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Oracle Application Server Adapter Concepts Guide, 10g Release 2 (10.1.2)

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Preface

This preface contains the following topics:

- [Audience](#)
- [Documentation Accessibility](#)
- [Related Documents](#)
- [Conventions](#)

Audience

Oracle Application Server Adapter Concepts Guide is intended for those users who want to learn about the concepts of the following adapters:

- Technology
- Packaged Application
- Legacy

Documentation Accessibility

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Conventions

This section describes the conventions used in the text and code examples of this documentation set. It describes:

- [Conventions in Text](#)
- [Conventions in Code Examples](#)
- [Conventions for Windows Operating Systems](#)

Conventions in Text

We use the following conventions in text to help you quickly identify special terms. The table also provides examples of their use.

Convention	Meaning	Example
Bold	Bold typeface indicates terms that are defined in the text or terms that appear in a glossary, or both.	When you specify this clause, you create an index-organized table .
<i>Italics</i>	Italic typeface indicates book titles or emphasis.	<i>Oracle Database 10g Concepts</i> Ensure that the recovery catalog and target database do <i>not</i> reside on the same disk.

Convention	Meaning	Example
UPPERCASE monospace (fixed-width) font	Uppercase monospace typeface indicates elements supplied by the system. Such elements include parameters, privileges, data types, Recovery Manager keywords, SQL keywords, SQL*Plus or utility commands, packages and methods, as well as system-supplied column names, database objects and structures, user names, and roles.	You can specify this clause only for a NUMBER column. You can back up the database by using the BACKUP command. Query the TABLE_NAME column in the USER_TABLES data dictionary view. Use the DBMS_STATS.GENERATE_STATS procedure.
lowercase monospace (fixed-width) font	Lowercase monospace typeface indicates executable programs, filenames, directory names, and sample user-supplied elements. <i>Note:</i> Some programmatic elements use a mixture of UPPERCASE and lowercase. Enter these elements as shown.	Enter sqlplus to start SQL*Plus. The password is specified in the orapwd file. Back up the datafiles and control files in the /disk1/oracle/dbs directory. The department_id, department_name, and location_id columns are in the hr.departments table. Connect as oe user. The JRepUtil class implements these methods.
lowercase italic monospace (fixed-width) font	Lowercase italic monospace font represents placeholders or variables.	You can specify the <i>parallel_clause</i> . Run <i>old_release.SQL</i> where <i>old_release</i> refers to the release you installed prior to upgrading.

Conventions in Code Examples

Code examples illustrate SQL, PL/SQL, SQL*Plus, or other command-line statements. They are displayed in a monospace (fixed-width) font and separated from normal text as shown in this example:

```
SELECT username FROM dba_users WHERE username = 'MIGRATE';
```

The following table describes typographic conventions used in code examples and provides examples of their use.

Convention	Meaning	Example
[]	Anything enclosed in brackets is optional.	DECIMAL (<i>digits</i> [, <i>precision</i>])
{ }	Braces are used for grouping items.	{ENABLE DISABLE}
	A vertical bar represents a choice of two options.	{ENABLE DISABLE} [COMPRESS NOCOMPRESS]
...	Ellipsis points mean repetition in syntax descriptions. In addition, ellipsis points can mean an omission in code examples or text.	CREATE TABLE ... AS <i>subquery</i> ; SELECT <i>col1</i> , <i>col2</i> , ... , <i>coln</i> FROM employees;
Other symbols	You must use symbols other than brackets ([]), braces ({ }), vertical bars (), and ellipsis points (...) exactly as shown.	acctbal NUMBER(11,2); acct CONSTANT NUMBER(4) := 3;
<i>Italics</i>	Italicized text indicates placeholders or variables for which you must supply particular values.	CONNECT SYSTEM/ <i>system_password</i> DB_NAME = <i>database_name</i>

Convention	Meaning	Example
UPPERCASE	Uppercase typeface indicates elements supplied by the system. We show these terms in uppercase in order to distinguish them from terms you define. Unless terms appear in brackets, enter them in the order and with the spelling shown. Because these terms are not case-sensitive, you can use them in either UPPERCASE or lowercase.	<pre>SELECT last_name, employee_id FROM employees; SELECT * FROM USER_TABLES; DROP TABLE hr.employees;</pre>
lowercase	<p>Lowercase typeface indicates user-defined programmatic elements, such as names of tables, columns, or files.</p> <p>Note: Some programmatic elements use a mixture of UPPERCASE and lowercase. Enter these elements as shown.</p>	<pre>SELECT last_name, employee_id FROM employees; sqlplus hr/hr CREATE USER mjones IDENTIFIED BY ty3MU9;</pre>

Conventions for Windows Operating Systems

The following table describes conventions for Windows operating systems and provides examples of their use.

Convention	Meaning	Example
Click Start , and then choose the <i>menu item</i>	How to start a program.	To start the Database Configuration Assistant, click Start , and choose Programs . From the Programs menu, choose Oracle - HOME_NAME and then click Configuration and Migration Tools . Choose Database Configuration Assistant .
File and directory names	File and directory names are not case-sensitive. The following special characters are not allowed: left angle bracket (<), right angle bracket (>), colon (:), double quotation marks ("), slash (/), pipe (), and dash (-). The special character backslash (\) is treated as an element separator, even when it appears in quotes. If the filename begins with \\, then Windows assumes it uses the Universal Naming Convention.	c:\winnt\\"system32 is the same as C:\WINNT\SYSTEM32
C:\>	Represents the Windows command prompt of the current hard disk drive. The escape character in a command prompt is the caret (^). Your prompt reflects the subdirectory in which you are working. Referred to as the <i>command prompt</i> in this manual.	C:\oracle\oradata>
Special characters	The backslash (\) special character is sometimes required as an escape character for the double quotation mark (") special character at the Windows command prompt. Parentheses and the single quotation mark (') do not require an escape character. Refer to your Windows operating system documentation for more information on escape and special characters.	C:\>exp HR/HR TABLES=employees QUERY=\"WHERE job_id='SA_REP' and salary<8000\"

Convention	Meaning	Example
<i>HOME_NAME</i>	Represents the Oracle home name. The home name can be up to 16 alphanumeric characters. The only special character allowed in the home name is the underscore.	C:\> net start Oracle <i>HOME_NAME</i> TNSListener
<i>ORACLE_HOME</i> and <i>ORACLE_BASE</i>	<p>In releases prior to Oracle8i release 8.1.3, when you installed Oracle components, all subdirectories were located under a top level <i>ORACLE_HOME</i> directory.</p> <p>This release complies with Optimal Flexible Architecture (OFA) guidelines. All subdirectories are not under a top level <i>ORACLE_HOME</i> directory. There is a top level directory called <i>ORACLE_BASE</i> that is C:\oracle\product\10.1.0 by default. If you install the latest Oracle release on a computer with no other Oracle software installed, then the default setting for the first Oracle home directory is C:\oracle\product\10.1.0\db_<i>n</i>, where <i>n</i> is the latest Oracle home number. The Oracle home directory is located directly under <i>ORACLE_BASE</i>.</p> <p>All directory path examples in this guide follow OFA conventions.</p> <p>Refer to <i>Oracle Database Installation Guide for Windows</i> for additional information about OFA compliances and for information about installing Oracle products in non-OFA compliant directories.</p>	Change to the <i>ORACLE_BASE\ORACLE_HOME\rdms\admin</i> directory.

Introduction

With the growing need for business process optimization, efficient integration with existing back-end applications has become the key to success. To optimize business processes, you can integrate applications by using Oracle Application Server adapters. Adapters support a robust, light-weight, highly scalable, and standard-based integration framework, which enables disparate applications to communicate with each other. For example, adapters enable you to integrate packaged applications, legacy applications, databases, and Web services. Using adapters, you can ensure interoperability by integrating applications that are heterogeneous, provided by different vendors, based on different technologies, and run on different platforms.

Note: Adapters support local transactions in this release and do not participate in global transactions. This document addresses the integration of adapters with OC4J, Business Process Execution Language for Web Services (BPEL) Process Manager, and OracleAS Integration InterConnect.

This chapter contains the following topics:

- [Features of Oracle Application Server Adapters](#)
- [Types of Oracle Application Server Adapters](#)
- [Types of Oracle Application Server Adapter Services](#)

1.1 Features of Oracle Application Server Adapters

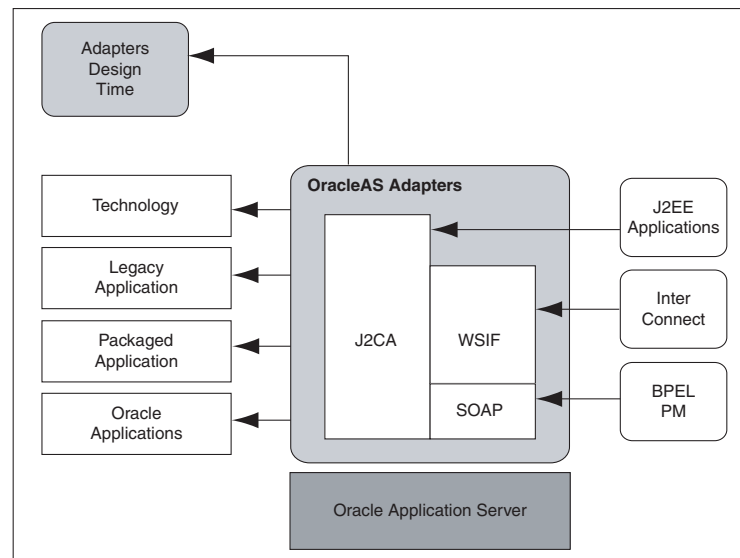
Oracle Application Server adapters provide the following benefits:

- Provide a connectivity platform for integrating complex business processes: Adapters integrate mainframe and legacy applications with enterprise resource planning (ERP), customer relationship management (CRM), databases, and messaging systems. Oracle provides more than 200 adapters to connect various packaged applications, such as SAP and Siebel, and databases. In addition, adapters integrate middleware messaging systems such as MQSeries and Oracle Advanced Queuing, and legacy applications, such as Tuxedo, to provide a complete solution.
- Support open standards: Adapters are based on a set of standards such as J2EE Connector Architecture (J2CA), Extensible Markup Language (XML), Web service Invocation Framework (WSIF), Web service Inspection Language (WSIL), and Web service Definition Language (WSDL). The support for standards reduces the learning curve of a user and eliminates the dependency of users on a single vendor.

- Implement a Service-Oriented Architecture (SOA): The support for open standards enables adapters to implement an SOA, which facilitates loose coupling, flexibility, and extensibility.
- Use native APIs: Adapters support multiple ways of interfacing with the back-end system and provide various deployment options. Using native APIs, adapters communicate with the back-end application and also translate the native data to standard XML, which is provided to the client.
- Model data: Adapters convert native APIs to standard XML and back based on the adapter metadata configured during design time. Adapter configurations are defined during design time that are used by run-time components.
- Facilitate real-time and bidirectional connectivity: Adapters offer bidirectional communication with various back-end systems. This includes sending requests to back-end systems and receiving a response. Adapters also support the real-time event notification service. This service notifies about the back-end events associated with successful back-end transactions for creating, deleting, and updating back-end data. This two-way connectivity ensures faster, flexible, efficient integration, and reduces the cost of integration.
- Maximize availability: Adapters are based on J2CA 1.5 specification and deployed in the Oracle Application Server Containers for J2EE (OC4J), which is the J2CA container of Oracle Application Server. Adapters can, therefore, fully leverage the scalability and high availability of the underlying Oracle Application Server platform. In addition, adapters can be deployed on the JBoss and Weblogic platform.
- Provide easy-to-use design-time tools: Adapters use design-time tools that provide a graphical user interface (GUI) to configure and administer adapters for fast implementation and deployment. In addition, the tools let you to browse, download, and configure back-end schemas.
- Support seamless integration with Oracle Application Server components: Adapters integrate with various Oracle Application Server components, such as Oracle Application Server Portal, and BPEL Process Manager, and J2EE applications, such as Enterprise Java Beans (EJBs), servlets, and Java applications.

1.2 Types of Oracle Application Server Adapters

There are three types of Oracle Application Server adapters: technology, packaged application, and legacy. [Figure 1-1](#) illustrates the different types of adapters.

Figure 1–1 Types of Oracle Application Server Adapters

This section describes the following types of adapters:

- [Technology Adapters](#)
- [Packaged-Application Adapters](#)
- [Legacy Adapters](#)

1.2.1 Technology Adapters

Technology adapters integrate Oracle Application Server with transport protocols, data stores, and messaging middleware. These adapters include OracleAS Adapter for FTP, OracleAS Adapter for JMS, OracleAS Adapter for Database, OracleAS Adapter for Advanced Queuing, and OracleAS Adapter for Files. Technology adapters are currently available with the BPEL Process Manager installation.

1.2.2 Packaged-Application Adapters

Packaged-application adapters integrate Oracle Application Server with various packaged applications, such as SAP and Siebel. These adapters include OracleAS Adapter for Oracle Applications, OracleAS Adapter for PeopleSoft, OracleAS Adapter for SAP R/3, OracleAS Adapter for Siebel, and OracleAS Adapter for J.D. Edwards. Packaged-application adapters are available as part of the OracleAS Adapters CD.

1.2.3 Legacy Adapters

Legacy adapters integrate Oracle Application Server with legacy and mainframe applications. These adapters include OracleAS Adapter for Tuxedo, OracleAS Adapter for CICS, OracleAS Adapter for VSAM, OracleAS Adapter for IMS/TM, and OracleAS Adapter for IMS/DB. Legacy adapters are available as part of the OracleAS Adapters CD.

