Oracle Utilities Application Framework Software Development Kit

Contents

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Welcome to the Oracle Utilities Application Framework Software Development Kit.

The Oracle Utilities Software Development Kit is a set of utilities designed to build applications based on Oracle Utilities Application Framework, the application framework built by Oracle. It provides utilities for implementers to extend applications without compromising upgradeability. This document describes the Software Development Kit.

This document is divided into the following parts:

- The **User Guide** describes how to use the Software Development Kit to customize products.
- The **Developer Guide** presents information that aid the development process including technical references and standards.
- The **Packaging Guide** describes the procedures for taking developed code and data to the target environments.

User Guide

Overview

The Oracle Utilities Software Development Kit is a set of utilities designed to build applications based on Oracle Utilities Application Framework, the application framework built by Oracle. It provides utilities for base product developers and implementers to extend OUAF applications without compromising upgradeability. This document discusses the details of application development using Software Development Kit, including:

- The **Development Environment** section describes the environment that developers work on while using the Software Development Kit.
- The **Build Server** section describes the procedure for setting up a build server.
- The **Technical Architecture** section describes applications developed on framework. It describes the framework technical architecture at a high level and then describes its components in detail.
- The **Meta-data** is the core component of applications built on framework. The meta-data section describes the purpose, structure, and use of the meta-data tables.
- The **Development Process** section contains high level, quick reference guides on common tasks in building applications based on framework.
- The **Cookbook** section describes the development tasks in detail. The Development Process section contains links to specific sections in this section.
- The **Utilities** section describes the tools provided with Software Development Kit. These tools include batch programs and Perl scripts developed to automate several stages of the development process.

Converted COBOL Programs

Important: As of Oracle Utilities Application Framework Release 4.3.0.0.0, all COBOL programs have been converted to Java. This version of the SDK therefore does *not* require a COBOL runtime or compiler. The term COBOL is still used to refer to metadata in some places, but in those and any other case, "COBOL" in this document implicitly means "Converted COBOL Program".

Development Environment

Overview

The App Server is the Development Environment

The Software Development Kit development environment is built on a standard app server install of the product being customized. Put another way, the app server is the development environment.

Source code is written and generated within the app server directory structure and executables are generated where the app server expects them and are therefore ready to be executed.

For example:

- UI code is written directly where the app server looks for them.
- The jar file for the Java programs is created directly where the app server looks for it.

Development App Server is Local, Not Shared

Each developer has a development app server in his workstation for each project. This means that a developer can code and unit test all within his workstation. This also means work-in-progress code contained within the developer's workstation.

Repository for Project

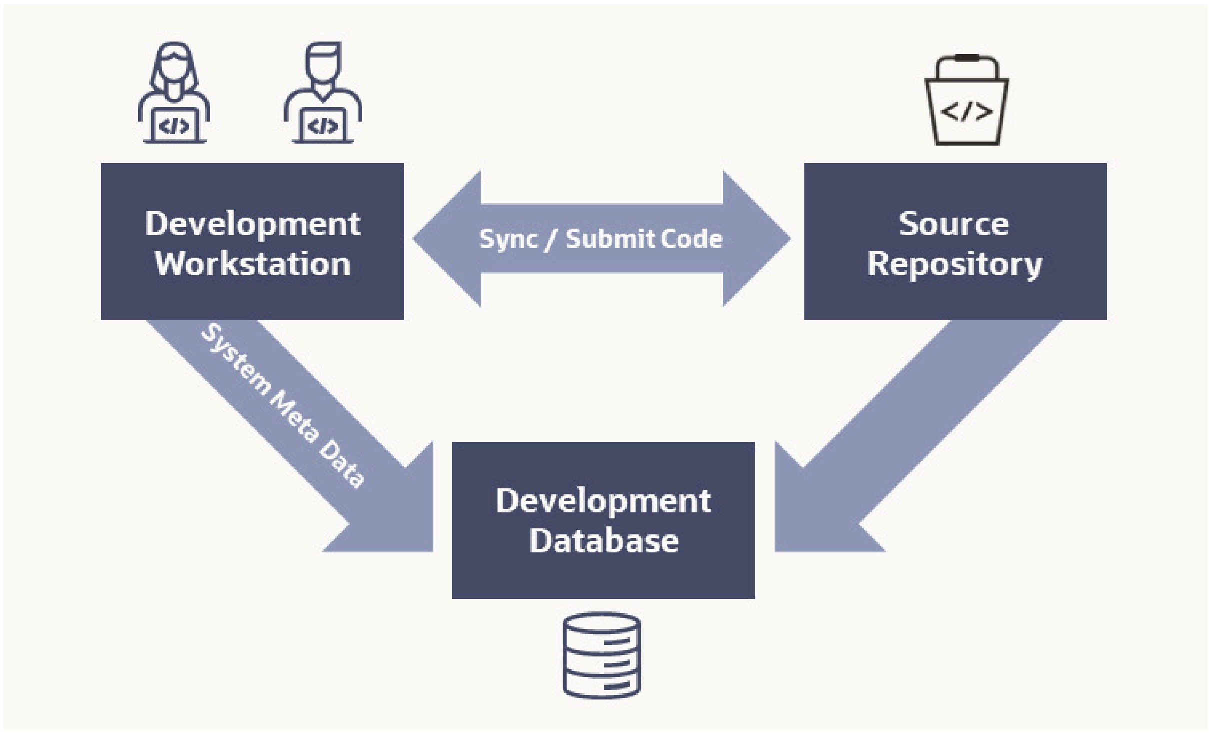
All finished code is submitted into the project repository. As such, developers synchronize with the project repository to get their local development environments current with the rest of the team.

The project repository is also set up as a development environment. When developers synchronize with the project repository, they get a development environment including configuration necessary for that project.

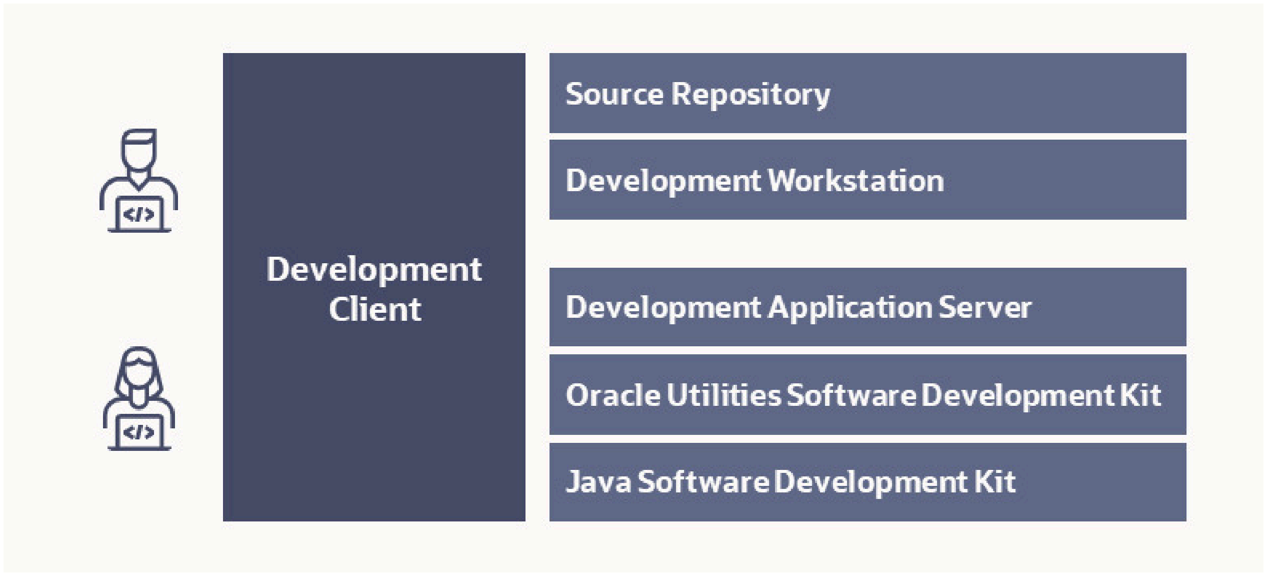
Components of the Software Development Kit

The following diagram illustrates the development environment.

Note: Please see the installation guide for instructions on how to set up the Software Development Kit and its components.



Development Environment


Development Client
Source Repository
Development Workstation
Development Application Server
Oracle Utilities Software Development Kit
Java Software Development Kit

Development Client

Project Development Database

Each project has a development database. This is a regular database install of the product that is being customized. System data for customizations are stored in this database. Development processes like code generation connect to this database. In addition, development app servers in development workstations connect to this database.

Project Repository

The project repository serves the following purposes:

- It is the central storage for all completed unit-tested code.
- It provides the environment from which to build the latest state of the project.

- It provides the latest state of the project dev app server from which all developers can synchronize with.
- It is the source for CM Packaging.

  To support these purposes:
- It must be accessible to all developers.
- It is set up as a development client, like a development workstation (see Development Workstation below).

Development Workstation

Developers write, generate, compile, and test code on development workstations. A development client is installed for each project that the developer works on.

The main components of a development client are the following:

- **Project Dev App Server**. Code is developed on, and executables built into, the project dev app server.
- **Software Development Kit Client**. This is the primary development tool of the Software Development Kit.
- **Eclipse SDK**. This is the Java development tool used in the Software Development Kit.

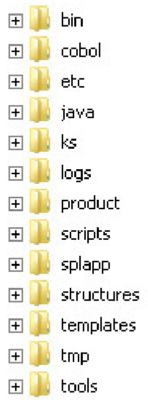
Directory Structure

The App Server Directory

As mentioned earlier, the app server is the development environment. Source code and executables are therefore placed within the directory structure of the app server.

Standard App Server Directory Structure

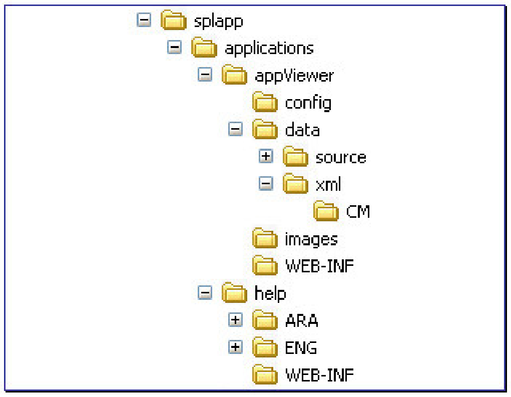
A typical application server will be installed with a directory structure such as the following:



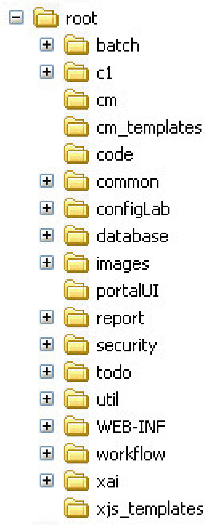
Within this structure only some of the subdirectories are of interest to a developer.

The `cobol` directory may still exist for some applications (for example, CCB), but that is now obsolete as all COBOL programs have been converted to Java for edge applications running on OUAF 4.5.0.x.

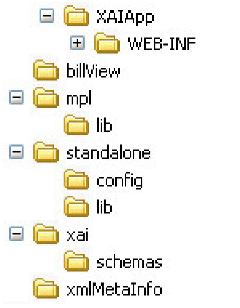
The `splapp` directory contains all the main application files, including the deployed custom jars (`cm.jar`) and Web server files (for example, JSP, Javascript).



```
splapp
  applications
    appViewer
      config
      data
        source
        xml
          CM
      images
      WEB-INF
    help
      ARA
      ENG
      WEB-INF
```



```
root
  batch
  c1
  cm
  cm_templates
  code
  common
  configLab
  database
  images
  portalUI
  report
  security
  todo
  util
  WEB-INF
  workflow
  xai
  xjs_templates
```

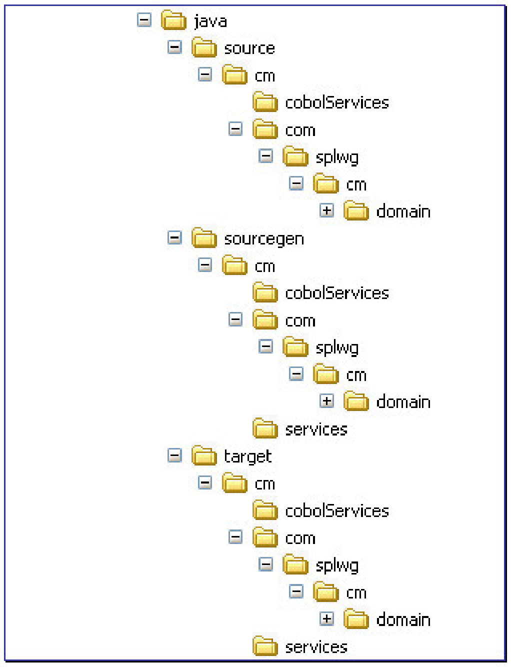


```
  XAIApp
    WEB-INF
billView
mpl
  lib
standalone
  config
  lib
xai
  schemas
xmlMetaInfo
```

Additional Directories for Development

Java

A directory structure with a base directory of **java** is used for Java development, as shown in the following image.



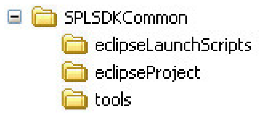
```
java
  source
    cm
      cobolServices
      com
        splwg
          cm
            domain
  sourcegen
    cm
      cobolServices
      com
        splwg
          cm
            domain
      services
  target
    cm
      cobolServices
      com
        splwg
          cm
            domain
      services
```

- **source** contains the code that the developer writes or generates that is submitted to the repository. Under this is the **com.splwg.cm.domain** folder, which contains the CM Java source code.
- **sourcegen** contains generated code that is necessary to build the project. All files in this structure are generated and therefore must not be modified manually in any way.
- **target** contains the runtime files created from **source** and **sourcegen**. The content of this directory is what is deployed as a jar file to the app server. All files in this structure are generated and therefore must not be modified manually in any way.
- The **cobolServices** folder contains any Converted COBOL service XML mapping files.

Project Configuration Information

Project information is stored in the SPLSDKCommon directory structure.

- **eclipseLaunchScripts** contains the Eclipse launch scripts for various tools.
- **eclipseProject** contains the project configuration information for Eclipse.
- **tools** contains the tools that are required for the project.



```
SPLSDKCommon
  eclipseLaunchScripts
  eclipseProject
  tools
```

Pertinent Directories in the App Server

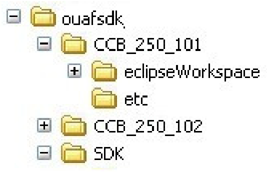
Item	Directory	Content
Java sources	java\source\cm\com\splwg\cm.domain	Java source code.
Web Application	splapp\applications\root\cm	UI code.
	splapp\applications\root\WEB-INF\lib	cm.jar file is deployed here.

Item	Directory	Content
Standalone Application	splapp\standalone\\lib	CM?*.jar file. cm.jar file is deployed here.
XAI Schemas	splapp\xai\schemas\CM*.xml	XAI schemas.
Service XML files	splapp\xmlMetaInfo\CM*.xml	Service XMLs for Java.
Eclipse Launch Scripts	SPLSDKCommon\eclipseLaunchScripts	Eclipse launch scripts.
Eclipse Project	SPLSDKCommon\eclipseProject	Project configuration information for Eclipse.
Software Development Kit Tools	SPLSDKCommon\tools	Tools required by the Software Development Kit.

Client Directory

The Oracle Utilities Application Framework (OUAF) Software Development Kit client directory contains both the Software Development Kit itself and some project-specific information such as the Eclipse workspace.

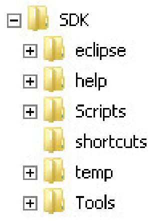
The location of the Software Development Kit client is stored in the environment variable **SPLSDKROOT**.



```
ouafsdk
  CCB_250_101
    eclipseWorkspace
    etc
  CCB_250_102
  SDK
```

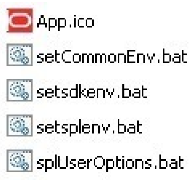
The Software Development Kit Client

The Software Development Kit client is installed in `SDK/<version>`.



```
SDK
  eclipse
  help
  Scripts
  shortcuts
  temp
  Tools
```

The SDK folder has the following scripts at the top level:



```
App.ico
setCommonEnv.bat
setsdkenv.bat
setsplenv.bat
splUserOptions.bat
```

Additionally, a copy of Eclipse is installed later into the **`eclipse`** directory.

Note: Updates are unique versions of the Software Development Kit and therefore have their own directories.

Note: A separate copy of Eclipse is installed per version of the Software Development Kit client because each version may have its own set of plug-ins and the plug-ins must be in the plugins directory of Eclipse.

These files are not meant to be executed directly by the developer and are intended to be executed through scripts in the **shortcuts** folder.

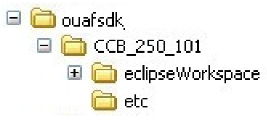
The `setsdkenv.bat` script specifies the OUAF SDK version and installation folder.

The `setplenv.bat` scriptsets up the environment variables needed to correctly run a development environment for the application server.

Note: A copy of Eclipse is installed later into the **`eclipse`** directory. This folder is created when the user first runs the **startEclipse** shortcut script. A separate copy of Eclipse is installed per version of the Software Development Kit client because each version may have its own set of plug-ins, and the plug-ins must be in the `plugins` directory of Eclipse.

Project Directories

Each project has its own directory.



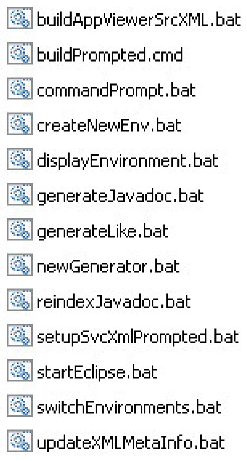
```
ouafsdk
  CCB_250_101
    eclipseWorkspace
    etc
```

- **eclipseWorkspace** contains Eclipse workspace files.
- **etc** contains additional project-related files, including `setsplenv.bat`, which is used to set environment variables for the project. This script is executed before other scripts so that succeeding scripts operate on the project.
- **eclipseProject** (not shown above) exists only in development workstations (not in the project repository). It is a copy of the same directory in the app server.

Note: setsplenv.bat is generated when the project is created/configured.

Shortcuts Directory

The shortcuts directory contains various scripts used in development.



```
buildAppViewerSrcXML.bat
buildPrompted.cmd
commandPrompt.bat
createNewEnv.bat
displayEnvironment.bat
generateJavadoc.bat
generateLike.bat
newGenerator.bat
reindexJavadoc.bat
setupSvcXmlPrompted.bat
startEclipse.bat
switchEnvironments.bat
updateXMLMetaInfo.bat
```

Except for `commandPrompt.bat`, `createNewEnv.bat`, and `startEclipse.bat`, these scripts are intended to be executed on the command line (see `commandPrompt.bat`).

The `commandPrompt.bat` script initializes the appropriate environment variables for a development environment so that OUAF SDK scripts, particularly those in the **shortcut** directory, can be executed on the Windows command prompt.

The `createNewEnv.bat` script allows a developer to set up another development environment for another application server in the workstation. The initial development environment is first created on installation of the OUAF SDK.

The `startEclipse.bat` script installs the Eclipse IDE and sets up the OUAF plugin in Eclipse if these are not yet installed. Otherwise, it initializes the appropriate environment variables for a development environment that the OUAF Eclipse plugin requires.

Synchronizing with the Project Repository

Developers synchronize the whole of the app server directory except for the following:

- java\sourcegen
- java\target
- splapp\xmlMetaInfo
- splapp\applications\root\WEB-INF\lib\cm.jar
- splapp\standalone\lib\cm.jar
- splapp\XAIApp\WEB-INF\lib\cm.jar
- logs\system

Versions

Version Number

The Software Development Kit version number comprises five period-delimited segments. The first four segments indicate the Framework (FW) version number, and the fifth specifies the SDK update number

The SDK update number starts with 1 (and increments by one) for each FW version. For example, an SDK version of 4.3.0.0.1 means that it is the first first SDK developed for FW 4.3.0.0, whereas 4.3.0.1.1 would be the first SDK version for FW 4.3.0 Service Pack 1.

Compatibility with Products

Generally, unless noted otherwise, an OUAF SDK product should only be used for its intended FW version. That general rule applies to all previous versions of the Oracle Utilities Framework SDK.

For example, OUAF SDK FW 4.2.0.2.4 is not compatible with OUAF SDK 4.3.0.0.1, and OUAF SDK 4.3.0.0.1 and FW 4.3.0.1.1 are never compatible.

Updates

Each new version of the OUAF SDK installs to its own folder, allowing you to use several versions of the SDK on the same workstation. An OUAF SDK installation should never be used to overwrite an existing SDK installation with the intent of "upgrading" it. You should only develop using the version of the OUAF SDK that runs the same OUAF version that your application server runs.

New versions of the OUAF SDK can be installed and old versions uninstalled without affecting the application server. These options allow you to migrate your application servers to a newer version of the OUAF while allowing you to still refer to the original application server setup.

Moving Up to a New Update

Since an update of the OUAF SDK installs to its own folder, a new development workspace for your application server must be created as well. If it has not yet been created by the OUAF SDK ClientSetup program, use the `createNewEnv.bat` shortcut script to create one for your application server.

You will also need to install Eclipse through the `startEclipse.bat` shortcut script and create a new Eclipse project for your project. Since the CM Java sources are already present in the application server, you need only re-run the **Generate Artifact** launch configuration in Eclipse to generate code before you rebuild your project.

You should *not* run the Generate Artifact launch configuration in the Eclipse installation of the older OUAF SDK installation at this point.

Moving Up to a New Version of a Product

Moving to a new version of a product requires creating a new development environment suited for the new version. A new version is likely to be built on a new version of the Framework, which would mean that a new compatible version of the Software Development Kit is required.

The steps are as follows:

1. **Stabilize the project on the old version of the product.** Ensure that the project is in a stable state and that all developers have submitted all code to the repository.
2. **Prepare the database for the new project:**
   a. Copy the database of the project in the old version to a new database.
   b. Upgrade this newly created database to the new version of the product by following the database upgrade procedures of the product.
3. **Set up the repository for the new project:**
   a. Prepare a project repository as described in the installation documentation.
   b. Copy source code from the repository of the previous version into the project repository.
   c. Update code, if necessary, as specified in the documentation of the new version of the product.
   d. Build the entire project. This includes generation of code, compilation, generation of services, etc.
   e. Test the customizations.
4. **Set up development workstations.** At this point, developers can set up their workstations for the new project on the new version of the product. Each developer must follow the workstation setup procedure.

Product Single Fixes

When single fixes to products are released, the following should be done for projects for which the single fixes are required:

- Stabilize the project by making sure that the project is in a stable state and that all developers have submitted all code to the repository.
- Apply the single fix to the project repository.
- Each developer of the project must then synchronize with the project repository.

Build Server

Every enterprise has its own software development practices that cover how developers update code, how changes are tracked and tested and how new releases are created. We generally expect that whatever practices have historically worked within an organization will continue to work for the implementation of this application. However, a build methodology was developed that has worked well for managing concurrent changes to the application that is based on the following principles:

- The application should work in its entirety at all times. Therefore, any change to a part of the application requires the application to be retested in whole.
- Bugs are more expensive to fix the longer they stay in a system. Hence the importance of spotting any defect immediately after a software failure or crash occurs.
- In a complex system, errors not always appear where the code is modified, so it would be unreliable to test selectively based on what is *likely* to fail to find all the places of actual malfunction.

Tailoring Your Oracle Utilities Application Implementation

This document describes the naming conventions and processes that must be followed to ensure a successful upgrade of the Oracle Utilities application base product release-on-release. The implementation team responsible for tailoring the Oracle Utilities application to meet specific customer needs must follow this guide to preserve their changes and ensure successful upgrades. Only the changes described in this document are considered as permitted for the tailoring of the base product. Any changes that do not conform to these rules may be overridden by the install utility during a base product upgrade.

Some naming conventions used in this document:

- `$SPLEBASE` (for UNIX) and `%SPLEBASE%` (for Windows) is the generic Oracle Utilities environment directory name.
- `$SPLENVIRON` (for UNIX) and `%SPLEBASE%` (for Windows) is the generic Oracle Utilities environment name.
- `$SPLDB` (for UNIX) and `%SPLDB%` (for Windows) is the database type.

Preserving Customer Changes

For any kind of a customer modification, the file's directory structure and naming conventions are defined in this section. The implementation team must follow these conventions to preserve the results of their work during a subsequent base product upgrade.

- The configuration parameters of the environment being upgraded are displayed (as default parameters) during the configuration stage of the install process. These parameters may be changed if new settings are preferred.
- The base product is shipped with examples of different kinds of modules that may be used by implementation teams. The examples can be found in the following directories:
  - `$SPLEBASE/splapp/applications/root/cm_templates` contains Oracle Utilities Application Framework Web file examples.
  - `$SPLEBASE/splapp/applications/root/<application product code>/cm_templates`. This directory contains Oracle Utilities application product Web file examples. The <application product code> varies by product; for example, the Oracle Utilities Customer Care and Billing, the <application product code> is `c1`.
  - `$SPLEBASE/scripts/cm_examples`. For batch script examples, this directory has two subdirectories: `FW` for Oracle Utilities Application Framework examples, and <application product code> for Oracle Utilities application product examples (for example, `CCB` for Oracle Utilities Customer Care and Billing).

Note: For simplicity, this document generally uses UNIX platform naming conventions. To apply these names to the Windows platform, use the Windows naming conventions "%" sign instead of the "$" sign, and backslashes ("\") instead of forward slashes ("/") as directory separators (e.g., `%SPLEBASE%\splapp\applications\root\cm_templates`).

Tailoring Web Files

Base product UI files are in the directory `$SPLEBASE/splapp/applications/root`. Implementers may develop their own UI files under the directory `$SPLEBASE/splapp/applications/root/cm`. No specific naming conventions are enforced under this directory.

The root directory may be deployed in war file format for runtime environment (`SPLApp.war`). Use provided utilities to incorporate your **cm** directory into the `SPLApp.war` file.

Tailoring the CM Java Application

Implementers may write their own Java classes to extend the Oracle Utilities application functionality. All Java files should belong to the `com.splwg.cm` package. The CM Java application should be compiled into a jar file named `cm.jar`. The SDK Customer Modification packaging utilities will help build this file. The `cm.jar` is typically deployed into the following directories:

```
$SPLEBASE/splapp/applications/root/WEB-INF/lib
$SPLEBASE/splapp/applications/XAIApp/WEB-INF/lib
$SPLEBASE/splapp/businessapp/lib
$SPLEBASE/splapp/standalone/lib
```

Additional third-party jar files can be deployed by following the `cm*.jar` naming standard. Customers may use this option to deploy any additional functionality, interfaces with other applications, and so on. These will not be built by the SDK Customer Modification packaging utilities, but will be deployed into the application once it is supplied in jar format.

The root directory may be deployed in a war file format for the runtime environment (`SPLApp.war`). Use the provided utilities to incorporate your `/cm` directory into `SPLApp.war` file.

Important: All `cm*.jar` files that need to be applied must be defined in `$SPLEBASE/structures/cm_jars_structure.xml`. If the file does not exist in the target environment, the sample `cm_jars_structure.xml.example` file can be copied from the SDK packaging's `/etc` folder.

Manual cm.jar deployment

The `cm.jar` file is usually deployed as part of the CM packaging process (`extractCMsource`, `applyCM`, `create_CM_release`, and so on.), but in some cases it may be desirable to manually deploy the `cm.jar` file to one or more target environments.

CAUTION: This should be done with care and should only be considered if the `cm.jar` components are self-contained and have no external dependencies.

To manually deploy `cm.jar`:

1. The SPLEBASE/structures/cm_jars_structure.xml must exist and should have at least the following:

```
<?xml version="1.0" encoding="UTF-8"?>
<jar_structure>
   <cm.jar>
  <source_dir_jar>@SPLEBASE@/etc/lib</source_dir_jar>
  <dest_folders>
 <dest_folder_1>@SPLEBASE@/splapp/applications/XAIApp/WEB-INF/lib</
dest_folder_1>
 <dest_folder_2>@SPLEBASE@/splapp/applications/root/WEB-INF/lib</
dest_folder_2>
 <dest_folder_3>@SPLEBASE@/splapp/businessapp/lib</dest_folder_3>
 <dest_folder_4>@SPLEBASE@/splapp/standalone/lib</dest_folder_4>
  </dest_folders>
  <child_jvm_path>@SPLEBASE@/splapp/standalone/lib</child_jvm_path>
   </cm.jar>
</jar_structure>
```

   The `<cm.jar>` element identifies the jar file name, usually `cm.jar`, as defined here.

   Element `<source_dir_jar>` defines the source location of the above mentioned jar. The directory in this example should work for most cases.

   The `dest_folder_` *n* elements point to the target locations where the jar will be placed. The directories in this example should work for all.
2. Manually copy the `cm.jar` to the directory specified in the `<source_dir_jar>` element, typically `$SPLEBASE/etc/lib`.
3. Run `initialSetup.sh` (or `.bat` on Windows) to do the rest. This will copy the `cm.jar` to the specified target locations and rebuild the war and ear files.

Positioning Custom Scripts

Customers and implementers may put their scripts under the directory `$SPLEBASE/scripts/cm`.

Using the Implementation Version File

Implementers may keep the implementation version number in the `CMVERSION.txt` file in the `$SPLEBASE/etc` directory. This file is preserved by the install utility.

Tailoring Templates and User Exits

The templates delivered under the folder `$SPLEBASE/templates` can be overridden by the application by creating a copy of the template file with the same name but prefixed by `cm.`. The `cm` copy will be customized.

Since the templates can contain user exits (special statements that allow to import external files during the template processing). Those user exits can be overridden by creating a copy of the user exit file with the same name but prefixed by `cm_`. The `cm` copy will be customized.

JUnit testing

JUnit is a Java framework that supports writing unit tests that help ensure your code works as desired, and existing code is not broken by new changes. It is often useful to create JUnit tests during development to verify that your code works as expected, and to keep and rerun the tests in the future to ensure that later changes in your (or someone else's code) don't unexpectedly break your code.

More information on JUnit testing philosophy is available at JUnit.org.

Note: This document assumes that you use Eclipse. However, if you choose to use a different IDE, you must learn how to achieve the equivalent functionality that Eclipse provides.

Assuming you have an existing JUnit test class, you can execute them directly within Eclipse by:

- Right-clicking on the class in Package Explorer

```
Run -> JUnit Test
```

All the tests for an application can be run from Eclipse by running the `com.splwg.AllTests` class in the "test" directory as a JUnit test.

Standard test cases

There are framework classes that are helpful for specific test cases:

Testing Searches

There is a convenient test superclass for search services, `com.splwg.base.api.testers.SearchTestCase`. This test class only requires that you override two methods:

- `String getServiceName()` - this method specifies the service name (CILCACCS) for the search.
- `List getSearchTrials()` - this method should return a list of `SearchTrials`.

A search trial describes information about a particular invocation of a search. You need to describe the inputs (the input fields and the search type), and then describe the expected output for that given input:

- Some expected rows, in the order expected.

In order to properly test searches, the expected results are not required to contain every search result- if new rows are added by some other process, they will not cause the test to fail. The search results, however, must contain at least all the expected results, in the relative order they are added.

- Possibly some prohibited rows, which the search should not find.

In addition, there may be times when you want to guarantee a certain row NOT to be found in the search result. This can be accomplished by adding a prohibitedRow, in the same manner as expected rows are added to the trial.

The search test FW will then use inputs from each search trial to execute the search and compare the expected and prohibited results to the actual search results. It expects to find the expected rows in the order added, and should find all of them. Any different order or missing row results in a failure. What will not result in a test failure is if new rows have been added interspersed throughout the expected rows. These are fine. If a given search result row does not match the next expected result row, it is compared against the prohibited rows. If it matches any of them, the test fails.

The search framework will also examine the information about the search, and ensure that each search type (main, alternate, alternate2, ...) is executed at least once.

Here is a sample search test class:

```
package com.splwg.base.domain.batch.batchControl;

import com.splwg.base.api.lookup.SearchTypeLookup;
import com.splwg.base.api.testers.SearchTestCase;
import com.splwg.base.api.testers.SearchTestResult;
import com.splwg.base.api.testers.SearchTrial;

import java.util.ArrayList;
import java.util.List;

/**
 * @author bosorio
 * @version $Revision: #2 $
 */
public class BatchControlSearchService_Test
    extends SearchTestCase {

    //~ Methods ----------------------------------------------------------

    protected String getServiceName() {
        return "CILTBTCS";
    }

    /**
     * @see com.splwg.base.api.testers.SearchTestCase#getSearchTrials()
     */
    protected List getSearchTrials() {
        List list = new ArrayList();

        // Search using Main Criteria
        SearchTrial trial = new SearchTrial("Main search");
        trial.setSearchType(SearchTypeLookup.constants.MAIN);

        trial.addInput(BatchControlSearchService.INPUT_MAIN.BATCH_CD,
              "ADM");
        SearchTestResult expectedResult = trial.newExpectedResult();
        expectedResult.put(BatchControlSearchService.RESULT.BATCH_CD,
              "ADM");
        list.add(trial);

        // Search using Alternate Criteria

        trial = new SearchTrial("Search by description");
        trial.setSearchType(SearchTypeLookup.constants.ALTERNATE);

        trial.addInput(BatchControlSearchService.INPUT_ALT.DESCR,
              "AcCount D");
        expectedResult = trial.newExpectedResult();
        expectedResult.put(BatchControlSearchService.RESULT.BATCH_CD,
              "ADM");
        expectedResult.put(BatchControlSearchService.RESULT.DESCR,
              "Account debt monitor");
        list.add(trial);

        return list;
    }
}
```

Testing Maintenance Classes

There is a convenient test superclass for entity page maintenance, `com.splwg.base.api.testers.EntityPageServiceTestCase`. This test class requires several methods to be implemented to handle setting up the data and validating for each action (Add, Read, Change, Delete).

In case your maintenance is read and change only, so it does not support add and delete, then implement this method:

```
    protected boolean isReadAndChangeOnly() {
        return true;
    }
```

The test framework will only exercise the *read* action.

Your maintenance test class must provide the name of the service being tested:

```
    protected String getServiceName() {
        return "CILTBTCP";
    }
```

Testing Add on Maintenance Class

First, to test an add, we need the data. This is provided in the method `protected PageBody getNewEntity()`. Here is an example:

```
protected PageBody getNewEntity() {
        PageBody body = new PageBody();
        body.put(Maintenance.STRUCTURE.BATCH_CD, "ZZTEST2");
        body.put(Maintenance.STRUCTURE.PROGRAM_NAME, "ZZPROG");
        body.put(Maintenance.STRUCTURE.ACCUM_ALL_INST_SW, Boolean.FALSE);
        body.put(Maintenance.STRUCTURE.DESCR, "Test service");
        body.put(Maintenance.STRUCTURE.LAST_UPDATE_DTTM,
             LAST_UPDATE_TIMESTAMP);
        body.put(Maintenance.STRUCTURE.LAST_UPDATE_INST, BigInteger.ZERO);
        body.put(Maintenance.STRUCTURE.NEXT_BATCH_NBR, BigInteger.ZERO);

        ItemList itemList =  body.newItemList
             (Maintenance.STRUCTURE.list_BCP.name);
        ListBody listBody = itemList.newListBody();

        listBody.put(Maintenance.STRUCTURE.list_BCP.BATCH_CD, "ZZTEST2");
        listBody.put(Maintenance.STRUCTURE.list_BCP.SEQ_NUM,
             BigInteger.valueOf(10));
        listBody.put(Maintenance.STRUCTURE.list_BCP.BATCH_PARM_NAME,
             "param1");
        listBody.put(Maintenance.STRUCTURE.list_BCP.BATCH_PARM_VAL, "val1");
        listBody.put(Maintenance.STRUCTURE.list_BCP.REQUIRED_SW,
             Boolean.FALSE);
        listBody.put(Maintenance.STRUCTURE.list_BCP.DESCR50, "Parameter 1");
        listBody.prepareToAdd();

        return body;
}
```

This may look like a considerable amount of typing, but any IDE that offers code-completion (such as Eclipse) will facilitate this kind of code entry.

If the maintenance performs some server-side *defaulting* (changing of the data), and the result after the add differs from the data above, you will need to override `protected PageBody getNewReadEntity(PageBody original)`. This method gets the original data from the method above, and allows manipulation to bring it to the expected form after a read from the database.

In order to actually perform the read, the read header should be specified in `protected abstract PageHeader getReadHeader()`. For example:

```
    protected PageHeader getReadHeader() {
        PageHeader header = new PageHeader();
        header.put(Maintenance.HEADER.BATCH_CD, "ZZTEST2");
        return header;
    }
```

Testing Change on Maintenance Class

Next, a new read is performed (using the same read header above), and you can perform a change to the page body in the method:

```
protected PageBody changedPageBody(PageBody original)
```

Here is an example:

```
    protected PageBody changedPageBody(PageBody original) {
        original.put(Maintenance.STRUCTURE.ACCUM_ALL_INST_SW, Boolean.TRUE);

        ItemList list = original.getList("BCP");
        ListBody param = (ListBody) list.getList().get(0);
        param.put(Maintenance.STRUCTURE.list_BCP.DESCR50,
             "Changed parameter 1");
        param.prepareToChange();

        return original;
    }
```

A read is performed after the above changes are sent, and the results are compared.

Testing Delete on Maintenance Class

Finally, a delete is issued on the data, and it is verified that the entity no longer exists.

Test default actions on Maintenance Class

In addition, all defaults that are registered for a page maintenance must also be tested. This should be done through separate tester methods for each default, calling the FW support method `public PageBody executeDefault(PageBody pageBody, String defaultValue)`:

```
    public void testDefaultChg() {
        PageBody input = new PageBody();

        // TODO populate inputs for default
        // e.g.
        input.put(Maintenance.STRUCTURE.FK, "FK CODE");
        PageBody output = executeDefault(input, Maintenance.DEFAULTS.CHG);

        // TODO compare the outputs
        //  e.g.
        assertEquals("FK Description",
             output.get(Maintenance.STRUCTURE.FK_DESCR));
    }
```

Here is an example to test the default on a field under a list.

```
 public void testDefaultAlogrithm() {
        PageBody input = new PageBody();

        ItemList itemList = input.newItemList
             (Maintenance.STRUCTURE.list_MRRA.name);
        ListBody listBody = itemList.newListBody();
        listBody.put(Maintenance.STRUCTURE.list_MRRA.MRR_ACTN_ALG_CD,
             "MRRCRESVCCC");

        PageBody output = executeDefault(input, Maintenance.DEFAULTS.AAD);
        ItemList outList = output.getList
             (Maintenance.STRUCTURE.list_MRRA.name);
        ListBody body = (ListBody) outList.getList().get(0);
        assertEquals(body.get(Maintenance.STRUCTURE.list_MRRA.MRRA_DESCR),
             "Create Service Customer Contact");
    }
```

The input page body should be populated with the expected inputs for the default action, while the output should be compared against the expected output.

The Comparisons

After adds or changes, the state of the row is compared against the new row. By default, the framework implementations should suffice, and no further action would be necessary. However, in some rare cases you may need to override the following methods:

```
protected void compareAddedRow(ListBody originalListBody,
    ListBody newListBody)
protected void compareChangedRow(ListBody originalListBody,
    ListBody newListBody)
```

Test default actions on Entity Page Maintenance Class

In addition, all defaults that are registered for a page maintenance must also be tested. This should be done through separate tester methods for each default, calling the FW support method `public PageBody executeDefault(PageBody pageBody, String defaultValue)`:

```
    public void testDefaultChg() {
        PageBody input = new PageBody();

        // TODO populate inputs for default
        // e.g.
        input.put("FK", "FK CODE");
        PageBody output = executeDefault(input, "CHG");

        // TODO compare the outputs
        //  e.g.
        assertEquals("FK Description", output.get("FK_DESCR"));
    }
```

Another example for testing the default on the field which in on the list.

```
 public void testDefaultAlogrithm() {
        ItemList itemList = new ItemList();
        itemList.setName("MRRA");
        List list = new ArrayList();
        itemList.setList(list);
        ListBody listBody = new ListBody();
        listBody.put("MRR_ACTN_ALG_CD", "MRRCRESVCCC");
        list.add(listBody);

        PageBody input = new PageBody();
        input.addList(itemList);

        PageBody output = executeDefault(input, "AAD");
        ItemList outList = output.getList("MRRA");
        List outputList = outList.getList();
        ListBody body = (ListBody) outList.getList().get(0);
        assertEquals(body.get("MRRA_DESCR"),
            "Create Service Customer Contact");
    }
```

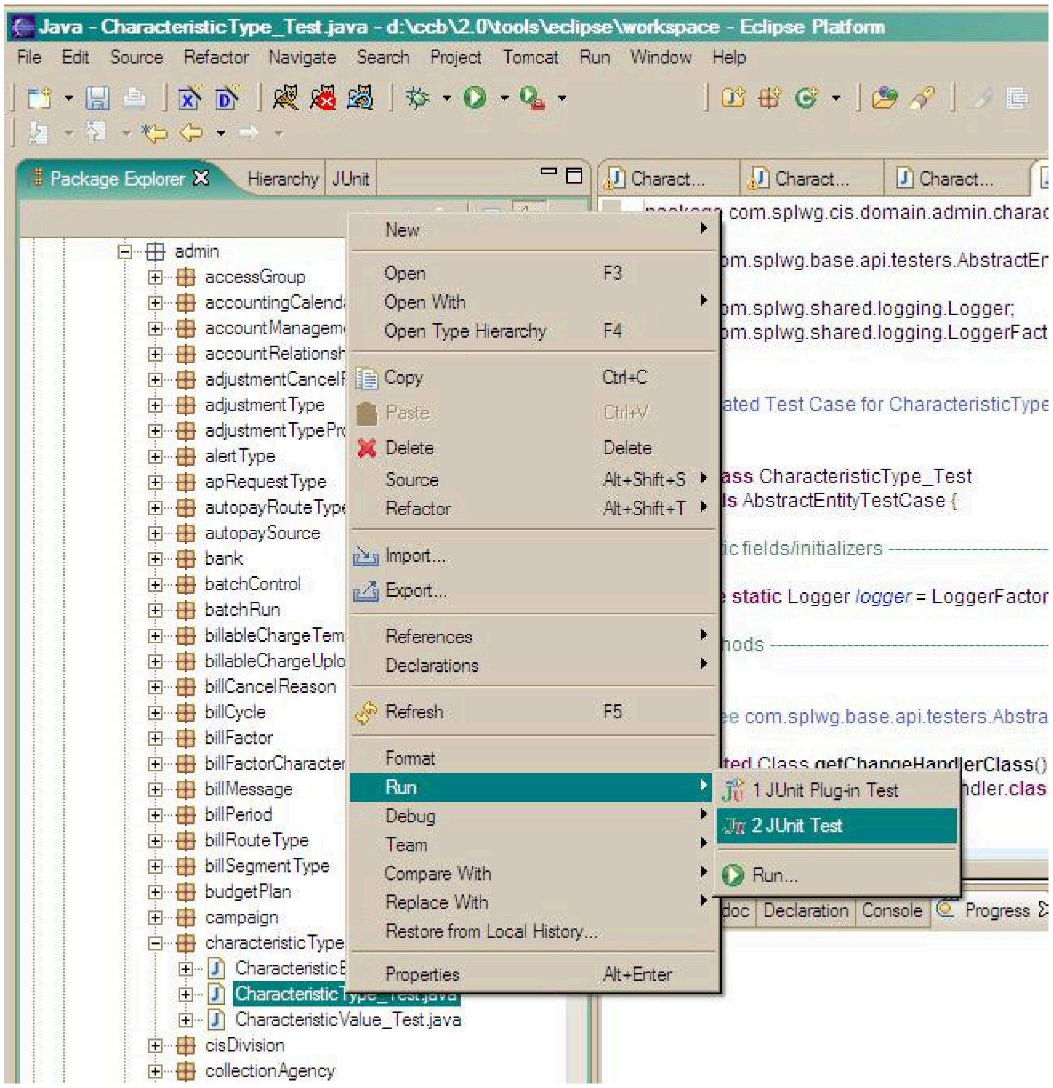
The input page body should be populated with the expected inputs for the default action, while the output should be compared against the expected output.

