Utility Methods to Retrieve the Resource Bundle and Error Message

```
ResourceBundle bundle = BundleFactory.getBundle(XLF_BUNDLE_NAME);
String message = Utility.getResourceString(bundle, "MY_ERROR_MESSAGE",null);
throw new AdfException(message,AdfException.ERROR);
```

Example 18–5 illustrates using the `adf.mf.api.amx.addMessage` JavaScript function to display the localized error message when an exception is thrown from a background thread.

Example 18–5 Displaying an Localized Error Method for a Background Exception

```
ResourceBundle bundle = BundleFactory.getBundle(XLF_BUNDLE_NAME);
String message = Utility.getResourceString(bundle, "MY_ERROR_MESSAGE_BG",null);
AdfmfContainerUtilities.invokeContainerJavaScriptFunction(AdfmfJavaUtilities.
                                                    getFeatureName(),
                                                    "adf.mf.api.amx.addMessage",
                                                     new Object[] {AdfException.ERROR,
                                                                   message,
                                                                   null,
```

```
                                                                null });
```

Part VI

Completing the Mobile Application

Describes how to enable security for a mobile application as well as how to deploy and debug an application

Part VI contains the following chapters:

19 Deploying Mobile Applications

This chapter describes how to deploy mobile applications for testing and for publishing.

This chapter includes the following sections:

19.1 Introduction to Deployment of Mobile Applications

Before you can publish an application for distribution to end users, you must test it on a simulator or on an actual device to assess its behavior and ease of use. By deploying an iOS application bundle (`.ipa` and `.app` files) or Android application package (`.apk`) file to the platform-appropriate device or simulator, MAF enables you to test applications before publishing them to the App Store (Apple iTunes), or to an application marketplace, such as Google Play.

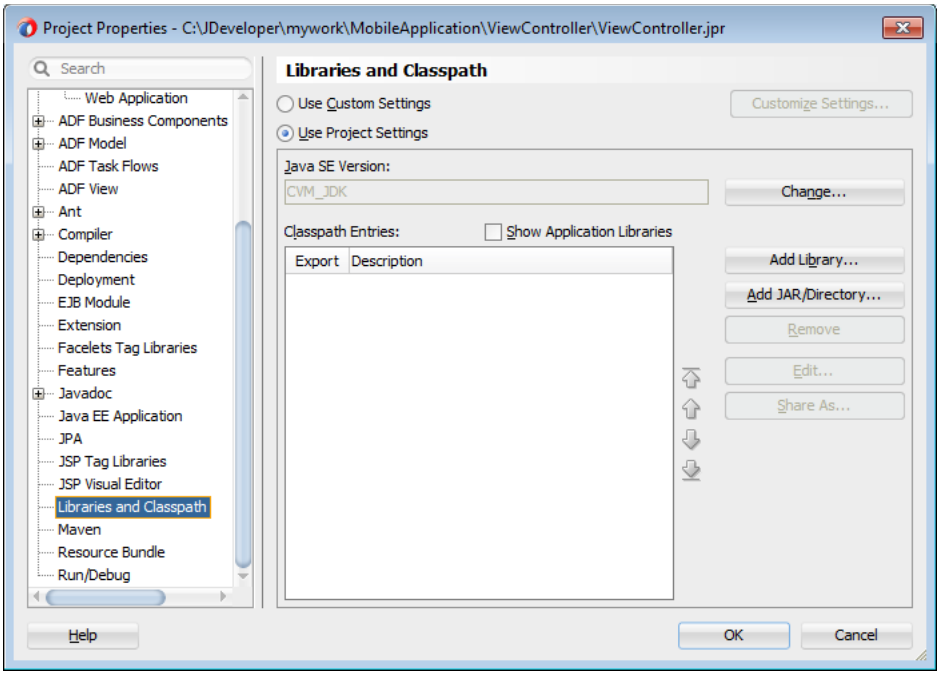
19.1.1 MAF Deployment Options

MAF executes the deployment a project by copying a platform-specific template application to a temporary location, updating that application with the code, resources, and configuration defined in the MAF project. MAF then builds and deploys the application using the tools of the target platform. You can deploy a mobile application as the platform-specific package (.ipa, .h for Android) which you can make available from a download site or application marketplace, such as the Apple App Store or Google Play. For testing and debugging, you can deploy to a simulator or to a device. You can reuse the application features by deploying the view controller projects as a feature archive (FAR). You also have the option to reuse the entire mobile application by deploying it as a Mobile Application Archive (`.maa`) file.

19.1.1.1 Deployment of Project Libraries

The libraries that you declare for the project using the Customize Libraries and Classpaths Dialog, shown in Figure 19–1, are included in the deployment artifacts for the project. This dialog enables the application features to access these libraries at runtime.

Figure 19–1 Adding Libraries to the Project



19.1.1.2 Deployment of the JVM 1.4 Libraries

For both Android and iOS applications, each MAF deployment includes a set of a different libraries that are specific to the type of deployment (release or debug) in combination with the deployment target (simulators or actual devices). In addition, each set of these libraries includes a JAR file of JVM 1.4. The application binding layer resides within this virtual machine, which is a collection of Objective-C libraries. For example, MAF deploys a JVM 1.4 JAR file and a set of libraries for a debug deployment targeted at an iOS simulator, but deploys a different JVM 1.4 JAR file and set of libraries to a debug deployment targeted to an actual iOS-powered device.

19.2 Working with Deployment Profiles

Preparing mobile applications for deployment begins with the creation of platform-specific deployment profiles. A deployment profile defines how an application is packaged into the archive that will be deployed to iOS- or Android-powered devices, iOS simulators, or Android emulators. The deployment profile does the following:

- Specifies the format and contents of the archive. For iOS, the archive format is an `.ipa` file, known as an application bundle. For Android, the format is an Android application package (`.apk`) file.

> **Note:** The `.apk` file is archive-compatible, meaning that you can view its contents using an archiving tool such as WinZip or 7-Zip.

- Lists the source files, deployment descriptors, and other auxiliary files that will be packaged into the archive file.
- Describes the type and name of the archive file to be created.
- Highlights dependency information, platform-specific instructions, and other information.

19.2.1 How to Create a Deployment Profile

As described in Section 3.2.2.4, "About Automatically Generated Deployment Profiles," MAF creates a set of deployment profiles when you create a mobile application. You can deploy an application using these profiles, edit them, or construct new ones using the MAF-specific deployment profile pages. The Create Deployment Profile wizard, shown in Figure 19–2, enables you to create a default deployment profile from these pages. You can create as many deployment profiles as needed. For more information on these standard deployment profile pages, click **Help** to see the JDeveloper online help.

> **Note:** MAF application deployment only requires the creation of an application-level deployment profile; you do not have to create a view controller-level deployment profile.

Before you begin:

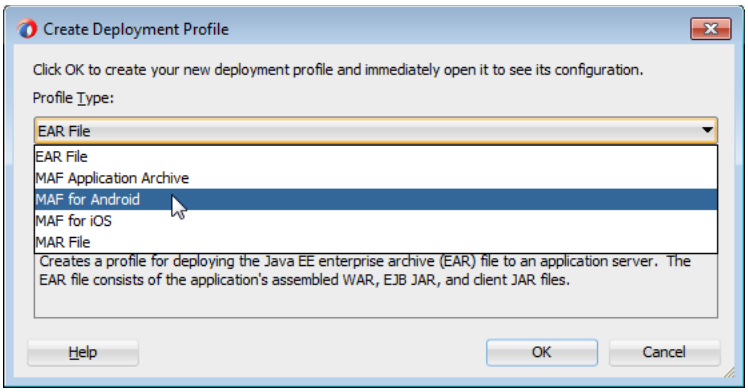
To enable JDeveloper to deploy mobile applications, you must designate the SDKs for the target platforms using the MAF Preferences page as described in Section 2.3.1, "How to Configure the Development Environment for Platforms and Form Factors." d

> **Tip:** For iOS deployments, run iTunes and the iOS Simulator at least once before you configure their directory locations in the MAF Platforms preferences page.

To create a deployment profile:

1. Choose **Application** and then **Deploy**.
2. Choose **New Deployment Profile**.
3. Depending on the target platform, select either **MAF for Android**, **MAF for iOS**, or **MAF Application Archive**, as shown in Figure 19–2.
4. Accept the default name for the profile or enter a new one. Click **OK**.
5. If needed, use the Options and Application Images pages as required for the applications and then click **OK**.

Figure 19–2 The Create Deployment Profile Wizard



19.2.2 What Happens When You Create a Deployment Profile

After you complete the wizard, JDeveloper creates a deployment profile and opens the Deployment Profile Properties editor.

Table 19–1 lists the MAF-specific pages in the Deployment Profile Properties editor, shown in Figure 19–5.

Table 19–1 MAF-Specific Deployment Profile Pages

Page	Function
iOS Options	Enables you to modify the settings for an application to be deployed on an iOS-powered device or iOS simulator.
Android Options	Enables you to modify the settings for an application deployed to an Android-powered device or Android emulator.
Application Images	Enables you to assign custom icons to an application by adding the appropriate graphics file.
Device Orientations	Enables you to restrict the display of an application to certain device orientations. This page is used only for iOS deployment profiles.

Note: Deployment depends on the needs of your application. You can deploy an application using the default values seeded in the pages listed in Table 19–1.

When you deploy an application, JDeveloper creates a deployment directory and related subdirectory. It also creates Feature Archive files (FARs) for the view controller projects (which must have different names) and application controller project. In addition to these two FARs, JDeveloper creates copies of any FARs that were imported into the project. Changes to the compilation profiles require the removal of the deployment directory. You can remove this directory, as well as the deployment directory within the view controller project that contains the FAR, by selecting **Build** and then **Clean All**.

19.2.3 How to Create an Android Deployment Profile

The deployment profile creates the template for the application deployment to an Android device or emulator, or for creating an application as an Android application package (`.apk`) file.

To create the deployment profile for Android, you must define the signing options for the application, the behavior of the `javac` compiler, and if needed, override the default Oracle images used for application icons with custom ones.

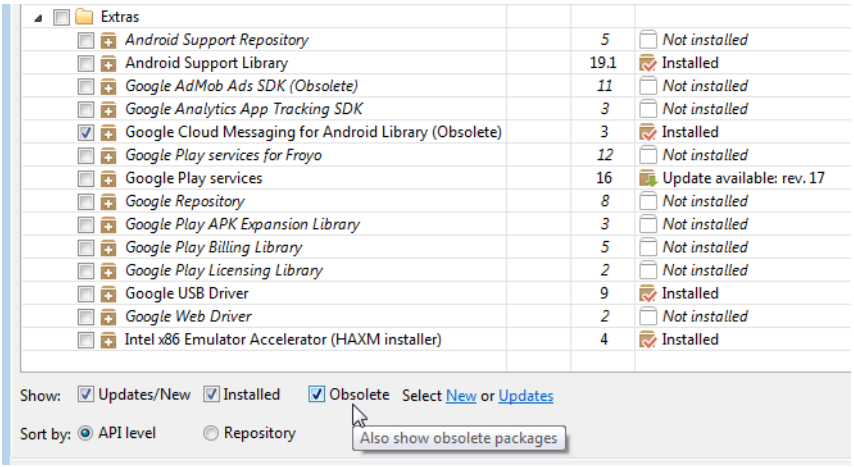
Before you begin:

Install and download the Android SDK as described in Section 2.5, "Setting Up Development Tools for Android Platform."

To enable the deployment framework to compile files required for push notifications, install the package for the Google Cloud Messaging Library (Revision 3 and later) and also the Android Support Library in the Android SDK Manager, as shown in Figure 19–3.

> **Note:** Although Google Cloud Messaging is deprecated, you must install it to enable push notifications. Select Show > Obsolete to ensure that it appears under Extras, as shown in Figure 19–3.

Figure 19–3 The Google Cloud Messaging For Android Library Package



If you deploy to an Android emulator, you must create a virtual device for each emulator instance using the Android Virtual Device Manager, as described in the "Managing Virtual Devices" document, available from the Android Developers website (`http://developer.android.com/tools/devices/index.html`).

You must also set the MAF preferences for the Android platform SDKs (accessed by choosing **Tools**, then **Preferences**, then **MAF**, then **Platforms**, and then **Android**) to the locations for the SDK and platform, which are part of the Android SDK package download. Figure 19–4 shows these locations.

The SDK and platform locations for Android 4.4.2 (API 19), which are illustrated in Figure 19–4, differ from earlier versions.

- For **Android SDK Location**, the path is:

  ```
  <SDK Installation>\adt-bundle-windows-x86\sdk
  ```

  For example, enter:

  ```
  C:\adt-bundle-windows-x86\sdk
  ```

- For **Android Platform Location**, the path is:

```
<SDK Installation>\adt-bundle-windows-x86\sdk\platforms\android-19
```

For example, enter:

```
C:\adt-bundle-windows-x86\sdk\platforms\android-19
```

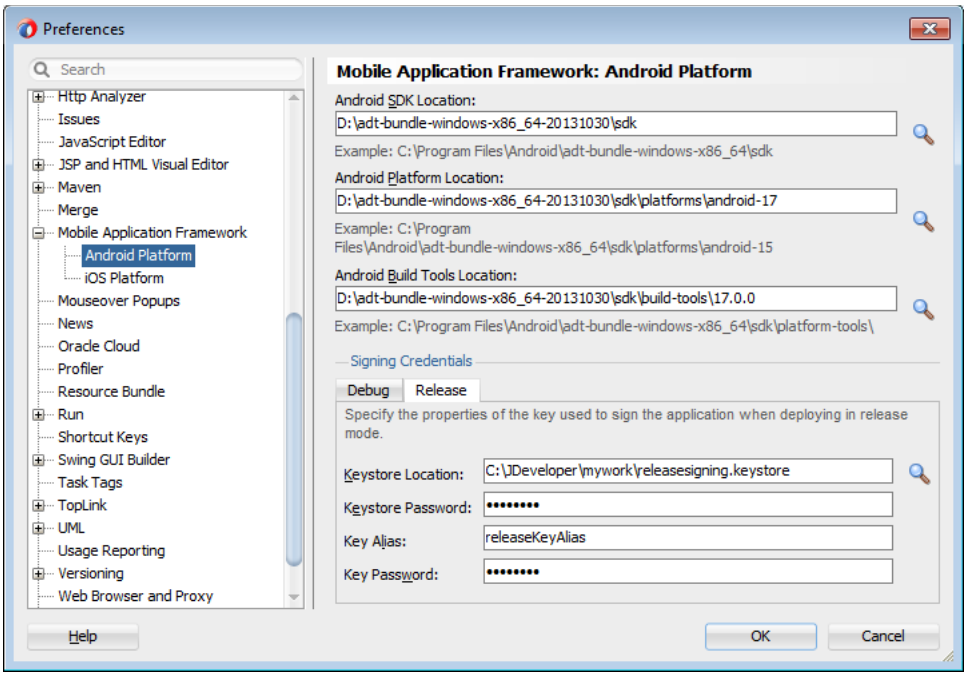
Note: The structure of the SDK tools is changed in the release of Revision 22, with the build tools components relocated from the `platform-tools` directory to the `build-tools` directory. To enable deployment, the **Android Build Tools Location** field must reference the location of the build tools, the `aapt` file (`appt.exe` on Windows systems). The location of this file differs depending on the SDK revision. For Revision 22, this file is located within the `build-tools` directory (such as *`SDK Installation`*`\adt-bundle-windows-x86\sdk\build-tools\Android-4.n`). For earlier revisions, it is located within the platform-tools directory (such as *`SDK Installation`*`\adt-bundle-windows-x86\platfrom-tools`).

MAF queries the Android SDK for the location of the `appt` file and populates the **Android Build Tools Location** field accordingly. For Revision 22 of the SDK, MAF populates the field with the latest version of the `build-tools` directory that is installed on the development computer. For revisions prior to 22, MAF populates the field with the location of the `platform-tools` directory. In this case, the field is read-only.

Note: Push notifications require devices and emulators running Android 2.2 platform (or later). The Google Play store must be installed on these devices. The Google API must be installed in the SDK to enable push notifications on emulators. Users must create a Google account (and be logged in) on devices running platforms earlier than 4.0.3 (API 15).

See also "GCM Architectural Overview" chapter in *Google Cloud Messaging for Android*, available from the Android Developers website (`http://developer.android.com/index.html`) and Section 19.2.3, "How to Create an Android Deployment Profile."

Figure 19–4 Setting the Android SDK, Platform, and Signing Properties



Using the Platforms page, you also define the debug and release properties for a key that is used to sign the Android applications. Within the deployment profile, you subsequently designate a mobile application's release type as either debug or release. You only need to define the signing key properties once. For more information, see Section 19.2.3.3, "Defining the Android Signing Options." See also the application publishing information in the "Signing Your Applications" document, available from the Android Developers website (`http://developer.android.com/tools/publishing/app-signing.html`).

> **Note:** To deploy an application to an Android emulator, you must install API 14 or later (that is, Platform 4.0.*n*)

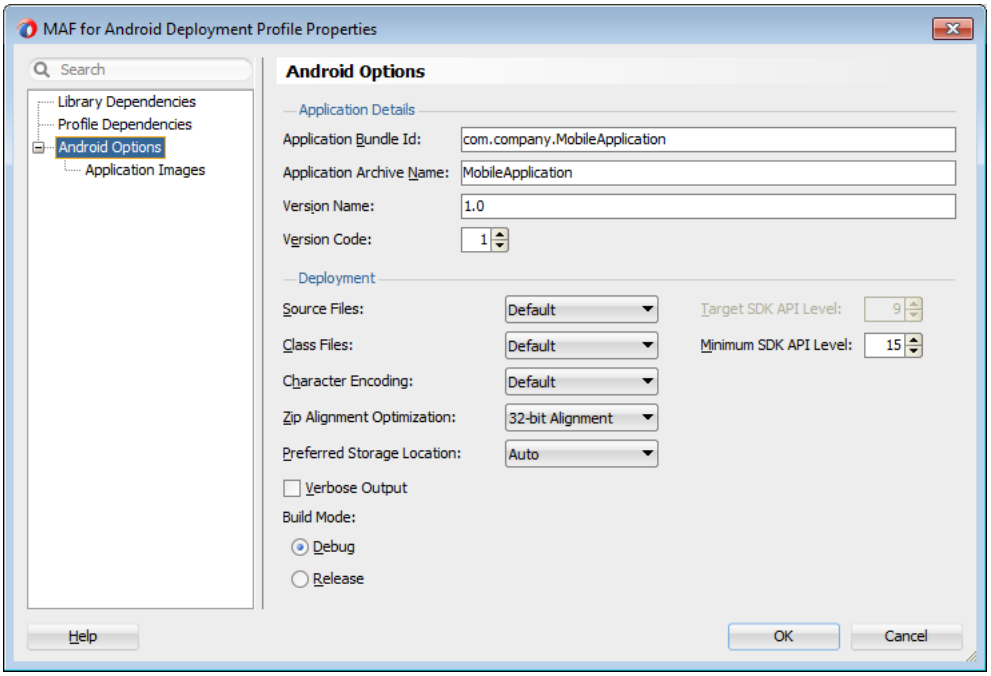
19.2.3.1 Setting the Options for the Application Details

The Android Options page, shown in Figure 19–5, enables you to do the following:

- Denote the version of the application. For more information, refer to the "Versioning Your Applications" document, available from the Android Developers website (`http://developer.android.com/tools/publishing/versioning.html`).
- Configure the Android zipalign tool, an archive alignment tool that optimizes the packaging of `.apk` files. Data files stored in each application package, such as data manifests, are continually accessed by multiple processes within the Android operating environment. For more information, see the "zipalign" document, available from the Android Developers website (`http://developer.android.com/tools/help/zipalign.html`).
- Set the logging level output as either non-verbose or debug (verbose).

- Set the signing options appropriate to the deployment target (emulator or device). For more information, see Section 19.2.3.3, "Defining the Android Signing Options."

Figure 19–5 The Deployment Profile Properties Editor (Android Options Page)



To set the application options:

1. Choose **Android Options**, as shown in Figure 19–5.
2. Accept the default values, or define the following options:
   - **Application Bundle ID**—A unique ID for the application, as set in the `id` attribute of the `maf-application.xml` file. Each application deployed to an Android device has a unique ID, one that cannot start with a numeric value. For more information, see Section 4.3, "Setting the Basic Information for a Mobile Application."

     If needed, you can override this value in the deployment file. However, for the application to deploy, this name must follow the `<manifest>` element's `package` attribute of the Android manifest file. This element is described in the document entitled "The AndroidManifest.xml File," which is available from the Android Developers website (`http://developer.android.com/guide/topics/manifest/manifest-intro.html`). Specifically, the ID uses a reverse package format of an internet domain (*com.company.application*). To avoid naming collisions, the package name reflects domain ownership, such as *com.oracle.application*.

     Note: The application bundle ID cannot contain spaces.

   - **Application Archive Name**—If needed, enter the name for the `.apk` file created by MAF. Otherwise, accept the default name.

By default, MAF bases the name of the `.apk` file on the application `id` attribute configured in the `maf-application.xml` file. For more information, see Section 4.3, "Setting the Basic Information for a Mobile Application."

- **Version Name**—The release version of the application code that displays for the user. See also Section 4.3, "Setting the Basic Information for a Mobile Application."
- **Version Code**—An integer value that represents the version of the application code, which is checked programmatically by other applications for upgrades or downgrades. The minimum and default value is 1. You can select any value and increment it by 1 for each successive release.

19.2.3.2 Setting Deployment Options

The Options page enables you to set values that are passed in by the `javac` compiler tool options, set the zipalign options, and also the Android API revisions.

To set the JDK-Compatibility level for the R.java and .class files:

1. Select the JDK-compatibility level from the **Source Files** dropdown list. The default value is 1.5. The value is specified when the deployment runs the `javac` tool to compile `R.java`, the Android-generated file for referencing application resources, using the `javac -source` option. Available values include:
   - 1.5
   - 1.6

   For information on `R.java`, see the "Accessing Resources" document, available from the Android Developers website (`http://developer.android.com/guide/topics/resources/accessing-resources.html`).
2. Select the JDK version compatibility for the compiled `.class` files from the **Class Files** dropdown list. The value is specified when the deployment runs the `javac` tool to compile the `R.java` file using the `javac -target` option. The default value is 1.5. Available values include:
   - 1.5
   - 1.6
3. Select the intended API Level on which the application is designed to run from the **Target SDK API Level** dropdown list. The minimum (and default) value is API Level 9, which corresponds to the Android 2.3.*n* platform. For more information, refer to the description of the `<uses-sdk>` attribute in the document entitled "The AndroidManifest.xml File," available through the Android Developers website (`http://developer.android.com/guide/topics/manifest/manifest-intro.html`).
4. Select the minimum API Level on which the application is able to run from the **Minimum SDK API Level** dropdown list. The minimum and default value is 15, which corresponds to Android 4.0.3 platform.
5. Select the native-encoding name that controls how the compiler interprets characters beyond the ASCII character set from the **Character Encoding** dropdown list. The default is **UTF-8**.

To set the ZIP alignment options:

Select the byte alignment (32-bit or 64-bit). Selecting 32-bit (the default) provides 4-byte boundary alignment.

To set the storage option for the deployed application:

By default, mobile applications are stored on a Android-powered device's internal storage after they have been deployed from JDeveloper to a device, or downloaded from an application marketplace, such as Google Play. The following options, which are available from the **Preferred Storage Location** dropdown list, enable you to specify a preferred storage location for the mobile application.

- **Internal**—Forces the mobile application to be installed on the device's internal storage.
- **External**—Allows the application to be installed on the device's SD card. However, if the Android system determines that the application cannot be installed on the SD card (for example, no SD card has been mounted, or the SD card exists but has insufficient space), then it installs the application on the device's internal storage instead. The mobile device user can move the application between internal and external storage using the system settings.
- **Auto**—Specifies that the application may be installed on the device's external or internal storage. The mobile device user can move the application between internal and external storage using the system settings.

Selecting the **External** or **Auto** options enables the deployment framework to update the `<manifest>` element in the `AndroidManifest.xml` file with an `android:installLocation` attribute and a value of `"preferExternal"` or `"auto"`. Populating the `AndroidManifest.xml` file with this attribute enables mobile applications to be stored on an external SD card or internal storage. For more information, see the "App Install Location" chapter in *Data Storage Guide*, available from the Android Developers website (`http://developer.android.com/guide/topics/data/install-location.html`) or from the Android SDK documentation.

To set the logging level:

Select **Verbose Output** for the Android deployment to log the full output provided by each of the command-line tools invoked by the deployment while building the `.apk`. If you do not select this option, then the deployment does not log the full output.

19.2.3.3 Defining the Android Signing Options

An application must be signed before it can be deployed to an Android device or emulator. Android does not require a certificate authority; an application can instead be self-signed.

Defining how the deployment signs a mobile application is a two-step process: within the MAF Platforms preference page, you first define debug and release properties for a key that is used to sign Android applications. You only need to configure the debug and release signing properties once. After you define these options, you configure the deployment profile to designate if the application should be deployed in the debug or release mode.

Before you begin:

If no keystore file exists, you can create one using the keytool utility, as illustrated in Example 19–1.

Example 19–1 Generating a Keystore

```
keytool -genkey
        -v
        -keystore c:\jdeveloper\mywork\releasesigning.keystore
        -alias releaseKeyAlias
        -keyalg RSA
        -keysize 2048
        -validity 10000
```

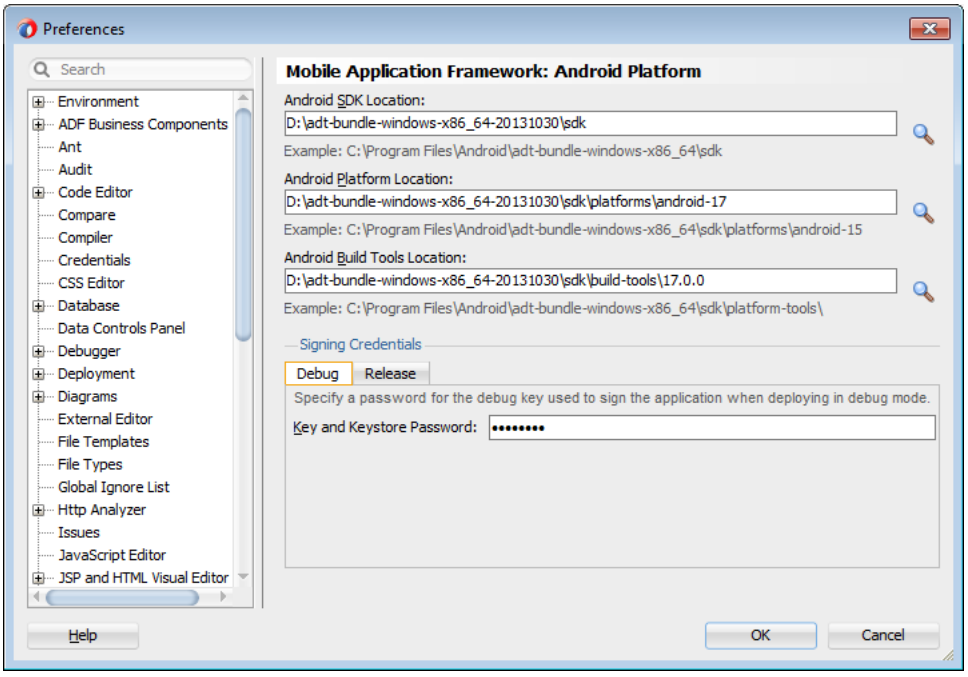
As described in the "Signing Your Applications" document, available from the Android Developers website (http://developer.android.com/tools/publishing/app-signing.html), the keytool prompts you to provide passwords for the keystore and key, and to provide the Distinguished Name fields for your key before it generates the keystore. In Example 19–1, the keystore contains a single key, valid for 10,000 days. Refer to Java SE Technical Documentation (http://download.oracle.com/javase/index.html) for information on how to use the keytool utility.

> **Tip:** Use the `-genkeypair` instead of the `-genkey` command for Java Platform Standard Edition (Java SE) 7.

To configure the key options for the debug mode:

1. Choose **Tools**, then **Preferences**, and then **Mobile Application Framework**.
2. Choose **Platforms**.
3. Select the Debug tab, shown in Figure 19–6.

Figure 19–6 Configuring a Debug Deployment



4. Enter a password used by the deployment to create a keystore file and key needed for a debug deployment in the **Key and Keystore Password** field. This password, which generates a keystore and keyfile for deployment to an Android-powered

device or emulator, can be any value, but must be at least six characters long. The default password is *Android*.

To configure the key options for a release mode:

1. Choose **Tools**, then **Preferences**, and then **Mobile Application Framework**.
2. Choose **Platforms**.
3. Select the Release tab, shown in Figure 19–4, and then define the following:
   - **Keystore Location**—Enter, or browse to and retrieve, the directory of the keystore containing the private key used for signing the application for distribution.
   - **Keystore Password**—Enter the password for the keystore. This password allows access to the physical file.
   - **Key Alias**—Enter an alias for the key. This is the value set for the keytool's `-alias` argument. Only the first eight characters of the alias are used.
   - **Key Password**—Enter the password for the key. This password allows access to the key (identified by the alias) within the keystore.

     Tip: Enter the password and key password requested by the keytool utility before it generates the keystore.

     In addition to designating how the application will be signed, these parameters designate how the `R.Java` classes are compiled.
4. Click **OK**.

To Set the Android build mode:

1. In the Options page, select either **Debug** or **Release** as the build mode:
   - Select **Debug** for developing and testing an application (such as Java and JavaScript debugging). This option enables you to deploy an application on the Android platform without having to provide a private key. Use this option when deploying an application to an Android emulator or to an Android-powered device for testing. See also Section 22.3.5, "How to Enable Debugging of Java Code and JavaScript."

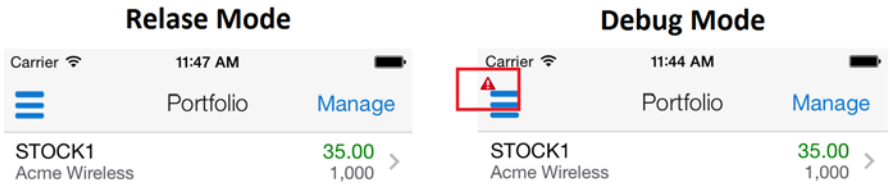
     Note: You cannot publish an application signed with the debug keystore and key; this keystore and key are used for testing purposes only and cannot be used to publish an application to end users.

   - When the application is ready to be published, select **Release**. Use this option when the application is ready to be published to an application marketplace, such as Google Play.

     Tip: Use the release mode, not the debug mode, to test application performance.
2. Click **OK**.

   After the `.apk` file is signed in either debug or release mode, you can deploy it to a device or to an emulator. At runtime, MAF indicates that an application has been deployed in debug mode by overlaying a debugging symbol that is represented by an exclamation point within a red triangle, as shown in Figure 19–7.

Figure 19–7 Deployment Modes



19.2.3.4 What You May Need to Know About Credential Storage

MAF stores passwords for the key and keystore in the file-based credential store, `cwallet.sso`. This file, which manages credential storage and retrieval, is located within the `o.maf` folder in the user's JDeveloper system folder. For example, in a Windows 7 environment, the `cwallet.sso` file is located at `C:\Users\jsmith\AppData\Roaming\JDeveloper\system12.1.3\o.maf`.

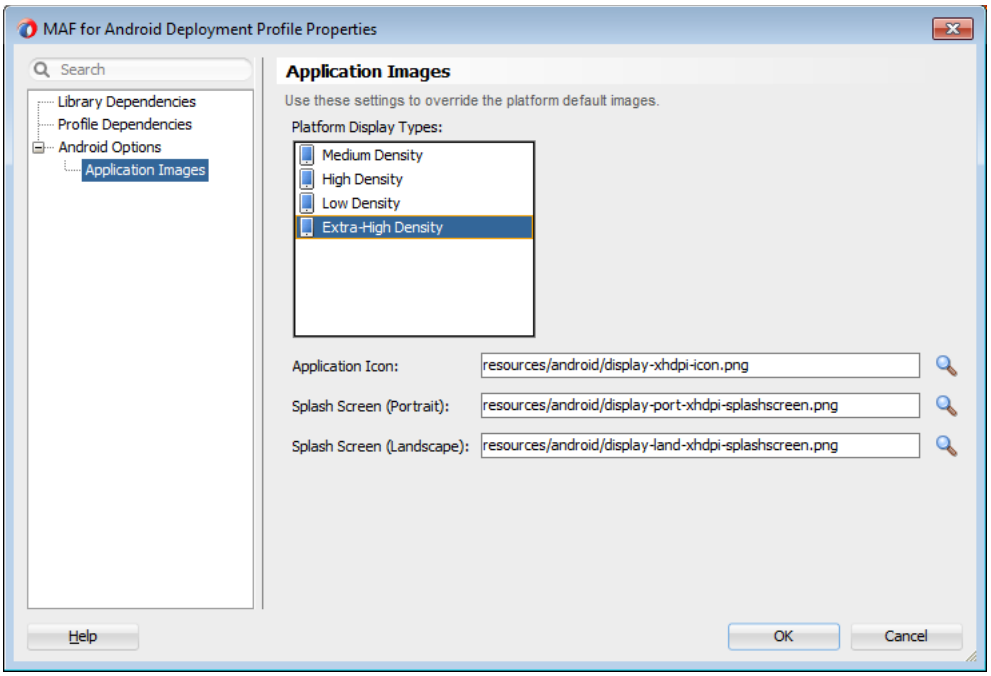
For more information, see the "About Oracle Wallet" section in *Oracle Fusion Middleware Administrator's Guide* and the "Credential Store Basics" section in *Oracle Fusion Middleware Securing Applications with Oracle Platform Security Services*.

Note: MAF stores the key and keystore credentials in a file called `product-preferences.xml`. MAF migrates these credentials to the `cwallet.sso` file if you preserve the preference settings by clicking **Yes** in the Confirm Import Preferences dialog during the installation process of the current version of JDeveloper and MAF. However, the `cwallet.sso` file is not migrated to other installations of the current version of Oracle JDeveloper with MAF. If you reinstall (or create a separate installation), you must either copy the `cwallet.sso` file to the `o.maf` folder or reconfigure the release mode credentials in the Platforms preferences page.

19.2.3.5 How to Add a Custom Image to an Android Application

Enabling MAF application icons to display properly on Android-powered devices of different sizes and resolutions requires low-, medium-, and high-density versions of the same images. MAF provides default Oracle images that fulfill these display requirements. However, if the application requires custom icons, you can use the Application Images page, shown in Figure 19–8, to override default images by selecting PNG-formatted images for the application icon and for the splash screen. For the latter, you can add portrait and landscape images. If you do not add a custom image file, then the default Oracle icon is used instead. To create custom images, refer to the "Iconography" document, available from the Android Developers website (`http://developer.android.com/design/style/iconography.html`).

Figure 19–8 Setting Custom Images for an Android Application



Before you begin:

Obtain the images in the PNG, JPEG, or GIF file format that use the dimensions, density, and components that are appropriate to Android theme and that can also support multiple screen types. For more information, see "Supporting Multiple Screens" document, available from the Android Developers website (`http://developer.android.com/guide/practices/screens_support.html`).

To add custom images:

1. Click **Application Images**.
2. Use the **Browse** function to select the splash screen and icon image files from the project file. Figure 19–8 shows selecting images for application icons and portrait orientation splash screen images that applications use for displaying on devices with low-, medium-, high- and extra-high density displays.
3. Click **OK**.

19.2.3.6 What Happens When JDeveloper Deploys Images for Android Applications

During deployment, MAF enables JDeveloper to copy the images from their source location to a temporary deployment folder. For the default images that ship with the MAF extension (located at *`application workspace directory`*`\Application Resources\Resources\images`), JDeveloper copies them from their seeded location to a deployment subdirectory of the view controller project (*`application workspace`*`\ViewController\deploy`). As shown in Table 19–2, each image file is copied to a subdirectory called `drawable`, named for the `drawable` object, described on the Android Developers website (`http://developer.android.com/reference/android/graphics/drawable/Drawable.html`). Each `drawable` directory matches the image density (`ldpi`, `mdpi`, `hdpi`, and `xhdpi`) and orientation (`port`, `land`). Within these directories, JDeveloper

renames each icon image file as `adfmf_icon.png` and each splash screen image as `adfmf_loading.png`.

Table 19–2 Deployment File Locations for Seeded Application Images

Source File (...\resource\Android)	Temporary Deployment File (...ViewController\deploy)
display-ldpi-icon.png	drawable-ldpi\adfmf_icon.png
display-mdpi-icon.png	drawable-mdpi\adfmf_icon.png
display-hdpi-icon.png	drawable-hdpi\adfmf_icon.png
display-xhdpi-icon.png	drawable-xhdpi\adfmf_icon.png
display-port-ldpi-splashscreen.png	drawable-port-ldpi\adfmf_loading.png
display-port-mdpi-splashscreen.png	drawable-port-mdpi\adfmf_loading.png
display-port-hdpi-splashscreen.png	drawable-port-hdpi\adfmf_loading.png
display-port-xhdpi-splashscreen.png	drawable-port-xhdpi\adfmf_loading.png
display-land-ldpi-splashscreen.png	drawable-land-ldpi\adfmf_loading.png
display-land-mdpi-splashscreen.png	drawable-land-mdpi\adfmf_loading.png
display-land-hdpi-splashscreen.png	drawable-land-hdpi\adfmf_loading.png
display-land-xhdpi-splashscreen.png	drawable-land-xhdpi\adfmf_loading.png

For custom images, JDeveloper copies the set of application icons from their specified location to the corresponding density and orientation subdirectory of the temporary deployment location.

19.2.4 How to Create an iOS Deployment Profile

For iOS, use the Deployment Profiles Properties Editor to define the iOS application build configuration as well as the locations for the splash screen images and application icons.

Before you begin:

Download Xcode (which includes the Xcode IDE, performance analysis tools, the iOS simulator, the Mac OS X, and the iOS SDKs) to the Apple computer that also runs JDeveloper.

> **Tip:** Refer to the Certification and Support Matrix on Oracle Technology Network (http://www.oracle.com/technetwork/developer-tools/maf/documentation) for the minimum supported version required to compile applications.

Because Xcode is used during deployment, you must install it on the Apple computer before you deploy the mobile application from JDeveloper.

> **Tip:** While the current version of Xcode is available through the App Store, you can download prior versions through the following site:
>
> https://developer.apple.com/xcode/
>
> Access to this site requires an Apple ID and registration as an Apple developer.

After you download Xcode, you must enter the location of its xcodebuild tool and, for deployment to iOS simulators, the location of the iOS simulator's SDK, in the iOS Platform preference page. For more information, see Chapter 2.3.1, "How to Configure the Development Environment for Platforms and Form Factors."

Note: Run both iTunes and the iOS simulator at least once before entering their locations in the iOS Platform preference page.

To deploy a mobile application to an iOS-powered device (as opposed to deployment to an iOS simulator), you must obtain both a provisioning profile and a certification from the iOS Provisioning Profile as described in Section 19.2.4.2, "Setting the Device Signing Options."

To create a deployment profile:

1. Choose **iOS Options**, as shown in Figure 19–9.
2. Accept the default values, or define the following:
   - **Application Bundle Id**—If needed, enter a bundle ID to use for this application that identifies the domain name of the company. The application bundle Id must be unique for each application installed on an iOS device and must adhere to reverse-package style naming conventions (that is, *com.<organization name>.<company name>*). For more information, see the *App Distribution Guide*, which is available through the iOS Developer Library at `http://developer.apple.com/library/ios/navigation/`). For information on obtaining the Bundle Seed Id using the iOS Provisioning Portal, see Section 19.4.4.3, "Registering an Application ID." See also Section 4.3, "Setting the Basic Information for a Mobile Application."

     Note: The application bundle ID cannot contain spaces.

     Because each application bundle ID is unique, you can deploy multiple mobile applications to the same device. Two applications can even have the same name as long as their application bundle IDs are different. Mobile applications deployed to the same device are in their own respective sandboxes. They are unaware of each other and do not share data (they have only the Device scope in common).
   - **Application Archive Name**—If needed, enter the name for the `.ipa` file or the `.app` file. MAF creates an `.ipa` file when you select either the **Deploy to distribution package** or **Deploy to iTunes for synchronization to device** options in the Deployment Action dialog, shown in Figure 19–22. It creates an `.app` file when you select the **Deploy application to simulator** option. Otherwise, accept the default name. For more information, see Section 19.4.2, "How to Deploy an Application to an iOS-Powered Device" and Section 19.4.5, "How to Distribute an iOS Application to the App Store."

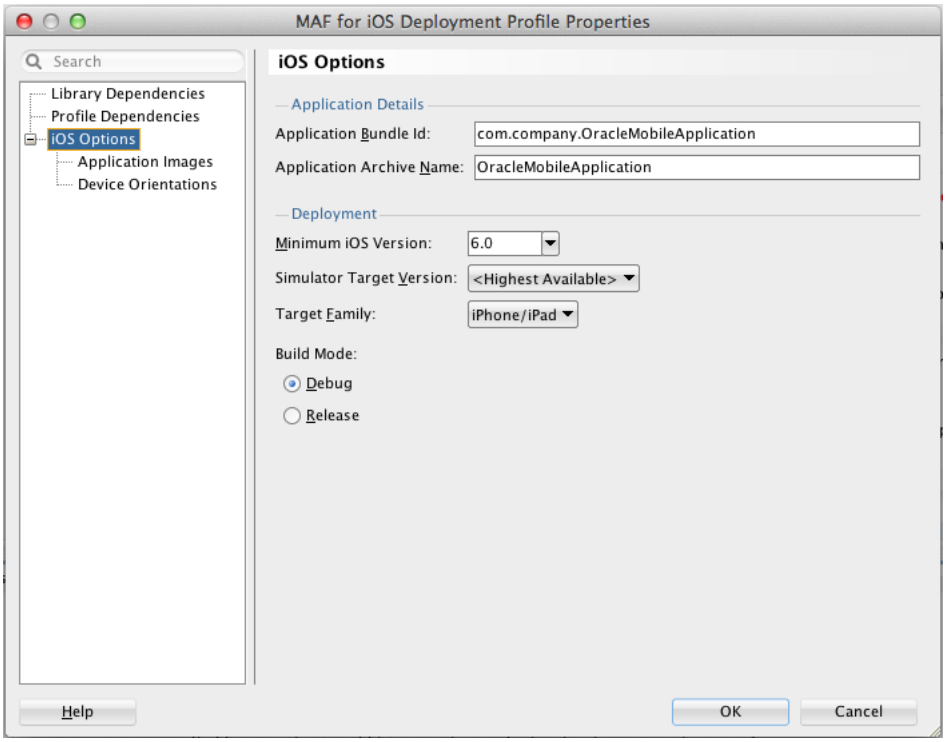
     By default, MAF bases the name of the `.ipa` file (or `.app` file) on the application `id` attribute configured in the `maf-application.xml` file. For more information, see Section 4.3, "Setting the Basic Information for a Mobile Application."
   - **Minimum iOS Version**—Indicates the earliest version of iOS to which you can deploy the application. The default value is the current version. The version depends on the version of the installed SDK.

- **Simulator Target Version**—Select the version of the emulator to which you are deploying the application. To find the available target versions, select **Hardware** and then **Version** on an iPhone simulator. The minimum version is 6.0. The default setting is **<Highest Available>**. For more information, see the *iOS Simulator User Guide*, which is available through the iOS Developer Library (`http://developer.apple.com/library/ios/navigation/`).

  Note: Older versions of the iOS target version are usually available in the simulator for testing.

- **Target Family**—Select the family of iOS products on which the application is intended to run. The default option is for both iPad and iPhone.

Figure 19–9 Setting the iOS Options



19.2.4.1 Defining the iOS Build Options

The iOS build options enable you to deploy an application with debug or release bits and libraries. The Options page presents the configuration options for the iOS signing modes, debug and release modes.

Before you begin:

Deployment of an iOS application (that is, an `.ipa` file) to an iOS-powered device requires a provisioning profile, which is a required component for installation, and also a signed certificate that identifies the developer and an application on a device. You must obtain these from the iOS Provisioning portal as described in Section 19.4.4, "What You May Need to Know About Deploying an Application to an iOS-Powered Device." In addition, you must enter the location for a provisioning profile and the name of the certificate in the iOS Platform preference page, as described in Section 19.2.4.2, "Setting the Device Signing Options."

How to set the build options:

1. Chose **iOS Options**, as shown in Figure 19–9.
2. Select one of the following build options.
   - **Debug**—Select this option for development builds. Designating a debug build results in the inclusion of debugging symbols. See also Section 22.3.2, "How to Debug on iOS Platform" and Section 22.3.5, "How to Enable Debugging of Java Code and JavaScript."
   - **Release**—Select to compile the build with release bits and libraries.

     Tip: Use the release mode, not the debug mode, to test application performance.

At runtime, MAF indicates that an application has been deployed in the debug mode by overlaying a debugging symbol that is represented by an exclamation point within a red triangle, as shown in Figure 19–7, "Deployment Modes".

19.2.4.2 Setting the Device Signing Options

The iOS Platform preference page for iOS includes fields for the location of the provisioning profile on the development computer and the name of the certificate. You must define these parameters if you deploy an application to an iOS device or as a MAF Application Archive.