1.3 Types of Oracle Application Server Adapter Services

Adapters provide the following types of services to facilitate communication between applications:

- [Request-Response \(Outbound Interaction\) Service](#)
- [Event Notification \(Inbound Interaction\) Service](#)
- [Metadata Service](#)

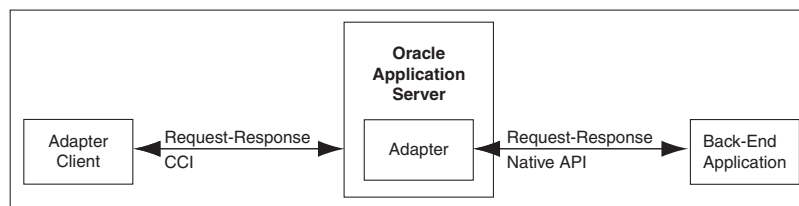
1.3.1 Request-Response (Outbound Interaction) Service

Adapters support the synchronous request-response service. The adapters receive requests from adapter clients, translate these requests into the native back-end data format, and call the appropriate method in the back-end application. In addition, the request-response service retrieves the back-end response to the Adapter Framework component after performing reverse translation. In J2CA terminology, this type of service is also known as outbound interaction.

The request-response service can be used to create, delete, update, and query back-end data as well as to call back-end workflows and transactions. For example, an OC4J application client can use OracleAS Adapter for SAP to create a customer within the SAP application.

Figure 1–2 illustrates the request-response service.

Figure 1–2 Request-Response Service



1.3.2 Event Notification (Inbound Interaction) Service

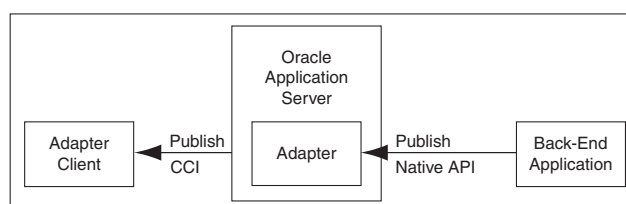
Adapters support the event-notification service, which is an asynchronous communication paradigm. In J2CA terminology, this type of service is also known as inbound interaction.

Adapters either listen or poll for back-end event changes. When listening for events, an adapter registers as a listener for the back-end application that is configured to push events to the adapter. The adapter can also poll the back-end application, which is usually a database or file, for the events required by the client application.

The event-notification service can be used to keep a track of back-end events associated with successful back-end transactions for creating, deleting, and updating back-end data.

Figure 1–3 illustrates the event-notification service.

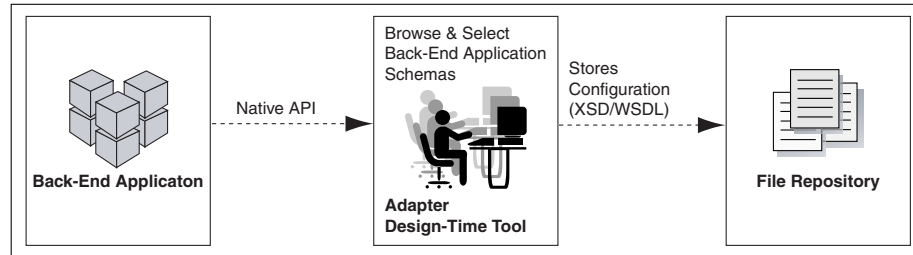
Figure 1–3 Event-Notification Service



1.3.3 Metadata Service

The adapter metadata definition stores information about the back-end connection and schemas for business objects and services. Adapters consist of a design-time component for browsing and storing metadata and a run-time component for running services. The adapter metadata definitions are generated as XML Schema Definition (XSD) and WSDL files. [Figure 1-4](#) illustrates the metadata interaction.

Figure 1-4 Metadata Service



Technology Adapters

Technology adapters integrate Oracle Application Server with transport protocols, data stores, and messaging middleware. These adapters include OracleAS Adapter for FTP, OracleAS Adapter for JMS, OracleAS Adapter for Databases, OracleAS Adapter for Advanced Queuing, and OracleAS Adapter for Files.

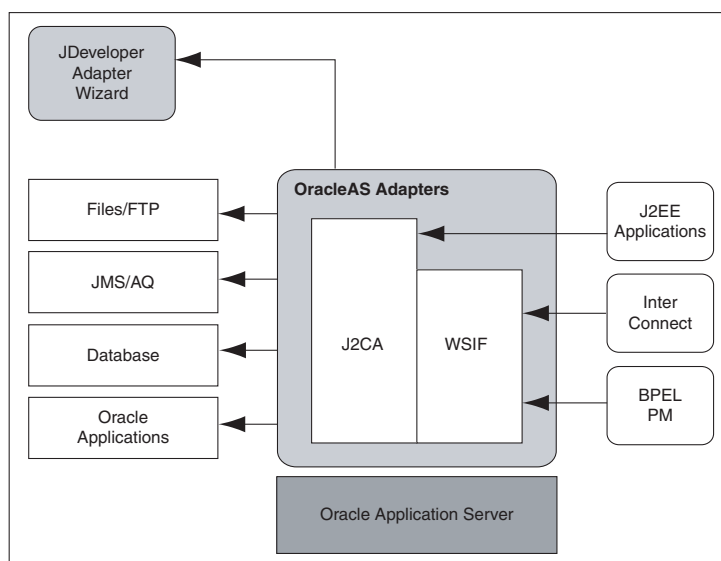
This chapter contains the following topics:

- [Architecture](#)
- [Design-Time Components](#)
- [Run-Time Components](#)
- [Deployment](#)

2.1 Architecture

Technology adapters are based on J2EE Connector Architecture (J2CA) 1.5 standards and deployed as a resource adapter in the same Oracle Application Server Containers for J2EE (OC4J) container as BPEL Process Manager. OracleAS Adapter for Oracle Applications consists of the same architecture as the technology adapters. [Figure 2-1](#) illustrates the architecture of technology adapters.

Figure 2-1 Technology Adapter Architecture



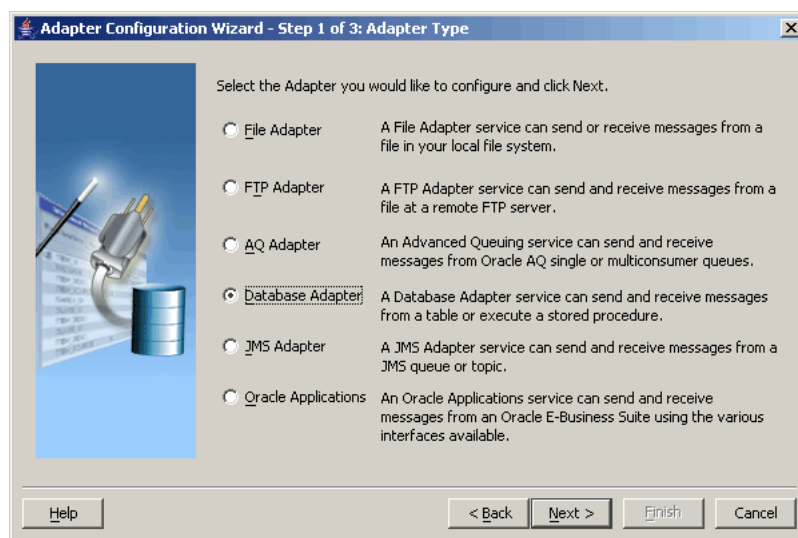
2.2 Design-Time Components

During design time, technology adapters use Oracle JDeveloper to generate the adapter metadata. The request-response service, also known as J2CA outbound interaction, and the event notification service, also known as J2CA inbound interaction, are described in J2CA WSIF WSDL files. These WSDL files consist of J2CA extension elements. The J2CA WSDL elements are used by the Adapter Framework to seamlessly integrate the J2CA 1.5 resource adapter with the BPEL Process Manager. For more information about integration of technology adapters with BPEL Process Manager, refer to [Section 5.2, "Adapter Integration with BPEL Process Manager"](#).

Example 2–1 Generating WSDL Files for OracleAS Adapter for Databases

Using JDeveloper, you can configure OracleAS Adapter for Databases. This adapter helps you perform data manipulation operations, call stored procedures or functions, and publish database events in real time. To configure adapter definitions, select **OracleAS Adapter for Databases**, as shown in [Figure 2–2](#).

Figure 2–2 Selecting the Database Adapter



[Figure 2–3](#) shows how to browse to select the required tables for the adapter.

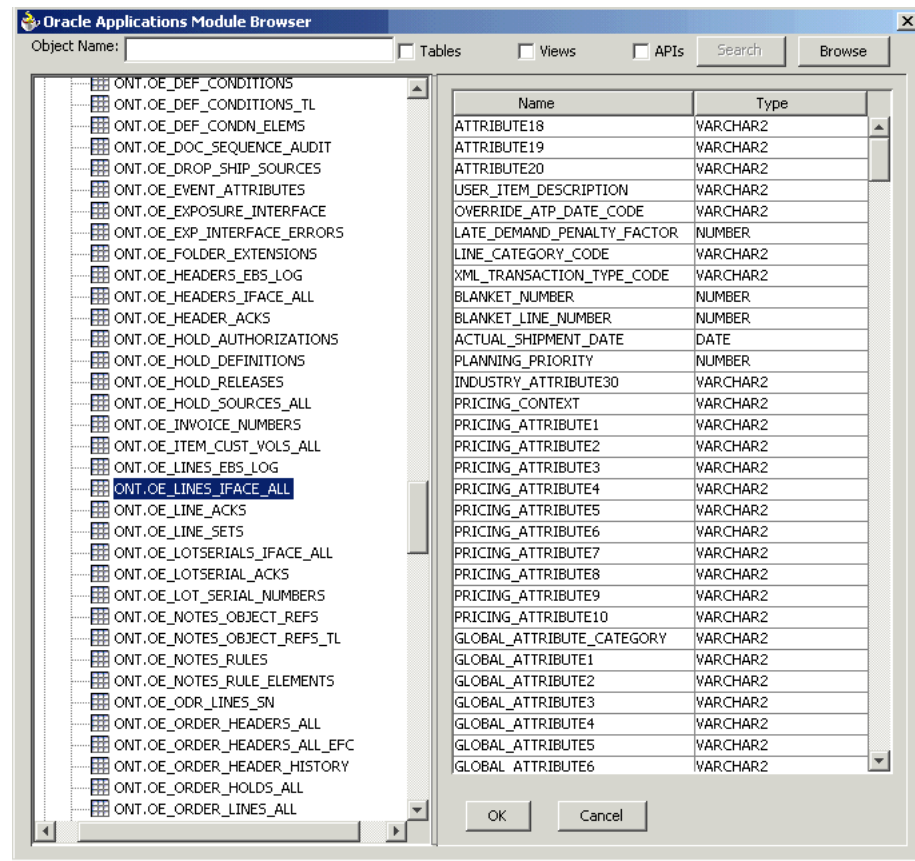
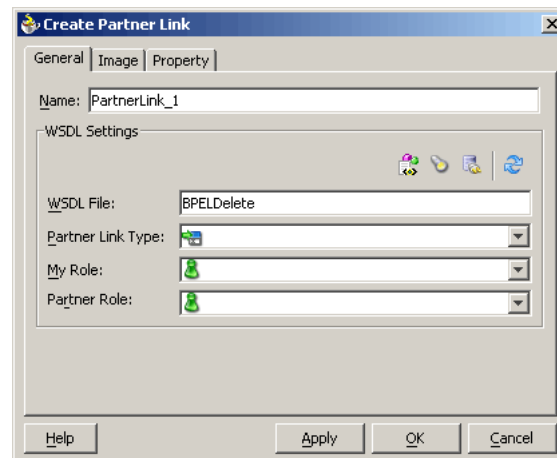
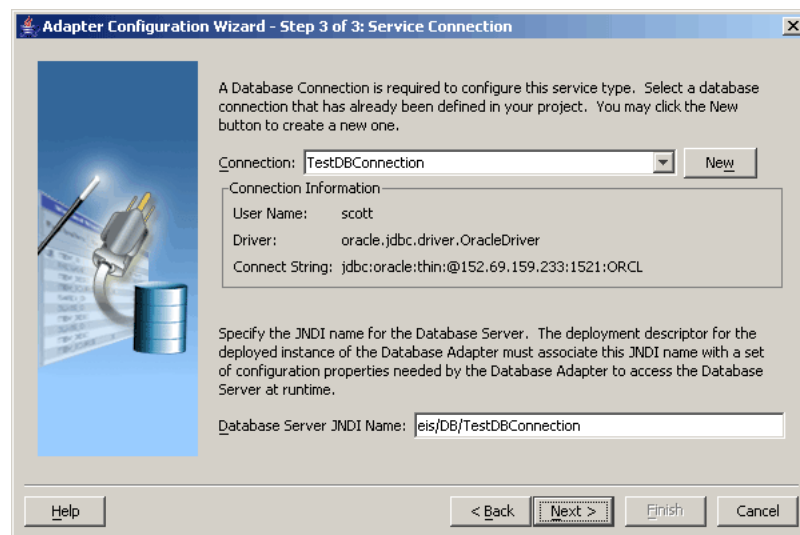
Figure 2–3 Browsing for Required Tables