Testing Business Entity Validation

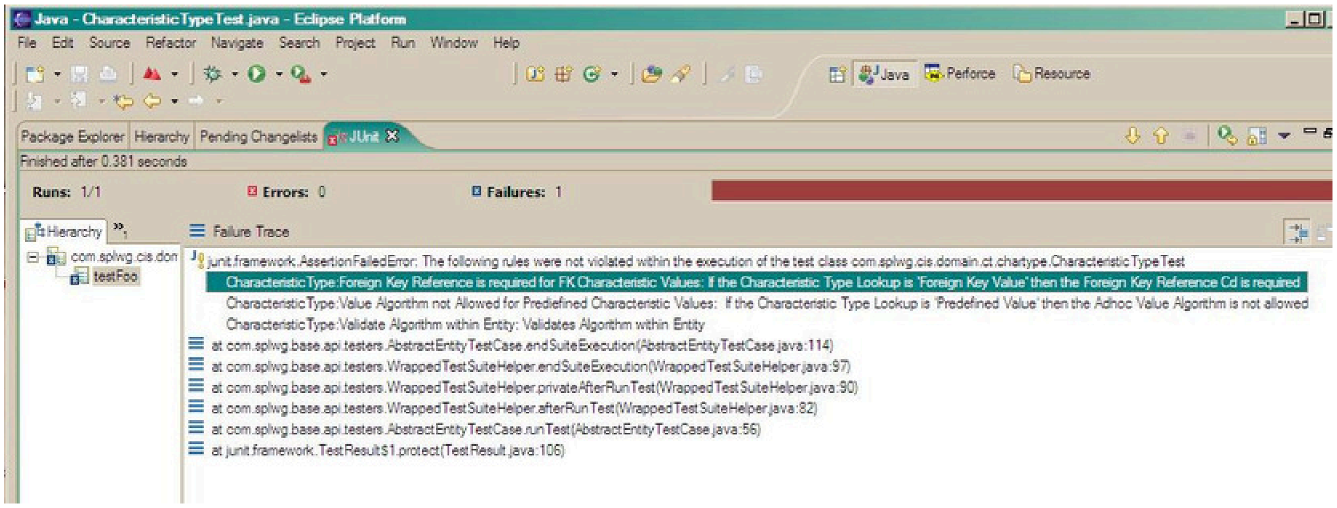
To test our validation, a test class needs to be created. The one-off generation process has created one for each of the existing entities in the system. The following is the one it created for the Characteristic Type entity:

```
public class CharacteristicType_Test extends AbstractEntityTestCase {

    private static Logger logger = LoggerFactory.getLogger(CharacteristicType_Test.class

    /**
      * @see com.splwg.base.api.testers.AbstractEntityTestCase#getChangeHandlerClass()
      */
    protected Class getChangeHandlerClass() {
        return CharacteristicType_CHandler.class;
    }
}
```

This is a JUnit test case. Let's run it. From within Eclipse, right-click on the test class from within the Package Explorer.



The following image shows the resulting output from JUnit:


Java - CharacteristicTypeTest.java - Eclipse Platform
File Edit Source Refactor Navigate Search Project Run Window Help
Java
Perforce
Resource
Package Explorer
Hierarchy
Pending Changelists
JUnit
Hierarchy
Failure Trace
com.splwg.cis.dom
testFoo

```
Finished after 0.381 seconds
Runs: 1/1          Errors: 0          Failures: 1

junit.framework.AssertionFailedError: The following rules were not violated within the execution of the test class com.splwg.cis.domain.ct.chartype.CharacteristicTypeTest
    CharacteristicType:Foreign Key Reference is required for FK Characteristic Values: If the Characteristic Type Lookup is 'Foreign Key Value' then the Foreign Key Reference Cd is required
    CharacteristicType:Value Algorthm not Allowed for Prediefined Characteristic Values:  If the Characteristic Type Lookup is 'Predefined Value' then the Adhoc Value Algorthm is not allowed
    CharacteristicType:Validate Algorthm within Entity: Validates Algorthm within Entity
at com.splwg.base.api.testers.AbstractEntityTestCase.endSuiteExecution(AbstractEntityTestCase.java:114)
at com.splwg.base.api.testers.WrappedTestSuiteHelper.endSuiteExecution(WrappedTestSuiteHelper.java:97)
at com.splwg.base.api.testers.WrappedTestSuiteHelper.privateAfterRunTest(WrappedTestSuiteHelper.java:90)
at com.splwg.base.api.testers.WrappedTestSuiteHelper.afterRunTest(WrappedTestSuiteHelper.java:82)
at com.splwg.base.api.testers.AbstractEntityTestCase.runTest(AbstractEntityTestCase.java:56)
at junit.framework.TestResult$1.protect(TestResult.java:106)
```

As we see, the tests failed and told us that none of our three validation rules where validated. This is, of course true, but some explanation is necessary. When we run entity test cases, the framework looks up the change handler class being tested and collects all its rules. Then it executes all the tests in the test class (basically every method starting with *test**). At the end of each test, it looks to see if the last rule violated was one of the rules we are testing. At the end of all the tests, if there are still validation rules that weren't violated, the framework complains. At a minimum, the goal from this point is to create tests that violate each of our rules at least once. Preferably, tests should be created to violate the rules for all additional conditions that we can think of that might compromise the state of the entity.

Let's start fixing the tests with the *Foreign Key Reference is required for FK Characteristic Values* rule. With a little head-scratching we determine that this is a RequireRule and we replace it as shown below:

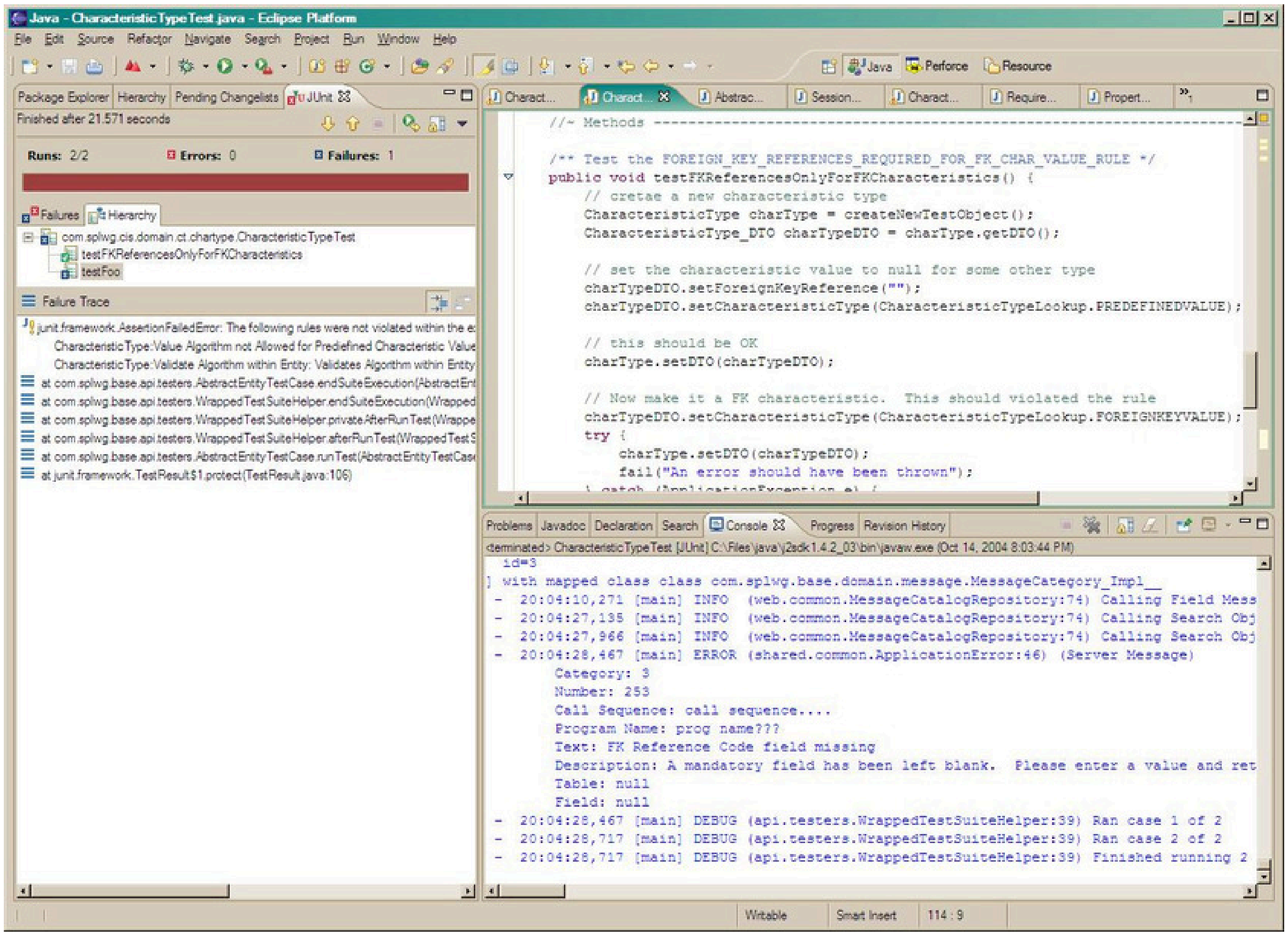
```
public static ValidationRule
        foreignKeyReferencesRequiredForFkCharValueRule(){
    return RequireRule...someFactoryMethod...(
        "CharacteristicType:Foreign Key Reference is required for FK
             Characteristic Values",
        "If the Characteristic Type Lookup is 'Foreign Key Value' then the
             Foreign Key Reference Cd is required",
      ... some fancy stuff ....
        fkReferencesRequiredForFKCharacteristicValueMessage);
}
```

Here's the test that was added to the test class to test it:

```
    /** Test foreignKeyReferencesRequiredForFkCharValueRule  */
    public void testFKReferencesOnlyForFKCharacteristics() {
        // create a new characteristic type
        CharacteristicType charType = createNewTestObject();
        CharacteristicType_DTO charTypeDTO = charType.getDTO();

        // set the characteristic value to null for some other type
        charTypeDTO.setForeignKeyReference("");
        charTypeDTO.setCharacteristicType
              (CharacteristicTypeLookup.PREDEFINEDVALUE);

        // this should be OK
        charType.setDTO(charTypeDTO);

        // Now make it a FK characteristic.  This should violated the rule
        charTypeDTO.setCharacteristicType
              (CharacteristicTypeLookup.FOREIGNKEYVALUE);
        try {
            charType.setDTO(charTypeDTO);
            fail("An error should have been thrown");
        } catch (ApplicationException e) {
            // Make sure the correct rule was violated.
            VerifyViolatedRule
               (CharacteristicType_CHandler.
               foreignKeyReferencesRequiredForFkCharValueRule());
        }
    }
```

Note: Important note: Both a valid test *AND* an invalid test were added to the method above.

Finally, when the test is rerun, we have one validation rule less needing to be violated.


Java - CharacteristicTypeTest.java - Eclipse Platform
File Edit Source Refactor Navigate Search Project Run Window Help
Package Explorer Hierarchy Pending Changelists JUnit
Java Perforce Resource
Problems Javadoc Declaration Search Console Progress Revision History
Writable Smart Insert 114 : 9

```
Finished after 21.571 seconds

Runs: 2/2    Errors: 0    Failures: 1

Failures  Hierarchy
com.splwg.cis.domain.ct.chartype.CharacteristicTypeTest
    testFKReferencesOnlyForFKCharacteristics
    testFoo

Failure Trace
junit.framework.AssertionFailedError: The following rules were not violated within the e
    CharacteristicType:Value Algorithm not Allowed for Prediefined Characteristic Value
    CharacteristicType:Validate Algorithm within Entity: Validates Algorithm within Entity
at com.splwg.base.api.testers.AbstractEntityTestCase.endSuiteExecution(AbstractEnt
at com.splwg.base.api.testers.WrappedTestSuiteHelper.endSuiteExecution(Wrapped
at com.splwg.base.api.testers.WrappedTestSuiteHelper.privateAfterRunTest(Wrappe
at com.splwg.base.api.testers.WrappedTestSuiteHelper.afterRunTest(WrappedTestS
at com.splwg.base.api.testers.AbstractEntityTestCase.runTest(AbstractEntityTestCase
at junit.framework.TestResult$1.protect(TestResult.java:106)
```

```
    //~ Methods -------------------------------------------------------------------

    /** Test the FOREIGN_KEY_REFERENCES_REQUIRED_FOR_FK_CHAR_VALUE_RULE */
    public void testFKReferencesOnlyForFKCharacteristics() {
        // cretae a new characteristic type
        CharacteristicType charType = createNewTestObject();
        CharacteristicType_DTO charTypeDTO = charType.getDTO();

        // set the characteristic value to null for some other type
        charTypeDTO.setForeignKeyReference("");
        charTypeDTO.setCharacteristicType(CharacteristicTypeLookup.PREDEFINEDVALUE);

        // this should be OK
        charType.setDTO(charTypeDTO);

        // Now make it a FK characteristic.  This should violated the rule
        charTypeDTO.setCharacteristicType(CharacteristicTypeLookup.FOREIGNKEYVALUE);
        try {
            charType.setDTO(charTypeDTO);
            fail("An error should have been thrown");
```

```
<terminated> CharacteristicTypeTest [JUnit] C:\Files\java\j2sdk1.4.2_03\bin\javaw.exe (Oct 14, 2004 8:03:44 PM)
  id=3
] with mapped class class com.splwg.base.domain.message.MessageCategory_Impl__
 -  20:04:10,271 [main] INFO  (web.common.MessageCatalogRepository:74) Calling Field Mess
 -  20:04:27,135 [main] INFO  (web.common.MessageCatalogRepository:74) Calling Search Obj
 -  20:04:27,966 [main] INFO  (web.common.MessageCatalogRepository:74) Calling Search Obj
 -  20:04:28,467 [main] ERROR (shared.common.ApplicationError:46) (Server Message)
        Category: 3
        Number: 253
        Call Sequence: call sequence....
        Program Name: prog name???
        Text: FK Reference Code field missing
        Description: A mandatory field has been left blank.  Please enter a value and ret
        Table: null
        Field: null
 -  20:04:28,467 [main] DEBUG (api.testers.WrappedTestSuiteHelper:39) Ran case 1 of 2
 -  20:04:28,717 [main] DEBUG (api.testers.WrappedTestSuiteHelper:39) Ran case 2 of 2
 -  20:04:28,717 [main] DEBUG (api.testers.WrappedTestSuiteHelper:39) Finished running 2
```

Iterate Until Done

Test handleChange / handleAdd / etc code

Although there is no way to enforce testing of any coding in any of the methods

```
HandleRegisteredChange
     (BusinessEntity changedBusinessEntity,
      RegisteredChangeDetail changeDetail)

handleAdd(BusinessEntity newBusinessEntity)

handleChange(BusinessEntity changedEntity, DataTransferObject oldDTO)
```

It is still imperative that this code should also be exercised AND verified when testing the change handler. Please ensure that every path through these methods is exercised and the results verified.

In general, there is a specific set of classes or functionality that is required to have explicitly defined tests.

- Every entity (and entity extension) class must have each of its validation rules explicitly tested. That is, each rule should fail once, with an explicit acknowledgement of the failed rule expected.
- Every service must have a test.
    - Searches must test each search type once.
        - "Page" services must test their complete cycle that are available.

    - Queries must test read
    - Maintenance classes must test add/change/read/delete
- Every maintenance extension must have a test class
- Every algorithm implementation must have a test

Note: Currently, the above *must have* tests may still not completely cover all the cases. For example, one search type may have several inputs, which trigger different code or queries to be executed. The testing FW as is cannot know this, so only requires a single test case for that search type. However, to achieve complete code coverage, it is strongly recommended that each possible specialized case be modeled with a test case.

Note: In addition, there is a desire to assure that each business component or business entity method has been tested. Currently these tests are not required. However, after a complete build server run, any business component methods or business entity methods that have not been explicitly tested will be reported.

Testing for Warnings

In both maintenance classes and entity change handlers, there is the possibility of issuing a warning. This code should be tested just as well as any other entity validation or default action.

Maintenance Classes

Here is complete valid example of verifying that a maintenance default action issues a proper warning.

```
public void testDefaultDEFAULT_FOR_ZONE_HNDL() {
    PageBody input = new PageBody();
    input.put(ContentZoneMaintenance.STRUCTURE.ZONE_CD, "CI_AFH");

    // test the default and expect to get a warning
    try {
        executeDefault(input, "ZH");
        fail("Should have a warning");
    } catch (ApplicationWarning e) {
        verifyWarningContains(e,
           MessageRepository.deleteZoneParametersWarning());
    }

    disableWarnings();

    // test the default and do not expect to get a warning or error
    PageBody output = executeDefault(input, "ZH");
    assertEquals(Boolean.TRUE, output.get("DELETE_SW"));
}
```

Note: Warnings are enabled by default. To catch an application warning, you should put the normal try/catch block around the default execution. Once inside the catch block, you should verify that the warnings are the expected ones. This verification is to be done considering only the message category and number (if there are parameters to the message construction, their values are irrelevant). You should then retry the default with the warnings disabled.

Entity tests

There is no current use of warnings in entity tests that can easily be improved, so for now we will use a slightly contrived example. (This is slightly contrived, because Installation is a special record, and the change below is not actually allowed in the application due to some records on the Adjustment Type table, and a validation on Installation.)

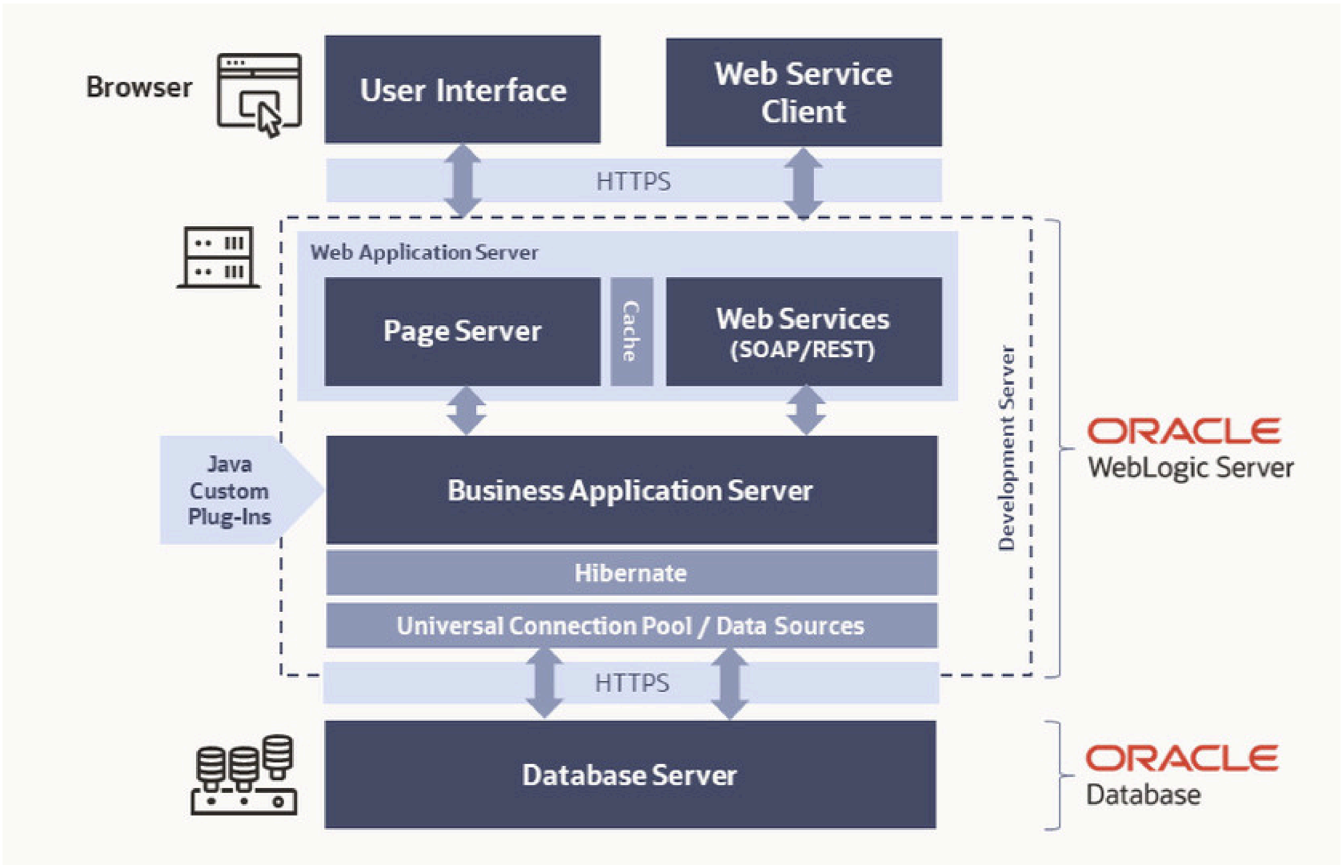
```
public void testChangeBillSegmentFreeze() {
    Installation installation = getValidTestObject();
    Installation_DTO instDto = (Installation_DTO) installation.getDTO();
```

```
        instDto.setBillSegmentFreezeOption
            (BillSegmentFreezeOptionLookup.FREEZE_AT_WILL);
        installation.setDTO(instDto);

        instDto.setBillSegmentFreezeOption
            (BillSegmentFreezeOptionLookup.FREEZE_AT_BILL_COMPLETION);
        installation.setDTO(instDto);
        verifyWarningsContain
            (MessageRepository.changeBillSegmentFreezeWarning());
    }
```

Since warnings are enabled by default, nothing needs to be stated at the outset. Additionally, the conversion of warnings to an exception occurs at a later point, so there is no ApplicationWarning to catch. Instead, after the offending statement (in this case the setDTO method) you should just verify that the current warnings contain the specified message.

Technical Background

Technology Overview



Technology Overview of the OUAF System

Information is presented in a Web browser using HTML and JavaScript (not Java, e.g., no applets). The browser communicates with a Web Application Server via HTTP.

The Web Application Server is divided into several logical tiers: presentation services, business logic, and data access. Inbound HTTP requests are handled by Java Servlets in the presentation layer, which may in turn invoke data service objects. In turns, these objects may route control to Java-based business entities, which use the Hibernate ORM framework for data access and persistence.

Various static data (control tables for dropdowns, language-specific messages/labels, etc.) are cached in the presentation layer of the Web Application Server. The presentation layer makes use of XSLT technology to create HTML for the browser.

As the browser may need several "pages" to show all the information relating to a particular business entity, a JavaScript "model" is used to manage the data in toto, and the Internet Explorer XMLHTTP object is used to send the data to the server as an XML document. Data is provided to the browser as literal JavaScript. The specialized portal and dashboard areas use server-side XSLT technology to render the final HTML directly on the server. The HTML for grids in the browser is created using client-side MSXML XSLT transforms.

This kind of architecture is described as Asynchronous Javascript and XML.

Portability

The system is highly portable to various hardware platforms, as web application servers are pure Java applications and run on myriad operating systems, including Windows clients, servers, and many versions of UNIX.

Note: The Oracle Utilities SDK is supported only on Oracle WebLogic.

Distribution

The various logical components can be distributed to as many machines as desired. In particular, the web application server architecture is stateless, so many parallel server machines can be utilized given an appropriate load-balancing architecture.

OUAF Web Services

For details on Inbound and Outbound Web Services, refer to the online documentation and Web Services Best Practices (Doc ID: 2214375.1) available in My Oracle Support.

Metadata Overview

The generation of program components is dependent upon the Oracle Utilities Application Framework meta-data. The meta-data used by framework consists of program variables, program locations, program elements, menu options, navigation keys, tables and fields, and many more.

The meta-data itself can be split into distinct groupings. These groupings will be covered in more detail below.

Table-Related Metadata

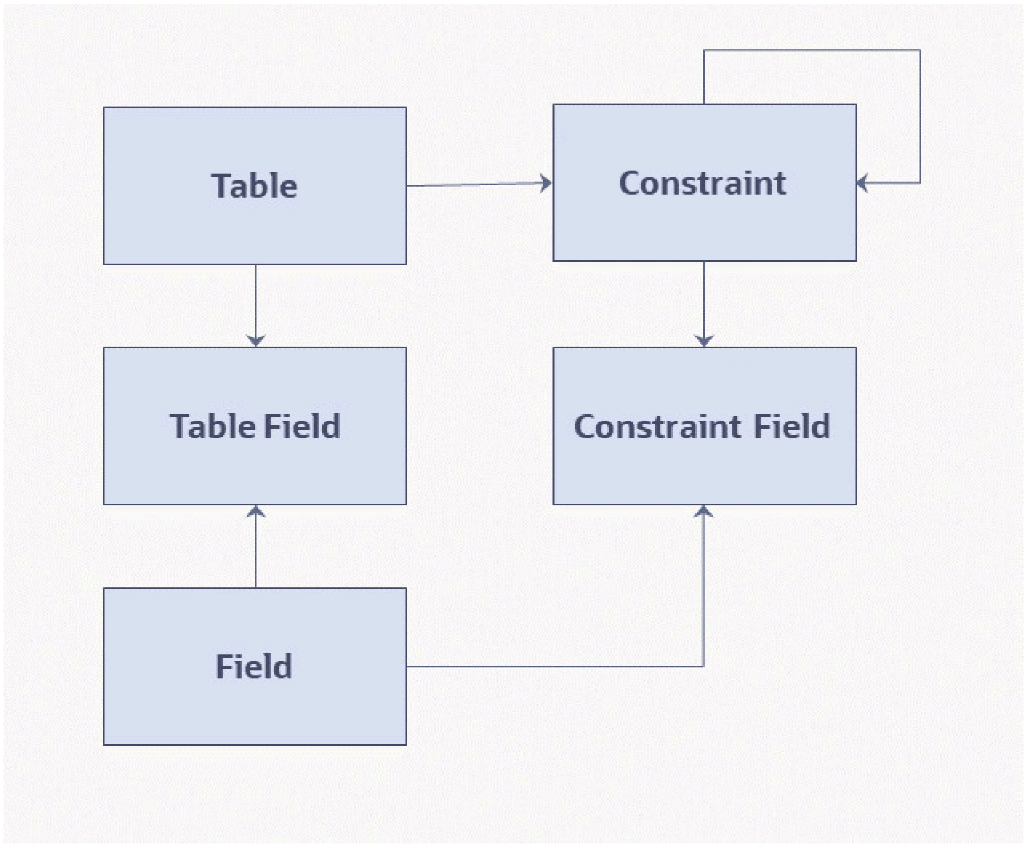


Table Metadata ERD

Table information is used for various purposes. Table information is stored in metadata. This includes which **fields** are on the table (**table field**) and business rules for the fields. **Constraints** define the keys of tables. Constraints also define relationships between tables. **Constraint fields** specify the fields involved in the keys or relationships between tables.

Multi-Language

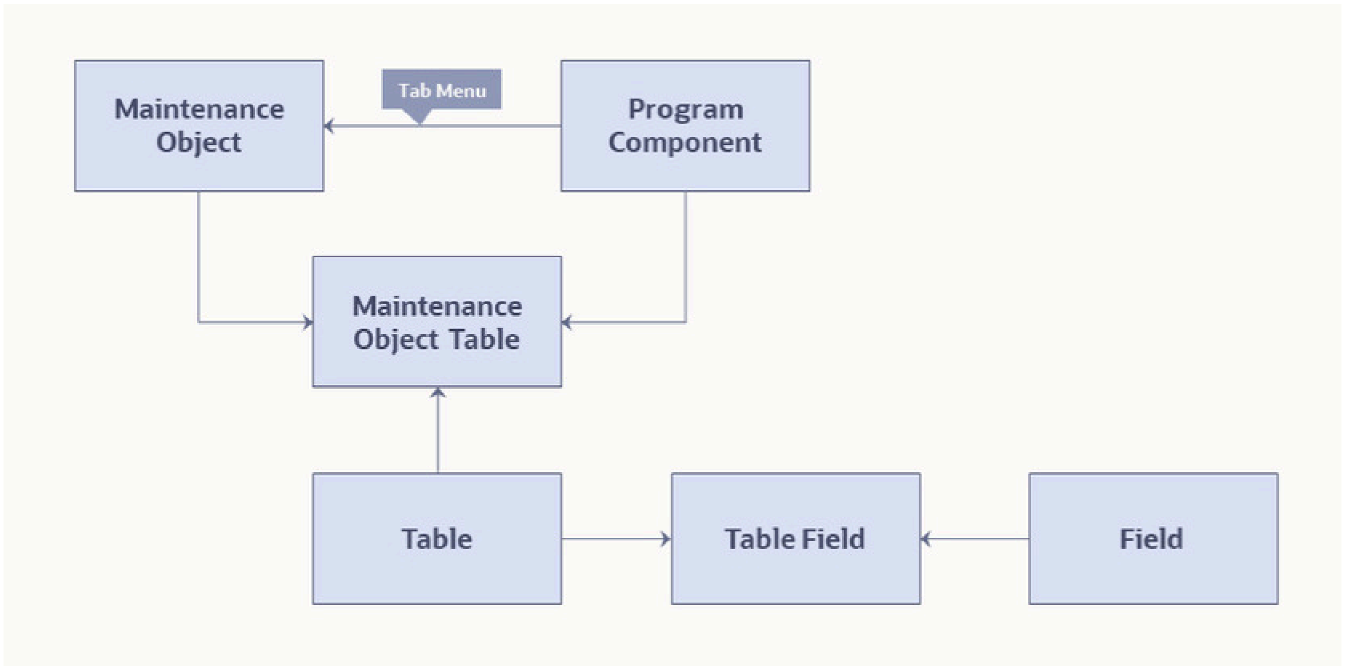
The framework product is available worldwide. This means that the product must be able to display information in many languages.

Some field and table information is language-dependent. Table, table / field, and field all have child language tables that hold descriptions specific to each supported language. When field information is retrieved, the system returns not only the base field information, but also the descriptions associated with the user's language.

This process is also used for labels (fields with Work Switch set to **Y**). When a label is needed by the system, the work field information is obtained, and the description (from the language table) is displayed on the UI.

Note: Developers should not use plain text on the UI. All labels should be defined as work fields so that the system will recognize the field and obtain the correct, language-based description to display.

Maintenance Object Metadata



Maintenance Object ERD

A maintenance object (MO) represents a group of tables maintained within framework. These objects are primarily used by the Content Migration Assistant functionality and by the Oracle Java Migration Cloud Service.

MOs also provide structure from which the various program components (needed to maintain an object) can be created. To be specific, both the front-end user interface (UI) components and the back-end program components can be generated from the MO. The MO specifies the key program component, namely:

- UI Tab Menu

MOs have at least one associated table (primary table), sometimes referred to as root table. In most cases, there are child tables associated with the primary table. For example, a language table, person name table (child of person table), and so on. The Table Role specifies whether the table is a child or a primary.

MO Table information is maintained from the Maintenance Object Tables Collection of the Maintenance Objects Object View.

Defining Generator Tools Metadata

Before generating new programs, you must create the metadata to be used by the generator tools.

Warning: Please refer to the System Table Guide in the Database Administration Guide for the standard naming convention of each metadata object. Compliance to the standard naming conventions is critical in ensuring the ability to upgrade.

Please refer to the *Oracle Utilities Application Framework Administration Guide* for details about setting up each of these metadata tables.

- Fields (*Database Tools, Defining Fields*)
- Foreign Key References (*Database Tools, Defining Foreign Key References*)
- Lookup Tables (*Database Tools, Defining Lookups*)
- Navigation Options (*User Interface Tools, Defining Navigation Options*)
- Services (*Configuration Tools, Service Program*)
- Tables (*Database Tools, Defining Tables*)
- Menus (*User Interface Tools, Defining Foreign Key References*)

- Maintenance Objects (*Database Tools, Defining Maintenance Objects*)

Development Process

This chapter provides a quick reference for common development tasks. The details are described in the Cookbook chapter.

Hooking into User Exits

Hooking into UI Javascript User Exits

Note: It is recommended to use UI Maps as alternatives to UI User Exits. Refer to the online documentation for UI Map information.

UI pages can have various events extended to add to or possibly override base product behavior. To create a Javascript user exit:

- Identify the page to extend.
- Create a JSP extension file (.xjs file) for the given page containing the necessary method for the given action.
- Identify user exits to code.
- Code the desired user exit logic into the JSP extension file.

Hooking into Java User Exits (interceptors)

Interceptors allow additional logic to be executed before or after the invocation of a service. To implement an interceptor:

- Identify the page to extend.
- Identify the interceptor interface to implement.
- Create an interceptor class.
- Code the desired logic into the interceptor class.
- Register the class in CMServiceConfig.xml.

Extending Business Entities

Business entities are the Java representation of persistent data in the system. These objects are transparently initialized and persisted into the database. Many entities are already defined by the base application but may be extended through customization. Likewise, new entities may be created which expose custom tables as business entities.

There are two kinds of hand-coded logic associated with business entities: logic that exposes useful methods to the outside world and logic that is used within the entity itself to perform validation and handle the cascading effects of its changes in state.

Logic exposed to outside callers is what is coded on the business entity's implementation class (the "Impl") class. These "business methods" are then generated onto the entity's "business interface" (e.g. the Person interface). The business interface is the contract that the entity has with other objects.

Quite another thing is how an entity validates and otherwise deals with its changes of state. This is event-driven logic that is not exposed to outside callers and never belongs on the business interface. This type of interface is commonly referred as a "specialization interface" rather than a "business interface" and is coded in change handlers. Unlike a business interface, which receives messages from other objects, a specialization interface is one that provides a mechanism purely for extension of some baseline behavior. In that spirit, the framework design clearly separates the two kinds of code.

Extending the Business Interface

- Create a new implementation class.
- Specify appropriate annotations for an extension implementation class.
- Code business methods.

- Generate artifacts.
- Create a JUnit test.
- Generate artifacts.
- Run JUnit tests.
- Deploy to runtime.
- Test in runtime.

Extending the Specialization Interface

- Create a new change handler.
- Specify appropriate annotations for a change handler.
- Code specialization interface.
- Generate artifacts.
- Create a JUnit test.
- Generate artifacts.
- Run JUnit tests.
- Deploy to runtime.
- Test in runtime.

Creating New Business Entities

Business entities are the object representation of persistent data in the database. To create a new business entity the tables, fields and other meta-data should have already been defined in corresponding meta-data tables. Likewise, the schema objects must already be in the database. Having completed these steps, the business entity is defined to the Java programming and runtime environment by:

Specifying the Business Interface

- Create a new implementation class.
- Specify appropriate annotations for an implementation class.
- Code business methods.
- Create a JUnit test.
- Generate artifacts.
- Run JUnit tests.
- Deploy to runtime.
- Test in runtime.

Specifying the Specialization Interface

- Create a new change handler.
- Specify appropriate annotations for a change handler.
- Code specialization interface, if any.
- Create a JUnit test.
- Generate artifacts.
- Run JUnit tests.
- Deploy to runtime.
- Test in runtime.

Extending Maintenance Classes

The topics in this section describe maintenance class extension procedures.

Maintenance extensions

Not all maintenance logic can go in the initial application's Maintenance. For instance, how can you retrieve the description of a foreign key whose table does not exist in that application?

An "extension" methodology exists whereby an existing page can have behavior added to it at predetermined plug-in points.

This is done by having a list of maintenance extensions that can be supplied for any given maintenance. At runtime, this list is kept and when a maintenance is initialized, new instances of its extensions are created. These extensions are called after any original maintenance behavior, and in the order of loaded applications. This means that the extensions should have no dependence on what other extensions have run, excepting the original maintenance having run.

To extend a maintenance:

- Create a new maintenance extension class.
- Specify the annotations required for a maintenance extension.
- Code desired logic in appropriate methods (see `AbstractMaintenanceExtension`).
- Generate artifacts.
- Code JUnit tests.
- Run JUnit tests.
- Deploy to runtime.
- Test in runtime.

Creating Business Components

Business Components provide a mechanism to provide non-persistent business logic (as opposed to business entities that add to persistent objects). An example business component is as follows:

```
/**
 * Component used to query for {@link Person} instances based on various
 * predefined criteria.
 *
 * @BusinessComponent
 *   (customizationReplaceable = false)
 */
public class PersonFinders_Impl
    extends GenericBusinessComponent
    implements PersonFinders
    /**
     * @param   nameType  a name type
     * @return  count of names by name type
     *
     * @BusinessMethod (customizationCallable = true)
     */
    public int findCountByNameType(Lookup nameType) {
        Query query = createQuery
            ("FROM PersonName name where name.nameType = :type");
        query.bindLookup("type", nameType);

        return (int) query.listSize();
    }
```

To add a new component:

- Create a new implementation class.
- Specify appropriate annotations for a business component implementation class.
- Code business methods.
- Specify appropriate annotations for business methods.
- Create a JUnit test.
- Generate artifacts.
- Run JUnit tests.
- Deploy to runtime.

- Test in runtime.

Plugging in Algorithms

Algorithms provide a powerful and flexible way of extending applications that use the Oracle Utilities Software Development Kit.

Algorithm spots in the application identify different areas that can be extended or customized by implementers. Each algorithm spot defines a set of inputs (typically via `set-` methods) and output (typically by `get-` methods).

During implementation, implementers can either re-use existing algorithm types or create new plug-in algorithm. To add a new plug-in algorithm, an implementer will follow these steps:

- Identify the plug-in spot.
- Create an algorithm component.
- Specify appropriate annotations for algorithm component.
- Code the desired logic into the `invoke()` method.
- Code methods to implement the algorithm spot interface.
- Create a JUnit test.
- Generate artifacts.
- Run JUnit tests.
- Deploy to runtime.
- Create a java class to perform a special plug-in action. This typically would be a modified version of an existing plug-in class. Refer to the algorithm spot definition for the various parameters that are available. In writing it, look out for possible soft parameters that will add flexibility to the plug-in.
- Add an Algorithm Type to correspond to the new plug-in behavior. This includes naming the java class that was created in the previous step. In addition, the soft parameters that are expected by the algorithm are also defined here.
- Create Algorithm specifying the specific algorithm parameter values where applicable. If the algorithm type is flexible enough, it may end up being reused in multiple algorithms, each having a different set of soft parameter values.
- Add the algorithm to the appropriate control table's algorithms. With this step, the plug-in is available to the application.
- Test in runtime.

Creating Background Processes

To create a background process, there are three important classes that need to be created.

- An implementation of com.splwg.base.api.batch.BatchJob. This is the "driver" and should:
    - Include a "BatchJob" class annotation
    - Extend a generated superclass. In the case where the batch job is named "Foo", the generated superclass will be "Foo_Gen".
- An implementation of com.splwg.base.api.batch.ThreadWorker. This is responsible for processing the work distributed to a processing thread. By convention, this is coded as a static inner class within the BatchJob class implementation described above. If the file becomes excessively large, the worker can be split into its own source file. The worker class extends a generated abstract superclass. In the case of the "Foo" batch job, the worker should be named FooWorker and extend "FooWorker_Gen".
- At least one test class extending com.splwg.base.api.testers.BatchJobTestCase. This class will perform automated tests on the batch process. The runs are performed within the test thread and transaction and all changes are rolled back at the end of the test.

After creating the background process, a corresponding entry should be made in the Batch Control table referencing the created BatchJob's class.

An example batch Job is com.splwg.base.domain.todo.batch.BatchErrorToDoCreation and the test is BatchErrorToDoCreationTest.

Testing Background Processes

BatchJob classes can be tested with JUnit in two ways:

- Extending the BatchJobTestCase class and implementing abstract methods.
- Calling the submitBatchJob(SubmissionParameters) method in any ContextTestCase. This allows testing a mix of one or more background process and other business logic to be tested.

In both approaches, the normal commit and rollback logic of BatchJobs is subverted so that all updates performed by the batch process are rolled back when the test completes, either successfully or unsuccessfully. Therefore, these JUnit tests provide a safe way to test batch processes without making irreversible database updates.

Creating MOs and Maintenance Transactions

A typical development of a new MO and its corresponding maintenance transaction entails the following steps:

- Create database objects, e.g., tables, indexes, etc.
- Enter database type of meta-data using online application from the Admin Menu. This includes:
  - Field
  - Table
  - Table/Field
  - Constraints
- Enter MO meta-data using the online system from the Admin Menu.
- Create the entity, changeHandler, and maintenance impl (implementation) classes using Eclipse.
- Generate artifacts based on the impl classes using the Artifact Generator. The artifact generator must also be executed whenever annotations and/or meta-data are changed.
- Add business rules on either the entity or changehandler using Eclipse.
- Create business components, if necessary, in Eclipse.
- Create test classes and then execute JUnit tests in Eclipse.
- If necessary, update maintenance impl class annotation to include fields with derived values using Eclipse. Regenerate artifacts after changing annotation. This generates the service metainfo.
- Add business logic on maintenance impl classes using Eclipse.
- Create maintenance test classes and then execute JUnit tests in Eclipse.
- Create search impl classes using Eclipse.
- Create search test classes and then execute JUnit tests in Eclipse.
- Create a new Maintenance Object from the Admin Menu -> Maintenance Object. This would automatically create the Tab Menus and Tab Pages necessary for a new transaction. This will also create the appropriate navigation key for each program component.
- Create javascript user exits for UI program components (tab menu, tab page, list grid, and so on.).
- Add security access to the new application service.
- Create Menu entry for new application service.
- Launch server and test the new application service.

Building General Purpose Maintenance Classes

The steps for developing general-purpose maintenance classes are like those for MO-based maintenance classes, as described above, but without the need to rely on entity or MO metadata.

- Create the maintenance impl (implementation) classes using Eclipse.
- Generate artifacts based on the impl classes using the Artifact Generator. The artifact generator must also be executed whenever annotations and/or meta-data are changed.
- Create business components, if necessary, in Eclipse.
- Create test classes and then execute JUnit tests in Eclipse.
- If necessary, update maintenance impl class annotation to include fields with derived values using Eclipse. Regenerate artifacts after changing annotation. This generates the service metainfo.
- Add business logic on maintenance impl classes using Eclipse.

- Create maintenance test classes and then execute JUnit tests in Eclipse.
- Create javascript user exits for UI program components (e.g. tab menu, tab page, list grid, etc.).
- Add security access to the new application service.
- Create Menu entry for new application service.
- Launch server and test the new application service.

Creating Javadocs for CM Source Code

Information about the Javadoc tool can be found at the following location: https://www.oracle.com/technical-resources/articles/java/javadoc-tool.html. Please refer to the documentation concerning how to write tags, troubleshoot warnings and errors, and any other Javadoc tool questions.

Some known warnings are generated as part of the CM Javadoc process. The following two warnings are safe to ignore:

- The product's annotations currently use tags that are unrecognized by the Javadoc tool. Currently, the Javadoc tool is reporting these as warnings. These warnings are safe to ignore. For the list of tags that are relevant, please refer to the reference guide. For example, the Javadoc tool emits the following warning when it encounters the product's EntityPageMaintenance annotation. It is safe to ignore.

  ```
  warning - @EntityPageMaintenance is an unknown tag
  ```
- The Javadocs tool may also generate warnings that appear from the generated artifacts. These are easily identifiable by looking at the path for the name "sourcegen." For example, the following warning can be ignored since the path name includes the "sourcegen" directory:

  C:\spl\CCB_PROJ1\java\sourcegen\cm\com\splwg\cm\domain\common\cmCisDiv\CmCisDivisionMaintenance_Gen.java:437

For all other warnings, please refer to the Javadoc documentation.

To generate Javadocs, run the utility script generateJavadoc.bat.

To integrate CM and the product's Javadocs, run the utility script reindexJavadoc.bat to recreate the indices to reflect current environment.

Generate CM Javadocs

Prerequisite: all artifacts need to be generated and the code needs to be compiled without errors.

The first step is to generate Javadocs for CM code. The standard behavior of the Javadoc tool is to create indices that show the packages and classes of the source code that the tool was run on. The resulting indices will only show links to the CM classes and not the product's. To recreate the indices so that they include both the CM and the product's Javadocs, follow the next step.

Recreate the Javadoc Indices

A utility script can recreate the Javadoc indices to include both the CM and the product's Javadocs. The script will scan the files in the Javadoc directory and recreate the indices based on the files that it finds.

Cookbook

Hooking into User Exits

Hooking into Maintenance Class User Exits

Maintenance extensions

Not all maintenance logic can go in the initial application's Maintenance. For instance, how can you retrieve the description of a foreign key whose table doesn't exist in that application?

Therefore, an "extension" methodology needs to exist whereby an existing page can have behavior added to it at predetermined plug-in points.

This is done by having a list of maintenance extensions that can be supplied for any given maintenance. At runtime, this list is kept and when a maintenance is initialized, new instances of its extensions are created. These extensions are called after any original maintenance behavior, and in the order of loaded applications. This means that the extensions should have no dependence on which other extensions have run, excepting the original maintenance having run.

Developing Maintenance Extensions

Maintenance extensions must use the same buffer structure as the original maintenance. The only change allowed is to add possible new default values. Thus, a maintenance extension with its annotation might look like this:

```
/**
 * @version $Revision: #1 $
 * @MaintenanceExtension (serviceName = CILTALTP,
 *      newDefaults={ @JavaNameValue (value = TEST, name = test)
 *                  }
 *      )
 */
public class AlgorithmTypeMaintenanceExtension
    extends AlgorithmTypeMaintenanceExtension_Gen {
   }
```

The maintenance extension will have its superclass generated to give easy access to the STRUCTURE definition and HEADER and DEFAULT constants, as well as provide an easy hook for any future functionality that might need to be inserted.

You must use the constants on the STRUCTURE or HEADER structure definitions to reference input header fields or which output fields to populate.