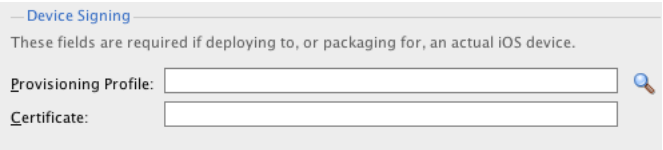
> **Note:** Neither a certificate nor a provisioning profile are required if you deploy a mobile application to an iOS simulator.

To set the signing options:

1. Choose **Tools**, then **Preferences**, and then **Mobile Application Framework**.
2. Choose **Platforms** and then choose **iOS**.
3. In the Device Signing section of the page, shown in Figure 19–10, enter the location of the provisioning profile in the **Provisioning Profile** field.
4. In the **Certificate** field, enter the name of the developer or distribution certificate that identifies the originator of the code (such as a developer or a company). You can view the name of the certificate using the Keychain Access utility (accessed from the Applications folder). Copy the entire name from the Keychain Access utility. The name entered into Certificate field must be in the following format:

   ```
   iPhone Developer: John Smith (PN3ENLQ3DU)
   ```

Figure 19–10 The Device Signing Section of the iOS Platform Preference Page



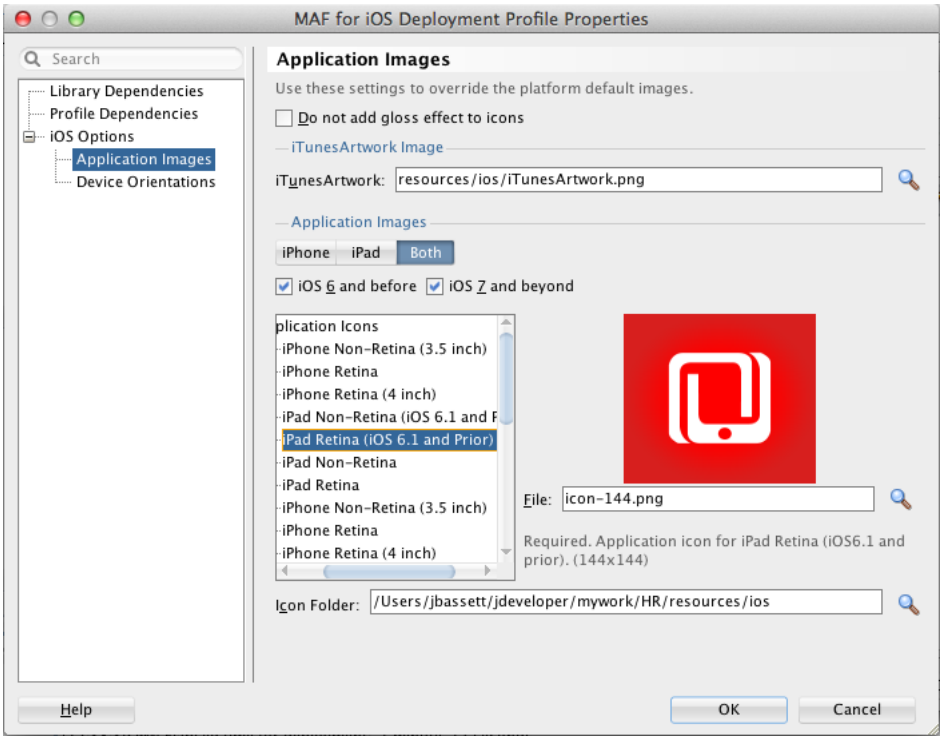
Note: There are provisioning profiles used for both development and release versions of an application. While a provisioning profile used for the release version of an application can be installed on any device, a provisioning profile for a development version can only be installed on the devices whose IDs are embedded into the profile. For more information, see the *App Distribution Guide*, which is available from the iOS Developer Library (http://developer.apple.com/library/ios/navigation/).

19.2.4.3 Adding a Custom Image to an iOS Application

The Application Images page enables you to rebrand an application by overriding the default Oracle image used for application icons and artwork with custom images. The options in this page, shown in Figure 19–11, enable you to enter the locations of custom images used for different situations, device orientation, and device resolutions. For more information on iOS application icon images, see the "Icon and Image Design" section in *iOS Human Interface Guidelines*. This document is available from the iOS Developer Library (http://developer.apple.com/library/ios/navigation/).

Note: All images must be in the PNG format.

Figure 19–11 Adding Custom Images



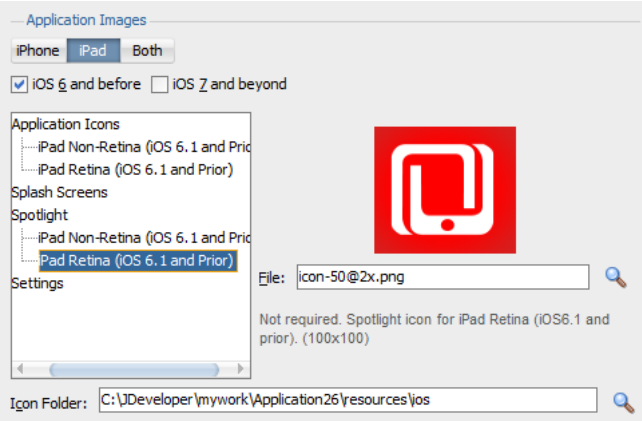
To add custom images:

1. Click **Application Images**.
2. Select **Do Not Add Gloss Effect to Icons** if the default iOS-style icon, which has a shine effect over the top of the icon is not used.

3. Choose **Browse** to select an icon image to override the default Apple image that iTunes assigns to `.ipa` files. This image is required for all applications and must be 512 x 512 pixels for both iPhone and iPad applications. For more information, see Section 19.2.4.4, "What You May Need to Know About iTunes Artwork."

4. Select the version and device type to display the available image types in the tree. By default, MAF displays all of the image styles and types available to iPad and iPhone devices. However, you can narrow the selection by selecting the device type and an operating system version, as shown in Figure 19–3. Within the Icon Folder field, MAF displays the location within the application's `Resources` directory that houses these image files.

Figure 19–12 Selecting the Image Type

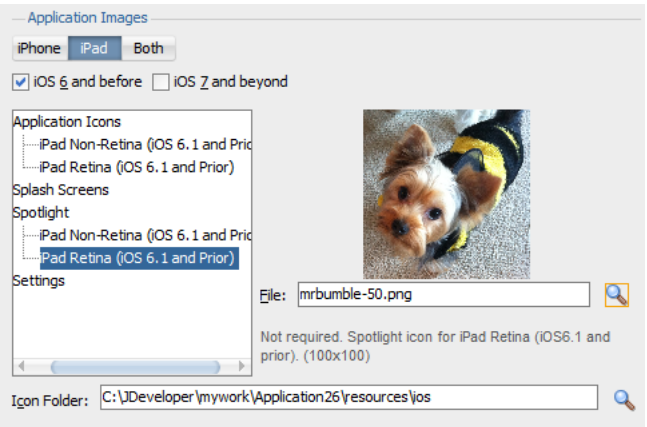


5. Select an image type from the tree.

6. In the File field, choose **Browse** to select another image, as shown in Figure 19–13. This image file must exist within the current application.

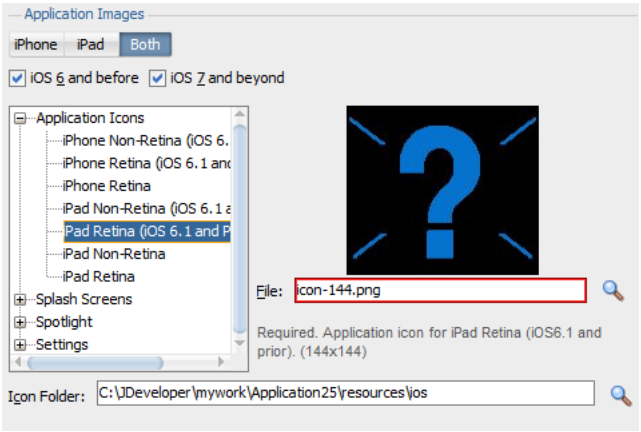
   During deployment, JDeveloper copies the custom image file into the deployment profile and renames it to match the name of the default image.

Figure 19–13 Adding a Custom Image



   If the name of the JDeveloper notes errors to safeguard against selecting an incorrect (or nonexistent) image file, as shown in Figure 19–14. See also Section 4.10.2, "What You May Need to Know About Selecting External Resources."

Figure 19–14 Nonexistent Image Warning



7. Click **OK**.

19.2.4.4 What You May Need to Know About iTunes Artwork

By default, mobile applications deployed to an iOS device through iTunes, or deployed as an archive (`.ipa` file) for download, use the default Oracle image unless otherwise specified.

By selecting an iTunes artwork image as the icon for the deployed application, you override the default image. You can use an image to differentiate between versions of the application. Figure 19–15 illustrates the difference between the default image and a user-selected image, where Application4 is displayed with the default image and Application6 is displayed with a user-selected image (the Oracle icon, scaled to 512 x 512 pixels).

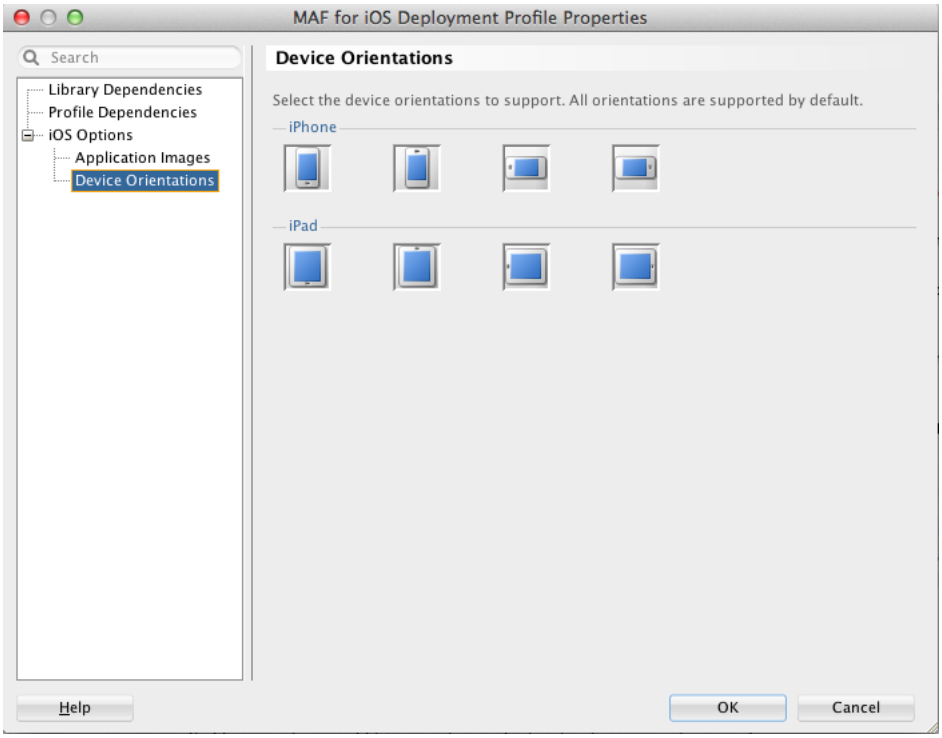
Figure 19–15 Custom and Default Application Icons

During deployment, MAF ensures that the icon displays in iTunes by adding the iTunes artwork image to the top-level of the `.ipa` file in a file called *iTunesArtwork*.

19.2.4.5 How to Restrict the Display to a Specific Device Orientation

By default, MAF supports all orientations for both iPhone and iPad. If, for example, an application must display only in portrait and in upside-down orientations on iPads, you can limit the application to rotate only to these orientations using the Device Orientation page, shown in Figure 19–16

Figure 19–16 Select a Device Orientation



To limit the display of an application to a specific device orientation:

1. Choose **Device Orientations**, as shown in Figure 19–16.
2. Clear all unneeded orientations from among those listed in Table 19–3. By default, MAF deploys to all of these device orientations. By default, all of these orientations are selected.

Table 19–3 iPhone Device Orientations

Icon	Description
	iPad, portrait—The home button is at the bottom of the screen.
	iPad, upside-down—The home button is at the top of the screen.
	iPad, landscape left—The home button is at the left side of the screen.

Table 19–3 (Cont.) iPhone Device Orientations

Icon	Description
	iPad, landscape right—The home button is at the right side of the screen.
	iPhone, portrait—The home button is at the bottom of the screen.
	iPhone, upside-down—The home button is at the top of the screen.
	iPhone, landscape left—The home button is at the left side of the screen.
	iPhone, landscape right—The home button is at the right side of the screen.

3. Click **OK**.

19.2.4.6 What Happens When You Deselect Device Orientations

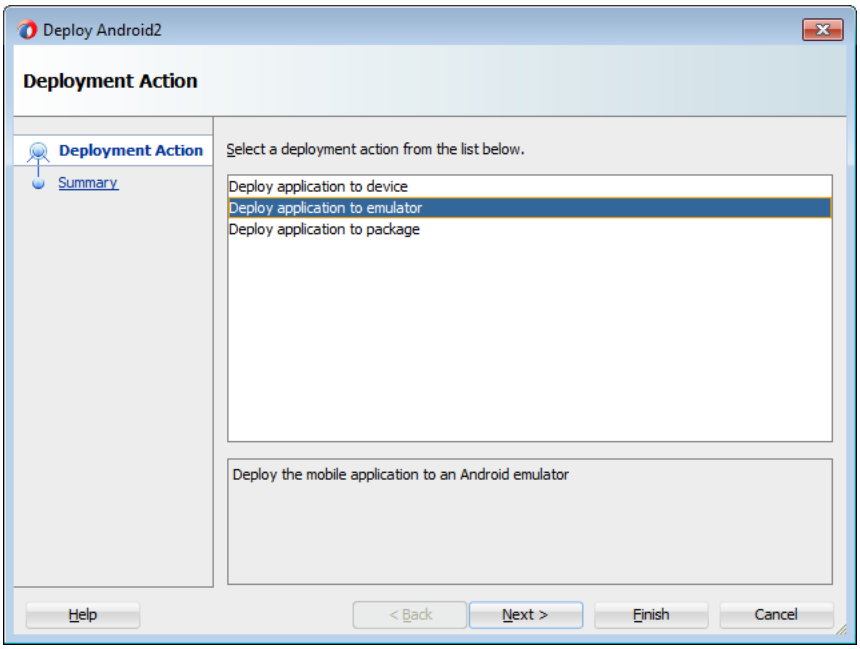
Deselecting a device orientation updates the source `.plist` file.

19.3 Deploying an Android Application

After you define the deployment profile, you can deploy a mobile application to the Android platform using the Deployment Action dialog, shown in Figure 19–17. Using this dialog, you can deploy the completed application to an Android emulator or to an Android-powered device for testing. After you have tested and debugged the application, this dialog enables you to bundle the mobile application as an Android application package (`.apk`) file so that it can be published to end users through an application marketplace, such as Google Play.

> **Tip:** As an alternative to the Deployment Action dialog, you can deploy a mobile application to the Android platform in a headless mode using the OJDeploy command line tool as described in Section 19.8, "Deploying Mobile Applications from the Command Line."

Figure 19–17 Deployment Action Dialog for Android Applications



19.3.1 How to Deploy an Android Application to an Android Emulator

You can deploy the mobile application directly to an Android emulator.

Before you begin:

Deployment to an Android emulator requires the following:

- Configure the debug password in the Android Platform preference page (accessed by choosing **Tools** > **Preferences** > **Mobile Application Framework**).

  Note: You must install the Android 4.0.*n* platform (API 14 or later).

- Ensure that the Android Virtual Device instance configuration reflects the ARM system image.
- In the Android Options page of the deployment profile:
  1. Ensure that **Debug** is selected.
  2. Click **OK**.

  Note: The Android Platform preferences page must be configured with the password that is used to generate the keystore and key for debug-mode deployment. See Section 19.2.3.3, "Defining the Android Signing Options."

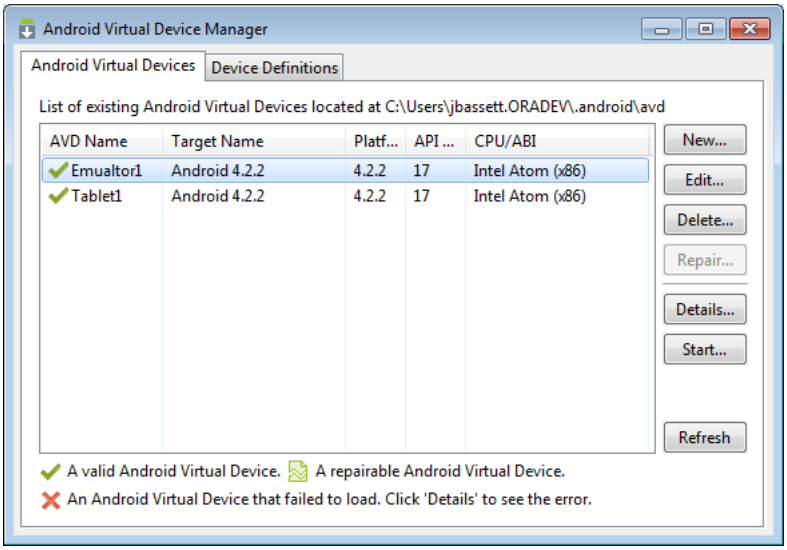
- Start the Android emulator before you deploy an application.

  You can start the emulator using the Android Virtual Device Manager, as illustrated in Figure 19–18, or from the command line by first navigating to the `tools` directory (located in `Android\android-sdk`) and then starting the emulator

by first entering `emulator -avd` followed by the emulator name (such as `-avd AndroidEmulator1`).

> **Note:** You can run only one Android emulator during a deployment.

Figure 19–18 Starting an Emulator Using Android Virtual Device Manager



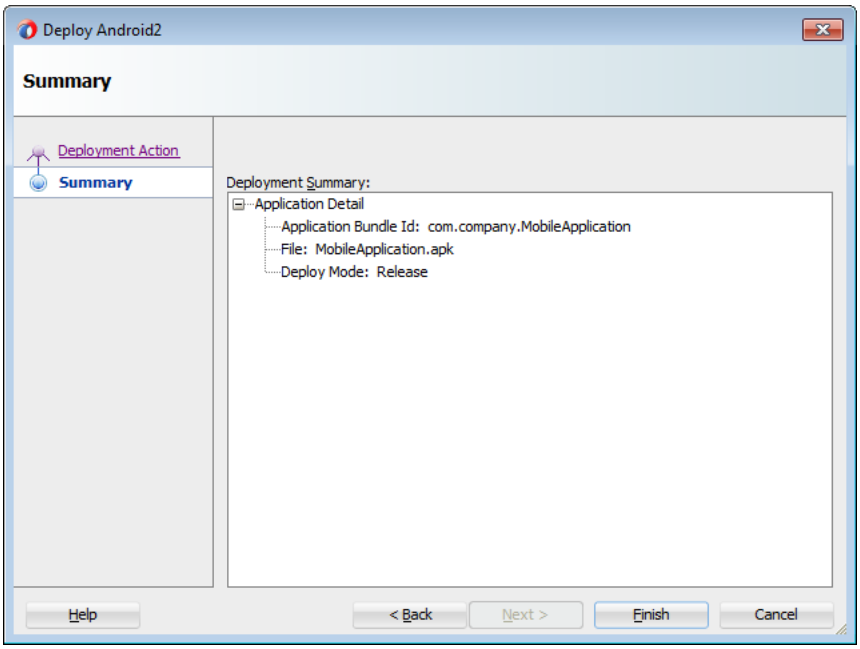
To deploy an application to an Android emulator:

1. Choose **Applications**, then **Deploy**, and then select an Android deployment profile.
2. Choose **Deploy application to emulator** and then choose **Next**.
3. Review the Summary page, shown in Figure 19–2, choose **Back** to select another deployment activity or choose **Finish**. The Summary page displays the following parameters from the deployment profile:
   - **Application Bundle Id**—The unique, Java language-like package name identifying the application.

     > **Note:** The Summary page shown in Figure 19–19 shows that the application bundle ID is in the reverse package format required for a successful deployment to an emulator. Deploying an application that does not follow the reverse-package format causes the emulator to shut down, which prevents the deployment from completing.

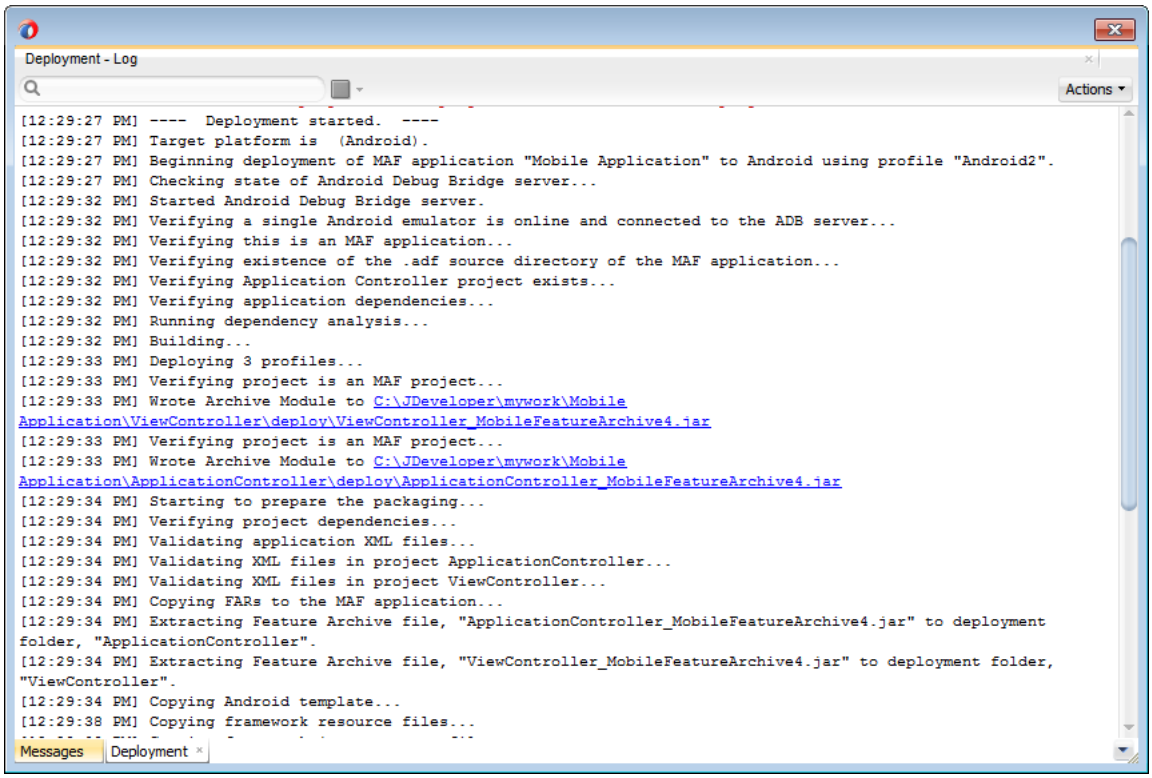
   - **File**—The name of the `.apk` that is deployed to an Android target.
   - **Deploy Mode**—The build mode. This value is either *Release* or *Debug*, depending on the value set in the deployment profile.

Figure 19–19 Summary for Android Emulator Deployment



4. Review the deployment log, as shown in Figure 19–20. The deployment log notes that the deployer starts the Android Debug Bridge server when it detects a running instance of an Android emulator. See also Section 19.3.6, "What You May Need to Know About Using the Android Debug Bridge."

Figure 19–20 The Deployment Log



19.3.2 How to Deploy an Application to an Android-Powered Device

You can deploy a mobile application directly to an Android-powered device that runs on a platform of 2.*n* (API Level 9) or later.

Before you begin:

Connect the device to the development computer that hosts JDeveloper, as described in Section 2.5.2, "How to Set Up an Android-Powered Device."

In the Deployment Options page, shown in Figure 19–5, select **Debug** as the build mode. Ensure that the debug signing credentials are configured in the Android Platform preference page, shown in Figure 19–6.

To deploy an application to an Android device:

1. Choose **Applications**, then **Deploy**, then select an Android deployment profile.
2. Choose **Deploy application to device** and then choose **Next**.
3. Review the Summary page. Click **Back** or **Next**.
4. Click **Finish**.

19.3.3 How to Publish an Android Application

After you have tested and debugged the application, as described in Chapter 22, "Testing and Debugging MAF Applications," you can publish it to an application marketplace (such as Google Play) by following the instructions provided on the Android Developers website (`http://developer.android.com/tools/publishing/publishing_overview.html`).

Before you begin:

In the Android Options page of the deployment profile, select **Release** as the build mode.

> **Note:** You must configure the signing options in the Android Platform preference page (accessed by choosing **Tools** > **Preferences** > **Mobile Application Framework**) as described in Section 19.2.3.3, "Defining the Android Signing Options."

To deploy an application as an .apk file:

1. Choose **Applications**, then **Deploy**, then select an Android deployment profile.
2. Choose **Deploy application to package** and then choose **Next**.
3. Review the Summary page, shown in Figure 19–19. Click **Back** or **Next**.
4. Click **Finish**.
5. Publish the application to an application marketplace.

19.3.4 What Happens in JDeveloper When You Create an .apk File

Deploying an application results in the following being deployed in an `.apk` file.

- The content in the `adfmsrc`
- The content in the `.adf` folder

- maf-application.xml and maf-feature.xml files
- logging.properties file
- The JVM 1.4 files

Table 19–4 Contents of the .apk File

Content	Location Within the .apk File
The content in the .adf folder	The root folder of the Android application file ([apkRoot]\.adf)
The content in the adfmsrc folder	The deployment packages the content in the adfmsrc folder into the default JAR file, which is located in a folder called user ([apkRoot]\user). This JAR file is added to the .apk using the Android Asset Packaging Tool (AAPT) and has a default name of the form ANDROID_MOBILE_NATIVE_archiveN where N is the nth Android created profile (you can override this name when creating the profile). This JAR file contains the following: ■ Any .class files generated from .java files that are added to the view controller project, as well as the adfmsrc content. The .java files are compiled using the JVM 1.4 JDK javac tool. ■ Contains data binding and pagedef metadata files. This JAR file is not processed by the Dalvik virtual machine. Because the .class files run in the JDK, they do not need to be converted into the Dalvik bytecode format (.dex).
adfmf_application.xml and adfmf_feature.xml files	Located in a file called Configuration ([apkRoot]\Configuration).
logging.properties file	Located in the root of the application file.
JVM 1.4 files	The JVM files are packaged into two separate folders: ■ The library file (\framework\build\java_res\libs\ ) in the template will be packaged into a lib folder in the APK - [apkRoot]\lib. ■ The \framework\build\java_res\assets\storage file is packaged in the assets\storage directory in the APK - [apkRoot]\assets\storage.

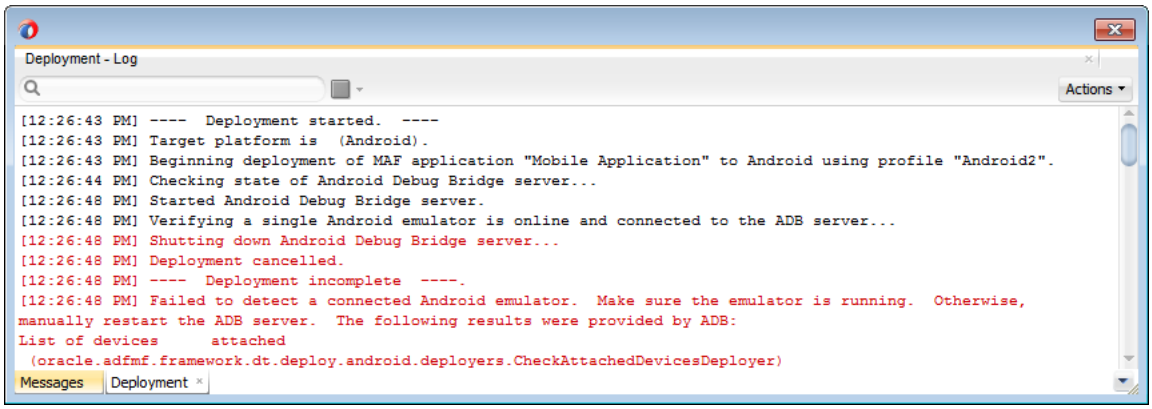
19.3.5 Selecting the Most Recently Used Deployment Profiles

After you select a deployment action, JDeveloper creates a shortcut on the Deploy menu that enables you to easily redeploy the application using that same deployment action.

19.3.6 What You May Need to Know About Using the Android Debug Bridge

The deployment restarts the Android Debug Bridge server five times until it detects a device (if deploying to a device) or emulator (if deploying to an Android emulator). If it detects neither, then it ends the deployment process, as shown in Figure 19–21.

Figure 19–21 Deployment Terminated

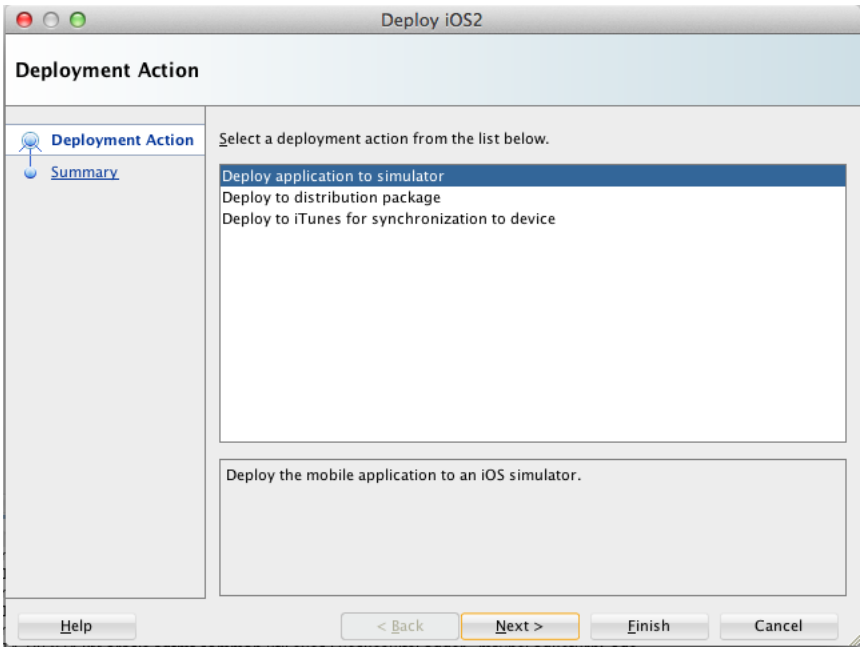


If you are using the Android Debug Bridge command line tool prior to deployment, then you must enter the same command again after the deployment has completed. For example, if you entered `adb logcat` to view logging information for an emulator or device prior to deployment, you would have to enter `adb logcat` again after the application has been deployed to resume the retrieval of the logging output. For more information about the Android Debug Bridge command line tool, which is located within (and executed from) the `platform-tools` directory of the Android SDK installation, refer to the Android Developers website (`http://developer.android.com/tools/help/adb.html`).

19.4 Deploying an iOS Application

The Deployment Action dialog, shown in Figure 19–22, enables you to deploy an iOS application directly to an iOS simulator or to a device through iTunes. You can only deploy an iOS application from an Apple computer. Deployment to the iOS simulator does not require membership to either the iOS Developer Program or the iOS Developer Enterprise Program; registration as an Apple developer, which provides access to versions of Xcode that are not available through the App Store, will suffice. For more information on iOS developer programs, which are required for deployment to iOS-powered devices (and are described at Section 19.4.2, "How to Deploy an Application to an iOS-Powered Device," and Section 19.4.5, "How to Distribute an iOS Application to the App Store"), see `https://developer.apple.com/programs/`.

Figure 19–22 The Deployment Action Dialog (for iOS Applications)



Tip: As an alternative to the Deployment Action dialog, you can deploy a mobile application to the iOS platform manually using the OJDeploy command line tool as described in Section 19.8, "Deploying Mobile Applications from the Command Line."

19.4.1 How to Deploy an iOS Application to an iOS Simulator

The Deployment Actions dialog enables you to deploy an iOS application directly to an iOS simulator.

Before you begin:

To enable deployment to an iOS simulator, you must perform the following tasks:

- Run Xcode after installing it, agree to the licensing agreements, and perform other post-installation tasks, as prompted.

  Note: You must run Xcode at least once before you deploy the application to the iOS simulator. Otherwise, the deployment will not succeed.

- Run the iOS simulator at least once after installing Xcode.
- Set the location of the SDK of the iOS simulator in the iOS Platform preference page, shown in Figure 19–24.
- In the iOS Options page of the deployment profile, select **Debug**, and then click **OK**.

Note: You must enter the location of the provisioning profile and the name of the certificate in the iOS Platform page (accessed by choosing **Tools** > **Preferences** > **Mobile Application Framework**). For more information, refer to Section 19.2.4.2, "Setting the Device Signing Options."

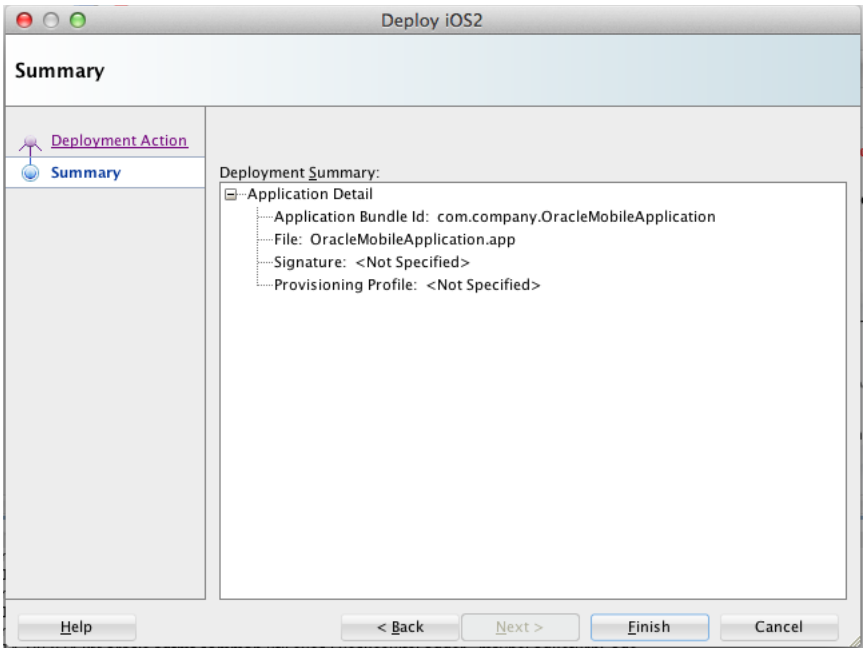
- Before you deploy an application, shut down the iOS simulator if it is running. If you do not shut down the simulator, the deployment will do it for you.
- Refer to the *iOS Simulator User Guide*, available through the iOS Developer Library (`http://developer.apple.com/library/ios/navigation/`). The iOS simulator is installed with Xcode.

To deploy an application to an iOS simulator:

1. Choose **Applications**, then **Deploy**, then select an iOS deployment profile.
2. Choose **Deploy application to simulator** and then choose **Next**.
3. Review the Summary page, shown in Figure 19–23, which displays the following values. Click **Finish**.
   - **Application Bundle Id**—The unique name that includes a Java language-like package name (*com.<organization name>.<application name>*) prefixed with the Bundle Seed that is generated from the iOS Provisioning Portal.
   - **File**—The file name of the final image deployed to an iOS target.
   - **Certificate**—The developer or company that authored the application. If this value has not been configured in the Options page of the deployment profile, then the Summary page displays *<Not Specified>*.
   - **Provisioning Profile**—The name of the provisioning profile that associates one or more development certificates and devices with an application ID. If this value is not configured in the Options page of the deployment profile, then the Summary page displays *<Not Specified>*.

Note: Deployment to an iOS simulator does not require that the values for Certificate and Provisioning profile be defined. In this deployment scenario, the Summary page displays *<Not Specified>* for these values.

Figure 19–23 The Deployment Actions Summary Dialog



19.4.2 How to Deploy an Application to an iOS-Powered Device

The **Deploy to iTunes for Synchronization to device** option enables you to deploy a mobile application to an iOS-powered device for debugging and testing. Deployment to an iOS-powered device or to a distribution site requires membership to either the iOS Developer Program or the iOS Developer Enterprise Program. For more information, see `https://developer.apple.com/programs/`.

Before you begin:

You cannot deploy an application directly from JDeveloper to a iOS device; an application must instead be deployed from the Applications folder in Apple iTunes. To accomplish this, you must perform the following tasks:

- Download Apple iTunes to your development computer and run it at least once to create the needed folders and directories.
- Set the location of the `Automatically Add to iTunes` folder (the location used for application deployment) in the iOS Platform preference page, shown in Figure 19–24.

Tip: Although your user home directory (`/User/<username>/Music/iTunes/iTunes Media/Automatically Add to iTunes.localized`) is the default directory for the iTunes Media folder, you can change the location of this folder as follows:

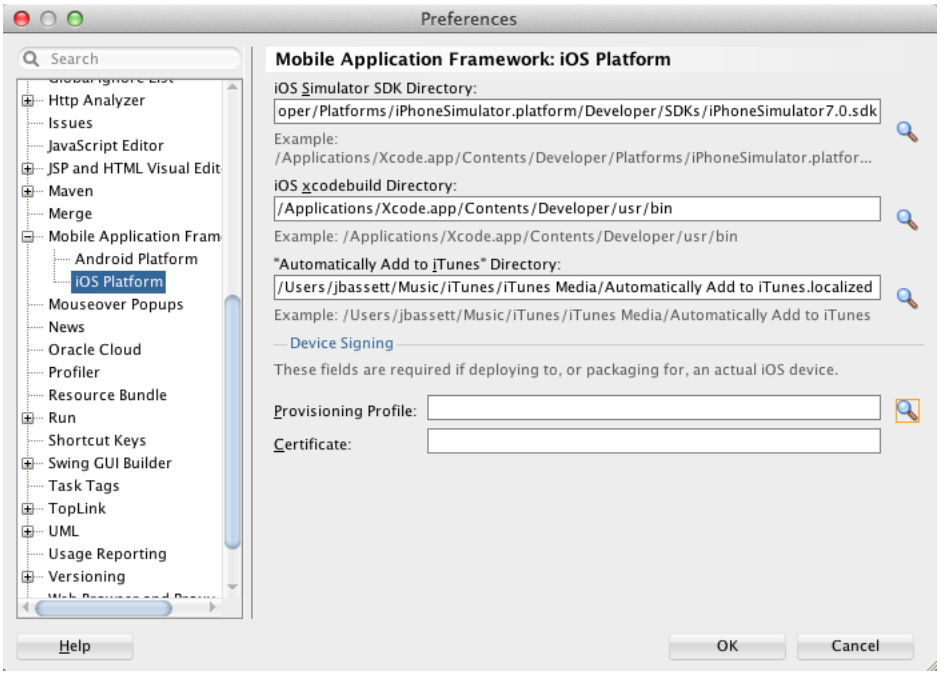
1. In iTunes, select **Edit**, **Preferences**, then **Advanced**.
2. Click **Change** and then browse to the new location.
3. Consolidate the library.
4. Delete the original iTunes Media folder.

For instructions, refer to Apple Support (`http://support.apple.com`).

You must also update the location in the iOS Platform preference page.

- Set the location of the Xcode folder where the xcodebuild tool is invoked, such as `/Developer/usr/bin` in Figure 19–24.

Figure 19–24 Setting the Locations for the iTunes Media Folder and the xcodebuild System



- Enter the name of the certificate and the location of the provisioning profile in the iOS Platform preference page. The OS Provisioning Portal generates the certificate and provisioning profile needed for deployment to iOS devices, or for publishing `.ipa` files to the App Store or to an internal download site.

Note: The deployment will fail unless you set the iOS provisioning profile and certificate to deploy to a device or to an archive. MAF logs applications that fail to deploy under such circumstances. For more information, see Section 19.4.4, "What You May Need to Know About Deploying an Application to an iOS-Powered Device."

- In the iOS Options page of the deployment profile, select **Debug** as the build mode and then **OK**.
- Refer to the *App Distribution Guide*, which is available through the iOS Developer Library (`http://developer.apple.com/library/ios/navigation/`).

To deploy an application to an iOS-powered device:

1. Choose **Applications**, then **Deploy**, and then select an iOS deployment profile.
2. Choose **Deploy to iTunes for Synchronization to device** and then choose **Next**.
3. Review the Summary page, which displays the following values. Click **Finish**.
   - **Application Bundle Id**—The unique name that includes a Java language-like package name (*com.<organization name>.<application name>*) prefixed with the Bundle Seed that is generated from the iOS Provisioning Portal.
   - **File**—The file name of the final image deployed to an iOS target.
   - **Certificate**—The developer (or company) who authored the application. If this value has not been configured in the Options page of the deployment profile, then the Summary page displays *<Not Specified>*.
   - **Provisioning Profile**—The name of the provisioning profile that associates one or more development certificates and devices with an application ID. If this value is not configured in the Options page of the deployment profile, then the Summary page displays *<Not Specified>*.

   Note: The Certificate and Provisioning Profile values cannot be noted as *<Not Specified>*; you must specify these values in the Options page to enable deployment to iTunes.
4. Connect the iOS-powered device to the development computer.
5. Open iTunes and then synchronize the device.

19.4.3 What Happens When You Deploy an Application to an iOS Device

The application appears in the iTunes Apps Folder, similar to the one illustrated in Figure 19–15 after a successful deployment.

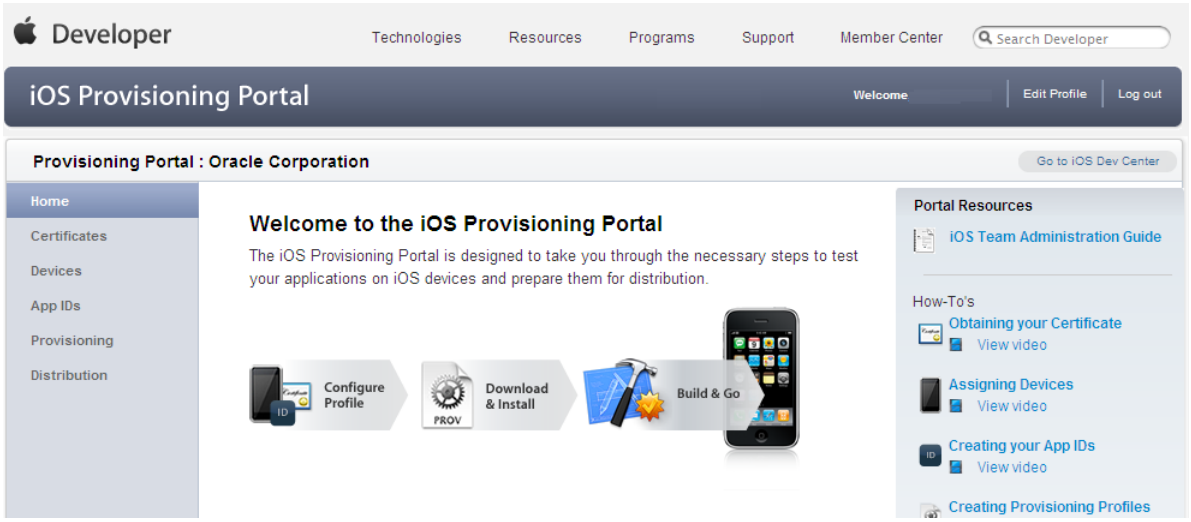
19.4.4 What You May Need to Know About Deploying an Application to an iOS-Powered Device

You cannot deploy an iOS application (that is, an `.ipa` file) to an iOS-powered device or publish it to either the App Store or to an internal hosted download site without first creating a provisioning profile using the iOS Provisioning Portal, which is accessible only to members of the iOS Developer Program. You enter the location of the provisioning profile and the name of the certificate in the Options page as described in Section 19.2.4.2, "Setting the Device Signing Options."

As noted in the *App Distribution Guide*, (which is available through the iOS Developer Library at `http://developer.apple.com/library/ios/navigation/`), a provisioning profile associates development certificates, devices, and an application ID. The iOS Provisioning Portal enables you to create these entities as well as the provisioning profile.

Tip: After you download the provisioning profile, double-click this file to add it to your `Library/MobileDevice/Provisioning Profile` directory.

Figure 19–25 The iOS Provisioning Portal



19.4.4.1 Creating iOS Development Certificates

A certificate is an electronic document that combines information about a developer's identity with a public key and private key. After you download a certificate, you essentially install your identity into the development computer, as the iOS Development Certificate identifies you as an iOS developer and enables the signing of the application for deployment. In the iOS operating environment, all certificates are managed by the Keychain.

Using the Certificates page in the iOS Provisioning Portal, you log a CSR (Certificate Signing Request). The iOS Provisioning Portal issues the iOS Development Certificate after you complete the CSR.