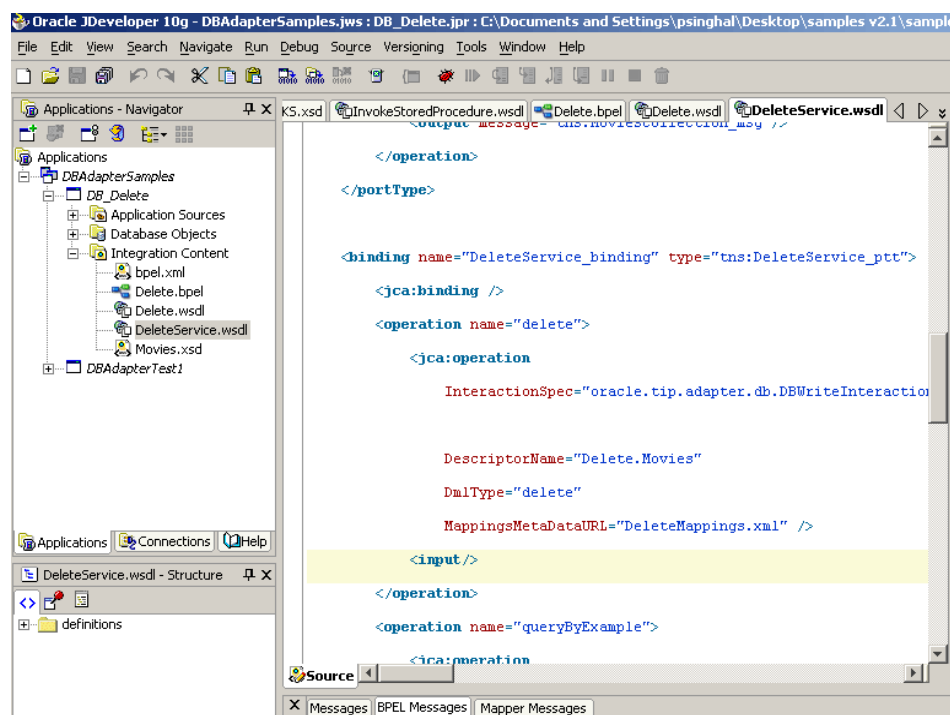
Figure 2–4 shows how to specify the WSDL settings for OracleAS Adapter for Databases.

Figure 2–4 Specifying WSDL Settings

Next, you need to establish a database connection, select an operation type and select the required tables. The run-time connection parameters are specified in the `oc4j-ra.xml` file and linked to a Java Naming and Directory Interface (JNDI) name, which is specified during design time. Figure 2–5 shows the creation of a new database connection.

Figure 2–5 Creating a New Database Connection

Finally, JDeveloper generates a WSDL file with the J2CA binding for the OracleAS Adapter for Databases, as shown in [Figure 2–4](#):

Figure 2–6 Structure of a WSDL File

Note: You can make technology adapters handle large XML payloads by including an additional setting in `bpel.xml`, under the activation agent as shown in the following example:

```
<activationAgents>
  <activationAgent ...>
    ...
    <property name="postAsString">true</property>
    ...
</activationAgents>
```

2.3 Run-Time Components

The run-time component of technology adapters is the J2CA 1.5 resource adapter for the specific back-end application. Technology adapters are deployed in OC4J, which is the J2CA container of Oracle Application Server. The BPEL Process Manager integrates with these J2CA 1.5 adapters through the Adapter Framework, which converts Web service messages into J2CA interactions and back.

BPEL Process Manager uses Adapter Framework to integrate the request-response service (J2CA outbound interaction) with a BPEL Invoke activity and publish the adapter events to a BPEL Receive activity. For more information about integration with the BPEL Process Manager, refer to [Section 5.2, "Adapter Integration with BPEL Process Manager"](#).

Note: Technology adapters can be integrated only with Business Process Execution Language for Web Services (BPEL) Process Manager.

2.4 Deployment

Technology adapters are deployed as J2CA 1.5 resource adapters within the same OC4J container as BPEL Process Manager during installation. Although, technology adapters are physically deployed as J2CA 1.5 resource adapters, their logical deployment involves creating the Connection Factory entries for the J2CA 1.5 resource adapter by editing the `oc4j-ra.xml` file and using JDeveloper during design time. Using JDeveloper, you specify the JNDI name, which acts as a placeholder for the connection used when your service is deployed to the BPEL Server. This enables you to use different databases for development and later production. However, for the logical deployment changes to take effect, the OC4J container process should be restarted.

Packaged-Application Adapters

Using packaged-application adapters, you can integrate Oracle Application Server with packaged applications such as J.D. Edwards and Siebel. These adapters include OracleAS Adapter for Peoplesoft, OracleAS Adapter for SAP R/3, OracleAS Adapter for Siebel, OracleAS Adapter for Oracle Applications, and OracleAS Adapter for J.D. Edwards.

This chapter describes the architecture of packaged-application adapters. It contains the following topics:

- [Architecture](#)
- [Design-Time Components](#)
- [Run-Time Components](#)
- [Deployment](#)

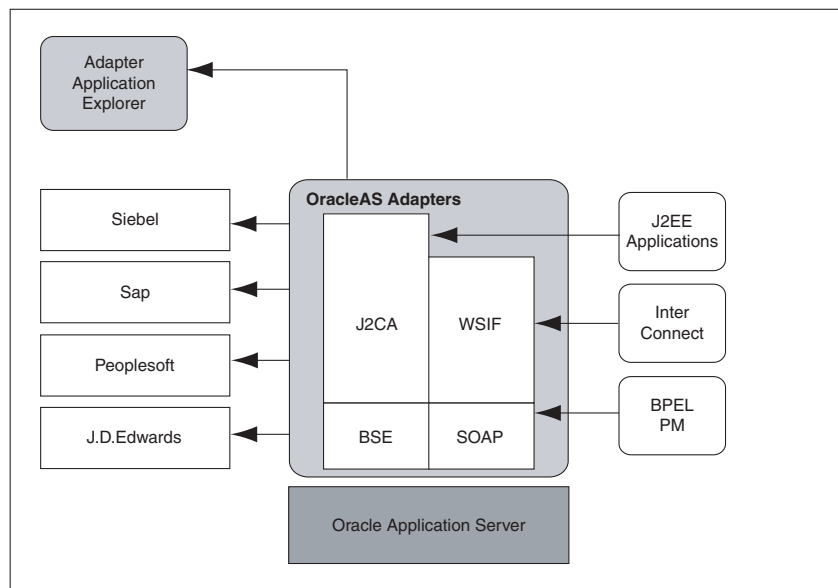
3.1 Architecture

Packaged-application adapters can be deployed as J2EE Connector Architecture (J2CA) 1.5 resource adapters or as Web service servlets within the Oracle Application Server Containers for J2EE (OC4J) container. In addition to a J2CA interface, packaged-application adapters support the Web Service Definition Language (WSDL) and Simple Object Access Protocol (SOAP) interface. J2CA and Web service deployments of packaged-application adapters should have a repository project. In J2CA deployment, the resource adapter points to a repository project that can contain multiple back-end connection objects. The deployment descriptor, `oc4j-ra.xml`, points to the J2CA repository project and the connection name to access within the J2CA repository project. In the WSDL deployment, the WSDL repository project consists of a set of WSDL files that describe the adapter metadata.

Note: Only four packaged-application adapters, including OracleAS Adapter for SAP, OracleAS Adapter for Siebel, OracleAS Adapter for Peoplesoft, and OracleAS Adapter for J.D. Edwards, support WSDL and SOAP extensions in this release. The architecture of the OracleAS Adapter for Oracle Applications is similar to technology adapters.

The architecture of packaged-application adapters consists of OracleAS Adapter Application Explorer (Application Explorer), J2CA 1.5 resource adapter, and Business Services Engine (BSE).

[Figure 3.1](#) illustrates the architecture of packaged-application adapters:

Figure 3–1 Packaged-Application Adapters Architecture

This section describes the following components of the packaged-application adapter architecture:

- [Application Explorer](#)
- [BSE](#)
- [J2CA 1.5 Resource Adapter](#)

3.1.1 Application Explorer

Application Explorer is a Java swing-based design-time tool for configuring packaged-application adapters. Using Application Explorer, you can configure the back-end application connection, browse the back-end application schemas, and expose these schemas as adapter services. Application Explorer is shipped with packaged application-specific plug-ins for browsing the back-end application-specific metadata.

You can use Application Explorer to create repository projects for either OracleAS Adapter J2CA or BSE. Each repository project can consist of multiple back-end application connections. The schemas are represented as either XML Schema Definition (XSD) for the OracleAS Adapter J2CA interface or as a WSDL with SOAP binding.

3.1.2 BSE

Application Explorer works in conjunction with the BSE, which is deployed in the Oracle Application Server Containers for J2EE (OC4J) container of the Oracle Application Server. BSE uses SOAP as a protocol for accepting requests from clients, interacting with the back-end application, and sending responses from the back-end application back to clients.

3.1.3 J2CA 1.5 Resource Adapter

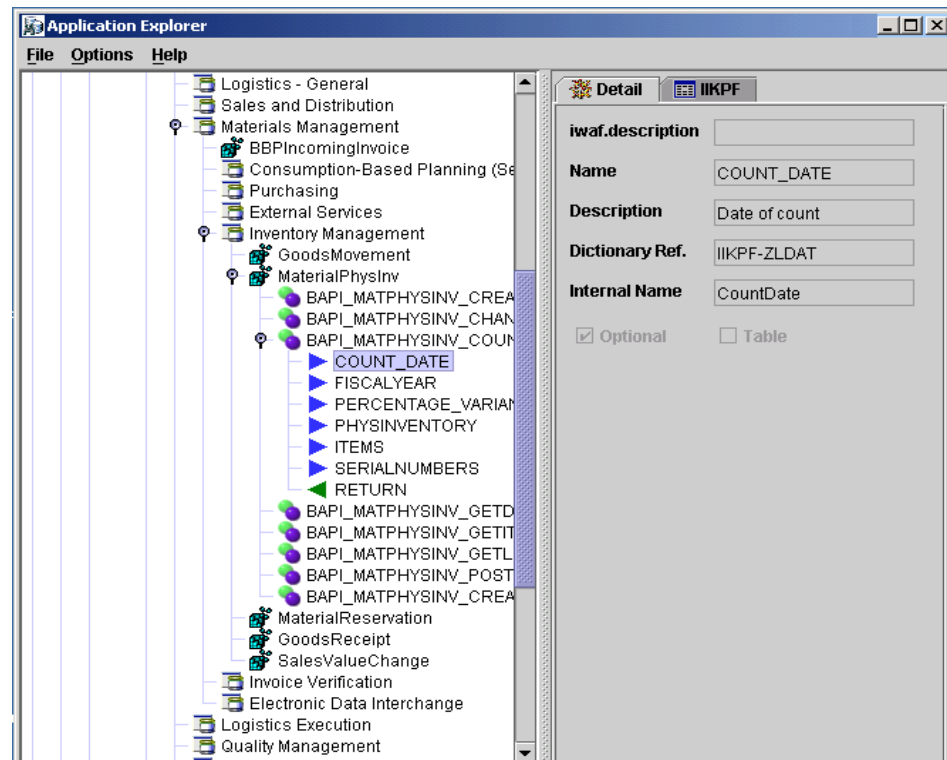
The J2CA 1.5 resource adapter consists of a Channel component for receiving back-end events.

3.2 Design-Time Components

Application Explorer is used to configure packaged-application adapters during design time. This tool is used to create a repository project for the J2CA 1.5 resource adapter, which contains a list of back-end connections. Application Explorer exposes back-end metadata as XSD and WSDL with J2CA extensions. The XSD metadata is used by OC4J application clients for integration through the J2CA Common Client Interface (CCI) Application Programming Interface (API). The WSDL with J2CA extension is used for integration with Business Process Execution Language for Web Services (BPEL) Process Manager. The BSE metadata can be defined as WSDL or SOAP.

Application Explorer is shown in [Figure 3–2](#).

Figure 3–2 Application Explorer



Example 3–1 Generating XML Request Schema for OracleAS Adapter for SAP

You can use Application Explorer to establish a connection for OracleAS Adapter for SAP. For this, you must first define a target to OracleAS Adapter for SAP, as shown in the following figures:

Figure 3–3 Selecting OracleAS Adapter for SAP

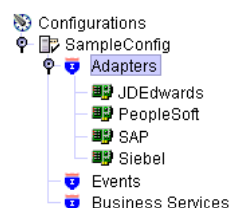
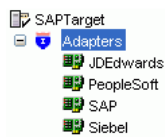


Figure 3–4 Defining a Target to OracleAS Adapter for SAP

After you explore the SAP business function library and select an object, you can use Application Explorer to create the XML request schema and the XML response schema for that function. To view the XML for each schema type, select the appropriate tab as shown in the following figure.

Figure 3–5 Viewing the XML Schema

3.3 Run-Time Components

The run-time components of packaged-application adapters include J2CA 1.5 resource adapter, BSE, and servlet. The OC4J application clients use the CCI API to directly interface with the J2CA 1.5 resource adapter. In this release, OC4J supports J2CA 1.0 specification only and the CCI API can be used for calling J2CA Outbound Interactions only. The J2CA 1.5 resource adapter integrates with BPEL Process Manager through the Adapter Framework. During run time, Adapter Framework translates the BPEL Process Manager service requests to J2CA calls and back based on the adapter metadata (WSDL or J2CA extension) configured during design time.