The maintenance extension can then override any methods needed to provide its functionality. Some examples of methods available are:

```
    /**
     * Process a default
     * @param defaultValue the raw string value of the default (can compare
     *     against DEFAULTS constants)
     * @param item the item to be modified with default values
     */
    public void processDefault(String defaultValue, DataElement item) {}

    /**
     * Process the data after the whole add (root and chidren) action is
     *     done.
     * @param originalItem the input item
     */
    public void afterAdd(DataElement originalItem) {}

    /**
     * Process the data after the whole read (root and children) action is
     *     done.
     * @param result the output item
     */
    public void afterRead(DataElement result) {}


    /**
     * Process the data after an element of the given list has been read.
     * @param listName the list name
     * @param outputElement the output element
     * @param sourceEntity the just read entity
     */
    public void afterPopulateElement(String listName,
        DataElement outputElement, BusinessEntity sourceEntity) {}

    /**
     * Process the data after an element of the given list has been changed.
     * @param listName the list name
     * @param inputElement the input element
     * @param changedEntity the changed entity
     */
    public void afterChangeElement(String listName,
        DataElement inputElement, BusinessEntity changedEntity) {}

    // ...
```

The complete list can be found in the hierarchy of the extension class (e.g., `AbstractMaintenanceExtension`) http://www.python.org/

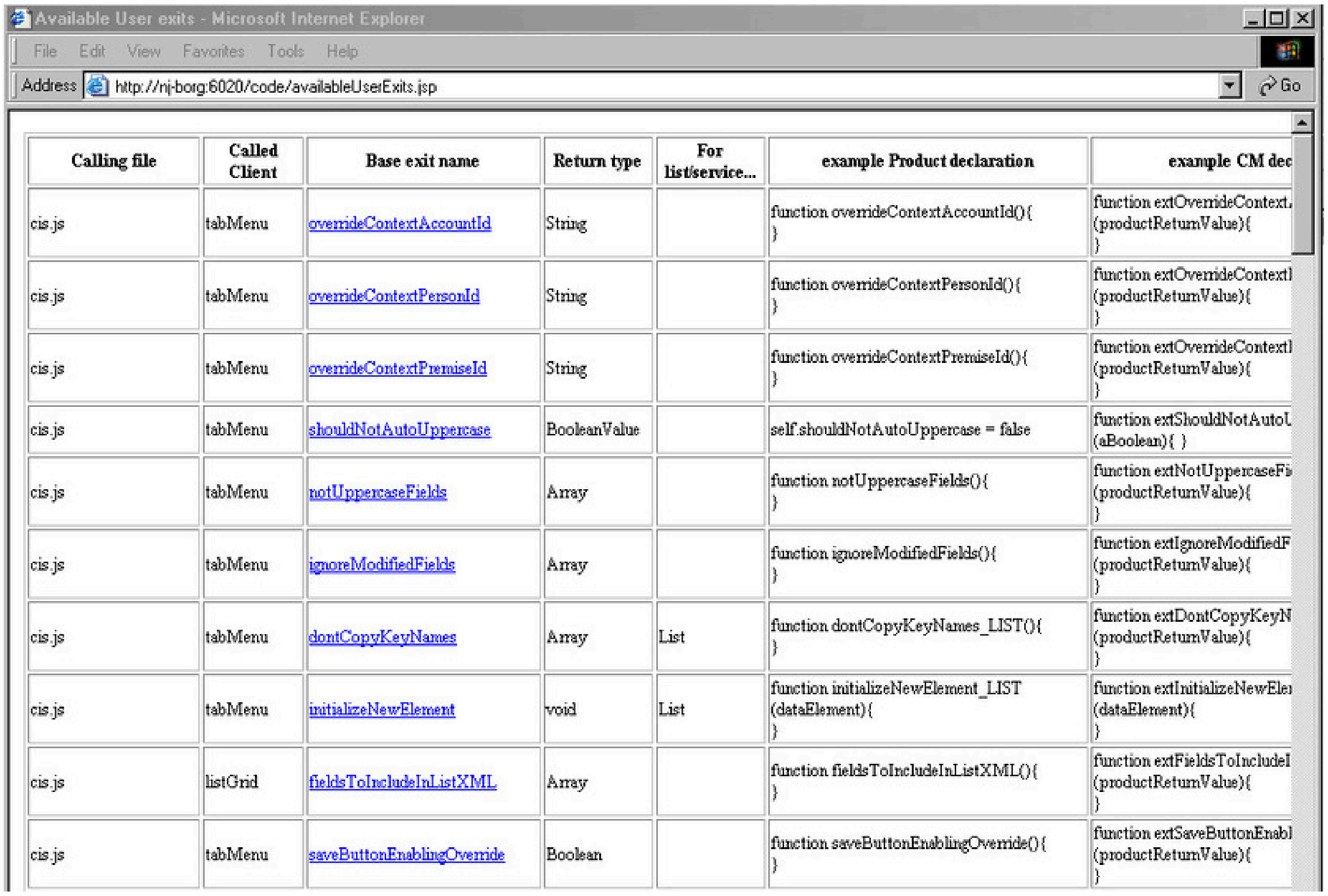
Hooking into UI Javascript User Exits

Note: The JSPs outlined in this section are no longer shipped automatically with the product for security purposes. Refer to the Installation Guide for details of how to add them to your installation.

The client-side external user exits are designed to give implementers flexibility and power to extend the base package user interface. Implementers can add additional business logic without changing base html files. These user exits were developed such that developers can create an include-like file based on external user exit templates.

There are two types of client user exits available. There are process-based user exits that wrap the similar product user exit code with pre- and post- external user exit calls, and there are also data-based user exits that simply allow the implementer to add/delete data from the product returned data.

Both types of external user exit are only called if the function exists in the implementer's external include JSP file. All available user exits are listed online in the system through the relative URL: /code/availableUserExits.jsp, with definition examples and links to the Framework code that executes the call.


Available User exits - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Address http://nj-borg:6020/code/availableUserExits.jsp
Go

Calling file	Called Client	Base exit name	Return type	For list/service...	example Product declaration	example CM dec
cis.js	tabMenu	overrideContextAccountId	String		function overrideContextAccountId(){ }	function extOverrideContext. (productReturnValue){ }
cis.js	tabMenu	overrideContextPersonId	String		function overrideContextPersonId(){ }	function extOverrideContextI (productReturnValue){ }
cis.js	tabMenu	overrideContextPremiseId	String		function overrideContextPremiseId(){ }	function extOverrideContextI (productReturnValue){ }
cis.js	tabMenu	shouldNotAutoUppercase	BooleanValue		self.shouldNotAutoUppercase = false	function extShouldNotAutoU (aBoolean){ }
cis.js	tabMenu	notUppercaseFields	Array		function notUppercaseFields(){ }	function extNotUppercaseFi (productReturnValue){ }
cis.js	tabMenu	ignoreModifiedFields	Array		function ignoreModifiedFields(){ }	function extIgnoreModifiedF (productReturnValue){ }
cis.js	tabMenu	dontCopyKeyNames	Array	List	function dontCopyKeyNames_LIST(){ }	function extDontCopyKeyN (productReturnValue){ }
cis.js	tabMenu	initializeNewElement	void	List	function initializeNewElement_LIST (dataElement){ }	function extInitializeNewEle (dataElement){ }
cis.js	listGrid	fieldsToIncludeInListXML	Array		function fieldsToIncludeInListXML(){ }	function extFieldsToIncludeI (productReturnValue){ }
cis.js	tabMenu	saveButtonEnablingOverride	Boolean		function saveButtonEnablingOverride(){ }	function extSaveButtonEnabl (productReturnValue){ }

Miscellaneous How-To's

The following are some how-to examples of typical behavior utilizing some of the standard user exits.

The examples are written for cases of modifying new CM transaction pages, where the function definitions are put into "extended JavaScipt" files (.xjs) that are meant to contain JavaScript user exits directly for a page.

If, on the other hand, an implementer wishes to modify the behavior of a shipped product page, each of the functions below have a corresponding "ext" function that can define in a /cm/extXXX.jsp file corresponding to the desired page that will fire after any product function call (see above an example of hiding the Sequence column in the algorithm maintenance page).

How Do I Control the Initial Focus Within Tab Pages/Grids/Search Pages?

The system automatically places the initial focus on an appropriate widget (generally input fields) within a Tab Page/ Search Page/Grid.

By default, focus is placed on the first enabled field that has a data class defined. (Fields with no Field Name / Table Name defined within Meta Data have no data class.)

If there are no fields within the tab page that satisfy this criterion, the system looks recursively into all the contained frames (list grids, for example).

If no field is found then no element receives focus.

You can override the default behavior at each level via the provision of a focusWidgetOverride() function within the user exit file; this returns either the Name of the Field to receive the focus or null.

If null is returned, the system ignores all fields within this document and continues to search in lower-level documents.

For example:

From within a Tab Page (if you want focus to go on to a sub document):

```
function focusWidgetOverride() {
  return null;
}
```

From within a List Grid:

```
function focusWidgetOverride() {
  return "TD_TYPE_DRLKY:0$TBL_NAME";
}
```

From within a Search Page:

```
function focusWidgetOverride() {
return "LAST_NAME";
}
```

Note: These functions can be as simple or complicated as you want. You could conditionally return a field name or null and this code would run each time the window loads. Also, if a tab page has a popup window or a search window open as it is loading, then the initial focus would stay on the popup window, and not on the tab page.

How Do I Mark Fields that Won't Make the Model Dirty?

In certain windows, we have a concept of a *locator* field, which typically acts as a filter on some lists of the current object. Examples are user group's filter on description and several IB windows' filter by date.

In case the page is dropped after a data change, locator fields throw an unexpected warning about loss of data. To avoid this warning on locator fields, you can add a function that enumerates the locator fields, such as the following:

```
function ignoreModifiedFields(){
    return ['START_DTTM']
}

You can include any number of fields in the array, e.g.
return ['FIELD_1', 'FIELD_2', 'FIELD_3']
```

How Do I Control the Triggering of Defaults After a Search?

If a search returns multiple fields and more than one of these fields can trigger default, then it might be more efficient to only have one of these fields trigger the defaulting.

This is accomplished by creating a new function called `overrideDefaultTriggersFor_SEARCHGROUP` within the tab page that contains the search, where `SEARCHGROUP` is the name of the `searchGroup` you want to override.

The function must return an object with the triggering field(s) are attributes with a `true` value.

For example:

```
function overrideDefaultTriggersFor_SRCH1() {
var triggers = {};

triggers["ACCT_ID"] = true;
```

```
            triggers["SA_ID"]=true;

return triggers;
}
```

How Do I Avoid Automatically Setting Fields to Uppercase?

Model attributes that are also key fields are automatically coerced to be in uppercase. You can block this behavior on a field-by-field basis by defining the `notUppercaseFields()` function in your TabMenu's user exit file to return an array of field names that should not be converted.

Example:

```
function notUppercaseFields() {
   return ['ELEM_ATT$AT_NAME']
}
```

You can also provide a global override for an entire TabMenu by setting the `shouldNotAutoUppercase` variable to `true`:

```
var shouldNotAutoUppercase = true;
```

How Can I Force the Save Button to be Enabled?

The save button usually synchronizes to the state of the model, such that if it has not been *dirtied*, the button is disabled. There are cases in which it may be useful to control the state of the save button. For example, when a save should always/never be allowed.

To return a boolean indicating whether the save button should be enabled, define the function `saveButtonEnablingOverride()` on the TabMenu user exit file. You can simply return a literal boolean, or perform any desired processing to determine the return value.

Example:

```
function saveButtonEnablingOverride() {
  return false;
}
```

How Can I Override the Processing After a Change/Add?

If you need to intervene in the processing after the system successfully completes a Change or Add operation, define the function `privatePostChangeSucceeded()` or `privatePostAddSucceeded()` in your TabMenu user exit file. The function should return a boolean to indicate whether the system should refresh the UI with the newly returned server data. For example, you would want to return `false` in case you navigate to a different TabMenu.

Example:

```
function privatePostAddSucceeded() {
    var model = parent.model;
    var modeFlag = model.getValue('COMPL_NAV_MODE_FLG');
    var navKey = model.getValue('COMPL_NAV_KEY');
    var complSw = model.getValue('CMPLT_CLICKED_SW');
    if (complSw && model.getValue('ENRL_STATUS_FLG') == '30') {
        if (modeFlg && navKey){
             if (modeFlag == 'G') {
                parent.tabPage.gotoContext(navKey);
                return false;
             } else if(modeFlag == 'A') {
                parent.tabPage.addContext(navKey);
                return false;
             }
        }
   }
   return true;
}
```

How Do I Prevent the System from Setting Focus to a Widget After an Error?

When a service receives an error and shows a message after calling a back-end service, the browser attempts to set focus to the relevant widget in error. If you do not need this behavior, you can define the TabMenu variable `dontSetFocusOnError` to `true`.

Example:

```
var dontSetFocusOnError = true;
```

How Do I Prevent Attributes From Being Copied into New List Elements?

To keep their prime keys consistent, key fields are automatically copied (based on name matching) from a parent list element into new child elements (for example, those created by using the scroll + button). If you want to inhibit this operation for certain fields, define the TabMenu function `dontCopyKeyNames_<LIST NAME>` to return an array of fields that should not be copied into new elements of the list named `LIST_NAME`.

Example:

```
function dontCopyKeyNames_ENRL_FLD() {
   return ['SEQ_NUM']
}
```

How Do I Customize New List Elements?

When you use the + button on a grid or scroll you get a new, empty list element. If you want to customize the object, define a function in the TabMenu's user exit file named `initializeNewElement_<LIST_NAME>(newElement)`.

Example:

```
function initializeNewElement_ENRL_LOG(newElement) {
    newElement.set('ENRL_LOG_TYPE_FLG', 'USER');
    newElement.set('USER_INFO', parent.model.getValue('CURRENT_USER_INFO'));
}
```

How Can I Get My Sequence Numbers to Default Properly on My List Grid?

If you are working with a List Grid that uses some type of sequence field (for example, `SEQNO`, `LINE_SEQ`, `SORT_SEQ`), there is a handy bit of technology that you can use that will cause the UI to do this job for you.

Just follow the steps below and you will solve this problem. The sequence field will be populated in your empty line, and any elements that are added from then on will have an appropriate value in the sequence field. If the user edits the sequence field at any point, the next element added to the list will incorporate the change without any problems.

Note: The default Sequence Number functionality will default the next nearest value from the highest sequence. The defaulting will do nothing after the sequence reaches the highest number it can hold.

- In the user exit file of the **Tab Menu** - **not** the main Page or the List Grid - copy this JavaScript code:

```
function initializeNewElement_LIST_NAME(newElement) {
      var myListName = "LIST_NAME";
      var myListSeqName = "FIELD_NAME";
      var myListMaxSeq = 999;
      defaultSequenceNumber(myListName,myListSeqName,myListMaxSeq,newElement)
}

</SCRIPT>
<SCRIPT src="/zz/defaultSequenceNumber/defaultSequenceNumber.js"></SCRIPT>
<SCRIPT>
```

- For `LIST_NAME`, substitute your List Grid's list name. Be careful not to lose that underscore [_] just in front of `LIST_NAME` in the first line! Remember that JavaScript is case-sensitive and make sure that you use all UPPERCASE letters as shown here.
- For `FIELD_NAME`, substitute the name of your sequence field, whatever that might be in your List. Don't lose the quotes ["] ! Again, use all UPPERCASE letters.

How Do I Override the Tab Page Shown After an Error in a List (Grid/Scroll)?

When the system receives an error (for example, after a Save), it attempts to set focus on the relevant widget, which might require flipping to a different tab page. If the error relates to a list (grid or scroll) the system might not choose the tab page you would prefer. In that event you can control the tab page that should be opened by defining the TabMenu function `overrideErrorTabPage_<LIST_NAME>()`.

Example:

```
function overrideErrorTabPage_BPA() {
    return 'bussProcessAssistantStepPage';
}
```

How Do I Disregard Unwanted Criteria from a Search Triggered by a Search Button?

When a search button (currently implemented as an IMG) is pushed, the system launches a search and pulls all applicable criteria values from the current model. It might be that certain criteria fields should be ignored in a particular case. You can define the function `addIgnoreFieldsFor_<triggerFieldName>()` on a tab or search page's user exit file to specify fields to ignore whenever the IMG button named **triggerFieldName** is pushed on that page.

The function takes a single argument, fields, and you should add key/value pairs where the key is a field name to ignore, and the value is `true`.

Example:

```
addIgnoreFieldsFor_ADDRESS1_SRCH = function(fields) {
  fields['CITY_SRCH'] = true
}

addIgnoreFieldsFor_PER_ID = function(fields) {
  fields['ENTITY_NAME_SRCH'] = true
}
```

How Do I Disregard Unwanted Search Result Columns?

When you accept the result of a `NOLOAD` search, the system tries to populate the selected search result row into the current model. There are cases in which this is not desirable, for example, when there is no corresponding attribute for a display-only column. You can exclude a column from being returned as part of a search result by defining the search client's (Tab Page or Search window) function `ignoreResultColumns()` in the corresponding page's user exit file. Return an object with keys specifying attributes and values all set to `true`.

Example:

```
function ignoreResultColumns() {
    return { ADDRESS1: true, CITY: true, POSTAL: true };
}
```

Since searches can be shared by many search clients, it is possible that some clients want to get a specific column, but others do not. In that case, define the TabMenu function `ignoreResultColumnsFor_<service>` as above.

Example:

```
function ignoreResultColumnsFor_CILCCOPS() {
    return {CONT_OPT_TYPE_CD: true}
}
```

How Do I Format a Value Based on a Given Format?

If you need to format a value based on a given format, for example, on Person ID Number, if you select ID Type as SSN (999-99-9999), you can always format the Person ID Number before committing it to the server.

To do so, you can call the `formatValue` javascript function.

- In the user exit file of the tab page include the following lines:

  ```
  </SCRIPT>
  <SCRIPT src="/zz/formatValue/formatValue.js"></SCRIPT>
  <SCRIPT>
  ```

- Now, you can start using the function to format a value. To use this function, you need to pass in both the **value** and the **format** into the function.

  ```
  var phFormat = myData.getValue(pureListName + 'PHONE_TYPE_FORMAT');
  if (pureFieldName == 'PHONE') {
    updateField(pureListName + 'PHONE' ,
          formatValue(myData.getValue(pureListName + 'PHONE'), phFormat));
  }
  ```

Hooking into Java User Exits (interceptors)

Create a class implementing any of the following Interceptor Java Interfaces whenever processing is required before or after the invocation of a service. The CMServiceConfig.xml file contains the mapping between services and corresponding classes that implement pre/post processing plug-ins. The files should reside in the same directory as the service xml files, that is, in the <classpath>/services folder. This can be arranged by placing the files in the web application server's WEB-INF/classes/services folder or in an existing jar file.

Note: CM interceptors defined on the CMServiceConfig.xml override base product interceptors on the same service and action.

To implement an interceptor:

- Creating a class implementing any of the Interceptor Java Interfaces.
- Register the class in CMServiceConfig.xml.

Example

The following is a sample interceptor and configuration file, where one interceptor class implements all four interfaces.

Configuration file CMServiceConfig.xml:

```
<ServiceInterceptors
    <Service name="CMLTBTCP">
        <Interceptor action="add">
            com.splwg.cis.interceptortest.InterceptorTest
        </Interceptor>
        <Interceptor action="change">
            com.splwg.cis.interceptortest.InterceptorTest
        </Interceptor>
        <Interceptor action="delete">
            com.splwg.cis.interceptortest.InterceptorTest
        </Interceptor>
        <Interceptor action="read">
            com.splwg.cis.interceptortest.InterceptorTest
        </Interceptor>
    </Service>
</ServiceInterceptors>
```

Class com.splwg.cm.interceptortest.InterceptorTest:

```
package com.splwg.cm.interceptortest;

import com.splwg.base.api.serviceinterception.IAddInterceptor;
import com.splwg.base.api.serviceinterception.IChangeInterceptor;
import com.splwg.base.api.serviceinterception.IDeleteInterceptor;
import com.splwg.base.api.serviceinterception.IReadInterceptor;
import com.splwg.base.api.service.PageBody;
import com.splwg.base.api.service.PageHeader;
import com.splwg.base.api.service.RequestContext;

public class InterceptorTest implements IAddInterceptor, IChangeInterceptor,
        IDeleteInterceptor, IReadInterceptor {

    public PageBody aboutToAdd(RequestContext context, PageBody in) {
        System.out.println("aboutToAdd: " + in);
        return null;
    }

    public void afterAdd(RequestContext context, PageBody added) {
        System.out.println("afterAdd: " + added);
    };

    public PageBody aboutToChange(RequestContext context, PageBody in) {
        System.out.println("aboutToChange: " + in);
        return null;
    };
    public void afterChange(RequestContext context, PageBody changed) {
        System.out.println("afterChange: " + changed);
    };

    public boolean aboutToDelete(RequestContext context, PageBody in) {
        System.out.println("aboutToDelete: " + in);
        return true;
    }

    public void afterDelete(RequestContext context, PageBody in) {
        System.out.println("afterDelete: " + in);
    }

    public PageBody aboutToRead(RequestContext context, PageHeader in) {
        System.out.println("aboutToRead: " + in);
        return null;
    }

    public void afterRead(RequestContext context, PageBody result) {
        System.out.println("afterRead: " + result);
    }
}
```

Maintaining General-Purpose Maintenance Classes

While most page maintenance classes are Entity-based (see Maintaining MO's below), it is sometimes necessary to write a general-purpose maintenance class for some specific purpose.

To develop such a Page Maintenance class, you need to create a hand-coded implementation class. This class subclasses a class (to be generated) with the same name (and package) as your class, but with the suffix "_Gen". For example, if your class is named `SamplePageMaintenance`, you'll subclass `SamplePageMaintenance_Gen`. Your class must include an annotation providing the metadata that describes the maintenance. This annotation is essentially a subset of the annotation for an entity page maintenance (MO maintenance), but leaves out details specific to the entity model (also known as the domain model). For example, the `RowField` annotation is not supported, since it links directly to an entity.

Here is an example of a simple `PageMaintenance` annotation:

```
@PageMaintenance (secured = false, service = CILABCDE,
      body = @DataElement (contents = { @DataField (name = DATA_FIELD1, overrideFieldNam
                  , @DataField (DATA_VALUE1)}),
      actions = { "read"},
      header = { @DataField (name = INPUT_FIELD1, overrideFieldName = FLD_NAME)
            , @DataField (name = INPUT_VALUE1)},
      headerFields = { @DataField (name = CONTEXT_NAME1, overrideFieldName = FLD_NAME)
            , @DataField (name = CONTEXT_VALUE1, overrideFieldName = FK_VALUE1)
            , @DataField (name = CONTEXT_NAME2, overrideFieldName = FLD_NAME)
            , @DataField (name = CONTEXT_VALUE10, overrideFieldName = FK_VALUE1)},
      modules = { "foundation"})
```

This example does not use any lists, but they are described and supported as are any entity maintenance classes. By default, any lists here are unmapped, that is, they are not populated by the framework from the entity model.

The supported actions are `read`, `change`, `add`, and `delete`. You can leave out the actions annotation completely if you intend to support all four of these actions. Otherwise, it's useful to declare what methods you'll support, so the framework can create an appropriate error message when an unsupported method is invoked.

You must implement one or more of the following action methods.

```
protected DataElement read(PageHeader header)
protected void change(DataElement item)
protected PageHeader add(DataElement item)
protected PageHeader copy(PageHeader header)
protected void delete(DataElement item)
```

The body of the implementation is completely up to you. The available API is largely the same as for entity page maintenance. For example, if you have a current session/transaction in which to execute queries, you can access the entity model. You are expected to throw `ApplicationError` or `ApplicationWarning` Java exceptions, as appropriate (for examplle, via `addError()` and `addWarning()`), unless a serious or unforeseen problem occurs, in which case you should throw a `LoggedException`, or simply let the underlying Java runtime exception *bubble up*.

The usual implementation of the read method would be to retrieve one or more parameters from the input page header, and construct a `DataElement` holding the desired return values, including any lists (which may be recursive).

For the `change` method, the usual behavior would be to examine the provided `DataElement` object, perform some operation, and return a different data element to hold the *changed* values.

The add method is similar to change in that it accepts an input `DataElement`, and returns the *newly added* `DataElement` instance (which should be a different instance than the input).

The `delete` method accepts a `DataElement`, but returns nothing after the conclusion of the operation.

Maintaining MOs

Maintaining Maintenance Classes for MOs

For a new MO, use the Eclipse plugin to create the skeletal class structure for a new maintenance object class.

For other services not linked to a MO, you will need to write a new maintenance subclass and create the annotation.

To develop an Entity Page Maintenance class, you need to create a hand-coded implementation class. This class must include an annotation providing the metadata that describes the maintenance. In addition, the business entities that "back" the maintenance must already have been created.

Let's take a look at a simple maintenance annotation example to illustrate its properties:

```

@EntityPageMaintenance (
      program = CIPTBTCP,
      service = CILTBTCP,
      entity = batchControl,
      copy = true,
      body = @DataElement (
          contents = {@DataField (DEFAULT_FOR_FLG)
                               , @RowField (name=foo, entity=batchControl)
                               , @ListField(name=BCP, owner=foo, property = parameters)
                          }
              ),
      lists = {@List (name = BCP, size = 50, copy = true,
                              program=CIPTBCPL, constantName="CI-CONST-CT-
MAX-FIFTY-COLL",
                              body = @DataElement (contents = {@RowField (batchControlI
               }
     )
```

First, we see that this tag is an EntityPageMaintenance, meaning it is a page maintenance for a single entity *root* object. Here it is a batch control, but account, person, premise, and so on, would also be examples. The idea here is that, by default, the maintenance framework tries to read, save, and delete the *tree* of data that starts with an instance of batch control. (Another kind of page maintenance is EntityListPageMaintenance, where you maintain a list of entities without a single *root* object. It has slightly different attributes than those discussed below.)

Next, we list some attributes of the top-level annotation. The required `program` attribute gives the equivalent Converted COBOL Program page module name that we are replacing.

The `service` is the name of the page service that we are implementing. This is required so the Framework knows that it should route requests for this service directly to this Java class.

The required `entity` property names the entity that this maintenance uses for its root. It should match an entity that is defined within the system, else the maintenance cannot work.

The copy attribute signals that certain copy fields should be defined in the service. Making the framework explicitly aware of these fields is preferable to *dumb coding* of these fields.

Now we hit the two major structural elements, the `body` and `lists` attributes.

The `body` attribute always resolves to a DataElement, which is simply a way to organize the collection of *rows*, *loose fields*, and lists that belong to a particular level in the service data structure. These contents are simply held in the `contents` array, which here starts with a simple datafield, DEFAULT_FOR_FLG. Note that you simply reference the field name, and the generator uses the field metadata to infer its type and size. The next element of the `contents` array in this example is RowField. This is essentially a way of naming a reference to the properties of a single entity/table, including its language fields, if appropriate. You need to specify its `entity` and name. Here I use a dummy name, *foo*.

Finally, we have a ListField, which consists of a reference to a list structure that is defined in a separate tag (`lists`). Here, we merely name the referenced list by name, provide the owner (which matches the name of the *parent* row), and the property (which tells the system how to access the list from the parent). We deduce that the `getParameters`() method on a batch control will yield the desired child list.

List Maintenance Classes

Writing a new list maintenance class requires you to create a new class, that provides an annotation with metadata, and lets you implement any user exits you need.

The class should subclass a generated class with the same name, but with suffix **_Gen**.

The annotation is `@ListService`, the same annotation structure that is used for lists within PageMaintenance. The service name should end with "L".

If there are child lists, you need to declare them with the `lists` annotation, just like for PageMaintenance.

You should specify any query criteria (from clause, where clause, order by clause) in the List Service annotation. See MaintenanceListFilter for details.

The default test superclass simply tests that at least one result row is returned.

Here is an example for testing this list maintenance:

```
package com.splwg.base.domain.batch.batchRun;

import com.splwg.base.api.service.ListHeader;
import com.splwg.base.api.testers.ListServiceTestCase;

import java.math.BigInteger;

public class ThreadListInquiry_Test
    extends ListServiceTestCase {
//~ Methods
//------------------------------------------------------------------------------------
    public String getServiceName() {
        return "CILTBTHL";
    }

    /**
```

```
      * @see com.splwg.base.api.testers.ListServiceTestCase#getReadListHeader()
      */
     protected ListHeader getReadListHeader() {
         ListHeader header = new ListHeader();
         header.put("BATCH_CD", "TD-BTERR");
         header.put("BATCH_NBR", BigInteger.valueOf(1));
         header.put("BATCH_RERUN_NBR", BigInteger.valueOf(0));

         return header;
     }
 }
```

Maintenance List Filters

A given list on a maintenance may not need to return all the data in the list. Instead, a filter can be applied to return a subset of the data. You get the main list by default.

You can modify the SQL that will be used for the list retrieval by writing an HQL to filter the list. This HQL goes into the `@List` annotation's `fromClause` and `whereClause` properties. This is written as an HQL filter HQL, where the main table (and its language alias, if there is one) already exists in the background, and can be referenced by the alias `this` (and `thisLang` for the language row).

New entities can be added to the *from* clause, and a *where* clause can be specified. However, a *select* clause should not be specified; instead, results can be added in the `bindList` user exit (see below). And neither should be an *order by* (the *order by* is to be specified separately).

Additionally, if there are extra values that can be retrieved via a join, the loose data fields can be specified as `@ListDataField`, with an `hqlPath` property specifying the hql path to select the result.

Finally, you can bind parameters and also specify extra results into the query in the `bindList` user exit specific for the given list.

List Maintenance Get More

When a list is too large to send to the UI in one shot, there is the ability to *get more* rows.

An @List can simply have its order set (separate from any other Maintenance List Filter properties). Everything else is automated by the FW. There is no need to add special **LAST_** fields to the annotation/service, nor even to add the parent's PKs.

The order of a maintenance's list can be given in two ways:

- The order can come from the domain _Impl class. However, this is limited as it may only use fields on the entity table itself (not even language properties).
- The order can be specified on the @List annotation as a string `orderBy`, written in hql form, using the special entity alias `this` to refer to the row (and `thisLang` to refer to the language row if one exists), and including any other aliases available from the `fromClause` property.

The list will retrieve rows in chunk sizes given by the size property on the @List annotation.

An example of using this filtering to join extra information is available on the class `MaintenanceObjectMaintenance`. Another example on a `ListService`, is available on the class `NavigationOptionMenuList`.

Besides using a MaintenanceListFilter and knowing how to deal with list *get mores*, lists in a page maintenance will automatically retrieve (and cache) the language row associated with the main row of the list. This helps the n+1 select problem (only a single SQL is issued, instead of the main one, plus an extra one for each of the rows' language row), and also provides the ability to have shorthand for the `orderBy` property of a list. If the order is simply by a language property, then you can reference it by `thisLang.property`, without having to supply a `filterClause`.

Maintaining Maintenance Objects

A maintenance object is a group of tables maintained together within the system.

Note: For detailed information about Maintenance Objects, please refer to user document *Framework Administration, Database Tools, Defining Maintenance Object Options*

Maintaining Database Meta-data

Maintaining Fields

Field represents a column on a database table. A Field must exist before it can be defined on a Table.

Note: For detailed information about fields, please refer to user document *Framework Administration, Database Tools, Defining Field Options.*

Maintaining Tables

Table represents a database table used to store data or a database view.

Note: For detailed information about menus, please refer to user document *Framework Administration, Database Tools, Defining Table Options.*

Maintaining Java Classes

Maintaining Business Entities

Business Entity Background

A central framework concept is the Business Entity that allows for persistent data in the database to be interacted with as objects. In general there is at least one Business Entity class corresponding to each table in the system. Likewise an instance of one of these classes corresponds to a row in the database. Here are some things to remember about Business Entities:

- When you create a new instance of a Business Entity and the current transaction commits, a new row is committed to the database. Likewise when instances are deleted or changed, corresponding deletes or updates are performed on the database. There is no concept of a transient entity in our architecture; application logic is dealing with only persistent objects.
- When the actual insert, update and delete statements are issued to the database is controlled by the framework and may be deferred for performance reasons. The framework is, however, expected to issue DML with sufficient timeliness to maintain data consistency so that application code need not concern itself with when statements are actually executed.
- When you use the query language (HQL) the returned objects are Business Entities (or scalars in the case of "count" or other aggregate functions). These objects may be modified by application code and those changes will be persisted to the database.
- The way you change the properties on entities is via the Data Transfer Objects corresponding to the entity.

How Do I Create a New Business Entity Instance?

Creating a new entity is equivalent to inserting a new row into the database. The first thing you need is to have the framework create a new instance of the correct Data Transfer Object for you, so that you can set properties for the new entity instance. This can be done via one of the standard framework methods accessible from the abstract superclasses of classes holding business logic. This method can be told which DTO to create by passing the business interface class for the entity. In the example below, we are creating a new `Person_DTO`.

```
Person_DTO personDTO = (Person_DTO) createDTO(Person.class);
```

Alternatively, if you find that you have a reference to an Id class, the appropriate DTO can be created via a method generated onto that Id class.

```
Person_Id aPersonId = new Person_Id("123467890");
Person_DTO personDTO = aPersonId.newDTO();
```

Now let's set some values for the new Person instance:

```
personDTO.setStateId(state.getId());
personDTO.setLanguageId(language.getId());
```

Finally, we try to create a persistent instance based on these values. This is equivalent to doing the insert against the underlying table except that: (1) required validation occurs, and (2) the timing of actual insert occurs at the discretion of the framework.

```
Person person = (Person) createBusinessEntity(personDTO);
```

That's it. When the current transaction is committed, a new person will be added to the database.

How Do I Change Values on an Existing Business Entity Instance?

There are really three steps:

- Ask the existing entity for its DTO.
- Change the appropriate values on the DTO.
- Call setDTO() on the entity instance.

```
Person_DTO dto = person.getDTO();
dto.setAddress1("invalid value");
person.setDTO(dto);
```

Necessary Change Handlers will fire to validate the change to this "person" object as well as other cascading events as specified in the entity's change handlers.

How Do I Delete a Business Entity Instance?

There are a number of ways to delete entities.

1. Delete an instance that you have a reference to:

```
person.delete();
```

2. Delete an instance where you have only its Id:

```
delete(personId);
```

3. Delete the results of a query

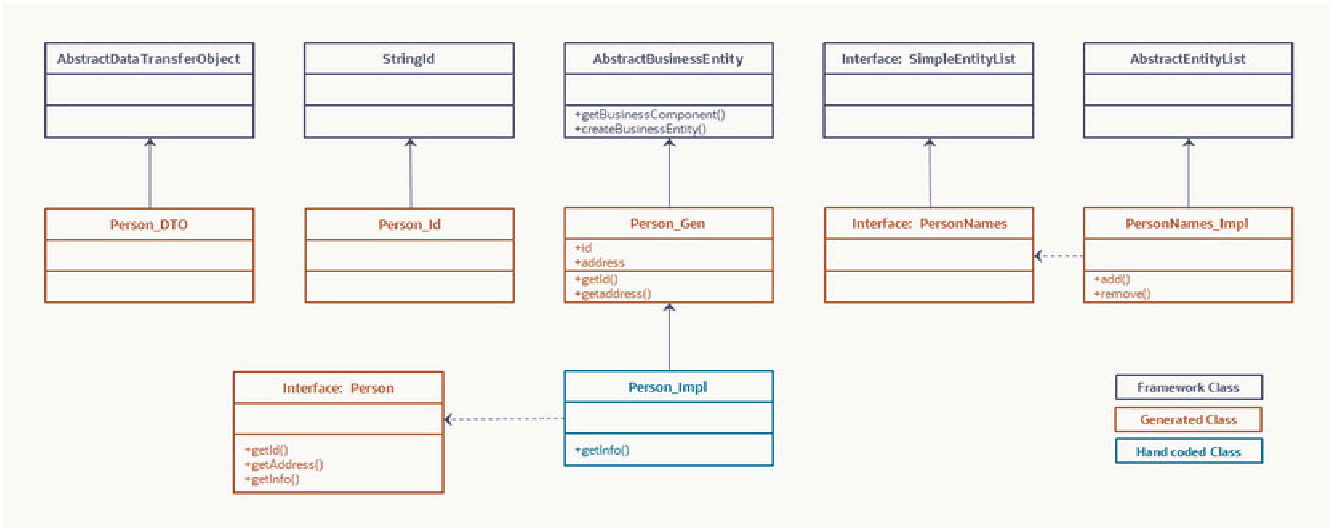
```
Query query = createQuery("from Person person where exists ( "
    + " from PersonName as perName where person = perName.id.person and "
    + "perName.isPrimaryName = :systemBool and perName.entityName "
    + "like :name)");
 query.bindLikableString("name", "ABC", 64);
 query.bindBoolean("systemBool", com.splwg.base.api.datatypes.Bool.TRUE);

 long rowsDeleted = query.delete();
```

Persistent Classes

Behind the scenes, the persistence and validation mechanisms are quite complex and require the collaboration of many classes and pieces of configuration data. Thankfully, most of this complexity is hidden from the application programmer. Still, there are various classes that the application programmer will deal with:

- Framework Classes that act as an application programming interface. These API classes are directly referenced by application code.
- Generated Classes that are created for each business entity that serve two purposes:
  - They provide convenient methods (like property *getters* and *setters*) based on the structure of the specific entity, its fields, child collections, and key structure, for example.
  - They are necessary for the persistence mechanisms to work correctly.
- Handcoded classes that the application programmer is expected to write. Many of the handcoded classes are read by the artifact generator so the framework can *wire up* the handcoded functionality.

Some examples of the above classes are shown below.



Creating the Implementation Class

There is very little that needs to be done by application developers to create a basic business entity. In addition to the setup of the CI_MD_* tables describing the entity and its constraints, only an implementation class (or `Impl`) needs to be added. In this case, a developer added `Person_Impl`. The following is a simple example of an `Impl` class for the `Person` entity.

```
/**
 * @BusinessEntity
 *   (tableName = CI_PER,
 *    oneToManyCollections  = { @Child( collectionName = names,
 *                                 childTableName = CI_PER_NAME,
 *                                 orderByColumnNames = { SEQ_NUM } )
 *                            }
 *   )
 */
public class Person_Impl
    extends Person_Gen {
    /**
     * @return the UI Display "info" for this person
     */
    public String getInfo() {
        return "PrimaryName: " + getPrimaryName().getInfo();
    }
}
```

Important parts of the implementation class are described below:

- **The implementation class name must end with the suffix `_Impl`.** For example, if the entity has a `person` name, then the implementation class name would be `some.package.Person_Impl`. This also means that the generated business interface will be named as `some.package.Person`.
- **A Class Annotation** which declares:
    - What table this entity represents.
    - What the owned-child tables are and what they should be called.
    - Other information. Please see the `BusinessEntityAnnotation` class for more details.
- **The class extends an abstract superclass having the suffix of `_Gen`.** Continuing the example of an entity with a `person` name, the implementation class would extend a not-yet-created abstract superclass named `some.package.Person_Gen`. This superclass is created by the artifact generator based on metadata about the table and contains:
    - Getter methods for properties, including parent objects and collections.
    - The `getDTO()` and `setDTO(...)` methods that allow for properties to be changed.
    - Access to standard framework methods like `createQuery(...)`.
- **Business methods.** Any hand-coded public methods are automatically exported onto the generated business interface (for example, `some.package.Person`). Client code can then access the added business method as follows:

```
Person aPerson = some logic retrieving a person instance
String thePersonsInfo = aPerson.getInfo();
```

- **Constants.** Any hand-coded public static final variables are automatically exported onto the generated business interface. This will be useful for constants related to the entity.
- Having created a new entity, it is likely that validation rules and other behaviors should be added to it. See Adding Change Handlers for more information.

Developing Change Handlers

The creation of Business Entities allows business logic to interact with rows in database tables as objects, such that business methods can be invoked on those objects to perform some business function.

Entities *react* to proposed changes in their state. Because of object encapsulation, outside callers are not to be exposed to internal validations and cascading state changes within the objects they interact with. Nonetheless, it is necessary to have a way of programming the internal logic of entities. This is the reason for Change Handlers: to enable objects to react to proposed changes in their state.

Change Handlers are classes that add behavior to entities. This behavior takes two forms.

- **Validation rules.** This allows for proposed changes to be validated against business rules. These rules are expected to be *side effect free*, meaning that the validation does not change the state of the system. By calling side effect free validations only after all changes to entity state have been performed, the framework can avoid many complex scenarios where invalid data can *slip past* validations.
- **Cascading change logic.** This allows changes to this entity to cause changes to other entities.

Creating the Change Handler Class

A Business Entity may have more than one Change Handler. The framework will call each handler associated with an entity when an attempt is made to modify the state of the underlying entity. The following are the important parts of a Change Handler class:

- The class should extend the `AbstractChangeHandler` class and have a class name ending with `_CHandler`.

- The `@ChangeHandler` class annotation. This tells the framework which entity to attach the change handler to at runtime.
- Implement any *handle* methods. These are methods that can implement any cascading effects of the proposed change to the entity's state.
- Construct Validation Rules that are returned by public static methods on the change handler class. There should be one static method per rule. The reason for exposing these methods is to facilitate testing (see below). Static methods are used instead of static variables to prevent timing problems associated with the static initialization of static variables.
- Return an array of the rules created above via the `getValidationRules()` method. The framework invokes this method at runtime to retrieve the rules.
- Make sure to run the artifact generator and rebuild source code after adding a Change Handler or modifying its annotation.

Testing the Change Handler Class

When adding behavior to an entity, it is desirable to do the following:

- Break the rules into modular pieces that can be independently maintained and tested.
- Test that each behavior works by creating a JUnit test for each distinct behavior.

The following steps are recommended when adding new change handlers so that the additional behavior is sufficiently tested.

- Add each rule to the change handler at once using instances of the `PlaceHolderRule` class. Use an appropriate `RuleId` and `Description` as self-documentation of what the rule is supposed to do.
- Add a new test class by extending `AbstractEntityTestCase`. This class should reference the change handler being added and will ensure that each rule is violated by at least one test. The test class name should end with `Test`.
- Run the test class as a JUnit test. The test class should complain that there was at least one rule that was not violated by the test class. For the rule that was not violated, add a test method to the test class and add the *real* validation logic to the change handler class. Try executing the test class again. Continue implementing more test methods and rules until all rules are tested and the JUnit class completes successfully. Below is an example, test method for a rule that tests both a successful change and an unsuccessful change. It is important to ensure that the validation error is thrown by the actual rule being tested.

```
public void testAddressOneLabelRequiredIfAddressOneIsAvailable() {
   //pass
   Country country = (Country) createQuery(
       "from Country country").firstRow();
   Country_DTO countryDto = country.getDTO();
   country.setDTO(countryDto);

   //fail
   countryDto.setAddress1Available(Bool.TRUE);
   countryDto.setLanguageAddress1("");
   try {
       country.setDTO(countryDto);
       fail("A validation error should have been thrown");
   } catch (ApplicationException e) {
     verifyViolatedRule(Country_Chandler
         .addressOneLabelRequiredIfAddressOneIsAvailable(), e);
   }
   }
```

- Add other test methods to test *handle* methods on the change handler as well as business methods that may have been added.

Validation Rules

Validation rules are the mechanism for describing to the runtime system how it should validate business entities. There are a few important characteristics of these rules:

- The coding style is **declarative**. That is, every attempt has been made so the programmer specifies **what** makes data valid, not **how** or **when** the validation should take place.
- The programmer needs to build the step-by-step logic specifying how the validation should take place only in the case of *custom rules*.
- Validation rules are **side-effect free**. That is, they cannot change the persistent state of the system. This ensures that all validations are performed on the complete set of changes. Likewise, it allows for the `startChange()`/ `saveChanges()` logic to safely defer the firing of rules until the end of the coherent set of changes.

The Rules

Several useful rules are provided in the interest that the application programmer can use them with a minimum of programming. These are classes that implement `ValidationRule` and can be used by application logic:

- **ProtectRule** will protect one or more properties on an entity.
- **RequireRule** will require that a property be populated.
- **AllowRule** allows a value to be populated.
- **AllowAndRequireRule** both allows and requires that a property be populated.
- **DecimalRule** provides some common validations against decimal data types.
- **CustomRule** will create a rule out of a **CustomValidation** class implementing logic that just cannot be handled by existing rules.
- **RestrictRule** will restrict a property to a set of values.

Each of the rules above provides **standard rules** that represent similarly configured rules that are used repeatedly in the system. These standard rules can be created via static *factory* methods on the rules themselves. Consider the following standard rule:

```
/**
 * Protect the dependant property when the primary property is equal to the supplied loo
 *
 * @param ruleId a unique ruleId
 * @param description a description
 * @param primaryProperty the property that the condition depends on
 * @param dependantProperty the property that is protected when the condition is true
 * @param primaryLookupValue a {@link Lookup} value that the primary property must equal
 *                            to be protected
 * @return a new rule
 */
public static ProtectRule
   dependantPropertyWhenPrimaryMathesLookup
        (String ruleId,
         String description,
         SingleValueProperty primaryProperty,
         SingleValueProperty dependantProperty,
         Lookup primaryLookupValue)
```

What this rule does is to prevent one property from being changed (the *dependant* property) when another property (the *primary* property) matches a certain value. An example would be "the freeze date/time cannot be changed when the status is 'frozen'". In this case, the dependant property would be freeze date/time and the primary property would be the status. The lookup value of *frozen* would be passed in as the lookup value.

Custom Rules

Custom rules become necessary for cases that are too complex to be handled by means of a declarative rule. The process is as follows:

- Create a class that extends `AbstractCustomValidation`. Implement one or more of the abstract methods corresponding to various *events* that may occur with respect to the underlying entity.
- Within any change handler requiring this rule, instantiate a `CustomRule` passing in the class created above.

  For details on the *events* that can be processed by the custom validation, please refer to the JavaDocs.