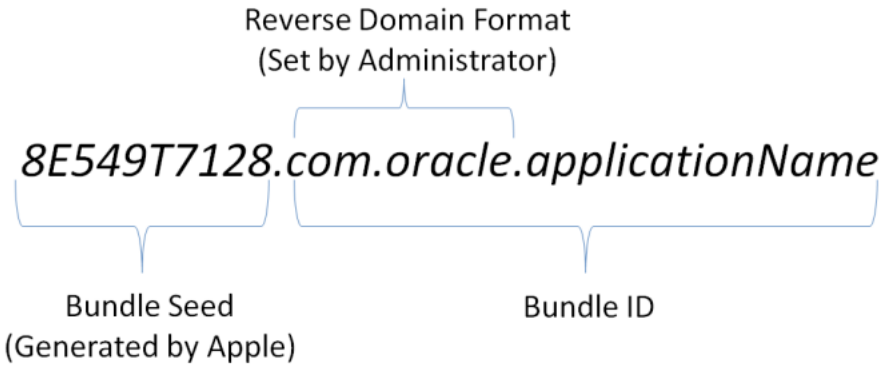
19.4.4.2 Registering an Apple Device for Testing and Debugging

After you install a certificate on your development computer, review the Current Available Devices tab (located in the iOS Provisioning Portal's Devices page) to identify the Apple devices used by you (or your company) for testing or debugging. The application cannot deploy unless the device is included in this list, which identifies each device by its serial number-like Unique Device Identifier (UDID).

19.4.4.3 Registering an Application ID

An application ID is a unique identifier for an application on a device. An application ID is comprised of the administrator-created reverse domain name called a Bundle Identifier in the format described in Section 4.3.1, "How to Set the ID and Display Behavior for a Mobile Application" prefixed by a ten-character alpha-numeric string called a bundle seed, which is generated by Apple. Figure 19–26 illustrates an application ID that is unique, one that does not share files or the Keychain with any other applications.

Figure 19–26 An Explicit Application ID



Using a wildcard character (*) for the application name, such as *8E549T7128.com.oracle.**, enables a suite of applications to share an application ID. For example, if the administrator names *com.oracle.MAF.** on the iOS Provisioning Portal, it enables you to specify different applications (*com.oracle.MAF.application1* and *com.oracle.MAF.application2*).

Note: For applications that receive push notifications, the application ID must be a full, unique ID, not a wildcard character; applications identified using wildcards cannot receive push notifications. For more information, see the "Provisioning and Development" section of *Local and Push Notification Programming Guide*, available from the iOS Developer Library (`http://developer.apple.com/library/ios/navigation/`)

When applications share the same prefix, such as *8E549T7128*, they can share files or Keychains.

Note: The Bundle ID must match the application ID set in the Options page of the deployment profile.

19.4.5 How to Distribute an iOS Application to the App Store

After you test and debug an application on an iOS device, you can distribute the application to a wider audience through the App Store or an internal download site. To publish an application to the App Store, you must submit the `.ipa` file to iTunes Connect, which enables you to add `.ipa` files to iTunes, as well as update applications and create test users.

Before you begin:

Before you distribute the application, you must perform the following tasks:

- In the iOS Platform preference page, shown in Figure 19–24, enter the location of the `Automatically Add to iTunes` directory.

  Tip: Run iTunes at least once before entering this location. See also Section 19.4.2, "How to Deploy an Application to an iOS-Powered Device."

- Test the application on an actual iOS device. See Section 19.4.2, "How to Deploy an Application to an iOS-Powered Device."
- Obtain a distribution certificate through the iOS Provisioning Portal.

> **Note:** Only the Team Agent can create a distribution certificate.

- Obtain an iTunes Connect account for distributing the `.ipa` file to iTunes. For information, see "Prepare App Submission" in the iOS Development Center's App Store Resource Center. Specifically, review the *App Store Review Guidelines* to ensure acceptance by the App Review Team.
- You may want to review both the and *iTunes Connect Developer Guide*. These guides are both available through the iOS Developer Library (`http://developer.apple.com/library/ios/navigation/`).
- In the iOS Options page of the deployment profile, select *App Distribution Guide* **Release** as the build mode and then click **OK**.

To distribute an iOS application to the App Store:

1. Choose **Applications**, then **Deploy**, and then select an iOS deployment profile.
2. Choose **Deploy to Distribution Package**.
3. Review the Summary page, which displays the following values. Click **Finish**.
   - **Application Bundle Id**—The unique name that includes a Java language-like package name (*com.<organization name>.<application name>*) prefixed with the Bundle Seed that is generated from the iOS Provisioning Portal.
   - **File**—The file name of the final image deployed to an iOS target.
   - **Certificate**—The application's author. If this value has not been configured in the iOS Platform preference page of the deployment profile, then the Summary page displays *<Not Specified>*.
   - **Provisioning Profile**—The name of the provisioning profile that associates one or more development certificates and devices with an application ID. If this value is not configured in the iOS Platform preference page, then the Summary page displays *<Not Specified>*.

   > **Note:** The Certificate and Provisioning Profile values cannot be noted as *<Not Specified>*; you must specify these values in the Options page to enable the `.ipa` file to be accepted by iTunes.

4. Log in to iTunes Connect.
5. Submit the `.ipa` file to iTunes Connect for consideration using the Manage Your Applications module and the Application Loader described in the "Adding New Apps" and "Using Application Loader" sections in iTunes Connect Developer Guide.
6. After the application has been approved, refer to the "Creating Test Users" section in *iTunes Connect Developer Guide* for information on using the *Manage Users* module. For testing multi-language applications, create a test user account for the regions for which the application is localized.

7. Refer to the "Editing and Updating App Information" section in *iTunes Connect Developer Guide* for information on updating the binary using the *Managing Your Application* module.

19.5 Deploying Feature Archive Files (FARs)

To enable re-use by MAF view controller projects, application features— typically, those implemented as MAF AMX or Local HTML— are bundled into an archive known as a Feature Archive (FAR). As stated in Section 4.13, "Working with Feature Archive Files," a FAR is a JAR file that contains the application feature artifacts that can be consumed by mobile applications. A FAR may contain Java classes, though these classes must be compiled. Example 19–2 illustrates the contents of a FAR, which includes a single `maf-feature.xml` file and a `connections.xml` file. For more information on `connections.xml`, see the "Lookup Defined in the connections.xml File" section in *Oracle Fusion Middleware Developing Fusion Web Applications with Oracle Application Development Framework*.

Example 19–2 Contents of a Feature Archive File

```
connections.xml (or some form of connection metadata)

  META-INF
     adfm.xml
     maf-feature.xml
     MANIFEST.MF
     task-flow-registry.xml

  oracle
    application1
      mobile
         Class1.class
         DataBindings.cpx
         pageDefs
           view1PageDefs

  model
     adfc-mobile-config.adfc.diagram
     ViewController-task-flow.adfc.diagram

  public_html
     adfc-mobile-config.xml
       index.html
       navbar-icon.html
       springboard-icon.html
     view1.amx
     ViewController-task-flow.xml
```

Working with Feature Archive files involves the following tasks:

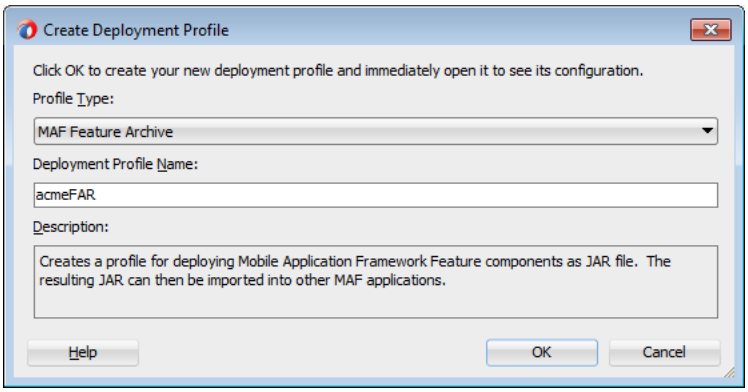
1. Creating a Feature Archive file—You create a Feature Archive by deploying a feature application as a library JAR file.
2. Using the Feature Archive file when creating a mobile application—This includes importing FARs and re-mapping the imported connection.
3. Deploying a mobile application that includes features from FARs—This includes unpacking the FAR to a uniquely named folder within the deployment template.

Note: MAF generates FARs during the deployment process. You only need to deploy a view controller project if you use the FAR in another application.

19.5.1 How to Create a Deployment Profile for a Feature Archive

Use the Create Deployment Profile dialog, shown in Figure 19–27.

Figure 19–27 Create MAF Feature Archive Dialog



Before you begin:

Create the appropriate connections for the application. Because FARs may be used in different MAF applications with different connection requirements, choose a connection name that represents the connection source or the actual standardized connection name.

How to create a deployment profile for a Feature Archive:

1. Right-click a view controller project, choose **New**, then **Deploy**, and then **New Deployment Profile**.

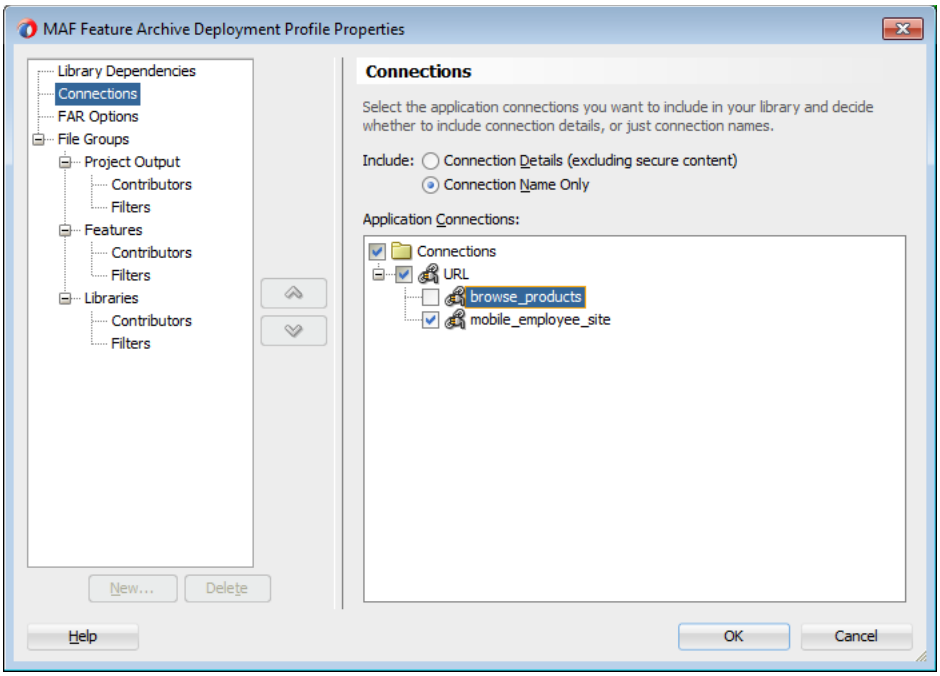
   Note: You do not need to create a separate, application-level deployment profile.

2. Select **MAF Feature Archive** in the Create Deployment Profile dialog.
3. Enter a profile name, or accept the default, and then click **OK**.

   Note: Name the profile appropriately. Otherwise, you may encounter problems if you upload more than one application feature with the same archive name. For more information, see Section 4.13.4, "What You May Need to Know About Enabling the Reuse of Feature Archive Resources."

4. Select the connections that you want to include in the Feature Archive JAR file, as shown in Figure 19–28.

Figure 19–28 Selecting a Connection for the FAR

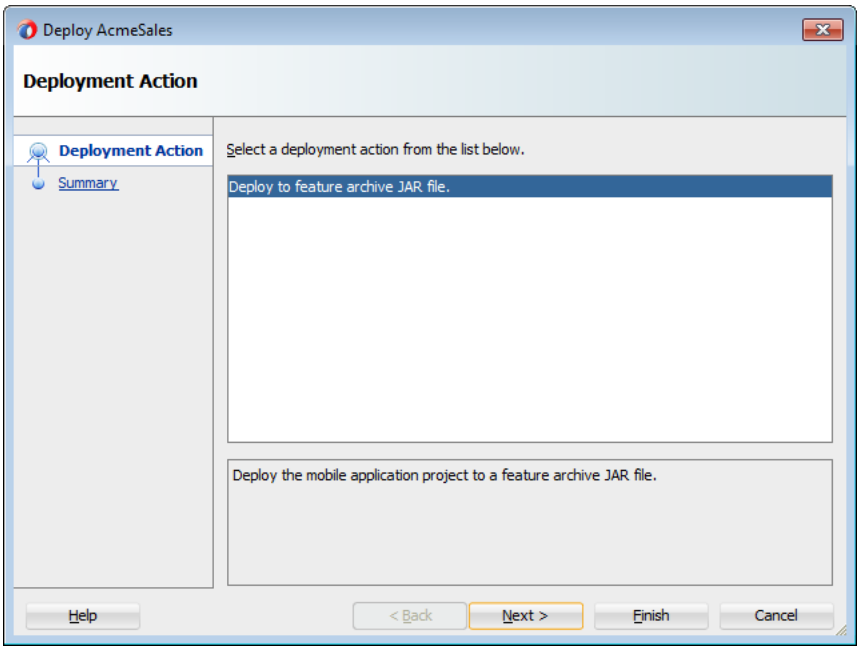


5. Click **Next**, review the options, and then click **Finish**.

19.5.2 How to Deploy the Feature Archive Deployment Profile

The Deployment Actions dialog enables you to deploy the FAR as a JAR file. This dialog, shown in Figure 19–29, includes only one deployment option, **Deploy to feature archive JAR file**.

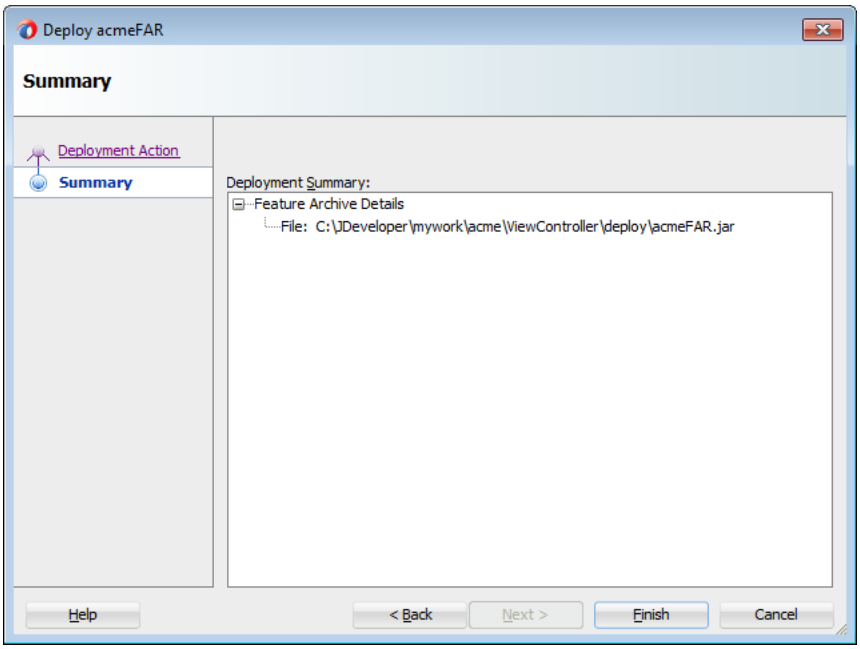
Figure 19–29 Deployment Actions



How to deploy the Feature Archive deployment profile:

1. Right-click the view controller project and then select the Feature Archive deployment profile.
2. Click **Finish**. The Summary page, shown in Figure 19–30, displays the full path of where the Feature Archive file's JAR path is deployed.

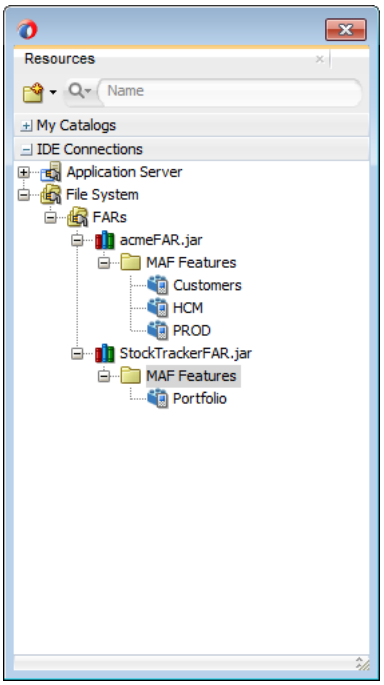
Figure 19–30 Deployment Summary Page



19.5.3 What Happens When You Deploy a Feature Archive File Deployment Profile

After you complete the deployment action dialog, MAF creates a library JAR in the path shown in the Summary page. To make this JAR available for consumption by other applications, you must first make it available through the Resource Palette, shown in Figure 19–31 (and described in Section 4.13.1, "How to Use FAR Content in a MAF Application") by creating a connection to the location of the Feature Archive JAR. Figure 19–31 shows Feature Archives that can be made available to a mobile application through a file system connection.

Figure 19–31 Deployed Feature Archive JARs in the Resource Palette



19.6 Creating a Mobile Application Archive File

You can create a new mobile application from an existing mobile application by first packaging the original mobile application as a Mobile Application Archive (`.maa`) file and then by deriving a new mobile application from this file. An `.maa` file can be used by third parties, as described in Section 19.7, "Creating Unsigned Deployment Packages."

An `.maa` file preserves the structure of the mobile application. Table 19–5 describes the contents of this file.

Table 19–5 Contents of a Mobile Application Archive File

Directory	Description
`adf`	Contains the `META-INF` directory, which contains the metadata files, including: ▪ The `adf-config.xml` file ▪ The `maf-application.xml` file ▪ The `maf-config.xml` file ▪ Other applicable application-level files, such as the `connections.xml`file
`Projects`	Contains a JAR file for each project in the workspace. For example, a `ViewController.jar` file and a `ApplicationController.jar` file are located in this directory when you deploy a default mobile application to an `.maa` file. The `Projects` directory of the `.maa` file does not include the `.java` files from the original project. Instead, the `.java` files are compiled and the resulting `.class` files are placed in a separate JAR file that is contained in the project JAR file (such as `ApplicationController.JAR/classlib/mobileApplicationArchive.jar`).

Table 19–5 (Cont.) Contents of a Mobile Application Archive File

Directory	Description
`ExternalLibs`	Contains the application-level libraries (including FARs) that are external to the original mobile application.
`META-INF`	Includes the `cvm.properties` and `logging.properties` files.
`resources`	Includes the following directories: ■ `android`—Contains Android-specific image files for application icons and splash screens. ■ `ios`—Contains iOS-specific image files for application icons and splash screens. ■ security—Includes the `cacerts` file (the keystore file).

In addition to the artifacts listed in Table 19–5, the `.maa` file includes any folder containing FARs or JAR files that are internal to the original mobile application, as well as its control (`.jws`) file. See also Section 19.7.2, "What Happens When You Import a MAF Application Archive File."

19.6.1 How to Create a Mobile Application Archive File

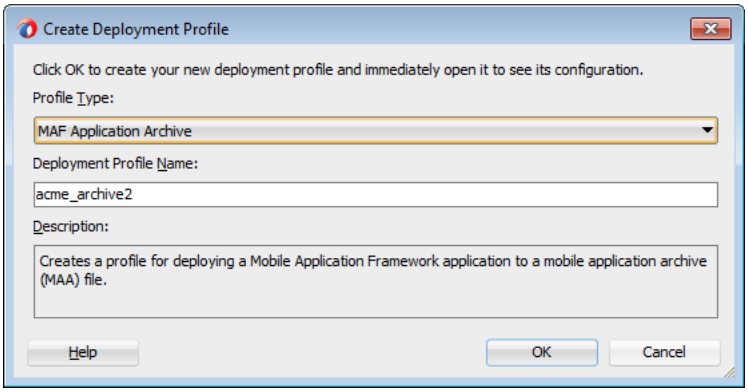
JDeveloper creates a default MAF Application Archive deployment profile after you create a mobile application. Using the Mobile Application Archive wizard, you can create the `.maa` file.

> **Tip:** You can also create an `.maa` file using OJDeploy, as described in Section 19.8, "Deploying Mobile Applications from the Command Line."

To create a Mobile Application Archive file:

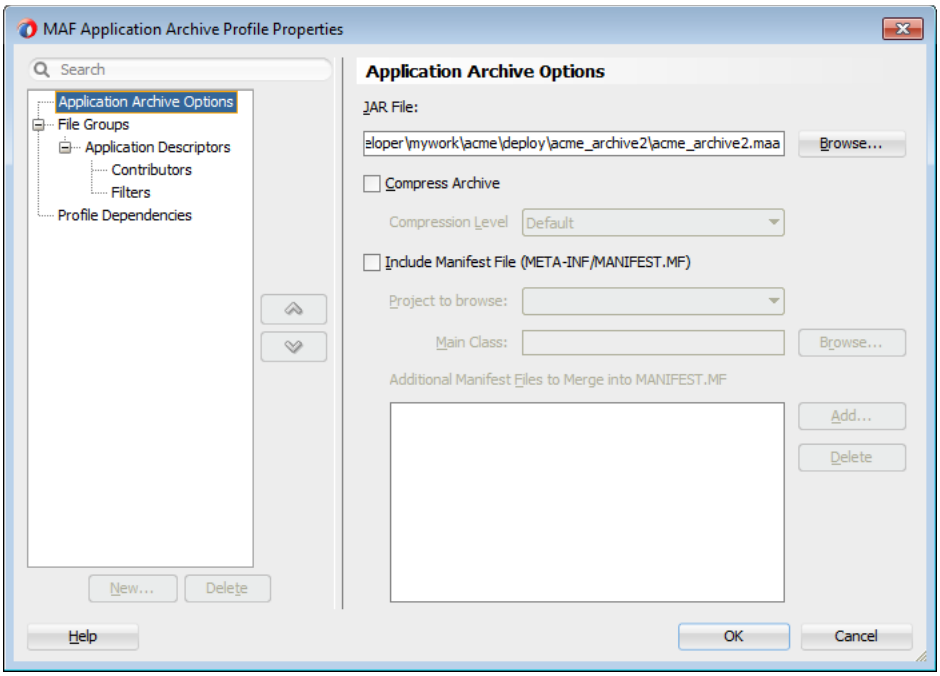
1. Click **Application**, then **Deploy**, then **New Deployment Profile**.
2. In the Create Deployment Profile dialog, choose **MAF Application Archive** and then click **OK**, as shown in Figure 19–32.

Figure 19–32 Creating an MAA Deployment Profile



3. If needed, enter a name for the Mobile Application Archive in the Application Archives Options page, shown in Figure 19–33, or accept the default name (and path). Click **OK**.

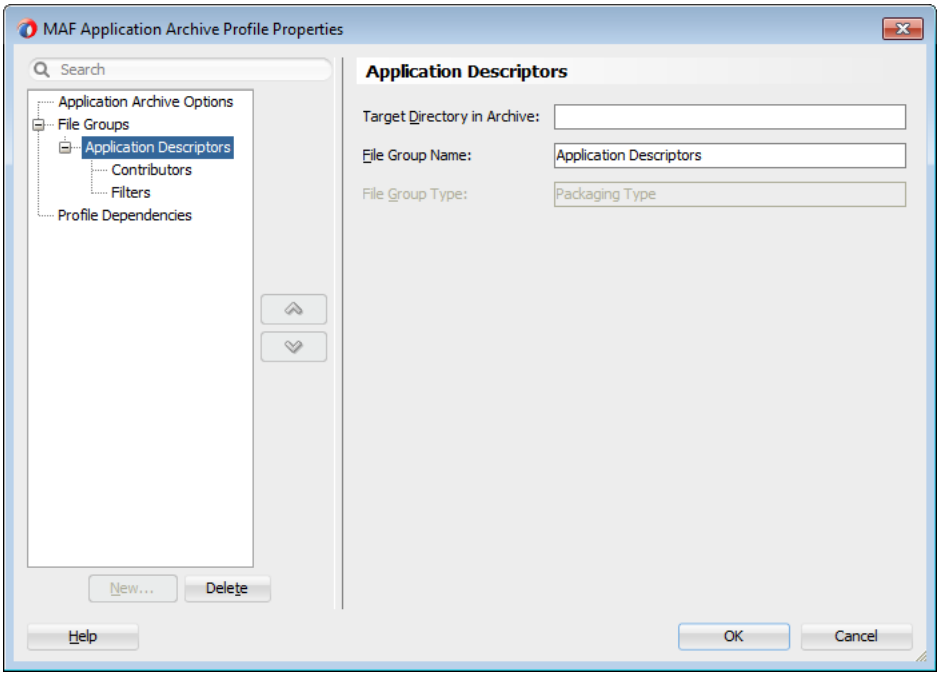
Figure 19–33 Entering a Name and Path for the Mobile Application Archive File



4. If needed, perform the following:

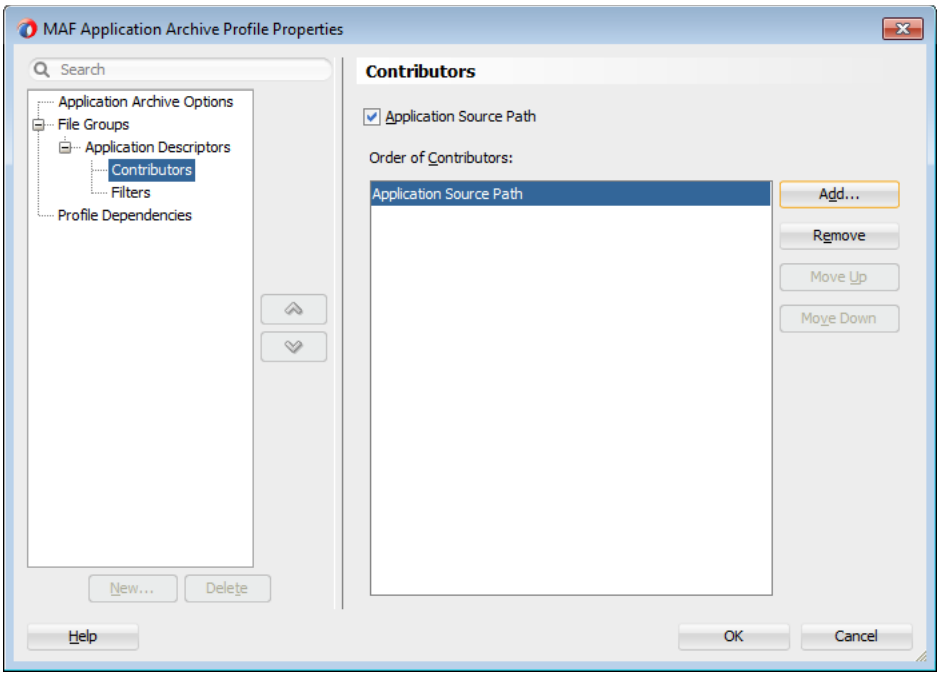
   a. In the Application Descriptors page, shown in Figure 19–34, enter the file group name (or accept the default name) used for the contents of the `META-INF` folder (`application_workspace\src\META-INF`).

Figure 19–34 Entering a File Group Name for the META-INF Contents



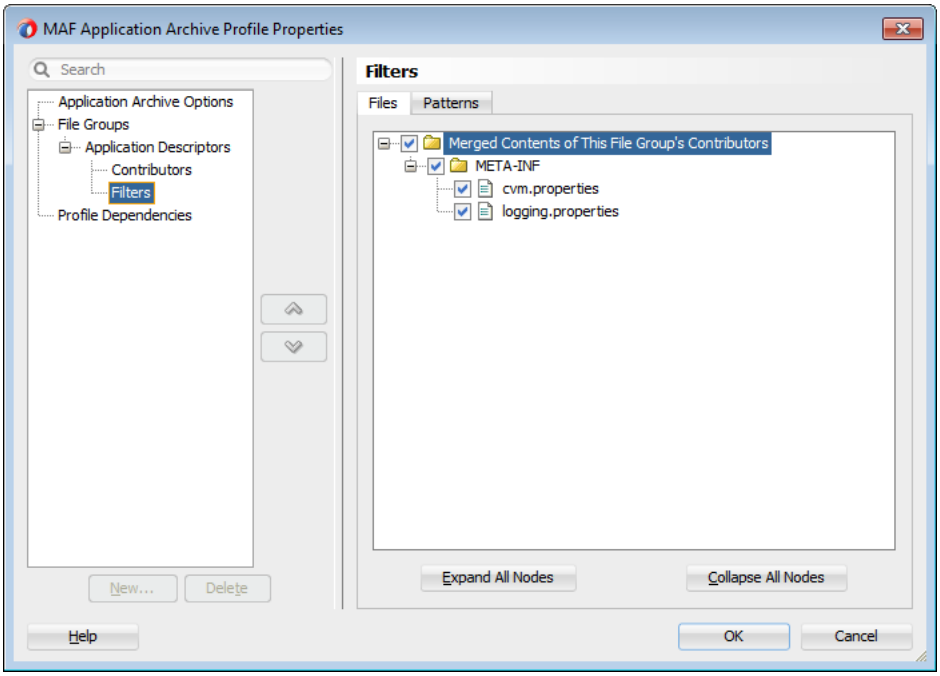
   b. Select the Contributors sub-page of this Application Descriptors page to edit the list of directories and JAR files that provide the contents for the file group.

Figure 19–35 Editing Contributors to the Mobile Application Archive File



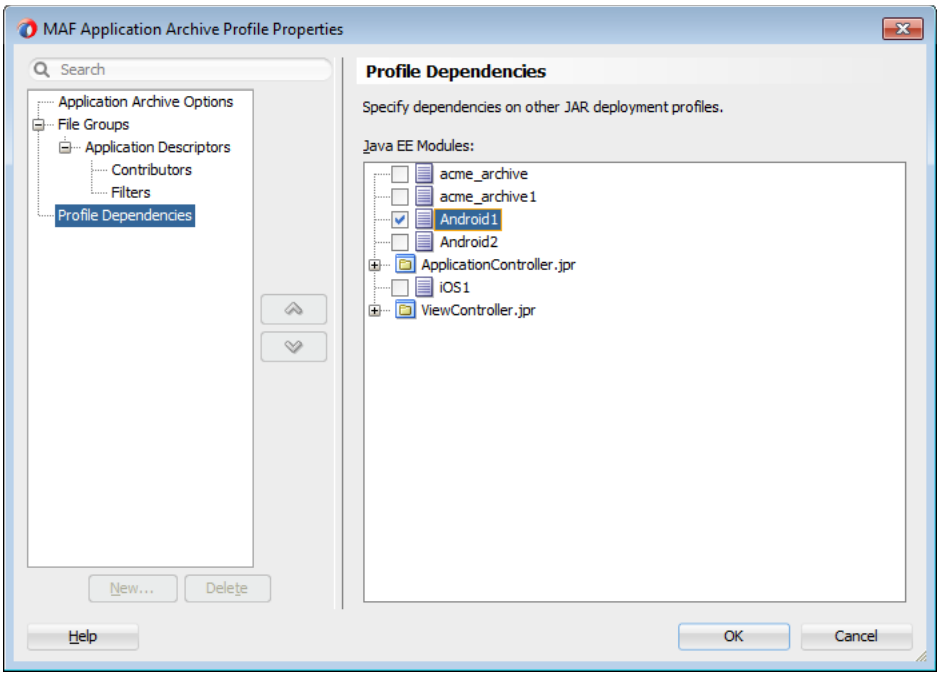
c. Use the Filters page, shown in Figure 19–36 to edit the files that will be included in the `.maa` file or set the content inclusion or exclusion rules.

Figure 19–36 Including (or Excluding) Files and Directories



d. Use the Profile Dependencies page, shown in Figure 19–37, to specify dependent profiles within the project.

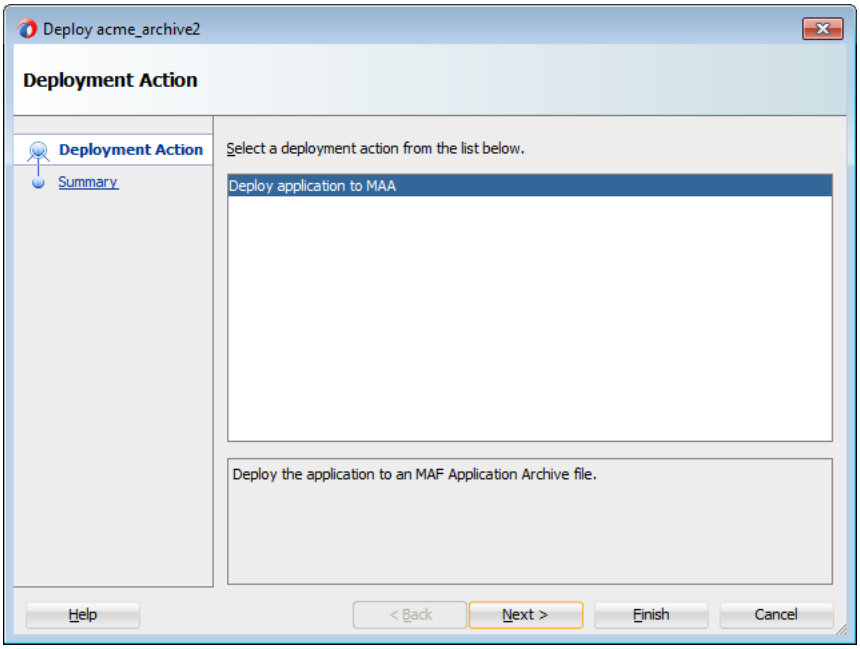
Figure 19–37 Selecting Deployment Profiles



To package a mobile application as a MAF Application Archive file:

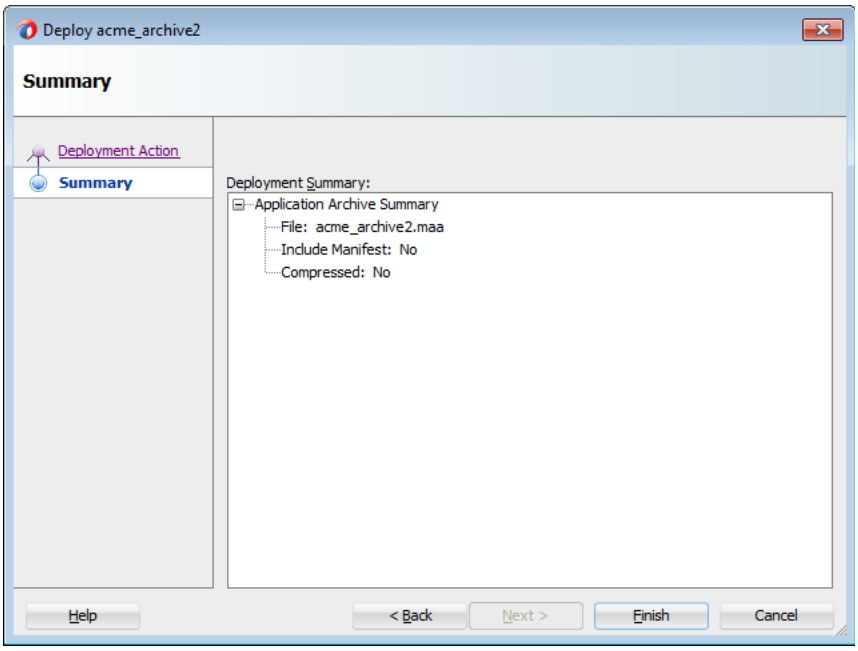
1. Choose **Application**, then **Deploy** and then choose the MAF Application Archive deployment profile.
2. In the Deployment Action wizard, select **Deploy application to MAA**, as shown in Figure 19–38.

Figure 19–38 Deployment to a MAF Application Archive File



3. Click **Next** to review the deployment summary, as shown in Figure 19–39.

Figure 19–39 MAF Application Archive Deployment Summary



4. Click **Finish**.

19.7 Creating Unsigned Deployment Packages

The MAF Application Archive (`.maa`) file format enables you to provide third-parties with an unsigned mobile application. By deriving a mobile application from an imported `.maa` file, you enable various customizations, which include:

- Giving an application a unique application ID (to enable push notifications, for example).
- Signing an application with a company-specific credential or certificate.
- Replacing the resources with customized splash screens and application icons.

> **Note:** Importing an `.maa` file into an existing application overwrites the workspace and project container files (the `.jws` and `.jpr` files, respectively). As a result, all prior changes to MAF AMX pages and configuration files, such as `maf-application.xml`, `maf-config.xml`, `connections.xml`, and `adf-config.xml`, will not be retained.

19.7.1 How to Create an Unsigned Application

You create an unsigned application by importing an `.maa` file into a new mobile application.

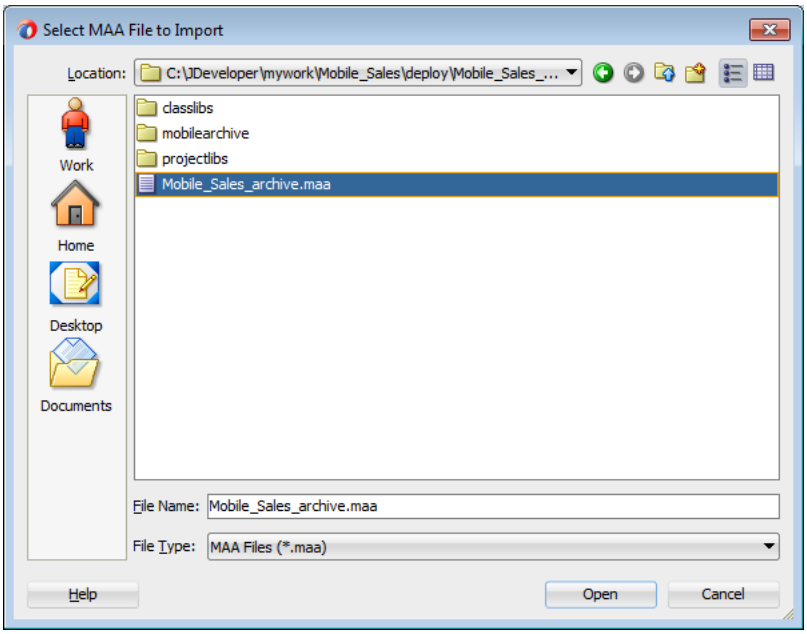
To create an unsigned application:

1. Choose **File** and then **New**.
2. In the New Gallery, choose **Applications** and then **MAF Application from Archive File**.

Note: Alternatively, you can choose **File**, then **Import**, and then **MAF Application from Archive File**.

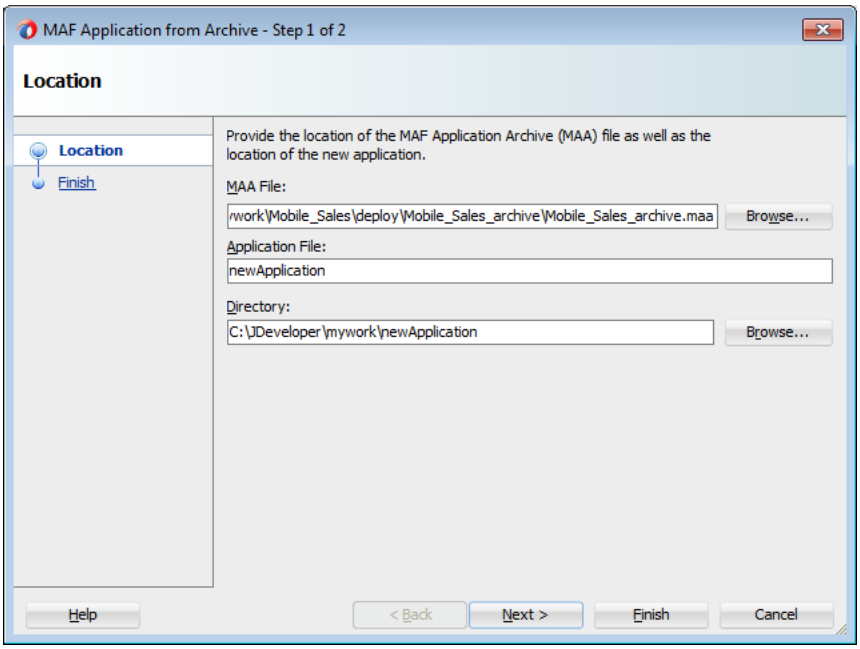
3. In the Location page, choose **Browse** in the MAA File field.
4. In the Select MAA File to Import page, highlight the `.maa` file, as shown in Figure 19–40, and then click **Open**.

Figure 19–40 Selecting the .maa File



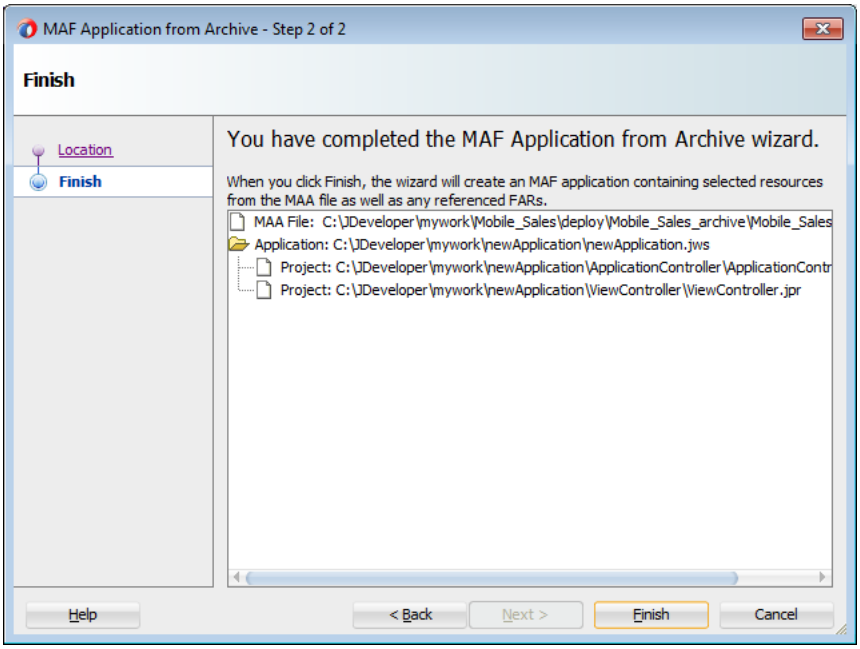
5. If needed, perform the following, or accept the default values:
    1. Enter a name for the mobile application derived from the `.maa` file in the Application File field, as shown in Figure 19–41.
    2. Click **Browse** to retrieve the directory of the mobile application.

Figure 19–41 Entering the Directory Location



6. Click **Next**.
7. Review the import summary information and then click **Finish**.

Figure 19–42 Summary of MAF Application Archive Contents



19.7.2 What Happens When You Import a MAF Application Archive File

MAF performs the following after you import an `.maa` file:

1. Creates an application folder.

2. Unpacks the workspace container (`.jws`) file from the `.maa` file to the application file and renames it per the user-specified value.
3. Unpacks the `adf` directory and its contents to the application folder. This directory is renamed `.adf`.
4. Unpacks the `META-INF` directory and its contents and places them in a `src` directory in the application folder.
5. Unpacks the `ExternalLibs` directory and its contents to the application folder.

   Note: While any of the external resources contained in this directory are available in the mobile application that has been packaged as an `.maa` file (and imported into the application), the references to these resources will be invalid for a mobile application derived from the `.maa` file.

6. Unpacks the `resources` directory to the application folder.
7. Unpacks all folders that contain FARs (or other libraries) that are internal to the original mobile application. MAF preserves the original locations of these artifacts.
8. For each JAR file within the original mobile application's `Projects` directory, MAF performs the following:
   - Creates a project folder under the application directory that corresponds to the name of the JAR file (but without the `.jar` extension).
   - Unpacks the contents of the JAR files into the appropriate project folder. MAF includes the following in these project folders:
     - The original `.jpr` file.
     - The standard directories, such as `META-INF`, `public_html`, `src`, and `adfmsrc`.
     - The contents of the `ExternalLibs` directory.

       Note: While any of the external resources contained in this directory are available in the MAF project that has been packaged with the imported `.maa` file, the references to these resources will be invalid for an existing project, or a project created by importing the `.maa` file.

     - The `classlib` directory, which contains any Java classes packaged in a JAR file.

       Note: If the `.maa` file includes a `classlib` directory, then MAF adds all of the JAR files from this directory as library dependencies in the newly created mobile application.

19.8 Deploying Mobile Applications from the Command Line

You can deploy iOS or Android applications from JDeveloper without starting the JDeveloper IDE using the OJDeploy command line tool. Command line deployment can serve as a tool for testing, as well as a means of deploying applications using a script.

After you have created iOS or Android deployment files using Deployment Profile Properties editor, you can use OJDeploy to deploy applications in the headless mode to iOS simulators and iOS-powered devices (through iTunes), or as iOS bundles (`.ipa` and `.app` files), or Feature Archive JAR files. Likewise, OJDeploy enables you to deploy applications to both Android emulators and Android-powered devices, or deploy them as an Android application package (`.apk`) file or as Feature Archive JAR files. For information on OJDeploy, see "Deploying from the Command Line" in *Oracle Fusion Middleware User's Guide for Oracle JDeveloper*.