During run time, the WSDL files generated during design time are consumed by the integrating components. For example, the BPEL Process Manager uses Adapter Framework to integrate the request-response service (J2CA outbound interaction) with a BPEL invoke activity and to publish adapter events to a BPEL receive activity. For more information about integrating with BPEL PM, refer to [Section 5.2, "Adapter Integration with BPEL Process Manager"](#).

The OC4J application clients, such as servlet, EJB, and Java applications, use the CCI API to interface with the J2CA Adapter. For more information about integration with OC4J, refer to [Section 5.1, "Adapter Integration with OC4J"](#).

3.4 Deployment

Packaged-application adapters are deployed as J2CA 1.5 resource adapters within the OC4J J2CA container during installation. The adapter needs to be in the same OC4J container as BPEL Process Manager for integration.

You can integrate any Web service client with the BSE servlet. The BSE exposes the underlying back-end functionality as Web services, which can be either WSDL or SOAP. BPEL Process Manager can integrate with the BSE layer as well through WSDL and SOAP binding.

BSE is deployed as a servlet within the OC4J container during installation. BSE can be remotely located and need not be in the same container as the BPEL Process Manager.

Legacy Adapters

Using legacy adapters, you can integrate Oracle Application Server with legacy and mainframe applications. These adapters include OracleAS Adapter for Tuxedo, OracleAS Adapter for CICS, OracleAS Adapter for VSAM, OracleAS Adapter for IMS/TM, and OracleAS Adapter for IMS/DB.

This chapter contains the following topics:

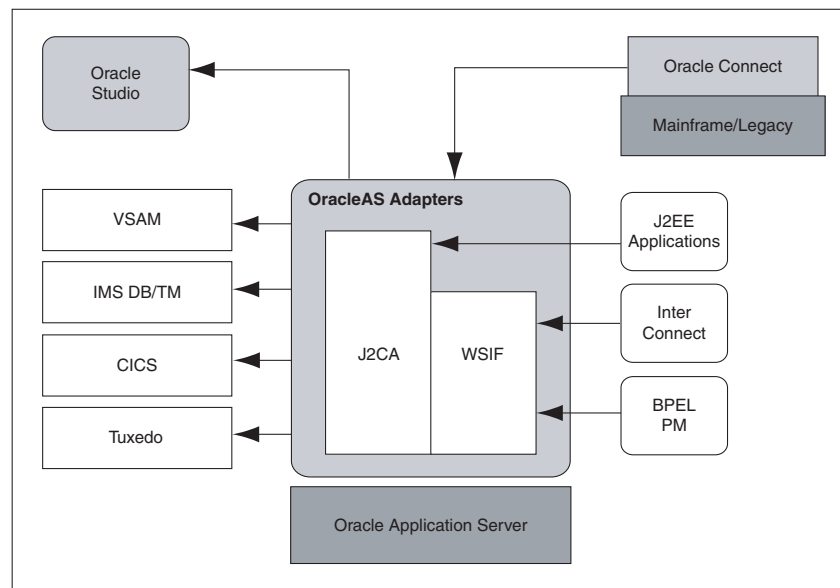
- [Architecture](#)
- [Design-Time Components](#)
- [Run-Time Components](#)
- [Deployment](#)

4.1 Architecture

Legacy adapters include the following components in the architecture:

- [Oracle Connect](#)
- [Oracle Studio](#)
- [J2CA Adapter](#)

[Figure 4-1](#) illustrates the architecture of legacy adapters.

Figure 4–1 Legacy Adapter Architecture

4.1.1 Oracle Connect

Oracle Connect is a component that resides on the legacy and mainframe platform. It consists of native adapters for communicating with the mainframe application and data stores. Oracle Connect consists of the following components:

- [Server Processes](#)
- [Native Adapters](#)
- [Daemon](#)
- [Repository](#)

Server Processes

Oracle Connect consists of multiple servers to process client requests.

Native Adapters

Oracle Connect consists of various embedded native adapters to communicate with Tuxedo and IMS-TM transaction systems and database drivers to communicate with various databases and file systems on mainframe systems such as VSAM and IMS-DB. The native adapters convert application structures, such as the legacy COBOL applications data, to and from XML. The XSD schema is used for precise mapping between mainframe data and standard XML data.

Daemon

Daemon is an RPC-based listener that manages and maintains multiple server configurations. It runs on every machine running Oracle Connect and handles user authentication and authorization, connection allocation, and server process management.

When a client requests for a connection, the daemon allocates a server process to handle this connection. The allocated server process may be a new process or any process that might have been already running. Further communication between the client session and the server process is direct and does not involve the daemon.

However, the daemon is notified when the connection ends and the server process is either killed or being used by another client.

The daemon supports multiple server configurations called workspaces. Each workspace defines accessible data sources, applications, environment settings, security requirements, and server allocation rules. The daemon authenticates clients, authorizes requests for a server process within a certain server workspace, and provides clients with the required servers. The allocation of servers by the daemon is based on the workspace that the client uses. Thus, a client can access a data source using one workspace, where a server process is allocated from an existing pool of servers, or the client can access a data source using a different workspace, where a new server process is allocated for each client request. A fail-safe mechanism enables the specification of alternate daemons, which function as a standby for high availability.

Repository

Oracle Connect supports a repository for storing the XML-based schema and configuration information. There is a single repository for each Oracle Connect instance. The repository stores the following information:

- Oracle Connect configuration settings (including the Daemon settings to control client server communication)
- User profiles to enable single sign-on to multiple back-end applications and data sources
- Adapter metadata for each adapter, which includes adapter Request-Response and event services

4.1.2 Oracle Studio

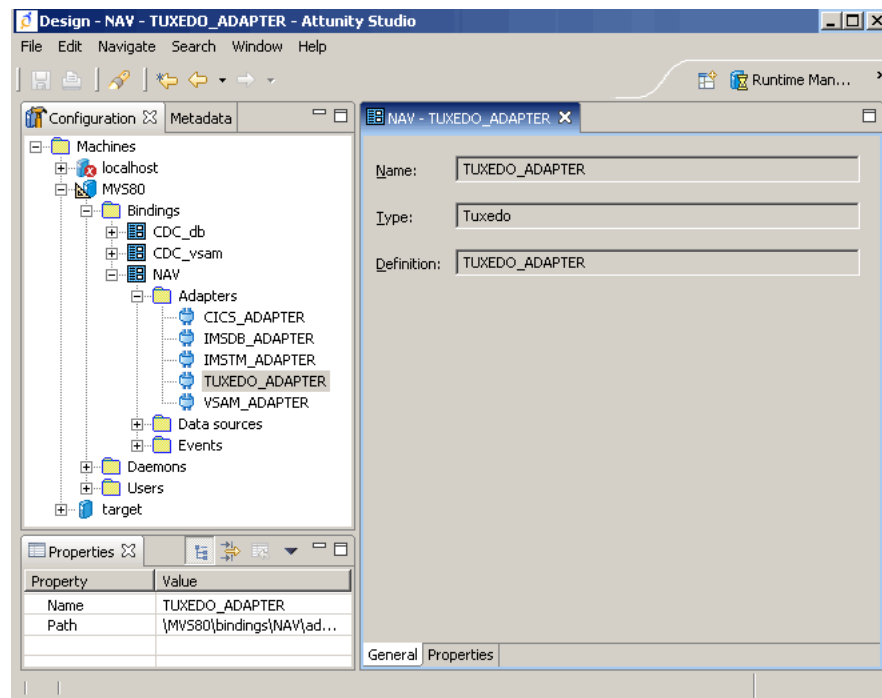
Oracle Studio is the design-time tool for configuring the Oracle AS Adapters for mainframes. It enables you to configure the services, events, and connection information for native adapters. The configuration information is stored in the Oracle Connect repository on the legacy or mainframe application. In addition, it enables you to do management and monitoring of Oracle Connect. The Oracle Studio is available only on the Windows platform. The Oracle Studio is based on the IBM Eclipse GUI framework.

4.1.3 J2CA Adapter

The J2EE Connector Architecture (J2CA) adapter forwards the OC4J application client requests to the Oracle Connect application. Oracle Connect communicates with the mainframe application and forwards the response back to the J2CA adapter. The response might contain the transaction data or might contain the exception data if the request generated an error. The Business Process Execution Language for Web Services (BPEL) Process Manager and Oracle Application Server components integrate with Oracle Connect through the J2CA adapter.

4.2 Design-Time Components

To configure legacy adapters during design time use Oracle Studio, as shown in the following figure.

Figure 4–2 Oracle Studio**Example 4–1 Configuring OracleAS Adapter for Tuxedo**

Using Oracle Studio, you can configure OracleAS adapter for Tuxedo, as shown in [Figure 4–3](#).

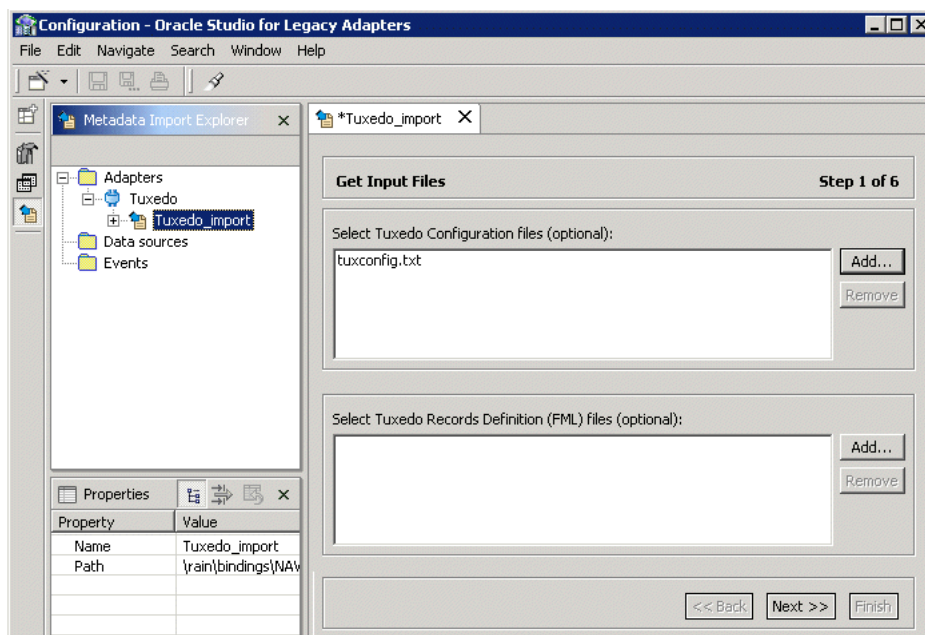
Figure 4–3 Configuring OracleAS Adapter for Tuxedo

Figure 4–4 *Selecting the Types of Interactions for OracleAS Adapter for Tuxedo*

[illegible]

4.3 Run-Time Components

During run time, WSDL files generated during design time are consumed by the integrating components. For example, BPEL Process Manager uses Adapter Framework to integrate the request-response service (J2CA outbound interaction) with a BPEL invoke activity and to publish the events to a BPEL receive activity. For more information, refer to [Section 5.2, "Adapter Integration with BPEL Process Manager"](#)

The OC4J application client, such as servlet and EJB, uses the Common Client Interface (CCI) API to communicate with the J2CA Adapter. For more information, refer to [Section 5.1, "Adapter Integration with OC4J"](#).

4.4 Deployment

Legacy adapters are deployed as J2CA resource adapters within the OC4J J2CA container during installation. The adapter must be in the same OC4J container as that of the BPEL Process Manager for integration.

Adapter Integration with Oracle Application Server Components

Oracle Application Server adapters can be integrated with various components such as Oracle Application Server Containers for J2EE (OC4J), Oracle Application Server InterConnect, and Business Process Execution Language for Web services (BPEL) Process Manager. This chapter discusses how to integrate adapters with OC4J, BPEL Process Manager, and OracleAS Integration InterConnect.

This chapter contains the following topics:

- [Adapter Integration with OC4J](#)
- [Adapter Integration with BPEL Process Manager](#)
- [Adapter Integration with OracleAS Integration InterConnect](#)

5.1 Adapter Integration with OC4J

Oracle Application Server adapters are deployed as J2EE Connector Architecture (J2CA) 1.0 resource adapters in an OC4J container. The resource adapter is used within the address space of the Oracle Application Server. This section provides an overview of OC4J and design-time and run time integration with an adapter. This section contains the following topics:

- [OC4J Overview](#)
- [OC4J Integration with Adapters](#)

5.1.1 OC4J Overview

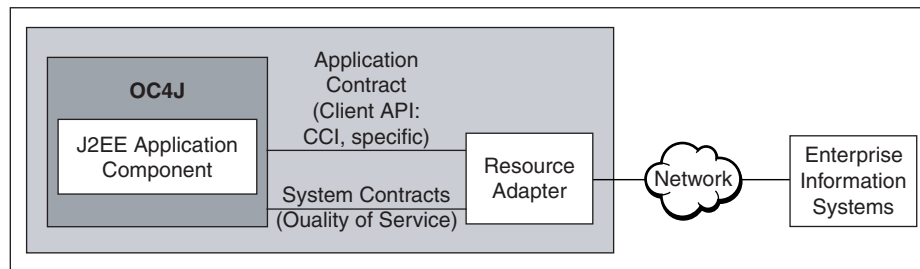
OC4J is the core J2EE run-time component of Oracle Application Server. OC4J is a J2EE 1.3 compliant container that runs on a standard JDK 1.4 Java Virtual Machine (JVM) and provides complete support for Java Server Page (JSP) files, servlets, enterprise java beans (EJBs), Web services, and all J2EE services. In addition, OC4J consists of a J2CA container for hosting J2CA resource adapters. J2CA defines standard Java interfaces for simplifying the integration of a J2EE server with various back-end applications.