  When coding a `CustomValidation` that will be used by a `CustomRule`, it is important to understand when these events fire.
- **Eager Validations** fire immediately, when the underlying entity is changed (either via `delete`, `setDTO()`, or `createEntity()`).
  - `validateAdd()` fires only on an add.
  - `validateChange()` fires only when an existing entity is changed.
  - `validateAddOrChange` fires **in addition to** either `validateAdd()` or `validateChange()`.
  - `validateDelete` fires when the entity is being deleted.
  - `validateRegisteredChange()` fires when some other object is changed (like a child). This can be any random entity instance that feels like notifying you regarding a change of state or, more commonly, the framework automatically registers a change when a child collection is manipulated. Your custom code can determine if a change has been made to a child it is interested in by calling the `getChangeToList()` method on the change detail passed in. You just pass in the class of your child collection, and it passes back changes, if any.
- **Lazy Validations** fire when a coherent set of changes is complete.
  - `validateSave()` can be used to implement validations that needs to be performed at the end of some set of changes. By default, a set of changes is both started and saved within individual calls to `setDTO`, `createBusinessEntity`, and so on. However, this can be controlled programmatically by calling the `startChanges()` and `saveChanges()` methods that are available from within all business objects (change handlers, entities, components, and so on). Any type of change (add, change, deleted, register change) will trigger `validateSave()`.

Conditions

The rules would not be very useful if all you could do was *always* protect or require properties. This behavior is usually based on conditions. Rules take as input one or more Conditions (for example, objects implementing the Condition interface). Right now, there are several conditions that can be used:

- **Equals**. This condition can compare properties to each other or to constants (lookup values, Strings, etc). Likewise, the size of a collection can be compared using Equals (for example, determine `personNames`' size equals 0 would mean there are no names for a person). Finally, null values can be tested using a special constant value `Constant.NULL`.
- **Not**. This is the basic boolean operator that can change the value of other conditions.
- **And**. This is the basic boolean operator that takes two child conditions, and returns `true` if each of them are `true`. This is evaluated *lazily* and will not even evaluate the second condition if the first is `false` (a performance enhancement).
- **Or**. This is the basic boolean operator that takes two child conditions, and returns `true` if either of them are `true`. This is evaluated *lazily* and will not even evaluate the second condition if the first is `true` (a performance enhancement).
- **GreaterThan** / **GreaterThanOrEquals**. This evaluates whether one property/constant is greater than (or greater than or equal to) to another property/constant.
- **LessThan** / **LessThanOrEquals**. This evaluates whether one property/constant is less than (or less than or equal to) to another property/constant.
- **Contains**. These are conditions for a collection of children- at least one element has condition x, at most 2 elements match condition y, and so on). The child condition's properties should be referenced from the point-of-view of the child row.

Each of these conditions is accessible from the corresponding property or condition. There should be no reason in normal development to use the constructors for the conditions above. Instead, you could say, for instance:

```
Condition isPrimaryName = PersonName.properties.isPrimaryName.isTrue();
```

or

```
Condition isAlias
   = PersonName.properties.nameType.isEqualTo(NameTypeLookup.ALIAS);
```

or

```
   Condition greaterThan
      = PersonName.properties.sequence.isGreaterThan(BigInteger.ZERO);
```

or

```
Condition hasOnePrimaryName
   = Person.properties.names.containsAtLeastOne(isPrimaryName);
```

or

```
Condition notAlias = isAlias.not();
```

Change Handler Helpers for Maintenance Objects

The Business Object based Maintenance objects have some standard validations. The Helper classes described below will help in reusing the validation code. The Change Handler Helpers have been created for the following objects:

- BO based MO.
- Standard MO Log table.
- Standard MO Log Parameter table.

BO-Based MO

The `com.splwg.base.api.maintenanceObject.BOBasedMaintenanceObjectCHandlerHelper` can be used for the BO-based MO Change Handler validations.

The following standard validations are provided by this helper class:

- The Business Object cannot be changed.
- The Business Object must be for the correct MO.
- Status is required if the Business Object has a lifecycle.
- Status must be a valid lifecycle status.

The following methods are provided by this helper class:

- Adding log entries for entity creation and entity status change (if the MO does not already have a transition algorithm).

To use the validations, create an instance of the helper class in the MO Change Handler and get the validation rules from the Helper, as illustrated in the following sample code.

Change Handler Sample Code

```
public class OutboundCrossReferenceMessage_CHandler extends AbstractChangeHandler<Outbou
{
private final BOBasedMaintenanceObjectCHandlerHelper helper = new BOBasedMaintenanceObje
OutboundCrossReferenceMessage> ( new MaintenanceObject_Id("O2-OXREFMSG"),
OutboundCrossReferenceMessage.properties,
OutboundCrossReferenceMessage.properties.lookOnBusinessObject() );
...
public void handleAddOrChange ( OutboundCrossReferenceMessage changedOutboundCrossRefere
DataTransferObject< OutboundCrossReferenceMessage> oldDTO )
{
helper.handleAddOrChange(changedOutboundCrossReferenceMessage, oldDTO);
}
public ValidationRule[] getValidationRules()
{
return helper.getValidationRules();
}
}
```

Change Handler Junit Test Code

```
public void testBoCannotBeChanged()
{
startChanges();
OutboundCrossReferenceMessage_DTO dto = (OutboundCrossReferenceMessage_DTO)
createDTO(OutboundCrossReferenceMessage.class);
dto.setBusinessObjectId(new BusinessObject_Id("ZZ-OXREFBO"));
setDtoData(dto);
OutboundCrossReferenceMessage outboundCrossReferenceMessage = dto.newEntity();
saveChanges();
try
{
dto.setBusinessObjectId(new BusinessObject_Id("ZZ-CASE"));
outboundCrossReferenceMessage.setDTO(dto);
saveChanges();
fail("An error should have been thrown");
}
catch (ApplicationError e)
{
verifyViolatedRule(BOBasedMaintenanceObjectCHandlerHelper.boCannotBeChanged(
OutboundCrossReferenceMessage.properties, OutboundCrossReferenceMessage.properties
.lookOnBusinessObject()), e);
}
}
```

Standard MO Log Table

The `com.splwg.base.api.maintenanceObject.MaintenanceLogCHandlerHelper` can be used for the Standard MO Log Table Change Handler validations.

The following standard validations are provided by this helper class:

- Log entry cannot be deleted if of type: Created, Exception, Status Transition, Status Transition Error, System, User Details.
- Validates the characteristic value possibly stored on the log entry.
- Long description or message are required, but not both.
- User details must provide long description.

The following default methods for Add are provided by this helper class:

- Log `dateTime` to system date time.
- User to current system user.
- Log sequence to next highest number.
- Status to the parent entity's status (will warn if specified input differs from parent status).

To use the validations, create an instance of the helper class in the MO Change Handler and get the validation rules from the Helper. First you must create a new Characteristic Entity in the Characteristic Entity Lookup for your object.

This entity can be selected on any Characteristic Type to indicate that that characteristic type can be used in the log messages for this log. Sample code follows.

Change Handler Sample Code

```
public class OutboundCrossReferenceMessageLog_CHandler extends AbstractChangeHandler<Out
{
private final MaintenanceLogCHandlerHelper helper = new MaintenanceLogCHandlerHelper<Out
OutboundCrossReferenceMessage>(new MaintenanceObject_Id("O2-
OXREFMSG"), OutboundCrossReferenceMessageLog.properties,
OutboundCrossReferenceMessageLog.properties.lookOnParentOutboundCrossReferenceMessage(),
CharacteristicEntityLookup.constants.OUTBOUND_CROSS_REFERENCE_MESSAGE_LOG);
public void prepareToAdd(DataTransferObject<OutboundCrossReferenceMessageLog> newDTO)
{
helper.prepareToAdd(newDTO);
}
public void prepareToChange(OutboundCrossReferenceMessageLog unchangedEntity,
DataTransferObject<OutboundCrossReferenceMessageLog> newDTO)
{
helper.prepareToChange(unchangedEntity, newDTO);
}
public ValidationRule[] getValidationRules()
{
return helper.getValidationRules();
}
}
```

Change Handler Junit Test Code

```
public void testLongDescRequiredIfLogTypeIsUserDetails()
{
startChanges();
OutboundCrossReferenceMessage_DTO dto = (OutboundCrossReferenceMessage_DTO) createDTO(Ou
dto.setBusinessObjectId(new BusinessObject_Id("ZZ-OXREFBO"));
outXrefMsgTest.setDtoData(dto);
OutboundCrossReferenceMessage outboundCrossReferenceMessage = dto.newEntity();
OutboundCrossReferenceMessageLog_DTO outboundCrossReferenceMessageLogDto1 = (OutboundCro
createDTO(OutboundCrossReferenceMessageLog.class);
outboundCrossReferenceMessageLogDto1.setLogEntryType(LogEntryTypeLookup.constants.USER_
try
{
outboundCrossReferenceMessage.getLogs().add(outboundCrossReferenceMessageLogDto1, null)
saveChanges();
fail("An error should have been thrown");
}
catch (ApplicationError e)
{
verifyViolatedRule(MaintenanceLogCHandlerHelper
.longDescriptionIsRequiredIfLogTypeIsUserDetails
(OutboundCrossReferenceMessageLog.properties), e);
}
}
```

Standard MO Log Parameter Table

The `com.splwg.base.api.maintenanceObject.MaintenanceLogParameterCHandlerHelper` can be used for the Standard MO Log Parameter Table Change Handler.

The following standard methods on Add are provided by this helper class:

- Parameter sequence to next highest number.

To use the Helper, create an instance of the helper class in the MO Change Handler and get the validation rules from the Helper, as illustrated in the following sample code.

Change Handler Sample Code

```
public class OutboundCrossReferenceMessageLogParameter_CHandler
extends AbstractChangeHandler<OutboundCrossReferenceMessageLogParameter>
{
private final MaintenanceLogParameterCHandlerHelper helper = new MaintenanceLogParameter
OutboundCrossReferenceMessageLogParameter, OutboundCrossReferenceMessageLog>(new Mainte
OXREFMSG"),
OutboundCrossReferenceMessageLogParameter.properties,
OutboundCrossReferenceMessageLogParameter.properties.
lookOnParentOutboundCrossReferenceMessageLog());
...
public void prepareToAdd(DataTransferObject newDTO)
{
helper.prepareToAdd(newDTO);
}
public ValidationRule[] getValidationRules()
{
return helper.getValidationRules();
}
}
```

Additional Validations

Using Helper Class Validations Only

If only validations from the helper class are required, use the Change Handlers `getValidationRules()` method to return the `helper.getValidationRules()`. This will enforce all the validations in the Helper class on the Change Handler.

Sample code:

```
public ValidationRule[] getValidationRules() {
return helper.getValidationRules();
}
```

Using Helper and Change Handler Validations

Create an Array of `ValidationRules` in the `getValidationRules()` method of the Change Handler and pass this array to the `helper.getValidationRules()` method. The Helper class adds the rules passed to it to the standard set to provided validations.

Sample code:

```
public ValidationRule[] getValidationRules() {
return helper.getValidationRules(<Array of Validation Rules>);
}
```

Maintaining Business Components

Business Components are business objects that have two important characteristics:

- They are **non-persistent** holders of business logic. That is, they are the place to put business logic not tied to a single business entity instance (for example, a single Account or Person). This makes them analogous to *common routines*.
- When allowed, implementations of business components may be replaced at runtime by custom classes implementing the same business interface. An example of this includes *info* logic.

Creating Business Components

Much like Business Entities, it is necessary to create an implementation class (*`_Impl`) containing the actual logic that is then processed by the artifact generator. Below is an example that would be created by hand:

```
/**
 * Component used to query for {@link Person} instances based on various
 * predefined criteria.
 *
 * @BusinessComponent
 *   (customizationReplaceable = false)
 */
public class PersonFinders_Impl
    extends GenericBusinessComponent
    implements PersonFinders
    /**
     * @param   nameType  a name type
     * @return  count of names by name type
     *
     * @BusinessMethod (customizationCallable = true)
     */
    public int findCountByNameType(Lookup nameType) {
        Query query = createQuery
            ("FROM PersonName name where name.nameType = :type");
        query.bindLookup("type", nameType);

        return (int) query.listSize();
    }
}
```

This example shows a `finder` component that is responsible for holding queries related to the `person` entity. These queries are not related to any particular `person` because, in that case, they would rightfully belong on the entity implementation class itself. Our (cooked up) example shows a single method that returns a count of `PersonName` instances by name type.

Let's look at various parts of the component:

- **`@BusinessComponent`** class annotation.
  - **`customizationReplaceable`** attribute specifies whether or not customers can replace this component at runtime. The default is `false`. If a component is replaceable, its methods are assumed to be `customizationCallable`.
- **`GenericBusinessComponent`** is extended, which gives this class access to framework methods.
- **`PersonFinders`** is implemented. This is the name of the generated business interface. Any customized replacement of the business component would implement this interface as well.
- The business method **`findCountByNameType`** . For the method to be exported to the business interface (and therefore callable by other business objects), it must be public.
  - **`@BusinessMethod`** is an optional method-level annotation.
    - **`customizationCallable`** specifies that this method is part of the supported API. That is, our customers are entitled to call this method from their customizations and therefore, we must change this method with great reluctance in future release.

Component Replacement

Business Components provide a simple extension mechanism where base-package code can be made available to be replaced by customizations. For this to take place, two things must happen:

- A component is added as described above with the `customizationReplaceable` annotation attribute set to `true`.
- A replacement component is created that implements the business interface of the original component and sets the `replacementComponent` attribute to `true`.

An example replacement of the `PersonFinders` component is shown below. Component implementations are registered in the same order as the application stack, that is: `base` followed by `ccb`, then followed by `cm`. After the component is defined in one application, derived applications (higher on the stack) can replace the implementation.

```
package com.abcutilities.cis.customizations.person;
/**
 * @BusinessComponent
 *    (replacementComponent = true)
 */
public class CustomizedPersonFindersImpl
    extends GenericBusinessComponent
    implements PersonFinders {

    public Integer findCountByNameType(PerOrBusLookup nameType) {
        ... customized code ...
    }
    ...
}
```

Calling Components

Business Components are accessed via their business interfaces. Following is an example of how to call the above component from some other business object:

```
PersonFinders finders = PersonFinders.Factory.newInstance();
int count = finders.findCountByNameType(NameTypeLookup.constants.PRIMARY);
logger.info(count + " primary names found");
```

Maintaining Maintenance Classes, including collections

Maintaining Services

Services available in the system include user interface services, as well as stand-alone Inbound Web Services. Use this transaction to introduce a new user interface or stand-alone Inbound Web Service.

Note: For detailed information about service programs, refer to user document *Framework Administration*, and *Inbound Web Services*.

Maintaining Foreign Key References

You need to set up foreign key references if you have characteristics whose valid values are defined in another table (for example, if you use `foreign key reference` characteristic types).

Note: For detailed information about foreign keys, see "Primary and Foreign Keys" in the *Oracle Utilities Application Framework Administration Guide*.

Maintaining Lookup Tables

Some special fields are defined as `lookups` in the system. These fields have a predefined set of values for which language-dependent descriptions are supplied to be displayed in the online system.

Note: For detailed information about lookups, please refer to user document *Framework Administration, Database Tools, Defining Look Up Options*.

Maintaining Navigation Keys

Each location to which a user can navigate (e.g., transactions, tab pages, tab menus, online help links, etc.) is identified by a navigation key. A navigation key is a logical identifier for a URL.

Note: For detailed information about navigation keys, please refer to user document *Framework Administration, User Interface Tools, Defining Navigation Keys*.

Maintaining Navigation Options

Every time a user navigates to a transaction, the system retrieves a navigation option to determine which transaction should open. Many navigation options are shipped with the base package and cannot be modified as these options support core functionality, but you may need to add additional navigation options to support your specific business processes.

Note: For detailed information about navigation options, please refer to user document *Framework Administration, User Interface Tools, Defining Navigation Options*.

Maintaining User Interfaces

The configuration tools allow you to extend the front-end user interface. The main component of this is a UI Map, supported by Business Objects and Business Services.

Note: For detailed information about user interfaces, please refer to user document *Framework Administration, Configuration Tools.*

Maintaining Menus

This metadata represents the root of a *menu tree*. A menu contains a list of *menu lines*, which, in turn, contains a list of *menu items*. Lines can define navigation keys and/or associated actions, or further submenus.

Note: For detailed information about menus, please refer to user document *Framework Administration, User Interface Tools, Defining Menu Options.*

Maintaining Application Security

Application security defines how a particular application service is used, namely:

- Which user groups can access the service.
- What actions may be performed within the service.

Note: For detailed information on how to define application security, please refer to user document *Framework Administration, Defining Security & User Options*.

Maintaining UI Components (Translation)

You can use the override fields on some of the system data tables to modify and customize the labels, buttons, titles, tab names and messages on the standard user interface. This may be helpful to correct minor interface inconsistencies and inappropriate translations as well as to provide translations for any single fixes that you may have applied to your environment. (Single fixes release without translation, so you may need to translate any labels and descriptions for new UI components or messages.)

You can manually modify the descriptions or translations of the following items:

- Dialog titles
- Transaction titles and tab labels
- Field labels on tab pages
- Button labels

- Messages

Flushing Server and Client Caches

A great deal of information in the user interface changes infrequently, including field labels, menu items, and drop-down lists. In order to avoid accessing the database every time this type of information is required by an end-user, the system maintains a cache of static information on the web server. Additionally, depending on how you set up the preferences on your Web browser, these items may also be cached in the browser.

After you make a change to a user interface item, such as a field label, you may need to flush the appropriate cache on the Web server as well as the client.

Note: For information about flushing caches on the Web server, refer to the *Caching Overview* section in the "Defining General Options" chapter of the Oracle Utilities Application Framework Administration documentation.

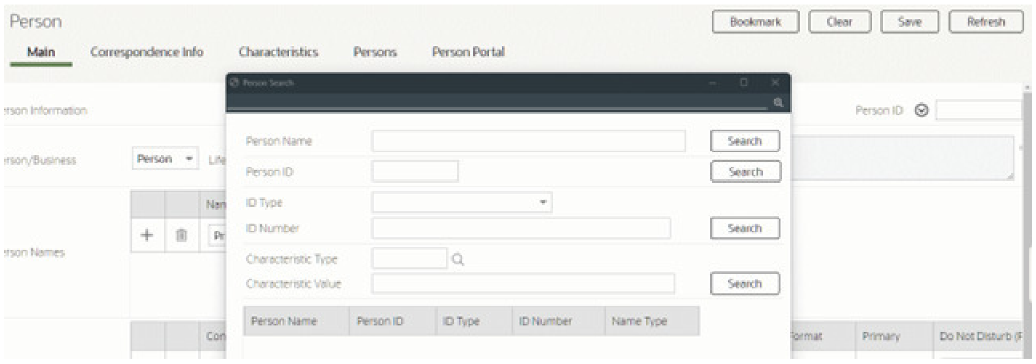
User Language

You must log in as a user ID that has the same language as the items for which you want to modify the description. For example, if you want to modify a French message, you must log in with a user ID that is set to use French. The instructions in the following sections assume that you are logged in with a user ID that has the appropriate language set.

Modifying Dialog Titles

Note: Screenshots in this section present screens from Google Chrome. Screens might look different in other browsers.

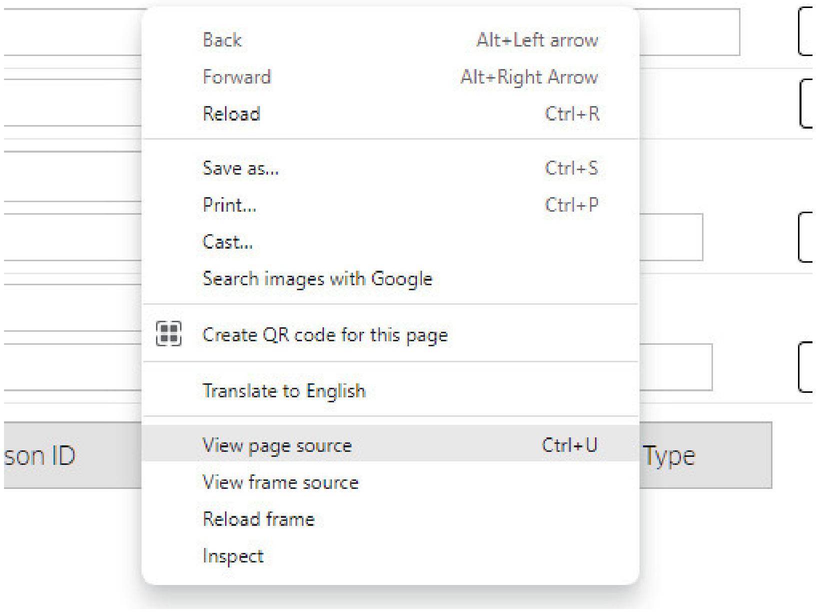
A dialog can be a search window or dialogs that provide additional functionality, such as the **Start / Stop Confirmation** dialog or the **Generate Bill** dialog.



Dialog Title

To modify a dialog title:

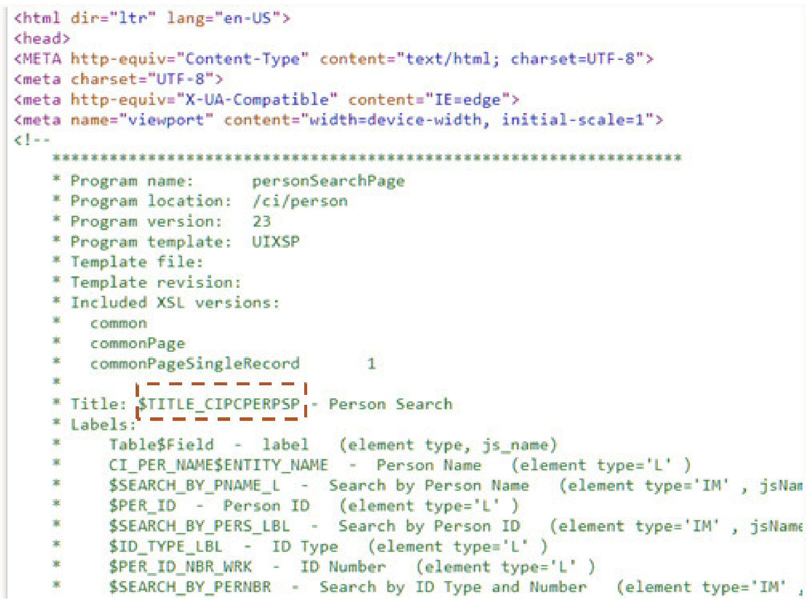
- Navigate to and open the dialog with the title that you want to change.
- Right-click near the top of the dialog and select **View Source** from the pop-up menu.



View Dialog Source

Note: Many dialogs and windows have multiple source files; if you cannot locate the field you are looking for, try right-clicking in a different area (closer to the label you want to modify). For example, if you right-click in the grid area of the **Person Search**, illustrated above, you will open a different source file. If you already know the name of the field you want to modify, you can skip this step.

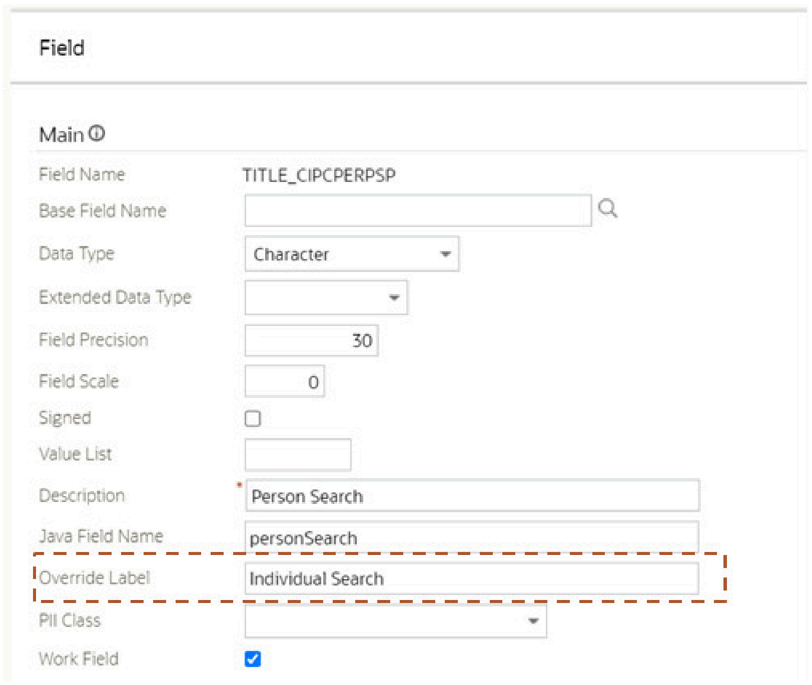
- In the displayed source file, locate the field name that has the value you want to modify. The field for the dialog title is clearly labelled, and the current value of the field is displayed after the hyphen.



```
<html dir="ltr" lang="en-US">
<head>
<META http-equiv="Content-Type" content="text/html; charset=UTF-8">
<meta charset="UTF-8">
<meta http-equiv="X-UA-Compatible" content="IE=edge">
<meta name="viewport" content="width=device-width, initial-scale=1">
<!--
    ******************************************************************
    * Program name:      personSearchPage
    * Program location:  /ci/person
    * Program version:   23
    * Program template:  UIXSP
    * Template file:
    * Template revision:
    * Included XSL versions:
    *   common
    *   commonPage
    *   commonPageSingleRecord       1
    *
    * Title: $TITLE_CIPCPERPSP - Person Search
    * Labels:
    *     Table$Field  -  label   (element type, js_name)
    *     CI_PER_NAME$ENTITY_NAME  -  Person Name   (element type='L' )
    *     $SEARCH_BY_PNAME_L  -  Search by Person Name   (element type='IM' , jsNam
    *     $PER_ID  -  Person ID   (element type='L' )
    *     $SEARCH_BY_PERS_LBL  -  Search by Person ID   (element type='IM' , jsName
    *     $ID_TYPE_LBL  -  ID Type   (element type='L' )
    *     $PER_ID_NBR_WRK  -  ID Number   (element type='L' )
    *     $SEARCH_BY_PERNBR  -  Search by ID Type and Number   (element type='IM' ,
```

Title Field Name

- To modify the field override via the application, navigate to **Admin Menu - Database - Field** in the Oracle Utilities Application Framework application.
- When the field search dialog appears, enter the name of the field as it appears in the source.
- Enter an Override Label with a title description to suit your needs and save your changes.


Field

Main ⓘ

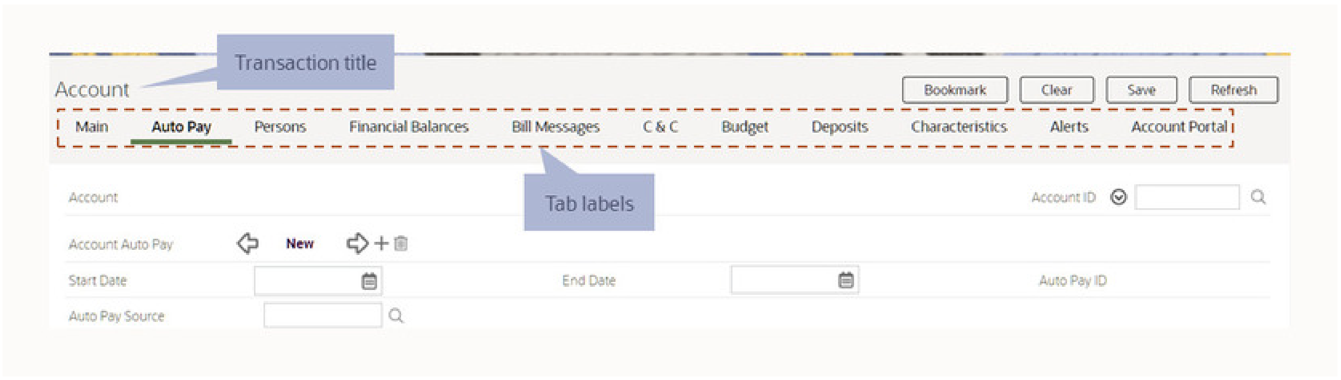
Field Name	TITLE_CIPCPERPSP
Base Field Name	
Data Type	Character
Extended Data Type	
Field Precision	30
Field Scale	0
Signed	☐
Value List	
Description	Person Search
Java Field Name	personSearch
Override Label	Individual Search
PII Class	
Work Field	✓

Database - Field

- Flush the server and browser caches and verify that the new dialog title appears correctly.

Modifying Transaction Titles and Tab Labels

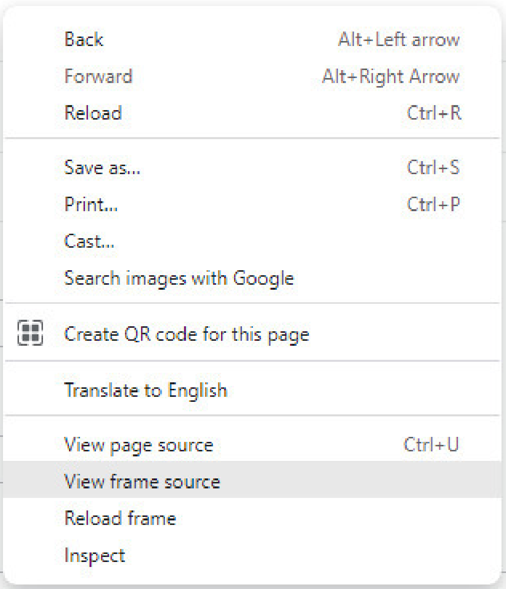
You can modify the transaction title and or the tab labels that appear on a transaction.



Transaction Title and Tab Labels

To modify the transaction title and/or tab labels:

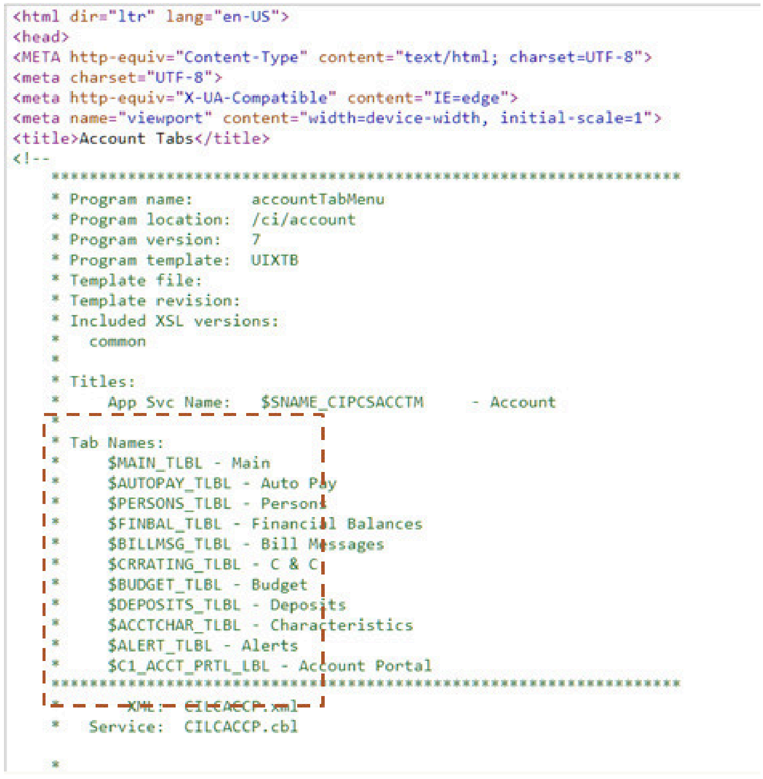
- Navigate to the transaction that has the title and/or tab name you want to modify.
- Right-click in the empty area to the right or left of the tab bar and select **View Frame Source** from the drop-down menu.



View Transaction Title/Tab Source

Note: Many dialogs and windows have multiple source files; so, if you cannot locate the field you are looking for, try right-clicking in a different area (closer to the label you want to modify). To view the source for the transaction title and tab bar, right-click directly to the right or left of the tab bar. If you already know the name of the field you want to modify, you can skip this step.

- In the displayed source file, locate the field name that has the value you want to modify. The fields for the transaction titles and tab labels are clearly labelled and the current values of the fields are displayed after the hyphens.

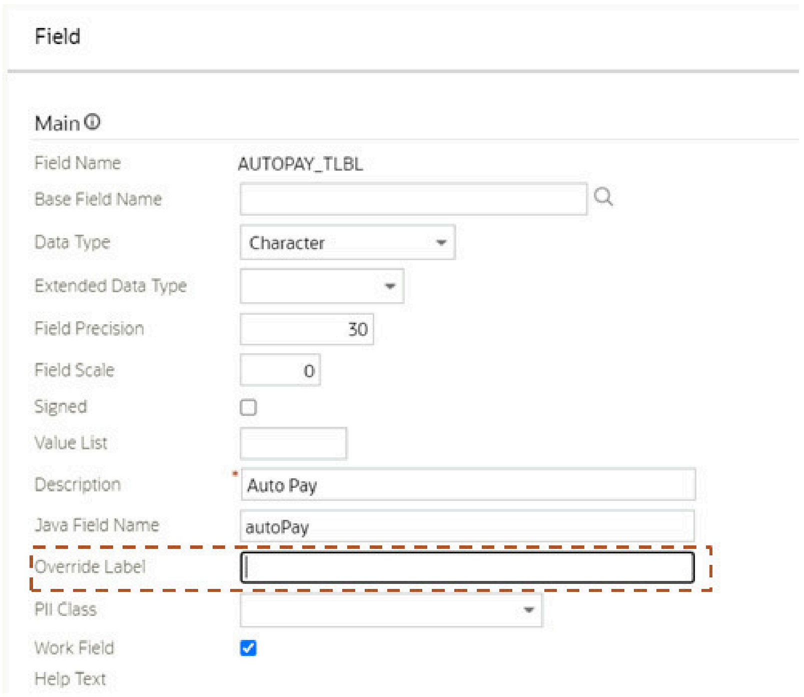


```
<html dir="ltr" lang="en-US">
<head>
<META http-equiv="Content-Type" content="text/html; charset=UTF-8">
<meta charset="UTF-8">
<meta http-equiv="X-UA-Compatible" content="IE=edge">
<meta name="viewport" content="width=device-width, initial-scale=1">
<title>Account Tabs</title>
<!--
    ******************************************************************
    * Program name:       accountTabMenu
    * Program location:   /ci/account
    * Program version:    7
    * Program template:   UIXTB
    * Template file:
    * Template revision:
    * Included XSL versions:
    *   common
    *
    * Titles:
    *     App Svc Name:    $SNAME_CIPCSACCTM      - Account
    *
    * Tab Names:
    *     $MAIN_TLBL - Main
    *     $AUTOPAY_TLBL - Auto Pay
    *     $PERSONS_TLBL - Persons
    *     $FINBAL_TLBL - Financial Balances
    *     $BILLMSG_TLBL - Bill Messages
    *     $CRRATING_TLBL - C & C
    *     $BUDGET_TLBL - Budget
    *     $DEPOSITS_TLBL - Deposits
    *     $ACCTCHAR_TLBL - Characteristics
    *     $ALERT_TLBL - Alerts
    *     $C1_ACCT_PRTL_LBL - Account Portal
    ******************************************************************
    *     XML:   CILCACCP.xml
    *   Service:  CILCACCP.cbl

    *
```

Transaction Title and Tab Field Names

Note: Subsystem Name. If you modify the subsystem field description, your changes will appear on every transaction that is part of the subsystem.

- To modify the field override via the application, navigate to **Admin Menu - Database - Field** in the Oracle Utilities Application Framework application.
- When the field search dialog appears, enter the name of the field as it appears in the source.
- Enter an Override Label with a title or tab description to suit your needs and save your changes.



Field

Main

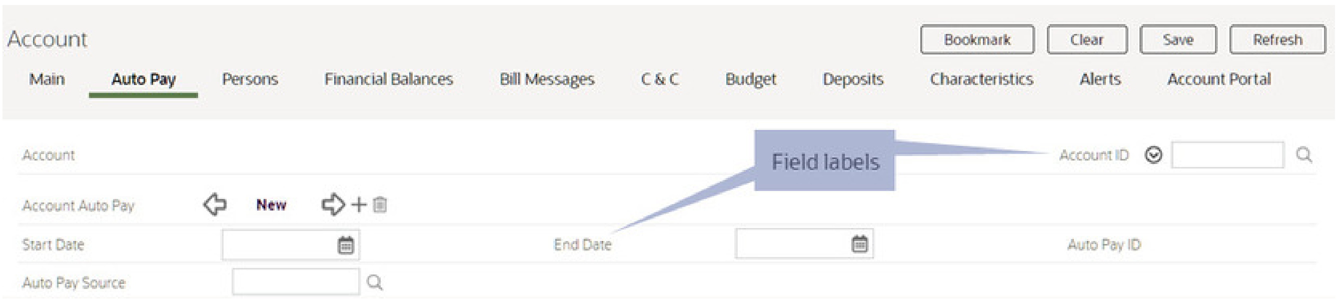
Field Name	AUTOPAY_TLBL
Base Field Name	
Data Type	Character
Extended Data Type	
Field Precision	30
Field Scale	0
Signed	☐
Value List	
Description	Auto Pay
Java Field Name	autoPay
Override Label	
PII Class	
Work Field	✓
Help Text	

Database - Field

- Flush the server and browser caches and verify that the new field label appears correctly.

Modifying Field Labels on Pages

You can modify field labels that appear on transactions.

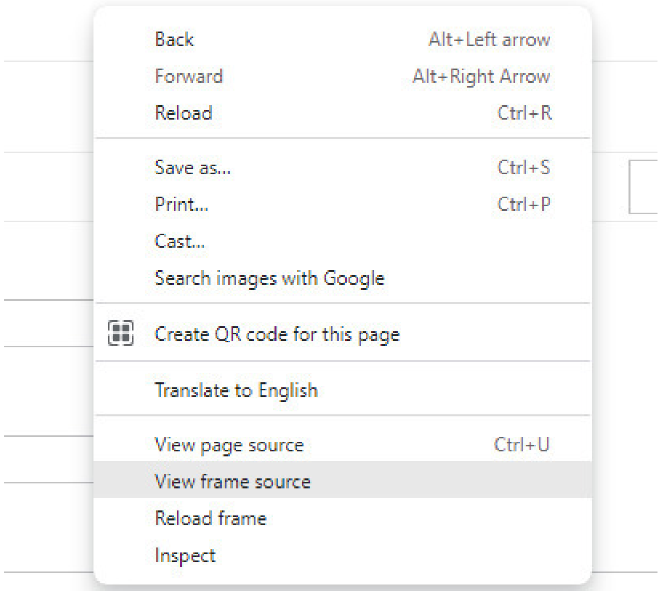


Field Labels

Warning: Field labels may be reused! A field label may be reused on multiple transactions and tabs. If you override the field's label, your changes affect all pages and transactions on which that field label appears.

To modify the field labels that appear on transactions:

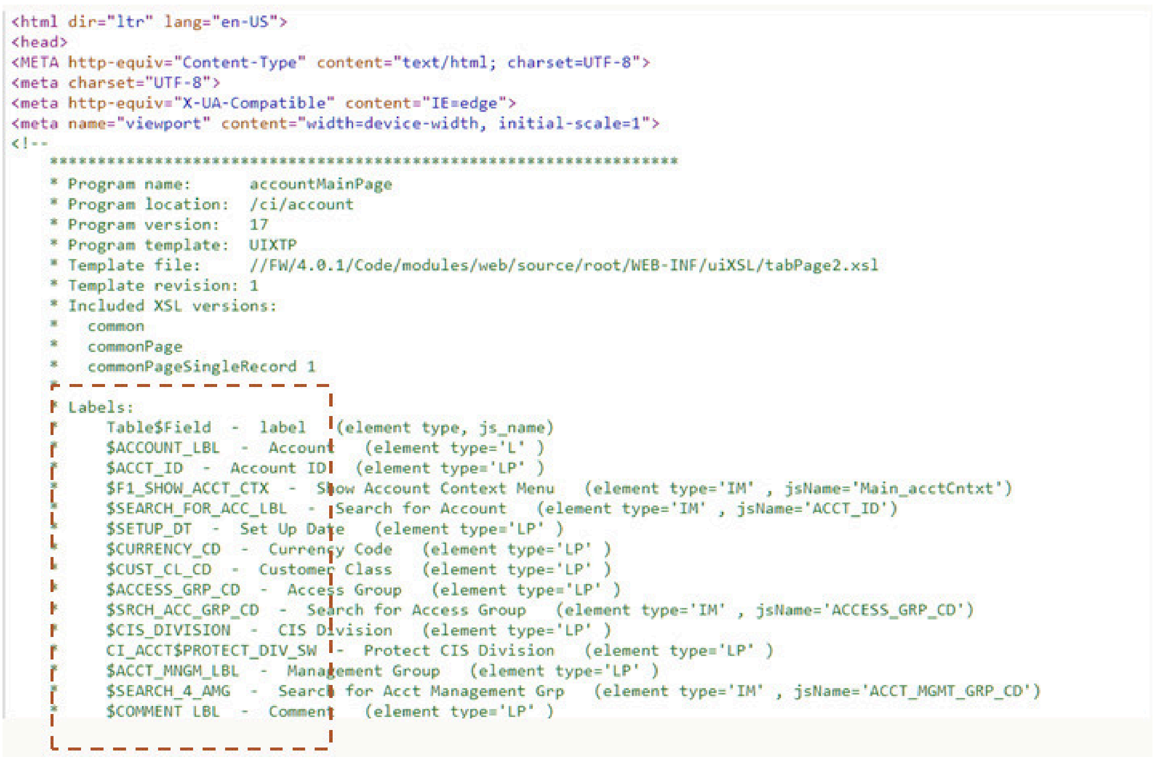
- Navigate to the transaction that has the field name you want to modify.
- Right-click in an empty area near the label and select **View Frame Source** from the drop-down menu.



View Page Source

Note: Many dialogs and windows have multiple source files; so, if you cannot locate the field you are looking for, try right-clicking in a different area (closer to the label you want to modify). If you already know the name of the field you want to modify, you can skip this step.

- In the displayed source file, locate the field name that has the value you want to modify. The fields for the labels are clearly identified and the current values of the fields are displayed after the hyphens.