Note: To use OJDeploy on a Mac, add the following line to the `ojdeploy.conf` file:

```
SetSkipJ2SDKCheck true
```

This file is located at: *`jdev_install`*`/jdeveloper/jdev/bin`

19.8.1 Using OJDeploy to Deploy Mobile Applications

The following commands enable you to deploy MAF deployment profiles:

- `deployToDevice`—Deploys an application to iOS- or Android-powered devices. For iOS applications, this command is used in debugging scenarios where the application is deployed to a device using iTunes. For more information, see Section 19.4.5, "How to Distribute an iOS Application to the App Store."
- `deployToSimulator`—Deploys an application to an iOS simulator (as an `.app` file) or Android emulator. You can only deploy a mobile application to an iOS simulator on an Apple computer.
- `deployToPackage`—Deploys an iOS application as an `.ipa` file or an Android application as an `.apk` file. You can only package an application as an `.ipa` file on an Apple computer.
- `deployToFeatureArchive`—Deploys a Feature Archive to a JAR file.
- `deployToApplicationArchive`—Packages a mobile application as a MAF Application Archive (`.maa`) file.

You use these commands in conjunction with the `ojdeploy` command line tool, OJDeploy's arguments, and its options as follows:

```
ojdeploy deployToSimulator -profile <profile name> -workspace <jws file location>
```

Note: OJDeploy commands and arguments are case-sensitive.

Table 19–6 lists the OJDeploy arguments that you use to modify the MAF deployment commands.

Tip: Using the `-help` option with any command (such as `ojdeploy deployToSimulator -help`) retrieves usage and syntax information.

Table 19–6 OJDeploy Arguments for MAF Deployments

Argument	Description
`-profile`	The name of the Android or iOS deployment profile. For example: `ojdeploy deployToSimulator -profile iosDeployProfile ...`

`-workspace`	The full path to the mobile application workspace container (`.jws`) file. For example:
	`... -workspace /usr/jsmith/mywork/Application1/Application1.jws`
	
	To package a mobile application as a mobile Application Archive:
	`ojdeploy deployToApplicationArchive`
	`-profile applicationArchiveProfile`
	`-workspace /usr/jdoe/Application1/application1.jws`

`-project`	For the `deployToFeatureArchive` command, you must provide the name of the project (that is, a view controller project) that contains the Feature Archive deployment profile. For example:
	`ojdeploy deployToFeatureArchive`
	`-profile farProfileName`
	`-project ViewController`
	`...`

`-buildfile`	The full path to a build file for batch deploy.
`-buildfileschema`	Print XML Schema for the build file.

In addition to the arguments listed in Table 19–6, you can also use OJDeploy options described in the "Command Usage" section of *Oracle Fusion Middleware User's Guide for Oracle JDeveloper*.

Note: The following options are not supported:

- `-forcerewrite`
- `-nocompile`
- `-nodatasources`
- `-nodepdendents`
- `-outputfile`
- `-updatewebxmlejbrefs`

Table 19–7 provides examples of how to use the OJDeploy options with the MAF deployment commands.

Table 19–7 OJDeploy Options for MAF Deployments

Option	Description

`-clean`	Deletes all files from the project output directory before compiling. For example:
	`ojdeploy deployToSimulator`
	`-profile iosDeployProfile`
	`-workspace /usr/jsmith/jdeveloper/mywork/Application1.jws`
	`-clean`

`-stdout, -stderr`	Redirects the standard output and error logging streams to a file for each profile and project. For example:
	`ojdeploy deployToSimulator -profile iosDeployProfile`
	`-workspace /usr/jsmith/jdeveloper/mywork/Application1.jws`
	`-clean`
	`-stdout /usr/jsmith/stdout/stdout.log`
	`-stderr /usr/jsmith/stderr/stderr.log`

Table 19–8 lists the macros used with the `deployToApplicationArchive` command:

Table 19–8 Macros Used with MAF Application Archive Packaging

Macros	Description
`workspace.name`	The name of the application workspace container file (without the `.jws` extension).
`workspace.dir`	The directory of the application workspace container (`.jws`) file.
`profile.name`	The name of the profile being deployed.
`profile.dir`	The default deployment directory for the profile.
`base.dir`	Override the current OJDeploy directory using this parameter. You can also override the current OJDeploy directory using the basedir attribute in the build script.

20

Understanding Secure Mobile Development Practices

Mobile Application Framework provides protection from common security risks identified by the Open Web Application Security Project (OWASP), which are described in the following sections:

- Section 20.1, "Weak Server-Side Controls"
- Section 20.2, "Insecure Data Storage on the Device"
- Section 20.3, "Insufficient Transport Layer Protection"
- Section 20.4, "Side-Channel Data Leakage"
- Section 20.5, "Poor Authorization and Authentication"
- Section 20.6, "Broken Cryptography"
- Section 20.7, "Client-Side Injection From Cross-Site Scripting"
- Section 20.8, "Security Decisions From Untrusted Inputs"
- Section 20.9, "Improper Session Handling"
- Section 20.10, "Lack of Binary Protections Resulting in Sensitive Information Disclosure"

20.1 Weak Server-Side Controls

Build security into a mobile application. Even in the earliest stages of designing a mobile application, you must assess not only the risks that are unique to mobile applications, but also those that are common to the sever-side resources that the mobile application accesses. Like their desktop counterparts, mobile applications can be made vulnerable by attacks on the backend services that store their data. Because this risk is not unique to mobile applications, the standards described by the OWASP Top Ten Project (`https://www.owasp.org/index.php/Category:OWASP_Top_Ten_Project`) also apply when you create mobile applications. Because client applications running on mobile devices can be vulnerable, do not use them to enforce access control. Because this function should be performed by the server-side application, MAF does not provide anything out-of-the box for validating data sent from the client. You must ensure that the data intended for a mobile application is valid. For more information, see the following:

- "Understanding Web Service Security Concepts" in *Oracle Fusion Middleware Understanding Oracle Web Services Manager*

- "Web Service Security Standards" in *Oracle Fusion Middleware Understanding Oracle Web Services Manager*
- *Oracle Fusion Middleware Securing Applications with Oracle Platform Security Services*

20.2 Insecure Data Storage on the Device

Shortcomings in a mobile application's design can make local files accessible to users, thereby exposing sensitive data stored on a device's local file system. This data may include usernames and passwords, cookies, and authentication tokens. Although most users may not be aware that their data is vulnerable—or that it is even stored on the device itself—a malicious user could exploit this situation by having the tools to open the local database and view credentials. When assessing the security requirements for an application, you should assume the likelihood of a phone falling into the wrong hands. MAF provides the API to secure data stored on the device by encrypting the device database and local data stores.

20.2.1 Encrypting the SQLite Database

MAF's embedded SQLite database protects locally stored data. MAF applications do not share the SQLite database; the application that creates the database is the only application that can access it. Further, only users with the correct username and password can access this database. The `AdfmfJavaUtilities` class enables you to create keys to secure the password for this database and also to encrypt the data stored within it. To provide a secure key to the database, the `AdfmfJavaUtilities` class includes the `GeneratedPassword` utility class that generates a strong password and then stores it securely. The `AdfmfJavaUtilities` class also provides the `encryptDatabase` method for encrypting the database with a password. For general information about the SQLite database, see Chapter 10, "Using the Local Database" For more information on the `GeneratedPassword`, the `encryptDatabase` (and its counterpart, `decryptDatabase`), see *Oracle Fusion Middleware Java API Reference for Oracle Mobile Application Framework* and Section 10.2.7, "How to Encrypt and Decrypt the Database." For a sample application, see the StockTracker sample in the `PublicSamples.zip`, as described in Appendix F, "Mobile Application Framework Sample Applications."

Note: Always use the `GeneratedPassword` utility. Do not hard-code the key.

20.2.2 Securing the Device's Local Data Stores

You can store files in the local file system programmatically on both the iOS and Android platforms using the `adfmfJavaUtilties` class' `getDirectoryPathRoot` method. Using this method provides agnostic access to store application data on the device. The following options are available for this method:

- Temporary directory
- Application directory
- Cache directory
- Download directory

Tip: When users synchronize their devices to their desktop computers, the data stored in the device's Application directory is transferred to the desktop system where it can be exposed. Store data in the Temporary directory. For iOS, data stored in the temporary directory is not synchronized with the desktop when the device is synchronized using iTunes.

For any files that require security, you can encrypt and decrypt them using the Java cryptographic APIs (`javax.crypto`). For more information on the `javax.crypto` package, see Java Platform, Standard Edition 1.4 API. For more information, refer to *Oracle Fusion Middleware Java API Reference for Oracle Mobile Application Framework* and Section B.3, "Accessing Files Using the getDirectoryPathRoot Method." See also the "File System Basics" section in *File System Programming Guide*, available from the iOS Developer Library (`https://developer.apple.com/library/`).

20.2.3 About Security and Application Logs

Ensure that no sensitive data can be written to log files because they can be viewed if the device is synchronized with a desktop computer. When users connect their iOS devices to a desktop system to synchronize data, the application log files are ultimately stored on the desktop in an unencrypted format. Log files synchronized from Android devices can be viewed using the Android Device Monitor tool. See also Section 20.4, "Side-Channel Data Leakage."

20.3 Insufficient Transport Layer Protection

Mobile applications may use SSL/TLS when accessing data over a provider network, or neither of these protocols if they use WiFi. Because provider networks can be hacked, never assume that they are safe. You should therefore enforce SSL when the application transports sensitive data and validate that all certificates are legitimate and signed by public authorities.

Because all of the endpoints used by a mobile application must be secured with SSL, MAF provides a set of web service policies that support SSL. For SOAP web services, MAF applications use the following policies:

- `oracle/http_basic_auth_over_ssl_client_policy`
- `oracle/wss_username_token_over_ssl_client_policy`
- `oracle/wss_http_token_over_ssl_client_policy`

For REST web services, MAF supports a number of SSL-based policies. For more information, see Section 8.5.2, "How to Enable Access to REST-Based Web Services" and Section 21.4.12, "What You May Need to Know About Adding Cookies to REST Web Service Calls."

MAF provides a `cacerts` file seeded with entries of known and trusted Certificate Authorities. Application developers can add other certificates to this file, if needed. For more information, see Section 21.8, "Supporting SSL."

20.4 Side-Channel Data Leakage

Unintended data leakage can originate from such sources as:

- Disabling screen shots (backgrounding) -- iOS and Android take screen shots of the application before backgrounding the application for improving perceived

performance of the application reactivation. However, these screen shots are a cause of security concern due to the potential leak of customer data.

- Key stroke logging -- On iOS and Android, some of the information entered via keyboard is automatically logged in the application directory for use with type-ahead capabilities. This feature could lead to potential leaks of customer data.
- Debugging messages -- Applications can write sensitive data in debugging logs. Setting the logging level to FINE results in log messages being written for all of the data transmitted between the user's device and the server.
- Disable clipboard copy and open-in functionality for sensitive documents displayed as part of the application. MAF currently does not provide the capability to disable copy and open-in functionality and is being targeted for a future release.
- Temporary directories -- They may contain sensitive information.
- Third-party libraries -- These libraries (such as ad libraries) can leak user information about the user, the device, or the user's location.

To prevent data leakage:

- Do not log credential, personally identifiable information (PII), or other sensitive data to the application log. Store all sensitive information in the native keychain or an encrypted database or file system.
- When debugging an application, review any files that are created and anything written to them.
- Remove debugging messages before publishing the application.

20.5 Poor Authorization and Authentication

Weak authentication mechanisms and client-side access control both compromise security.

Although it may be easier for end users to authenticate a device using a phone number or some type of identifier (IMEI, IMSI, or UUID) rather than a user name and password, these identifiers can easily be discovered through brute force attacks and should never be used as a sole authenticator. Mobile applications must instead use strong credentials when accessing sensitive data. The authentication should reflect the user, not the device. Further, you can enhance authentication by using contextual identifiers (such as location), voice, fingerprints, or behavioral information.

A developer can use either the default login page provided by MAF or a custom login page that they create. For more information, see Section 21.5.2, "How to Designate the Login Page."

All features in a MAF application that require secure access must enable security, as described in Section 21.5.1, "How to Enable Application Features to Require Authentication."

Additionally, access control must be enforced by the server, not the client. Locating this function on the client mobile application is less secure. Access Control Service (ACS) allows developers to use roles/privileges defined on the server to enforce access control in the mobile application. Access Control Service is a RESTful service that could be implemented by application developers to filter the user roles/privileges that are valid for the application. While an application may support thousands of user roles, the service only returns the roles that you designate for the mobile application. For more information, see Section 21.4.16, "How to Configure Access Control."

20.6 Broken Cryptography

Encryption becomes fallible because:

1. Applications use broken implementations or use known algorithms improperly.
2. Data is insecure because of easily defeated cryptography.

In addition, Base-64 encoding, obfuscation, and serialization are not encryption (and should not be mistaken for encryption).

To encrypt data successfully:

- Do not store the key with the encrypted data.
- Use the platform-specific file encryption API or another trusted source. Do not create your own cryptography.

In addition to securing the embedded SQLite database using the encryption methods mentioned in Section 20.2, "Insecure Data Storage on the Device." Also, apply SSL to create secure web service calls as described in Section 20.3, "Insufficient Transport Layer Protection." MAF uses Oracle Access Manager for Mobile and Social IDM SDK for secure handling of credentials.

20.7 Client-Side Injection From Cross-Site Scripting

Because mobile applications draw content and data from many different sources, they can be vulnerable to Cross-Site Scripting (XSS) injections, which co-opt the user session. While MAF protects against XSS primarily through encoding, it uses whitelists as an additional safeguard.

Whitelisting protects MAF applications from CSRF attacks by allowing only the permitted domains to open within the application feature's web view. The URIs that are not included in the list automatically open within the device's browser, outside of the mobile application's sandbox.

In addition to injection attacks, mobile applications are vulnerable to Cross-Site Request Forgery (CSRF), where a malicious page performs an unintended action in a targeted application on behalf of a user through the cookies cached in a web browser that store user identity. The combination of whitelists and application sandboxing address CSRF concerns.

20.7.1 Protecting Applications Against XSS Through Whitelists

For MAF applications, XSS and CSRF attacks may occur in applications whose user interface is delivered through a remote server. When you configure a mobile application to derive its content from a remote URL, the overview editor provided by MAF enables you to create a whitelist of the URLs that deliver the content. Whitelisted URLs open with the MAF web view and can access specified devices features and services. As described in Section 13.1.1, "Enabling Remote Applications to Access Device Services through Whitelists," you can configure a whitelisted URI using a wildcard.

Caution: To prevent an unintended URI from accessing device features, define the whitelist for specific target domains only. Use the wildcard carefully when defining a whitelisted domain; do not define wildcard-based whitelist configurations, which can be used for a wide range of URI (for example, avoid configurations, such as: `<adfmf:domain>*.*</adfmf:domain>` or `<adfmf:domain>*.com</adfmf:domain>`).

20.7.2 Protecting MAF Applications from Injection Attacks Using Device Access Permissions

The URIs that you whitelist can access data stored on the user's device and its various device capabilities, such as its camera or address book. Such access is not granted by default; as described in Section 21.6, "Allowing Access to Device Capabilities," you can configure a MAF application to limit the device's capabilities that a whitelisted URI can access to any of the following:

- open network sockets (must be granted when user authentication is configured)
- GPS and network-based location services
- contact
- e-mail
- SMS
- phone
- push notifications
- locally stored files

Tip: In addition to the whitelist configuration, you can programmatically protect users against such security risks as fake login pages injected by XSS through the `updateSecurityConfigWithURLParameters` method, which detects changes in the login configuration and then prompts users to confirm the change by re-authenticating, as described in Section 21.4.7, "How to Update Connection Attributes of a Named Connection at Runtime." Additionally, MAF informs users whenever they open a secured application feature. Authentication can be deferred when the default application does not participate in security. For more information, see *Oracle Fusion Middleware Java API Reference for Oracle Mobile Application Framework*.

20.7.3 About Injection Attack Risks from Custom HTML Components

Using HTML to create a custom user interface component in a MAF AMX page may leave an application open to an injection attack. MAF provides two components for HTML content in MAF AMX pages: the `<amx:verbatim>` component and the `<amx:outputHTML>` component. Because the `<amx:verbatim>` component does not allow dynamic HTML, it is not susceptible to an injection attack. However, the `<amx:outputHTML>` component, which delivers dynamic HTML content through an EL binding, may be vulnerable when you configure its `security` attribute to `none`. By default, this attribute is set to `high` to enable the framework to escape various HTML tags and remove JavaScript, such as an `onClick` event. Because setting it to `none` enables iFrame components and JavaScript (which allows AJAX requests within the

AMX page), you must ensure that the HTML and JavaScript are properly encoded. For more information, see Section 6.3.18, "How to Use Verbatim Component" and Section 6.3.19, "How to Use Output HTML Component." See also Section 20.8, "Security Decisions From Untrusted Inputs."

20.7.4 About SQL Injections and XML Injections

Mobile applications are vulnerable to SQL injections, which can enable an attacker to read the data stored in the embedded SQLite database.

To prevent SQL injections:

- Application developers are required to validate and encode all data stored in the local database.
- Application developers are expected to encode and validate XML and HTML content processed by the application.

20.8 Security Decisions From Untrusted Inputs

On both iOS and Android platforms, applications (such as Skype) may not always request permissions from outside parties, providing an entry point for attackers that may result in malicious applications circumventing security. As a result, applications are vulnerable to client-side injection and data leakages. Always prompt for additional authorization or provide additional steps to launch sensitive applications when additional authorization is not possible.

You must ensure that all of the data that the application receives from (or sends to) an untrusted third-party application can be subject to input validation. The client side XML input to the application must be encoded and validated. Although MAF AMX components can validate user input, data must be validated on the server, which should never trust the data it receives from a client. In other words, the server is responsible for ensuring that the XML, JSON, and JavaScript that is sent back and forth between it and the client is properly encoded.

When you configure the URL scheme that launches a MAF application from another application, you must validate the parameters sent through the URL to ensure that no malicious data or URIs can be passed to the MAF application. For more information, see Section 4.4, "Invoking a Mobile Application Using a Custom URL Scheme." See also Section 20.1, "Weak Server-Side Controls."

About JSON Parsing

Use MAF's JSON encoding API where possible. For scenarios requiring custom JSON composition, be careful when composing JSON with user-entered data. For more information about processing JSON data, see the *Oracle Fusion Middleware Java API Reference for Oracle Mobile Application Framework*.

20.9 Improper Session Handling

Usability requirements for mobile applications often require sessions to last for long periods. Mobile applications use cookies, SSO services, and OAUTH tokens for session management. Oracle Access Management Mobile and Social (OAMMS) supports OAuth tokens.

Note: OAuth access tokens can be revoked remotely.

To enable proper session handling:

- Configure session timeout in the Login Server connection to a value less than server-side session timeout.

  Do not use a device ID as a session token because it never expires. An application should expire tokens, even though doing so forces users to re-authenticate.

- Ensure that proper best practices (see OWASP Top Ten Project, `https://www.owasp.org/index.php/Category:OWASP_Top_Ten_Project`) are followed for token generation on the server.

  Do not use session tokens that can be easily guessed or are poorly generated. A session token should be unpredictable and have high entropy.

  Oracle Identity Management (IDM) stack provides support for standards-based tokens (such as, OAuth Access Token, JWT Token) for use with mobile applications. MAF provides out of the box support for Oracle IDM OAuth server and Oracle recommends using such standards-based authentication mechanisms with MAF applications.

As described in Section 21.4.2, "How to Configure Basic Authentication," configuring an application that requires users to authenticate against a login server includes options to set the duration of the session and idle timeouts. By default, the duration of an application feature session lasts eight hours. The default time for an application feature to remain idle is five minutes. MAF expires user credentials when either of the configured time periods expire and prompts users to re-authenticate.

20.10 Lack of Binary Protections Resulting in Sensitive Information Disclosure

Using reverse engineering, attackers can discover such sensitive data as API keys, passwords, and sensitive business logic. To protect this information:

- Store API keys and sensitive business logic on the server.
- Do not store passwords in the application binary.
- Never hard-code a password. Instead, use the `GeneratedPassword` utility described in Section 20.2, "Insecure Data Storage on the Device."
- Because log files can be monitored, ensure that applications do not write sensitive information to the log files. See also Section 20.4, "Side-Channel Data Leakage."
- Keep in mind that information stored on a file system (that is, stored externally from the mobile application). Store sensitive data in an encrypted database or file system, or in the native keychain. See also Risk 1: Insecure Data Storage on the Device.

21

Securing Mobile Applications

This chapter provides an overview of the security framework within Oracle Mobile Application Framework and also describes how to configure mobile applications to participate in security.

This chapter includes the following sections:

21.1 About Mobile Application Framework Security

MAF presents users with a login page when a secured application feature has been activated. For example, users are prompted with login pages when an application feature is about to be displayed within the web view or when the operating system returns an application to the foreground. MAF determines whether access to the application feature requires user authentication when an application feature is secured by an authentication server, or when it includes constraints based on user roles or user privileges. Only when the user successfully enters valid credentials does MAF render the intended web view, UI component, or application page.

While the presence of these conditions in any of the application features can prevent users from accessing a mobile application without a successful login, you can enable users to access a mobile application that contains both secured and non-secured application features by including a default application feature that is neither secured nor includes user access-related constraints. In this situation, users can access the MAF application without authentication. The default application feature provides the entrance point to the mobile application for these anonymous users, who can both view non-secured data and authenticate against the remote server when accessing a secured application feature. You can designate a non-secure default application feature by:

- Allowing anonymous users access to public information through the default application feature, but only enabling authorized users to access secured information.

- Allowing users to authenticate only when they require access to a secured application feature. Users can otherwise access the mobile application as anonymous users, or login to navigate to secured features.
- Allowing users to log out of secured application features when secured access is not wanted, thereby explicitly prohibiting access to secured application features by unauthorized users.

> **Note:** MAF enables anonymous users because the application login process is detached from the application initialization flow; a user can start a mobile application and access unsecured application features as an anonymous user without having to provide authentication credentials. In such a case, MAF limits the user's actions by disabling privileged UI components.

For more information, see Section 21.5.1, "How to Enable Application Features to Require Authentication," and Section 15.2.4, "About User Constraints and Access Control."

The IDM Mobile SDKs provide APIs for authentication, cryptography, user and role management, and secure storage. The SDKs support authentication through Basic Authentication and REST web services exposed by the Mobile and Social server. The Mobile and Social server supports authentication against the Oracle Access Manager (OAM) Server with (or without) strong authentication using Relying Party authentication (that is, authentication against third-party OpenId and OAuth service providers), and authentication against a directory server with (or without) strong authentication.

A mobile application uses either the default page or a customized login page that is written in HTML. When authentication beyond a login page, a knowledge-based authentication (KBA) page can be enabled when knowledge-based authentication is configured on OAMM server. KBA screens provide an additional challenge to users by prompting for additional information, such as "mother's maiden name." Like the login page, the KBA screen can be customized.

21.1.1 About Constraint-Dictated Access Control

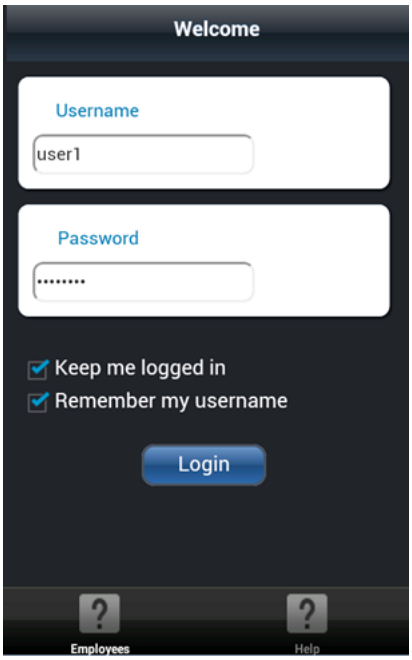
Application features defined with `user.roles` or `user.privileges` constraints can be accessed only by users who have been granted the specific role and privileges. When users log into such an application feature, a web service known as the Access Control Service (ACS) returns the user objects that grant them access to this application feature. For more information about ACS, see Section 21.4.17, "What You May Need to Know About the Access Control Service."

21.2 About the User Login Process

From the end-user perspective, the login process is as follows:

1. MAF presents a web view of a login page, shown in Figure 21–1 whenever the user attempts to access an application feature that is secured. If the secured application feature is the default, then MAF prompts users with the login page when they launch the mobile application.

Figure 21–1 The Login Page



Note: As described in Section 21.5.3.2, "The Custom Login Page," MAF provides not only a default login page, but also supports the use of a custom login page and, optionally, a custom knowledge-based authentication (KBA) screen.

2. The user enters a user name and password and then clicks **OK**.

Note: MAF allows multiple users for the same application. Users may freely log in to an application after a previous user logs out.

3. If the user name and password are verified, MAF displays the intended web view, page, or user interface component.
4. MAF presents challenges to the user name and password until the user logs in successfully. When users cannot login, they can only navigate to another application feature.
5. After authenticating their user name and password, the user may be presented with knowledge-based authentication (KBA) screen to challenge their credentials with additional questions. When KBA is configured, the user must correctly reply to the questions in order to complete the login process. KBA is an optional configuration that requires the appropriate configuration on OAMM server.

Note: Authentication times out when a predefined time period has passed since the last activation of an application feature. MAF only renews the timer for the idle timeout when one of the application features that uses the connection to the authentication server has been activated.

21.3 Overview of the Authentication Process for Mobile Applications

Mobile applications may require that user credentials be verified against a remote login server (such as the Oracle Access Manager Identity Server used by Oracle ADF Fusion web applications) or a local credential store that resides on the user's device. To support local and remote connectivity modes, MAF supports these authentication protocols:

- HTTP Basic
- Mobile-Social
- OAuth
- Web SSO

By default, authentication of the mobile application user is against the remote login server regardless of the authentication protocol chosen at design time. Developers may configure the application, in the case of Oracle Access Management Mobile and Social (OAMMS) and basic authentication to enable local authentication. However, initially, because the local credential store is not populated with credentials, login to access secured application features requires authentication against a remote login server. Successful remote authentication enables the subsequent use of the local credential store, which houses the user's login credentials from the authentication server on the device. Thus, after the user is authenticated against the server within the same application session (that is, within the lifecycle of the application execution), MAF stores this authentication context locally, allowing it to be used for subsequent authentication attempts. In this case, MAF does not contact the server if the local authentication context is sufficient to authenticate the user. Although a connection to the authentication server is required for the initial authentication, continual access to this server is not required for applications using local authentication.

> **Tip:** While authentication against a local credential store can be faster than authentication against a remote login server, Oracle recommends authentication using OAuth or Web SSO authentication protocols, which only support remote connectivity.

Table 21–1 summarizes the login configuration options of a MAF application. The connectivity mode depends on the chosen authentication protocol.

Table 21–1 MAF Connectivity Modes and Supported Authentication Protocols

Connectivity Mode	Support Protocols	Mode Description
local	■ **HTTP Basic** ■ **Mobile-Social**	Requires the application to authenticate against a remote login server only when locally stored credentials are unavailable on the device. The initial login is always against the remote login server. After the initial successful login, MAF persists the credentials locally within a credential store in the device. These credentials will be used for subsequent access to the application feature. See also Section 21.4.15, "What You May Need to Know about Web Service Security."

Table 21–1 (Cont.) MAF Connectivity Modes and Supported Authentication Protocols

Connectivity Mode	Support Protocols	Mode Description
remote	■ **HTTP Basic** ■ **Mobile-Social** ■ **OAuth** ■ **Web SSO**	Requires the application to authentication against a remote login server, such as Oracle Access Manager (OAM) Identity Server or a secured web application. Authentication against the remote server is required each time a user logs in. If the device cannot contact the server, then a user cannot login to the application despite a previously successful authentication.
hybrid	■ **HTTP Basic** ■ **Mobile-Social**	Requires the application to authenticate against a remote login server when network connectivity is available, even when local credentials are available on the device. Only when a lack of network connectivity prevents access to the login server will local credentials on the device will be used.

The flow of security is as follows when mobile applications verify user credentials against an authentication server:

1. MAF presents the user with the login page (similar to the one shown in Figure 21–1) or knowledge-based authentication screen.
2. The APIs of the Oracle Access Management Mobile and Social (OAMMS) client SDKs handle credential authentication against both the authentication server and the credential store on the device, which may store a saved user object. If the authentication succeeds, the APIs return a valid user object to MAF. Otherwise, they return a failure.

> **Note:** Logging into OAMMS populates the roles and privilege collections to the `user` object.

3. If the login succeeds, MAF receives an OAM token used in the cookie. MAF sets the cookie into each login connection.
4. The OAMMS client SDK APIs save the credentials in the device's credential store.
5. If the login fails, the login page or KBA screen remains, thereby preventing users from continuing.

21.4 Configuring MAF Connections

You must define at least one connection to the application login server for an application feature that participates in security. The absence of a defined connection to an application login server results in an invalid configuration. As a result, the application will not function properly.

21.4.1 How to Create a MAF Login Connection

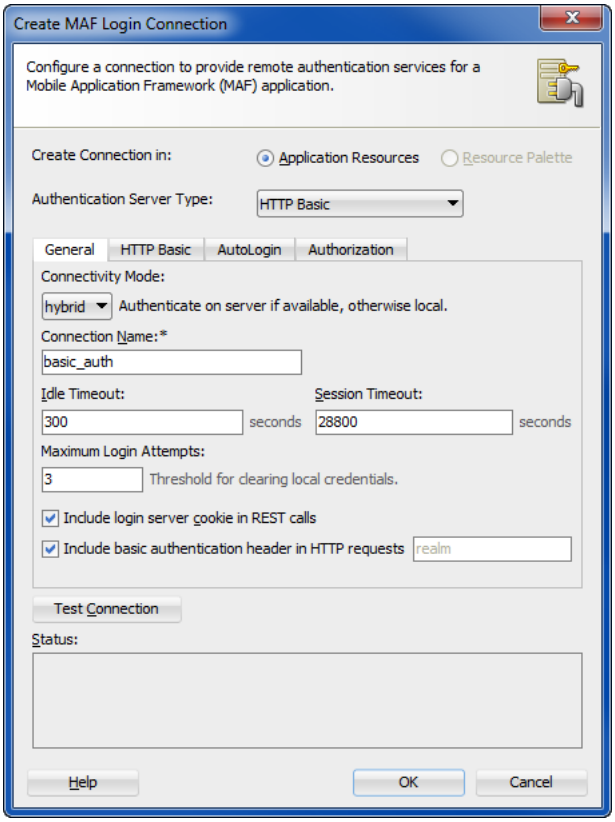
As Figure 21–2 shows, you can use the Create MAF Connection dialog to select the connection type and, depending on the connection type, enable both local and remote authentication (hybrid). Depending on application requirements, you can configure a connection to servers that support the following authentication protocols:

- HTTP Basic
- Mobile-Social

- OAuth
- Web SSO

> **Note:** Oracle recommends that you configure a connection to the login server using the OAuth or Web SSO connection type. OAuth and Web SSO require authentication against a remote login server and do not allow users to authenticate on the device from a local credential store.

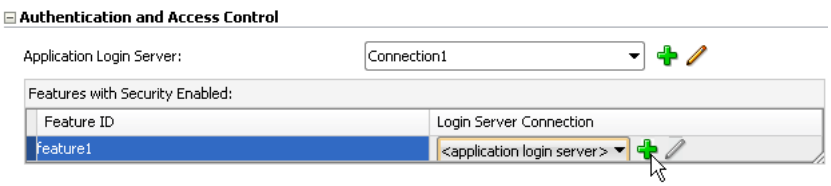
Figure 21–2 Configuring Authentication



To create a login server connection:

1. Perform one of the following actions.
   - In the Navigator, expand the **Descriptors** node and then **ADF META-INF**, and double-click **maf-application.xml**. Then, in the overview editor for the `maf-application.xml` file, expand the **Authentication and Access Control** section and click **Add**, as shown in Figure 21–3.

Figure 21–3 Adding a Server Connection



Note: The overview editor for the `maf-application.xml` file lets you define the application login server connection and assign it to the default application feature (if the default application feature is secured). In this case, credentials specified for the application login server are also used to retrieve user and roles and services through the Access Control Service (ACS). See also Section 21.4.17, "What You May Need to Know About the Access Control Service."

- Alternatively, choose **Connections** in the New Gallery and then **MAF Login Server Connection**.

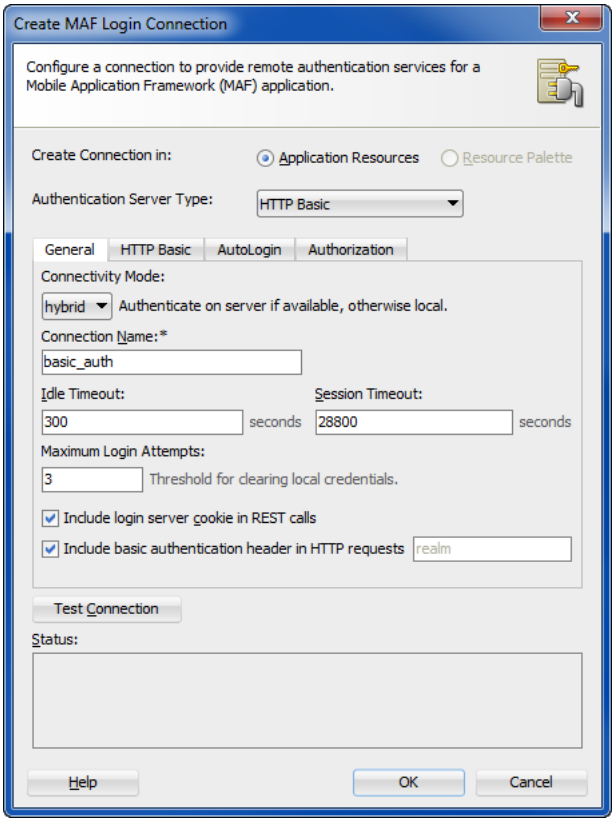
2. In the Create MAF Login Connection dialog, choose the desired **Authentication Server Type**.
3. Configure the connection type as described in the following sections.

   Note that options that appear in the dialog with an asterisk are required fields. The dialog enables the **Test Connection** button only after all required fields are completed. This button appears only when basic authentication is selected in the dialog.

21.4.2 How to Configure Basic Authentication

As Figure 21–4 shows, you can select the **HTTP Basic** authentication server type in the Create MAF Login Connection dialog to configure a connection for basic authentication.

Figure 21–4 Configuring Basic Authentication



To configure basic authentication:

1. In the Create MAF Login Connection dialog, choose **HTTP Basic** for **Authentication Server Type**.

   For information about opening the Create MAF Login Connection dialog, see Section 21.4.1, "How to Create a MAF Login Connection."

2. In the General tab, define the following:

   - **Connectivity Mode**—Select the type of authentication, as described in Table 21–1.
   - **Connection Name**—Enter a name for the connection.
   - **Idle Timeout**—Enter the time for an application feature to remain idle after MAF no longer detects the activation of an application feature. After this period expires, the user is timed-out of all the application features that are secured by the login connection. In this situation, MAF prompts users with the login page when they access the feature again. By default, MAF presents the login page when an application remains idle for 300 seconds (five minutes).

     Note: MAF authenticates against the local credential store after an idle timeout, but does not perform this authentication after a session timeout.

   - **Session Timeout**—Enter the time, in seconds, that a user can remain logged in to an application feature. After the session expires, MAF prompts the user with a login page if the idle timeout period has not expired. By default, a user session lasts for 28,800 seconds (eight hours).
   - **Maximum Login Attempts**—Set the maximum number of failed login attempts allowed for a user before local credentials will be cleared. By default, MAF grants a user three unsuccessful login attempts before it clears the user's locally stored credentials and contacts the remote login server for subsequent login attempts. Subsequent to contacting the remote server, the user is allowed an indefinite number of login attempts.

     Note that when the user fails login attempts for the number of times specified, the local credentials will be cleared and MAF will thus execute authentication against the server. This ensures that users can login with a new password after an administrator changes their password and it is not yet stored on a device. Where local authentication is allowed, the password will be stored securely on a device when the user successfully logs into the server connection.

     Note: MAF clears locally stored user credentials even when the application feature is configured to use local authentication.

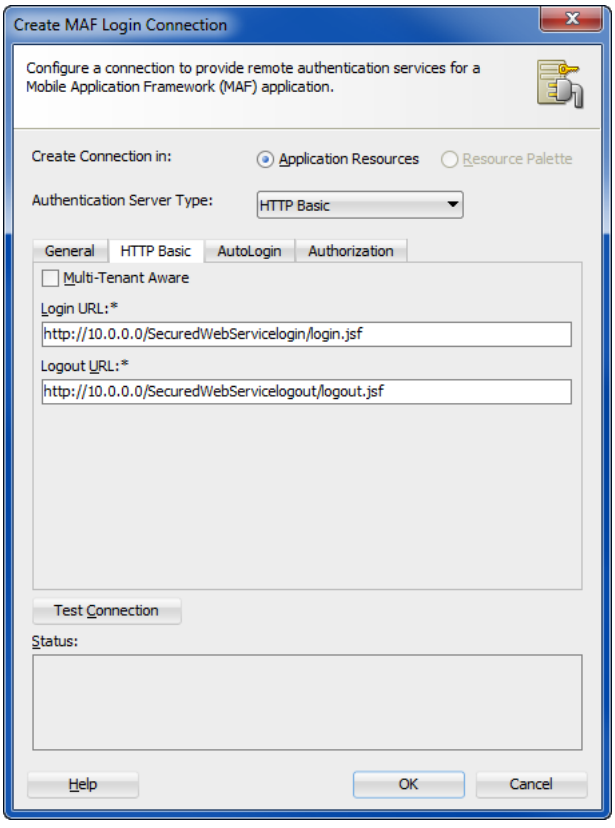
   - **Include login server cookie in REST calls**—For application features using remote authentication, select this option to enable a REST web service to retrieve the authorized user data that is stored on a login server through a login server-generated user session cookie. For more information, see Section 21.4.12, "What You May Need to Know About Adding Cookies to REST Web Service Calls."

Note: To enable cookies to be injected in the REST web service call, the application feature must use remote authentication (MAF does not support injecting cookies for application features that store user credentials locally) and the domain entered for **Login URL** must be identical to the domain of the REST web service end point.

- **Include basic authentication header in HTTP requests**—Select this option to enable MAF to add a basic authentication header into the HTTP requests made from a web view. Basic authentication is the default request method used by MAF. A basic authentication header is injected only when the login connection type is HTTP Basic. See also Section 21.4.14, "What You May Need to Know About Injecting Basic Authentication Headers."

3. Click the HTTP Basic tab and configure the following, as shown in Figure 21–5.
   - **Multi-Tenant Aware**—MAF supports the notion of multi-tenancy, where a mobile application includes a hosted application feature that can be shared by different organizations (tenants), but can appear as though it is owned by a particular tenant. You can define multi-tenancy awareness for the mobile application connection by selecting this option. See also Section 21.4.19, "What Happens When You Define a Multi-Tenant Connection."
   - **Login URL**—Enter the login URL for the authentication server.
   - **Logout URL**—Enter the logout URL for the authentication server.

Figure 21–5 Configuring Basic Authentication

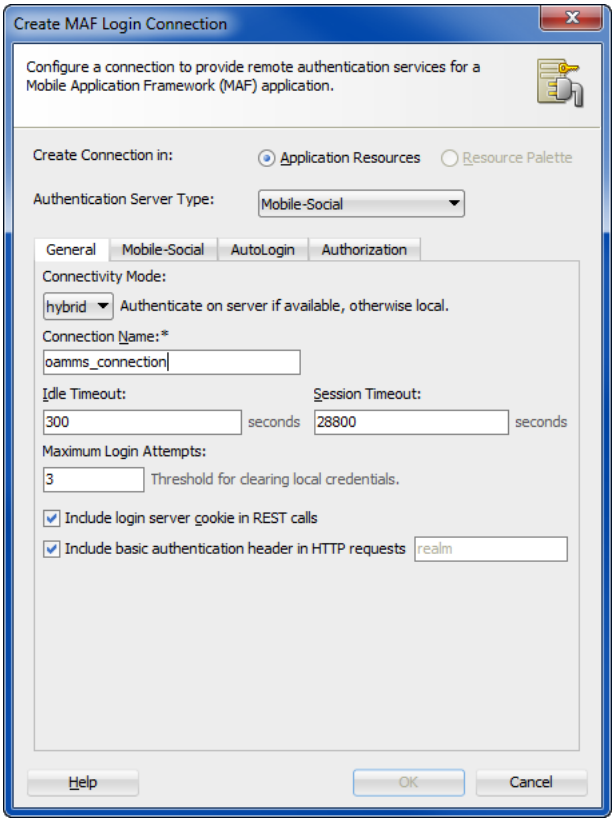


4. Click the Auto Login tab and configure the parameters as described in Section 21.4.8, "How to Store Login Credentials."
5. Click the Authorization tab and configure the parameters as described in Section 21.4.16, "How to Configure Access Control."
6. Click the General tab, and then click **Test Connection**.
7. Click **OK**.

21.4.3 How to Configure Authentication Using Oracle Mobile and Social Identity Management

As Figure 21–6 shows, you can select the **Mobile-Social** authentication server type in the Create MAF Login Connection dialog to configure a connection for mobile applications to authenticate with the Oracle Access Manager (OAM) server. The OAM backend for this connection type must be running Oracle Mobile and Social server and 10*g* WebGate (a web server plug-in that intercepts HTTP requests for resources and forwards them to the OAM server for authentication and authorization).

Figure 21–6 Configuring Authentication with Mobile-Social



Before you begin:

Confirm that the OAM backend runs Oracle Mobile and Social Server and 10*g* Webgate.

Configure the server to use the `OM_PROP_OAMMS_URL` property key. This URL (including protocol, host name, and port number) is required to reach the Mobile and Social server. Only the HTTP and HTTPS protocols are supported. You must also configure the server to inject an `OAM_ID` cookie into the web server request header.

Note: This connection type requires KBA (knowledge-based authentication). For more information, see Section 21.5.2, "How to Designate the Login Page."

To configure authentication with Oracle Access Management through an Oracle Mobile and Social server:

1. In the Create MAF Login Connection dialog, choose **Mobile-Social** for **Authentication Server Type**.

   For information about opening the Create MAF Login Connection dialog, see Section 21.4.1, "How to Create a MAF Login Connection."

2. In the General tab, define the following:

   - **Connectivity Mode**—Select the type of authentication, as described in Table 21–1.
   - **Connection Name**—Enter a name for the connection.
   - **Idle Timeout**—Enter the time for an application feature to remain idle after MAF no longer detects the activation of an application feature. After this period expires, the user is timed-out of all the application features that are secured by the login connection. In this situation, MAF prompts users with the login page when they access the feature again. By default, MAF presents the login page when an application remains idle for 300 seconds (five minutes).

     Note: MAF authenticates against the local credential store after an idle timeout, but does not perform this authentication after a session timeout.

   - **Session Timeout**—Enter the time, in seconds, that a user can remain logged in to an application feature. After the session expires, MAF prompts the user with a login page if the idle timeout period has not expired. By default, a user session lasts for 28,800 seconds (eight hours).
   - **Maximum Login Attempts**—Set the maximum number of failed login attempts allowed for a user before local credentials will be cleared. By default, MAF grants a user three unsuccessful login attempts before it clears the user's locally stored credentials and contacts the remote login server for subsequent login attempts. Subsequent to contacting the remote server, the user is allowed an indefinite number of login attempts.

     Note that when the user fails login attempts for the number of times specified, the local credentials will be cleared and MAF will thus execute authentication against the server. This ensures that users can login with a new password after an administrator changes their password and it is not yet stored on a device. Where local authentication is allowed, the password will be stored securely on a device when the user successfully logs into the server connection.

     Note: MAF clears locally stored user credentials even when the application feature is configured to use local authentication.

   - **Include login server cookie in REST calls**—For application features using remote authentication, select this option to enable a REST web service to

retrieve the authorized user data that is stored on a login server through a login server-generated user session cookie. For more information, see Section 21.4.12, "What You May Need to Know About Adding Cookies to REST Web Service Calls."

Note: To enable cookies to be injected in the REST web service call, the application feature must use remote authentication (MAF does not support injecting cookies for application features that store user credentials locally) and the domain entered for **Login URL** must be identical to the domain of the REST web service end point.

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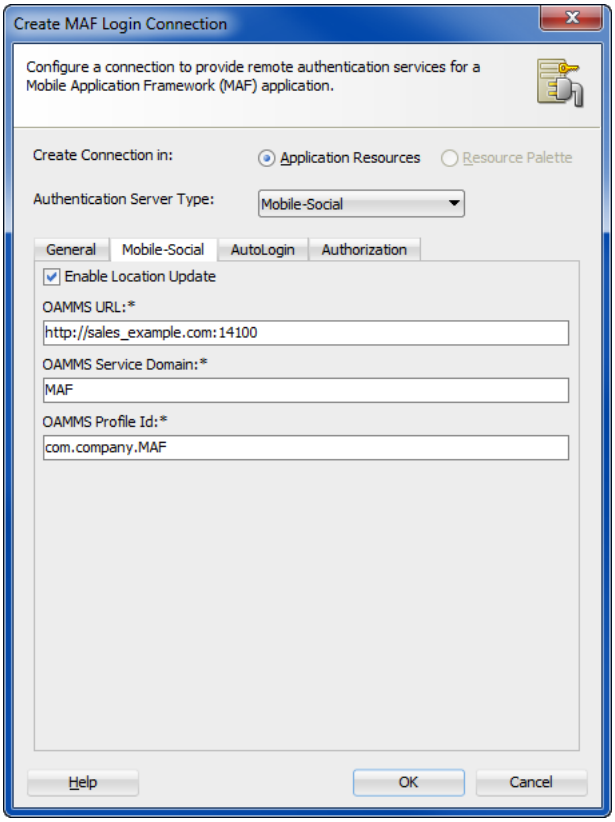
3. Click the Mobile-Social tab and enter the URL to the Oracle Access Management Mobile and Social server and enter the mobile application service domain.