All client applications run within the OC4J environment. To integrate an OC4J client application with a resource adapter, use the common client interface (CCI). The OC4J adapter clients include a servlet, EJB, or Java application client that implements the CCI Application Programming Interface (API). The CCI defines a standard client API for application components to access the back-end application.

On the other hand, the contract between the OC4J container and the resource adapter is defined by the service provider interface (SPI). Contracts define a standard between

OC4J and adapters. The system handles these contracts automatically and hides them from the application developer. The following figure illustrates the CCI and SPI contracts:

Figure 5–1 Contracts between OC4J and Resource Adapter



The OC4J architecture includes the following set of system-level contracts:

- **Connection management:** Enables application components to connect to a back-end application and leverage any connection pooling support of the OC4J container. This leads to a scalable and efficient environment that can support a large number of components requiring access to a back-end application.
- **Transaction management:** Enables an application server to use a transaction manager to manage transactions across multiple resource managers. Most of the adapters support only local transactions (single-phase commit) and not XA transactions (two phase commit).
- **Security management:** Provides authentication, authorization, and secure communication between the J2EE server and the back-end application. The OC4J supports both container-managed (the Oracle Application Server is responsible for sending security credentials to the back-end application) and component-managed sign-on (the J2CA adapter is responsible for forwarding the security credentials to the back-end application).

5.1.2 OC4J Integration with Adapters

Oracle Application Server adapters are J2CA 1.5 based and deployed within OC4J during installation. The OC4J component supports only the J2CA 1.0 specification in this release. The J2CA resource adapter is packaged into a Resource Adapter Archive (RAR) file using the Java Archive (JAR) format. An RAR file contains a correctly formatted deployment descriptor (`/META-INF/ra.xml`). In addition, it contains declarative information about the contract between the OC4J and resource adapter.

OC4J generates the corresponding `oc4j-ra.xml` file during the deployment of the J2CA adapter. The `oc4j-ra.xml` file is the deployment descriptor for a resource adapter. It contains deployment configurations for deploying resource adapters to OC4J, which includes the back-end application connection information as specified in the deployment descriptor of the resource adapter, Java Naming and Directory Interface (JNDI) name to be used, connection pooling parameters, and resource principal mapping mechanism and configurations.

Design Time

Use the adapter design-time tool to generate XML Schema Definition (XSD) files for the adapter request-response service. The OC4J clients use these XSD files during run time for calling the J2CA outbound interaction. Packaged-application adapters use OracleAS Adapter for Application Explorer (Application Explorer), Legacy adapters use OracleAS Studio, and technology adapters use JDeveloper.

Run Time

Oracle Application Server adapters are based on the J2CA 1.5 specification but are deployed as the J2CA 1.0 resource adapter within the OC4J container in this release. The J2CA 1.0 specification addresses the request-response service also known as outbound interaction and does not address the asynchronous publication of back-end events by the adapter. The J2CA 1.5 specification addresses the life-cycle management, message-inflow (for Adapter Event publish) and work management contracts.

5.2 Adapter Integration with BPEL Process Manager

Oracle Application Server adapters can be integrated with BPEL Process Manager. This section discusses the follows topics:

- [BPEL Process Manager Overview](#)
- [BPEL Process Manager Integration with Adapters](#)

5.2.1 BPEL Process Manager Overview

BPEL Process Manager is a comprehensive solution for creating, deploying, and managing BPEL business processes. BPEL Process Manager is based on the Service Oriented Architecture (SOA) to provide flexibility, interoperability, reusability, extensibility, and rapid implementation. BPEL Process Manager reduces the overall cost of management, modification, extension, and redeployment of existing business processes. Each business activity is a self-contained, self-describing, modular application with an interface that is defined by a WSDL file and the business process that is modeled as a Web service.

5.2.2 BPEL Process Manager Integration with Adapters

Adapter Framework is used for the bidirectional integration of the J2CA 1.5 resource adapters with BPEL Process Manager. Adapter Framework is based on standards and employs the Web service Invocation Framework (WSIF) technology for exposing the underlying J2CA interactions as Web services.

Design Time

While integrating adapters with BPEL Process Manager, the underlying adapter services are exposed as WSDL files with the J2CA extension. The following table lists the design time tools used for generating WSDL files for various types of adapters.

Adapter	Tool
Technology and OracleAS Adapter for Oracle Applications	JDeveloper
Packaged application	Application Explorer
Legacy	Oracle Studio

WSDL files are created for both Request-Response and Event Notification services of an adapter. The J2CA extension contains J2CA elements that are required by Adapter Framework during run time to convert Web service messages to J2CA Interactions and back. The J2CA WSDL extension elements contain the metadata for Adapter Framework to call any Request-Response service and activate any inbound J2CA 1.5 endpoint to receive inbound events. The J2CA extension elements for the request-response service contains the JNDI location and `InteractionSpec` details for calling an outbound interaction. The J2CA extension elements for the

event-notification service contains the resource adapter class name and `ActivationSpec` parameters for publishing an adapter event through the J2CA inbound interaction.

Figure 5–2 illustrates the design time tool, JDeveloper, used by technology adapters.

Figure 5–2 Design Time Configuration of Technology Adapters

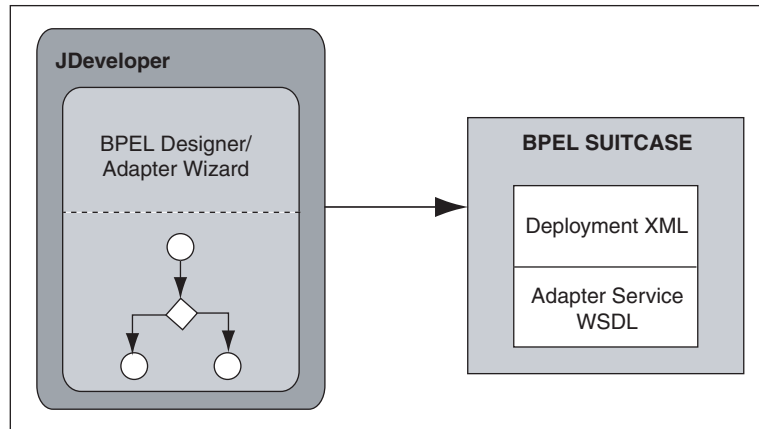
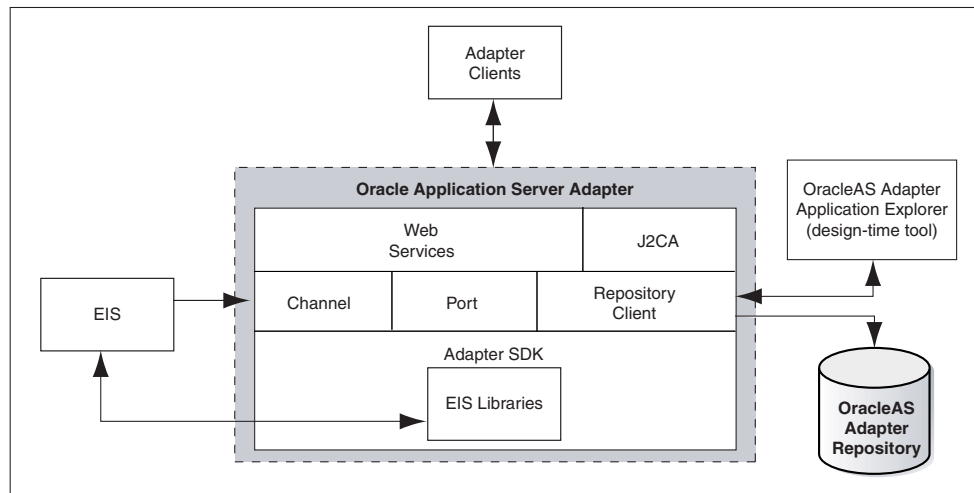


Figure 5–3 illustrates the design-time tool for configuring packaged-application and legacy adapters. In this figure, the design-time tools are used to expose adapter metadata as WSDL files. The WSDL files are consumed by BPEL Process Manager during run time.

Figure 5–3 Configuring Legacy and Packaged-Application Adapters



Run Time

Oracle Application Server adapters are based on J2CA 1.5 specification and deployed with the Oracle BPEL Process Manager in the same OC4J container. Adapter Framework acts as the glue layer that integrates the standard J2CA 1.5 resource adapter with the Oracle BPEL Process Manager during run time. Adapter Framework acts as a pseudo-J2CA 1.5 container, which enables implementation although the Oracle Application Server OC4J container supports only J2CA 1.0.

Adapter Framework consists of a WSIF J2CA Provider for wrapping the J2CA interactions as Web services. In addition, Adapter Framework translates Web service

messages to J2CA interaction message based on the WSDL files generated during design time.

The WSIF Provider converts the Web service invocation (from BPEL PM Invoke activity) to a J2CA outbound interaction call and performs the reverse conversion in the other direction. In other words, Web service invocation launched by the BPEL Invoke activity is converted to a J2CA CCI outbound interaction and the J2CA response is converted back to a Web service response. This end-to-end invocation is synchronous. The WSIF Provider also supports the one-way asynchronous J2CA outbound interaction invocation. The WSIF Provider element hides the J2CA implementation details from the BPEL Process Manager process and the Web service details from the J2CA 1.5 resource adapter.

BPEL Process Manager Integration with Outbound Interaction

BPEL Process Manager uses the WSIF technology to start the request-response service of the resource adapter. WSIF is used for calling Web services and separating the abstract part of the Web service definition from the physical binding (transport and protocol) to generate a Service-Oriented Architecture (SOA). The following list summarizes the process of BPEL Process Manager integration with the outbound interaction.

- During design time, adapter services are exposed as WSDL files and consumed during configuration of the `PartnerLink` activity of the BPEL process.
- The WSDL extensions specify the JNDI address of the resource adapter, `InteractionSpec` class name, `InteractionSpec` parameters.
- During run time, the `Invoke` activity of the BPEL Process Manager is used to call the `PartnerLink` activity, which is J2CA Resource Adapter outbound interaction.
- The WSIF J2CA provider receives the Web service request from BPEL Process Manager.
- The WSDL file associated with this Web service request contains the JNDI name of the J2CA `ConnectionFactory` class in the WSDL extension element.
- The WSIF provider performs the JNDI lookup and obtains a `Connection` instance.
- The WSIF provider creates an `InteractionSpec` Bean object from the WSDL extension element `jca:operation`.
- The WSIF provider starts the J2CA outbound interaction by passing the `InteractionSpec`, the `InputRecord`, and an empty `OutputRecord` parameter.
- The J2CA 1.5 resource adapter calls the back-end application and returns the back-end application response to the WSIF Provider.
- This XML record is translated to a Web service Response for consumption by the BPEL PM instance.
- The whole end-to-end scenario is synchronous and any J2CA exception is forwarded as a Web service fault message.

BPEL Process Manager Integration with Inbound Interaction

BPEL Process Manager receives events from the J2CA 1.5 resource adapter through Adapter Framework, which is the pseudo J2CA 1.5 container and implements the message-inflow contracts for receiving events from the adapter. The J2CA inbound interaction is captured in a WSDL file during design time. The J2CA Inbound WSDL binding section contains the J2CA 1.5 `ActivationSpec` parameter. The `ActivationSpec` parameter captures the inbound connectivity and inbound

interaction details (according to J2CA 1.5 specification). The J2CA Inbound WSDL Service section contains the J2CA 1.5 `ResourceAdapter` class name. In addition, the Service section can optionally contain a JNDI location. The following list summarizes the process of BPEL Process Manager integration with the inbound interaction:

- The `ResourceAdapter` class name and the `ActivationSpec` parameter are captured in the WSDL extension section of the J2CA inbound interaction WSDL during design time and made available to BPEL Process Manager and Adapter Framework during run time.
- An instance of the J2CA 1.5 `ResourceAdapter` class is created and the `Start` method of the J2CA `ResourceAdapter` class is called.
- Each inbound interaction operation referenced by the BPEL Process Manager processes results in invoking the `EndPointActivation` method of the J2CA 1.5 `ResourceAdapter` instance. Adapter Framework creates the `ActivationSpec` class (Java Bean) based on the `ActivationSpec` details present in the WSDL extension section of the J2CA inbound interaction and activates the endpoint of the J2CA 1.5 resource adapter.
- The `messageEndPoint` method consists of a `messageListener` component and the J2CA 1.5 resource adapter calls the `onMessage` method when it receives an back-end application event. A `MessageEndpoint` is a class that exposes the `onMessage` method, which creates `MessageEndpoint` through the `MessageEndpointFactory` provided to the resource adapter during `endpointActivation`.
- Adapter Framework receives the event through the `MessageListener` class and forwards it to the `Receive` activity of the BPEL Process Manager instance.
- All end points are deactivated and the `EndPointDeactivation` method is called.

BPEL WSIF JCA Connection Pool

In the case of J2CA adapters, particularly the JDBC based ones, such as DB adapters and AQ adapters there are two kinds of connection management at play: one for inbound (endpoint) activations (BPEL Receive) and one for outbound interactions (BPEL Invoke).

In the case of inbound activations, the J2CA adapter is fully in-charge of connection creation and recovery. The Adapter Framework (AF) can only be requested to lookup and provide a J2CA `ConnectionFactory` handle to the adapter through its `ActivationSpec`. This is possible only if it implements a certain interface, which it can use to create connections, thereby going through the Application Server connection manager. Whenever a managed (JDBC) connection goes bad, the adapter must close the J2CA connection handle (and subsequently the managed connection if `destroy()` is called by the Application Server), enter a temporary recovery loop and then try to re-establish a new connection.