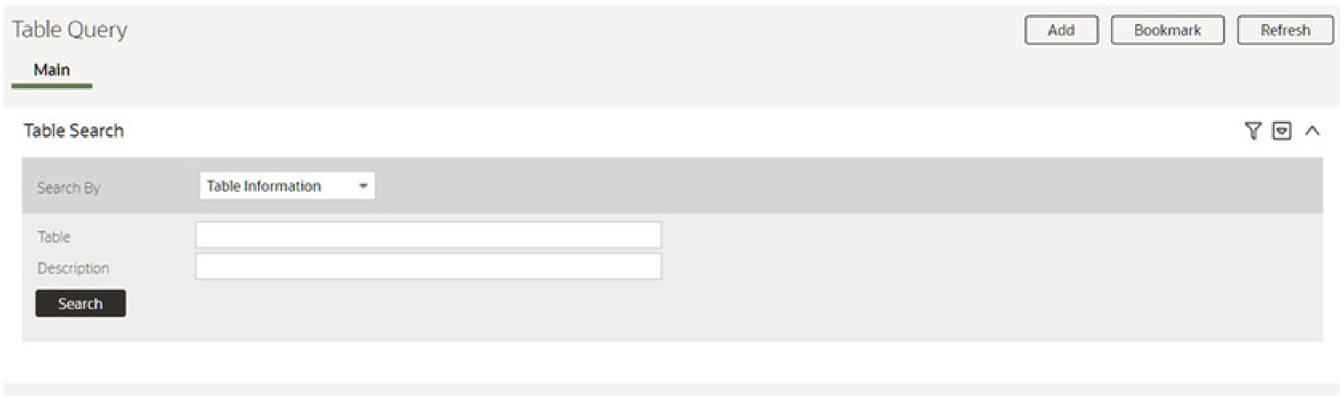


```
<html dir="ltr" lang="en-US">
<head>
<META http-equiv="Content-Type" content="text/html; charset=UTF-8">
<meta charset="UTF-8">
<meta http-equiv="X-UA-Compatible" content="IE=edge">
<meta name="viewport" content="width=device-width, initial-scale=1">
<!--
    *******************************************************************
    * Program name:      accountMainPage
    * Program location:  /ci/account
    * Program version:   17
    * Program template:  UIXTP
    * Template file:     //FW/4.0.1/Code/modules/web/source/root/WEB-INF/uiXSL/tabPage2.xsl
    * Template revision: 1
    * Included XSL versions:
    *   common
    *   commonPage
    *   commonPageSingleRecord 1
    *
    * Labels:
    *     Table$Field  -  label  (element type, js_name)
    *     $ACCOUNT_LBL  -  Account   (element type='L' )
    *     $ACCT_ID  -  Account ID   (element type='LP' )
    *     $F1_SHOW_ACCT_CTX  -  Show Account Context Menu   (element type='IM' , jsName='Main_acctCntxt')
    *     $SEARCH_FOR_ACC_LBL  -  Search for Account   (element type='IM' , jsName='ACCT_ID')
    *     $SETUP_DT  -  Set Up Date   (element type='LP' )
    *     $CURRENCY_CD  -  Currency Code   (element type='LP' )
    *     $CUST_CL_CD  -  Customer Class   (element type='LP' )
    *     $ACCESS_GRP_CD  -  Access Group   (element type='LP' )
    *     $SRCH_ACC_GRP_CD  -  Search for Access Group   (element type='IM' , jsName='ACCESS_GRP_CD')
    *     $CIS_DIVISION  -  CIS Division   (element type='LP' )
    *     CI_ACCT$PROTECT_DIV_SW  -  Protect CIS Division   (element type='LP' )
    *     $ACCT_MNGM_LBL  -  Management Group   (element type='LP' )
    *     $SEARCH_4_AMG  -  Search for Acct Management Grp   (element type='IM' , jsName='ACCT_MGMT_GRP_CD')
    *     $COMMENT_LBL  -  Comment   (element type='LP' )
```

Field Label Names and Values

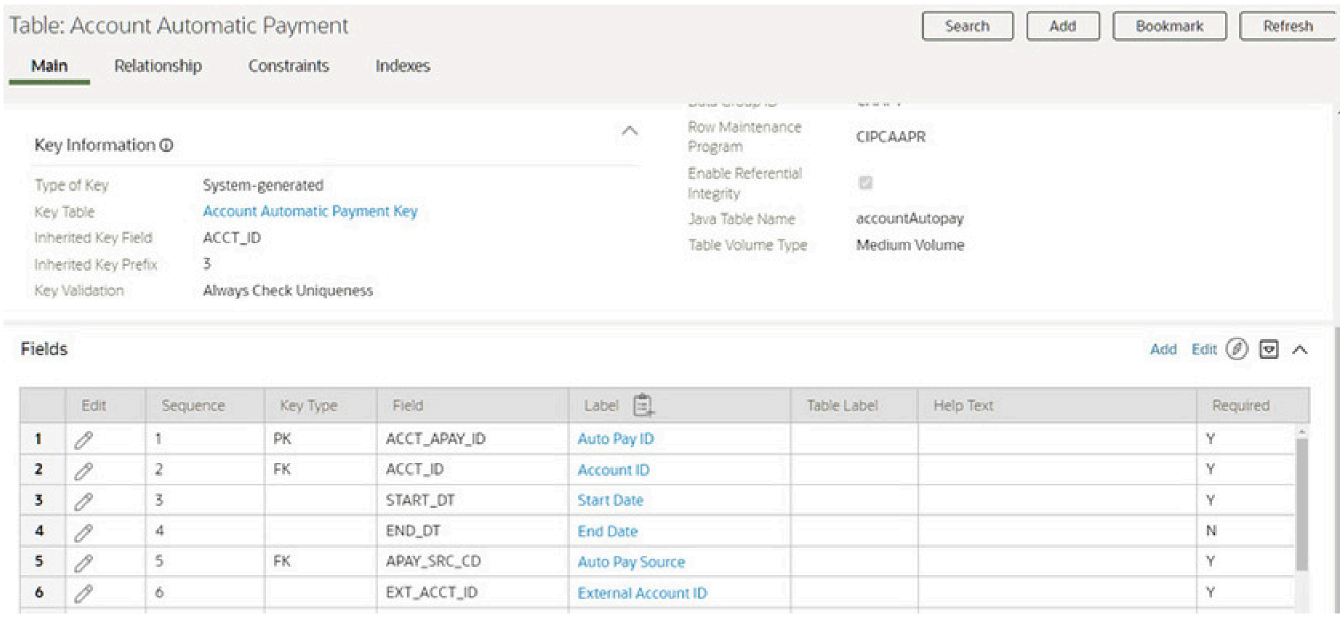
Note: Table-specific Fields. Note that some labels may be specific to the table on which they appear, while other labels are generic throughout the application. If a field label is specific to a table, the table name appears before the $ in the field list.

- If the label is table-specific, navigate to **Admin Menu - Database - Table** in the Oracle Utilities Application Framework application and search for the name of the table.



Search for Table

- Navigate to the **Field** zone, and scroll to the field whose label you wish to modify.



Key Information

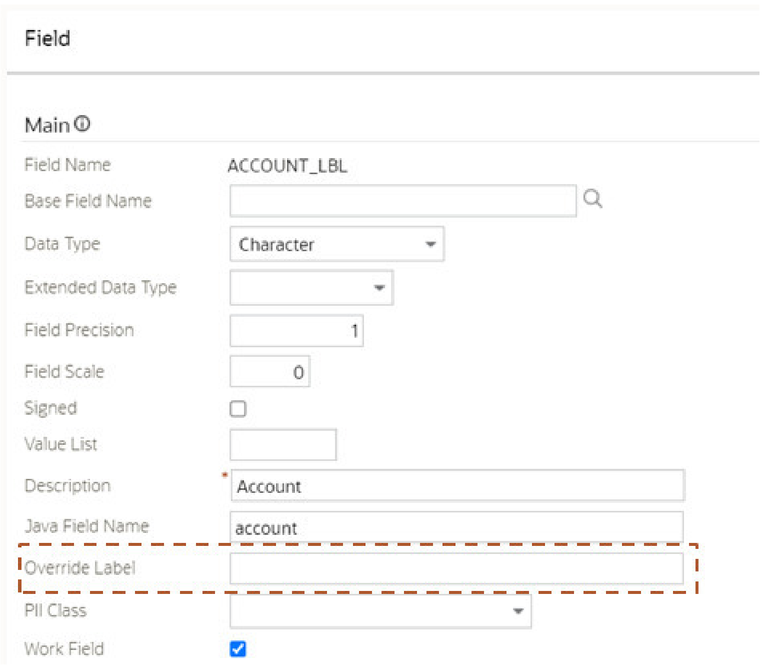
Type of Key	System-generated
Key Table	Account Automatic Payment Key
Inherited Key Field	ACCT_ID
Inherited Key Prefix	3
Key Validation	Always Check Uniqueness

Row Maintenance Program	CIPCAAPR
Enable Referential Integrity	✓
Java Table Name	accountAutopay
Table Volume Type	Medium Volume

	Edit	Sequence	Key Type	Field	Label	Table Label	Help Text	Required
1		1	PK	ACCT_APAY_ID	Auto Pay ID			Y
2		2	FK	ACCT_ID	Account ID			Y
3		3		START_DT	Start Date			Y
4		4		END_DT	End Date			N
5		5	FK	APAY_SRC_CD	Auto Pay Source			Y
6		6		EXT_ACCT_ID	External Account ID			Y

Table Field

- Enter an Override Label to suit your needs and save your changes.
- If the label is not table-specific, navigate to **Admin Menu - Database - Field** and search for the field name.
- When the field appears, enter an Override Label to suit your needs and save your changes.



Field

Main

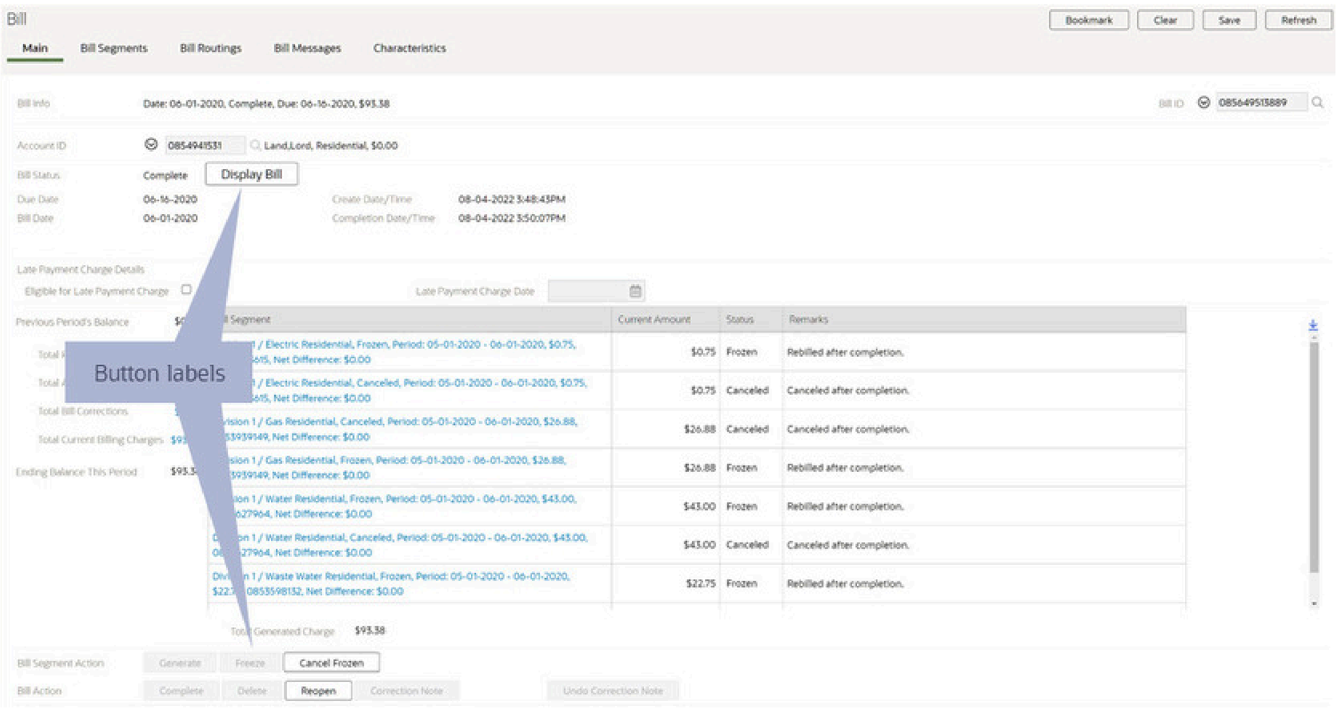
Field Name	ACCOUNT_LBL
Base Field Name	
Data Type	Character
Extended Data Type	
Field Precision	1
Field Scale	0
Signed	☐
Value List	
Description	* Account
Java Field Name	account
Override Label	
PII Class	
Work Field	✓

Database - Field

- Flush the server and browser caches and verify that the new field label appears correctly.

Modifying Button Labels

Button labels are just like field labels; they are stored in the field table. You can modify button labels just like you can field labels.



Bill Info	Date: 06-01-2020, Complete, Due: 06-16-2020, $93.38
Bill ID	0856495I3889
Account ID	0854941531 Land,Lord, Residential, $0.00
Bill Status	Complete
Due Date	06-16-2020
Bill Date	06-01-2020
Create Date/Time	08-04-2022 3:48:43PM
Completion Date/Time	08-04-2022 3:50:07PM

Late Payment Charge Details

Eligible for Late Payment Charge	☐
Late Payment Charge Date	
Previous Period's Balance	$0
Total I	
Total A	
Total Bill Corrections	
Total Current Billing Charges	$9
Ending Balance This Period	$93.3

l Segment	Current Amount	Status	Remarks
1 / Electric Residential, Frozen, Period: 05-01-2020 - 06-01-2020, $0.75, 615, Net Difference: $0.00	$0.75	Frozen	Rebilled after completion.
1 / Electric Residential, Canceled, Period: 05-01-2020 - 06-01-2020, $0.75, 615, Net Difference: $0.00	$0.75	Canceled	Canceled after completion.
vision 1 / Gas Residential, Canceled, Period: 05-01-2020 - 06-01-2020, $26.88, 53939149, Net Difference: $0.00	$26.88	Canceled	Canceled after completion.
sion 1 / Gas Residential, Frozen, Period: 05-01-2020 - 06-01-2020, $26.88, 3939149, Net Difference: $0.00	$26.88	Frozen	Rebilled after completion.
ion 1 / Water Residential, Frozen, Period: 05-01-2020 - 06-01-2020, $43.00, 627964, Net Difference: $0.00	$43.00	Frozen	Rebilled after completion.
D on 1 / Water Residential, Canceled, Period: 05-01-2020 - 06-01-2020, $43.00, 08 27964, Net Difference: $0.00	$43.00	Canceled	Canceled after completion.
Div n 1 / Waste Water Residential, Frozen, Period: 05-01-2020 - 06-01-2020, $22.7 0853598132, Net Difference: $0.00	$22.75	Frozen	Rebilled after completion.

Tot Generated Charge $93.38

Bill Segment Action

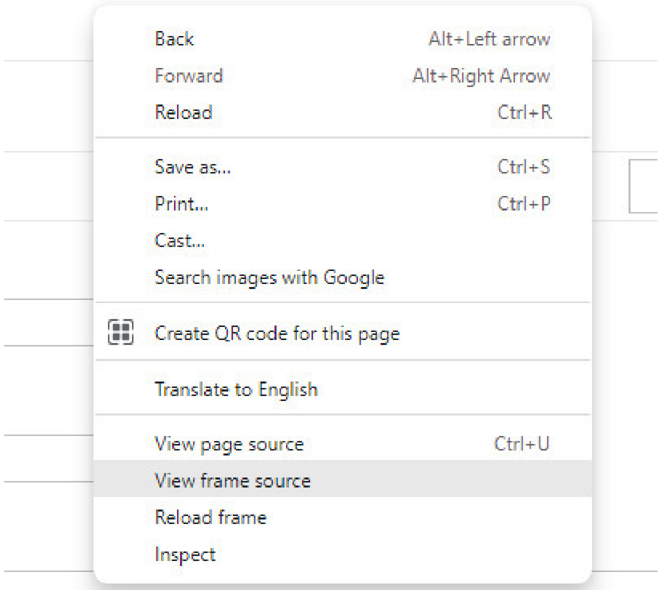
Bill Action

Button Labels

To modify button labels:

- Navigate to the transaction that has the button label you want to modify.

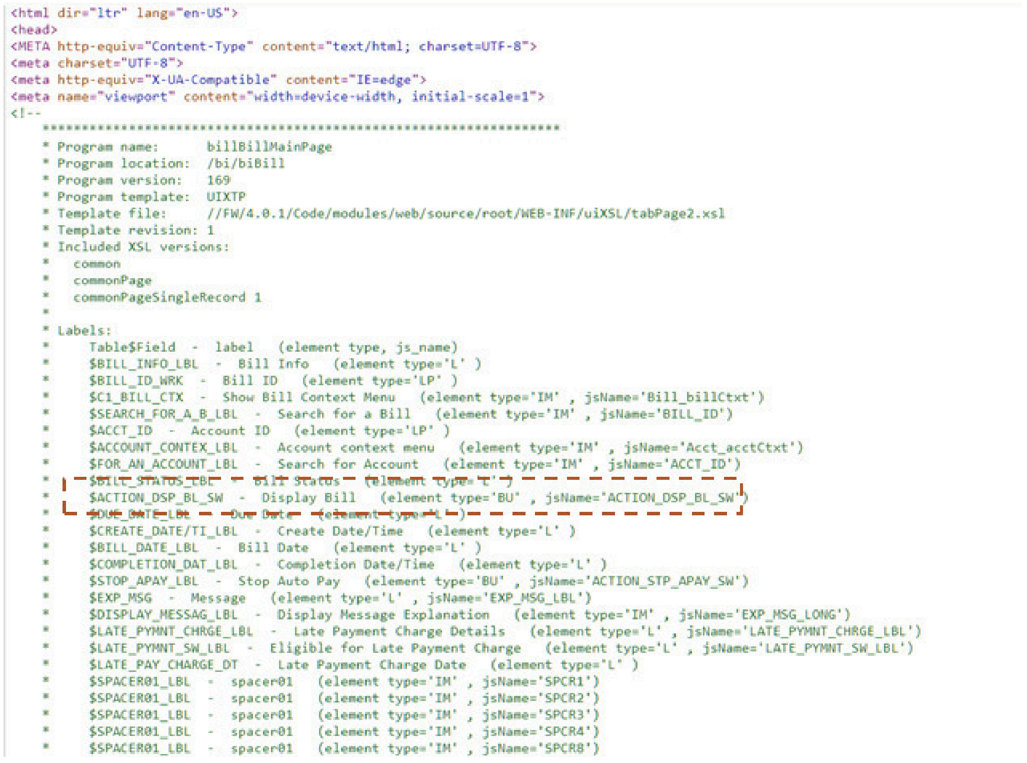
- Right-click in an empty area near the label and select **View Frame Source** from the drop-down menu.



View Page Source

Note: Many dialogs and windows have multiple source files; so, if you cannot locate the field you are looking for, try right-clicking in a different area (closer to the label you want to modify). If you already know the name of the field you want to modify, you can skip this step.

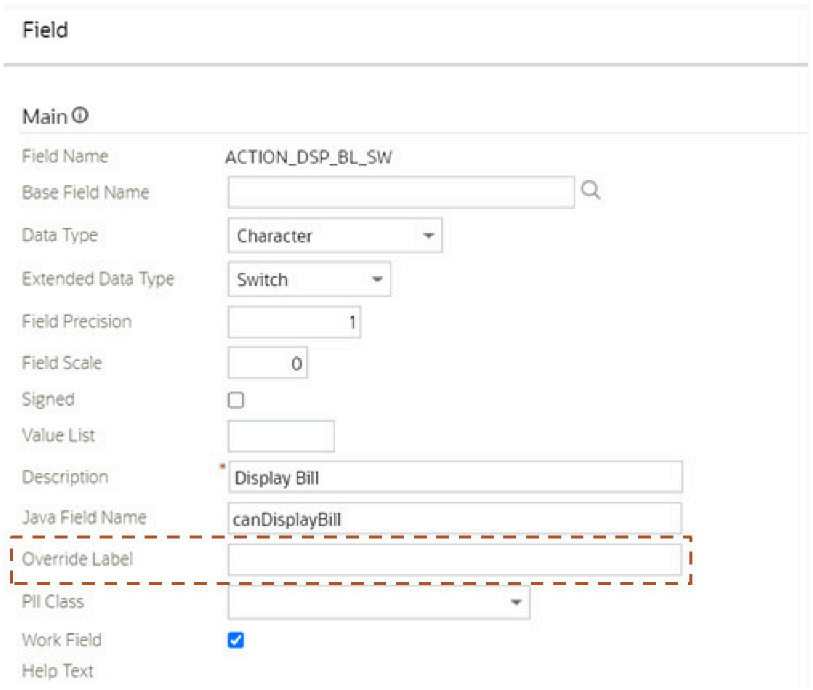
- In the displayed source file, locate the field name that has the value you want to modify. The fields for the labels are clearly identified and the current values of the fields are displayed after the hyphens. Look for element type of value BU.



```
<html dir="ltr" lang="en-US">
<head>
<META http-equiv="Content-Type" content="text/html; charset=UTF-8">
<meta charset="UTF-8">
<meta http-equiv="X-UA-Compatible" content="IE=edge">
<meta name="viewport" content="width=device-width, initial-scale=1">
<!--
    ******************************************************************
    * Program name:      billBillMainPage
    * Program location:  /bi/biBill
    * Program version:   169
    * Program template:  UIXTP
    * Template file:     //FW/4.0.1/Code/modules/web/source/root/WEB-INF/uiXSL/tabPage2.xsl
    * Template revision: 1
    * Included XSL versions:
    *    common
    *    commonPage
    *    commonPageSingleRecord 1
    *
    * Labels:
    *     Table$Field  -  label   (element type, js_name)
    *     $BILL_INFO_LBL  -  Bill Info   (element type='L' )
    *     $BILL_ID_WRK  -  Bill ID   (element type='LP' )
    *     $C1_BILL_CTX  -  Show Bill Context Menu   (element type='IM' , jsName='Bill_billCtxt')
    *     $SEARCH_FOR_A_B_LBL  -  Search for a Bill   (element type='IM' , jsName='BILL_ID')
    *     $ACCT_ID  -  Account ID   (element type='LP' )
    *     $ACCOUNT_CONTEX_LBL  -  Account context menu   (element type='IM' , jsName='Acct_acctCtxt')
    *     $FOR_AN_ACCOUNT_LBL  -  Search for Account   (element type='IM' , jsName='ACCT_ID')
    *     $BILL_STATUS_LBL  -  Bill Status   (element type='L' )
    *     $ACTION_DSP_BL_SW  -  Display Bill   (element type='BU' , jsName='ACTION_DSP_BL_SW')
    *     $DUE_DATE_LBL  -  Due Date   (element type='L' )
    *     $CREATE_DATE/TI_LBL  -  Create Date/Time   (element type='L' )
    *     $BILL_DATE_LBL  -  Bill Date   (element type='L' )
    *     $COMPLETION_DAT_LBL  -  Completion Date/Time   (element type='L' )
    *     $STOP_APAY_LBL  -  Stop Auto Pay   (element type='BU' , jsName='ACTION_STP_APAY_SW')
    *     $EXP_MSG  -  Message   (element type='L' , jsName='EXP_MSG_LBL')
    *     $DISPLAY_MESSAG_LBL  -  Display Message Explanation   (element type='IM' , jsName='EXP_MSG_LONG')
    *     $LATE_PYMNT_CHRGE_LBL  -  Late Payment Charge Details   (element type='L' , jsName='LATE_PYMNT_CHRGE_LBL')
    *     $LATE_PYMNT_SW_LBL  -  Eligible for Late Payment Charge   (element type='L' , jsName='LATE_PYMNT_SW_LBL')
    *     $LATE_PAY_CHARGE_DT  -  Late Payment Charge Date   (element type='L' )
    *     $SPACER01_LBL  -  spacer01   (element type='IM' , jsName='SPCR1')
    *     $SPACER01_LBL  -  spacer01   (element type='IM' , jsName='SPCR2')
    *     $SPACER01_LBL  -  spacer01   (element type='IM' , jsName='SPCR3')
    *     $SPACER01_LBL  -  spacer01   (element type='IM' , jsName='SPCR4')
    *     $SPACER01_LBL  -  spacer01   (element type='IM' , jsName='SPCR8')
```

Field Label Names and Values

- Navigate to **Admin Menu - Database - Field** in the Oracle Utilities Application Framework application and search for the field name.
- When the field appears, enter an Override Label to suit your needs and save your changes.



Field

Main

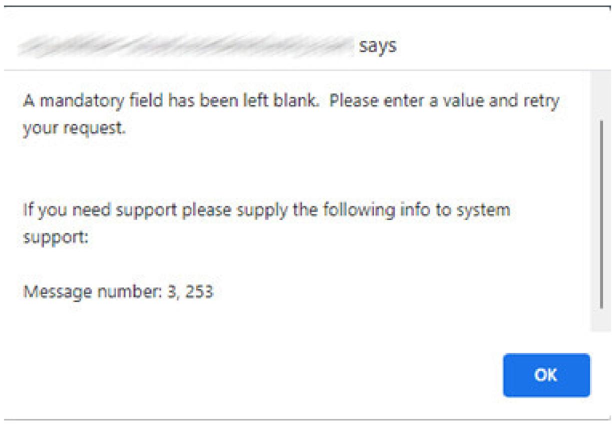
Field Name	ACTION_DSP_BL_SW
Base Field Name	
Data Type	Character
Extended Data Type	Switch
Field Precision	1
Field Scale	0
Signed	☐
Value List	
Description	* Display Bill
Java Field Name	canDisplayBill
Override Label	
PII Class	
Work Field	✓
Help Text	

Database - Field

- Flush the server and browser caches and verify that the new field label appears correctly.

Modifying Messages

You can modify the message text and description for messages, such as error, warning, and validation messages. The following example shows a validation message:



says

A mandatory field has been left blank. Please enter a value and retry your request.

If you need support please supply the following info to system support:

Message number: 3, 253

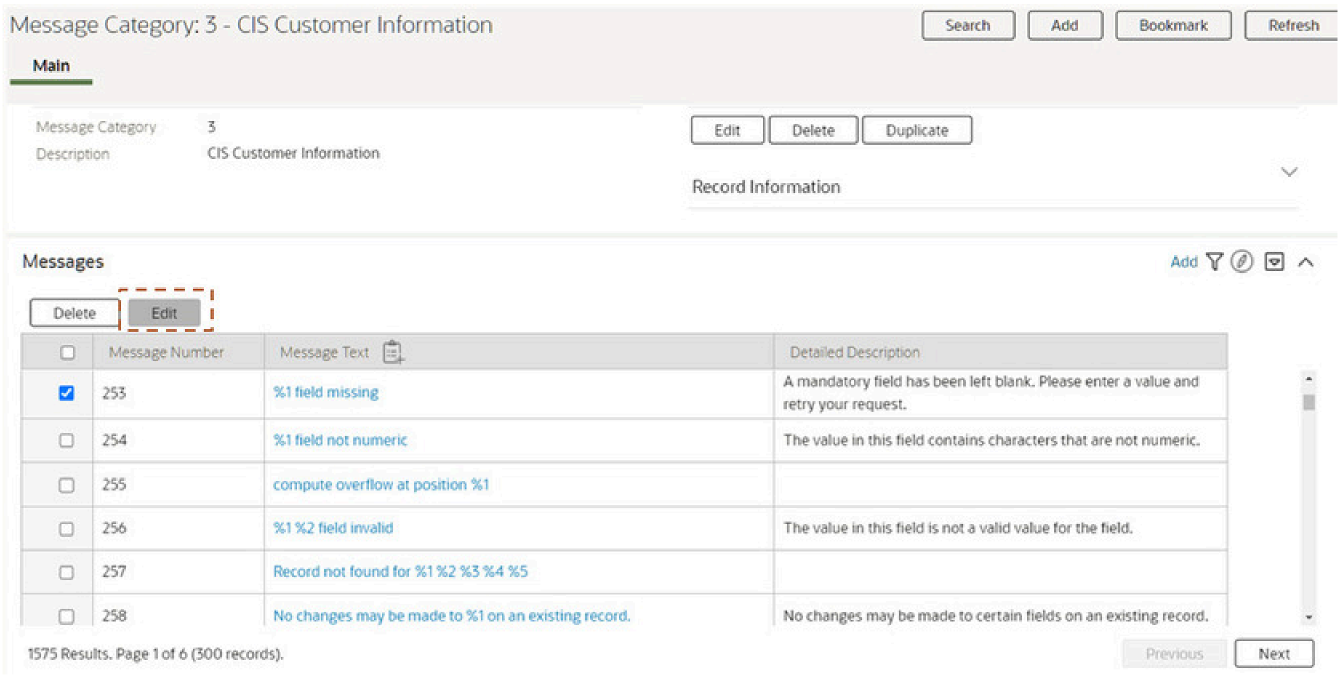
Message

To edit messages, you need to know the message category and number. The category is the part of the message number that appears before the comma. In the example message above, the category is 3. The number is the part of the message number that appears after the comma. In the example message above, the message number is 253.

To edit the message text or description:

- Navigate to **Admin Menu - System - Message**.

- Specify the message category in the search dialog.
- Specify the starting message number and click the search icon.



Message Category: 3 - CIS Customer Information

Message Category	3
Description	CIS Customer Information

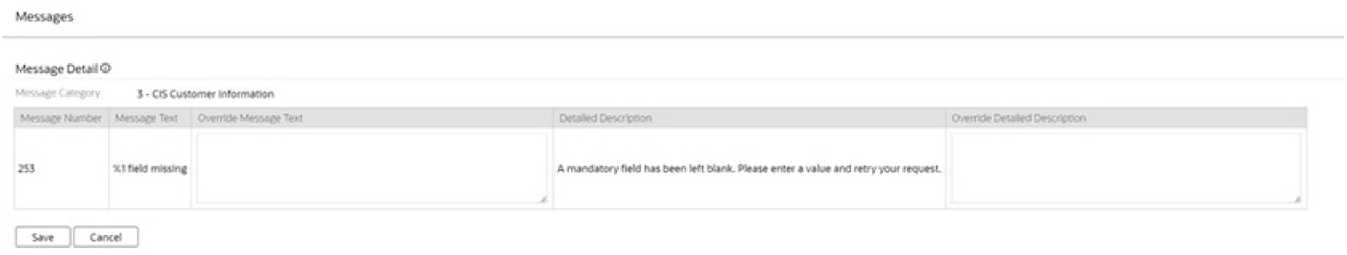
Messages

	Message Number	Message Text	Detailed Description
✓	253	%1 field missing	A mandatory field has been left blank. Please enter a value and retry your request.
	254	%1 field not numeric	The value in this field contains characters that are not numeric.
	255	compute overflow at position %1	
	256	%1 %2 field invalid	The value in this field is not a valid value for the field.
	257	Record not found for %1 %2 %3 %4 %5	
	258	No changes may be made to %1 on an existing record.	No changes may be made to certain fields on an existing record.

1575 Results. Page 1 of 6 (300 records).

System - Message

- Select the message you want to edit, and click the **Edit** button. You are transferred to the **Message Details** zone for that message.



Message Detail

Message Category 3 - CIS Customer Information

Message Number	Message Text	Override Message Text	Detailed Description	Override Detailed Description
253	%1 field missing		A mandatory field has been left blank. Please enter a value and retry your request.	

Message Details

- Enter the customer specific message text and description as appropriate for your needs.

Note: **Message Variables.** Messages may have one or more variables. Variables are indicated by a percent sign (%) followed by a number. A value is substituted for the variable before the message is displayed. Do not modify the message variables and make sure that your custom message contains the same number of variables as the original.

- Save your changes.

If possible, you can attempt to verify that the message was changed correctly. However, it is not always easy to determine and duplicate the situations where a specific message may appear.

Note: For more information about system messages, please refer to user document *Framework Administration, User Interface Tools, Defining System Messages*.

Plugging in Algorithms

The following will illustrate the steps to create a new plug-in algorithm. This example will create a new *adhoc* characteristic validation algorithm that is very similar to a delivered plug-in.

Creating Algorithm Spot Implementation Class

Review Algorithm Spot Definition

The algorithm spot definition identifies the purpose of the algorithm spot and the required methods per implementation. It may also help to look at existing implementations of the relevant algorithm spot.

The relevant algorithm spot in this example is `AdhocCharacteristicValueValidationAlgorithmSpot` in `com.splwg.base.domain.common.characteristicType`.

Create Algorithm Component Implementation

Copy the existing numeric validation plug-in `AdhocDateValidationAlgComp_Impl` and rename it to `AdhocDateAgeValidationiiiAlgComp_Impl` where `iii` is your initials.

Modify the annotation to replace the last Date Format soft parameter with two decimal parameters (`ageFrom` and `ageTo`).

In addition, modify the `validateDateInRange` method to check that the age (given date less the system's current date / 365.25) will be greater than the soft parameter `ageFrom` (if non-zero), and will be less than the `ageTo` (if non-zero). Make sure that negative numbers are allowed so that this plug-in can be used to compare against some future *expiration date* kind of scenarios.

Generate and build the java classes.

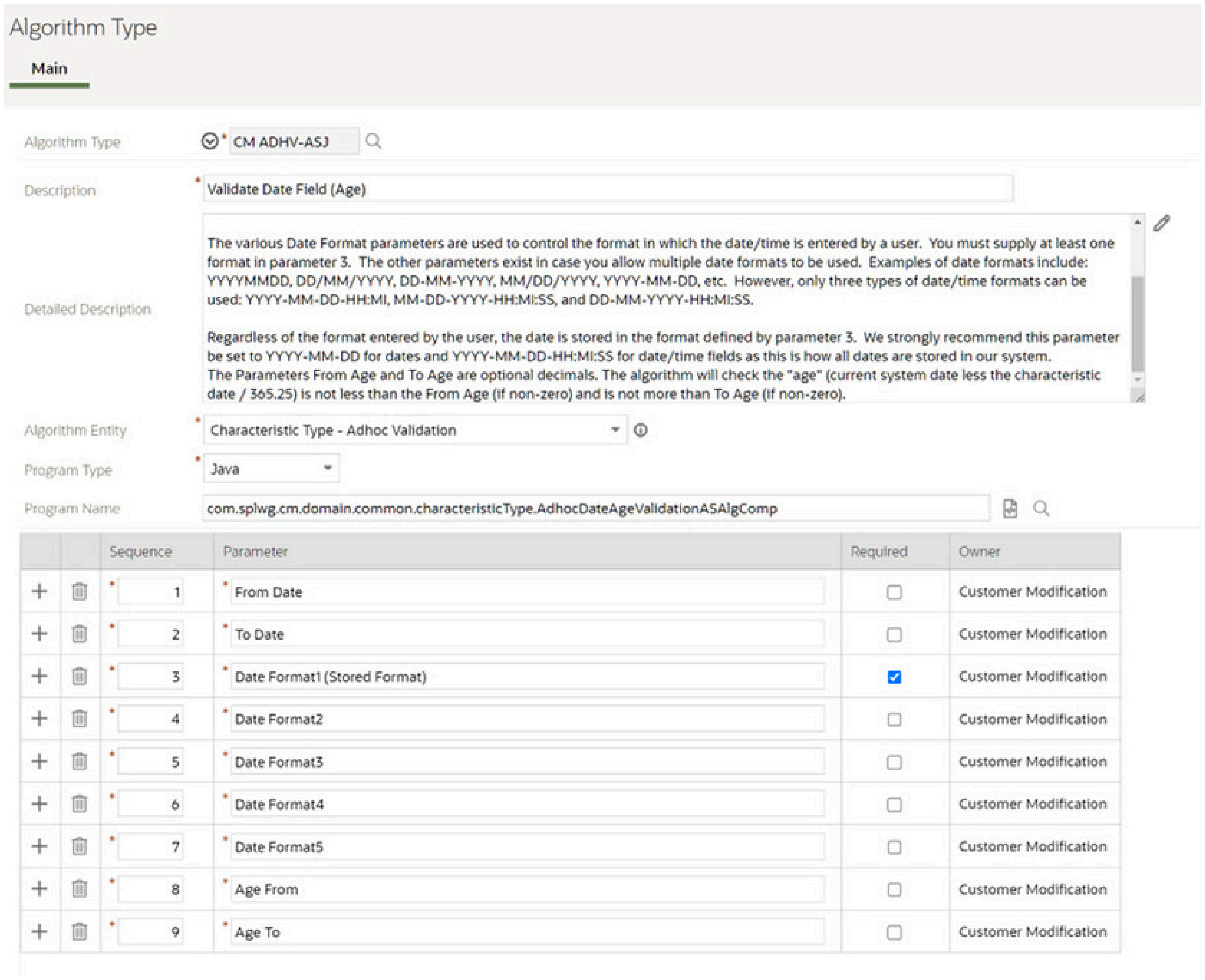
Note: The various adhoc characteristic value validation algorithms that come with the Oracle Utilities Software Development Kit are good references for algorithm plug-ins.

Add Algorithm Type

Note: This is just an example for illustrative purposes.

Add a new algorithm type copying most of the entries for ADHV-DTD:

- Algorithm Type: **CM ADHV-iiiJ** where `iii` is your initials.
- Description: **Validate Date Field (Age)**
- Long Description: **<Copy ADHV-DTD description here>. The Parameters From Age and To Age are optional decimals. The algorithm will check the "age" (current system date less the characteristic date / 365.25) is not less than the From Age (if non-zero) and is not more than To Age (if non-zero).**
- Algorithm Entity: **Characteristic Type - Adhoc Value Validation**
- Program Type: **Java**
- Program name: **com.splwg.cm.domain.common.characteristicType.AdhocDateAgeValidationiiiAlgComp** where `iii` is your initials.
- Parameters:
    - Sequence: **1**, Parameter: **From Date**, Required: **Not Checked**
    - Sequence: **2**, Parameter: **To Date**, Required: **Not Checked**
    - Sequence: **3**, Parameter: **Date Format1 (Stored Format)**, Required: **Checked**
    - Sequence: **4**, Parameter: **Date Format2**, Required: **Not Checked**
    - Sequence: **5**, Parameter: **Date Format3**, Required: **Not Checked**
    - Sequence: **6**, Parameter: **Date Format4**, Required: **Not Checked**
    - Sequence: **7**, Parameter: **Date Format5**, Required: **Not Checked**
    - Sequence: **8**, Parameter: **Age From**, Required: **Not Checked**
    - Sequence: **9**, Parameter: **Age To**, Required: **Not Checked**


Algorithm Type

Main

Algorithm Type	CM ADHV-ASJ
Description	Validate Date Field (Age)
Detailed Description	The various Date Format parameters are used to control the format in which the date/time is entered by a user. You must supply at least one format in parameter 3. The other parameters exist in case you allow multiple date formats to be used. Examples of date formats include: YYYYMMDD, DD/MM/YYYY, DD-MM-YYYY, MM/DD/YYYY, YYYY-MM-DD, etc. However, only three types of date/time formats can be used: YYYY-MM-DD-HH:MI, MM-DD-YYYY-HH:MI:SS, and DD-MM-YYYY-HH:MI:SS. Regardless of the format entered by the user, the date is stored in the format defined by parameter 3. We strongly recommend this parameter be set to YYYY-MM-DD for dates and YYYY-MM-DD-HH:MI:SS for date/time fields as this is how all dates are stored in our system. The Parameters From Age and To Age are optional decimals. The algorithm will check the "age" (current system date less the characteristic date / 365.25) is not less than the From Age (if non-zero) and is not more than To Age (if non-zero).
Algorithm Entity	Characteristic Type - Adhoc Validation
Program Type	Java
Program Name	com.splwg.cm.domain.common.characteristicType.AdhocDateAgeValidationASAlgComp

Sequence	Parameter	Required	Owner
1	From Date	☐	Customer Modification
2	To Date	☐	Customer Modification
3	Date Format1 (Stored Format)	✓	Customer Modification
4	Date Format2	☐	Customer Modification
5	Date Format3	☐	Customer Modification
6	Date Format4	☐	Customer Modification
7	Date Format5	☐	Customer Modification
8	Age From	☐	Customer Modification
9	Age To	☐	Customer Modification

Algorithm Type

Add Algorithm

Add a new algorithm as follows:

- Algorithm: **CM EXPDT-iii.**
- Description: **Date must be a future date**
- Algorithm Type: **CM ADHV-iiiJ**
- Effective Date: **1/1/2010**
- Parameters:
  - Sequence: **1**, Parameter: **blank**
  - Sequence: **2**, Parameter: **blank**
  - Sequence: **3**, Parameter: **YYYY-MM-DD**
  - Sequence: **4**, Parameter: **YYYY/MM/DD**
  - Sequence: **5**, Parameter: **MM-DD-YYYY**
  - Sequence: **6**, Parameter: **MM/DD/YYYY**
  - Sequence: **7**, Parameter: **MM.DD.YYYY**
  - Sequence: **8**, Parameter: **0.001**
  - Sequence: **9**, Parameter: **0**

Create References to New Algorithm

Create an ad hoc characteristic type and reference the previously created algorithm on it.

- Char type: **CM J-iii**
- Description**: iii's Adhoc validation test / Expiration Date**
- Type of Characteristic Value: **Ad hoc Value**
- Validation rule: **CM EXPDT-iii**
- Allow Search by Char Val: **Not Allowed**

Characteristic entity: choose **Notification Upload Staging**.

Maintaining Portals and Zones

The system uses portals and zones to display information throughout the system.

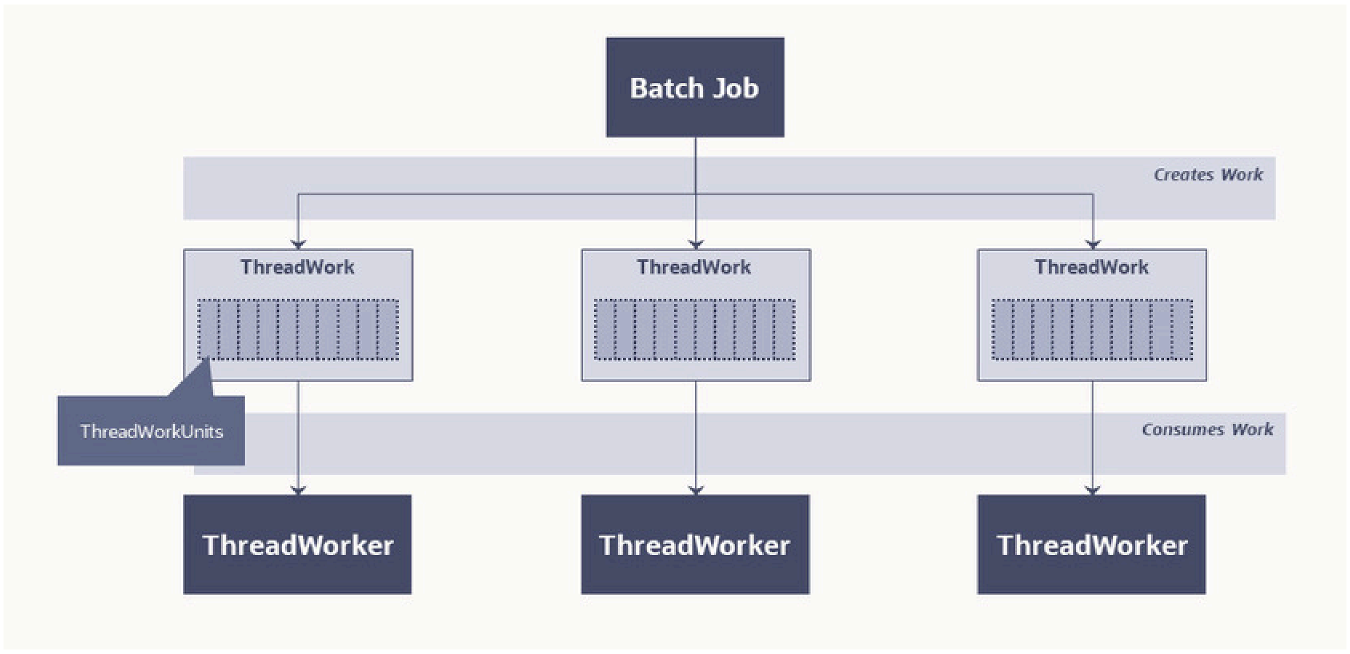
Note: For more information on this topic, please refer to user documents *Framework Administration*, *User Interface Tools*, *The Big Picture of Portals and Zones*, and *Setting Up Portals and Zones*.

Maintaining Background Processes

Maintaining Background Processes Overview

Each new background processes require the creation of two new classes: a `BatchJob` and a `ThreadWorker`. These classes fit into the *master-worker pattern* used by the background process runtime infrastructure to overcome the throughput limitations encountered by single-threaded processes. By splitting work among many concurrent threads, often on multiple physical nodes, background processes can achieve excellent scalability and react to changing work demands without additional programming. In this pattern:

- A `BatchJob` is responsible for determining the work to be processed for a batch run and then splitting that work into pieces that each `ThreadWorker` will process. When running a single process, a single `BatchJob` object is instantiated by the framework. The framework then makes calls to the `BatchJob` instance at the appropriate time. One such set of calls to the `BatchJob` instance is to return to the framework a collection of `ThreadWork` instances that will be distributed for execution.
- A `ThreadWorker` is responsible for processing a single `ThreadWork` instance for a run. Within the `ThreadWork`, there are many `WorkUnits` representing the fine-grained units of work to be processed. In many cases, these `WorkUnits` represent a complete database transaction. For example, a bill being created for an account, whether or not the `ThreadWorker` executes on the same computer as other `ThreadWorkers`, or the `BatchJob` that created its work is left as a configuration choice to be made at runtime. Within a single process, there may be many `ThreadWorker` objects. In general, each `ThreadWorker` instantiated in a batch run has a corresponding row in the Batch Instance table. The Batch Instance rows provide persistent state that is needed for the `ThreadWorkers` to operate correctly in failure/restart situations.



Creating a BatchJob

A `BatchJob` class is responsible for determining what work needs to be done within the run, and for splitting the work among `ThreadWorkers`.

The BatchJob Annotation

Each `BatchJob` class must declare a `BatchJob` annotation that specifies important attributes of the job. An example is shown below:

```
@BatchJob (rerunnable = false,
multiThreaded = true,
modules={todo},
softParameters = { @BatchJobSoftParameter
(name=OUTPUT-DIR, type=string) },
toDoCreation = @ToDoCreation (drillKeyEntity = user,
sortKeys = {lastName, firstName},
messageParameters = {firstName, lastName}
)
)
```

The annotation declares if the job can be rerun, supports more than one thread of operation, the modules that the job belongs to, its nonstandard runtime parameters and the details of how `ToDo` entries should be created in the case of errors. When not specified in the annotation, default values will be used.

Creating JobWork

The most important goal of a `BatchJob` class is to return an instance of `JobWork` describing what work should be done (`ThreadWorkUnits`) and have that work split into manageable chunks (`ThreadWork`) that can be processed by a single `ThreadWorker`.

Most commonly, `ThreadWorkUnits` contain only the ID values of the entities to be processed. For example, one can envision a process that performs an operation on a set of accounts. In general, one would expect that each `ThreadWorkUnit` would contain a single `AccountId`. The `ThreadWorker` objects would then be constructed in such a way that when asked to execute for a `ThreadWorkUnit` it would pull out the embedded `AccountId` and then perform the required business function.

There are convenience methods available from the `AbstractBatchJob` that make it easier to create `JobWork` instances. For example, the `createJobWorkForEntityQuery(Query)` method will accept a query returning `BusinessEntity` instances, and create a `JobWork` instance containing the appropriate number of `ThreadWork` instances, each containing (notwithstanding rounding) the same number of `ThreadWorkUnits`.

Declaring a ThreadWorker Class

It is the responsibility of the `BatchJob` to declare what class defines the `ThreadWorkers` that should perform the work. By returning a Class instance rather than `ThreadWorker` instances, the framework controls `ThreadWorker` instantiation, which may occur in a different JVM than the one the `BatchJob` instance resides in.

Creating a ThreadWorker

The `ThreadWorker` performs the heavy lifting of a batch process. For a given run, there will be `ThreadWorkers` created equal in number to the thread count parameter provided when a process is requested.