   You can also configure the connection to enable the server to make location updates on the device, as shown in Figure 21–7.

Figure 21–7 Configuring the OAM Authentication

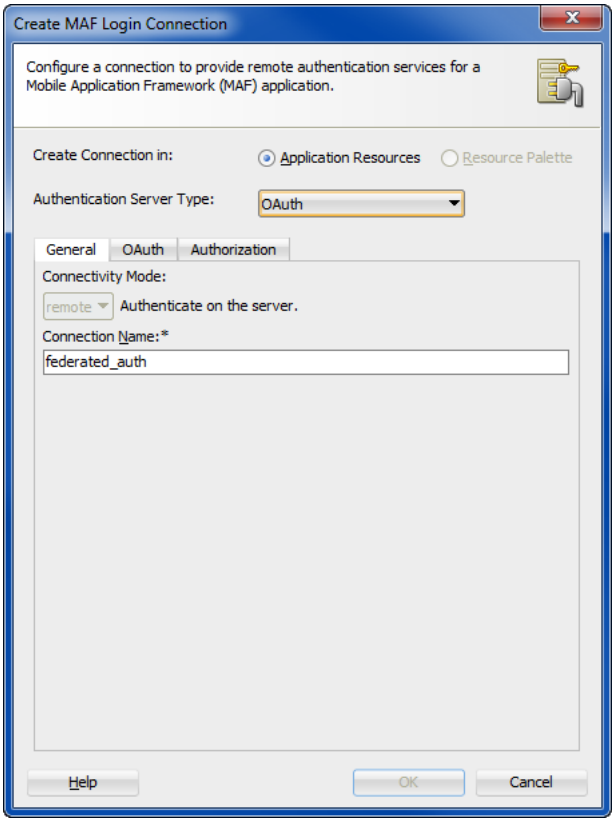


4. Click the AutoLogin tab and configure the parameters as described in Section 21.4.8, "How to Store Login Credentials."
5. Click the Authorization tab and configure the parameters as described in Section 21.4.16, "How to Configure Access Control."

21.4.4 How to Configure OAuth Authentication

As Figure 21–8 shows, you can use the Create MAF Login Connection dialog to configure how third-party applications (clients) gain limited access to protected data or services stored on a remote server. The Relying Party authentication provided by Oracle Mobile and Social server enables an application to authenticate against a third-party OAuth provider. Oracle Web Services Manager (OWSM) Lite Mobile ADF Application Agent injects the cookie into the security header of the web service call.

Figure 21–8 Configuring OAuth



Before you begin:

Configure the server to use the `OM_PROP_OAUTH_OAUTH20_SERVER` property key.

To configure authentication with an OAuth server:

1. In the Create MAF Login Connection dialog, choose **OAuth** for **Authentication Server Type**.

   For information about opening the Create MAF Login Connection dialog, see Section 21.4.1, "How to Create a MAF Login Connection."

2. In the General tab, configure the following:

   - **Connection Name**—Enter a name for the connection.

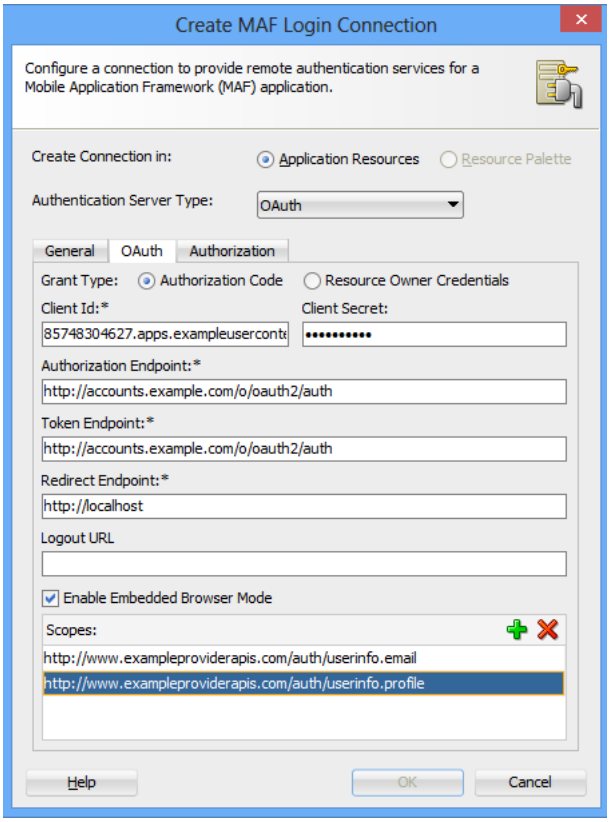
3. Click the OAuth tab and configure the following, as shown in Figure 21–9:

   - Choose the **Grant Type** to determine where the application obtains the login page. Select **Authorization Code** when you want the server login page to display. Select **Resource Owner Credentials** when you want the MAF

application to display the default login page, or custom login page, when one is configured.

- Enter enter the **Client Identifier** and, optionally, enter a connection password value in the **Client Secret** field.
- Enter the authorization server's **Redirect Endpoint** and the URIs for the endpoints for the **Authorization Server Endpoint** itself and the **Token Endpoint**.
- Select **Enable Embedded Browser Mode** when you want the login page to display within the embedded browser within the application. Deselect to display the login page in an external browser. Note that when single sign-on (SSO) is desired, you must deselect this option to force the application to use the external browser.

Figure 21–9 Configuring the Client ID and Endpoints

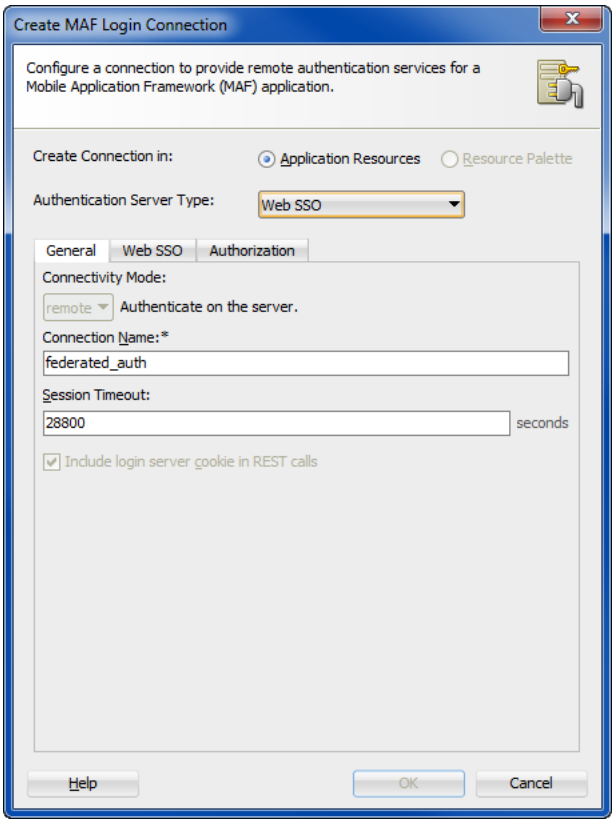


4. Click the Authorization tab and configure the parameters as described in Section 21.4.16, "How to Configure Access Control."

21.4.5 How to Configure Web SSO Authentication

As Figure 21–10 shows, you can use the Create MAF Login Connection dialog to configure a cross-domain single sign-on.

Figure 21–10 Configuring Federated SSO Authentication



To configure authentication with a Web SSO server:

1. In the Create MAF Login Connection dialog, choose **Web SSO** for **Authentication Server Type**.

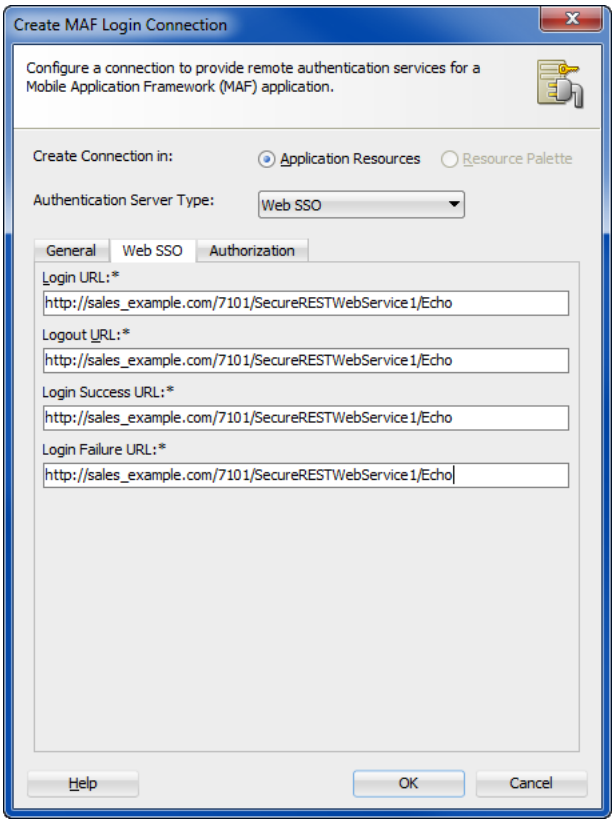
   For information about opening the Create MAF Login Connection dialog, see Section 21.4.1, "How to Create a MAF Login Connection."

2. In the General tab, configure the following:

   - **Connection Name**—Enter a name for the connection.
   - **Session Timeout**—Enter the time, in seconds, that a user can remain logged in to an application feature. After the session expires, MAF prompts the user with a login page if the idle timeout period has not expired. By default, a user session lasts for 28,800 seconds (eight hours).

3. Click the Web SSO tab, and configure the URLs that enable successful and unsuccessful logins, as shown in Figure 21–11.

Figure 21–11 Configuring the Authentication URLs



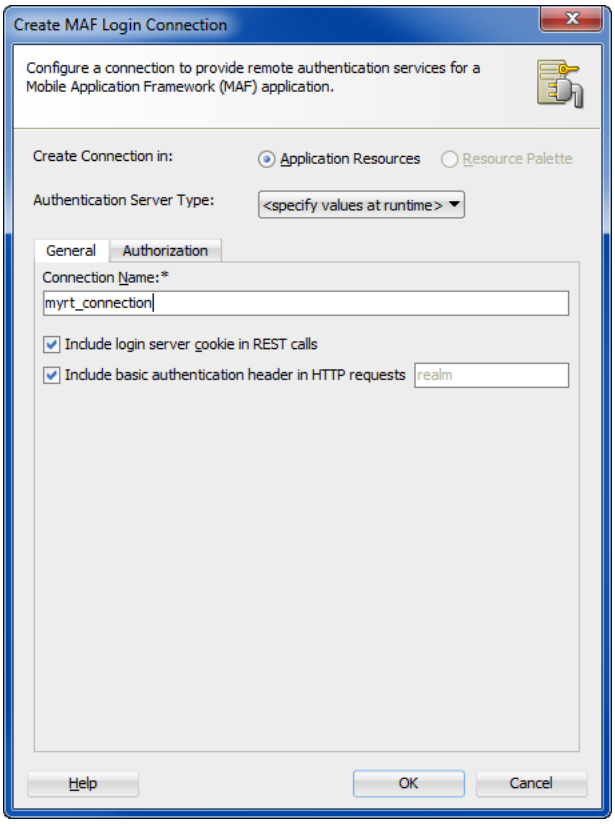
4. Click the Authorization tab and configure the parameters, as described in Section 21.4.16, "How to Configure Access Control."

21.4.6 How to Configure a Placeholder Connection for MAF Application Login

As Figure 21–12 shows, you can use the Create MAF Login Connection dialog to create a named connection during development and populate the login attributes to fully define the connection at runtime. This connection type is particularly useful when the connection attributes are not all known at design time.

Application developers must use `AdfmfJavaUtilities.updateSecurityConfigWithURLParameters` API to fully define the placeholder connection created at design time, as described in Section 21.4.7, "How to Update Connection Attributes of a Named Connection at Runtime."

Figure 21–12 Configuring a Placeholder Connection



To configure a placeholder connection for definition at runtime:

1. In the Create MAF Login Connection dialog, choose **Specify Values at Runtime** for **Authentication Server Type**.

   For information about opening the Create MAF Login Connection dialog, see Section 21.4.1, "How to Create a MAF Login Connection."

2. In the General tab, configure the following:

   - **Connection Name**—Enter a name for the connection. This identifier will be used by the application developer to identify the connection to update, as described in Section 21.4.7, "How to Update Connection Attributes of a Named Connection at Runtime."
   - **Include login server cookie in REST calls**—For application features using remote authentication, select this option to enable a REST web service to retrieve the authorized user data that is stored on a login server through a login server-generated user session cookie. For more information, see Section 21.4.12, "What You May Need to Know About Adding Cookies to REST Web Service Calls."

     Note: To enable cookies to be injected in the REST web service call, the application feature must use remote authentication (MAF does not support injecting cookies for application features that store user credentials locally) and the domain entered for **Login URL** must be identical to the domain of the REST web service end point.

- **Include basic authentication header in HTTP requests**—Select this option when the connection type will use Basic authentication to enable MAF to add a basic authentication header into the HTTP requests made from a web view. Basic authentication is the default request method used by MAF. A basic authentication header is injected only when the login connection type is HTTP Basic. See also Section 21.4.14, "What You May Need to Know About Injecting Basic Authentication Headers."

3. Click the Authorization tab and configure the parameters, as described in Section 21.4.16, "How to Configure Access Control."

21.4.7 How to Update Connection Attributes of a Named Connection at Runtime

Application developers can use the `AdfmfJavaUtilities.updateSecurityConfigWithURLParameters` API to define or to redefine the connection attributes of a connection that already exists: either by placeholder (when you select **Specify Values at Runtime** in the Create MAF Login Connection dialog, as shown in Figure 21–12) or by a fully populated connection definition.

> **Note:** The typical timing is to call the `AdfmfJavaUtilities.updateSecurityConfigWithURLParameters` API in a `start()` method implementation within an application lifecycle listener. You must not call this method from within the feature lifecycle listener.

To update connection attributes associated with the `configUrlParam` parameter, call the `updatedSecurityConfigWithURLParameters` method as follows:

```
import oracle.adfmf.framework.api.AdfmfJavaUtilities;
...
   AdfmfJavaUtilities.updateSecurityConfigWithURLParameters(configUrlParam,
              key, message, showConfirmation);
```

The `key` parameter is set as a `String` object from the value defined for the `adfCredentialStoreKey` parameter in the `connections.xml` file. The method may be invoked with the `showConfirmation` parameter set to `true` to allow MAF to display a confirmation prompt to the end user once MAF detects a connection configuration change to an existing attribute of the connection.

For more information on the `AdfmfJavaUtilties` class and the usage of the `configUrlParam` parameter, see the *Oracle Fusion Middleware Java API Reference for Oracle Mobile Application Framework*.

21.4.8 How to Store Login Credentials

When security is not critical, MAF supports storing user credentials, which can be replayed to the login server or used to authenticate users locally (depending on the mode defined for the login connection. Storing credentials enhances the user experience by enabling users to access the mobile application without having to login. The IDM Mobile SDKs enable MAF to support the following modes:

- auto login—MAF caches the user credentials and then replays them to the authentication server during subsequent authentications. In this mode, users can start an application without MAF prompting them to enter or confirm their

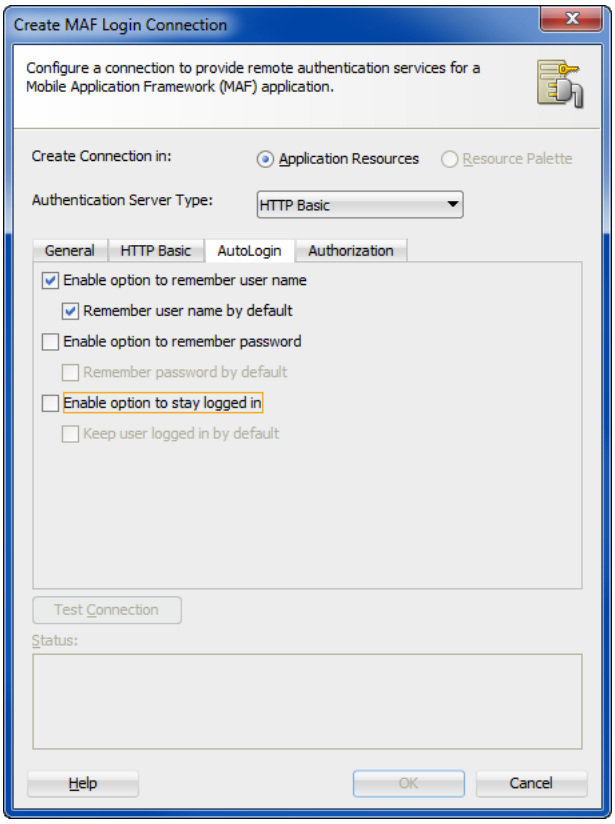
credentials. MAF can, however, inform users that it has started a new application session.

- remember credentials—MAF caches the user credentials and populates the login page's username and password fields. After the user confirms these credentials by tapping the login button, MAF replays them to the authentication server.
- remember username—MAF caches the user name and populates the login page's **username** field. After the user enters the password and confirms by tapping the login button, MAF replays these credentials to the authentication server.

> **Note:** Users can decide whether MAF stores their credentials.

As Figure 21–13 shows, you can use the AutoLogin page of the Create MAF Login Connection dialog to select credential storing options. Selecting credential options populates the login page with options to remember the user name and password and should not be selected when a device is shared by multiple end users.

Figure 21–13 Caching User Credentials



21.4.9 What You May Need to Know About Multiple Identities for Local and Hybrid Login Connections

Like a remote connection, local and hybrid login connection modes allow a user to log in and log out using any number of identities within an application lifecycle. When you define a login connection to use these connectivity modes, you enable users to log back into a secured application feature using the local credential store if they have previously logged into a secured application feature within the current session timeout

duration. In this case, users who have logged out explicitly, or have been logged out because the idle timeout has expired, can log back into a secured application feature (or any other application feature secured by the login server that protects that application feature).

> **Note:** Local and hybrid connections are only available for basic authentication and authentication to Oracle Access Management Mobile and Social (OAMMS). Because OAuth and Federate SSO use remote authentication, application users cannot log back into an application unless they authenticate successfully.

21.4.10 What You May Need to Know About Migrating a MAF Application and Authentication Modes

When you migrate a MAF application, you must verify that the authentication mode defined in `maf-feature.xml` (such as `<adfmf:feature id="feature1" name="feature1" credentials="remote">`) is defined by the `authenticationMode` attribute in the `connections.xml` file. Use JDeveloper's audit rules, which detect the presence of the `credentials` attribute, to assist you in removing it from `maf-feature.xml`.

Because the `authenticationMode` attribute in the `connections.xml` file can only be defined as either `remote` or `local`, do not migrate the value of `none` (`<adfmf:feature id="feature1" name="feature1" credentials="none">`), as doing so causes the deployment to fail.

21.4.11 What Happens When You Enable Cookie Injection into REST Web Service Calls

If you selected the **Include login server cookie in REST call** option in the Create MAF Login Connection dialog, shown in Figure 21–15, you instructed MAF to retrieve this user session cookie sent by the login server and then inject it into the HTTP header of the REST web service call that originated from the mobile application.

Each time a mobile application requests a REST web service, MAF's security framework enables the transport layer of the REST web service to check if cookie injection is enabled for the login connection associated with the URL endpoint of the REST web service. That is, the `connections.xml` file must include `<injectCookiesToRESTHttpHeader value="true"/>`, as illustrated in Example 21–4.

If the connection allows cookie injection, and if the domains for the login server and the REST web service endpoint are identical, then the security framework retrieves the cookies stored when a user has logged into an application feature. MAF propagates all of the cookies stored for a domain in a REST web service request. MAF stores cookies per the `Set-Cookie` headers in the Rest web service response. The `Set-Cookie` headers may add cookies to the store, or replace existing cookies with new ones if they have the same name. The cookies returned by the REST web service response, as well as those returned by the authentication process, are injected into subsequent REST web service requests.

> **Note:** MAF constructs the cookie string by calling the Oracle Access Management Mobile and Social (OAMMS) API, which returns cookies by name from a platform-specific cookie store. The IDM Mobile SDK manages the cookies returned by authentication servers, the names of which are defined in the `connections.xml` file.

21.4.12 What You May Need to Know About Adding Cookies to REST Web Service Calls

After a user has been successfully authenticated by a mobile application, the login server creates the security context for the user and generates a cookie that tracks the user session. If you selected the **Include login server cookie in REST call** option in the Create MAF Login Connection dialog, shown in Figure 21–15, you instructed MAF to retrieve this user session cookie sent by the login server and then inject it into the HTTP header of the REST web service call that originated from the mobile application.

Propagating the cookie to the web service call enables the retrieval of the user's security context, which is stored on the login server, and enables the mobile application to use the REST web service to access the application data that is authorized for the user. After the user session cookie expires, MAF challenges the user for credentials and then re-authenticates the user. A user that has been re-authenticated can continue to access the authorized application data through the REST web service call.

21.4.13 What Happens at Runtime: When MAF Calls a REST Web Service

After a user is authenticated locally, MAF silently authenticates the user against the login server when the mobile application calls a REST web service. After the user's credentials are authenticated, MAF executes the application's request to the REST web service. If the REST web service returns a `401` status code (Unauthorized), MAF prompts the user to authenticate again. If the REST web service returns a `302` code (Found or temporarily moved), MAF checks the login server to confirm if the user is authenticated. If so, then the code is handled as a `302` redirect.

If the user has not been authenticated against the login server, then MAF prompts the user to authenticate again. In some cases, a login server may prompt users to authenticate using its own web page when it returns a `302` status code. MAF does not support redirection in these instances and instead prompts the user to login again using a MAF login page.

21.4.14 What You May Need to Know About Injecting Basic Authentication Headers

When servers do not honor cookies, MAF enables application features to access secure resources by injecting a basic authentication header into the HTTP requests made from their web views. By default, MAF uses basic authentication. Because the **Include basic authentication header in HTTP requests** option is selected by default, MAF enables application features to access secure resources by injecting a basic authentication header into the HTTP requests made from their web views.

> **Note:** To prevent MAF from injecting the basic authentication header, set the value attribute to `false` for the `<injectBasicAuthHeader>` element.

Defining an authentication realm for the user name and password populates the `connections.xml` file with a defined `<realm>` element. As illustrated in Example 21–1, MAF adds the header regardless of whether the `connections.xml` file includes these definitions or not.

Example 21–1 Using the connections.xml File to Inject the Basic Authentication Header

```
<?xml version = '1.0' encoding = 'UTF-8'?>
<References xmlns="http://xmlns.oracle.com/adf/jndi">
   <Reference name="connection1"
```

```
            className="oracle.adf.model.connection.adfmf.LoginConnection"
            adfCredentialStoreKey="connection1"
            partial="false" manageInOracleEnterpriseManager="true"
            deployable="true" xmlns="">
      <Factory className=
                    "oracle.adf.model.connection.adfmf.LoginConnectionFactory"/>
      <RefAddresses>
         <XmlRefAddr addrType="adfmfLogin">
            <Contents>
               <login url="http://www.us.example.com/userInfo"/>
               <logout url="http://www.us.example.com/userInfo"/>
               <accessControl url="http://10.0.0.0/identity/authorize"/>
               <idleTimeout value="300"/>
               <sessionTimeout value="28800"/>
               <cookieNames/>
               <realm value="Secure Area"/>
               <injectBasicAuthHeader value="true"/>
               <userObjectFilter/>
            </Contents>
         </XmlRefAddr>
      </RefAddresses>
   </Reference>
</References>
```

21.4.15 What You May Need to Know about Web Service Security

There are no login pages for web services; user access is instead enabled by MAF injecting credentials into the header of the web service call. Web services gain access to application data using the locally stored credentials persisted by MAF after the user's first successful login to the authentication server. The name of the local credential store is reflected by the `adfCredentialStoreKey` attribute of the login server connection (such as `adfCredentialStoreKey="Connection_1"` in Example 21–4). To enable a web service to use this credential store, the name defined for the `adfCredentialStoreKey` attribute of a SOAP or REST web service connection must match the name defined for the login server's `adfCredentialStoreKey` attribute.

Note: Because there is no overview editor for the `connections.xml` file, you can use the Properties window to update the `<Reference>` element's `adfcredentialStoreKey` attribute with the name configured for `adfCredentialStoreKey` attribute of the login server connection. Alternatively, you can add or update the attribute using the Source editor.

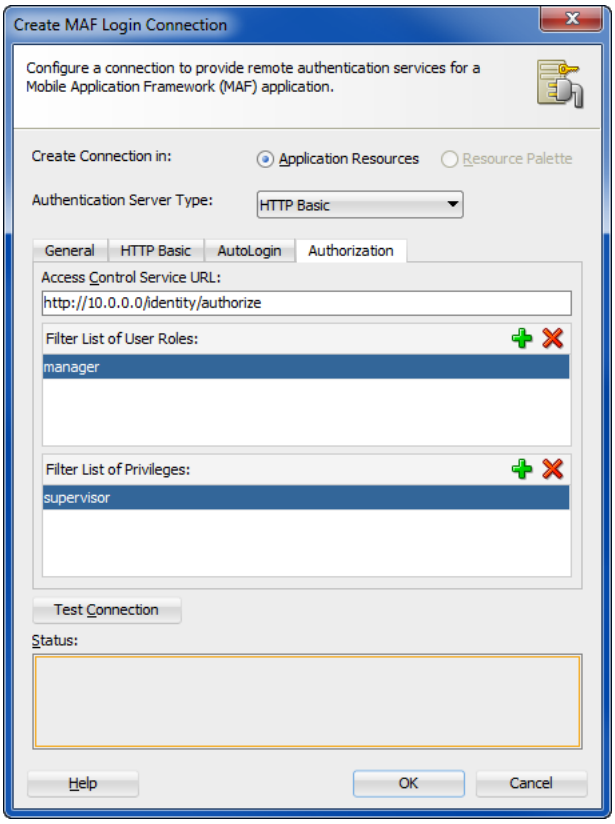
For more information, see Section 8.5.3, "What You May Need to Know About Credential Injection."

21.4.16 How to Configure Access Control

As Figure 21–14 shows, you can use the Authorization page of the Create MAF Login Connection dialog to configure access control. You will use this page when an application feature contains any component that is secured. For example, an expense report application that includes a submit button may be configured with a EL expression containing a `securityContext` object defined as `disabled` to allow only users who log in to this application with the *manager* privilege to view the submit button. Completing the fields in this Authorization page configures the Access Control

Service, a RESTful web service that enables the retrieval of the specific user roles that are checked by an application feature.

Figure 21–14 Configuring Access Control



The access control granted by the application login server is based on the evaluation of the `user.roles` and `user.privileges` constraints configured for an application feature, as described in Section 15.2.4, "About User Constraints and Access Control." For example, to allow only a user with *manager_role* role to access an application feature, you must define the `<adfmf:constraints>` element in the `maf-feature.xml` file with the following:

```
<adfmf:constraint property="user.roles"
                  operator="contains"
                  value="manager_role"/>
</adfmf:constraints>
```

At the start of application, the RESTful web service known as the Access Control Service (ACS) is invoked for the application login server connection and the roles and privileges assigned to the user are then fetched. MAF then challenges the user to login against the application login server connection.

MAF evaluates the constraints configured for each application against the retrieved user roles and privileges and makes only the application features available to the user that satisfy all of the associated constraints.

To configure access control:

1. In the Create MAF Login Connection dialog, click the Authorization tab.

For information about opening the Create MAF Login Connection dialog, see Section 21.4.1, "How to Create a MAF Login Connection."

2. On the Authorization page, complete the authorization requirements, as shown in Figure 21–14.

   - **Access Control Service URL**—Enter the URL that is the endpoint for the Access Control Service (ACS).

     Note: MAF injects all cookies issued by the authentication server (that is, the login server) into the HTTP request header when it invokes the ACS. Cookie injection occurs when you select **Include login server cookie in REST calls** and enter identical domains for **Access Control URL** and the **Login URL** parameters. MAF verifies the domains of the ACS URL and login URL are identical before injecting a cookie. Otherwise, a cookie from login server will not be injected in the ACS request and thus authentication against ACS will fail. Ideally, the ACS URL should be protected so user authentication is required for secure access. See also Section 21.4.12, "What You May Need to Know About Adding Cookies to REST Web Service Calls."

   - **Filter List of User Roles**—Enter the user roles checked by the application feature. Because there may be thousands of user roles and privileges defined in a security system, use the manifest provided by the application feature developer that lists the roles specific to the application feature to create this list.
   - **Filter List of Privileges**—Enter the privileges checked by the application feature.

21.4.17 What You May Need to Know About the Access Control Service

The Access Control Service (ACS) is a RESTful web service with JSON that enables users to download their user roles and privileges through a single HTTP `POST` message. This is a request message, one which returns the roles or privileges (or both) for a given user. It can also return specific roles and privileges by providing lists of required roles and privileges. The request message is comprised of the following:

- Request header fields: `If-Match`, `Accept-Language`, `User-Agent`, `Authorization`, `Content-Type`, `Content Length`.
- A request message body (a request for user information).
- The requested JSON object that contains:
  - `userId`—The user ID.
  - `filterMask`—A combination of `"role"` and `"privilege"` elements are used to determine if either the filters for user roles, or for privileges, should be used.
  - `roleFilter`—A list of roles used to filter the user information.
  - `privilegeFilter`—A list of privileges used to filter the user information.

Note: If all of the roles should be returned, then do not include the `"role"` element in the `filterMask` array.

If all of the privileges should be returned, then do not include the `"privilege"` element in the `filterMask` array.

Example 21–2 illustrates an HTTP `POST` message and identifies a JSON object as the payload, one that requests all of the filters and roles assigned to a user, John Smith.

Example 21–2 The ACS Request for User Roles and Privileges

```
Protocol: POST
Authoization: Basic xxxxxxxxxxxx
Content-Type: application/json

{
        "userId": "johnsmith",
        "filterMask": ["role", "privilege"],
        "roleFilter": [ "role1", "role2" ],
        "privilegeFilter": ["priv1", "priv2", "priv3"]
}
```

The response is comprised of the following:

- A response header with the following fields: `Last-Modified`, `Content-Type`, and `Content-Length`.
- A response message body that includes the user information details.
- The returned JSON object, which includes the following:
  - `userId`—the ID of the user.
  - `roles`—A list of user roles, which can be filtered by defining the `roleFilter` array in the request. Otherwise, the response returns an entire list of roles assigned to the user.
  - `privileges`—A list of the user's privileges, which can be filtered by defining the `privilegeFilter` array in the request. Otherwise, the response returns an entire list of privileges assigned to the user.

Example 21–3 illustrates the returned JSON object that contains the user name and the roles and privileges assigned to the user, John Smith.

Example 21–3 The Returned JSON Object

```
Content-Type: application/json

{
        "userId": "johnsmith",
        "roles": [ "role1" ],
        "privileges": ["priv1", "priv3"]
}
```

Note: There are no login pages for web services; user access is instead enabled by MAF, which automatically adds credentials to the header of the web service. For more information, see Section 8.5.3, "What You May Need to Know About Credential Injection."

Note: You must implement and host the ACS service; MAF does not provide this service.

21.4.18 How to Alter the Application Loading Sequence

MAF invokes the Access Control Service (ACS) after a user successfully authenticates against a login connection that defines the ACS endpoint, such as `http://10.0.0.0/Identity/Authorize` in Figure 21–14. By changing this behavior to prevent the ACS from being called immediately after a successful login, you can insert a custom process between the login and the invocation of the ACS. This additional logic may be a security context called by MAF after a successful login that is based on the specifics of an application, or related to the user's responsibilities, organization, or security group.

You can change the sequence by updating the `connections.xml` file with `<isAcsCalledAutomatically value = "false"/>` and through the following method of the `AdfmfJavaUtilities` class, which enables MAF application features to call the ACS whenever it is required:

```
invokeACS(String key, String OptionalExtraPayLoad, boolean appLogin)
```

The `invokeACS` method enables you to inject extra payload into an ACS request. The `key` parameter is returned as a `String` object from the value defined for the `adfCredentialStoreKey` parameter in the `connections.xml` file, as illustrated in Example 21–1. The `appLogin` parameter may be set to `true` to cause ACS to reevaluate the feature access. The `OptionalExtraPayLoad` parameter is reserved for future use and is not used.

Invoking ACS through either the `invokeACS` method or the `isAcsCalledAutomatically` parameter retrieves the role-based constraints for an application.

Note: MAF automatically invokes the ACS after a successful login if `<isAcsCalledAutomatically value = "false"/>` is not included in the `connections.xml` file.

When a secured application feature calls the `invokeACS` method, MAF fetches the user constraints for all of the application features associated with the application login connection, including those configured for the secured application feature. When an unsecured application feature calls this method, MAF only retrieves the constraints associated with the login connection.

Note: In addition to the `invokeACS` method, the `AdfmfJavaUtilities` class includes the following lifecycle methods:

- `applicationLogout`—Logs out the application login connection.
- `featureLogout(<feature_ID>)`—Logs out the login connection associated with the application feature.

For more information, see the *Oracle Fusion Middleware Java API Reference for Oracle Mobile Application Framework*.

21.4.19 What Happens When You Define a Multi-Tenant Connection

After you complete the Create MAF Login Connection dialog, MAF populates the `connections.xml` file with the `<isMultiTenantAware>` element set to `true`. In multi-tenant connection, the user name is the aggregation of tenant name and user name.

The login page uses a JavaScript utility to discern if a connection is multi-tenant aware. If the login page detects such a connection, it provides an additional field that requires the user to enter the tenant name configured in the Create MAF Login Connection. After a successful login (which includes entering the correct tenant ID), MAF stores the tenant ID in the local credential store.

21.4.20 What Happens When You Create a Connection for a Mobile Application

MAF aggregates all of the connection information in the `connections.xml` file (located in the Applications window's Application Resources panel under the **Descriptors** and **ADF META-INF** nodes). This file, shown in Example 21–4, can be bundled with the application or can be hosted for the Configuration Service. In the latter case, MAF checks for the updated configuration information each time an application starts.

Example 21–4 MAF Connections Defined in the connections.xml File

```
<?xml version = '1.0' encoding = 'UTF-8'?>
<References xmlns="http://xmlns.oracle.com/adf/jndi">
  <Reference name="Connection_1"
             className="oracle.adf.model.connection.adfmf.LoginConnection"
             adfCredentialStoreKey="Connection_1"
             partial="false"
             manageInOracleEnterpriseManager="true"
             deployable="true"
             xmlns="">
     <Factory className="oracle.adf.model.connection.adfmf.LoginConnectionFactory"/>
     <RefAddresses>
        <XmlRefAddr addrType="adfmfLogin">
           <Contents>
              <login url="http://10.0.0.0/SecuredWebServicelogin/login.jsf"/>
              <logout url="http://10.0.0.0/SecuredWebServicelogout/logout.jsf"/>
              <accessControl url="http://10.0.0.0/Identity/Authorize"/>
              <isAcsCalledAutomatically value="false"/>
              <idleTimeout value="300"/>
              <sessionTimeout value="28800"/>
              <isMultiTenantAware value="true"/>
              <multiTenantHeaderName value="Oracle_Multi_Tenant"/>
              <injectCookiesToRESTHttpHeader value="true"/>
              <userObjectFilter>
                 <role name="manager"/>
                 <privilege name="account manager"/>
                 <privilege name="supervisor"/>
                 <privilege name=""/>
              </userObjectFilter>
              <rememberCredentials>
                   <enableRememberUserName value="true"/>
                   <rememberUserNameDefault value="true"/>
                   <enableRememberPassword value="true"/>
                   <rememberPasswordDefault value="true"/>
                   <enableStayLoggedIn value="true"/>
                   <stayLoggedInDefault value="true"/>
              </rememberCredentials>
           </Contents>
```

```
        </XmlRefAddr>
      </RefAddresses>
   </Reference>
</References>
```

For more information, see the "Lookup Defined in the connections.xml File" section in *Oracle Fusion Middleware Developing Fusion Web Applications with Oracle Application Development Framework*.

21.5 Configuring Security for Mobile Applications

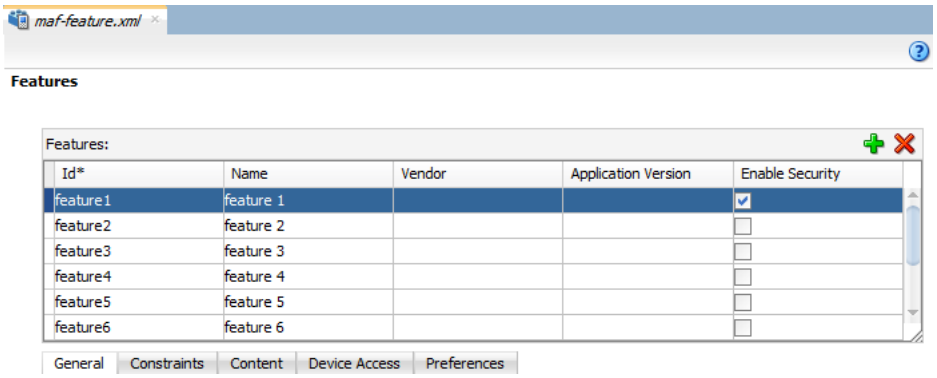
You configure security using the overview editors for the `maf-feature.xml` and `maf-application.xml` files, as well as the Create MAF Login Connection dialog. The overview editors enable you to designate the type of login page (default or custom) that MAF presents to users when they select application features that require authentication or to include user role- or user privilege-based constraints. They also enable you to select which embedded application features require security.

21.5.1 How to Enable Application Features to Require Authentication

You can define each application feature to participate in security. You perform the remainder of the security configuration using the Security page of the `maf-application.xml` overview editor. For application features whose content is served from a remote URL, the overview editor enables you to whitelist the domains so that remote URL content can display within the MAF web view. For more information, see Chapter 13, "Implementing Application Feature Content Using Remote URLs."

The General tab of the `maf-feature.xml` overview editor, shown in Figure 21–15, enables you to designate which application features participate in security and the type of authentication they require.

Figure 21–15 Designating User Credentials Options for an Application Feature



Before you begin:

When you enable security for a feature, the application requires access the network to authenticate the user. For more information about granting the application access to network sockets, see Section 21.6.1, "How to Enable Access to Device Capabilities."

To designate user access for an application feature:

1. In the Navigator, in the user interface project, expand **Application Sources** and then **META-INF** folder nodes, and then double-click **maf-feature.xml**.

2. In the overview editor for the `maf-feature.xml` file, select an application feature listed in the **Features** table or click **Add** to add an application feature.
3. Select **Enable Security** for any application feature that requires login.

> **Tip:** If you do not apply this option to the default application, you enable users to login anonymously (that is, without presenting login credentials). Users can then access unsecured data and features and, when required, login (authenticated users can access both secured and unsecured data). Providing unsecured application features within a mobile application enables users to logout of secured application features, but remain within the mobile application itself and continue to access both unsecured application features and data.

21.5.2 How to Designate the Login Page

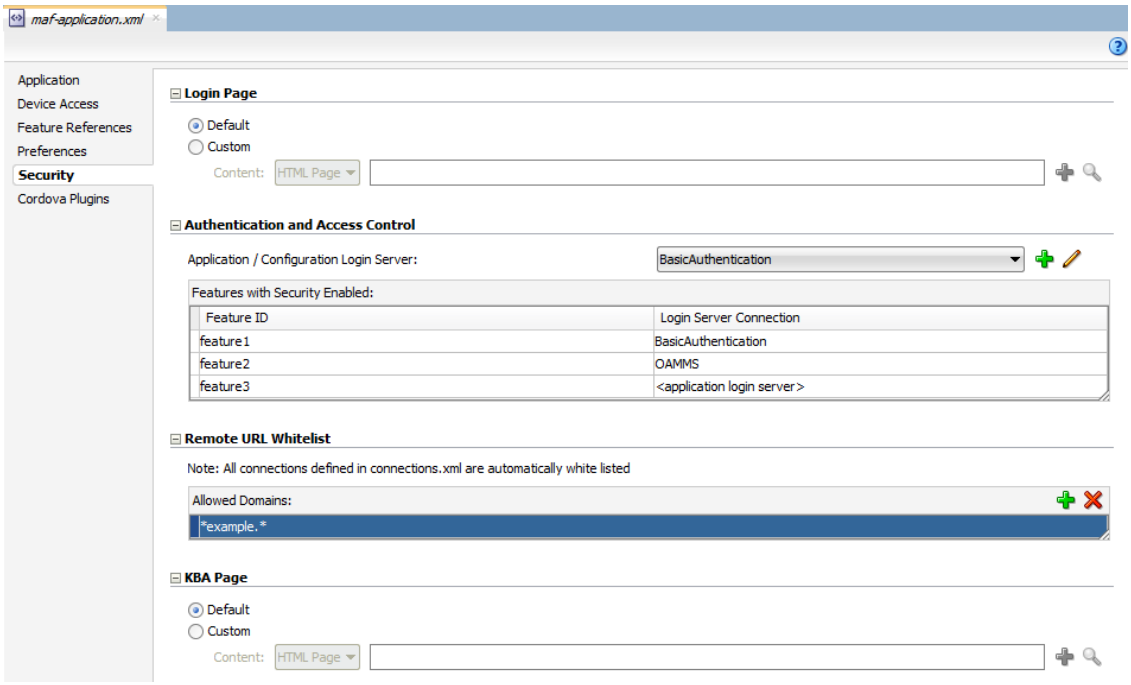
After you designate security for the application features, you use the Security page of the `maf-application.xml` overview editor, shown in Figure 21–16, to configure the login page as well as create a connection to the login server and assign it to each of the application features that participate in security. All of the application features listed in this page have been designated in the `maf-feature.xml` file as requiring security. Typically, a group of application features are secured with the same login server connection, enabling users to open any of these applications without MAF prompting them to login again. In some cases, however, the credentials required for the application features can vary, with one set of application features secured by one login server and another set secured by a second login server. To accommodate such situations, you can define any number of connections to a login server for a mobile application. In terms of the `maf-application.xml` file, the authentication server connections associated with the feature references are designated using the `loginConnRefId` attribute as follows:

```
<adfmf:featureReference id="feature1" loginConnRefId="Connection_1"/>
<adfmf:featureReference id="feature2" loginConnRefId="Connection2"/>
```

Mobile applications can be authenticated against any standard login server that supports basic authentication over HTTP or HTTPS. MAF also supports authentication against Oracle Identity Management. You can also opt for a custom login page for a specific application feature. For more information, see Section 21.5.3, "What You May Need to Know About Login Pages."

> **Note:** By default, all secured application features share the same connection, which, as shown in Figure 21–16, is denoted as <*application login server*>. The Property Inspector for a Feature Reference notes this default option in its Login Server Connection dropdown menu as `<default> application login server`. You can select other connections that are defined for the mobile application using the Create MAF Login Connection dialog.

Figure 21–16 The Security Page of the maf-application.xml Overview Editor



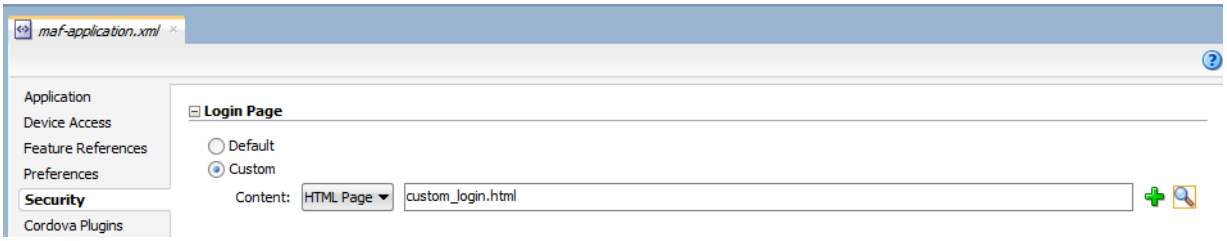
Before you begin:

If the mobile application uses a custom login page, add the file to the `public_html` directory of the application controller project (`JDeveloper\mywork\`*`Application`*`\ApplicationController\public_html`) to make it available from the **Web Content** node in the Application Navigator, as shown in Figure 21–17. See also Section 21.5.3.3, "Creating a Custom Login HTML Page" and Section 4.10.2, "What You May Need to Know About Selecting External Resources."

Add constraints for user privileges and roles, as described in Section 15.2.4, "About User Constraints and Access Control."

Provision an Access Control Service (ACS) server. For more information, Section 21.4.17, "What You May Need to Know About the Access Control Service."

Figure 21–17 Adding a Custom Login Page



To designate the login page and KBA page:

1. In the Navigator, expand the **Application Resources** panel, expand **Descriptors** and then **ADF META-INF** folder nodes, and then double-click **maf-application.xml**.
2. In the overview editor for the `maf-application.xml` file, click the **Security** navigation tab.