In the case of outbound activations (WSIF for J2CA) each WSIF port caches tuples of the following:

- `ConnectionFactory`
- `ConnectionSpec`
- `Connection`
- `Interaction`
- `InteractionSpec`

As the BPEL engine typically invokes the WSIF port concurrently with any number of threads. The size of the cache will typically reflect the highest concurrency level at any given time. The cache can be tuned to auto-expire unused tuples after a configured idle period (interactions and connection handles are then closed). The main reason for this is that currently all outbound J2CA adapter interactions are scoped by LocalTransaction's only (we add XA support with 10.1.3), and hence two threads must each have their own exclusive Connection/LocalTransaction to work with. The cache also greatly improves performance in high load environments, for example, Retek (8 million transactions every hour).

If just one JCA adapter interaction using the cache throws a `ResourceException`, all members of the cache are closed and released immediately (purged) so new interactions will have to re-create (fresh) members to the cache. The BPEL engine has a feature known as *PartnerLink* retry which can be configured for each invoke. Thus, any JCA adapter invoke or interaction which throws a `ResourceException` marked as `Retryable`, will make the engine retry the Invoke (DB update) which will then repopulate the WSIF port cache (if the DB has become available again: typically immediately the case with RAC).

For non-transactional adapters (`adapterMetadata.supportsLocalTransactionDemarcation() == false`), such as File adapter, the J2CA connection cache only contains one member. Thus all threads coming through will multiplex over the same CCI Connection handle.

The JCA connection cache can be enabled or configured explicitly using the following `bpel.xml` partnerlink properties:

```
<property name="useJCAConnectionPool">true</property>
```

Normally this property is derived from the declared transactional support of the adapter. For example, the File adapter does not use this connection pool because it is multi-thread safe, but that can be overridden through the following property:

```
<property name="maxSizeJCAConnectionPool">500</property>
```

If the property mentioned in the preceding example is not specified, then it is assumed to be unbounded. This applies on a each of the WSIFPort (partnerlink) as shown in the following example:

```
<property name="lruConnectionMaxIdleAge">50000</property>
```

Maximum age of idle connections in the pool is important because some type of connections hold on to expensive external resources, for example DB shadow processes which is measured in ms as shown in the following example:

```
<property name="lruConnectionCheckInterval">10000</property>
```

5.3 Adapter Integration with OracleAS Integration InterConnect

Packaged-application adapters including OracleAS Adapter for PeopleSoft, OracleAS Adapter for SAP R/3, OracleAS Adapter for Siebel, and OracleAS Adapter for J.D. Edwards can be integrated with OracleAS Integration InterConnect. In addition to J2CA deployment, packaged-application adapters support web service servlet deployment, which is called Business Service Engine (BSE). This integration can be deployed within an enterprise or across enterprise boundaries through the Internet. OracleAS Integration InterConnect is designed as a hub and spoke system. In this system, spokes function as OracleAS Integration InterConnect adapters that access other applications and systems. The hub acts as a OracleAS Integration InterConnect

repository server, which is a standalone Java application. The OracleAS Integration InterConnect repository is a database that stores the design-time metadata definition.

Deployment and Integration through BSE

BSE integrates with OracleAS Integration InterConnect products and enables access to packaged applications. It helps businesses to integrate heterogeneous information systems faster, more cost effectively, and more uniformly by implementing standards that provide simple and consistent connections between these systems over the Internet. Business functions and data can be exposed as a Web Service, and tools on other platforms can use these services with minimal effort. The OracleAS Adapter Business Services Engine supports the following standards:

- A Simple Object Access Protocol (SOAP) request makes a Web Service perform a task.
- Web Services Definition Language (WSDL) describes all of the SOAP calls that can be used for a set of services.
- A Universal Description, Discovery, and Integration (UDDI) server acts as a directory of relevant Web Services and the WSDL that describes them.

No programming knowledge is necessary to generate these services, which reuse functionality from ERP or CRM systems, legacy applications, and diverse data sources.

BSE is deployed as a servlet within the OC4J container of the Oracle Application Server, and it depends on the OC4J container for scalability and high availability. The Swing-based design-time tool, Application Explorer, is used for browsing the EIS metadata that it passes to BSE. Adapter creates the WSDLs for the various adapter services and stores the WSDL schemas in an XML-based file repository or an Oracle Database repository. BSE must be running during both design time and at runtime.

Integration with OracleAS Integration InterConnect

The OracleAS Integration InterConnect EIS Adapter Plugin integrates the OracleAS Web Services adapter with OracleAS Integration InterConnect by translating XML payloads between XSD and DTD formats, respectively.

The OracleAS Integration InterConnect product supports four messaging paradigms: implemented procedures (request-response service), subscribe (one-way request service), publish (event service), and invoked procedure (OracleAS Integration InterConnect is the server in this case and EIS is the client making the request).

OracleAS Integration InterConnect EIS Adapter Plugin supports only the first three messaging paradigms. It uses SOAP for implemented procedure and subscription and RMI for the request-response and event notification services.

The following components are used in integrating with OracleAS Integration InterConnect:

- BSE, which is the OracleAS Adapter deployed as a Web Services servlet within OC4J
- OracleAS Integration InterConnect EIS Adapter Plugin to talk to the BSE
- OracleAS Integration InterConnect deployment
- Oracle iStudio
- Application Explorer

OracleAS Integration InterConnect at Design Time

During design time, Application Explorer configures BSE. In addition to the standard WSDL schemas, BSE generates DTD schemas and stores them locally in a file system specified by the user. The OracleAS Integration InterConnect iStudio tool includes a DTD browser plugin, and can be used to convert DTD schemas to the native OracleAS Integration InterConnect schema and store these in the OracleAS Integration InterConnect repository. More specifically, the following steps complete configuration for Request-Response and Event Notification scenarios during the design time.

Request-Response; Implemented Procedures and Subscribe

1. Configure the BSE for request-response service using Application Explorer. The WSDL schemas are stored in the OracleAS Adapter repository and the DTD schemas are saved to a local file system.
2. Use OracleAS Integration InterConnect iStudio DTD browser to consume the DTD schemas generated in the previous step and store the configuration information in the OracleAS Integration InterConnect repository.

Event Notification; Publish

1. Configure the BSE for event services, including the RMI port definition, using Application Explorer. The WSDL schemas are stored in the Oracle Adapter repository and the DTD schemas are saved to a local file system.
2. Use OracleAS Integration InterConnect iStudio DTD browser to consume the DTD schemas generated in the previous step and store the configuration information in the OracleAS Integration InterConnect repository.

OracleAS Integration InterConnect During Runtime

The OracleAS Integration InterConnect EIS Adapter Plugin loads the metadata from the OracleAS Integration InterConnect repository using its own API. The OracleAS Integration InterConnect EIS Adapter Plugin interfaces with the EIS application and translates the data between EIS native format and the Application View, a format recognized by OracleAS Integration InterConnect. This interaction is illustrated in Figure 6. More specifically, the following steps describe run-time behavior for Request-Response and Event Notification scenarios.

Request-Response; Implemented Procedures and Subscribe

The OracleAS Integration InterConnect hub sends the request to OracleAS Integration InterConnect EIS Adapter Plugin, which creates a SOAP client request and makes a call to the BSE. The adapter invokes the EIS and forwards the EIS response as a SOAP response back to the OracleAS Integration InterConnect EIS Adapter Plugin, which in its turn translates the SOAP response to appropriate OracleAS Integration InterConnect format and forwards it on to the OracleAS Integration InterConnect hub.

Event Notification; Publish

BSE receives an EIS event notification through the Channel component. It then forwards this event as an RMI request to the OracleAS Integration InterConnect EIS Adapter Plugin, which acts as an RMI server and consumes this event, translates it to the appropriate OracleAS Integration InterConnect format and forwards it to the OracleAS Integration InterConnect hub.

Deployment and Integration through J2CA

The OracleAS Adapter J2CA supports only synchronous outbound interactions, such as the request-response service, not event notification. At runtime, an EJB, a servlet or

a Java application client communicates with the OracleAS Adapter J2CA through the CCI API. The OracleAS Adapter J2CA is deployed within OC4J as a standard J2CA 1.0 Resource Adapter, and runs in managed mode within the OC4J container. Similar to the BSE, it is configured using Application Explorer. The OracleAS Adapter J2CA is in practice a J2CA wrapper around the adapter SDK.

An OracleAS Adapter J2CA is universal; its repository project can contain more than one EIS connection and it can talk to more than one EIS type. The repository project can be in a file or database repository; its `ra.xml` file contains the repository connection parameters and the repository project name. Multiple managed `ConnectionFactory` objects can be specified in the `oc4j-ra.xml` file generated by OC4J, each pointing to a different repository project and JNDI name. To connect to a particular EIS, the J2CA CCI `ConnectionSpec` class is used to specify the EIS type and the EIS connection name.

The basic outline for using CCI with the OracleAS Adapter J2CA consists of the following steps:

1. Find a `ConnectionFactory` object for the OracleAS Adapter J2CA.
2. Create a `ConnectionSpec` object that uses the EIS type and EIS connection name.
3. Create a `Connection` to the EIS using the `ConnectionFactory` and `ConnectionSpec` objects.
4. Create an `Interaction` object based on the request and response XSD schemas.
5. Call the `execute()` method on the `Interaction`.
6. After the required interactions have been processed, close the `Interaction` and `Connection` objects.

Adapter Life-Cycle Management

Oracle Application Server adapters are based on J2EE Connector Architecture (J2CA) 1.5 standards and deployed in the Oracle Application Server Containers for J2EE (OC4J). The life cycle of Oracle Application Server adapters depends on Business Process Execution Language for Web Services (BPEL) Process Manager. These adapters integrate with BPEL Process Manager through the Adapter Framework component.

This chapter contains the following sections:

- [Installing Oracle Application Server Adapters](#)
- [Starting and Stopping an Adapter](#)
- [Physically Deploying an Adapter](#)
- [Logically Deploying an Adapter](#)
- [Viewing Adapter Logs](#)
- [Using Adapter Headers](#)
- [Setting the Trace Level of an Adapter](#)
- [Adapter Deployment Validation Within JDeveloper](#)
- [Turning on the XML Validation](#)
- [Describing XML Data Structure](#)
- [Encrypting Passwords in oc4j-ra.xml](#)
- [Managing Errors](#)
- [Handling Connection Errors](#)
- [Handling Adapter Data Errors](#)
- [Describing Message Ordering](#)
- [Describing Message Rejection Handlers](#)
- [Describing How Adapters Ensure no Message Loss](#)
- [Load Balancing and BPEL Clustering Support Within Adapters](#)
- [Deploying Adapter Services](#)
- [Validating Adapter Deployment](#)
- [Batching and Debatching Support](#)
- [Migrating Repositories](#)

6.1 Installing Oracle Application Server Adapters

Technology adapters and OracleAS Adapter for Oracle Applications are available as part of the Oracle BPEL Process Manager install. In addition, these adapters support both standalone OC4J and middle tier deployments. Packaged-application adapters and Legacy adapters are available as part of the OracleAS Adapters CD. These adapters support middle tier deployment only.

6.2 Starting and Stopping an Adapter

Oracle Application Server adapters are deployed as J2CA 1.5 resource adapters. Therefore, to start or stop an adapter, every resource adapter must implement the `start (BootstrapContext)` and `stop` methods as part of the SPI interface. Oracle Application Server adapters are started when a BPEL process using them starts a J2CA Outbound Interaction. Adapters can also be started when the BPEL process is itself loaded for inbound interactions or when adapters publish events to the BPEL process.

After an adapter is started, the only way to stop the adapter is to shut down OC4J. In this release, Adapter Framework acts as a part of the J2CA 1.5 container.

6.3 Physically Deploying an Adapter

Oracle Application Server adapters are deployed as J2CA 1.5 resource adapters in an OC4J container. Adapters are packaged as Resource Adapter Archive (RAR) files using the Java Archive (JAR) format. The physical deployment of adapters involves using the RAR file and registering adapters as connectors with the underlying OC4J or the middle tier platform. The RAR file contains the `ra.xml` file, which is the deployment descriptor XML file containing deployment-specific information about the resource adapter. In addition, the RAR file contains declarative information about the contract between OC4J and resource adapter.

In addition to the `ra.xml` file in the `.rar` file, adapters package the `oc4j-ra.xml` template file. The `oc4j-ra.xml` file is used to define resource adapter `ConnectorFactory` objects (logical deployment). The `oc4j-ra.xml` file is the OC4J-specific deployment descriptor for a resource adapter. It contains deployment configurations for deploying resource adapters to OC4J, which includes the back-end application connection information as specified in the deployment descriptor of the resource adapter, Java Naming and Directory Interface (JNDI) name to be used, connection pooling parameters, resource principal mapping mechanism, and configurations.

Example 6–1 Standalone OC4J install

This example illustrates the physical deployment of technology and OracleAS Adapter for Oracle Applications as a part of the BPEL Process Manager standalone OC4J installation. For the standalone OC4J installation, use the following command to deploy the JCA 1.5 resource adapter: `$Oracle_`

```
Home\integration\orabpel\system\appserver\oc4j\j2ee\home\admin.jar  
ar ormi://localhost admin welcome -deployConnectorname -file rar  
filename Adaptername
```

For the standalone OC4J installation, use the following command to remove the JCA 1.5 resource adapter:

```
$Oracle_  
Home\integration\orabpel\system\appserver\oc4j\j2ee\home\admin.j
```

ar ormi://localhost admin welcome -undeployConnectorname
Adaptername

The Connectors folder also contains MANIFEST.MF, oc4j-ra.xml, and ra.xml files.