Initializing ThreadWork

Each `ThreadWorker` instance can expect to have its `initializeThreadWork()` method called once by the framework before any actual work is performed. This method may be implemented to do any setup necessary for that thread's execution, most commonly output files opened, or variables initialized.

Warning: It is very important that any setup necessary to execute a `WorkUnit`, including accessing batch parameters, is done here and not in the creation of `JobWork`. There is no guarantee that static variables set at the time of the `JobWork` creation will be available at this time. The framework may be calling `ThreadWork` in a different process from the creation of `JobWork`.

Executing a WorkUnit

The `ThreadWorker` can expect that its `executeWorkUnit` method will be called once for each `ThreadWorkUnit` that the `ThreadWorker` will process. For example, if the batch process will act upon 10,000 accounts, and the process is submitted with a `ThreadCount=10`, we can expect that there are 10 `ThreadWorkers` created by the framework, each of which will have its `executeWorkUnit` method called by the framework for each of the 1,000 `ThreadWorkUnits` allocated to that thread.

Finalizing ThreadWork

Each `ThreadWorker` instance can expect to have its `finalizeThreadWork()` method called once after all `ThreadWorkUnits` have been processed. This gives the opportunity to close any open files or to do any other tear down processing for the `ThreadWorker`.

Choosing a ThreadExecutionStrategy

`ThreadWork` instances need to provide a strategy defining the execution policies for its work. That is, how the work for a thread will be processed. The interface that is implemented is `ThreadExecutionStrategy`. The most important aspect of this is how exceptions will be treated with respect to transactions.

- Should all the `ThreadWorkUnits` be wrapped in a single transaction with a single rollback on an exception?
- Should each `ThreadWorkUnit` be in its own transaction?
- Should the framework attempt to process many `ThreadWorkUnits` within a single transaction?
- If an exception occurs should the framework back up and reprocess the successful units?
- In general, new background processes are expected to chose from existing instances of `ThreadExecutionStrategy`, not create new ones. Please scan for existing implementations of `ThreadExecutionStrategy`.

Creating Javadocs for CM Source Code

Javadocs can be created for CM source code. They are designed to be integrated into the product's Javadocs.

The product's Javadocs are only delivered for objects or supporting objects that are intended to be referenced by CM code. For instance, only the domain and api packages are included, and some of the files created by the artifact generator are not delivered since they have no practical relevance to CM code. These files have been deliberately and explicitly omitted when creating the product's Javadocs.

Note: The process that generates Javadocs on CM source code is not selective, and running Javadocs on CM source code may include more object types than what is delivered with the product's Javadocs.

Refer to Creating Javadocs for CM Source Code on page 36 for more information.

Utilities

Environment Batch Programs

displayEnvironment.bat

Property	Detail
Purpose	Displays the current configuration.
Description	Displays a set of environment variables and settings that may be needed to diagnose compile issues.
Usage	`displayEnvironment.bat`
Parameters	None.

switchEnvironments.bat

Property	Detail
Purpose	Sets the current development environment (project) for the Software Development Kit.
Description	Displays a list of development environments on the development client, allows the user to select one, and sets it as the current development environment for the Software Development Kit.
Usage	`switchEnvironments.bat`
Parameters	None.

createNewEnv.bat

Property	Detail
Purpose	Creates a new development environment (project) or configures a development environment to use the version of the Software Development Kit used for the current development environment.
Description	Configures a new app server to be a development environment. Also, executing this for an existing development environment configures that development environment to use the version of the Software Development Kit used by the current development environment.

Property	**Detail**
Usage	`createNewEnv.bat -a <appServerDir>`
Parameters	• **`<appServerDir>`** . Specify the base directory of the app server to configure.

Services

Batch Program setupSvcXMLPrompted.bat

Property	**Detail**
Purpose	Setup service XML.
Description	After prompting the user for the program name of the service, this script sets up a service by creating the service XML file.
Usage	`setupSvcXmlPrompted.bat`
Parameters	None.

Batch Program updateXMLMetaInfo.bat

Property	**Detail**
Purpose	Updates the XML Metainfo directory with the latest service XMLs.
Description	Updates the XML Metainfo directory of the current development environment with the latest service XMLs. This is needed, for example, for creating schemas for XAI.
Usage	`updateXMLMetainfo.bat`
Parameters	None.

Eclipse Tools/Wizards

There are a few wizards and tools available for developing against the framework within Eclipse plugins.

Batch Program startEclipse.cmd

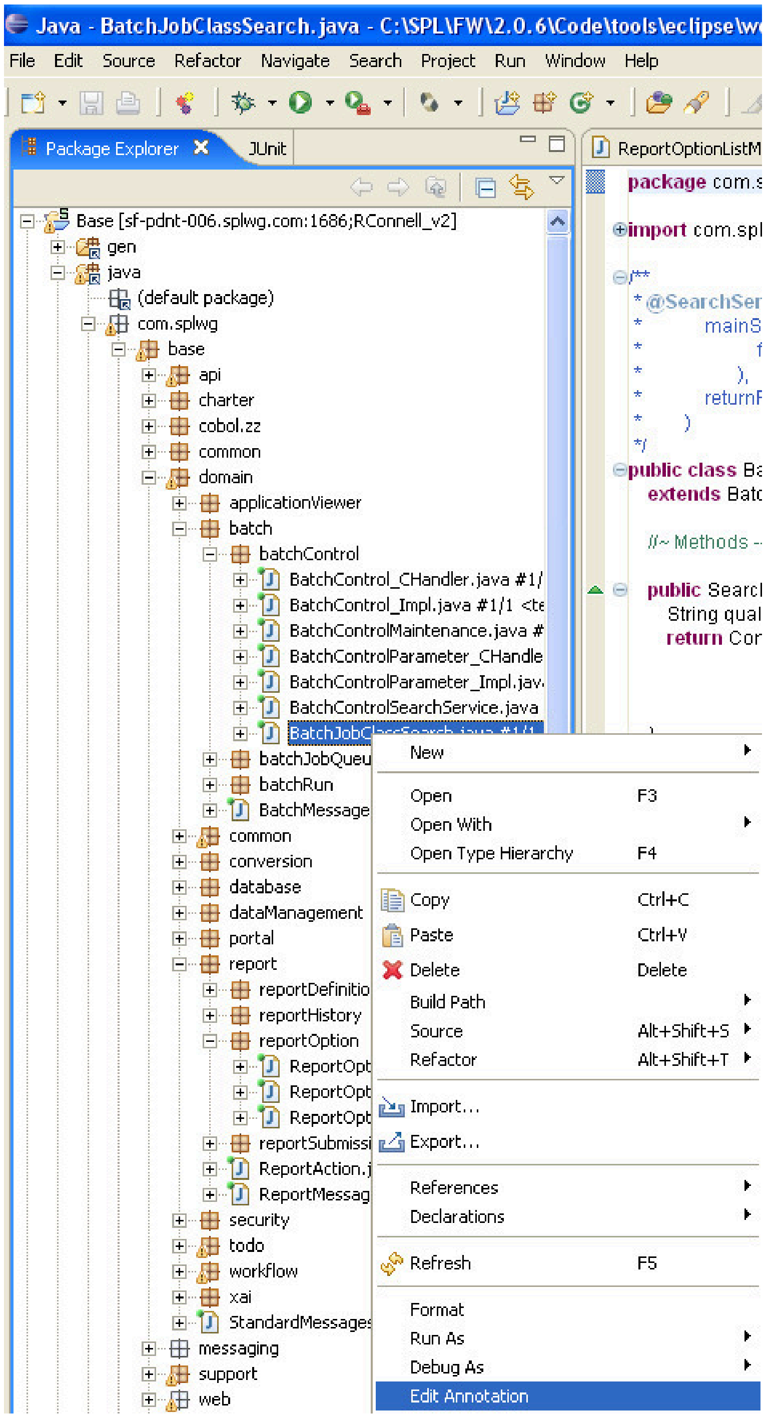
Property	**Detail**
Purpose	Launch the Eclipse SDK for the current development environment (project).
Description	Launches the Eclipse SDK for the current development environment.
Usage	`startEclipse.cmd.`

Property	**Detail**
Parameters	None.

Annotation Editor

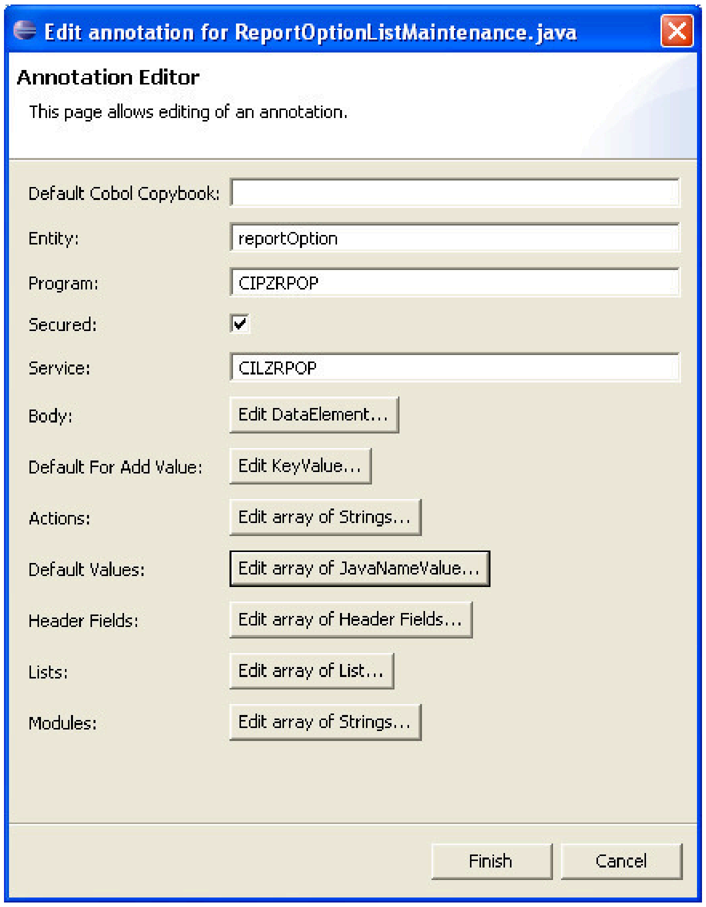
A lot of the Java classes that will be created to add behavior to the application require Annotations to provide metadata about the implementation (see "Java Annotations" chapter in the *Developer Guide*).

The annotation editor plugin provides a convenient way to edit the annotations on these classes. It is available on any class that has an existing annotation, under the **Package Explorer** panel in Eclipse. Right-click on the file in the **Package Explorer**, to get to **Edit Annotation** menu item.



```
package com.s

import com.spl

/**
 * @SearchSer
 *        mainS
 *            f
 *          ),
 *        returnF
 *     )
 */
public class Ba
    extends Batc

    //~ Methods -

    public Searcl
        String qual
      return Cor
```

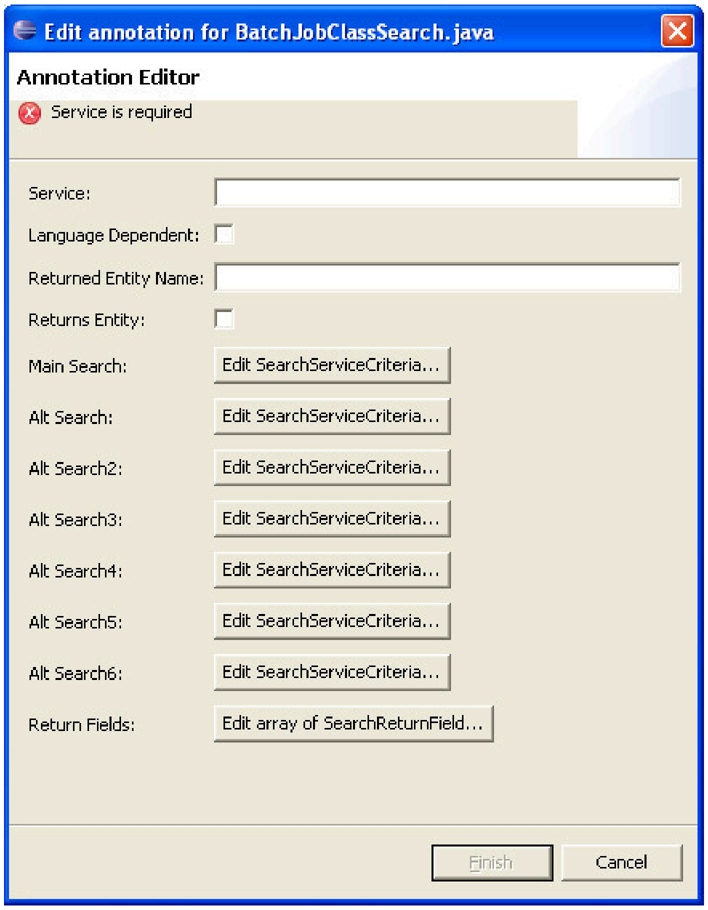
Choosing this menu item will cause a new dialog window to appear, and the file to open into an editor if it is not already open. The dialog that appears will allow maintenance of the file's current annotation contents.


Edit annotation for ReportOptionListMaintenance.java
Annotation Editor
This page allows editing of an annotation.

Default Cobol Copybook:	
Entity:	reportOption
Program:	CIPZRPOP
Secured:	✓
Service:	CILZRPOP
Body:	Edit DataElement...
Default For Add Value:	Edit KeyValue...
Actions:	Edit array of Strings...
Default Values:	Edit array of JavaNameValue...
Header Fields:	Edit array of Header Fields...
Lists:	Edit array of List...
Modules:	Edit array of Strings...

The appearance of the dialog is dependent upon the annotation, but the standard dialog will present a layout of two columns, a label and an input for each annotation property. The bottom of the dialog will always present the **Finish** and **Cancel** buttons. The **Cancel** button is always available, and will throw away any changes made, leaving the file with the annotation unchanged.

The **Finish** button will only be enabled when the annotation has no errors. The annotation is validated after any change, and errors will be displayed near the top of the dialog and the Finish button disabled.



Annotation Editor

Service is required

Service:

Language Dependent: ☐

Returned Entity Name:

Returns Entity: ☐

Main Search: Edit SearchServiceCriteria...

Alt Search: Edit SearchServiceCriteria...

Alt Search2: Edit SearchServiceCriteria...

Alt Search3: Edit SearchServiceCriteria...

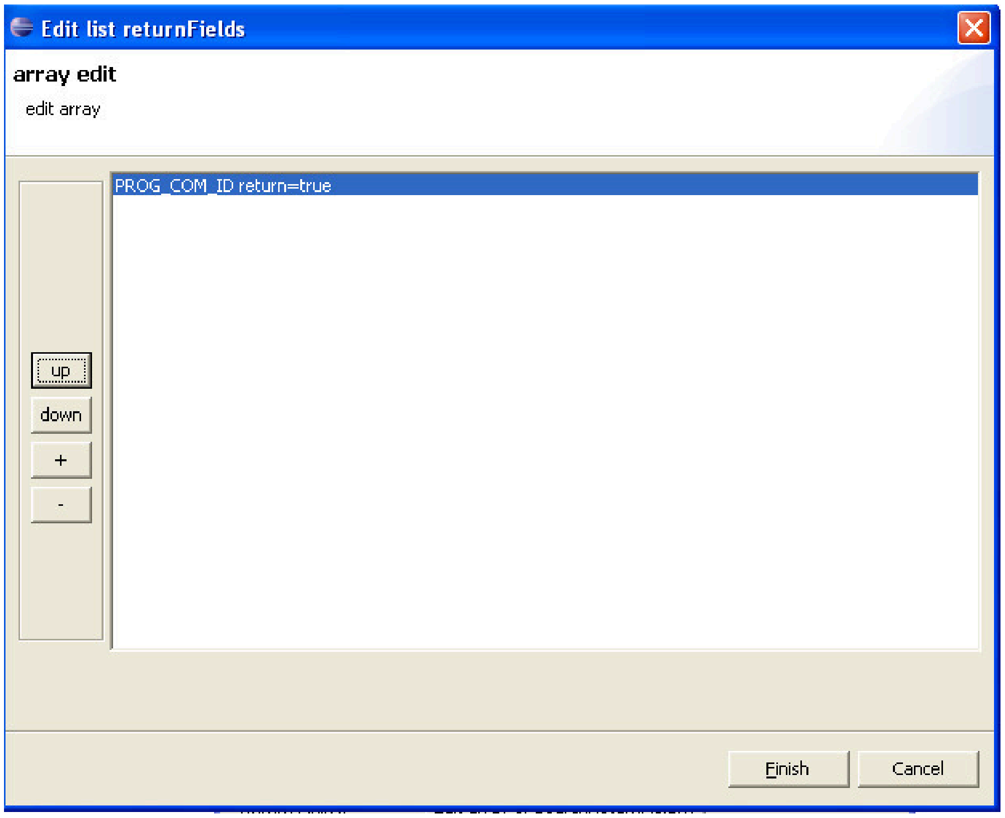
Alt Search4: Edit SearchServiceCriteria...

Alt Search5: Edit SearchServiceCriteria...

Alt Search6: Edit SearchServiceCriteria...

Return Fields: Edit array of SearchReturnField...

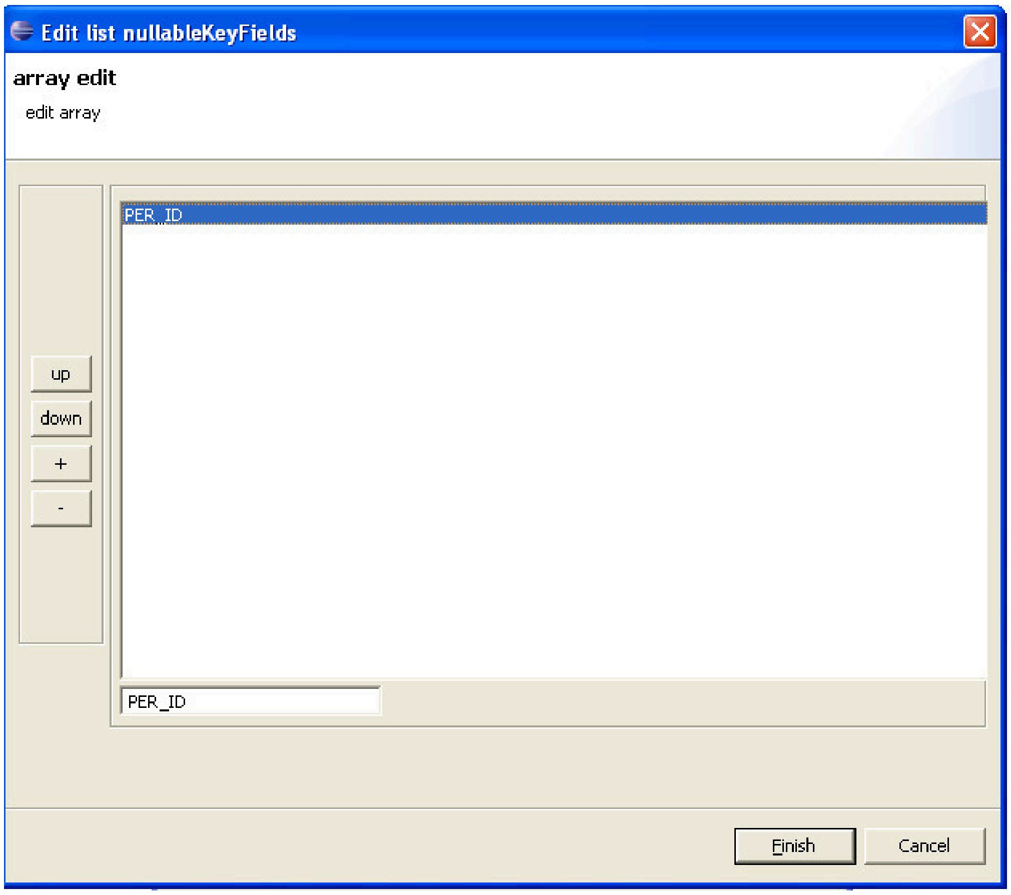
When the property value is itself a list of values or another annotation, there will be a button instead of an input text box. Clicking the button will bring up another dialog to edit its information. In the case of lists, there is a standard dialog where elements can be added, deleted, or reordered.



PROG_COM_ID return=true

To add a new element, click the '+' button. This will pop up a new dialog for the annotation being added (or sometimes a choice of the new annotation's type might need to be chosen first). Clicking the '-' button will delete the highlighted element. The 'up' and 'down' buttons can be used to move the highlighted element up or down within the list. To modify an existing element, double click its row in the list dialog, and a new dialog will open to edit its values.

Finally, there is a special list dialog for lists of strings. Instead of editing the elements in the list in a new dialog, a single input field near the bottom of the dialog is used to edit the highlighted entry.



When the finish button is finally pressed, the annotation (and only the annotation) in the file will change to contain the new values entered into the annotation dialogs. The changed file's annotation may be slightly reformatted. The changed file will also remain unsaved, pending user review of the annotation's changes.

Project database information

To use the Maintenance Object Wizard described in the next section, some information will have to be provided so Eclipse can connect to the database, and retrieve the Maintenance Object metadata.

There are two ways to specify the database connection information.

The first is a way for each project to possibly specify different connection information. This is done in the `.project` file stored in the project's directory. This is an XML file that describes the project. The database information can be supplied in a **buildCommand** node under **buildSpec** under the **projectDescription** root node:

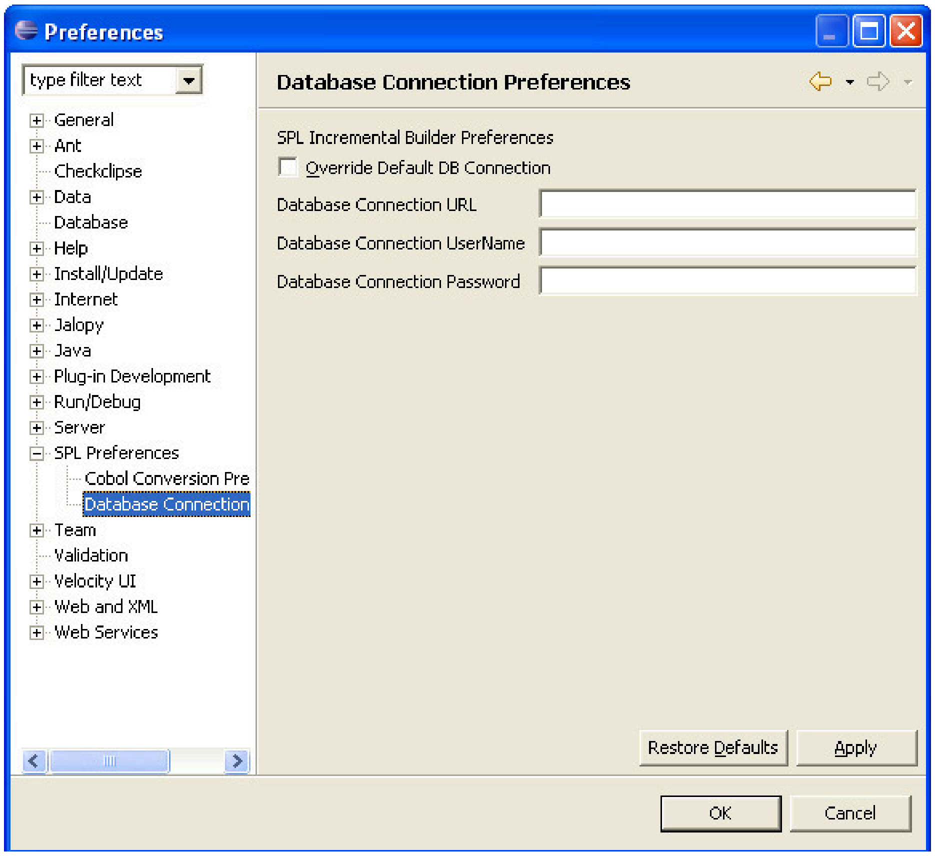
```
<buildSpec>
<buildCommand>
<name>com.splwg.tools.dbConnection</name>
<arguments>
<dictionary>
<key>url</key>
<value><URL></value>
</dictionary>
<dictionary>
<key>username</key>
<value><USERNAME></value>
</dictionary>
<dictionary>
<key>password</key>
<value><PASSWORD></value>
```

```
</dictionary>
</arguments>
</buildCommand>
...
</buildSpec>
```

The values <URL>, <USERNAME>, <PASSWORD> should be replaced (including the surrounding '<' and '>') with the appropriate values for the database for the project.

This file will need to be hand edited, and Eclipse should be restarted after the edit is complete.

The second way is to provide a workspace-wide database connection. This is available in an Eclipse preference- go to **Window | Preferences...**. Then in the tree pane on the left of the **Preferences** dialog, choose **SPL Preferences**. Under **OUAF preferences**, choose **Database Connection**. The preference pane on the right will now show inputs for the database connection information.



Database Connection Preferences

SPL Incremental Builder Preferences

☐ Override Default DB Connection

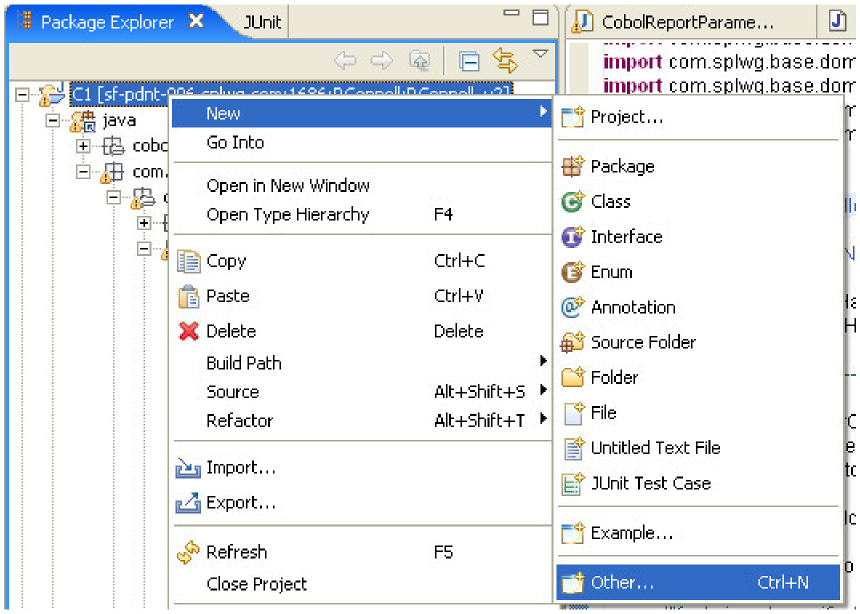
Database Connection URL	
Database Connection UserName	
Database Connection Password	

Click the override default DB connection if the database contains materialized views to the true development database for performance reasons. Enter the information into the appropriate text boxes and click **OK**. This will take effect immediately, without need of restarting Eclipse.

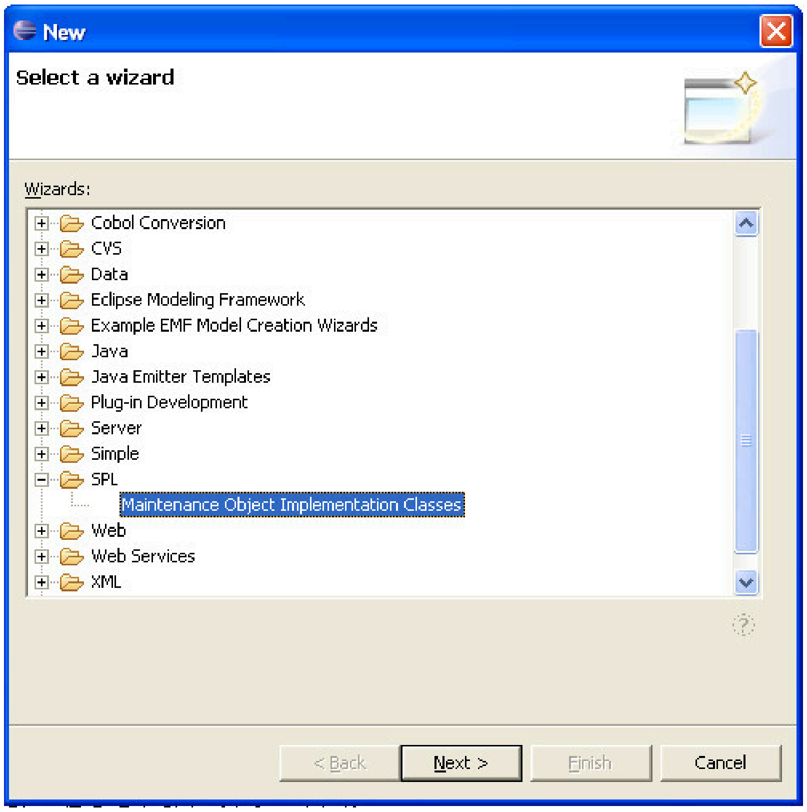
Maintenance Object wizard

In cases where a new Maintenance Object is being added to the application, and the data is first entered onto the `CI_MD_MO` and related tables, there is a wizard that will use that meta data as a starting point and with some developer input, create all of the manually coded `Java Entity_Impl` classes with their proper tree structure, and also optionally create a Java Maintenance class starting point.

The **Maintenance Object Wizard** is available under the **New** menu item, either under the file menu, or by right clicking a node in the package explorer (the package explorer option is recommended, as it will default the project and source directory selected). From the list of new wizards available, choose **Other...**.

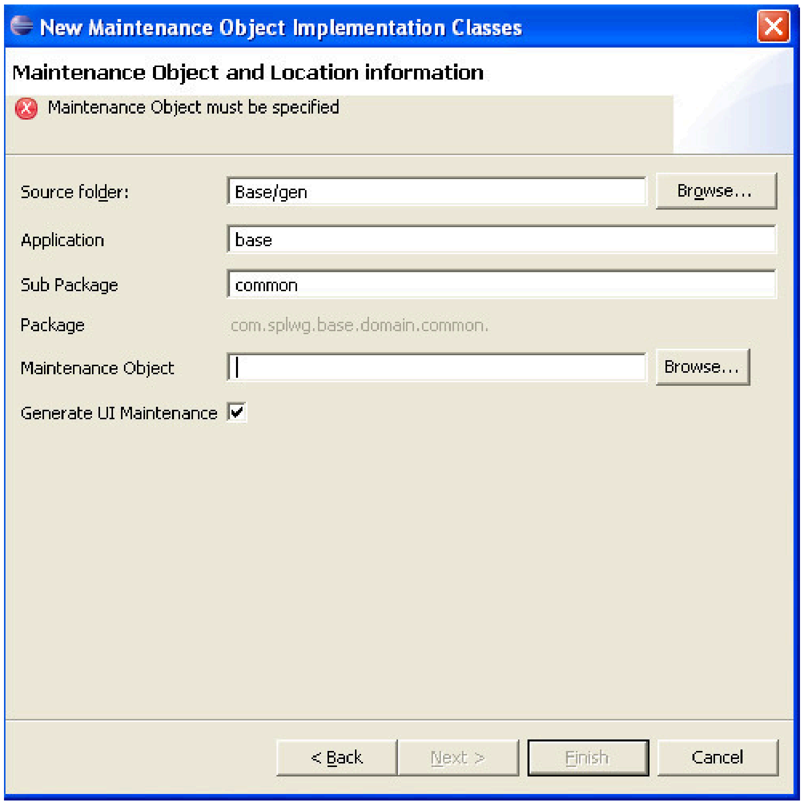


This will open a new dialog, where the maintenance object wizard is under SPL:



(Note that you can configure Eclipse so that in the future the **Maintenance Object implementation classes** wizard appears directly under the first **New** menu.)

The first page of the wizard asks for the project and source path to place the new files. Then it asks for information it uses to construct the package name for the new files. The standard is that the new classes go under the application's domain path, with a possible extra sub package (for example, a subsystem, like 'common' or 'customerInformation'), followed by the top-level entity's name (for example, account). The top-level entity's name, along with lots of data used by the next page, comes from the maintenance object itself.



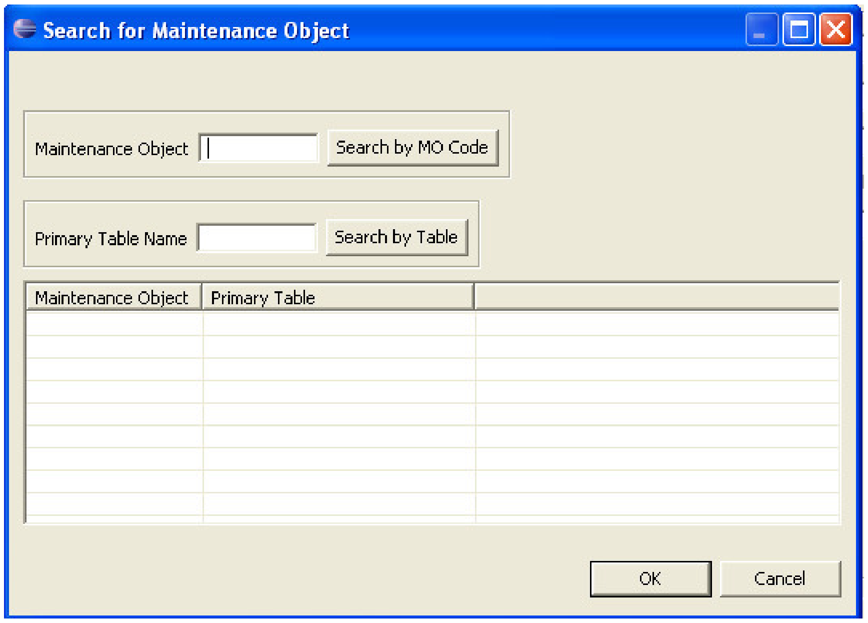
Maintenance Object and Location information

Maintenance Object must be specified

Source folder:	Base/gen	Browse...
Application	base	
Sub Package	common	
Package	com.splwg.base.domain.common.	
Maintenance Object		Browse...
Generate UI Maintenance	✓	

Finally, you can optionally choose to Generate the UI Maintenance (the default is to generate it).

The maintenance object input has a "Browse..." button associated with it that will launch a search dialog where the maintenance object can be searched for by either the Maintenance Object's code, or by the primary table for the maintenance object.

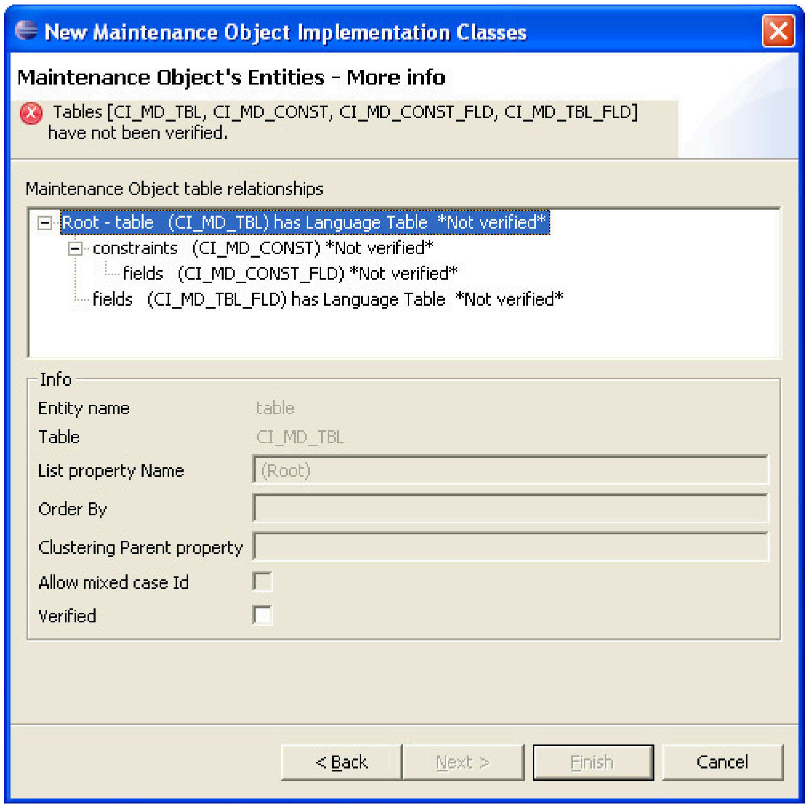


Maintenance Object	Primary Table	

Both searches are *likable* in that partial matches starting with the input will be shown.

Pressing **OK** on the search or double clicking a row will bring the selected maintenance object back into the Maintenance Object input on the main wizard.

Once the main wizard's inputs are specified, the **Next** button can be pressed. This will display the second detailed wizard page. A tree view is displayed with the tree representation of the Maintenance Object selected, with its child tables.



Maintenance Object's Entities - More info

Tables [CI_MD_TBL, CI_MD_CONST, CI_MD_CONST_FLD, CI_MD_TBL_FLD] have not been verified.

Maintenance Object table relationships

```
⊟ Root - table  (CI_MD_TBL) has Language Table  *Not verified*
    ⊟ constraints  (CI_MD_CONST) *Not verified*
        fields  (CI_MD_CONST_FLD) *Not verified*
    fields  (CI_MD_TBL_FLD) has Language Table  *Not verified*
```

Info

Entity name	table
Table	CI_MD_TBL
List property Name	(Root)
Order By	
Clustering Parent property	
Allow mixed case Id	☐
Verified	☐

Each node in the tree must be visited to enter some information or at least verify that the default data is correct. The nodes themselves show the list property name, the table, whether the table has a language table, and whether the node has been verified.

The selected node's data is shown in the "Info" box below the tree. Only editable information is available to be changed- other values may be disabled. The values that can be changed for each node include the list property name, the order by fields, the clustering parent property, and whether the Id can contain mixed case.

The list property name is the name on the parent that the child collection will be accessed by. For example, in the above Maintenance Object for Table, the table's child collection of rows on the table `CI_MD_CONST` will be accessed via the property 'constraints'. And likewise, each constraint will then have a child collection called fields.

The order by is an optional property. It is a comma-separated list of columns that specify the order in which the list will be retrieved when the collection is read from the database. An example for the constraints collection would be `CONST_ID, OWNER_FLG`.

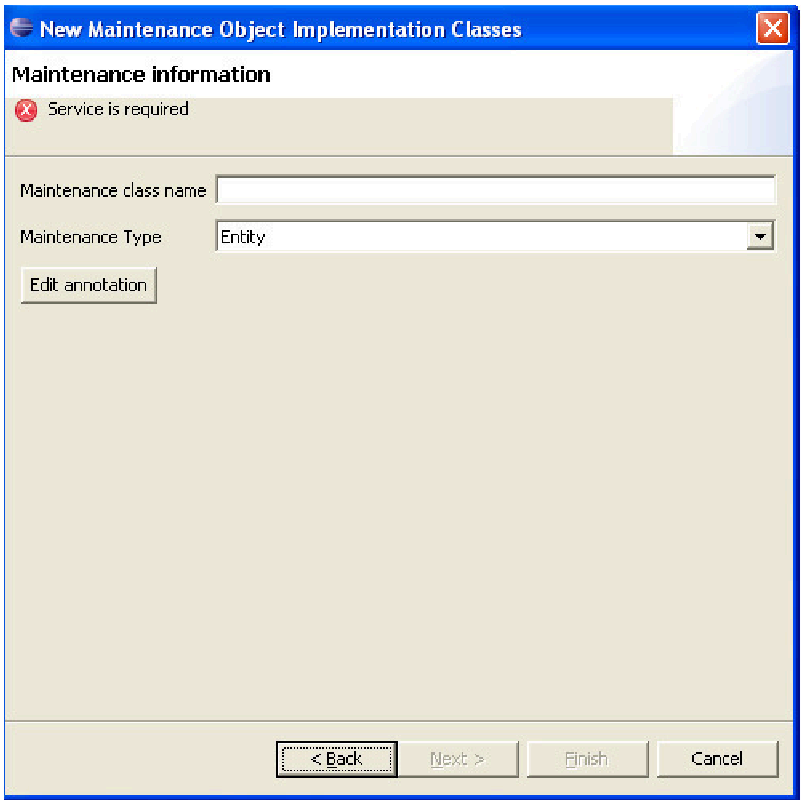
The clustering parent property comes into play for generated IDs. In some cases, it is beneficial to cluster the generated keys for related objects so that batch threading is more efficient. An example is every Service Agreement can have its ID generated with some portion of its account ID. The account will be accessed off a `serviceAgreement` via the property account. Thus, the Service Agreement root node in the above dialog would probably have a value of 'account' for the clustering parent property.

In case of user-defined string keys, most of the time the application only uses uppercase keys. However, in some cases, mixed case keys are allowed. The **Allow mixed case Id** checkbox should be checked in this event.

Finally, to ensure that the developer reviews each node's values, the **Verified** checkbox must be checked for each node, prior to proceeding to the next page or finishing.

If the option to generate the Maintenance was not chosen, the **Finish** button will be enabled when the tree nodes' data is complete and valid. Clicking **Finish** will cause all of the entity classes to be created in the specified package, and will open an editor window on each new class.

If the option to generate the Maintenance was chosen on the first page, the **Next** button should be enabled after all the tree nodes data is finished and valid. Clicking **Next** will then present the final wizard page, where information about the maintenance class can be entered.



Service is required

Maintenance class name:

Maintenance Type: Entity

On this page, you can choose the maintenance class name and maintenance type. The maintenance class name is something like the root entity name followed by `Maintenance` by convention, although it can differ. The maintenance type choices are **Entity**, which is a standard maintenance for a single instance of the maintenance object at a time, with nested child lists, and so on. The other choice is **List**, which is a simplified maintenance where many instances of the maintenance object are edited at once in a grid. This is usually limited to simple objects with a code and description, and maybe one or two other fields. Anything more complex would be difficult to present in the single grid.

Note: Changing the Maintenance Type will clear out any existing information on the annotation.

After the class name and maintenance type is chosen, there is more information required to be edited on the Annotation. See "Java Annotation" in the *Developer Guide* for details about annotations. Clicking the **Edit Annotation** button will launch a new dialog window for editing the annotation. The most important information that every maintenance must specify on the annotation is the service name. This field is immediately visible on the main dialog for the annotation, and must have a value entered. Most everything else will have been defaulted with appropriate values from the Maintenance Object metadata. See the developer guide mentioned above for more information on using the annotation editor.

After the maintenance information and annotation are complete and valid, pressing **Finish** will cause the entity files and an empty maintenance class to be created, and an editor windows to be opened on each of them.

Upgrade JSP to XSLT

Note: JSPs other than trees and subpanels must have been upgraded to XSLTs in v1.5.x. Thus, there is no tool to upgrade such code in V2.

Batch Program convertTreePageExits.pl

convertTreePageExits Purpose

Creates user exit files from tree JSP files.

convertTreePageExits Description

This program creates user exit .xjs files for all tree JSP files under the current and child directories. The .xjs file will be created in the same directory with the same name as the JSP.

This should be run from a command prompt in the directory or parent directory of the JSP files.

convertTreePageExits Usage

```
Perl convertTreePageExits.pl
```

Batch Program convertSubPanelExits.pl

convertSubPanelExits Purpose

Creates user exit files from subpanel JSP files.

convertSubPanelExits Description

This program creates .xjs files for all subpanel JSP files under the current and child directories. The .xjs file will be created in the same directory with the same name as the JSP.

This should be run from a command prompt in the directory or parent directory of the JSP files.

convertSubPanelExits Usage

Perl convertSubPanelExits.pl

SQL Script changeTemplateCodesTTRAndPN.pl

changeTemplateCodesTTRAndPN Purpose

Changes the tree and subpanel template codes to the XSLT template codes.

changeTemplateCodesTTRAndPN Description

This changes the template codes of from JSP to XSLT template codes. This template code instructs the application to use the XSLT engine instead of the referring to a JSP.

These SQL commands should be run against the database.

Javadocs

Batch Program generateJavadoc.bat

Property	Detail
Purpose	Create javadocs from custom source code.
Description	This script runs the javadoc tool bundled with the jdk against CM source code in the standard directory and targets the javadocs directory. To integrate the javadocs with the product's javadocs the reindex tool needs to be run.
Usage	`generateJavadoc.bat`

Property	Detail
Parameters	None.

Batch Program reindexJavadoc.bat

Property	Detail
Purpose	Recreate the Javadoc indices.
Description	This script recreates the Javadoc indices so that it shows all of the Javadocs in the Javadoc folder. If Javadocs have been generated for CM code, this will update the indices to include both the CM and the product's classes and packages.
Usage	`reindexJavadoc.bat`
Parameters	None.

Developer Guide

Overview

The Oracle Utilities Application Framework provides a rich environment for developing applications. This document provides a reference for various topics that will help developers make the most of this application development framework. The sections in this document include:

- The **Java Annotations** section describes the meta-data that can be embedded in Java code for various purposes.
- The **Public API** section describes available methods, interfaces, etc., in the various Java classes like entities, maintenance classes, etc.
- The **Application Logs** section describes how logs are set up and used.
- The **Java Programming Standards** section describes Java coding practices that promote efficient development and maintenance as well as upgradeability.
- The **HQL Programming Standards** section describes HQL coding practices that promote efficient development and maintenance as well as upgradeability.
- The **SQL Programming Standards** section describes SQL coding practices that promote efficient development and maintenance as well as upgradeability.
- The **Database Design Standards** section describes database design practices that promote an efficient database, maintenance as well as upgradeability.
- The **System Table Guide** section describes the set of database tables that contain crucial information for the configuration and operation of the application. It also describes standards to be followed to ensure upgradeability.
- The **Key Generation** section describes the automatic generation of random and sequential primary keys.