3. On the Security page, designate the type of login page:
   - Choose **Login Page** for a view that accepts a user name and password.
   - Choose **KBA Page** for a knowledge-based (KBA) view that presents users with challenges to their credentials and also accepts their answers. Knowledge based authentication can be configured on OAAM server and user can be prompted with another page that asks additional questions such as "mother's maiden name". This feature is available for the Mobile-Social authentication type only.
4. Select the content (or user interface) for the selected login page and, optionally, a KBA page:
   - **Default**—The default login page or KBA screen used for all of the selected embedded application features. For more information, see Section 21.5.3.1, "The Default Login Page." The default login page and default KBA page is provided by MAF.
   - **Custom**—Click **Browse** to retrieve the path location of the file within the application controller project. Alternatively, click **New** to create a custom HTML page within the application controller project for either the login page or the KBA page. For more information, see Section 21.5.3.2, "The Custom Login Page" and Section 21.5.3.3, "Creating a Custom Login HTML Page."

     Tip: Rather than retrieve the location of the login page using the **Browse** function, you can drag the login page from the Application Navigator into the field.

21.5.3 What You May Need to Know About Login Pages

The entry point for the authentication process to an application feature is the `activate` lifecycle event, described at Section 4.7.2, "Timing for Mobile Application Events." Every time an application feature is activated (that is, the `activate` event handler for the application feature is called), the application feature login process is executed. This process navigates to the login page (which is either the default or a custom login page) where it determines if user authentication is needed. Before the process navigates to the login page, however, the originally intended application feature must be registered with MAF. When authentication succeeds, the login page retrieves the originally intended destination from MAF and navigates to it.

21.5.3.1 The Default Login Page

The default login page provided by MAF (shown in Figure 21–1, "The Login Page") is comprised of a login button, input text fields for the user name, password, and multi-tenant name, and an error message section. This is a cross-platform page, one written in HTML.

21.5.3.2 The Custom Login Page

When you add a custom login page for a selected application feature using the overview editor for the `maf-application.xml` file, JDeveloper adds the `<adfmf:login>` element and populates its child `<adfmf:LocalHTML>` element, as shown in Example 21–5. As with all `<adfmf:LocalHTML>` elements, its `url` attribute references a location within the `public_html` directory. The user authentication mechanism and navigation control are identical to the default login page.

Example 21–5 The Login Element

```
<adfmf:login defaultConnRefId="Connection_1">
    <adfmf:localHTML url="newlogin.html"/>
</adfmf:login>
```

Custom login pages are written in HTML. The fields for both the default login page and the knowledge-based (KBA) pages must include specifically defined `<input>` and `<label>` elements.

> **Tip:** Use the default the login pages that are generated when you deploy a MAF application as a guide for creating custom login pages. To access the login pages within the `www` directory, deploy a mobile application and then traverse to the `deploy` directory.
>
> For iOS deployments, the pages are located at the following: application workspace directory`/deploy/deployment profile name/temporary_xcode_project/www/adf.login.html` and application workspace directory`/deploy/deployment profile name/temporary_xcode_project/www/adf.kba.html`.
>
> For Android deployments, the pages are located within the Android application package (`.apk`) file at the following: application workspace directory`/application name/deploy/deployment profile name/deployment profile name.apk/assets/www/adf.login.html` and application workspace directory`/application name/deploy/deployment profile name/deployment profile name.apk/assets/www/adf.kba.html`.

Example 21–6 illustrates the required `<input>` and `<label>` elements for a default login page.

Example 21–6 Required Elements for the Default Login Page

```
<input type="text"
       autocorrect="off"
       autocapitalize="none"
       name="oracle_access_user_id"
       id="oracle_access_user_id" value="">
   </input>

<input type="text"
       autocorrect="off"'
       autocapitalize="none"
       name="oracle_access_iddomain_id"
       id="oracle_access_iddomain_id" value="">
   </input>

<input type="password"
       name="oracle_access_pwd_id"
       id="oracle_access_pwd_id" value="">
   </input>

<input type="checkbox"
       class="message-text"
       name="oracle_access_auto_login_id"
       id="oracle_access_auto_login_id">
   </input>Keep me logged in

<input type="checkbox"
```

```
       class="message-text"
       name="oracle_access_remember_username_id"
       id="oracle_access_remember_username_id">
   </input>Remember my username

<input type="checkbox"
       class="message-text"
       name="oracle_access_remember_credentials_id"
       id="oracle_access_remember_credentials_id">
   </input>Remember my password

<label id="oracle_access_error_id"
       class="error-text">
   </label>

<input class="commandButton"
       type="button"
       onclick="oracle_access_sendParams(this.id)"
       value="Login" id="oracle_access_submit_id"/>
```

Example 21–7 illustrates the required elements for a KBA login page.

Example 21–7 Required Elements for a KBA Login Page

```
<input type="text"

<label id="oracle_access_kba_ques_id" >Question</label><br>

<input class="field-value"
       name="oracle_access_kba_ans_id"
       id="oracle_access_kba_ans_id">
   </input>

<label id="oracle_access_error_id"
       class="error-text">
   </label>

<label id="message_id"
      class="message-text">
   </label>

<input type="button"
       onclick="oracle_access_sendParams(this.id)"
       value="Login"
       id="oracle_access_submit_id"/>
```

21.5.3.3 Creating a Custom Login HTML Page

You can create the custom login page using the default login page, `adf.login.html` or `adf.kba.html`, artifacts generated by the MAF deployment in the `www` directory.

Before you begin:

To access the login pages within the `www` directory, deploy a mobile application and then traverse to the `deploy` directory. For iOS deployments, the pages are located at the following:

application workspace directory`/deploy/`*deployment profile name*`/temporary_xcode_project/www/adf.login.html`

and

application workspace directory/deploy/*deployment profile name*/temporary_xcode_project/www/adf.kba.html

For Android deployments, the pages are located within the Android application package (.apk) file at the following:

application workspace directory/*application name*/deploy/*deployment profile name*/*deployment profiile name.apk*/assets/www/adf.login.html

and

application workspace directory/*application name*/deploy/*deployment profile name*/*deployment profiile name.apk*/assets/www/adf.kba.html

To create a custom login page:

1. Copy the default login page to a location within the user interface project's public_html directory, such as JDeveloper\mywork*application name*\ApplicationController\public_html.
2. Rename the login page.
3. Update the page.
4. In the Security page for the overview editor of the maf-application.xml file, select **Custom** and then click **Browse** to retrieve the location of the login page. For more information, see Section 4.5, "Configuring the Springboard and Navigation Bar Behavior."

21.5.4 What You May Need to Know About Login Page Elements

Every HTML login page should include the user interface elements listed in Table 21–2.

Table 21–2 Login Page Fields and Their Associated IDs

Page Element	ID
username field	oracle_access_user_id
password field	oracle_access_pwd_id
login button	oracle_access_submit_id
cancel button	oracle_access_cancel_id
identity domain/tenant name field	oracle_access_iddomain_id
KBA question field (read-only/label)	oracle_access_kba_ques_id
KBA answer field	oracle_access_ans_id
error field	oracle_access_error_id
auto login check box	oracle_access_auto_login_id
remember credentials check box	oracle_access_remember_credentials_id
remember username check box	oracle_access_remember_username_id

Table 21–3 lists the recommended JavaScript code used by the `OnClick` event.

Table 21–3 JavaScript Used by the OnClick Event

Button	JavaScript
login button	`oracle_access_sendParams(this.id)`
cancel button	`oracle_access_sendParams(this.id)`
KBA submit button	`oracle_access_sendParams(this.id)`
KBA cancel button	`oracle_access_sendParams(this.id)`

21.5.5 What Happens in JDeveloper When You Configure Security for Application Features

After an application feature has been designated to participate in security, JDeveloper updates the **Features With Security Enabled** table with a corresponding feature reference, as shown in Figure 21–16. If each of the referenced application features authenticate against the same login server connection defined in the `connections.xml` file, JDeveloper updates the `maf-application.xml` file with a single `<adfmf:login>` element defined with a `defaultConnRefId` attribute (such as `<adfmf:login defaultConnRefId="Connection_1">`).

For application features configured to use different login server connections defined in the `connections.xml` file JDeveloper updates each referenced application feature with a `loginConnReference` attribute (`<adfmf:featureReference id="feature2" loginConnRefId="Connection2"/>`). For more information, see Section 21.5.1, "How to Enable Application Features to Require Authentication." See also the *Oracle Fusion Middleware Tag Reference for Oracle Mobile Application Framework*.

21.6 Allowing Access to Device Capabilities

Access to all of the Apache Cordova-enabled device capabilities is not enabled by default for mobile applications. Instead, MAF ensures security by allowing access to specific capabilities. When you assess the security and privacy requirements for a mobile application, you can select which type of access the application should have. By default, the following functions are not enabled for a mobile application:

- **Network**—Allows the application to open network sockets. This capability must be granted to the application when security is enabled for at least one device capability.
- **Location**—Covers both fine (GPS) and course (network-based) location services.
- **Camera**—Allows the application to use the device's camera.
- **Contacts**—Allows the application to access the contacts on the device.
- **E-mails**—Allows the application to access and send e-mails.
- **SMS**—Allows the application to access and send SMS messages.
- **Phone**—Allows the application to access voice services and make phone calls.
- **Push Notifications**—Allows the application to receive push notifications. See also Section 17.2, "Enabling Push Notifications for a Mobile Application."
- **Files**—Allows the application to access files on device SD Card.

Because you can grant, or restrict, device services, the various platform-specific configuration files and manifest files that are updated by the deployment framework

list only the services in use (or rather, the devices services that the mobile application is permitted to use). These files enable MAF to share information about the use of these services with other applications. For example, a mobile application can report to the AppStore or to Google Play that it does not use location-based services (even though mobile applications have this capability).

21.6.1 How to Enable Access to Device Capabilities

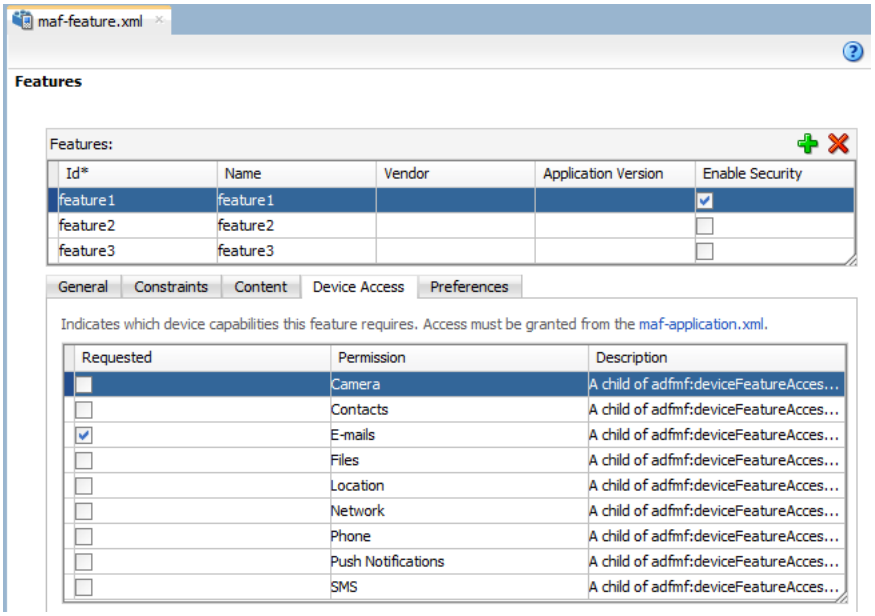
Device access for mobile applications is configured at both the application and application-feature level, with the configuration set at the application level taking precedence; an application feature's configuration describes its device requirements, while the permission to use these capabilities is granted through the application configuration.

The overview editors for `maf-feature.xml` and `maf-application.xml` enable you designate and manage the device capabilities by creating the `<adfmf:deviceFeatureAccess>` element. Although both configuration files share this element and its device-specific child elements, the elements in the `maf-feature.xml` file are defined using `requestAccess` attribute and those in the `maf-application.xml` file are defined with the `allowAccess` attribute.

To specify the required device capabilities for an application feature:

1. In the Navigator, in the user interface project, expand **Application Sources** and then **META-INF** folder nodes, and then double-click **maf-feature.xml**.
2. In the overview editor for the `maf-feature.xml` file, select an application feature listed in the **Features** table, and then click the Device Access tab and enable the device capabilities required by the application, as shown in Figure 21–18.

Figure 21–18 Designating Device Access Requirements

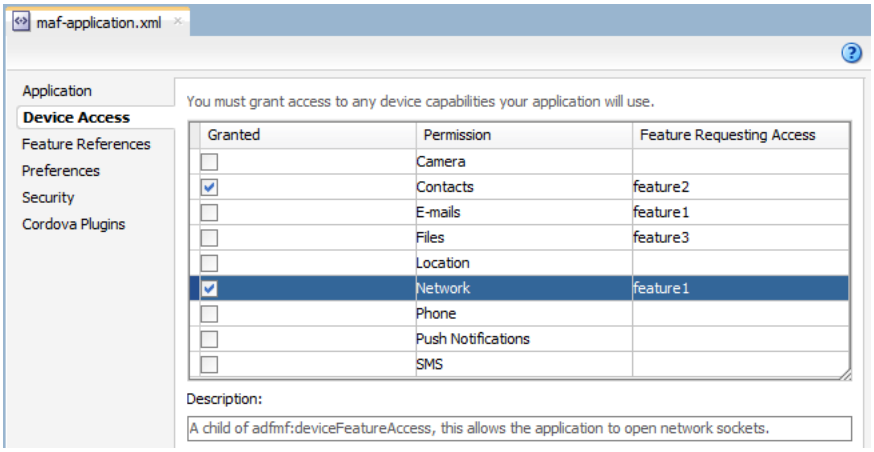


Note that when you enable security for at least one device feature, as described in Section 21.5.1, "How to Enable Application Features to Require Authentication," you must also enable access to the network. In this case, you can grant permission to the Network capability in the `maf-application.xml` file, as described below.

To grant permission to a device capability:

1. In the Navigator, expand the **Application Resources** panel, expand **Descriptors** and then **ADF META-INF** folder nodes, and then double-click **maf-application.xml**.
2. In the overview editor for the `maf-application.xml` file, click the **Device Access** navigation tab and grant permission to the device capabilities required by the application, as shown in Figure 21–19.

Figure 21–19 Granting Device Access



21.6.2 What Happens When You Define Device Capabilities

MAF populates the `<adfmf:feature>` element with `<adfmf:deviceFeatureAccess>`, as illustrated in Example 21–8.

Example 21–8 Defining Device Capabilities in the maf-feature.xml File

```
<adfmf:feature id="feature3" name="feature3">
    <adfmf:content id="feature3.1">
      <adfmf:amx file="feature3/datapage.amx"/>
    </adfmf:content>
    <adfmf:deviceFeatureAccess>
      <adfmf:deviceEmails id="de1" requestAccess="true"/>
    </adfmf:deviceFeatureAccess>
</adfmf:feature>
```

In the `maf-application.xml` file, MAF populates the `<adfmf:deviceFeatureAccess>` element, as illustrated in Example 21–9.

Example 21–9 Adding Device Capability Permissions in the maf-application.xml File

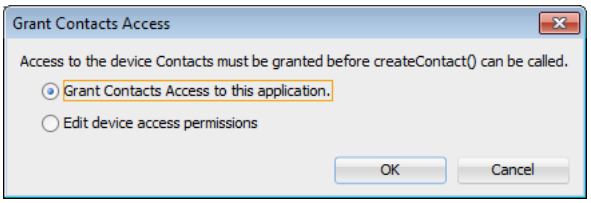
```
<adfmf:deviceFeatureAccess>
    <adfmf:deviceCamera id="dc1" access="true"/>
    <adfmf:deviceContacts id="dc2" access="true"/>
    <adfmf:deviceEmails id="de1" access="true"/>
    <adfmf:deviceFiles id="df1" access="true"/>
    <adfmf:deviceLocation id="dl1"/>
    <adfmf:deviceNetwork id="dn1"/>
    <adfmf:devicePhone id="dp1"/>
    <adfmf:deviceSMS id="dsms1" access="true"/>
</adfmf:deviceFeatureAccess>
```

For more information, see the *Oracle Fusion Middleware Tag Reference for Oracle Mobile Application Framework*.

21.6.3 What You May Need to Know About Device Capability Permissions

If you create a component from a `DeviceFeatures` data control method that has no related device access permission configured in the `maf-application.xml` file, then MAF prompts you with a dialog for the method, illustrated in Figure 21–20. The dialog's default option updates the `maf-application.xml` file with the permission, or enables you to do so manually by opening the file through the **Edit device access permissions** option.

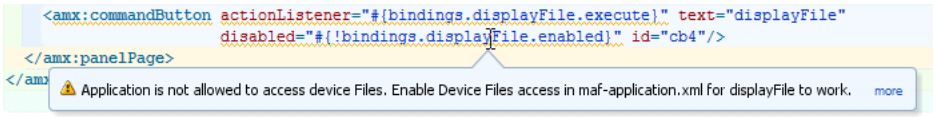
Figure 21–20 Granting Device Access



Within a MAF AMX page, MAF issues an error in the following format (and illustrated by the alert in Figure 21–21) if device-related `methodAction` bindings exist, but the applicable device access permissions have been removed (or not defined). Unless the appropriate device access is granted in the `adfmf:application.xml` file, the method will not function and cause a runtime error.

```
Application is not allowed to access device <deviceFeatureName>. Enable Device
<deviceFeatureName> access in maf-application.xml for <bindingId> to work
```

Figure 21–21 The Device Access Permission Warning in a MAF AMX Page



21.6.4 What You May Need to Know About Device Capabilities During Deployment

During each deployment, MAF updates the iOS `cordova.plist` file as well as the Android `config.xml`, `AndroidManifest.xml` and `AndroidManifest.template.xml` files with the device capabilities permitted by the mobile application. Specifically, the MAF deployment process omits the default Cordova plugin information from these files and maps the child elements defined in the `maf-application.xml` file's `<adfmf:deviceFeatureAccess>` element to the permissions defined in the iOS and Android files. Table 21–4 provides an example of the `<adfmf:deviceSMS>` element maps to elements in the platform specific files. MAF regenerates these files with each deployment.

Table 21–4 Mapping <adfmf:deviceSMS> to Platform-Specific Files

Map to <key> in the cordova.plist File	Map to <plugin name> in the config.xml File	Map to Permission in the AndroidManifest.xml File

`<key>Plugins</key>`
`<dict>`
`  <key>AdfmfSMS</key>`
`  <string>AdfmfSMSAdaptor</string>`
`</dict>`
	`<plugin name="AdfmfSMS" value="oracle.adfmf.phonegap.AdfmfSMS"/>`	`<uses-permission android:name="android.permission.RECEIVE_SMS" />`

Certain plugins share permissions in the `AndroidManifest.xml` file, as described in Table 21–5. The deployment process adds these permissions to the file if they did not already exist, or the if permission is required by a device feature that is enabled out-of-the-box.

Table 21–5 Shared Permissions

Device Access	Permission
■ Network ■ Push Notifications	`<uses-permission android:name="android.permission.ACCESS_NETWORK_STATE" />`
■ Contacts ■ Push Notifications	`<uses-permission android:name="android.permission.GET_ACCOUNTS" />`
■ Camera ■ Files	`<uses-permission android:name="android.permission.WRITE_EXTERNAL_STORAGE" />`

Note: MAF extracts the `AndroidManifest.template.xml` file during first deployment of a given deployment profile. This file provides the initial content for the `AndroidManifest.xml` file.

Similar to the mapping of the `<adfmf:deviceSMS>` element described in Table 21–4, MAF maps the following elements to the iOS and Android configuration files during deployment:

- <adfmf:deviceCamera>
- <adfmf:deviceContacts>
- <adfmf:deviceEmails>
- <adfmf:deviceNetwork>
- <adfmf:deviceFiles>
- <adfmf:deviceLocation>
- <adfmf:devicePushNotifications>

<adfmf:deviceCamera>

Table 21–6 describes how MAF maps `<adfmf:deviceCamera allowAccess="true" />` to platform-specific files.

Table 21–6 Mapping <adfmf:deviceCamera> to Platform-Specific Files

Map to <key> in the cordova.plist File	Map to <plugin name> in the config.xml File	Map to Permission in the AndroidManifest.xml File
<key>Plugins</key> <dict> <key>Camera</key> <string>CDVCamera</string> <key>Capture</key> <string>CDVCapture</string> </dict>	<plugin name="Camera" value="org.apache.cordova.CameraLauncher"/> <plugin name="Capture" value="org.apache.cordova.Capture"/>	<uses-permission android:name="android.permission.RECORD_AUDIO"/> <uses-permission android:name="android.permission.WRITE_EXTERNAL_STORAGE"/>

<adfmf:deviceContacts>

Table 21–7 describes how MAF maps `<adfmf:deviceContacts allowAccess="true"/>` to platform-specific files.

Table 21–7 Mapping <adfmf:deviceContacts> to Platform-Specific Files

Map to <key> in the cordova.plist File	Map to <plugin name> in the config.xml File	Map to Permission in the AndroidManifest.xml File
<key>Plugins</key> <dict> <key>Contacts</key> <string>CDVContacts</string> </dict>	<uses-permission android:name="android.permission.READ_CONTACTS"/> <uses-permission android:name="android.permission.WRITE_CONTACTS"/> <uses-permission android:name="android.permission.GET_ACCOUNTS"/>	<uses-permission android:name="android.permission.READ_CONTACTS"/> <uses-permission android:name="android.permission.WRITE_CONTACTS"/> <uses-permission android:name="android.permission.GET_ACCOUNTS"/>

<adfmf:deviceEmails>

Table 21–8 describes how MAF maps `<adfmf:deviceEmails allowAccess="true"/>` to platform-specific files.

Table 21–8 Mapping <adfmf:deviceEmails> to Platform-Specific Files

Map to <key> in the cordova.plist File	Map to <plugin name> in the config.xml File	Map to Permission in the AndroidManifest.xml File
<key>Plugins</key> <dict> <key>AdfmfEmail</key>	<plugin name="AdfmfEmail" value="oracle.adfmf.phonegap.AdfmfEmail"/>	Not applicable because there is no e-mail entry in the AndroidManifest.xml file.

<adfmf:deviceNetwork>

Table 21–9 describes how MAF maps `<adfmf:deviceNetwork allowAccess="true"/>` to platform-specific files.

Table 21–9 Mapping <adfmf:deviceNetwork> to Platform-Specific Files

Map to <key> in the cordova.plist File	Map to <plugin name> in the config.xml File	Map to Permission in the AndroidManifest.xml File
<key>Plugins</key> <dict> <key>NetworkStatus</key> <string>CDVConnection</string> </dict>	<plugin name="NetworkStatus" value="org.apache.cordova.NetworkManager"/>	<uses-permission android:name="android.permission.INTERNET"/> <uses-permission android:name="android.permission.READ_PHONE_STATE"/> <uses-permission android:name="android.permission.ACCESS_NETWORK_STATE"/>

<adfmf:deviceFiles>

Table 21–10 describes how MAF maps `<adfmf:deviceFiles allowAccess="true"/>` to platform-specific files.

Table 21–10 Mapping <adfmf:deviceFiles> to Platform-Specific Files

Map to <key> in the cordova.plist File	Map to <plugin name> in the config.xml File	Map to Permission in the AndroidManifest.xml File
<key>Plugins</key> <dict> <key>File</key> <string>CDVFile</string> </dict> <key>Plugins</key> <dict> <key>FileTransfer</key> <string>CDVFileTransfer</string> </dict>	<plugin name="File" value="org.apache.cordova.FileUtils"/> <plugin name="FileTransfer" value="org.apache.cordova.FileTransfer" /> <plugin name="Storage" value="org.apache.cordova.Storage"/>	<uses-permission android:name="android.permission.WRITE_EXTERNAL_STORAGE"/>

<adfmf:deviceLocation>

Table 21–11 describes how MAF maps `<adfmf:deviceLocation allowAccess="true"/>` to platform-specific files.

Table 21–11 Mapping <adfmf:deviceLocation> to Platform-Specific Files

Map to <key> in the cordova.plist File	Map to <plugin name> in the config.xml File	Map to Permission in the AndroidManifest.xml File

`<dict>`
`  <key>Plugins</key>`
`  <dict>`
`  <key>Geolocation</key>`
`  <string>CDVLocation</string>`
`  <key>Compass</key>`
`  <string>CDVLocation</string>`
`  </dict>`
`</dict>`
	`<plugin name="Geolocation" value="org.apache.cordova.GeoBroker"/>`
	`<plugin name="Compass" value="org.apache.cordova.CompassListener"/>`
		`<uses-permission android:name="android.permission.ACCESS_COARSE_LOCATION"/>`
		`<uses-permission android:name="android.permission.ACCESS_FINE_LOCATION"/>`
		`<uses-permission android:name="android.permission.ACCESS_LOCATION_EXTRA_COMMANDS"/>`

<adfmf:devicePushNotifications>

Table 21–12 describes how MAF maps `<adfmf:deviceSMS allowAccess="true"/>` to platform-specific files.

Table 21–12 Mapping <adfmf:devicePushNotifications> to Platform-Specific Files

Map to <key> in the cordova.plist File	Map to <plugin name> in the config.xml File	Map to Permission in the AndroidManifest.xml File

`<key>Plugins</key>`
`<dict>`
`  <key>PushPlugin</key>`
`  <string>PushPlugin</string>`
`</dict>`
	`<plugin name="PushPlugin" value="com.plugin.gcm.PushPlugin"/>`	Not applicable.

21.7 Enabling Users to Log Out from Application Features

MAF does not terminate application features when a user logs out of one that contains secured content or is restricted through constraints; a user can remain within the application and access its unsecured content and features as an anonymous user. Because MAF enables constraints to be re-initialized, it allows a user to login to an application repeatedly using the same identity. It also enables multiple identities to share the access to the application by allowing the user to login using different identities.

The `logoutFeature` and `logout` methods of the `AdfmfJavaUtilities` class, described in the *Oracle Fusion Middleware Java API Reference for Oracle Mobile Application Framework*, enable users to explicitly login and logout from the authentication server after launching an application. In addition, they enable a user to login to the authentication server after the user invokes a secured application feature. Although a user can log out from individual application features, a user will be simultaneously logged out of application features secured by the same connection.

These methods enables users to perform the following the following:

- Logging out of an application feature but continuing to access its unsecured content (that is, MAF does not terminate the application).

- Authenticating with the login server while in an application to enable its secured content and UI components.
- Logging out of a mobile application or application feature and then logging in again using a different identity.
- Logging out of a mobile application or application feature and then logging in again using the same identity but with updated roles and privileges.

To enable logging out of the current authentication server, call the `logout` method of the `AdfmfJavaUtilities` class as follows. For example:

```
import oracle.adfmf.framework.api.AdfmfJavaUtilities;
...
   AdfmfJavaUtilities.logout();
```

To enable logging from the authentication server associated with the `key` parameter, call the `logoutFeature` method as follows:

```
import oracle.adfmf.framework.api.AdfmfJavaUtilities;
...
   AdfmfJavaUtilities.logoutFeature(adfCrendentialStorykey);
```

The `adfCredentialStorykey` parameter is returned as a `String` object from the value defined for the `adfCredentialStoreKey` parameter in the `connections.xml` file. For more information on the `AdfmfJavaUtilties` class and the usage of the `key` parameter, see the *Oracle Fusion Middleware Java API Reference for Oracle Mobile Application Framework*.

21.8 Supporting SSL

MAF provides a `cacerts` certificate file, the Java mechanism for HTTPS handshakes between the client application and the server. As described in Section 3.2.2.1, "About the Application Controller Project-Level Resources," JDeveloper creates this file within the Application Resources `Security` folder (located at `JDeveloper\mywork\application name\resources\Security\cacerts`). The MAF `cacerts` file identifies a set of certificates from well-known and trusted sources to JVM 1.4 and enables deployment. For an application that requires custom certificates (such as in cases where RSA cryptography is not used), you must add private certificates before deploying the application.

Before you begin:

Refer to Java SE Technical Documentation (`http://download.oracle.com/javase/index.html`) for information on the `cacerts` file and how to use the keytool utility.

To add private certificates:

1. Create a private certificate. For example, create a certificate file called `new_cert`.
2. Add the private certificate to the application as follows:
   a. Create a copy of the seeded `cacerts` file (`cp cacerts cacerts.org`).
   b. Use the Java SE keytool utility to add certificates to a `cacerts` file. Example 21–10 illustrates adding certificates to a `cacerts` file called `new_cert`.

Example 21–10 Adding a Certificate Using the keytool Utility

```
keytool -importcert
```

```
-keystore cacerts
-file new_cert
-storepass changeit
-noprompt
```

Example 21–10 illustrates how to add a single certificate. Repeat this procedure for each certificate. Table 21–13 lists the keytool options

Table 21–13 Options For Adding Certificates

Option	Description
`-importcert`	Imports a certificate.
`-keystore` *`cacerts file`*	Identifies the file location of the imported certificate.
`-file` *`certificate file`*	Identifies the file containing the new certificate.
`-storepass changeit`	Provides a password for the `cacerts` file. By default, the password is *changeit*.
`-noprompt`	Instructs the keytool not to ask the user (through `stdin`) whether to trust the certificate or not.

c. Visually inspect the contents of the new `cacerts` file to ensure that all of the fields are correct. Use the following command:

```
keytool -list -v -keystore cacerts | more
```

d. Verify that the certificate is for the given hostname.

Note: The certificate's common name (CN) must match the hostname exactly.

---

e. Ensure that the customized certificate file is located within the `Security` directory (`JDeveloper\mywork\`*`application name`*`\resources\Security`) so that it can be read by JVM 1.4.

3. Deploy the application.

Note: During deployment, if a certificate file exists within the `Security` directory, MAF copies it into the Android or Xcode template project, replacing any default copies of the `cacerts` file.

---

4. Validate that you can access the protected resources over SSL.

22

Testing and Debugging MAF Applications

This chapter provides information on testing and debugging MAF applications developed for both iOS and Android platforms.

This chapter includes the following sections:

- Section 22.1, "Introduction to Testing and Debugging MAF Applications"
- Section 22.2, "Testing MAF Applications"
- Section 22.3, "Debugging MAF Applications"
- Section 22.4, "Using and Configuring Logging"

22.1 Introduction to Testing and Debugging MAF Applications

Before you start any testing and debugging of your MAF application, you have to deploy it to one of the following:

- iOS-powered device
- iOS-powered device simulator
- Android-powered device
- Android-powered device emulator

You cannot run the MAF application until it is deployed. For more information, see Chapter 19, "Deploying Mobile Applications."

To test and debug a MAF application, you generally take the following steps:

1. Test the application's infrastructure, such as a splash screen, application feature navigation, authentication, and preferences, ensuring that all declared application features are available.
2. If the application includes MAF AMX content, test this application feature's logic, page flows, data controls, and UI components.
3. Make changes to the application as necessary.
4. Reconnect the mobile device or restart the simulator, and then deploy and run the application for further testing and debugging.

For more information, see the following:

- Section 22.3, "Debugging MAF Applications"
- Section 22.2, "Testing MAF Applications"

22.2 Testing MAF Applications

There are two approaches to testing a MAF application:

1. Testing on a mobile device: this method always provides the most accurate behavior, and is also necessary to gauge the performance of your application. However, you may not have access to all the devices on which you wish to test, making device testing inconclusive.
2. Testing on a mobile device emulator or simulator: this method usually offers better performance and faster deployment, as well as convenience. However, even though a device emulator or simulator closely approximates the corresponding physical device, there might be differences in behavior and limitations on the capabilities that can be emulated.

Typically, a combination of both approaches yields the best results.

22.2.1 How to Perform Accessibility Testing on iOS-Powered Devices

You should use a combination of the following methods to test the accessibility of your MAF application developed for iOS-powered devices:

- Testing with the Accessibility Inspector on an iOS-powered device simulator.

  For detailed information, see the "Testing the Accessibility of Your iPhone Application" section in the *Accessibility Programming Guide for iOS* available through the iOS Developer Library.

- Testing with the VoiceOver on an iOS-powered device.

  For more information, see the "Using VoiceOver to Test Your Application" section in the *Accessibility Programming Guide for iOS* available through the iOS Developer Library.

22.3 Debugging MAF Applications

JDeveloper is equipped with debugging mechanisms that allow you to execute a Java program in debug mode and use standard breakpoints to monitor and control execution of an application. For more information, see the section on debugging applications in *Oracle Fusion Middleware User's Guide for Oracle JDeveloper*.

Since a MAF application cannot be run inside JDeveloper, the debugging approach is different: you can use the JDeveloper debugger to connect to a Java Virtual Machine (JVM) 1.4 instance on a mobile device or simulator and control the Java portions of your deployed MAF application.

MAF automatically configures the project properties for remote debugging (see Section 22.3.1, "What You May Need to Know About the Debugging Configuration"). The following are the steps you need to take to use JDeveloper to debug the Java code in your MAF application:

1. Specify the following debugging parameter in the `cvm.properties` file:

   ```
   java.debug.enabled=true
   ```

   For more information, see Section 22.3.5, "How to Enable Debugging of Java Code and JavaScript."

2. Redeploy the application to the mobile device or simulator.
3. Launch the application in a mobile device or simulator by clicking the application icon.

4. Start the debugger from JDeveloper as follows:
    1. Use the debug icon on JDeveloper's main menu to select the **ViewController.jpr:default** run configuration.
    2. Confirm the debugger **Attach to JPDA Debugger** dialog.

    Note: To avoid time-out, start the debugger immediately after launching the application on the mobile device or simulator.

If you use the mobile device for debugging, perform the following:

1. Ensure that your development computer and mobile device are visible to each other through TCP (they can ping each other).
2. Modify the Host field of the **ViewController.jpr:default** run configuration by replacing the localhost with the IP address of the mobile device.

For additional information, see the following:

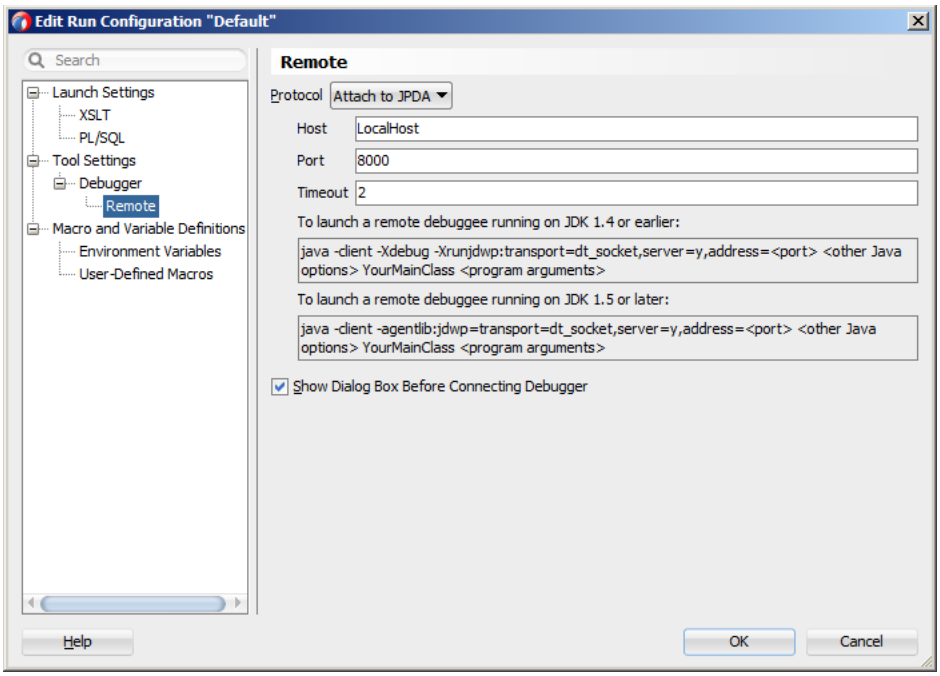
- Section 19.1.1.2, "Deployment of the JVM 1.4 Libraries"
- Section 22.3.1, "What You May Need to Know About the Debugging Configuration"

22.3.1 What You May Need to Know About the Debugging Configuration

When the application is created, MAF automatically configures the project properties for remote debugging. This includes creating a model debugging configuration. If this were a manual step, you would perform it as follows:

1. From the JDeveloper's main menu, click **Application > Project Properties** to open the Project Properties dialog.
2. In the Project Properties dialog, select the **Run/Debug** node.
3. Using the **Run Configurations** pane of the Run/Debug dialog, create a new configuration, or click **Edit** to modify an existing one.
4. In the **Edit Run Configuration > Launch Settings** dialog, select **Remote Debugging**.
5. Expand the Tools Settings node of the Edit Run Configuration dialog, then expand **Debugger**, and then select **Remote**.
6. In the **Edit Run Configuration > Remote** dialog that Figure 22–1 shows, perform the following configurations:
    - Set the protocol to **Attach to JPDA**.
    - Set the host to one of the following:
        - For simulator or emulator debugging, set to **localhost**.
        - For the device debugging, ensure that your development computer can access that device over the network (you may use the `ping` command to test network access), and then enter the device's IP address.
    - Set the port to the appropriate port number.
    - Set the time-out to **2**.

Figure 22–1 Configuring Remote Debugging



In addition, MAF specifies the following debugging parameter in the `cvm.properties` file:

```
java.debug.port=8000
```

This port number matches the one set in JDeveloper.

22.3.2 How to Debug on iOS Platform

To debug a MAF application on the iOS platform using JDeveloper, follow the generic debugging procedure described in Section 22.3, "Debugging MAF Applications."

For information on how to configure an iOS-powered device or simulator and how to deploy a MAF application for debugging, see the following:

- Section 19.4.1, "How to Deploy an iOS Application to an iOS Simulator"
- Section 19.4.2, "How to Deploy an Application to an iOS-Powered Device"
- Section 19.4.4.2, "Registering an Apple Device for Testing and Debugging"

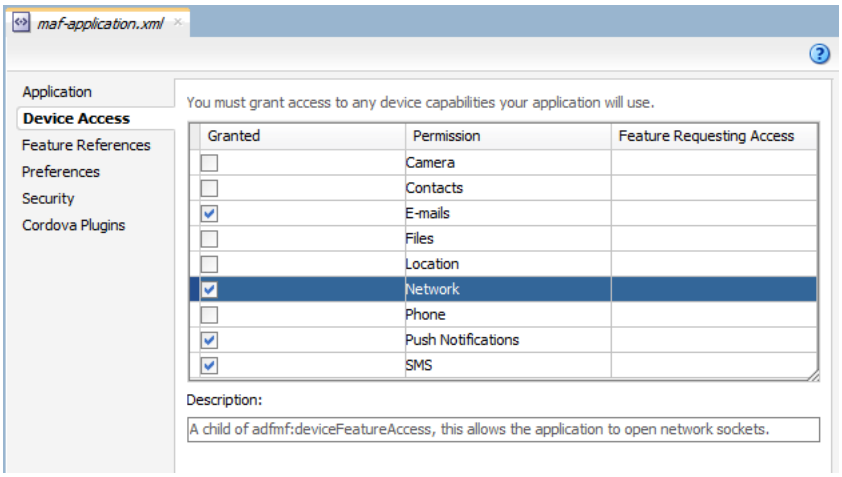
22.3.3 How to Debug on Android Platform

To debug a MAF application on the Android platform using JDeveloper, follow the generic debugging procedure described in Section 22.3, "Debugging MAF Applications."

For information on how to configure an Android-powered device or emulator and how to deploy a MAF application for debugging, see Section 19.3.1, "How to Deploy an Android Application to an Android Emulator."

To allow debugging of a MAF application running on an Android-powered device or its emulator, you enable the Network device access option in the `maf-application.xml` file, as Figure 22–2 shows.

Figure 22–2 Enabling Android Debugging



When you debug Java code, either on an Android-powered device connected through USB or on an Android-powered device emulator, you need to forward the TCP port by executing the following command on a terminal:

- For the device debugging:

  ```
  adb -d forward tcp:8000 tcp:8000
  ```

- For the emulator debugging:

  ```
  adb -e forward tcp:8000 tcp:8000
  ```

Upon execution, the debugging setting in the `cvm.properties` file (see Section 22.3.5, "How to Enable Debugging of Java Code and JavaScript") should be defined as follows:

```
java.debug.enabled=true
```

> **Note:** If the connection is made through Wi-Fi, ensure that this connection is correct. It is recommended to place both the debugger and target on the same network without the use of the virtual private network (VPN).

22.3.4 How to Debug the MAF AMX Content

If your MAF application includes the MAF AMX content, after you configure the device or emulator, you can set breakpoints, view the contents of variables, and inspect the method call stack just as you would when debugging other types of applications in JDeveloper.

> **Note:** You can only debug your Java code and JavaScript (see Section 22.3.5, "How to Enable Debugging of Java Code and JavaScript"). Debugging of EL expressions or other declarative elements is not supported.

22.3.5 How to Enable Debugging of Java Code and JavaScript

A `cvm.properties` file allows you to specify startup parameters for the JVM and web views of MAF to enable debugging of the Java code and JavaScript. The

`cvm.properties` file is automatically created and placed in the `Descriptors/META-INF` directory under the Application Resources (see Section 22.4, "Using and Configuring Logging"), which corresponds to the *<application_name>*`/src/META-INF` location in your application file system.

You can use the following debugging properties in the `cvm.properties` file:

- `java.debug.enabled`: Enables or disables Java debugging for MAF. Valid values are `true` and `false`.

  Caution: When `java.debug.enabled` is set to `true`, the JVM waits for a debugger to establish a connection to it. Failure of the debugger to connect will result in the failure of the MAF AMX application feature to load.

- `java.debug.port`: Specifies the port to be used during debugging. The valid value is an integer.
- `javascript.debug.enabled`: Enables or disables JavaScript debugging when the application is running in the device simulator. Valid values are `true` and `false`.
- `javascript.debug.feature`: Specifies the application feature that is to trigger the activation of JavaScript debugging in MAF. The format of the value is `featureId:port` . The port must be specified (it is initially set to a placeholder value).

  Note: The `javascript.debug.enabled` and `javascript.debug.feature` settings are only valid on iOS and Safari versions earlier than 6.0.

  If both iOS and Safari versions are later than 6.0, then neither of these two properties should be specified. Instead, follow the instructions from Section 22.3.5.1, "What You May Need to Know About Debugging of JavaScript Using an iOS-Powered Device Simulator on iOS 6 Platform."

The contents of the `cvm.properties` file may be similar to the following:

```
java.debug.enabled=true
java.debug.port=8000

javascript.debug.enabled=true
javascript.debug.feature=products:8888
```

After the `cvm.properties` file has been configured to debug JavaScript, you can navigate to the following URL to see a listing of all the loaded pages that can be debugged in MAF:

```
http://localhost:9999
```

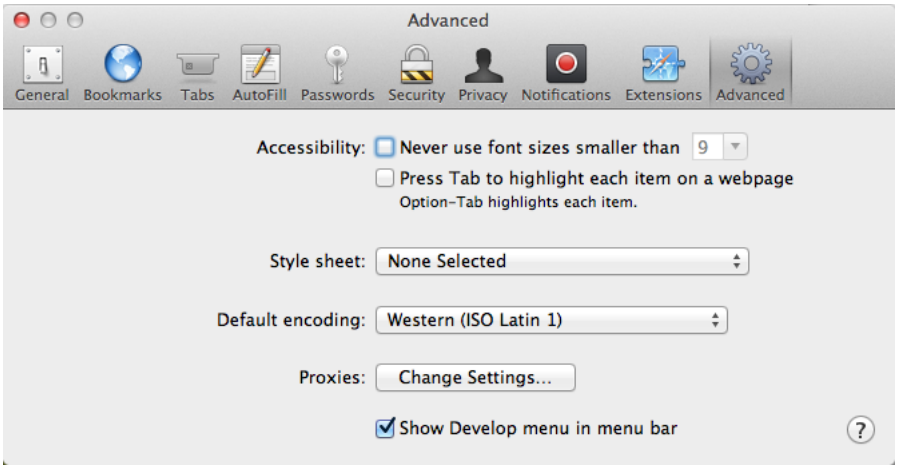
For information on how to use JDeveloper to debug the Java code, see Section 22.3, "Debugging MAF Applications."

22.3.5.1 What You May Need to Know About Debugging of JavaScript Using an iOS-Powered Device Simulator on iOS 6 Platform

If you are working with the iOS 6 platform, you can use the Safari 6 browser to debug JavaScript. To do so, open the Safari preferences, select **Advanced**, and then enable the

Develop menu in the browser by selecting **Show Develop menu in menu bar**, as shown in Figure 22–3.

Figure 22–3 Enabling Safari Browser Options



When the Develop menu is enabled, select either **iPhone Simulator** or **iPad Simulator**, as Figure 22–4 and Figure 22–5 show, and then select a UIWebView that you are planning to debug. Whether the Develop menu displays an iPhone Simulator or iPad Simulator option depends on which device simulator is launched.