The following is a sample oc4j.xml file:

```
<config-property name="maxReadConnections" value="1"/>
<config-property name="usesExternalConnectionPooling" value="false"/>
<config-property name="dataSourceName" value=""/>
<config-property name="usesExternalTransactionController" value="false"/>
<config-property name="usesNativeSequencing" value="true"/>
<config-property name="sequencePreallocationSize" value="50"/>
<config-property name="tableQualifier" value=""/>
</connector-factory>

<!-- A connection used by the samples/tutorials to run out of the
     box using the olite repository.
     Also a template olite connection.
-->
<connector-factory location="eis/DB/BPELSamples" connector-name="Database Adapter">
  <config-property name="driverClassName" value="oracle.jdbc.pool.PooledConnectionDriver"/>
  <config-property name="platformClassName"
value="oracle.toplink.internal.databaseaccess.OraclePlatform"/>
  <config-property name="connectionString" value="jdbc:polite4@localhost:100:orabpel"/>
  <config-property name="userName" value="system"/>
  <config-property name="password" value="any"/>
  <config-property name="minConnections" value="1"/>
  <config-property name="maxConnections" value="5"/>
  <config-property name="minReadConnections" value="1"/>
  <config-property name="maxReadConnections" value="5"/>
  <config-property name="usesExternalConnectionPooling" value="false"/>
  <config-property name="dataSourceName" value=""/>
  <config-property name="usesExternalTransactionController" value="false"/>
  <config-property name="usesNativeSequencing" value="true"/>
  <config-property name="sequencePreallocationSize" value="50"/>
  <config-property name="tableQualifier" value=""/>
</connector-factory>
</oc4j-connector-factories>
```

Note: For the middle tier installation, run the dcmctl utility to remove the J2CA 1.5 resource adapter. Use the following command:

```
cd dcm/bin dcmctl deployApplication -f rar file -a
application_name -co container_name
```

6.4 Logically Deploying an Adapter

The logical deployment of adapters refers to the creation of ConnectionFactory objects in oc4j-ra.xml deployment descriptor file. To add the connection information and assign to a JNDI name, edit the corresponding OC4Jra.xml file of the resource adapter. In addition, you must manually locate and edit oc4-ra.xml for the required adapter. The oc4j.xml file contains run-time connection parameters for an adapter.

For example, to deploy OracleAS Adapter for Database logically, edit the oc4j.xml file at the following location: `$Oracle_Home\integration\bpelpm\orabpel\system\appserver\OC4J\j2ee\home\application-deployments\default\DbAdapter\oc4j-ra.xml`.

6.5 Viewing Adapter Logs

You can view the logs for Oracle Application Server adapters as follows:

- Technology adapters and OracleAS Adapter for Oracle Applications: These adapters implement the LogManager interface of Adapter Framework, which

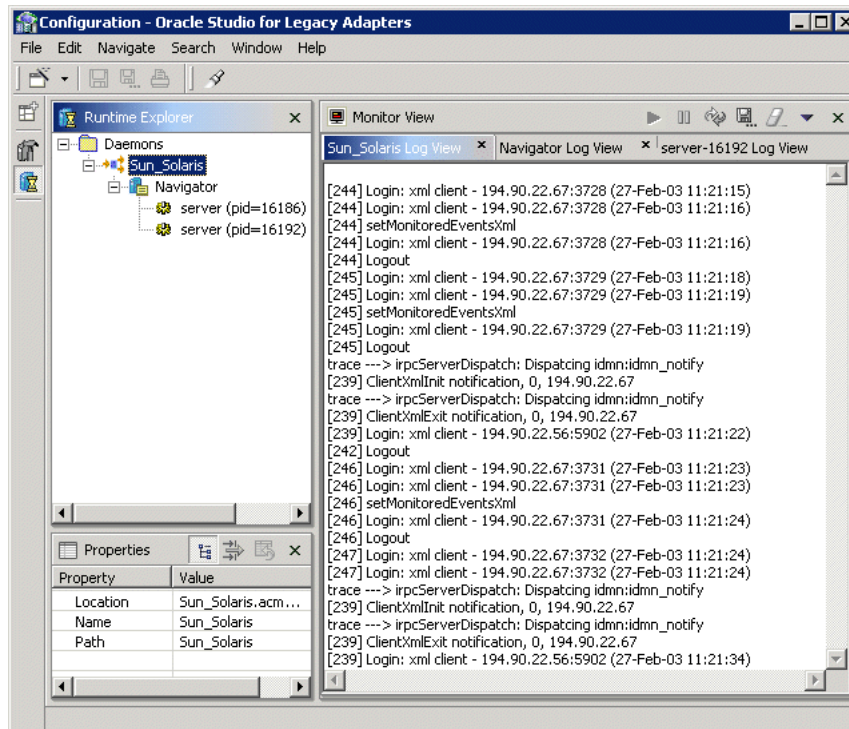
redirects the adapter logs to the BPEL domain logs. For both outbound and inbound interactions, the log files are redirected to BPEL domain logs.

The BPEL domain logs can be present at the following location:

```
$Oracle_
Home\integration\bpel\pm\orabpel\domains\default\logs\domain.1
og.
```

Note: You can also view adapter logs from BPEL Console.

- **Packaged-application:** These adapters do not implement the `LogManager` interface because it is not part of the J2CA 1.5 standard. Therefore, the log outputs of these adapters are redirected to the `opmn/logs` directory. For Outbound Interactions, the logs are directed to `opmn` logs. On the other hand, for Inbound Interactions, logs are redirected to the BPEL domain logs.
- **Legacy adapters:** In addition to the J2CA resource adapter, legacy adapters consists of Oracle Connect, which consists of native adapters for communicating with the mainframe application and data stores. Oracle Connect logs can be viewed using Oracle Studio, which is the mainframe adapter design-time tool and Oracle Connect management tool. Oracle Connect generates various types of logs, such as the daemon log, workspace log, and server process log. The following figure shows the daemon log monitor, which displays activity between clients and the daemon, including clients logging in and out from the daemon.



6.6 Using Adapter Headers

Adapters expose the underlying back-end operation specific properties as Header elements and allow the manipulation of these elements within a business process. For

example, the Header element for OracleAS Adapter for Advanced Queuing exposes Header properties, such as Correlation ID and Message ID, for correlating two Advanced Queuing messages within a business process.

6.7 Setting the Trace Level of an Adapter

Set the trace level for Oracle Application Server adapters as follows:

- Technology adapters and OracleAS Adapter for Oracle Applications: Using BPEL Console, set the trace level for technology adapters and OracleAS Adapter for Oracle Applications. After opening the BPEL Console, click **Manage BPEL Domain**, and then select the **Logging** tab. For outbound interaction, set the `default.collaxa.cube.ws` property. For inbound interaction, set the `default.collaxa.cube.activation` property.
- Packaged-application adapters: For outbound interactions, set the `Loglevel` property for packaged-application adapters in the `oc4j-ra.xml` file.
- Legacy adapters: The trace level for Oracle Connect, the mainframe server, can be set by using Oracle Studio.

6.8 Adapter Deployment Validation Within JDeveloper

During the deployment step (JDev or obant) the WSDL's containing J2CA bindings will be scrutinized by a J2CA WSDL Validation Service. The WSDL Validation Service will only select the WSDLs containing J2CA bindings.

The following validation steps occur:

- Integrity of WSDL (JCA) Bindings
- Validation of JNDI location if it is deployed through JDev, or `managedConnectionFactory/ConnectionSpec` (if provided in `jca:service`)
- Existence of `InteractionSpec` or `ActivationSpec` specified in `jca:operation`
- Validation of all property names and values bound to the `InteractionSpec` or `ActivationSpec` in `jca:operation`
- Validation of any XML Record converter specified in `jca:binding` or `pc:inbound_binding`
- Finally, if the `InteractionSpec` or `ActivationSpec` implements the `DeploymentValidation` interface, its `validate()` method will be invoked

6.9 Turning on the XML Validation

XML validation can be turned on for the BPEL server domain through BPEL Console or at the `PartnerLink` level. The inbound and outbound XML validation is turned on in the BPEL Process Manager.

6.10 Describing XML Data Structure

The Record implementation for Oracle Application Server adapters is `XMLRecord`. All adapter interactions are started with an `XMLRecord`. Each JCA record must be an implementation of `oracle.tip.adapter.api.record.XMLRecord`. Each instance of `XMLRecord` contains one or two instances of `RecordElements`: one mandatory `Payload RecordElement` and one optional `Header RecordElement`. `RecordElements`

contain data. In addition, each `RecordElement` contains one BLOB of data, which can either be an UTF-8-encoded XML string or a binary opaque byte stream.

`XMLRecord` consists of the following methods:

- `getHeaderRecordElement`: Retrieves the Header `RecordElement`.
- `getPayloadRecordElement`: Retrieves the Payload `RecordElement`.
- `setHeaderRecordElement`: Sets the header record element of the `XMLRecord`.
- `setPayloadRecordElement`: Sets the header record element of the `XMLRecord`.

6.11 Encrypting Passwords in oc4j-ra.xml

Use the `encrypt` command in the `orabpel\bin` directory (`encrypt.sh` or `encrypt.bat`) to encrypt passwords in the `oc4j-ra.xml` file.

6.12 Managing Errors

The Adapter and the underlying Adapter Framework (AF) library throw the following type of exceptions:

- `WSIFException`: The JCA artifacts for both the inbound and outbound interactions are captured in the WSDL that defines the Adapter Service. At run-time, the JCA WSIF Provider component of the AF parses the WSDL for JCA artifacts and creates `InteractionSpec` for outbound interaction. If the `InteractionSpec` class cannot be located in the class path, or if the instantiation fails, then the AF throws `WSIFException`.
- `ActivationException`: The BPEL Process throws `ActivationException` on failure of activation of the Adapter endpoint associated with JCA inbound interaction.
- `PCRetriableResourceException`: The Adapter throws `PCRetriableResourceException` for transient connection errors, which are recoverable errors in case of outbound interaction. The `PCRetriableResourceException` exception can be retried by defining a retry policy in `bpel.xml`.
- `ResourceException`: The `ResourceException` exception is thrown in all cases.

6.13 Handling Connection Errors

Technology and OracleAS Adapter for Oracle Applications adapters can handle connection errors for the following interactions:

- Outbound Interaction: technology adapters and OracleAS Adapter for Oracle Applications raise `oracle.tip.adapter.api.exception.PCRetriableResourceException` for transient connection errors, which are recoverable connection errors. For example, a database listener may not have started and this might be giving connection errors.

You can define the maximum number of reconnection attempts that can be made in the `bpel.xml` file. In this file, under the `PartnerLinkBinding` parameter, specify the parameters for reconnection attempts as shown in the following example:

```
<BPELSuitcase>
```



```

<BPELProcess ...>
  <partnerLinkBindings>
    <partnerLinkBinding name="myOutboundPartnerLink">
      <property name="wsdlLocation">Outbound.wsdl</property>
      <property name="retryInterval">10</property>
      <property name="retryMaxCount">30</property>
    </partnerLinkBinding>
  </partnerLinkBindings>
</BPELProcess>

```

In this example, the reconnection parameter settings specify the BPEL run time to make an attempt to reconnect every 10 seconds and allow the maximum number of 30 attempts to reconnect. After the maximum number of attempts, the `RemoteFault` exception is raised for the BPEL process. However, if you do not specify the maximum number of attempts, then reconnection cycle will continue indefinitely. It will stop reconnecting only if the BPEL Process Manager is stopped or the connection is established.

All other exceptions are cannot be recovered and result in throwing the `BindingFault` exception to the BPEL process.

Note: Packaged-application adapters, except OracleAS Adapter for Oracle Applications, and Legacy adapters return connection exception errors. For these adapters, you cannot specify reconnection parameters. Therefore, the adapter interactions are not functional after the first connection failure.

- Inbound interaction: Technology adapters, Oracle AS adapters, and legacy adapters support a poll model for connecting to the back-end application for receiving events. In case of unrecoverable connection failures, the adapters recycle old connections, and send out alerts or notifications to the BPEL process. In addition, the adapter shuts down the inbound endpoint and the associated BPEL process instance. The inbound interaction connection errors are written to a log, and can be viewed through the BPEL console.

6.14 Handling Adapter Data Errors

You can handle errors that might occur during the following interactions:

- Outbound interaction: The J2CA Adapter throws a `ResourceAdapter` exception for the Outbound Interaction case. The correction of data and replaying of the message has to be handled within the BPEL Process.
- Inbound interaction: Each J2CA adapter can have one or more Message Rejection handlers associated, as well as a fail over BPEL process in the case of a termination condition. In `bpel.xml`, you can configure how these messages should be handled as follows:
 - Write the error to a specific directory
 - Write the error to an Advanced Queue (AQ) queue
 - Send the error to an error handler BPEL process
 - Call a WSIF service

6.15 Describing Message Ordering

Message ordering can be achieved by making a BPEL process synchronous, as it implies that the resource adapter thread publishing a message to the BPEL engine will be used for executing the entire BPEL instance.

For asynchronous BPEL processes, a pool of BPEL engine worker threads will process received messages. Thus, it will prevent a message ordering guarantee, as the duration of one BPEL instance will almost always be different from that of others.