Java Annotations

Annotations provide information so the application can deal with the code in certain classes. These annotations can instruct the generator on how to generate the superclass, how to register the class, and at runtime can affect the behavior of the class. The annotations are potent metadata used at several levels in the application.

Technically, annotations are structures described inside a JavaDoc comment before classes or methods. They start with an at sign character (@), followed by the annotation name, and the body of the annotation inside parenthesis. The body can be either comma-separated key=value pairs or a single value specified for a unique default key. The values can be any of strings (needing to be bound by quotes if there are special characters inside the string itself), lists (of either annotations or strings) bound by curly braces {} and separated by commas, or other annotations.

Each managed class (entity, change handler, business component, maintenance, and so on) typically has its own annotation. Each of these annotations has an underlying Java class in the `com.splwg.shared.annotations` package, where the name of the class is the name of the annotation suffixed by `Annotation`. The JavaDoc comments of these annotation classes should give more detail for each specific annotation.

For example:

Here is the entity annotation for batch control:

```
/**
 * @BusinessEntity (tableName = CI_BATCH_CTRL,
      oneToManyCollections = { @Child (collectionName = parameters, childTableName = CI_
                  orderByColumnNames = { "SEQ_NUM"})})
*/
public class BatchControl_Impl
```

The name of the annotation is `BusinessEntity`. It has as specified properties `tableName` and `oneToManyCollections` (there are others available, but not all of them need to be specified). The property `tableName` specifies the `CI_BATCH_CTRL` table as the table that this entity maintains. It also contains some `oneToMany` child collections, specified by the list of child annotations. In this case, there is a single child, with a collection name of parameters, pointing to the child table `CI_BATCH_CTRL_P`, with a native order given by the column name `SEQ_NUM`.

Once an annotation exists, the annotation wizard (in the Eclipse editors' plugin) can be used to maintain the annotation, showing the available annotation properties and validating the values entered. Thus, one way to create an annotation from scratch is to create a purely empty annotation with the correct name at the start of the class, and then use the annotation editor to fill in the details, avoiding typographical errors and the need to hunt down the allowed properties.

Here is a list of top-level annotations and their corresponding purpose or managed class type, and a pointer to an example class in the FW code where available.

- `BatchJobAnnotation` for batch jobs, defining such properties as whether the batch is multithreaded and what soft parameters it uses. An example batch job in Java is defined in the class `com.splwg.base.domain.todo.batch .BatchErrorToDoCreation`.
- `BusinessComponentAnnotation` for business components. This will register the business component either as a new one (and define whether it can be replaced or not), or a replacement of an existing one. An example business component is `com.splwg.base.domain.todo.toDoEntry.ToDoEntryAssigner_ Impl`.
- `AlgorithmComponentAnnotation` for defining algorithm implementations. This is used to create a new algorithm implementation, defining which algorithm spot it is for, and what soft parameters it uses. An example algorithm component is `com.splwg.base.domain.common.characteristicType.AdhocNumericValidationAlgComp_ Impl`.
- `EntityChangeAuditorAnnotation` for implementing audit behavior when an entity is modified. An example auditing component is `com.splwg.base.domain.common.audit.DefaultTableAuditor_ Impl`.
- `BusinessEntityAnnotation` for defining or extending business entities, with properties defining the table maintained and any one-to-many child tables, etc. An example entity is `com.splwg.base.domain.batch.batchControl.BatchControl_Impl`.

- `ChangeHandlerAnnotation` for extending entity persistence behavior by adding validations or extra code to execute on add/change/delete actions. An example change handler is `com.splwg.base.domain.common.characteristicType.CharacteristicType_CHandler`.
- `CodeDescriptionQueryAnnotation` for adding services to handle drop-down lists for the UI. There are no examples of this general component; the Oracle Utilities Application Framework implements only entity code descriptions.
- `EntityCodeDescriptionQueryAnnotation` for adding services to handle drop-down lists for the UI, that are directly related to entities. An example of an entity code description component is `com.splwg.base.domain.common.country.CountryCodeDescriptionQuery`.
- `MaintenanceExtensionAnnotation` for extending a maintenance. There are no examples of maintenance extensions in the framework. It is purely an implementer component. See Maintenance Extensions (User Guide: Cookbook, Hooking into User exits: Hooking into Maintenance Class User Exits).
- `QueryPageAnnotation` for creating a new query page service. An example is `com.splwg.base.domain.todo.toDoQueryByCriteria.ToDoQueryByCriteriaMaintenance`.
- `PageMaintenanceAnnotation` for creating a new generic page maintenance. An example is `com.splwg.base.domain.security.user.SwitchUserLanguageMaintenance`.
- `EntityListPageMaintenanceAnnotation` for creating a new maintenance for an entity-type, with a list based front end. An example is `com.splwg.base.domain.common.phoneType.PhoneTypeListMaintenance`.
- `EntityPageMaintenanceAnnotation` for creating a new entity maintenance, that maintains a single instance at a time. An example is `com.splwg.base.domain.batch.batchControl.BatchControlMaintenance`.
- `ListServiceAnnotation` for creating a list service (read only), meant for trees for example. An example is `com.splwg.base.domain.security.user.UserAccessGroupCountListInquiry`.

Public API

SQL Return Codes

The framework generally returns the database-specific return codes from SQL execution. However, the framework returns Oracle Utilities-specific return codes for commonly used SQL execution result messages. These Oracle Utilities-specific return codes are the same regardless of the database. This allows programs to be portable across different databases.

The following lists the return codes:

SQL Execution Result	Return Code
OK	0
* Unnumbered SQL Error	999999990
Warning	999999991
End / no (more) row retrieved	999999992
Duplicate / unique index violation	999999993
More / multiple rows retrieved in single-row select	999999994

SQL Execution Result	Return Code
Deadlock	999999995
No connection	999999996
* Application Error	999999997
* Hibernate Error	999999998
* Programmatic Error	999999999

Note: The SQL return codes marked with an asterisk (*) are for errors peripheral to the actual execution of the SQL and do not have equivalent database return codes.

Standard Business Methods

In general, classes that are created to implement business logic, including change handlers, business entities, maintenance classes, and business components have access to standard methods intended to give application code access to framework functionality. Commonly, these classes extend the `GenericBusinessObject` class within their inheritance hierarchy. Below are some general descriptions of the provided methods. Refer to the JavaDocs for more detail.

- `createQuery(String)` -Create an HQL query.
- `createPreparedStatement(String)` -Create a "raw" SQL statement. It is preferable to use the `createQuery` method.
- `getActiveContextLanguage()`/`getActiveContextUser()` -Get the language and user associated with the current request.
- `createDTO(Class)` -Create a new `DataTransferObject` instance for the entity corresponding to the provided business interface class.
- `getDynamicComponent(various)` -Get a Business Component instance corresponding to the input business interface for the component.
- `getSystemDateTime()` -Get the current `DateTime` instance appropriate for business logic.
- `IsNull(Object)`/`notNull(Object)` -Methods that answer the question if an object is null or is equivalent to null.
- `isNullOrBlank(String)`/`notBlank(String)` -Methods that answer the question if a string reference is null, zero length, or all blank.
- `startChanges()`/`saveChanges()` -Used to defer validation when making complex changes to entities. It may be the case where a valid entity can only be constructed by passing through one or more invalid states. By calling `startChanges()` at the beginning of the set of changes and `saveChanges()` at the end, some validations may be deferred until the entire coherent change is complete.

Business Entity Public Methods

BusinessEntity classes implement a combination of methods inherited from their generated superclasses as well as the framework classes that those generated superclasses extend. The generated methods are typically "convenience" methods based on the specific features of the entity. The framework methods are ones implemented by many or all entities. Similarly, some methods are expected to be invoked from other objects (public methods) and others are to facilitate business logic coded into the entities' business methods themselves.

Public Methods

These methods are exposed via the generated business interface of the entity.

- `registerChange(Change)` - Allows for an entity to register the fact that a different entity has changed, in order to fire any dependent change handler logic in *this* entity. This is most useful in situations where the changed

object and the dependent object (the one needing to know about the change) are not directly related by parent-child relationships.
- `getDTO()` - Get a `DataTransferObject` representing the current state of the entity.
- `setDTO(DataTransferObject)` - Update the state of the entity based on the passed values in the DTO.
- `getId()` - Each entity has a method by this name, which retrieves and Id instance of the appropriate class for the entity.
- `getFoo()` - Get the value of the persistent property `foo`.
- `fetchBar()` - Convenience method that will fetch the value of `bar`, where `bar` is a parent entity referenced by an optional foreign key reference. The word `fetch` is used to denote that navigation to that entity is not provided from within HQL.
- `getBazzes()` - Get the `EntityList` containing members of the entity `baz`. For example, a `getPersonNames()` method on the `person` entity might return an instance of an `EntityList` containing `PersonName` instances.

Protected Methods

These methods are exposed via the extended generated superclass of an entity (the `_Gen` class) for the use of business methods implemented on the entity. With few exceptions, the methods exposed as public methods on business entities are also exposed within the entity as protected methods for the convenience of business logic. Additionally, the following methods are added:

- `thisEntity()`- Return the instance of the current entity. Generally, this is used when an entity needs to pass itself as an argument in a method call.
- `addError(ServerMessage)`- Add an error relating to the current entity.
- `addError(ServerMessage, Property)`- Add an error relating to the passed property on the current entity.
- `addWarning(ServierMessage)`- Add a warning to the current warning list.

Data Transfer Object Methods

`DataTransferObjects` (or DTOs) are transient objects meaning that changes to their state are not directly persisted. They provide a mechanism where the set of properties of an entity can be passed around in business logic without the implication that changes to their values will be transparently persisted to the database.

- `getFoo()/setFoo(Bar)`- Get or set the value of the property `foo`.
- `newEntity()`- Create a new persistent entity based on the values currently held in the DTO.

Id Methods

Entities generally have an Id class created for them by the artifact generator. This provides clarity in the application code as to what kind of Id is being held or passed. Likewise, there are useful methods on these Id classes. Id instances are immutable.

- `getEntity()`- Get the business entity that this Id refers to or null if no such entity instance exists.
- `getFoo()`- In the case where the Id contains a persistent entity `foo`, return that entity.
- `getBarId()`- Get the contained Id referring to the entity `bar`.
- `newDTO()`- Create a new DTO instance with the Id property already set to this Id's value.

Maintenance Class Public Methods

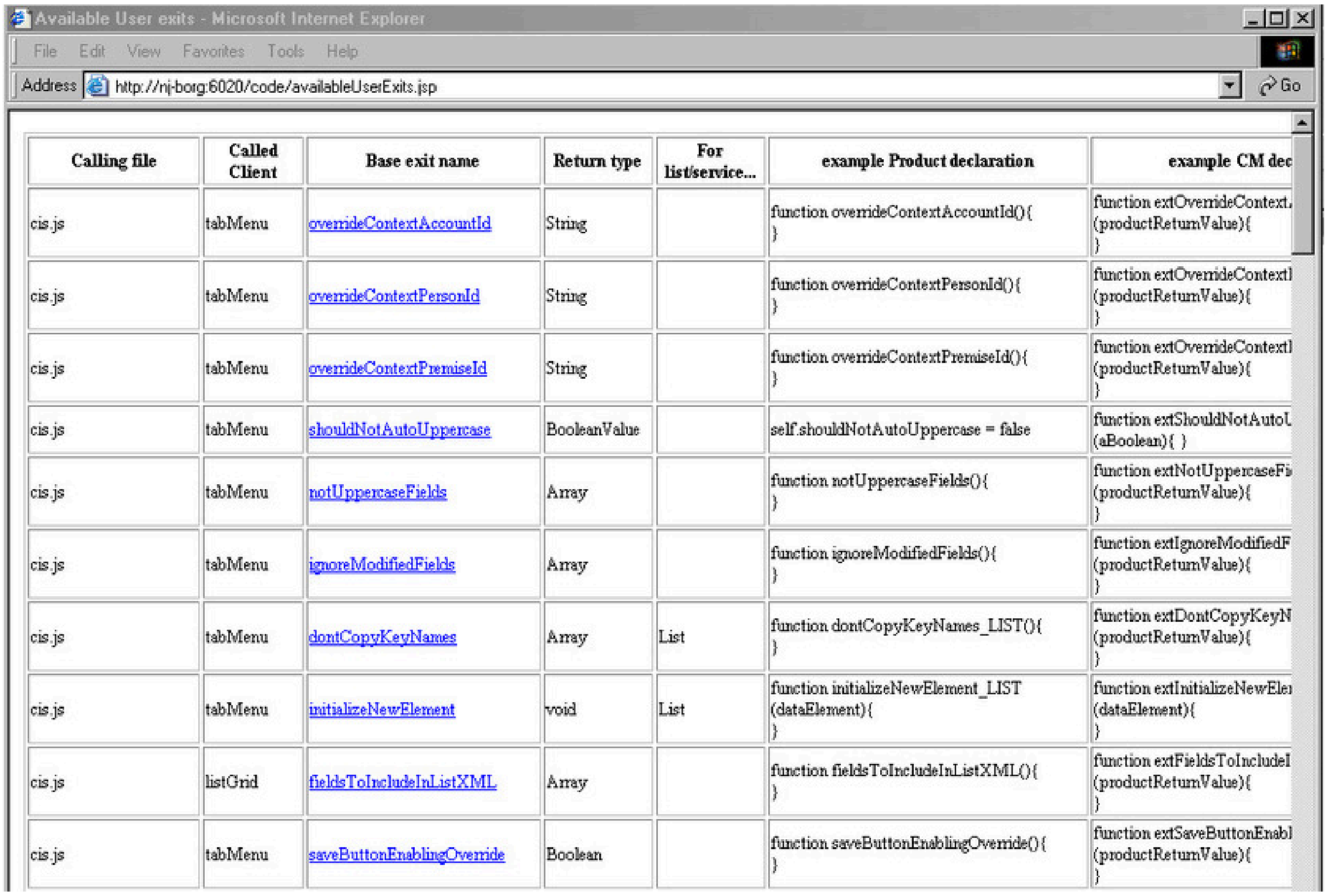
Please refer to the Javadocs for the public API.

UI Javascript User Exits

The client-side external user exits are designed to give implementers flexibility and power to extend the user interface of a OUAF product. Implementers can add additional business logic without changing OUAF product HTML files. These user exits were developed such that developers can create an include-like file based on external user exit templates.

There are two types of client user exits available. There are process-based user exits that wrap the similar product user exit code with pre- and post- external user exit calls, and there are also data-based user exits that simply allow the implementer to add or delete data from the product returned data.

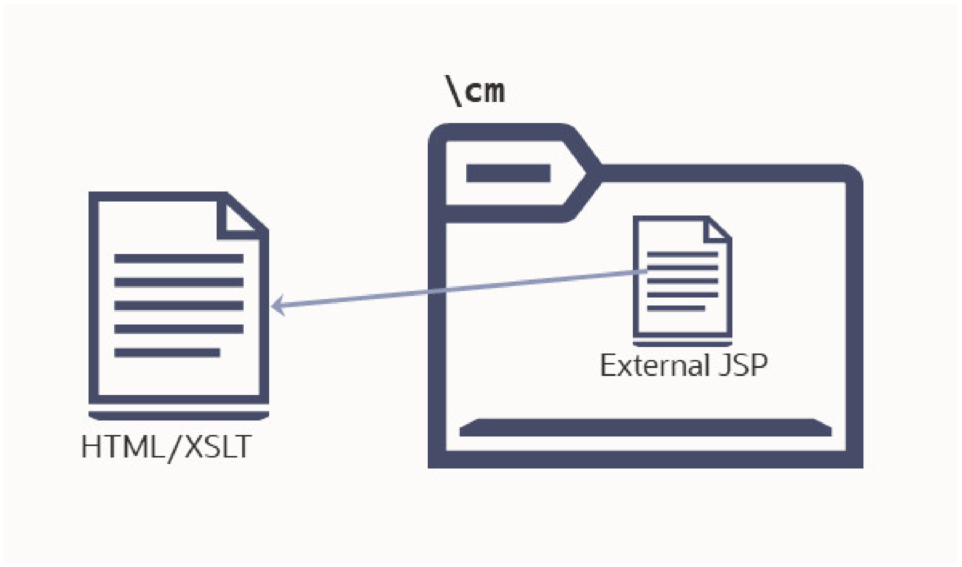
Both types of external user exit are only called if the function exists in the implementers external JSP file. All available user exits are listed online in the system through the relative URL: `/code/availableUserExits.jsp`, with definition examples and links to the framework code that executes the call.


Available User exits - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Address http://nj-borg:6020/code/availableUserExits.jsp
Go

Calling file	Called Client	Base exit name	Return type	For list/service...	example Product declaration	example CM dec
cis.js	tabMenu	overrideContextAccountId	String		function overrideContextAccountId(){ }	function extOverrideContext (productReturnValue){ }
cis.js	tabMenu	overrideContextPersonId	String		function overrideContextPersonId(){ }	function extOverrideContextI (productReturnValue){ }
cis.js	tabMenu	overrideContextPremiseId	String		function overrideContextPremiseId(){ }	function extOverrideContextI (productReturnValue){ }
cis.js	tabMenu	shouldNotAutoUppercase	BooleanValue		self.shouldNotAutoUppercase = false	function extShouldNotAutoU (aBoolean){ }
cis.js	tabMenu	notUppercaseFields	Array		function notUppercaseFields(){ }	function extNotUppercaseFi (productReturnValue){ }
cis.js	tabMenu	ignoreModifiedFields	Array		function ignoreModifiedFields(){ }	function extIgnoreModifiedF (productReturnValue){ }
cis.js	tabMenu	dontCopyKeyNames	Array	List	function dontCopyKeyNames_LIST(){ }	function extDontCopyKeyN (productReturnValue){ }
cis.js	tabMenu	initializeNewElement	void	List	function initializeNewElement_LIST (dataElement){ }	function extInitializeNewEle (dataElement){ }
cis.js	listGrid	fieldsToIncludeInListXML	Array		function fieldsToIncludeInListXML(){ }	function extFieldsToIncludeI (productReturnValue){ }
cis.js	tabMenu	saveButtonEnablingOverride	Boolean		function saveButtonEnablingOverride(){ }	function extSaveButtonEnabl (productReturnValue){ }

UI Available User Exits - Online Reference

The location of the external JSP file is the `\cm` directory under the web application root directory:

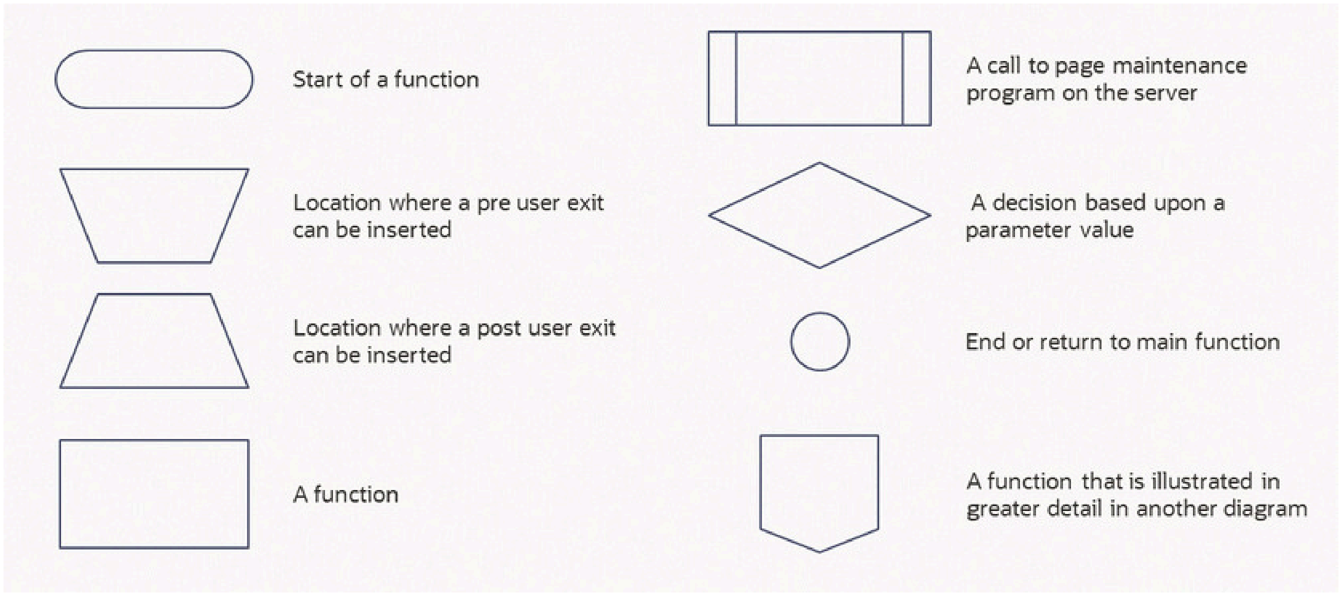


This document assumes that you are familiar with the framework architecture and its UI program component templates (XSLT) and that you know how the base exits work. It also assumes that you are proficient in JavaScript and HTML.

Client User Exit Flow

The following flowcharts illustrate the most common user exit functions used to modify the user interface. The flowcharts are designed to help you see the coordination of processing between the client and the server as well as where the pre and post external user exits can be used.

The following diagram explains the shapes used on subsequent flowcharts:

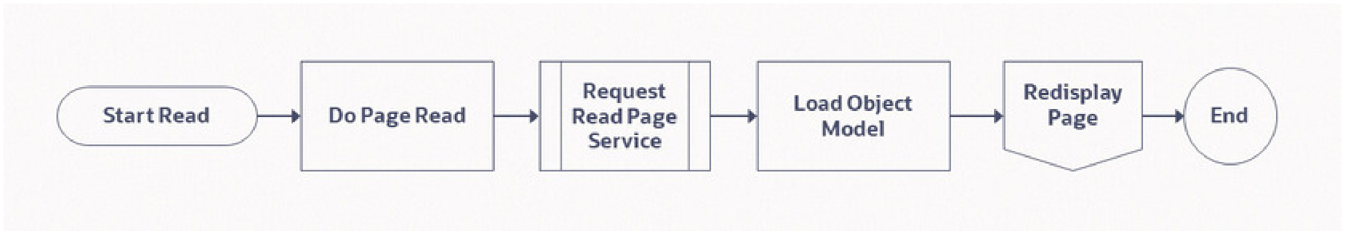

Start of a function
A call to page maintenance program on the server
Location where a pre user exit can be inserted
A decision based upon a parameter value
Location where a post user exit can be inserted
End or return to main function
A function
A function that is illustrated in greater detail in another diagram

Flowchart Legend

Whenever you see a request for a server-side page service, you can refer to the Page Maintenance Program flowchart to see the server-side processing. You can determine the Page Action based on the service being requested: Read, Add, Change, Delete, or Default.

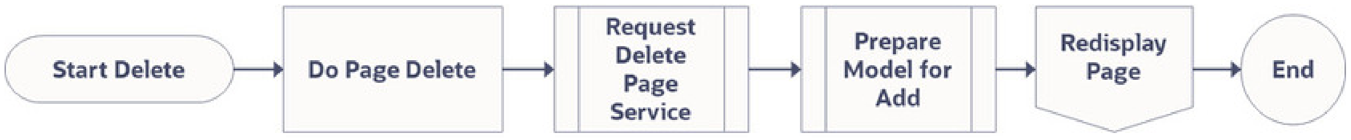
Read Page

The Read Page function is executed whenever data needs to be presented from the database to the user. It is called after a root item is selected from a search page or when navigating to another transaction via a **Go To** button or a **Context** menu.



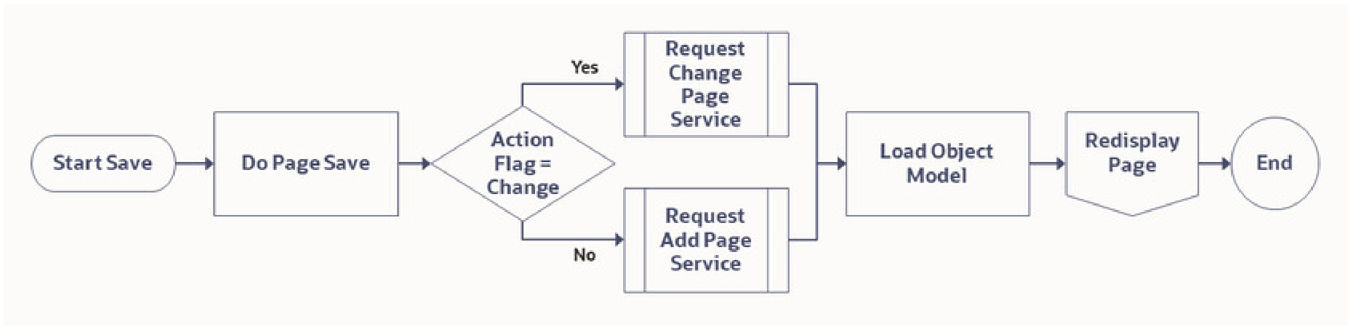
Delete Page

The Delete Page function is executed when the user clicks the delete icon.



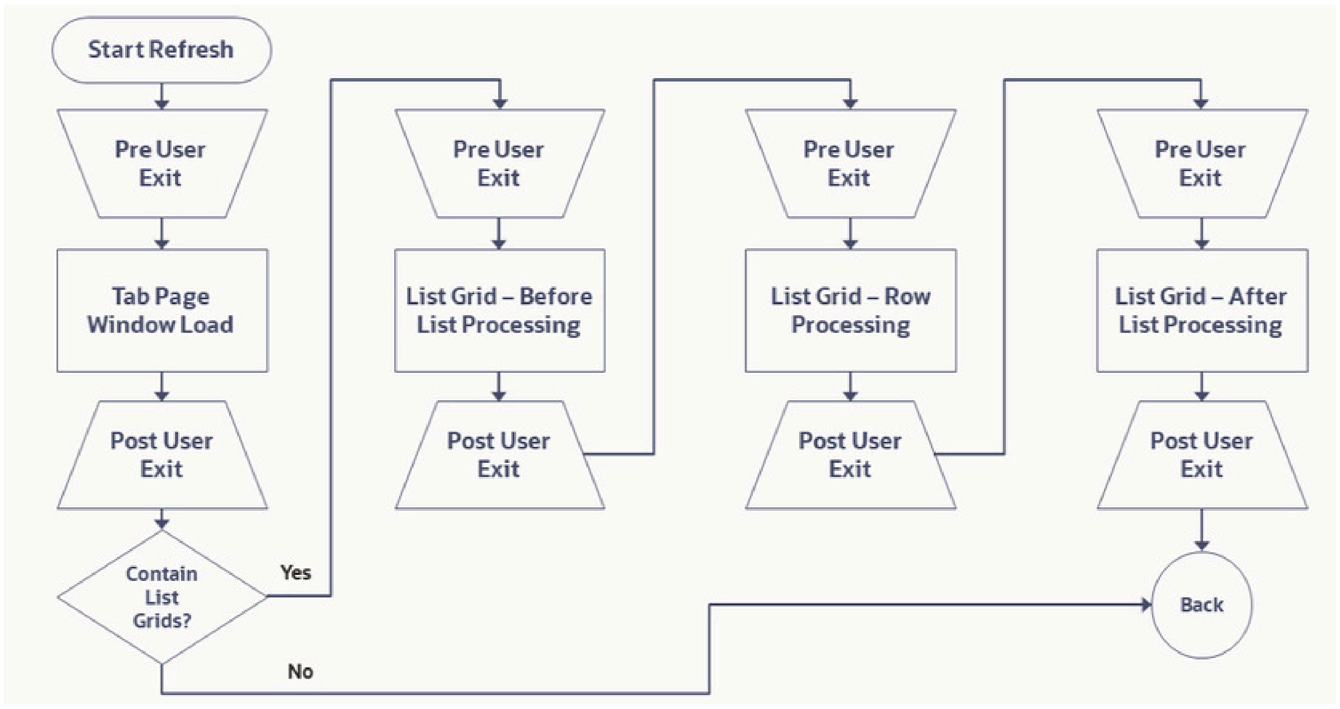
Save Page

The Save Page function is called whenever a user clicks the save icon (or the associated accelerator key). If the user has displayed an existing object on a maintenance page, the Action Flag and therefore the Change Page Service is requested. If an existing object is not displayed on a maintenance page and the user presses save (for example, they are adding a new object to the database), the Action Flag does not equal change and therefore the Add Page Service is called.



Refresh Page

The Refresh Page function is called from the Read, Delete, and Save page processes. It is also called when the user clicks the refresh page icon (or the related accelerator key) or when the user navigates to a different tab page.

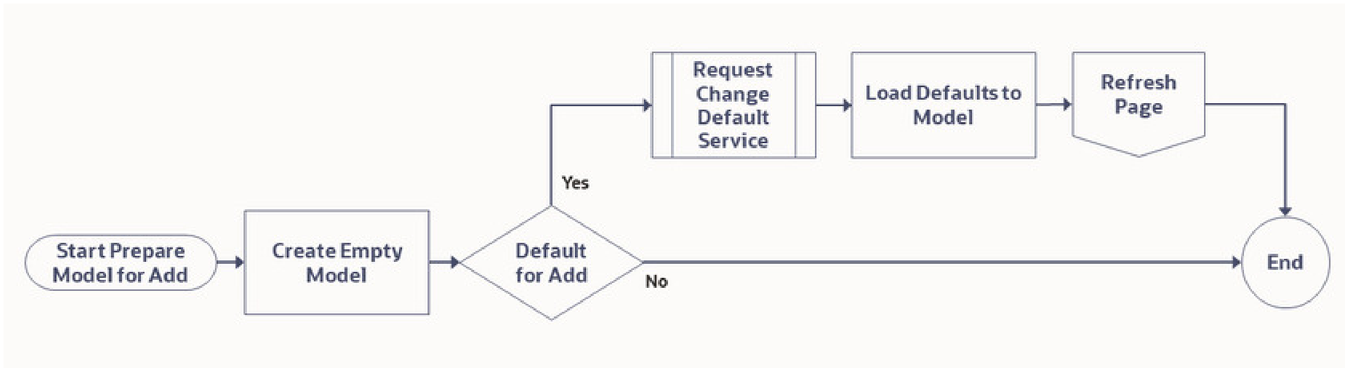


The pre/post Tab Page Window Load user exit is a good place to implement Field Level Security logic. By using the `getFieldLevelSecurityInfo()` function found on the *top object* (refer to the Free Functions section found within the Technical Background chapter of the Development Tools documentation), an implementer can extend the behavior or look of the window. For example, a field can be made read-only if the user's Field Level security is lower than the required security level. This prevents the user from changing the value of the field.

You can use pre/post List Grid Row Processing exit to manipulate fields within the grid. For example, you can calculate the default value of a column depending on the values of other columns.

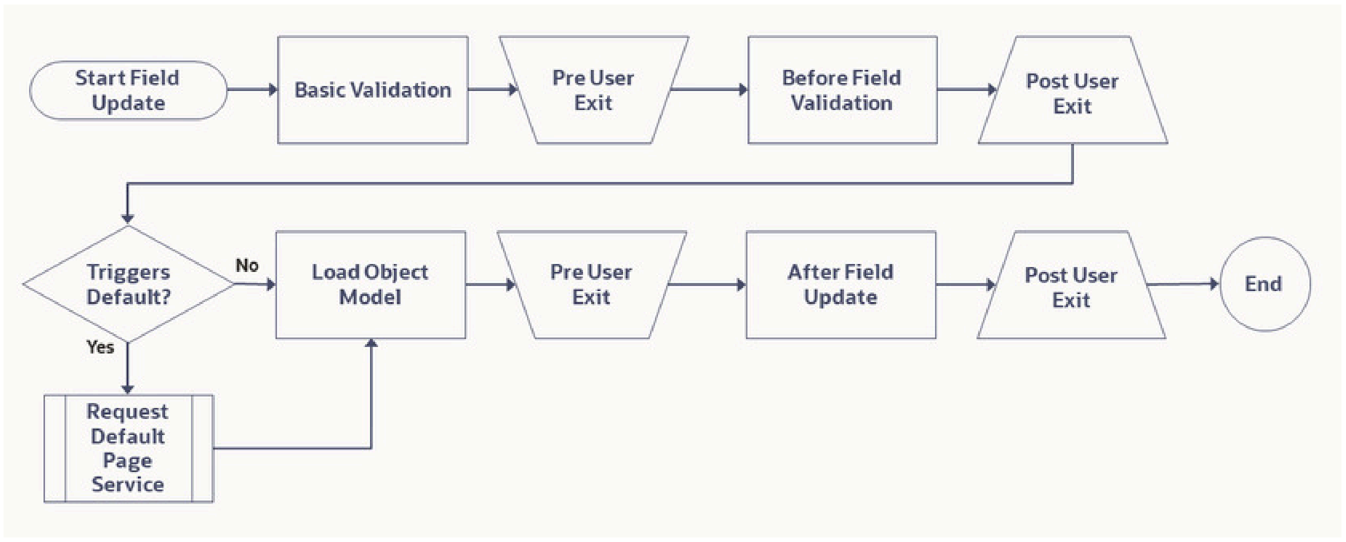
Prepare Model for Add

Prepare Model for Add is called when a user enters a page in Add mode. For example, they click the add button (+) next to a menu item. It is also called by Delete Page to load an empty model, which displays page with empty fields.



Update Field

The Update Field function is called when a user changes the focus from one field on the page to another (for example, when a user tabs out of a field or clicks on another field).



The pre/post After Field Update user exit is a good place to manipulate HTML elements (for example, hiding/ unhiding or enabling/disabling) depending on the value entered by a user.

External User Exit Templates

Below is the list of all available external template files. They are located under the `\cm_templates` folder of the application root directory.

Note: The flowcharts above illustrate user exits in the Tab Page and List Grid templates only; these are the templates in which most of your customizations will occur.

Accordion: `accordionPage.jsp`

Graph Panel: `graphPanelExit.jsp`

List Grid: `listGridExit.jsp`

Search Data: `newSearchDataExit.jsp`

Search Page: `newSearchPageExit.jsp`

Sub Panel: `subPanelExit.jsp`

Tab Page: `tabPageExit.jsp`

Tree Page: `treePageExit.jsp`

Template Structure

Each template has three main sections into which you insert your code.

- **User Variable Declaration** contains global variable declarations. (Do not declare any global variables unless it is necessary.)
- **User Function Declarations** contains your own functions. Your own functions are not called from the corresponding JSP file. Take coupling and cohesion into consideration when you design your functions.
- **Functions Called from the Corresponding HTML page** contains functions that are called from the HTML page. Uncomment the functions you need to use and add your code. You can find more technical information about the behavior of these functions in the external template files.

Design Approach

Examine the partial template below to see how the external include file looks. As you might notice, everything is commented out. If you want to call a certain function, you must uncomment the functions and/or sections.

Note: Only declared functions in the external files can be called from the HTML Page.

To see the entire external file templates or available functions, examine the `\cm_templates` folder under the application root directory.

```
<%@page contentType="text/html;charset=UTF-8"%>
<%@ taglib uri="spl.tld" prefix="spl" %>
<spl:initializeLocale/>

<!--
        *****************************************************************
        *                                                               *
        * Copyright (c) 2000, 2007, Oracle. All rights reserved.        *
        *                                                               *
        *****************************************************************
        *                                                               *
$#BSES* REVISION-INFO Start Exit, Do not modify - Dev. Only.
      *  $DateTime$
      *  $File$
      *  $Revision$
$#BSEE* REVISION-INFO End Exit, Do not modify - Dev. Only.
        *****************************************************************
-->

<script type="text/javascript">

//                           User Variable Declarations
//--------------------------------------------------------------------------------

/*
Replace With Your Code
*/

//                           User Function Declarations
//--------------------------------------------------------------------------------

/*
Replace With Your Code
*/

//            User Functions That Are CALLED From According JSP File
//--------------------------------------------------------------------------------

/*
function extPreOnWindowLoadNoListBefore(){
//This should be used to set values/attributes when the page loads.
//This includes actions after a default.
//
//This function is called BEFORE SPL's internal functions are called

// Your Code
}
*/
```

The following discussion explains how the external file is included. The external file is a JSP file. This JSP is executed with appropriate HTTP request header data from within the XSLT engine that creates the HTML from the UI metadata. The XSLT engine will output the rendered JSP code textually into the final HTML. If the file does not exist, the server will not include the external file, otherwise every defined function (uncommented) in the file will be included and called at the appropriate times.

Using the External User Exit Templates

All the external user exit templates are located in the `\cm_templates` directory. Once the UI Program to be extended is known, the appropriate user exit template can be selected from the templates directory.

- Use any editor that supports the JSP file editing and open the approprite user exit.
- Determine the base user exit around which to insert your external user exit.
- Uncomment the necessary functions, and add your code.
- Save the external user exit file as `ext_<JSPfilename>.jsp` under the `\cm` directory. Where JSPfilename is the JSP file you want to extend.
- Test.

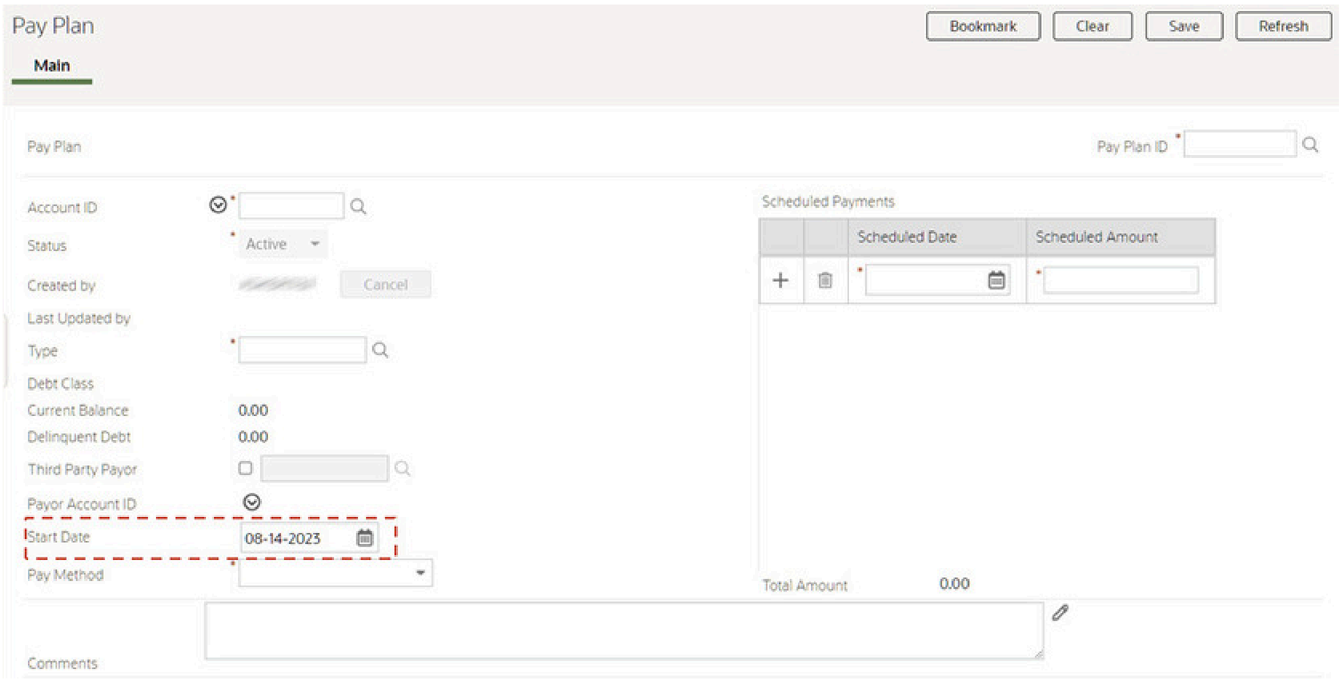
Create an External User Exit

The following example shows the process of creating an external user exit. In this example, we would like to disable the **Start Date** on the **Pay Plan** page and default it to the current date.

Find the Name of the JSP File

Note: JSP files are only used for legacy pages. In newer versions, UI Maps and Business Object UI Hints are used as alternatives.

In Utilities **CC&B**, navigate to the **Pay Plan** Maintenance page and find the section where the **Start Date** field is displayed. See in the screenshot below that **Start Date** is under the main section of the page.



Pay Plan	
Pay Plan ID	
Account ID	
Status	Active
Created by	
Last Updated by	
Type	
Debt Class	
Current Balance	0.00
Delinquent Debt	0.00
Third Party Payor	
Payor Account ID	
Start Date	08-14-2023
Pay Method	
Comments	

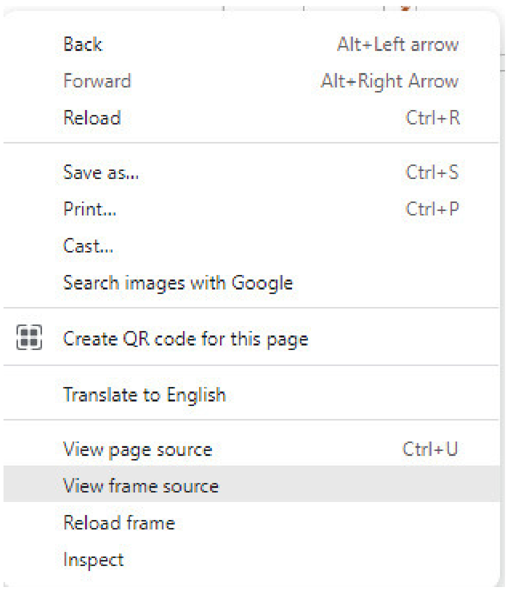
Scheduled Payments

		Scheduled Date	Scheduled Amount
+			

Total Amount 0.00

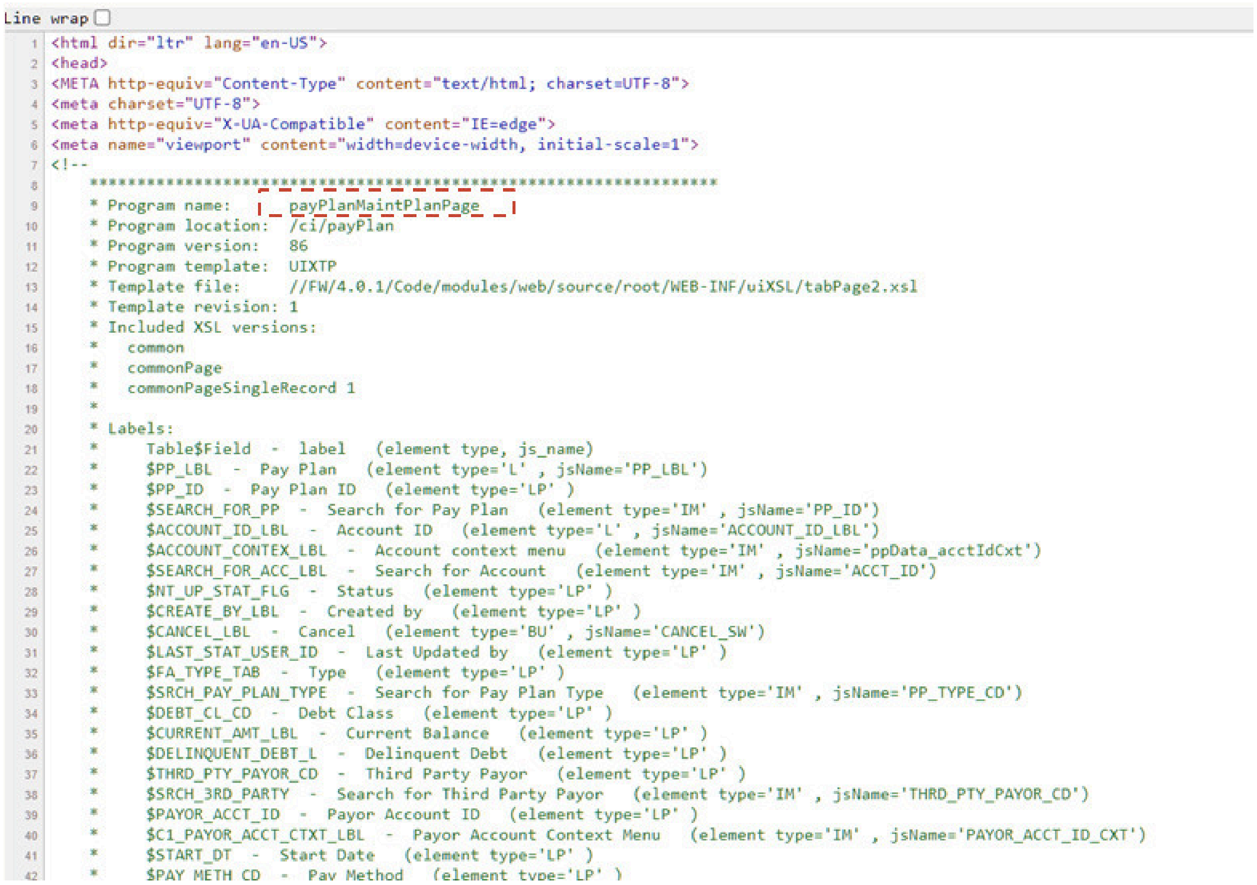
Pay Plan Maintenance Page

Determine the name of the program component we need to extend. Right-click on the page and select the menu option **View Source**.