Figure 22–4 Using Develop Menu on Safari Browser for Debugging on iPhone Simulator

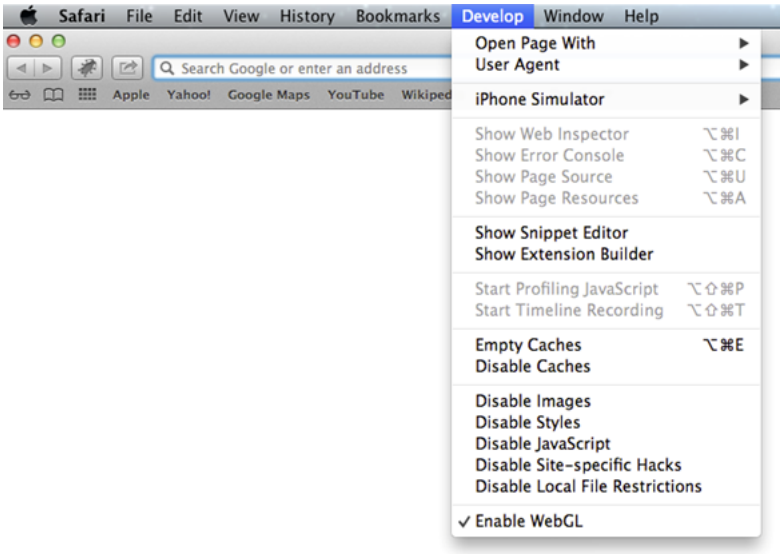
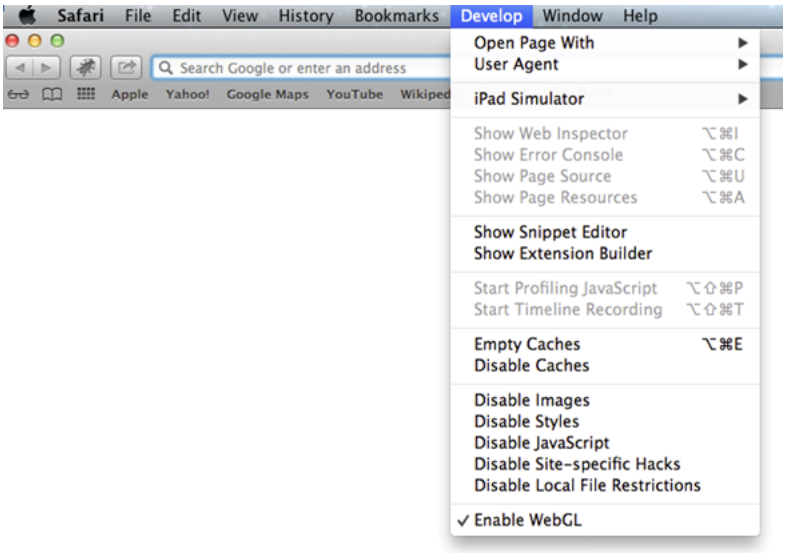


Figure 22–5 Using Develop Menu on Safari Browser for Debugging on iPad Simulator



22.3.6 How to Configure the Debug Mode

You use the application's deployment profile to specify either the release or debug execution mode for your MAF application. Only the debug mode enables you to interactively debug Java and JavaScript code. The debug mode allows for inclusion of special debugging libraries and symbols at compile time.

Figure 22–6 shows how to set the debug mode option on Android.

Figure 22–6 Setting Debug Mode for Android

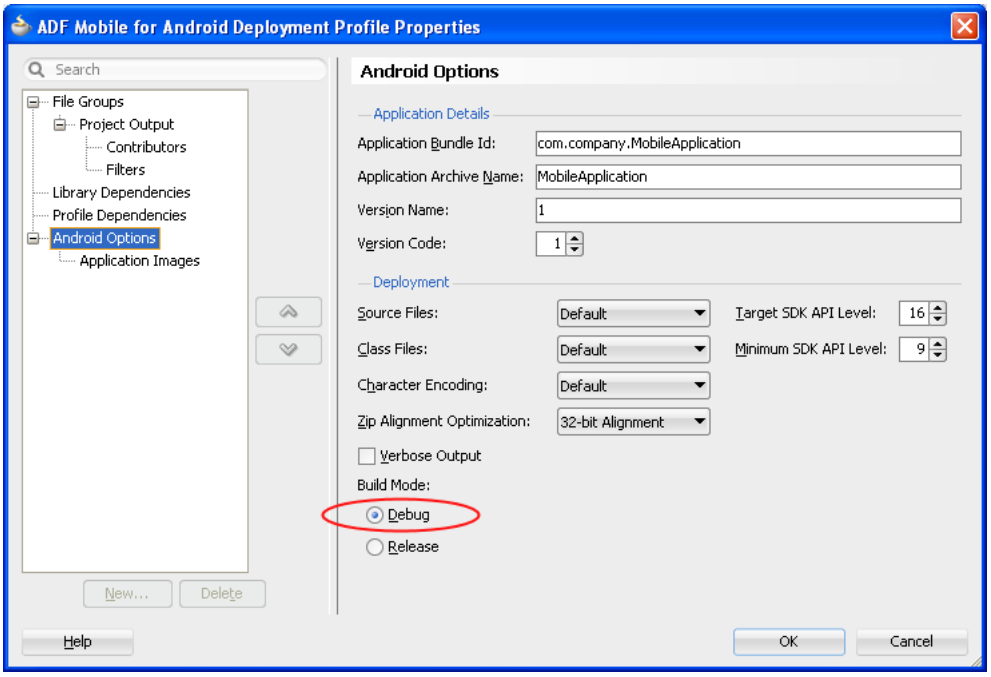
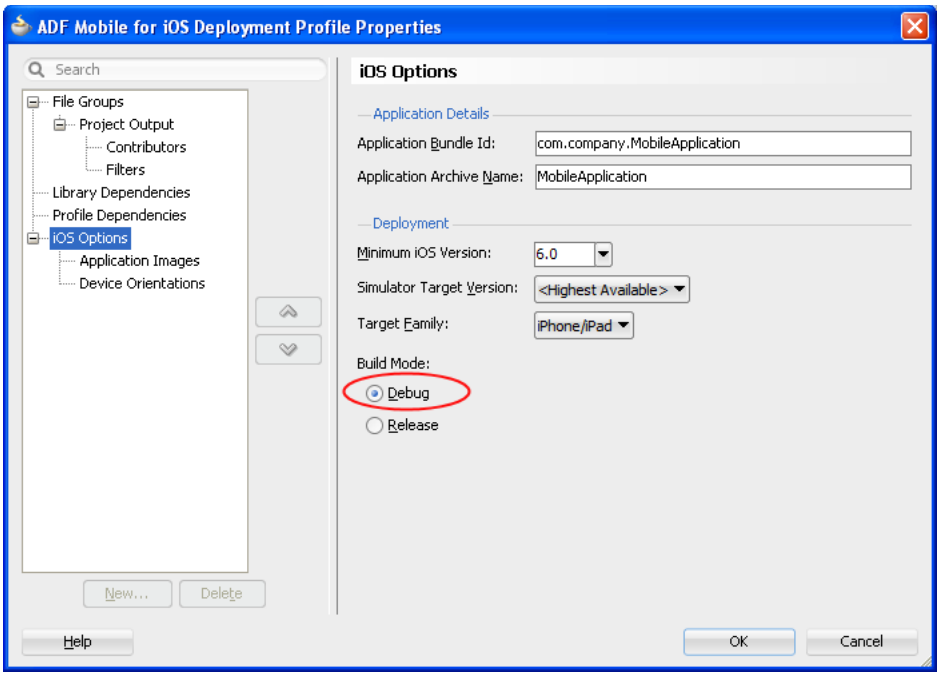


Figure 22–7 shows how to set the debug mode option on iOS.

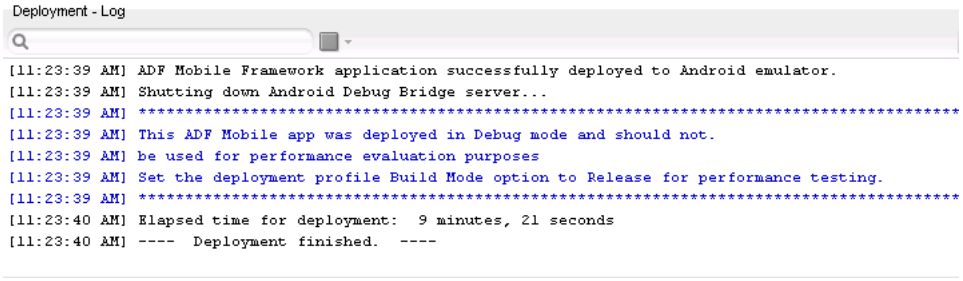
Figure 22–7 Setting Debug Mode for iOS



When you deploy your application in debug mode, just before the end of the deployment process the following log message is printed out in JDeveloper:

```
This MAF app was deployed in Debug mode and should not be used for
performance evaluation purposes. Set the deployment profile Build Mode
option to Release for performance testing.
```

Figure 22–8 Deployment Log Message



For more information, see the following:

- Section 19.2.3, "How to Create an Android Deployment Profile"
- Section 19.2.4.1, "Defining the iOS Build Options"
- Section 19.4.4.1, "Creating iOS Development Certificates"

22.4 Using and Configuring Logging

For your MAF application, you can enable logging on all supported platforms through JavaScript (see Section 22.4.2, "How to Use JavaScript Logging") and embedded code (see Section 22.4.3, "How to Use Embedded Logging") using a single configuration with the log output directed to a single file. This log output includes the output produced by `System.out.println` and `System.err.println` statements.

The default MAF's logging process is as follows:

- The logging begins at application startup.
- The existing log file from the previous application run is deleted, so only the contents of the current run are available.
- When you are running your application on an iOS-powered device simulator, all logging output is typically sent to the console which you can access through the `Application/Utilities` directory on your development computer. However, if your development computer is running on Mac OS 10.8.*n*, you can only access the Java logging output through a file of whose name and location you are notified as soon as the output redirection occurs and the file is generated. One of the possible locations for this file is `/Users/<userid>/Library/Application Support/iPhone Simulator/6.0/Applications/<AppID>/Documents/logs/application.log`

  When you are running your application on an iOS-powered device, the console output is redirected to an `application.log` file that is placed in the `Documents/logs` directory of your application.

  On Android, the output is forwarded to a text file with the same name as the application. The output file location is `/sdcard`. If this location is not present or is configured as read-only, the log output is rerouted to the application's writable data directory.
- The `logging.properties` file is automatically created and placed in the `Descriptors/META-INF` directory under the Application Resources (see Section 22.4, "Using and Configuring Logging"), which corresponds to the `<application_name>/src/META-INF` location in your application file system. In this file, it is defined that all loggers use the `com.sun.util.logging.ConsoleHandler` and `SimpleFormatter`, and the log level is set to `SEVERE`. You can edit this file to specify different logging behavior (see Section 22.4.1, "How to Configure Logging Using the Properties File").

  Note: In your MAF application, you cannot use loggers from the `java.util.logging` package.

MAF loggers are declared in the `oracle.adfmf.util.Utility` class as follows:

```
public static final String APP_LOGNAME = "oracle.adfmf.application";
public static final Logger ApplicationLogger = Logger.getLogger(APP_LOGNAME);

public static final String FRAMEWORK_LOGNAME = "oracle.adfmf.framework";
public static final Logger FrameworkLogger = Logger.getLogger(FRAMEWORK_LOGNAME);
```

The logger that you are to use in your MAF application is the `ApplicationLogger`.

You can also use methods of the `oracle.adfmf.util.logging.Trace` class.

For more information, see *Oracle Fusion Middleware Java API Reference for Oracle Mobile Application Framework*.

22.4.1 How to Configure Logging Using the Properties File

Example 22–1 shows the `logging.properties` file that you use to configure logging.

Example 22–1 logging.properties File

```
# default - all loggers to use the ConsoleHandler
.handlers=com.sun.util.logging.ConsoleHandler
```

```
# default - all loggers to use the SimpleFormatter
.formatter=com.sun.util.logging.SimpleFormatter

oracle.adfmf.util.logging.ConsoleHandler.formatter=
             oracle.adfmf.util.logging.PatternFormatter
oracle.adfmf.util.logging.PatternFormatter.pattern=
             [%LEVEL%-%LOGGER%-%CLASS%-%METHOD%]%MESSAGE%

#configure the framework logger to only use the adfmf ConsoleHandler
oracle.adfmf.framework.useParentHandlers=false
oracle.adfmf.framework.handlers=oracle.adfmf.util.logging.ConsoleHandler
oracle.adfmf.framework.level=SEVERE

#configure the application logger to only use the adfmf ConsoleHandler
oracle.adfmf.application.useParentHandlers=false
oracle.adfmf.application.handlers=oracle.adfmf.util.logging.ConsoleHandler
oracle.adfmf.application.level=SEVERE
```

The `oracle.adfmf.util.logging.ConsoleHandler` plays the role of the receiver of the custom formatter.

The `oracle.adfmf.util.logging.PatternFormatter` allows the following advanced formatting tokens that enable log messages to be printed:

- `%LEVEL%`—the logging level.
- `%LOGGER%`—the name of the logger to which the output is being written.
- `%CLASS%`—the class that is being logged.
- `%METHOD%`—the method that is being logged.
- `%TIME%`—the time the logging message was sent.
- `%MESSAGE%`—the actual message.

The following logging levels are available:

- `SEVERE`: this is a message level indicating a serious failure.
- `WARNING`: this is a message level indicating a potential problem.
- `INFO`: this is a message level for informational messages.
- `FINE`: this is a message level providing tracing information.
- `FINER`: this level indicates a fairly detailed tracing message.
- `FINEST`: this level indicates a highly detailed tracing message.

> **Caution:** When selecting the amount of verbosity for a logging level, keep in mind that by increasing the verbosity of the output at the `SEVERE`, `WARNING`, and `INFO` level negatively affects performance of your application.

The logger defined in the `logging.properties` file matches the logger obtained from the `oracle.adfmf.util.Utility` class (see Section 22.4, "Using and Configuring Logging"). The logging levels also match. If you decide to use the logging level that is more fine-grained than `INFO`, you have to change the `ConsoleHandler`'s logging level to the same level, as Example 22–2 shows.

Example 22–2 Setting Very Fine-Grained Logging Level

```
oracle.adfmf.util.logging.ConsoleHandler.formatter=
             oracle.adfmf.util.logging.PatternFormatter
oracle.adfmf.util.logging.ConsoleHandler.level=FINEST
oracle.adfmf.util.logging.PatternFormatter.pattern=
             [%LEVEL%-%LOGGER%-%CLASS%-%METHOD%]%MESSAGE%
```

22.4.2 How to Use JavaScript Logging

JavaScript writes the output to the `console.log` or `.error/.warn/.info`. This output is redirected into the file through the `System.out` utility.

You customize the log output by supplying a message. The following JavaScript code produces `"Message from JavaScript"` output:

```
<script type="text/javascript" charset="utf-8">
   function test_function() { console.log("Message from JavaScript"); }
</script>
```

To make use of the properties defined in the logging file, you need to use the `adf.mf.log` package and the `Application` logger that it provides.

The following logging levels are available:

- `adf.mf.log.level.SEVERE`
- `adf.mf.log.level.WARNING`
- `adf.mf.log.level.INFO`
- `adf.mf.log.level.CONFIG`
- `adf.mf.log.level.FINE`
- `adf.mf.log.level.FINER`
- `adf.mf.log.level.FINEST`

To trigger logging, use the `adf.mf.log.Application` logger's `logp` method and specify the following through the method's parameters:

- the logging level
- the current class name as a String
- the current method as a String
- the message string as a String

Example 22–3 shows how to use the `logp` method in a MAF application.

Example 22–3 Using Logging Method

```
adf.mf.log.Application.logp(adf.mf.log.level.WARNING,
                            "myClass",
                            "myMethod",
                            "My Message");
```

Upon execution of the `logp` method, the following output is produced:

```
[WARNING - oracle.adfmf.application - myClass - myMethod] My Message
```

22.4.3 How to Use Embedded Logging

Embedded logging uses the `com.sun.util.logging.Logger`, as illustrated in Example 22–4. Note that the `EmbeddedClass` represents a Java class defined in the project.

Example 22–4 Using Embedded Logging

```
import com.sun.util.logging.Level;
import com.sun.util.logging.Logger;
import oracle.adfmf.util.logging.*;
...
   Utility.ApplicationLogger.logp(Level.WARNING,
                                  EmbeddedClass.class.getName(),
                                  "onTestMessage",
                                  "embedded warning message 1");
   Logger.getLogger(Utility.APP_LOGNAME).logp(Level.WARNING,
                    this.getClass().getName(),
                    "onTestMessage",
                    "embedded warning message 2");
   Logger.getLogger("oracle.adfmf.application").logp(Level.WARNING,
                                                     this.getClass().getName(),
                                                     "onTestMessage",
                                                     "embedded warning message 3");
```

The preceding code produces the following output:

```
[WARNING - oracle.adfmf.application - EmbeddedClass - onTestMessage] embedded warning message 1
[WARNING - oracle.adfmf.application - EmbeddedClass - onTestMessage] embedded warning message 2
[WARNING - oracle.adfmf.application - EmbeddedClass - onTestMessage] embedded warning message 3
```

22.4.4 How to Use Xcode for Debugging and Logging on iOS Platform

Even though it is not recommended to manipulate your MAF projects with Xcode because you can lose some or all of your changes during the next deployment with JDeveloper, you may choose to do so in exceptional circumstances.

Before you begin:

Deploy the application to the iOS simulator from JDeveloper.

To open the generated project directly in Xcode:

1. Navigate to the *workspace_directory*`\deploy\`*deployment profile name*`\temporary_xcode_project\`.
2. Open the Xcode project called `Oracle_ADFmc_Container_Template.xcodeproj`.

If your development computer is running on Mac OS 10.8.*n* and you are debugging your MAF application using Xcode, you cannot see the Java output in the IDE (on either JDeveloper console or Xcode console). Instead, the output is redirected to a file (see Section 22.4, "Using and Configuring Logging"). By adding the following argument to your application's schema, you can disable this behavior and enable access to the Java, JavaScript, and Objective-C log output in Xcode in real time when debugging on either an iOS-powered device or its simulator:

```
-consoleRedirect=FALSE
```

22.4.5 How to Access the Application Log

Using the following APIs, you can access the application log information:

- `oracle.adfmf.framework.api.PerfMon`
- `oracle.adfmf.framework.api.LogEntry`
- `oracle.adfmf.util.HOTS`

For more information, see *Oracle Fusion Middleware Java API Reference for Oracle Mobile Application Framework*.

Part VII

Appendixes

Part VIII contains the following appendixes:

- Appendix A, "Troubleshooting"
- Appendix B, "Local HTML and Application Container APIs"
- Appendix C, "Converting Preferences for Deployment"
- Appendix D, "MAF Application Usage"
- Appendix E, "Parsing XML"
- Appendix F, "Mobile Application Framework Sample Applications"

A

Troubleshooting

This appendix describes problems with various aspects of mobile applications, as well as how to diagnose and resolve them.

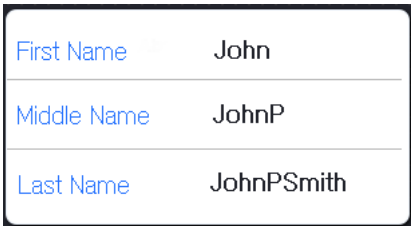
This appendix includes the following sections:

A.1 Problems with Input Components on iOS Simulators

Issue:

On mobile applications deployed to iOS simulators, text entered into one `<amx:inputText>` component field becomes attached to the beginning of the text entered in subsequent field when navigating from one field to another using a mouse. For example, on a page with First Name, Middle Name, and Last Name input text fields, if you enter *John* in the First Name field, then click the Middle Name field, and enter *P*, the text displays as *JohnP*. Likewise, when you click the Last Name field, and enter Smith, the text in that field displays as *JohnPSmith*, as shown in Figure A–1.

Figure A–1 Text Values Concatenate in Subsequent <amx:inputText> fields



> **Note:** This behavior only occurs on iOS simulators and in web pages, not on actual devices.

Solution:

Use the keyboard on the simulator to traverse the input text fields rather than the mouse.

A.2 Code Signing Issues Prevent Deployment

Issue:

In some iOS development environments, mobile application deployment fails because of code signing errors.

Solution:

To ensure that the mobile application is signed, add code signing data to the Mach-O (Mach object) file by configuring the environment with `CODESIGN_ALLOCATE`. For example, enter the following from the Terminal:

```
export CODESIGN_
ALLOCATE="/Applications/Xcode.app/Contents/Developer/usr/bin/codesign_allocate"
```

For more information, *see codesign_allocate(1) OS X Manual Page* and *OS X ABI Mach-O File Format Reference*, both available from the iOS Developer Library (`http://developer.apple.com/library/ios/navigation/`).

A.3 The credentials Attribute Causes Deployment to Fail

Issue:

The presence of the `credentials` attribute defined for the `adfmf:feature` element in the `maf-feature.xml` file causes JDeveloper to cancel deployment and write an error similar to the following to the deployment log:

```
XML validation failed for file
/Users/jsmith/jdeveloper/mywork/MobileApplication/ViewController/src/META-INF/maf-
feature.xml.
[12:26:44 PM] The file contains the following errors:
Error (Line 3, Column 44): Attribute credentials not defined on element
adfmf:feature
Error (Line 10, Column 49): Attribute credentials not defined on element
adfmf:feature
Error (Line 19, Column 51): Attribute credentials not defined on element
adfmf:feature
Error (Line 35, Column 69): Attribute credentials not defined on element
adfmf:feature
Error (Line 50, Column 65): Attribute credentials not defined on element
adfmf:feature
[12:26:50 PM] Deployment cancelled.
[12:26:50 PM] ----  Deployment incomplete  ----.
[12:26:50 PM] XML validation failed.
```

Solution:

When you migrate an application created by ADF Mobile, you must verify that the authentication mode once defined in `maf-feature.xml` (such as `<adfmf:feature id="feature1" name="feature1" credentials="remote">`) is now defined using the `authenticationMode` attribute in the `connections.xml` file. JDeveloper's audit rules can detect the presence of the `credentials` attribute and assist you in removing it from the `maf-feature.xml` file.

Because only the `local` and `remote` values are valid for the `autneticationMode` attribute, do not migrate the value of `none` (`<adfmf:feature id="feature1" name="feature1" credentials="none">`) to the `authenticateionMode` attribute, as doing so will cause the deployment will fail. For more information, see Section 21.3,

"Overview of the Authentication Process for Mobile Applications."

B

Local HTML and Application Container APIs

This chapter describes the MAF JavaScript API extensions, the MAF Container Utilities API, and how to use the `AdfmfJavaUtilities` API for HTML application features, including custom HTML springboard applications.

This chapter includes the following sections:

- Section B.1, "Using MAF APIs to Create a Custom HTML Springboard Application Feature"
- Section B.2, "The MAF Container Utilities API"
- Section B.3, "Accessing Files Using the getDirectoryPathRoot Method"

B.1 Using MAF APIs to Create a Custom HTML Springboard Application Feature

Using JavaScript to call the JavaScript API extensions enables you to add the navigation functions to a custom springboard page authored in HTML. As stated in Section 4.5.4, "What You May Need to Know About Custom Springboard Application Features with HTML Content," you can enable callbacks and leverage Apache Cordova by including methods in the JavaScript `<script>` tag. Example B–1 illustrates using this tag to call Cordova.

Example B–1 Embedding the <script> Tag in an HTML Springboard Page

```
...
<script type="text/javascript">if (!window.adf) window.adf = {};
                                adf.wwwPath = "../../../www/";</script>
<script type="text/javascript" src="../../../www/js/base.js"></script>
...
```

The relative path to the location of the `www/js` directory always reflects the location of the HTML springboard page (or any custom HTML page), which can be located at the root of the view controller's `public_html` directory, or within a subdirectory of it. In Example B–1, the paths defined by the `src` attribute (`../../../www/js/base.js`) and the `adf.wwwPath` variable are relative to the location of the HTML springboard file when it is located at the root of the `public_html` directory, as follows:

```
JDeveloper\mywork\application name\ViewController\public_html\customspringboard.html
```

In other words, the `adf.wwwPath` variable must have the same number of `../` entries as `base.js`.

Note: MAF does not load a JQuery JavaScript file if it has already loaded a custom version of JQuery before the `base.js` library file.

To enable the springboard files and custom HTML files located within the subdirectories of `public_html` to access hosted JavaScript files, you must adjust the relative path definition accordingly by adding `../` entries for each subdirectory location. The number of `../` entries varies; it depends on the location of the HTML page within the mobile application, relative to the location of the deployed `www` directory. If the HTML file is moved to a deeper level of folders, then you must add the appropriate number of `../` entries to the `<script>` tags.

Tip: To access (and determine the location of) the `www/js` directory, you must first deploy a mobile application and traverse to the `deploy` directory. The `www/js` directory resides within the platform-specific artifacts generated by the deployment. For iOS deployments, the directory is located within the `temporary_xcode_project` directory. For Android deployments, this directory is located in the `assets` directory of the Android application package (`.apk`) file. See also Section 4.5.4, "What You May Need to Know About Custom Springboard Application Features with HTML Content."

Note: Because the path does not exist during design time, JDeveloper notes the JavaScript includes in the source editor as an error by highlighting it with a red, wavy underline. This path is resolved at runtime.

The MAF extension to the Cordova API enables the mobile device's API to access the configuration metadata in the `maf-feature.xml` and `maf-application.xml` files, which in turn results in communication between the mobile device and MAF's infrastructure. These extensions also direct the display behavior of the application features.

Note: Because MAF requires Cordova 2.2.0, you must migrate any installed PhoneGap plugins to the Cordova 2.2.0 versions of those plugins. For more information, see the upgrading guides, available in the Apache Cordova Documentation (`http://docs.phonegap.com/en/2.2.0/index.html`).

For information on the default MAF springboard page, `springboard.amx`, and about the ApplicationFeatures data control that you can use to build a customized springboard, see Section 4.5.5, "What You May Need to Know About Custom Springboard Application Features with MAF AMX Content."

B.1.1 About Executing Code in Custom HTML Pages

Example B–2 illustrates a script defining the `showpagecomplete` event on the `handlePageShown` callback function. By listening to this event using standard DOM (Document Object Model) event listening, custom HTML pages (such as login pages) can invoke their own code after MAF has loaded and displayed the page for the first time.

Example B–2 Using the showpagecomplete Event

```
<script>
        function handlePageShown()
        {
          console.log("Page is shown!");
        }
        document.addEventListener("showpagecomplete", handlePageShown, false);
</script>
```

Note: The `showpagecomplete` event guarantees the appropriate MAF state; other browser and third-party events, such as `load` and Cordova's `deviceready`, may not. Do not use them.

B.2 The MAF Container Utilities API

The methods of the MAF Container Utilities API provide MAF applications with such functionality as navigating to the navigation bar, displaying a springboard, or displaying application features. You can use these methods at the Java and JavaScript layers of MAF.

In Java, the Container Utilities API is implemented as static methods on the `AdfmfContainerUtilities` class, which is located in the `oracle.adfmf.framework.api` package. Example B–3 illustrates calling the `gotoSpringboard` method. For more information on `oracle.adfmf.framework.api.AdfmfContainerUtilities`, see *Oracle Fusion Middleware Java API Reference for Oracle Mobile Application Framework*.

Example B–3 Calling the Container Utilities API in Java

```
import oracle.adfmf.framework.api.AdfmfContainerUtilities;
...
AdfmfContainerUtilities.gotoSpringboard();
...
```

B.2.1 Using the JavaScript Callbacks

The signatures of Java and JavaScript both match. In Java, they are synchronous and return results directly. Because JavaScript is asynchronous, there are two callback functions added for every function: a `success` callback that returns the results and a `failed` callback that returns any exception that is thrown. Within a Java method, the `success` value is returned from the function, or method, and the exception is thrown directly from the method. The pseudocode in Example B–4 illustrates how a call with no arguments, `public static functionName() throws`, is executed within Java using `try` and `catch` blocks.

Example B–4 Executing a Call with No Arguments in Java

```
...
 try {
    result = AdfmfContainerUtilities.functionName();
 }
 catch() {
    ...
 }

...
```

Because JavaScript calls are asynchronous, the return is required through the callback mechanism when the execution of the function is complete. The pseudocode in Example B–5 illustrates the signature of the JavaScript call.

Example B–5 The JavaScript Call Signature

```
adf.mf.api.functionName(
           function(req, res) { alert("functionName complete"); },
           function(req, res) { alert("functionName failed with " +
                                      adf.mf.util.stringify(res); }
);
```

As illustrated by Example B–5, this call is defined as *`function(request, response)`*. The value of the request argument is the actual request. The `response` is defined as `function(request, response)` and its value is the actual request. The response is thrown during the execution of the function.

The pseudocode in illustrates how a call with one or more arguments, such as `public static <return value> <function name>(<arg0>, <arg1>, ...) throws <exceptions>`, is executed within Java using a `try-catch` block.

Example B–6 Executing a Call with Multiple Arguments in Java

```
try {
   result = AdfmfContainerUtilities.<function_name>(<arg0>, <arg1>, ...);
}
catch(<exception>) {
   ...
}
```

JavaScript calls cannot return a result because they are asynchronous. They instead require a callback mechanism when the execution of the function has completed. The signature for both the success and failed callbacks is `function(request, response)`, where the `request` argument is a JSON representation for the actual request and the `response` is the JSON representation of what was returned by the method (in the case of `success` callback functions) or, for `failed` callback functions, a JSON representation of the thrown exception.

Note: The callback functions must be invoked before subsequent JavaScript calls can be made to avoid problems related to stack depth or race conditions.

B.2.2 Using the Container Utilities API

The Container Utilities API provides the following methods:

- getApplicationInformation—Retrieves the metadata for the mobile application.
- gotoDefaultFeature—Displays the default application feature.
- getFeatures—Retrieves the application features.
- gotoFeature—Displays a specific application feature.
- getFeatureByName—Retrieves information about the application feature using the application feature's name.
- getFeatureById—Retrieves an application feature using its ID.

- resetFeature—Resets the application feature to the same state as when it was loaded.
- gotoSpringboard—Displays the springboard.
- hideNavigationBar—Hides the navigation bar.
- showNavigationBar—Displays the navigation bar.
- invokeMethod—Invokes a Java method.
- invokeContainerJavaScriptFunction—Invokes a JavaScript method.

The Container Utilities API also include methods for placing badges and badge numbers on applications. For more information, see Section B.2.15, "Application Icon Badging."

B.2.3 getApplicationInformation

This method returns an `ApplicationInformation` object that contains information about the application. This method returns such metadata as the application ID, application name, version, and the vendor of an application.

Within Java, this method is called as follows:

```
public static oracle.adfmf.framework.ApplicationInformation
              getApplicationInformation()
              throws oracle.adfmf.framework.exception.AdfException
```

Example B–7 illustrates calling this method.

Example B–7 Retrieving Application Information Using Java

```
import oracle.adfmf.framework.api.AdfmfContainerUtilties;

  ...
    try {
       ApplicationInformation ai = AdfmfContainerUtilities.getApplicationInformation();
       String applicationId = ai.getId();
       String applicationName = ai.getName();
       String vendor = ai.getVendor();
       String version = ai.getVersion();
       ...
    }
    catch(AdfException e) {
       // handle the exception
    }
```

In JavaScript, the `success` and `failed` callback functions enable the returned value and the exception to be passed back to the JavaScript calling code as follows:

```
public void getApplicationInformation(success, failed)
```

The `success` callback must be in the form of `function(request, response)`, where the `request` argument contains the original request and the `response` argument contains the associated `AdfmfContainerUtilities` method's return value, which is the `ApplicatiaonInformation` object containing application-level metadata. This includes the application name, vendor, version, and application ID.

The `failed` callback must be in the form of `function(request, response)`, where the request contains the original request and the response contains the error.

Example B–8 illustrates using these callback functions to retrieve the application information.

Example B–8 Using Callback Functions in JavaScript to Return Application Information

```
adf.mf.api.getApplicationInformation(
          function(req, res) { alert("getApplicationInformation complete"); },
          function(req, res) { alert("getApplicationInformation failed with " +
                                    adf.mf.util.stringify(res); }
);
```

B.2.4 gotoDefaultFeature

This method requests that MAF display the default application feature. The default application feature is the one that is displayed when the mobile application is started.

> **Note:** This method may not be able to display an application feature if it has authentication- or authorization-related problems.

In JavaScript, the `success` and `failed` callback functions enable the returned value and the exception to be passed back to the JavaScript calling code as follows:

```
public void gotoDefaultFeature(success, failed)
```

The `success` callback function must be in the form of `function(request, response)`, where the `request` argument contains the original request and the `response` argument contains the associated `AdfmfContainerUtilities` method's return value (`void`).

The `failed` callback function must be in the form of `function(request, response)`, where the `request` argument contains the original request and the `response` argument contains the error.

Example B–9 illustrates using these callbacks to call the default application feature.

Example B–9 Using JavaScript Callback Functions to Activate the Default Application Feature

```
adf.mf.api.gotoDefaultFeature(
          function(req, res) { alert("gotoDefaultFeature complete"); },
          function(req, res) { alert("gotoDefaultFeature failed with " +
                                    adf.mf.util.stringify(res); }
);
```

B.2.5 getFeatures

This method returns an array of `FeatureInformation` objects that represent the available application features. The returned metadata includes the feature ID, the application feature name, and the file locations for the image files used for the application icons. This call enables a custom springboard implementation to access the list of application features that are available after constraints have been applied. (These application features would also display within the default springboard.)

Within Java, this method is called as follows:

```
public static oracle.adfmf.framework.FeatureInformation[] getFeatures()
              throws oracle.adfmf.framework.exception.AdfException
```

Example B–10 illustrates using this method.

Example B–10 Retrieving the Application Feature Information Using Java

```
import oracle.adfmf.framework.api.AdfmfContainerUtilties;

  ...
   try {
      FeatureInformation[] fia = null;
      fia = AdfmfContainerUtilities.getFeatures();

      for(int f = 0; f < fia.length; ++f) {
           FeatureInformation fi = fia[i];
           String featureId = fi.getId();
           String featureName = fi.getName();
           String featureIconPath = = fi.getIcon();
           String featureImagePath = fi.getImage();
           ...
      }
   }
   catch(AdfException e) {
      // handle the exception
   }
```

In JavaScript, the `success` and `failed` callback functions enable the returned values and the exceptions to be passed back to the JavaScript calling code as follows:

```
public void getFeatures(success, failed)
```

The `success` callback function must be in the form of `function(request, response)`, where the `request` argument contains the original request and the `response` argument contains the associated `AdfmfContainerUtilities` method's return value (the array of `FeatureInformation` objects).

The `failed` callback function must be in the form of `function(request, response)`, where the `request` argument contains the original request and the `response` argument contains the error (`AdfException`).

Example B–11 Using JavaScript Callback Functions to Retrieve Application Feature Information

```
adf.mf.api.getFeatures(
          function(req, res) { alert("getFeatures complete"); },
          function(req, res) { alert("getFeatures failed with " +
                                adf.mf.util.stringify(res); }
);
```

B.2.6 gotoFeature

This method requests that MAF display the application feature identified by its ID.

> **Note:** This method may not be able to display an application feature if it has authentication- or authorization-related problems.

Within Java, this method is called as follows:

```
public static void gotoFeature(java.lang.String featureId)
                  throws oracle.adfmf.framework.exception.AdfException
```

This method's parameter, as shown in Example B–12, is the ID of the application feature.

Example B–12 Activating an Application Feature

```
import oracle.adfmf.framework.api.AdfmfContainerUtilties;

   ...
   try {
      AdfmfContainerUtilities.gotoFeature("feature.id");
   }
   catch(AdfException e) {
      // handle the exception
   }
```

In JavaScript, the `success` and `failed` callback functions enable the returned value and the exception to be passed back to the JavaScript calling code as follows:

```
public void gotoFeature(featureId, success, failed)
```

The `featureId` parameter is the application feature ID. This parameter activates the `success` callback function and must be in the form of `function(request, response)`, where the request contains the original request and the response contains the associated `AdfmfContainerUtilities` method's return value (`void`).

The `failed` callback function must be in the form of `function(request, response)`, where the request contains the original request and the response contains the error.

Example B–13 illustrates using these callback functions to call an application feature.

Example B–13 Activating an Application Feature Using JavaScript Callback Functions

```
adf.mf.api.gotoFeature("feature0",
          function(req, res) { alert("gotoFeature complete"); },
function(req, res) { alert("gotoFeature failed with " +
                           adf.mf.util.stringify(res); }
);
```

B.2.7 getFeatureByName

This method returns information about the application feature using the passed-in name of the application feature.

Within Java, this method is called as follows:

```
public static oracle.adfmf.framework.FeatureInformation getFeatureByName(java.lang.String
                                                                          featureName)
                                    throws oracle.adfmf.framework.exception.AdfException
```

This method's parameter, as shown in Example B–14, is the name of the application feature.

Example B–14 Retrieving the Application Feature Information Using the Application Feature Name

```
   ...
   try {
        FeatureInformation fi = AdfmfContainerUtilities.getFeatureByName("feature.name");
        String featureId = fi.getId();
        String featureName = fi.getName();
        String featureIconPath = = fi.getIcon();
        String featureImagePath = fi.getImage();
   }
   catch(AdfException e) {
      // handle the exception
   }
```

In JavaScript, the `success` and `failed` callback functions enable the returned value and the exception to be passed back to the JavaScript calling code as follows:

```
public void getFeatureByName(featureName, success, failed)
```

The `featureName` parameter is the name of the application feature. The `success` callback function and must be in the form of `function(request, response)`, where the request contains the original request and the response contains the associated `AdfmfContainerUtilities` method's return value (`void`).

The `failed` callback function must be in the form of `function(request, response)`, where the request contains the original request and the response contains the error.

Example B–15 illustrates using these callback functions.

Example B–15 Using JavaScript Callback Functions to Retrieve the Application Feature Information Using the Application Feature Name

```
adf.mf.api.getFeatureByName("feature.name",
          function(req, res) { alert("getFeatureByName complete"); },
          function(req, res) { alert("getFeatureByName failed with " +
                                     adf.mf.util.stringify(res); }
);
```

B.2.8 getFeatureById

This method retrieves an application feature using its application ID.

Within Java, this method is called as follows:

```
import oracle.adfmf.framework.api.AdfmfContainerUtilties;
```

This method's parameter, as shown in Example B–16, is the ID of the application feature.

Example B–16 Retrieving an Application Feature Using its ID in Java

```
try {
   FeatureInformation fi =AdfmfContainerUtilities.getFeatureById("feature.id");
}
catch(AdfException e) {
   // handle the exception
}
```

In JavaScript, the `success` and `failed` callback functions enable the returned value and the exception to be passed back to the JavaScript calling code as follows:

```
public void getFeatureById(featureId, success, failed)
```

The `featureId` parameter is the ID of the application feature. The `success` callback function and must be in the form of `function(request, response)`, where the request contains the original request and the response contains the associated `AdfmfContainerUtilities` method's return value (`void`).

The `failed` callback function must be in the form of `function(request, response)`, where the request contains the original request and the response contains the error.

Example B–17 illustrates using these callback functions to retrieve an application feature.

Example B–17 Using JavaScript Callback Functions to Retrieve an Application Feature by its ID

```
adf.mf.api.getFeatureById("feature.id",
          function(req, res) { alert("getFeatureById complete"); },
          function(req, res) { alert("getFeatureById failed with " +
                                     adf.mf.util.stringify(res); }
);
```

B.2.9 resetFeature

This method resets the state of the application feature. It resets the Java-side model for the application feature and then restarts the user interface presentation as if the mobile application had just been loaded and displayed the application feature for the first time.

Within Java, this method is called as follows:

```
public static void resetFeature(java.lang.String featureId)
                  throws oracle.adfmf.framework.exception.AdfException
```

The method's parameter, as shown in Example B–18, is the ID of the application feature that is to be reset.

Example B–18 Resetting an Application Feature in Java

```
import oracle.adfmf.framework.api.AdfmfContainerUtilties;

   ...
   try {
      AdfmfContainerUtilities.resetFeature("feature.id");
   }
   catch(AdfException e) {
      // handle the exception
}
```

In JavaScript, the `success` and `failed` callback functions enable the returned value and exception to be passed back to the JavaScript calling code as follows:

```
public void resetFeature(featureId, success, failed)
```

The `success` callback function and must be in the form of `function(request, response)`, where the request contains the original request and the response contains the associated method's return value (The ID of the application feature).

The `failed` callback function must be in the form of `function(request, response)`, where the request contains the original request and the response contains the error.

Example B–19 illustrates using these callback functions to call an application feature.

Example B–19 Using JavaScript Callback Functions to Reset an Application Feature

```
adf.mf.api.resetFeature("feature0",
          function(req, res) { alert("resetFeature complete"); },
          function(req, res) { alert("resetFeature failed with " +
                                     adf.mf.util.stringify(res); }
);
```

B.2.10 gotoSpringboard

This method requests that MAF activate the springboard.

> **Note:** This method may not be able to display the springboard if it has not been designated as a feature reference in the `maf-application.xml` file, or if it has authentication or authorization-related problems. See also Section 4.5, "Configuring the Springboard and Navigation Bar Behavior."

Within Java, this method is called as follows:

```
public static void gotoSpringboard()
```

Example B–20 illustrates using this method

Example B–20 Activating the Springboard in Java

```
import oracle.adfmf.framework.api.AdfmfContainerUtilties;

   ...
   try {
      AdfmfContainerUtilities.gotoSpringboard();
   }
   catch(AdfException e) {
      // handle the exception
   }
```

In JavaScript, the `success` and `failed` callback functions enable the returned value and the exception to be passed back to the JavaScript calling code as follows:

```
public void gotoSpringboard(success, failed)
```

The `success` callback function must be in the form of `function(request, response)`, where the request contains the original request and the response contains the associated method's return value (`void`).

The `failed` callback function must be in the form of `function(request, response)`, where the request contains the original request and the response contains the error.

Example B–21 illustrates using these callback functions.

Example B–21 Using JavaScript Callback Functions to Activate the Springboard

```
adf.mf.api.gotoSpringboard(
    function(req, res) { alert("gotoSpringboard complete"); },
    function(req, res) { alert("gotoSpringboard failed with " +
                               adf.mf.util.stringify(res); }
);
```

B.2.11 hideNavigationBar

This method requests that MAF hide the navigation bar.

Within Java, this method is called as follows:

```
public static void hideNavigationBar()
```

Example B–22 illustrates using this method.

Example B–22 Hiding the Navigation Bar in Java

```
import oracle.adfmf.framework.api.AdfmfContainerUtilties;
```

```
   ...
   try {
      AdfmfContainerUtilities.hideNavigationBar();
   }
   catch(Exception e) {
      // handle the exception
   }
```

In JavaScript, the `success` and `failed` callback functions enable the returned value and the exception to be passed back to the JavaScript calling code as follows:

```
public void hideNavigationBar(success, failed)
```

The `success` callback function must be in the form of `function(request, response)`, where the request contains the original request and the response contains the associated method's return value (`void`).

The `failed` callback function must be in the form of `function(request, response)`, where the request contains the original request and the response contains the error.

Example B–23 illustrates using these callback functions.

Example B–23 Using JavaScript Callback Functions to Hide the Navigation Bar

```
adf.mf.api.hideNavigationBar(
       function(req, res) { alert("hideNavigationBar complete"); },
       function(req, res) { alert("hideNavigationBar failed with " +
                                  adf.mf.util.stringify(res); }
);
```

B.2.12 showNavigationBar

This method requests that MAF display the navigation bar.

Within Java, this method is called as follows:

```
public static void showNavigationBar()
```

Example B–24 illustrates using this method.

Example B–24 Showing the Navigation Bar in Java

```
import oracle.adfmf.framework.api.AdfmfContainerUtilties;

   ...
   try {
      AdfmfContainerUtilities.showNavigationBar();
   }
   catch(Exception e) {
      // handle the exception
   }
```

In JavaScript, the `success` and `failed` callback functions enable the returned value and the exception to be passed back to the JavaScript calling code as follows:

```
public void showNavigationBar(success, failed)
```

The `success` callback function must be in the form of `function(request, response)`, where the request contains the original request and the response contains the associated method's return value (`void`).

The `failed` callback function must be in the form of `function(request, response)`, where the request contains the original request and the response contains the error.

Example B–25 illustrates using these callback functions.

Example B–25 Using JavaScript Callback Functions to Show the Navigation Bar

```
adf.mf.api.showNavigationBar(
          function(req, res) { alert("showNavigationBar complete"); },
          function(req, res) { alert("showNavigationBar failed with " +
                                     adf.mf.util.stringify(res); }
);
```

B.2.13 invokeMethod

This method is not available in Java. Example B–26 illustrates using the JavaScript callback methods to invoke a Java method from any class in a classpath.

Example B–26 Using JavaScript Callback Function to Call a Java Method

```
adf.mf.api.invokeMethod(classname,
                        methodname,
                        param1,
                        param2,
                         ...
                        paramN,
                        successCallback,
                        failedCallback);
```

Table B–1 lists the parameters taken by this method.

Table B–1 Parameters Passed to invokeJavaMethod

Parameter	Description
`classname`	The class name (including the package information) that MAF uses to create an instance when calling the Java method.
`methodname`	The name of the method that should be invoked on the instance of the class specified by the `classname` parameter.