Generally, a JCA resource adapter wizard only creates a one way (asynchronous) WSDLs, that is, WSDLs where the operation has only an input message. It is necessary to manually modify the wizard generated WSDLs, that is, changing it so that it becomes a request-response (synchronous) type WSDL with input and output messages.

Consider the following example to create a XML schema type for a response (output) message that is generally not generated:

```
<types>
  <schema xmlns="http://www.w3.org/2001/XMLSchema"
    targetNamespace="http://acme.com/adapterService/">
    <import namespace="http://TargetNamespace.com/adapterService/type"
      schemaLocation="adapterTypes.xsd" />
    .
    .
    .
    <element name="empty">
      <complexType/>
    </element>
```

After creating an XML schema type, the next step is to define the WSDL message (in the adapter WSDL file) as shown in the following example:

```
<message name="ignoreMessage">
  <part name="empty" element="tns:empty"/>
</message>
```

The next step is to add an output message to the inbound WSDL operation as shown in the following example:

```
<portType name="Receive_ptt">
  <operation name="Receive">
    <input message="tns:payloadMessage"/>
    <output message="tns:ignoreMessage"/>
  </operation>
</portType>
```

Next, you need to add an output element in the binding section as shown in the following example:

```
<binding name="Receive_binding" type="tns:Receive_ptt">
  <pc:inbound_binding />
  <operation name="Receive">
    <jca:operation .../>
    <input/>
    <output/>
  </operation>
</binding>
```

The WSDL is OK.

Next, in the BPEL Process you should add a *reply* activity at the end of the business process logic as shown in the following example:

```
<variables>
  <variable name="ignore" messageType="ns1:ignoreMessage"/>
  .
  .
  .
</variables>
<sequence name="main">
  <receive partnerLink="ReceivePL" portType="ns1:Receive_ptt"
    operation="Receive"
    variable="Receive_1_Read_InputVariable"
    createInstance="yes"/>
    .
    .
    .
    <!-- processing -->
  <invoke partnerLink="DB_Insert" portType="ns1:DB_Insert_ptt"
    operation="InsertCust" inputVariable="NewCust"/>

  <reply partnerLink="ReceivePL" portType="ns1:Receive_ptt"
    operation="Receive" variable="ignore"/>
    .
    .
    .
    <!-- optionally more processing -->
</sequence>
```

If the resource adapter in the preceding example supports multi-threading inbound, it must be configured/tuned to only use one thread, because multiple threads will break the message ordering guarantee due to their stochastic durations.

6.16 Describing Message Rejection Handlers

You can configure the Message Rejection handler to do the following:

- Process translation errors
- Take corrective action
- Issue an alert or a notification message to the BPEL process

You should specify the Message Rejection handler in the `bpel.xml` file under the associated `PartnerLink` activity. In addition, you should define Message Rejection handlers as part of the Activation agent properties. The following are four types of Message Rejection handlers:

- File system based Message Rejection handler: The file system based Message Rejection handler writes the bad messages to the configured directory by using the following file name pattern:

```
INVALID_MSG_ + <process-name> + <operation-name> + <current-time>
```

The syntax for specifying a file system based Rejection handler is as follows:

```
<property name="rejectedMessageHandlers">
  file://<directory-path>
</property>
```

An example for specifying file based Rejection handler is as follows:

```
<property name="rejectedMessageHandlers">
```

```
file://C:/orabpel/domains/default/rejectedMessages
</property>
```

- RAW Oracle Advanced Queue based Message Rejection handler: The RAW Oracle Advanced Queue based Message Rejection handler allows the user to designate a Oracle RDBMS RAW AQ queue as the rejection storage.

An example for specifying RAW Oracle Advanced Queue based Message Rejection handler is as follows:

```
<property name="rejectedMessageHandlers">
queue://jdbc:oracle:thin:@<db-host>:<tns-port>:<sid>|<user>/<password>|<queue-name>
</property>
```

Ensure that you type : and | in the exactly the same location in the code as shown in this example.

- BPEL Process Message Rejection Handler: The BPEL Process Message Rejection handler sends the bad message to the designated error handling BPEL process.

The syntax for specifying a BPEL Process Message Rejection Handler is as follows:

```
<property name="rejectedMessageHandlers">
bpel://<bpel-domain[:<password>]>|<process-name>|<operation-name>|<input-message-partname>
</property>
```

Note: [:<password>] in the preceeding syntax can be encrypted by using the `encrypt.bat/encrypt.sh` utility.

You can thus define a process with a receive operation of your choice by choosing (WSDL and BPEL source wise) - the only constraint is on the *WSDL Message Type* of the message that will be sent to this rejection handler. It must be declared to have the type `RejectedMessage`. You can do this by importing the `xml1lib` resident WSDL `RejectionMessage.wsdl`, which defines such a message as shown in the following example:

```
<message name="RejectionMessage">
  <part name="message" element="err:RejectedMessage" />
</message>
```

You can import an `xml1lib` WSDL from another WSDL by using the URL shown in the following example:

```
<import namespace="http://xmlns.oracle.com/pcbpel/rejectionHandler"
location="http://localhost:9700/orabpel/xml1lib/jca/RejectionMessage.wsdl" />
```

The BPEL process would only contain the import as shown in this example. The port type would reference the following:

```
<definitions ...
xmlns:rej="http://xmlns.oracle.com/pcbpel/rejectionHandler"
  <portType name="MyRejectionHandlerPortType">
    <operation name="myHandleRejectionOperation">
      <input message="rej:RejectionMessage" />
    </operation>
  </portType>
```

- **WSIF Based Rejection Handler:** In WSIF based Message Rejection handler, you can configure any type of WSIF WSDL, such as JCA, EJB, JMS, HTTP, and Java. You can configure any kind of service that can be reached through WSIF as the bad message handler.

The syntax for specifying a WSIF based Message Rejection handler is as follows:

```
<property name="rejectedMessageHandlers">
    wsif://<wsif-wsdl-location>|<operation-name>|<input-message-part-name>
</property>
```

You can specify a WSIF based Message Rejection handler as shown in the following example:

```
<property name="rejectedMessageHandlers">
wsif://file:/C:/orabpel/samples/test/ErrorTest/FileAdapterWrite.wsdl|write|message
</property>
```

The WSIF based Message Rejection handler has the same constraint on message type as that of BPEL Process Rejection Handler. Refer to the BPEL Process Rejection Handler section.

6.17 Describing How Adapters Ensure no Message Loss

This section describes how Adapters ensure no message loss, and how you can recover recover messages stuck in the BPEL dehydration store.

The BPEL engine is constructed to always ensure delivery. Dehydration points are established before each *receive*, *pick*, *wait* and after each *reply* and *invoke*. By default dehydration after an invoke is deferred but you have control of that through tuning process parameters (see the idempotent setting option in the BPEL Tuning Guide).

The JCA Resource Adapters extend the reach of the BPEL engine and in a specific way contribute to making sure that the delivery guarantee is upheld.

Transactional adapters allow the EIS to participate in one-phase or two-phase commits (local transactions or global/distributed transactions). These commits are controlled either by the adapter (inbound) or by the BPEL engine (outbound). Non-transactional adapters implement their own schemes to ensure delivery, without the use of transactional semantics.

6.17.1 Local transaction and Global (XA) transactions

In BPEL PM 10.1.2 all adapters only support local (one-phase commit) transactions. Adapters cannot leverage global transactions (JCA XA) inbound because there is no JCA 1.5 (transaction inflow) support in OracleAS 10.1.2. OracleAS 10.1.2 only supports JCA 1.0. The BPEL PM 10.1.2 implementation only simulates the basic inbound JCA 1.5 contracts, without including XA, which requires it to be intrinsically integrated with the internal of OC4J. However, this limited JCA 1.5 support allows BPEL PM to leverage most JCA 1.5 resource adapters today, for example, resource adapters from iWay with OC4J 10.1.2.

6.17.2 Inbound Transactions

For an asynchronous BPEL process, a transactional adapter will not commit its inbound local transaction before it receives a communication from the BPEL engine, at which point the message has been safely dehydrated, that is, the message persisted in the BPEL dehydration storage.

The inbound message is queued into the dehydration store through the *Delivery Service* in the BPEL engine. The inbound message remains in the store until the next dehydration point occurs, for example, until the first *invoke*. At that point the message from the *receive* activity is removed from the Delivery Service. Any activities between these checkpoints are treated as a Java transaction API (JTA). If the BPEL server fails between the two dehydration points, the entire transaction is rolled back so that state is assured. Your last message would be replayed by the next available BPEL server. All this happens under the covers.

For a synchronous process, a transactional adapter will perform commit right after the first BPEL *reply* activity, which is, typically placed at the end of a process flow.

6.17.3 Outbound Transactions

Outbound JCA resource adapter interactions (the *invoke* activities) are each scoped by a local transaction. If the interaction (JCA execute) is successful, the local transaction is committed. If the interaction fails, the adapter will raise a resource exception back to the engine.

Depending on the exception the BPEL engine will either retry the *invoke* or mark the process instance as failed. This happens specifically, if the resource adapter throws an exception of the following type:

```
oracle.tip.adapter.api.exception.PCRetriableResourceException
```

The BPEL engine retries interactions that are controlled by the partnerlink properties in `bpel.xml` as shown in the following example:

```
<property name="retryInterval">60</property>
<property name="retryMaxCount">10</property>
```

If the partnerlink properties are not specified, then the interaction fails.

Note: The current OracleAS 10.1.2 implementation will not incur message loss. However, there is a very small chance of message duplication (if the BPEL server crashes right after successful dehydration of the inbound message, but before the adapter commits its delete operation of the inbound message at the EIS endpoint.) When the BPEL PM engine starts up again, the original message will therefore still exist at the endpoint and be consumed again.

The duplicate message can be detected by adding a small Java-exec after the *receive* activity which checks whether the *ConversationId* or some other unique property already exists in the dehydration store.

6.18 Load Balancing and BPEL Clustering Support Within Adapters

The Adapter Framework supports active fail-over of inbound Adapter Services. You can achieve this by adding a property to a particular JCA activation agent (in `bpel.xml`) as shown in the following example:

```
<activationAgents>
  <activationAgent className="..." partnerLink="MyInboundAdapterPL">
    <property name="clusterGroupId">myBpelCluster</property>
```

If the BPEL PM servers (JVMs) in the cluster are located across TCP/IP subnet boundaries, then it is necessary to add the attribute `clusterAcrossSubnet=true`.

In a cluster group, the multiple activations of the same (for example, File) adapter Activation Agent (for a specific partnerlink) will be detected implicitly and automatically by all the instances of the adapter framework active in that cluster. Only one activation will be allowed to actually start the reading or publishing messages. The adapter framework instances chooses one among them, randomly as to who should assume the Primary Activation responsibility. The other activations (instances) in the cluster will initiate to a hot stand-by state, without actually invoking *EndpointActivation* on the JCA resource adapter.

If a primary activation at some point becomes unresponsive, is deactivated manually or if it crashes/exits, then any one of the remaining adapter framework members of the cluster group will immediately detect this, and reassign the primary activation responsibility to one of activation agents standing by. This feature uses JGroups underneath for the implementation, hence the *clusterGroupId* property.

6.19 Deploying Adapter Services

Adapter services can be deployed in two ways, using JDeveloper and BPEL Console. In addition, deploying a BPEL process deploys an adapter service. You can remove an adapter service from the BPEL Console.

6.20 Validating Adapter Deployment

You can validate the deployment of only technology adapters and OracleAS Adapter for Oracle Applications. During the deployment step in JDeveloper, the following validation steps occur:

1. Verifying the integrity of WSDL (JCA) bindings.
2. Validating the JNDI location.
3. Verifying the existence of *InteractionSpec* or *ActivationSpec* parameters specified in *jca:operation*.
4. Validating all property names and values bound to *InteractionSpec* or *ActivationSpec* parameters in *jca:operation*.
5. Validating any XML Record converter specified in *jca:binding* or *pc:inbound binding*.

All exceptions that are raised during validation steps are reported back to JDeveloper.

6.21 Batching and Debatching Support

The batching and debatching functionality is supported only by OracleAS Adapter for Files and OracleAS Adapter for FTP, and OracleAS Adapter for Databases. OracleAS Adapter for File and OracleAS Adapter for FTP consist of a Reader to debatch a single huge file into several batches. You need to specify the batch size during the design-time configuration. In addition, the adapter includes a Writer to batch a set of messages into a single file.

OracleAS Adapter for Databases consists of a Publish component to poll a set of tables to detect events. This component can raise events to the BPEL process one record at a time or multiple records at a time.

6.22 Migrating Repositories

All the adapter service WSDLs generated by the Adapter Configuration wizard have a reference to the JNDI name. The reference is defined in the `oc4j-ra.xml` file which is the adapter's deployment descriptor, through the location attribute on the `jca:address` element. This is the *key* when you want to migrate from a development environment to a test environment to a production environment. You should update the `oc4j-ra.xml` file to have the same JNDI name in all three environments: development, testing, and production. You should specify values for deployment time properties, such as retry interval and retry count, and then redeploy to testing environment or production environment. The `oc4j-ra.xml` will identify the end point as a development EIS or testing EIS or production EIS. For example, consider that when running through the Database Adapter Service wizard, you specify `eis/DB/custStore` as the JNDI name for `createCustomer` service. After modeling the BPEL process by using this adapter service, you should deploy it to the development, test or production environments without making any changes. But before you do this, ensure that you have a corresponding JNDI entry for `eis/DB/custStore` in each of your various environments pointing to the right EIS instance.

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