The `success` callback function must be in the form of `function(request, response)`, where the request contains the original request and the response contains the associated method's return value.

The `failed` callback function must be in the form of `function(request, response)`, where the request contains the original request and the response contains the error.

Examples of using this method with multiple parameters are as follows:

```
adf.mf.api.invokeMethod("TestBean", "setStringProp", "foo", success, failed);

adf.mf.api.invokeMethod("TestBean", "getStringProp", success, failed)
```

An example of using an integer parameter is as follows:

```
adf.mf.api.invokeMethod("TestBean", "testSimpleIntMethod", "101", success, failed);
```

The following illustrates using complex parameters:

```
adf.mf.api.invokeMethod("TestBean", "testComplexMethod",
          {"foo":"newfoo","baz":"newbaz",".type":"TestBeanComplexSubType"}, success, failed);
```

The following illustrates using no parameters:

```
adf.mf.api.invokeMethod("TestBean", "getComplexColl", success, failed);
```

The following illustrates using `String` parameters:

```
adf.mf.api.invokeMethod("TestBean", "testMethodStringStringString", "Hello ",
                        "World", success, failed);
```

B.2.14 invokeContainerJavaScriptFunction

The `invokeContainerJavaScriptFunction` invokes a JavaScript method. Table B–2 lists the parameters passed by this method.

Table B–2 Parameters Passed to invokeContainerJavaScriptFunction

Parameter	Description
`featureId`	The ID of the application feature used by MAF to determine the context for the JavaScript invocation. The ID determines the web view in which this method is called.
`method`	The name of the method that should be invoked.
`args`	An array of arguments that are passed to the method. Within this array, these arguments should be arranged in the order expected by the method.

This method returns a JSON object.

> **Note:** The `invokeContainerJavaScriptFunction` API expects the JavaScript function to finish within 15 seconds for applications running on an Android-powered device or emulator, or it will return a timeout error.

Example B–27 The invokeContainerJavaScriptFunction Method

```
public static java.lang.Object invokeContainerJavaScriptFunction(java.lang.String featureId,
                                                                  java.lang.Object[] args)
                           throws oracle.adfmf.framework.exception.AdfException
```

The pseudocode in Example B–28 illustrates a JavaScript file called `appFunctions.js` that is included in the application feature, called `feature1`. The JavaScript method, `application.testFunction`, which is described within this file, is called by the `invokeContainerJavaScriptFunction method`, shown in Example B–29. Because the application includes a command button that is configured with an action listener that calls this function, a user sees the following alerts after clicking this button:

- APP ALERT 0
- APP ALERT 1
- APP ALERT 2

Example B–28 appFunctions.js

```
(function()
    {
       if (!window.application) window.application = {};

       application.testFunction = function()
```

```
        {
           var args = arguments;

           alert("APP ALERT " + args.length + " ");
           return "application.testFunction - passed";
        };
    })();
```

The pseudocode in Example B–29 illustrates how the `invokeApplicationJavaScriptFunction` method calls the JavaScript method (`application.testFunction`) that is described in Example B–28.

Example B–29 Calling the JavaScript Function from Java

```
invokeApplicationJavaScriptFuntions
    public void invokeApplicationJavaScriptFuntions(ActionEvent actionEvent) {
        AdfmfContainerUtilities.invokeContainerJavaScriptFunction("feature1",
                                                                  "application.testFunction",
                                                                   new Object[] {} );
        AdfmfContainerUtilities.invokeContainerJavaScriptFunction("feature1",
                                                                  "application.testFunction",
                                                                   new Object[] {"P1"} );
        AdfmfContainerUtilities.invokeContainerJavaScriptFunction("feature1",
                                                                  "application.testFunction",
                                                                   new Object[] {"P1", "P2"} );
    }
```

For more information, see *Oracle Fusion Middleware Java API Reference for Oracle Mobile Application Framework* and the APIDemo sample application. This sample application is in the `PublicSamples.zip` file at the following location within the JDeveloper installation directory of your development computer:

jdev_install`/jdeveloper/jdev/extensions/oracle.maf/Samples`

B.2.15 Application Icon Badging

The `AdfmfContainerUtilities` class includes methods to place or retrieve a badge number on a mobile application icon. Table B–3 describes these methods.

Table B–3 Icon Badging Methods

Method	Description	Parameters
`getApplicationIconBadgeNumber`	Gets the current badge value on the mobile application icon. Returns zero (0) if the application icon is not badged.	None
`setApplicationIconBadgeNumber`	Sets the badge number on a mobile application icon.	The value of the badge (`int badge`).

Note: Application icon badging is not supported on Android.

B.3 Accessing Files Using the getDirectoryPathRoot Method

The `adfmfJavaUtilties` API includes the `getDirectoryPathRoot` method. This method, which can only be called from the Java layer, enables access to files on both iOS and Android systems. As shown in Example B–30, this method enables access to the location of the temporary files, application files (on iOS systems), and the cache directory on the device using the `TemporaryDirectory`, `ApplicationDirectory`, and `DeviceOnlyDirectory` constants, respectively. Files stored in the `DeviceOnlyDirectory` location are not synchronized when the device is connected.

> **Note:** Verify that any directories or files accessed by an application exist before the application attempts to access them.

For more information on `oracle.adfmf.framework.api.AdfmfJavaUtilities`, see *Oracle Fusion Middleware Java API Reference for Oracle Mobile Application Framework*.

Example B–30 Accessing Files

```
import oracle.adfmf.framework.api.AdfmfJavaUtilities;

...

public void getDirectoryPathRoot() {
   // returns the directory for storing temporary files
   String tempDir =
      AdfmfJavaUtilities.getDirectoryPathRoot(AdfmfJavaUtilities.TemporaryDirectory);

   // returns the directory for storing application files
   String appDir =
      AdfmfJavaUtilities.getDirectoryPathRoot(AdfmfJavaUtilities.ApplicationDirectory);

   // returns the directory for storing cache files
   String deviceDir =
      AdfmfJavaUtilities.getDirectoryPathRoot(AdfmfJavaUtilities.DeviceOnlyDirectory);

   // returns the directory for storing downloaded files
   String downloadDir =
      AdfmfJavaUtilities.getDirectoryPathRoot(AdfmfJavaUtilities.DownloadDirectory);
   }
```

B.3.1 Accessing Platform-Independent Download Locations

File storage requirements differ by platform. The Android platform does not prescribe a central location from which applications can access files; instead, an application can write a file to any location to which it has write permission. iOS platforms, on the other hand, generally store files within an application directory. Because of these differences, passing `ApplicationDirectory` to the `getDirectoryPathRoot` method can return the file location needed to display attachments for applications running on iOS-powered devices, but not on Android-powered devices. Rather than writing platform-specific code to retrieve these locations for applications intended to run on both iOS- and Android-powered devices, you can enable the `getDirectoryPathRoot` method to return the paths to both the external storage location and the default attachments directory by passing it `DownloadDirectory`. This constant (an `enum` type) reflects the locations used by the `displayFile` method of the `DeviceManager` API,

which displays attachments by using platform-specific functionality to locate these locations.

On Android, `DownloadDirectory` refers to the path returned by the `Environment.getExternalStorageDirectory` method (which retrieves the external Android storage directory, such as an SD card). For mobile applications running on iOS-powered devices, it returns the same location as `ApplicationDirectory`. For more information on the `getExternalStorageDirectory`, see the package reference documentation, available from the Android Developers website (`http://developer.android.com/reference/packages.html`). See also *Files System Programming Guide*, available from the iOS Developer Library (`http://developer.apple.com/library/ios/navigation/`).

C

Converting Preferences for Deployment

This appendix describes how MAF converts user preferences during deployment.

This document includes the following sections:

- Section C.1, "Naming Patterns for Preferences"
- Section C.2, "Converting Preferences for Android"
- Section C.3, "Converting Preferences for iOS"

C.1 Naming Patterns for Preferences

Conversion of mobile application preferences to a mobile-platform representation occurs when a deployment target is invoked. Following conversion, the naming pattern described in Table C–1 ensures that each preference can be uniquely identified on the mobile platform. Each preference element in the `maf-application.xml` and `maf-feature.xml` files must be uniquely identified within the scope of its sibling elements prior to deployment.

The following are examples of identifier values:

- `application.gen.gps.trackGPS`
- `feature.f0.gen.gps.trackGPS`

Table C–1 describes how to generate fully qualified preference identifiers.

Table C–1 MAF Naming Patterns for Preferences

Expression	Description	Syntax
`PreferenceIdentifier`	Represents an identifier value of a preference element that has been converted to a mobile platform representation.	`ApplicationPreferences` | `FeaturePreferences`

`ApplicationPreferences`	Use this expression to build a preference identifier value that is generated from the `maf-application.xml` file.	*application*`.ApplicationElementPath`
		`ApplicationElementPath` represents a dot-separated list of `id` attribute values beginning with the top-most parent element, `<adfmf:preferences>`, and ending with the element that is to be identified. In the following segment from the `maf-application.xml` file, this generated identifier is shown in the comment as `application.gen.gps.trackGPS`.
		`<adfmf:preferences>`
		`  <adfmf:preferenceGroup id="gen">`
		`  <adfmf:preferenceGroup id="gps">`
		`<!-- The mobile-platform identifier would be "application.gen.gps.trackGPS" -->`
		`  <adfmf:preferenceBoolean id="trackGPS"/>`
		`  </adfmf:preferenceGroup>`
		`  </adfmf:preferenceGroup>`
		`</adfmf:preferences>`

`FeaturePreferences`	Use this expression to build a preference identifier value that is generated from the `maf-feature.xml` file.	*feature*`.FeatureElementPath`
		`FeatureElementPath` represents a dot-separated list of `id` attribute values beginning with `<adfmf:feature>`, the top-most parent element, and ending with the element that is to be identified. In the following segment from the `maf-feature.xml` file, this generated identifier is displayed in the comment as `feature.f0.gen.gps.trackGPS`.
		`<adfmf:feature id="f0">`
		`  <adfmf:preferences>`
		`  <adfmf:preferenceGroup id="gen">`
		`  <adfmf:preferenceGroup id="gps">`
		`<!-- The mobile-platform identifier would be "feature.f0.gen.gps.trackGPS" -->`
		`  <adfmf:preferenceBoolean id="trackGPS"/>`
		`  </adfmf:preferenceGroup>`
		`  </adfmf:preferenceGroup>`
		`  </adfmf:preferences>`
		`</adfmf:feature>`

The `<adfmf:preferences>` element cited in the code examples in Table C–1 does not have an `id` attribute and is therefore not represented in any preference identifiers.

C.2 Converting Preferences for Android

The MAF deployment uses XML and XLS to transform the user preference pages defined at both the application feature and application-level into the following three XML documents:

- preferences.xml
- arrays.xml
- strings.xml

C.2.1 Preferences.xml

This file contains the transformed preferences from both of the maf-feature.xml and maf-application.xml files.

C.2.1.1 Preferences Element Mapping

Table C–2 shows the mapping of MAF's preference definitions to Android template preferences, and Android native preferences:

Table C–2 Mapping MAF Preferences to Android Preferences

MAF Preference Definition	Custom or Android Native Preference Definition (Used by MAF Deployment)	Android Native Preference Definition (Not used by MAF Deployment)
<adfmf:preferenceBoolean>	oracle.adfmf.preferences.AdfMFPreferenceBoolean	CheckBoxPreference
<adfmf:preferenceNumber>	oracle.adfmf.preferences.AdfMFPreferenceText	EditPreferenceText
<adfmf:preferenceText>	oracle.adfmf.preferences.AdfMFPreferenceText	EditTextPreference
<adfdmf:preferenceList>	oracle.adfmf.preferences.AdfMFPreferenceList	ListPreference
<adfmf:PreferenceGroup>	PreferenceCategory	PreferenceCategory
<adfmf:PreferencePage>	PreferenceScreen	PreferenceScreen

C.2.1.2 Preference Attribute Mapping

The Preferences.xml file contains references to string resources contained in both the strings.xml and arrays.xml files. The Android SDK defines the syntax for resources in XML files as *@[<package_name>:]<resource_type>/<resource_name>*. This file contains references to string values as well as the name and value pairs of list preferences. The XSL constructs the following for the strings and list preferences:

- <package_name> is the name of the package in which the resource is located (not required when referencing resources from the same package). This component of the reference will not be used.
- <resource_type> is the R subclass for the resource type. This component will have a value of string if constructing a string reference or array if constructing a list preference.
- <resource_name> is the android:name attribute value in the XML element. The value for this component will be the value of the <PreferenceIdentifier>_title when specifying the android:title attribute (see Section C.1, "Naming Patterns for Preferences." for the definition of <PreferenceIdentifier>.

Table C–3 and Table C–4 show the mapping of MAF attributes for a given MAF preference to the Android preference.

In this table:

- Entries of the form {*X*} (such as {default} in Table C–3) indicate the value of a MAF attribute named *X*.
- Entries having <PreferenceIdentifier> indicate the value of the preference identifier, as defined in Section C.1, "Naming Patterns for Preferences."

- Attributes with an asterisk (*) are custom template attributes defined in a MAF namespace and must appear in the `preferences.xml` in the form `adfmf:<attributeName>`. Otherwise, the attributes are part of the Android namespace and must appear in the `preferences.xml` as `android:<attributeName>`.

Table C–3 Mapping of MAF Preference Attributes to Android Preferences

MAF Attribute Definition	Template Custom or Android Native Preference Attribute	Android Attribute Value	Applies to
`id`	`key`	`<PreferenceIdentifier>`	`AdfMFPreferenceBoolean`, `AdfMFPreferenceText`, `AdfMFPreferenceList`, `PreferenceScreen`, `PreferenceCategory`
`default`	`defaultValue`	`{default}`	`AdfMFPreferenceBoolean`, `AdfMFPreferenceText`, `AdfMFPreferenceList`
`label`	`title`	`@string/<PreferenceIdentifier>___` `title` if the given `{label}` value is not a reference to a string resource bundle. References a string in `strings.xml` having the given `{label}`.	`AdfMFPreferenceBooleanAdfM`, `FPreferenceNumber`, `AdfMFPreferenceText`, `AdfMFPreferenceList`, `PreferenceScreen`, `PreferenceCategory`
`secret`	`password`	`{secret}`	`AdfMFPreferenceText`
`min`	`min*`	`{min}`	`AdfMFPreferenceText`
`max`	`max*`	`{max}`	`AdfMFPreferenceText`
`name`	`entryValues`	`@array/<PreferenceIdentifier>___` `entryValues`	`AdfMFPreferenceList`
`value`	`entries`	`@array/<PreferenceIdentifier>___` `entries`	`AdfMFPreferenceList`

C.2.1.3 Attribute Default Values

The overview editors for the `maf-application.xml` and `maf-feature.xml` files exclude an attribute name and value from the XML if:

- The attribute type is `xsd:boolean`.
- The attribute value has a `<default>` value option.
- The user specifies `<default>` as the value.

The XSL must know the MAF attributes that are boolean typed and their corresponding default values. The XSL, then, specifies the appropriate Android or template custom attribute value where has been selected by the user.

Table C–4 indicates what the deployment will specify for the `android:defaultValue` attribute if the MAF preference being transformed does not contain a `default` attribute:

Table C–4 Transforming Attributes with Non-Default Values

MAF Preference Element	Android Preference Equivalent	Default Attribute Value
`preferenceBoolean`	`AdfMFPreferenceBoolean`	`false`

Table C–4 (Cont.) Transforming Attributes with Non-Default Values

MAF Preference Element	Android Preference Equivalent	Default Attribute Value
preferenceText	AdfMFPreferenceText	Empty string
preferenceList	AdfMFPreferenceList	Empty string

C.2.1.4 Preferences Screen Root Element

The preferences.xml file has a root element called <PreferenceScreen>. The Android template requires that this element have the following XML namespace definition:

xmlns:adfmf="http://schemas.android.com/apk/res/<Application Package Name>

The <Application Package Name> element is defined as the same application package name in the AndroidManifest.xml file. <Android Package Name> defines the definition for the Android package name specified in the AndroidManifest.xml file. For more information, see Section 4.3.1, "How to Set the ID and Display Behavior for a Mobile Application."

The deployment uses the Application Bundle Id value from the Android deployment profile if it exists. If it does not exist in the profile, the deployment obtains this value from the application display name and Application Id contained in the maf-application.xml file. The deployment Java code will pass the value to the XSL document as a parameter.

Example C–1 shows MAF preferences contained in the maf-feature.xml file.

Example C–1 Preferences Defined in the maf-feature.xml File

```
<?xml version="1.0" encoding="UTF-8" ?>
<adfmf:features xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance
                xmlns:adfmf="http://xmlns.oracle.com/jdev/adfmf">
   <adfmf:feature id="oracle.hello"
                  name="Hello"
                  icon="oracle.hello/navbar-icon.png"
                  image="oracle.hello/springboard-icon.png">
      <adfmf:content id="Hello.Generic">
         <adfmf:localHTML url="oracle.hello/index.html"/>
      </adfmf:content>
      <adfmf:preferences>
         <adfmf:preferenceGroup id="prefGroup"
                                label="preference group">
            <adfmf:preferenceBoolean id="boolPref"
                                     label="boolPref perference"
                                     default="true"/>
            <adfmf:preferenceNumber id="numPref"
                                    label="numPref preference"
                                    default="1"
                                    min="1"
                                    max="10"/>
            <adfmf:preferenceText id="textPref"
                                  label="textPref preferences"
                                  default="Foo"/>
            <adfmf:preferenceList id="listPref"
                                  label="listPref preference"
                                  default="value2">
            <adfmf:preferenceValue name="name1"
```

```
                                value="value1"/>
            <adfmf:preferenceValue name="name2"
                                value="value2"/>
            </adfmf:preferenceList>
         </adfmf:preferenceGroup>
      </adfmf:preferences>
   </adfmf:feature>
</adfmf:features>
```

C.2.2 arrays.xml

The `arrays.xml` file consists of string-array elements that enumerate the names and values of list preferences that are referenced from the `preferences.xml` file. Each `<preferenceList>` element contained in the `maf-application.xml` and `maf-feature.xml` files is transformed into two string-array elements, one element for the name and one element for the values. For example, the MAF `preferenceList` definition described in Example C–2 results in `<string-array name="feature.oracle.hello.prefGroup.MyList___entry_values">` and `<string-array name="feature.oracle.hello.prefGroup.MyList___entries">` in the `arrays.xml` file shown in Example C–3.

Example C–2 PreferenceList Definition in the maf-feature.xml File

```
<adfmf:features xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
                xmlns:adfmf="http://xmlns.oracle.com/jdev/adfmf">

<adfmf:feature id="oracle.hello" name="Hello" icon="oracle.hello/navbar-icon.png"
image="oracle.hello/springboard-icon.png">
...
   <adfmf:preferences>
      <adfmf:preferenceGroup id="prefGroup">
         <adfmf:preferenceList id="MyList" label="My List">
            <adfmf:preferenceValue name="name1" value="value1"/>
            <adfmf:preferenceValue name="name2" value="value2"/>
            <adfmf:preferenceValue name="name3" value="value3"/>
         </adfmf:preferenceList>
      </adfmf:preferenceGroup>
   </adfmf:preferences>
</adfmf:feature>
...
```

Example C–3 illustrates the pair of string array elements in the `arrays.xml` file that are transformed from a `<preferenceList>` element.

Example C–3 Preference Lists Converted to <string-array> Elements in arrays.xml

```
<resources xmlns:android="http://schemas.android.com/apk/res/android"
           xmlns:adfmf="http://schemas.android.com/apk/res/oracle.myandroidapp">

   <string-array name="feature_oracle_hello_prefGroup.MyList___entry_values">
      <item>name1</item>
      <item>name2</item>
      <item>name3</item>
   </string-array>

   <string-array name="feature_oracle_hello_prefGroup.MyList___entries">
      <item>value1</item>
      <item>value2</item>
```

```
      <item>value3</item>
   </string-array>
</resources>
```

Example C–4 shows the <string-arrays> referenced in preferences.xml.

Example C–4 PreferenceList Reference from the preferences.xml File

```
<oracle.adfmf.preferences.AdfMFPreferenceList android:key="feature.oracle.hello.MyList"
android:title="@string/feature_oracle_hello_prefGroup.MyList___title"
android:entries="@array/feature_oracle_hello_prefGroup.MyList___entries"
android:entryValues="@array/feature_oracle_hello_prefGroup.MyList___entry_values" />
```

C.2.3 Strings.xml

The strings.xml file, shown in Example C–5, consists of string elements that are referenced by the preferences.xml file, as well as any resource bundle references defined in the maf-application.xml and maf-feature.xml files. Each string element has a name attribute that uniquely identifies the string and the string value.

Example C–5 The strings.xml File

```
<resources xmlns:android="http://schemas.android.com/apk/res/android"
           xmlns:adfmf="http://schemas.android.com/apk/res/oracle.myandroidapp">
...
  <string name="feature.PROD.bundle.FeatureName">Products</string>
  <string name="feature.oracle.hello.prefGroup.MyBooleanPreference___title">My
feature boolean pref</string>
...
</resources>
```

If the source of the string is not a reference to a resource bundle string, the naming convention for the name attribute is <PreferenceIdentifier>___ <androidAttributeName>.

Example C–6 Resource Bundle References Defined in the maf-feature.xml File

```
<adfmf:features xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
                xmlns:adfmf="http://xmlns.oracle.com/jdev/adfmf">
   <adfmf:loadBundle basename="mobile.ViewControllerBundle"
                     var="bundle"/>
   <adfmf:feature id="oracle.hello"
                  name="Hello"
                  icon="oracle.hello/navbar-icon.png"
                  image="oracle.hello/springboard-icon.png">
   <adfmf:feature id="PROD"
                  name="#{bundle.FeatureName}"
                  icon="openMore.png"
                  image="G.png"
                  credentials="none">
...
      <adfmf:preferences>
         <adfmf:preferenceGroup id="prefGroup">
            <adfmf:preferenceBoolean default="true"
                                     id="MyBooleanPreference"
                                     label="My feature boolean pref"/>
         </adfmf:preferenceGroup>
      </adfmf:preferences>
   </adfmf:feature>
```

C.3 Converting Preferences for iOS

The MAF deployment transforms the MAF preferences listed in Table C–3 to the preference list (`.plist`) file representation required by an iOS Settings application.

Table C–5 MAF Preferences and Their iOS Counterparts

MAF Preferences Component	iOS Representation
`<adfmf:preferencePage>`	`PSChildPaneSpecifier`
`<adfmf:preferenceGroup>`	`PSGroupSpecifier`
`<adfmf:preferenceBoolean>`	`PSToggleSwitchSpecifier`
`<adfmf:preferenceList>`	`PSMultiValueSpecifier`
`<adfmf:preferenceText>`	`PSTextFieldSpecifier`
`<adfmf:preferenceNumber>`	`PSTextFieldSpecifier`

For information on the iOS requirement for preference list (`.plist`) files, see *Preferences and Settings Programming Guide*, which is available through the iOS Developer Library (http://developer.apple.com/library/ios/navigation/).

Example C–7 XML Based on the maf-application.xml File

```
<adfmf:preferences>
   <adfmf:preferenceGroup id="gen"
                          label="Oracle Way Cool Mobile App">
      <adfmf:preferenceGroup id="SubPage01"
                             label="Child Page">
   </adfmf:preferenceGroup>
</adfmf:preferences>
```

D

MAF Application Usage

This appendix provides an introductory information on the MAF user experience.

This appendix includes the following sections:

D.1 Introduction to MAF Application Usage

After installing a MAF application (see Section D.2, "Installing the MAF Application on a Mobile Device"), the end user can start using it by selecting the application icon on their mobile device's home screen (see Figure D–1), which displays the splash screen while the application launches. After the completion of the launch, the end user can navigate between application features (see Section D.3, "Navigating Between Application Features"), set preferences (see Section D.4, "Setting Preferences"), and perform all other tasks.

Figure D–1 Application Icon on iPhone

D.2 Installing the MAF Application on a Mobile Device

The end user can download and install a MAF application through their regular application provisioning mechanism.

During installation, the application's Preferences are populated with default settings. For information on how to modify the defaults, see Section D.4, "Setting Preferences" and Section D.2.2, "How to Install MAF Applications on Android-Powered Devices".

Removing the MAF application from a mobile device is not different from uninstalling any other application (see Section D.2.3, "How to Uninstall a MAF Application").

D.2.1 How to Install MAF Applications on iOS-Powered Devices

Users of iOS-powered devices download and install MAF applications in one of the following ways:

- From an enterprise-specific distribution mechanism:
  - using iTunes;
  - deploying through iPhone Configuration Utility;
  - wirelessly, hosted on a web server.
- From Apple's App Store.

D.2.2 How to Install MAF Applications on Android-Powered Devices

In addition to installing MAF applications available through the application marketplace, the end user can download applications available outside of the application marketplace. It is recommended to search the web for information on how to do this.

D.2.3 How to Uninstall a MAF Application

A MAF application is removed from the mobile device just like any other application. During the uninstall process, all application data and all external preferences are removed along with the application.

D.3 Navigating Between Application Features

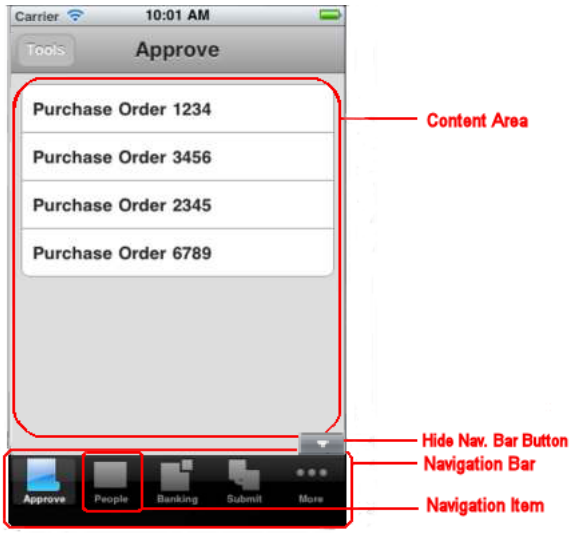
To provide access to each application feature, MAF applications allow for navigation between enabled application features using either a navigation bar or a springboard.

For information on configuring navigation during the application development, see Section 4.5, "Configuring the Springboard and Navigation Bar Behavior."

D.3.1 How to Navigate Between Application Features on iOS-Powered Devices

Figure D–2 shows elements of the MAF UI displayed on an iPhone.

Figure D–2 UI Elements on iPhone



The UI consists of a navigation bar populated with navigation items (icons). The first navigation item is highlighted to indicate that it is selected.

Note: If the springboard is defined for the application, a Home navigation button represented by an overlay is rendered above the navigation bar, but is not a part of it. This button allows the end user to return to the springboard from the application content:

If the springboard is not specified for the application, the Home icon is not displayed.

For more information, see Section 4.5, "Configuring the Springboard and Navigation Bar Behavior."

The navigation bar in the example that Figure D–2 shows contains six navigation items, and since not all of them can be displayed at the same time due to the space limitations on an iPhone, the fifth icon is represented by the **More** feature. When activated, the More feature expands the navigation bar into the mode that lists the remaining navigation items. On an iPad, all navigation items are displayed. The content area above the navigation bar provides the content specific to this particular solution, which is an approval tool for purchase orders and is bundled with the application.

Note: If at least one icon for an application feature is shown on the navigation bar, the end user is presented with Hide and Show buttons that allow to display the navigation bar when it is hidden, and hide when it is shown:

If the application XML file (`adfmf-application.xml`) only defines a single application feature, or if the constraints (or conditions) allow for only a single application feature to be displayed, then the navigation bar is hidden.

The Hide and Show buttons may not be presented to the end user and the navigation bar could be initially hidden if the adfmf-application.xml file does not reference any application features to be displayed on the navigation bar. In this case, if the springboard is defined, it will be the only navigation tool for the application.

For more information, see Section D.3.1.2, "Using Single-Featured Applications."

Figure D–3 shows the iPhone screen after the activation of the More icon and display of the remaining navigation items as a list. The end user can rearrange items within the More list.

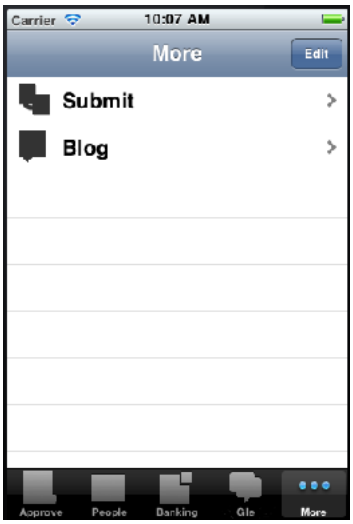
Figure D–3 Display of All Navigation Items on iPhone

To change which navigation items appear on the navigation bar at the application startup, the end user can select **Edit** to enter the **Configure** mode, as Figure D–4 shows.

Figure D–4 "Configure" Mode on iPhone

The Configure mode allows for dragging icons from the content area and dropping them onto the navigation bar. In this example, Submit navigation item was replaced with Gle navigation item on the navigation bar, and Submit is listed under More items, as Figure D–5 shows. To exit the configuration mode, the user selects **Done** to return to the More screen.

Figure D–5 Changing Navigation Bar Display on iPhone



If the end user selects the newly repositioned **Gle** navigation item in the navigation bar, Gle page is displayed in the **content area**, as Figure D–6 shows.

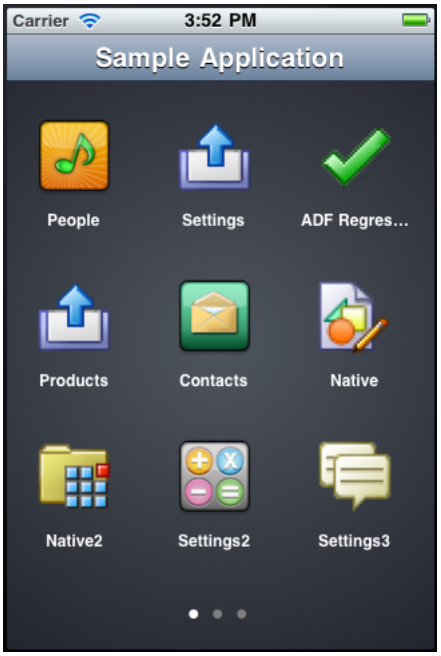
Figure D–6 Activation of Repositioned Navigation Item on iPhone

D.3.1.1 Navigating Using the Springboard

By default, the springboard navigation is disabled in MAF. It is enabled during development by configuring the `adfmf-application.xml` file (see Section 4.5, "Configuring the Springboard and Navigation Bar Behavior").

If a MAF application is enabled for navigation using the springboard, the end user is presented a display similar to the one shown in Figure D–7 when the application starts.

Figure D–7 Springboard Display



In the preceding illustration, the default springboard supplied by MAF is displayed on an iPhone in the default portrait layout (for information on how to create a custom springboard during development, see Section 4.5, "Configuring the Springboard and Navigation Bar Behavior"). There are three pages of the application content features

that are available to the end user, which is indicated by the three dots at the bottom of the screen. The end user is on page one of the three pages, which is denoted by the bright dot in the first position.

To open the second page of features (see Figure D–8), the end user swipes the iPhone screen from right to left, pushing the first page to the left and bringing the second page from the right. As the first page moves left, it fades out, and as the second page moves in, it fades in.

Figure D–8 Springboard - Second Page

In the preceding illustration, the end user is on page two of the three pages, which is denoted by the bright dot in the second position.

When the end user rotates the mobile device to landscape orientation, the springboard icons animate into positions that will better accommodate such change (see Figure D–9).

Figure D–9 Springboard Display in Landscape

Note that the page did not change when the display orientation changed, and the end user is still on page two.

To return to the first page of features while the display is in landscape orientation (see Figure D–10), the end user swipes the iPhone screen from left to right, pushing the second page to the right and bringing the first page from the left.

Figure D–10 Springboard in Landscape - First Page

To view a particular feature (such as Contacts) from page one, the end user touches the Contacts icon or its corresponding text.

On iOS-powered devices, the end user can return to the springboard from any application feature by performing a device shake gesture.

On Android-powered devices, the end user can use a menu item that lets them return to the springboard at any time.

D.3.1.2 Using Single-Featured Applications

Some applications may have only a single feature, and this feature is not configured to be displayed on a Springboard or navigation bar. In this case, only this single feature is presented to the end user; the special buttons that control the display of the navigation bar or return to the Springboard are not visible.

D.3.2 How to Navigate on Android-Powered Devices

The application feature navigation on Android-powered devices is almost identical to the navigation on iOS-powered devices (see Section D.3.1, "How to Navigate Between Application Features on iOS-Powered Devices"), with the exception of the More feature: on Android-powered devices, the More feature, when activated, triggers the display of a list of the remaining navigation items. The navigation bar does not change its appearance.

D.4 Setting Preferences

The end user can configure the application preferences in the manner already prescribed by the mobile platform.

For information on configuring preferences during the application development, see Chapter 14, "Enabling User Preferences."

D.4.1 How to Set Preferences on iOS-Powered Devices

The end user can open the Settings application on their iOS-powered device and select MAF application's Settings icon to access all the settings available for that application. The modified settings take effect upon exiting the Settings application. This is a typical behavior of all applications on iOS-powered devices.

Preferences are populated with default values at startup. These values are defined in the `adf-feature.xml` file. In addition to the standard ways of setting Preferences values, they can be defined as follows:

- By making selection from a list of values.
- As non-readable values (for entering passwords and such).
- As binary values.

Preferences are displayed on cascading pages. Modifiable preferences can be easily distinguished from the ones that cannot be modified.

Preferences can be used to globally set the user credentials (see Chapter 21, "Securing Mobile Applications").

D.4.2 How to Set Preferences on Android-Powered Devices

Setting Preferences on Android-powered devices does not differ from the same operation on iOS-powered devices (see Section D.4.1, "How to Set Preferences on iOS-Powered Devices"): the Preferences are accessed through the Preferences menu item.

Note: The Preferences menu item does not appear in the menu if there are no preferences defined for the application.

D.5 Viewing Log Files

For diagnostic and support purposes, the application log file for enabled application features is available for viewing on the device.

On an iOS-powered device, log files are located in `~/Library/Logs/CrashReporter/MobileDevice/<DEVICE_NAME>`. Note that the device must be synchronized prior to accessing log files.

For information on locating and viewing log output on Android-powered devices, see `http://developer.android.com/tools/help/logcat.html`.

For more information on logging, see Section 22.4, "Using and Configuring Logging".

D.6 Limitations to the Application Usage

There is a number of limitations to the usage of various modules of a typical MAF application.

D.6.1 List View Component Limitations

When using a MAF AMX List View component (see Section 6.3.15, "How to Use List View and List Item Components"), the end user should be aware of the following limitation:

- If a List View component is in edit mode, the end user is only allowed to reorder rows (represented by List Item components) and cannot select or highlight a row.

D.6.2 Data Visualization Components Limitations

The following are limitations of which the end user should be aware when using MAF AMX data visualization components (see Section 6.5, "Providing Data Visualization"):

- With the exception of the geographic map (see Section 6.5.18, "How to Create a Geographic Map Component"), MAF AMX data visualization components do not support interactivity on the Android 2.*n* platform.
- WAI-ARIA accessibility functionality is not supported on Android for data visualization components.

D.6.3 Device Back Button Limitations on Android Platform

On Android 4.*n*, the device back button returns the end user to the previously visited application feature. If the end user continues to activate the device back button until they reach the application feature they visited first at the start of the application, the application exists.

For information on how to configure navigation between views, see Section 6.3.5.7, "Enabling the Back Button Navigation."

D.6.4 Accessibility Support Limitations

The following are limitations of which the end user should be aware when accessibility is required (see Section 6.8, "Understanding MAF Support for Accessibility"):

- MAF AMX UI components might not perform as expected when the application is run in the Android screen reader mode.
- WAI-ARIA accessibility functionality is not supported on Android for DVT components.

E

Parsing XML

This appendix contains information about libraries that can be used to parse XML.

This appendix includes the following section:

- Section E.1, "Parsing XML Using kXML Library"

E.1 Parsing XML Using kXML Library

kXML, one of the core MAF libraries, provides API that you can use to parse XML. This library is exposed to the application through the JDK Profiler Interface (JVMPI).

For more information, consult kXML documentation at:

- `http://kxml.sourceforge.net/kxml2`
- `http://kxml.sourceforge.net/kxml2/javadoc`

F

Mobile Application Framework Sample Applications

This appendix describes the Mobile Application Framework sample applications.

This appendix includes the following section:

- Section F.1, "Overview of the MAF Sample Applications"

F.1 Overview of the MAF Sample Applications

Mobile Application Framework ships with a set of a sample applications that provide different development scenarios, such as creating the basic artifacts, accessing such device-native features as SMS and e-mail, or performing CRUD (Create, Read, Update, and Delete) operations on a local SQLite database. These applications are in the `PublicSamples.zip` file at the following location within the JDeveloper installation directory of your development computer:

`jdev_install``/jdeveloper/jdev/extensions/oracle.maf/Samples`

To view these applications, extract the `PublicSamples.zip` file to your JDeveloper working directory (typically, this is *`User Home Directory`*`/jdeveloper/mywork`).

Note: The sample applications that include a default springboard must be extracted to, and opened from, the `Samples` directory. To enable these applications to function properly, you must ensure that the springboard is added to the classpath by updating the `maf-application.xml` file as described in Section 4.5.1, "How to Configure Application Navigation."

To add the springboard to the classpath:

1. Open the application from the `Samples` directory.
2. In the Applications page of the overview editor for the `maf-application.xml` file, change the springboard option from **Default** to **None**.
3. Choose **Default** as the springboard option.
4. Click **Save All**.
5. Deploy the application.

These applications, which are described in Table F–1, are complete. Except where noted otherwise, these applications can be deployed to a simulator after you configure

the development environment as described in Chapter 2, "Setting Up the Development Environment."

> **Tip:** To get an idea of how to create a mobile application, review these applications in the order set forth in Table F–1.

Table F–1 MAF Sample Applications

Application Name	Description	Additional Resources Required to Run the Sample Application
HelloWorld	The "hello world" application for MAF, which demonstrates the basic structure of the framework. This basic application has a single application feature that is implemented with a local HTML file. Use this application to ascertain that the development environment is set up correctly to compile and deploy an application. See also Section 3.2.2, "What Happens When You Create a MAF Application."	
CompGallery	This application serves as an introduction to the MAF AMX UI components by demonstrating all of these components. Using this application, you can change the attributes of these components and see the effects of those changes in real time without recompiling and redeploying the application after each change. See generally Chapter 6, "Creating the MAF AMX User Interface."	
UIDemo	This application demonstrates the user interface layout and shows how to create the various list and button styles that are commonly used in mobile applications. It also demonstrates how to create the action sheet style of a popup component and how to use various chart and gauge components. See Section 6.3, "Creating and Using UI Components" and Section 6.5, "Providing Data Visualization."	This application must be opened from the `Samples` directory. The **Default** springboard option must be cleared in the Applications page of the `maf-application.xml` overview editor, then selected again.
FragmentDemo	This application shows how you can use fragments to define reusable artifacts that can used as templates. It demonstrates how you can have multiple content types for each feature, one for tablet, one for phone, and use the fragment so that you don't have to code the list/form each time.	
Navigation	This application demonstrates the various navigation techniques in MAF, including bounded task flows and routers. It also demonstrates the various page transitions. See also Section 5.2, "Creating Task Flows."	This application must be opened from the `Samples` directory. The **Default** springboard option must be cleared in the Applications page of the `maf-application.xml` overview editor, then selected again.
LifecycleEvents	This application implements lifecycle event handlers on the mobile application itself and its embedded application features. This application shows you where to insert code to enable the applications to perform their own logic at certain points in the lifecycle. See also Section 4.7, "About Lifecycle Event Listeners."	For iOS, the LifecycleEvents sample application logs data to the Console application, located at Applications-Utilities-Console application.

Table F–1 (Cont.) MAF Sample Applications

Application Name	Description	Additional Resources Required to Run the Sample Application
DeviceDemo	This application shows you how to use the DeviceFeatures Data Control to expose device features such as geolocation, e-mail, SMS, and contacts, as well as how to query the device for its properties. This feature demonstrates how to use `displayFile` method from DeviceFeatures data control to display various types files like .doc, .ppt, .xls, and .png. For more information, see Section 7.11, "Using the DeviceFeatures Data Control" and Section 7.11.9, "How to Use the displayFile Method to Enable Displaying Files."	You must also run this application on an actual device, because SMS and some of the device properties do not function on an iOS simulator or Android emulator.
GestureDemo	This application demonstrates how gestures can be implemented and used in MAF applications. See also Section 6.4, "Enabling Gestures."	
StockTracker	This sample demonstrates a simple example of how to build CRUD operations using a SQLite DB and a dean data control. It displays a list of stocks and allows you to Create, Update, Delete or Reorder the stocks. It uses a local SQLite database to store its data. The StockTracker application persists the data during CRUD operations. This sample also demonstrates how data change events use Java to enable data changes to be reflected in the user interface. It also has a variety of layout use cases, gestures, and basic mobile application layout patterns. This sample also demonstrates how to use CREATE and DELETE operations to add or delete items to and from a collection. For more details, look at the `addStock` and `deleteStock` methods in `Portfolio.java` class located in the Portfolio package. See also Section 7.13, "About Data Change Events."	
WorkBetter	This human resources application contains two features: People and Organizations. People: This feature includes a search component, which allows you to search for people. It also demonstrates the ability to create custom components as well as how to build reusable layouts as fragments and use them between different features. It demonstrates how to use various DVT visualization components to display performance, compensation, and timeline-related information. Organizations: Like the People feature, this feature demonstrates how to build reusable layouts as fragments and use them between different features. It also demonstrates how to create views for different form factors and configure them. This application is meant to be an end-to-end demo of the various UI techniques and components available. It shows a variety of layout patterns and demonstrates various uses for both common and more complex components. It is not meant to showcase a compete application but rather focus on the user interface. Please consult other samples for things like data-model or web services.	

Table F–1 (Cont.) MAF Sample Applications

Application Name	Description	Additional Resources Required to Run the Sample Application
SkinningDemo	This application demonstrates how to skin applications and add a unique look and feel by either overriding the supplied style sheets or extending them with their own style sheets. This application also shows how skins control the styling of MAF AMX UI components based on the type of device. It also demonstrates the ability to change skin families (out-of-the-box or custom) at runtime. See also Section 4.12, "Skinning Mobile Applications."	
PrefDemo	This application demonstrates application-wide and application feature-specific user setting pages. See generally Chapter 14, "Enabling User Preferences."	
Weather1	This application, which does not use Java code, demonstrates using declarative web services. The web services used by this application are SOAP web services, specifically a public web service provided by CDYNE Corporation (`http://www.cdyne.com/`), that provides weather forecasts by Zip code. Ensure that this service is available before running this application. See, generally, Chapter 8, "Using Web Services."	
Weather2	This application demonstrates using a programmatic invocation of web services and parsing the `GenericType` object returned into real Java objects. The user interface is then bound to the Java Beans instead of directly to the web service. For more information, see Section 8.6, "Invoking Web Services From Java."	
Weather3	Although this application is identical to the Weather2 sample application, it demonstrates the use of a non-blocking background thread to invoke the web service and how the user interface is updated when the service returns. This application demonstrates how it updates the user interface by flushing the data change events from the thread.	

Table F–1 (Cont.) MAF Sample Applications

Application Name	Description	Additional Resources Required to Run the Sample Application
RESTDemo	This application demonstrates using REST web services. Its two application features, REST-XML and REST-JSON use the same publicly available web service to retrieve the geo-coordinates of a given IP address or domain. The service can return either XML or JSON formats. The REST-XML application feature uses an XSD and creates a URL data control to access the structured data. The user interface binds to that data control. In the REST-JSON version, the URL connection is used directly by the `RESTServiceAdapter` helper class to invoke the web service and then the response is parsed using the `JSONSerializationHelper` class and populates a bean data control. The user interface is bound to this bean. For both of the application features, the web service call results in a form and a map. The latter is centered with a marker with the returned geo-coordinate. For more information, see Section 8.2.4, "How to Create a Web Service Data Control Using REST."	
APIDemo	This application demonstrates how to invoke custom JavaScript methods from within a MAF AMX page. Use this approach to invoke the Apache Cordova APIs that are not included in the DeviceFeatures data control. You can also use this approach to add custom JavaScript methods to an application and invoke them as well. This application also demonstrates calling back to Java from the JavaScript methods. For more information, see Section 4.9.1, "How to Define the Basic Information for an Application Feature" and Section B.2, "The MAF Container Utilities API."	
RangeChangeDemo	This sample demonstrates how to invoke a `rangeChangeListener` by invoking a Java handler method when the Load More Rows link within the List View component is activated or when the List View is scrolled to the end. It also demonstrates that `rangeChangeListener` is called every time new data is being fetched by the List View. It shows how you can use `RangeChangeEvent` to define whether or not more data is available to download on the client.	
BarcodeDemo	This application demonstrates how to make use of a Cordova plugin by calling the BarcodeScanner plugin from embedded JavaScript that is invoked from a backing bean. Android and iOS versions of the plugin were manually added to the application controller and view controller projects, then registered within the `maf-application.xml` file.	