Pay Plan Maintenance Page - View Source

View Source would open the page source in a text editor.



```
Line wrap ☐
<html dir="ltr" lang="en-US">
<head>
<META http-equiv="Content-Type" content="text/html; charset=UTF-8">
<meta charset="UTF-8">
<meta http-equiv="X-UA-Compatible" content="IE=edge">
<meta name="viewport" content="width=device-width, initial-scale=1">
<!--
    *****************************************************************
    * Program name:     payPlanMaintPlanPage
    * Program location:  /ci/payPlan
    * Program version:   86
    * Program template:  UIXTP
    * Template file:     //FW/4.0.1/Code/modules/web/source/root/WEB-INF/uiXSL/tabPage2.xsl
    * Template revision: 1
    * Included XSL versions:
    *   common
    *   commonPage
    *   commonPageSingleRecord 1
    *
    * Labels:
    *     Table$Field  -  label   (element type, js_name)
    *     $PP_LBL  -  Pay Plan   (element type='L' , jsName='PP_LBL')
    *     $PP_ID  -  Pay Plan ID   (element type='LP' )
    *     $SEARCH_FOR_PP  -  Search for Pay Plan   (element type='IM' , jsName='PP_ID')
    *     $ACCOUNT_ID_LBL  -  Account ID   (element type='L' , jsName='ACCOUNT_ID_LBL')
    *     $ACCOUNT_CONTEX_LBL  -  Account context menu   (element type='IM' , jsName='ppData_acctIdCxt')
    *     $SEARCH_FOR_ACC_LBL  -  Search for Account   (element type='IM' , jsName='ACCT_ID')
    *     $NT_UP_STAT_FLG  -  Status   (element type='LP' )
    *     $CREATE_BY_LBL  -  Created by   (element type='LP' )
    *     $CANCEL_LBL  -  Cancel   (element type='BU' , jsName='CANCEL_SW')
    *     $LAST_STAT_USER_ID  -  Last Updated by   (element type='LP' )
    *     $FA_TYPE_TAB  -  Type   (element type='LP' )
    *     $SRCH_PAY_PLAN_TYPE  -  Search for Pay Plan Type   (element type='IM' , jsName='PP_TYPE_CD')
    *     $DEBT_CL_CD  -  Debt Class   (element type='LP' )
    *     $CURRENT_AMT_LBL  -  Current Balance   (element type='LP' )
    *     $DELINQUENT_DEBT_L  -  Delinquent Debt   (element type='LP' )
    *     $THRD_PTY_PAYOR_CD  -  Third Party Payor   (element type='LP' )
    *     $SRCH_3RD_PARTY  -  Search for Third Party Payor   (element type='IM' , jsName='THRD_PTY_PAYOR_CD')
    *     $PAYOR_ACCT_ID  -  Payor Account ID   (element type='LP' )
    *     $C1_PAYOR_ACCT_CTXT_LBL  -  Payor Account Context Menu   (element type='IM' , jsName='PAYOR_ACCT_ID_CXT')
    *     $START_DT  -  Start Date   (element type='LP' )
    *     $PAY_METH_CD  -  Pay Method   (element type='LP' )
```

JSP Source Code View - payPlanMaintPlanPage

From the **menu bar** or the program file information section you can identify the program name as `payPlanMaintPlanPage` (look for the `Program name` in the source code comments).

Determine the Base User Exit

For this example, we want to disable the input element corresponding to the **start date** and display a message that the start date is disabled. This means we want to disable the field when the page loads; and therefore we want to insert our code inside the `onWindowLoad()` function. The external user exit function that allows us to do this is the `extPostOnWindowLoad()` function.

You can check the field names under the `payPlanMaintPlanPage's` Labels section.

```
    * Program name:      payPlanMaintPlanPage
    * Program location:  /ci/payPlan
    * Included XSL versions:
    *   common
    *   commonPage
    *   commonPageSingleRecord 3
    *
    * Labels:
    *     Table$Field  -  label   (element type, js_name)
    *     $PP_LBL  -  Pay Plan   (element type='L' , jsName='PP_LBL')
    *     ...
    * Widget Info:
    *     Widget_ID , Element Type - label info - label
    *     ...
    *     START_DT, IT - $START_DT -  Start Date

    *     PAY_METH_CD, IS - $PAY_METH_CD -  Pay Method
    *     ...
```

The two important pieces of information in this source view are:

The **Program name** definition - `payPlanMainPlanPage` in this example;

The **Template file** definition - `tabPage2.xsl` in this example.

Uncomment the Function and Add Code

Once the program name to be extended (for example, `payPlanMainPlanPage`) and the template to use (for example, `tabPage2.xsl`) are known, the associated template jsp file can be copied from the web application source's `/cm_templates` directory to the `/cm` directory and renamed to have the form `ext_XXXX.jsp`, where `XXXX` is the name of the program to be extended.

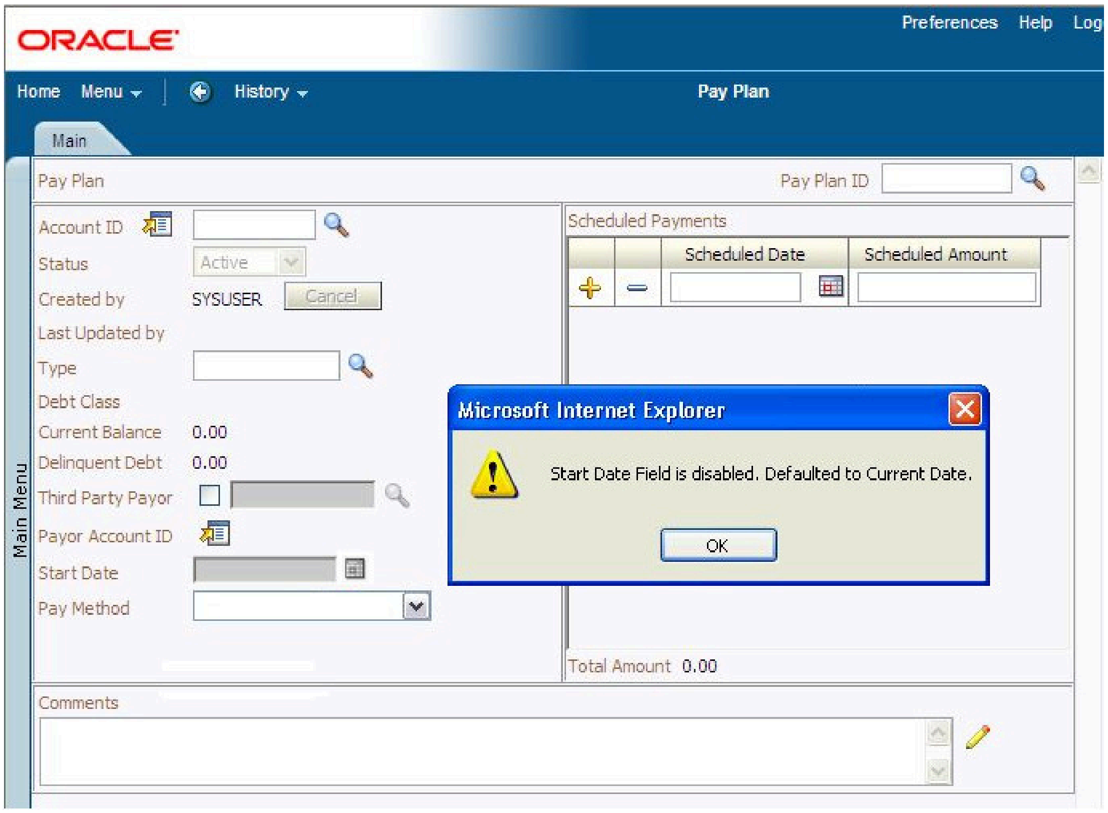
For example, in this case the jsp user exit template `./cm_examples/tabPageExit.jsp` would be copied and renamed to `./cm/ext_payPlanMaintPlanPage.jsp`. The following coding change inside the `extPostOnWindowLoad()` function would then be made for the modified behavior.

```
function extPostOnWindowLoad(){
//This should be used to set values/attributes when the page loads.
//This includes actions after a default.
//This function is called AFTER SPL's internal functions are called

protectField("START_DT");
alert ("Start Date Field is disabled. Defaulted to Current Date.");

}
```

Test Your Code

Now let's see if it works. First make sure that the user exit file is copied under the `\cm` folder of the application root directory. Reload the page by right-clicking the page and choosing Refresh from the context menu.

Note: You may need to delete the browser cache before refreshing the page.



Start Date Field is disabled. Defaulted to Current Date.

Pay Plan Main Page after implementing External User Exit

Field-level Security Client-Side User Exit Example

Field level security information is exposed on the browser side.

Use the following function to retrieve a user's field level security for a given service or Navigation Key:

`top.getFieldLevelSecurityInfo(serviceNameOrNavigationKey)`, which returns an Object keyed by security type.

The following example illustrates how to implement security for adjustment amount on the client. In the example, User Group 1 is authorized to freeze adjustments less than $10,000, and User Group 2 can authorize any adjustment. We want to disable the Freeze button if the user's security doesn't meet the condition. There is a security type **ADJAMT** defined for the Adjustment Maintenance.

Fastpath: Refer to *Field Level Security* in the Administration Guide, Defining General Options chapter for information about the data setup.

The following example code would be added to the `extPreOnWindowLoad` user exit:

```
var secInfo = top.getFieldLevelSecurityInfo("adjustmentMaint");
var adjAmtSecInfo = secInfo["ADJAMT"];
if (adjAmtSecInfo < "2" && parseFloat(model.getValue("ADJ_AMT")) > 10000 ) {
//disable the field
   protectField("FREEZE_SW")
}
```

How-To

The following are some how-to examples of typical behavior utilizing some of the standard user exits.

The examples are written for cases of modifying new CM transaction pages, where the function definitions are put into extended JavaScipt files (.xjs) that are meant to contain JavaScript user exits directly for a page.

If, on the other hand, an implementer wishes to modify the behavior of a shipped product page, each of the functions below have a corresponding `ext` function defined in a `/cm/extXXX.jsp` file corresponding to the desired page that will fire after any product function call (see the above example of hiding the Sequence column in the algorithm maintenance page).

How Do I Control the Initial Focus Within Tab Pages/Grids/Search Pages?

The system automatically places the initial focus on an appropriate widget (generally input fields) within a Tab Page/ Search Page/Grid.

By default, focus is placed on the first enabled field that has a data class defined. (Fields with no Field Name / Table Name defined within Meta Data have no data class.)

If there are no fields within the tab page that satisfy this criterion, the system looks recursively into all the contained frames (list grids, for example).

If no field is found then no element receives focus.

You can override the default behavior at each level via the provision of a focusWidgetOverride() function within the user exit file; this returns either the Name of the Field to receive the focus or null.

If null is returned, the system ignores all fields within this document and continues to search in lower-level documents.

For example:

From within a Tab Page (If you want focus to go on to a sub document):

```
function focusWidgetOverride() {
  return null;
}
```

From within a List Grid:

```
function focusWidgetOverride() {
  return "TD_TYPE_DRLKY:0$TBL_NAME";
}
```

from within a Search Page:

```
function focusWidgetOverride() {
return "LAST_NAME";
}
```

Note: These functions can be as simple or complicated as you want. You could conditionally return a field name or null and this code would run each time the window loads. Also, if a tab page has a popup window or a search window open as it is loading, then the initial focus would stay on the popup window, and not on the tab page.

How Do I Mark Fields that Won't Make the Model Dirty?

In certain windows, we have a concept of a *locator* field, which typically acts as a filter on some lists of the current object. Examples are user group's filter on description and several IB windows' filter by date.

In case the page is dropped after a data change, locator fields throw an unexpected warning about loss of data. To avoid this warning on locator fields, you can add a function that enumerates the locator fields, such as the following:

```
function ignoreModifiedFields(){
    return ['START_DTTM']
}

You can include any number of fields in the array, e.g.
return ['FIELD_1', 'FIELD_2', 'FIELD_3']
```

How Do I Control the Triggering of Defaults After a Search?

If a search returns multiple fields and more than one of these fields can trigger default, then it might be more efficient to only have one of these fields trigger the defaulting.

This is accomplished by creating a new function called `overrideDefaultTriggersFor_SEARCHGROUP` within the tab page that contains the search, where `SEARCHGROUP` is the name of the `searchGroup` you want to override.

The function must return an object with the triggering field(s) are attributes with a `true` value.

For example:

```
function overrideDefaultTriggersFor_SRCH1() {
var triggers = {};

triggers["ACCT_ID"] = true;
            triggers["SA_ID"]=true;

return triggers;
}
```

How Do I Avoid Automatically Setting Fields to Uppercase?

Model attributes that are also key fields are automatically coerced to be in uppercase. You can block this behavior on a field-by-field basis by defining the `notUppercaseFields()` function in your TabMenu's user exit file to return an array of field names that should not be converted.

Example:

```
function notUppercaseFields() {
   return ['ELEM_ATT$AT_NAME']
}
```

You can also provide a global override for an entire TabMenu by setting the `shouldNotAutoUppercase` variable to `true`:

```
var shouldNotAutoUppercase = true;
```

How Can I Force the Save Button to be Enabled?

The save button usually synchronizes to the state of the model, such that if it has not been *dirtied*, the button is disabled. There are cases in which it may be useful to control the state of the save button. For example, when a save should always/never be allowed.

To return a boolean indicating whether the save button should be enabled, define the function `saveButtonEnablingOverride()` on the TabMenu user exit file. You can simply return a literal boolean, or perform any desired processing to determine the return value.

Example:

```
function saveButtonEnablingOverride() {
  return false;
}
```

How Can I Override the Processing After a Change/Add?

If you need to intervene in the processing after the system successfully completes a Change or Add operation, define the function `privatePostChangeSucceeded()` or `privatePostAddSucceeded()` in your TabMenu user exit file. The function should return a boolean to indicate whether the system should refresh the UI with the newly returned server data. For example, you would want to return `false` in case you navigate to a different TabMenu.

Example:

```
function privatePostAddSucceeded() {
    var model = parent.model;
    var modeFlag = model.getValue('COMPL_NAV_MODE_FLG');
    var navKey = model.getValue('COMPL_NAV_KEY');
    var complSw = model.getValue('CMPLT_CLICKED_SW');
    if (complSw && model.getValue('ENRL_STATUS_FLG') == '30') {
        if (modeFlg && navKey){
             if (modeFlag == 'G') {
                parent.tabPage.gotoContext(navKey);
                return false;
             } else if(modeFlag == 'A') {
                parent.tabPage.addContext(navKey);
                return false;
             }
        }
   }
   return true;
}
```

How Do I Prevent the System from Setting Focus to a Widget After an Error?

When a service receives an error and shows a message after calling a back-end service, the browser attempts to set focus to the relevant widget in error. If you do not need this behavior, you can define the TabMenu variable `dontSetFocusOnError` to `true`.

Example:

```
var dontSetFocusOnError = true;
```

How Do I Prevent Attributes from Being Copied into New List Elements?

To keep their prime keys consistent, key fields are automatically copied (based on name matching) from a parent list element into new child elements (for example, those created by using the scroll + button). If you want to inhibit this operation for certain fields, define the TabMenu function `dontCopyKeyNames_<LIST NAME>` to return an array of fields that should not be copied into new elements of the list named `LIST_NAME`.

Example:

```
function dontCopyKeyNames_ENRL_FLD() {
   return ['SEQ_NUM']
}
```

How Do I Customize New List Elements?

When you use the + button on a grid or scroll you get a new, empty list element. If you want to customize the object, define a function in the TabMenu's user exit file named `initializeNewElement_<LIST_NAME>(newElement)`.

Example:

```
function initializeNewElement_ENRL_LOG(newElement) {
    newElement.set('ENRL_LOG_TYPE_FLG', 'USER');
    newElement.set('USER_INFO', parent.model.getValue('CURRENT_USER_INFO'));
}
```

How Can I Get My Sequence Numbers to Default Properly on My List Grid?

If you are working with a List Grid that uses some type of sequence field (for example, `SEQNO`, `LINE_SEQ`, `SORT_SEQ`), there is a handy bit of technology that you can use that will cause the UI to do this job for you.

Just follow the steps below and you will solve this problem. The sequence field will be populated in your empty line, and any elements that are added from then on will have an appropriate value in the sequence field. If the user edits the sequence field at any point, the next element added to the list will incorporate the change without any problems.

Note: The default Sequence Number functionality will default the next nearest value from the highest sequence. The defaulting will do nothing after the sequence reaches the highest number it can hold.

- In the user exit file of the **Tab Menu** - **not** the main Page or the List Grid - copy this JavaScript code:

```
function initializeNewElement_LIST_NAME(newElement) {
      var myListName = "LIST_NAME";
      var myListSeqName = "FIELD_NAME";
      var myListMaxSeq = 999;
      defaultSequenceNumber(myListName,myListSeqName,myListMaxSeq,newElement)
}

</SCRIPT>
<SCRIPT src="/zz/defaultSequenceNumber/defaultSequenceNumber.js"></SCRIPT>
<SCRIPT>
```

- For `LIST_NAME`, substitute your List Grid's list name. Be careful not to lose that underscore [_] just in front of `LIST_NAME` in the first line! Remember that JavaScript is case-sensitive and make sure that you use all UPPERCASE letters as shown here.
- For `FIELD_NAME`, substitute the name of your sequence field, whatever that might be in your List. Don't lose the quotes ["] ! Again, use all UPPERCASE letters.

How Do I Override the Tab Page Shown After an Error in a List (Grid/Scroll)?

When the system receives an error (for example, after a Save), it attempts to set focus on the relevant widget, which might require flipping to a different tab page. If the error relates to a list (grid or scroll) the system might not choose the tab page you would prefer. In that event you can control the tab page that should be opened by defining the TabMenu function `overrideErrorTabPage_<LIST_NAME>()`.

Example:

```
function overrideErrorTabPage_BPA() {
    return 'bussProcessAssistantStepPage';
}
```

How Do I Disregard Unwanted Criteria from a Search Triggered by a Search Button?

When a search button (currently implemented as an IMG) is pushed, the system launches a search and pulls all applicable criteria values from the current model. It might be that certain criteria fields should be ignored in a particular case. You can define the function `addIgnoreFieldsFor_<triggerFieldName>()` on a tab or search page's user exit file to specify fields to ignore whenever the IMG button named **triggerFieldName** is pushed on that page.

The function takes a single argument, fields, and you should add key/value pairs where the key is a field name to ignore, and the value is `true`.

Example:

```
addIgnoreFieldsFor_ADDRESS1_SRCH = function(fields) {
  fields['CITY_SRCH'] = true
}

addIgnoreFieldsFor_PER_ID = function(fields) {
  fields['ENTITY_NAME_SRCH'] = true
}
```

How Do I Disregard Unwanted Search Result Columns?

When you accept the result of a `NOLOAD` search, the system tries to populate the selected search result row into the current model. There are cases in which this is not desirable, for example, when there is no corresponding attribute for a display-only column. You can exclude a column from being returned as part of a search result by defining the search client's (Tab Page or Search window) function `ignoreResultColumns()` in the corresponding page's user exit file. Return an object with keys specifying attributes and values all set to `true`.

Example:

```
function ignoreResultColumns() {
    return { ADDRESS1: true, CITY: true, POSTAL: true };
}
```

Since searches can be shared by many search clients, it is possible that some clients want to get a specific column, but others do not. In that case, define the TabMenu function `ignoreResultColumnsFor_<service>` as above.

Example:

```
function ignoreResultColumnsFor_CILCCOPS() {
    return {CONT_OPT_TYPE_CD: true}
}
```

How Do I Format a Value Based on a Given Format?

If you need to format a value based on a given format, for example, on Person ID Number, if you select ID Type as SSN (999-99-9999), you can always format the Person ID Number before committing it to the server.

To do so, you can call the `formatValue` javascript function.

- In the user exit file of the tab page include the following lines:

  ```
  </SCRIPT>
  <SCRIPT src="/zz/formatValue/formatValue.js"></SCRIPT>
  <SCRIPT>
  ```

- Now, you can start using the function to format a value. To use this function, you need to pass in both the **value** and the **format** into the function.

  ```
  var phFormat = myData.getValue(pureListName + 'PHONE_TYPE_FORMAT');
  if (pureFieldName == 'PHONE') {
    updateField(pureListName + 'PHONE' ,
          formatValue(myData.getValue(pureListName + 'PHONE'), phFormat));
  }
  ```

Java User Exits (interceptors) Interfaces and Classes

The following are the interfaces used for Java User Exits (interceptors).

IAddInterceptor Interface

This interface defines the processing plug-in spots before or after invoking a service in add mode:

`interface com.splwg.base.api.serviceinterception.IAddInterceptor`

Methods

PageBody aboutToAdd(RequestContext, PageBody)

This method is called before the service is invoked.

Input

- `RequestContext` - Contains session parameters, such as language cd, user id, and so on.

Input/Output

- `PageBody` - The input page body to be added.

Return value

- `PageBody or null` - If a page body is returned, this is considered the result of the service and the underlying service will not be executed. If null is returned, the service will run normally.

Throws

`InterceptorError` - Throw this exception when an error occurs.

`InterceptorWarning` - Throw this exception to signal an application warning.

void afterAdd(RequestContext, PageBody)

This method is called after the service is invoked in add mode.

Input

- `RequestContext` - Contains session parameters, such as language cd, user id, and so on.

Input/Output

- `PageBody` - This contains the information that was added by the underlying service.

Return value

- `Void`.

Throws

`InterceptorError` - Throw this exception when an error occurs.

`InterceptorWarning` - Throw this exception to signal an application warning.

IChangeInterceptor Interface

This interface defines the processing plug-in spots before or after invoking a page service in change mode:

`interface com.splwg.base.api.serviceinterception.IChangeInterceptor`

Methods

PageBody aboutToChange(RequestContext, PageBody)

This method is called before the service is invoked in change mode.

Input

- `RequestContext` - Contains session parameters, such as language cd, user id, and so on.

Input/Output

- `PageBody` - This object contains the information that is to be submitted to the underlying service.

Return value

`PageBody` or `null` - If a page body is returned, this is considered the result of the invocation and the underlying service will not be called. If null is returned, the underlying service will be invoked normally.

Throws

`InteceptorError` - Throw this exception when an error occurs.

`InterceptorWarning` - Throw this exception to signal an application warning.

void afterChange(RequestContext, PageBody)

This method is called after change action is invoked in change mode.

Input

- `RequestContext` - Contains session parameters, such as language cd, user id, and so on.

Input/Output

- `PageBody` - This holds the result of the underlying change service.

Return value

- `Void`.

Throws

`InterceptorError` - Throw this exception when an error occurs.

`InterceptorWarning` - Throw this exception to signal an application warning.

IDeleteInterceptor Interface

This interface defines the processing plug-in spots before or after invoking a service in delete mode:

`interface com.splwg.base.api.serviceinterception.IDeleteInterceptor`

Methods

boolean aboutToDelete(RequestContext, PageBody)

This method is called before the service with a delete action.

Input

- `RequestContext` - Contains session parameters, such as language cd, user id, and so on.

Input/Output

- `PageBody` - The data to be deleted.

Return value

- `Boolean` - Indicates whether or not to continue processing the service. If true, continue with the normal underlying invocation. If false, do not continue (but the service returns "success" to the client invoker).

Throws

`InterceptorError` - Throw this exception when an error occurs.

`InterceptorWarning` - Throw this exception to signal an application warning.

void afterDelete(RequestContext, PageBody)

This method is called after the service is invoked in delete mode.

Input

- `RequestContext` - Contains session parameters, such as language cd, user id, and so on.

Input/Output

- `PageBody` - The data that was deleted by the underlying service.

Return value

- `Void`.

Throws

`InterceptorError` - Throw this exception when an error occurs.

`InterceptorWarning` - Throw this exception to signal an application warning.

IReadInterceptor Interface

This interface defines the processing plug-in spots before or after a service retrieves information:

`interface com.splwg.base.api.serviceinterception.IReadInterceptor`

Methods

PageBody aboutToRead(RequestContext, PageHeader)

This method is called before a service retrieves information.

Input

- `RequestContext` - Contains session parameters, such as language cd, user id, and so on.

Input/Output

- `PageHeader` - The data describing the information that should be read.

Return value

- `PageBody` or `null` - If a page body is returned, this is considered the result of the service and the underlying service will not be invoked. If null is returned, the underlying service will be invoked normally.

Throws

`InterceptorError` - Throw this exception when an error occurs.

`InterceptorWarning` - Throw this exception to signal an application warning.

void afterRead(RequestContext, PageBody)

This method is called after the service retrieved the information.

Input

- `RequestContext` - Contains session parameters, such as language cd, user id, and so on.

Input/Output

- `PageBody` - Result of read service.

Return value

- `Void`.

Throws

`InterceptorError` - Throw this exception when an error occurs.

`InterceptorWarning` - Throw this exception to signal an application warning.

InterceptorError class

The class `com.splwg.base.api.serviceinterception.InterceptorError` subclasses the `java.lang.Exception` class. This class contains information regarding an error condition that occurred during the pre/post processing plug-in. This exception is caught by the framework and is used to build the appropriate application error object.

Attributes

- Message Category
- Message Number
- List of Parameters (Strings) and types

Methods

void setMessageNumber(BigInteger messageNumber)

Set the message number (required).

void setMessageCategory(BigInteger messageCategory)

Set the message category (required).

void setMessageParameters(List messageParameters)

Set the message parameters list.

void setMessageParameterTypeFlags(List messageParameterTypeFlags)

Set the message parameter type flags list. The size should match the message parameters list.

InterceptorWarning class

The class `com.splwg.base.api.serviceinterception.InterceptorWarning` subclasses the `java.lang.Exception` class. This class contains information regarding one or more warning conditions that occurred during the pre/post processing plug-in. This exception is caught by the framework and is used to build the appropriate application warning objects.

Attributes

- List of warning server messages.

Constructors

InterceptorWarning(ServerMessage warningMessage)

Create a new `InterceptorWarning` with the given warning message as its sole message.

InterceptorWarning(List warningMessages)

Create a new `InterceptorWarning` with the given List of warning messages.

Methods

void addWarningMessage(ServerMessage message)

Add the given server message to the list of warning messages.

RequestContext Methods

Class `com.splwg.base.api.service.RequestContext` includes the following accessor methods:

String getLanguageCode()

Return the current user's language code.

String getUserId()

Return the user id.

Data Objects

Both `PageHeader` and `PageBody` are "wrappers" on underlying Maps that hold datatypes of various types, keyed by field names (strings). The valid field names for a service are described in the service meta info file (an xml document). Null values are not allowed; use empty strings to represent missing values (for null date, for example).

Note that most system datatypes are represented in these Java objects as simple strings. Note the following:

- Booleans are represented by the Java Boolean class.
- Date values are represented as Strings in the format YYYY-MM-DD.
- Date/Time values are represented as Strings in the format YYYY-MM-DD-HH:MM:SS.
- Time values are represented as Strings in the format HH:MM:SS.
- BigInteger values are represented as Java BigInteger values.
- BigDecimal and Money values are represented as Java BigDecimal values, with the appropriate scale.

PageHeader and PageBody Methods

Both `PageHeader` and `PageBody` implement the methods described in the following topics.

Object get(String fieldName)

Returns the object value of the field named `fieldName` (may need to cast the result to the appropriate datatype).

String getString(String fieldName)

Convenience method that returns the string value of the field named `fieldName`.

boolean getBoolean(String fieldName)

Convenience method that returns the boolean value of the field named `fieldName`.

BigInteger getBigInteger(String fieldName)

Convenience method that returns the BigInteger value of the field name `fieldName`.

void put(String fieldName, Object value)

Set the value at the given `fieldName` to the given value.

PageHeader

The methods for class `com.splwg.base.api.service.PageHeader` are described above.

PageBody

Class `com.splwg.base.api.service.PageBody` implements the methods described above. In addition, it supports the following methods:

ItemList getList(String name)

Return the ItemList with the given name.

ItemList

Class `com.splwg.base.api.service.ItemList` is the Java representation of a list header and list children objects. The methods are as follows:

ListHeader getHeader()

Return the list header object.

String getName()

Return the ItemList's name.

List getList()

Return the `java.util.List` of ListBody child objects.

void setList(List list)

Set the underlying list to the provided list of ListBody instances.

ListHeader

The class `com.splwg.base.api.service.ListHeader` is functionally equivalent to the class `PageHeader`, see above.

ListBody

The class `com.splwg.base.api.service.ListBody` is functionally identical to the class PageBody, above. In addition, it has this useful method:

String getActionFlag()

Return the flag describing the pending action for this ListBody (for example, add, change, delete).

CMServiceConfig.xml structure

The `ServiceConfig.xml` and `CMServiceConfig.xml` will look like the following:

```
<ServiceInterceptors>
    <Service name="CMLPXXXX">
        <Interceptor action="add">
            com.splwg.interceptor.CMLPXXXXAddInterceptor
        </Interceptor>
        <Interceptor action="change">
            com.splwg.interceptor.CMLPXXXXChangeInterceptor
        </Interceptor>
    </Service>
</ServiceInterceptors>
```

The above example illustrates how interceptors are defined for the service CMLPXXXX. You can define one or more interceptors, depending on the action, for each service. The valid actions are add, change, delete, and read.

Note: It is valid to have the same interceptor class for more than one action, as long as the class implements the corresponding interceptor interface.

Application Logs

Logging has many purposes. Notably, it allows tracing of what is happening when something goes wrong. However, a user/developer does not always want to see EVERY log entry-besides clutter, which may slow down the application. In this light, the framework has wrapped the powerful and flexible log4j logging framework as an API. There are two important aspects:

- Placing logging statements within application code so that logging entries may be created at runtime.
- Configuring logging at runtime so that the appropriate logging entries are created and directed to the appropriate log destination.

Logging within Business Logic

The following describes how to implement logging when adding a class that implements business logic:

- Add a constant referencing the logger for the class. By convention, logger should be named "logger" and should pass the declaring class as its argument. For example, a logger in the Adjustment_CHandler class would be declared as follows:

  ```
  private static final Logger logger
  = LoggerFactory.getLogger(Adjustment_CHandler.class);
  ```

- Add entries with the appropriate logging level. The levels are: debug, info, warn, error, and fatal. The following will log a warning entry to the log:

  ```
  logger.warn("Unexpected status for frozen adjustment: " + status);
  ```

- In general, we expect entries of level *info* or more severe to be rare, and therefore, to not impose a substantial performance penalty. However, we can expect *debug* entries to be very fine grained, and they usually will not find their way to actual logs, but will be filtered out via runtime configuration. To lessen the performance impact of debug logging, the logging statement should be wrapped as follows:

  ```
  if (logger.isDebugEnabled()) {
     logger.debug("Processing adjustment " + adjustment.getId());
  }
  ```

- There are times when you want to know how long a code block takes to execute. In general, the logging provides the time each log statement is issued. However, it is clearer to see an actual elapsed time of some process being investigated. In this case, there are some additional methods on the logger:

  ```
  debugStart(message) or infoStart(message)
  debugTime(message, start) or infoTime(message, start)
  ```

- These should be used in the pairs given, as follows:

  ```
  long start = debugStart("Starting process");
  //... code for process
  debugTime("End process", start);
  ```

- This will cause each statement to be logged, plus the final End Process statement will give the elapsed time since `debugStart` was called.

Please refer to the JavaDocs on the `com.splwg.shared.logging.Logger` class for more details.

Configuring Logging at Runtime

Having instrumented the code to create logging entries, the question remains, how to cause the various logger level messages to trigger at runtime? A very detailed description of this can be found at http://home.apache.org/~rpopma/log4j/2.6/index.html.

Property Configuration

Control of log4j occurs based on properties typically set in the `log4j.properties` file in the application classpath. You can change the log level of a given logger in this file. Note, however, that values may be overridden on the command line by specifying system properties (for example, via `-Dlog4j...`). Note that inheritance of logger levels works such that (in our standard of qualified class name as the logger name) you can change a whole package's log level by specifying only a portion of the logger name. Note that you may commonly desire to enable global debug logging on your local environment. To do this, you can simply change the line:

```
logger.spl.level=info
```

to

```
logger.spl.level=debug
```

Note: Changing the log is not recommended.

Trace Flags

Trace flags allow for specialized logging that cuts across many classes. They can be set for user requests by entering the online system in debug mode and setting the trace flags appropriately. Likewise, they can be set in batch either by interactive prompts for the trace flag values when a job starts or by setting system property values. See the `JobSubmitterConfiguration` class for specific system property names.

- `traceSQL` - Causes special detail of the submitted SQL. This can be useful when troubleshooting performance problems.
- `traceTime` - This can only be enabled for online requests or JUnit tests by setting `traceTime(true)` on the request context. Enabling time tracing will cause special profiling entries to be placed in the application log for the purpose of attributing request latency to the various layers of the application or to specific SQL statements. These entries are queued in memory until after profiling entries are no longer being generated and then spooled to the logs, so as not to corrupt the performance instrumentation with logging overhead. The `ProfilingReport` standalone Java program can be run to post-process these logs or a portion of them, and generate a report.

Java Programming Standards

Rationale

To make it easier for programmers working on the same codebase to easily read each other's (and their own) code, we need to enforce certain standard coding conventions. These conventions will also be helpful when comparing code revisions under version control, as the code should be formatted consistently, and no irrelevant formatting-related differences will appear in the diff.

Guidelines

First, there are basic code standards documented for Java here: Java Code Conventions. Like most coding guidelines, these are quite reasonable and differ only in minor details from other guidelines.

The web page Java Programming Style Guidelines also has nice tips. Note that we do not prefix instance variable names with underscores; instead, we use Eclipse syntax coloring to make `ivars` easily visible.

We use the prefix *fetch* in method names in entity implementation classes to perform object navigations that are not already defined by Hibernate mappings.

Here are some additional notes:

All code should be:

- Written with tabs equal to 4 spaces, not hard tabs. Each level of indentation should be one tab.
- Generally free of hard-coded *magic strings* or *magic numbers* (for example, max number of items in some list). If you need such a string or number value, you should use (or create) a constant or property.
- Classes should use specific, not package-based imports, where practical. That is, import `com.foo.UsefulClass`, not `com.foo.*`.
- Variables should generally be private. Only create accessor methods (for example, get/set) when absolutely necessary.
- Prefix getter methods with `get`, for example, `getFoo()`; setters with `set`, for example, `setBar(aBar)`. Do not use "Flag" or "Switch", or abbreviations thereof. For example, `getAllowedSw()` should be `getIsAllowed()`, and `setAllowedSw(aBoolean)` should be `setIsAllowed(aBool)`.
- Use camel-case instance and parameter variable names, without underscore prefixes or suffixes (do use uppercase for constants, as suggested in the guidelines reference above). Instance variables start with lower-case letters.
- Methods should generally be public or private (again, to allow future subclassing). Use of interfaces is encouraged to declare useful sets of public methods.
- Do not abbreviate, except for standard industry abbreviations (for example, HTML, HTTP). Use long, meaningful class, method, and variable names.
- Methods should be short and clear. Instead of placing comments before a section of code in a method, rather create another method that describes what is being done by the method name.
- When using Java API collections, reference them through generic interfaces, not specific implementation classes, for example:

```
List someList = new ArrayList();
...
Map someMap = new HashMap();
...
```

This lets you change your mind about implementation (for example, ArrayList to LinkedList) without breaking any code.

Naming Standards

General guidelines

- Do not use reserved java words.
- Do not use spaces.
- Do not abbreviate.
- Do not use punctuation.
- Do not start the name with a number.

Here are our project guidelines for naming properties:

- Generally, do not abbreviate. The exceptions are SA, and SP, for when the name would get too long if written as is. For example: `ServiceAgreement`, as part of a much longer field name.
- In line with the above, spell out `amount` and `total`.
- Boolean values (SW) are prefixed with `is`, `has`, `can`, `are`, or `should`, according to what is grammatically correct.
- Date fields end with `Date`.
- Time fields end with `Time`.
- Datetime fields end with `DateTime`.
- Id is spelled `Id`.
- Do not include a final *Flag* (FLG) or *Code* (CD).
- Use `min` instead of minimum, and `max` instead of `maximum`.
- Can be generic. That is, for the field `BILL_STATUS`, you can just name it `status`.

Entity Naming Guidelines

- Be specific. The name MUST be unique.
- Language tables (_L) do not need to be named.
- Do not append "View" to a view.
- Do not abbreviate.
- Do not use plural names (for example, `BillMessages`).

Collection Naming Guidelines

Class Name

The class name for a collection includes the owning entity name and the collection name in singular form:

`<owning_entity><collection_name_in_singular_form>`

Examples:

- `AdjustmentTypeAlgorithm`
- `AdjustmentTypeCharacteristic`
- `BillableChargeTemplateLine`

Collection Name

For collections, the one-off generation created many collection names. Many of these are overly verbose and should be shortened. Simply modify the `collectionName` in the entity annotation. Here are some guidelines:

- Shorten `adjustmentTypeAlgorithms` to `algorithms`.
- Shorten `adjustmentTypeCharacteristics` to `characteristics` (in rare cases you may have more than one kind of characteristic, in which case you need more specific names).
- Remove the owning entity name from the front of the collection name. For example, `billableChargeTemplateLines` becomes `lines`.

Lookup Naming Guidelines

Here are guidelines for naming Lookups (on the Lookup Field maintenance):

- Be specific. The name MUST be unique across all lookups.
- Do not include a final standard suffix *Flag* or *Lookup* (The suffix Lookup is automatically added by the generator to the classes generated for each Lookup field.)

Examples:

- `WO_STATUS_FLG` -> `writeOffStatus`
- `STM_RTG_METH_FLG` -> `statementRoutingMethod`

Here are guidelines for naming Lookups Value properties (on Lookup Value maintenance):

- Try to word the name in a way that makes sense when prepended by *is*, and is also valid when standing alone as a constant. For example, `{isComplete, COMPLETE}`, `{isFrozen, FROZEN}`.
- The name might match the English description of the lookup value.

Examples:

- `HOW_TO_USE_FLG : -` -> `subtractive`
- `ITEM_STATUS_FLG : A` -> `active`
- `DGRP_PRIO_FLG : 10` -> `highest10`
- `DGRP_PRIO_FLG : 20` -> `priority20`

Special Cases

'Type' Entity Controlling Characteristics for 'Instance' Entities - Characteristic Controls

There are type entities that control the characteristics for their instance entities. These are tables typically named `CI_CHTY_<type_entity>`, for example: `CI_CHTY_CCTY`. These type entities specify a list for its instances: the valid characteristic types, default characteristic types, required characteristic types, and so on. This list is the type entity's `Characteristic Controls`.

The following are the naming conventions for the characteristic controls:

Characteristic control class	`<type_entity>CharacteristicControl`
Characteristic control collection	`characteristicControls`

For example, the class name for characteristic control of Customer Contact Type is: `CustomerContactTypeCharacteristicControl`.

And the collection is defined as follows:

```
/**
  * @version $Revision: #1 $
  * @BusinessEntity (tableName = CI_CC_TYPE,
      oneToManyCollections = { @Child (collectionName = characteristicControls, childTab
*/
```

HQL Programming Standards

Note: This section is provided for legacy customers only. It is not recommended to alter SQL at the Hibernate level for consistency and to reduce costs.

The applications use an object relational mapping library called Hibernate (information available at http://www.hibernate.org/). This library handles persistence operations against the database for changed entities, and also provides a querying language.

The Hibernate Query Language provides a more object-oriented approach to querying against the database. Joins can more clearly be indicated via navigation to the related foreign key, letting hibernate fill in the join when it constructs the SQL.

Note: In most situations, only a subset of the hibernate query language is used. For instance, when constructing a query whose order is important, the query must programmatically specify the order by, as opposed to placing the order by clause into the HQL itself. This allows the application to perform additional operations upon the HQL that may be required for different databases, and also to apply validations to the HQL.

Here are some examples of creating and using queries. The convenience methods to create the query are available on any *context managed object*. That is, entities, change handlers, business components, maintenance classes, and the implementer extensions of any of them.

To select all algorithms with a given algorithm type:

```
AlgorithmType algorithmType = ... ;
Query query = createQuery("from Algorithm algorithm where " +
"algorithm.algorithmType = :algorithmType");
query.bindEntity("algorithmType", algorithmType);
List algorithms = query.list();
```

The above algorithms list will contain as elements the algorithms for that algorithm type.

To sort the above query by the algorithm's code/Id:

```
AlgorithmType algorithmType = ... ;
Query query = createQuery("from Algorithm algorithm where " +
"algorithm.algorithmType = :algorithmType");
query.bindEntity("algorithmType", algorithmType);
query.addResult("algorithm", "algorithm");
query.addResult("algorithmId", "algorithm.id");
query.orderBy("algorithmId", Query.ASCENDING);
List queryResults = query.list();
```

The above `queryResults` list will contain as elements instances of the interface `QueryResultRow`. Each query result row will have two values, keyed by "algorithm" and "algorithmId". The list will be ordered (on the database) ascending by the algorithm's IDs.

Since HQL works with the entity's properties instead of the tables' column names, there may be extra research required when writing queries. The source of the property information is in the hibernate mapping document for each entity class- they are documents that exist in the same package as the entity, have the same root file name as the entity's interface, and end with `.hbm.xml`. These files will give the list of properties available for each entity that can be referenced when writing HQL.

More information can be found in the JavaDocs associated with the Query interface.

Examples

Even with what is explained above, there are a few cases that stand out, for which a couple of examples may be necessary. Notably, dealing with language entries and lookups can be challenging.

Here is an example of selecting all algorithm types where the description is like some input:

```
String likeDescription = ...;
Query query = createQuery("from AlgorithmType_Language algTypeLang join algTypeLang.id.p
query.bindEntity("language", getActiveContextLanguage());
query.addResult("algType", "algType);
query.bindLikableStringProperty("likeDescription", AlgorithmType.properties.languageDesc
List algorithmTypes = query.list();
```

The `algorithmTypes` list will contain as elements the algorithm types whose description is like `likeDescription`. Note that the string `likeDescription` will have a trailing '%' appended when it is bound to the query.

Here is an example of selecting lookup values, with descriptions like an input value:

```

        String description = header.getString(STRUCTURE.HEADER.DESCR);
        Query query = createQuery("from LookupValue_Language lookupValLang "
                 + "where upper(lookupValLang.description) like upper(:description) and
                 + "lookupValLang.id.parent.id.fieldName = 'RPT_OPT_FLG');
        query.bindLikableStringProperty("description", LookupValue.properties.languageDe
        query.bindEntity("language", getActiveContextLanguage());
        query.addResult("lookupValue", "lookupValLang.id.parent");
        query.addResult("description", "lookupValLang.description");
        query.orderBy("description");
        List results = query.list();
```

The list results will contain `QueryResultRows`, with values keyed by "lookupValue" and "description".

Union queries

You may note that hibernate's HQL does not allow unions, as this does not reconcile with the object-oriented approach of HQL. However, as this can be a common technique to apply, a programmatic union has been provided in the Oracle Utilities Application Framework. The application will open two cursors and flip back and forth between rows from each cursor when each would be the next one, based upon the order by clause. This should at most read one extra row from each cursor opened than may be needed (in the case of limited maximum rows).

To union two queries, they must have identical result columns, order by clauses, and max rows setting. Note that some of the properties of the union query be modified directly, leaving the individual queries to omit those properties.

Creating a union query is simple. Given two queries that need to be unioned together, simply issue:

```
UnionQuery union = query.unionWith(query2);
```

If a third (or later) query needs to be unioned, add it to the union directly:

```
union.addQueryToUnion(query3);
```

Performance

In order to evaluate the performance of HQL queries, it is necessary to first run the HQL through the hibernate engine at run-time in order to produce the equivalent SQL. First, code the initial HQL into the application or a unit test or standalone executable program. Start the application or test program with SQL tracing turned on. When the HQL under construction executes, grab the SQL from the log/console.

In general, most of the advice under the SQL programming standards applies equally for coding HQL when applicable at all.

Raw SQL

In rare cases, it may be necessary to forgo the use of HQL and instead use raw SQL. This is not a preferred approach, as the data returned will not be Java entities, but columns of primitive data types. However, for possible performance reasons (no db hints are allowed in HQL) or if a table is not mapped into a Java entity, this approach exists.

There are parallel methods available on subclasses of GenericBusinessObject that create PreparedStatements, instead of Query objects. So, instead of createQuery, the method createPreparedStatement should be called on a Raw SQL statement.

The PreparedStatement is similar to the regular jdbc PreparedStatement, but has some extra functionality, and a slightly different interface so that it is similar to the regular HQL Query interface (they are interchangeable in some cases).

The main difference is that the prepared statement is created with raw SQL. Use the actual table and column names instead of the Java entity names and property names. Also, the select clause must exist as in normal SQL but not HQL.

Additionally, this break-out into raw SQL allows SQL statements that update table data. Again, this is normally frowned upon, and instead should be done by entity manipulation. However, in cases where a set-based SQL could update many rows at once, this option is available, whereas HQL is ONLY meant for querying without any updates.

For more help on constructing raw SQL queries please see SQL Programming Standards.

SQL Programming Standards

This document describes the SQL programming standards to be used in any database query. These standards will ensure that all database queries across the system have been structured properly and thus have less chance to cause performance issues. All developers must adhere to these standards.

Composing SQL Statements

Prerequisite

This document assumes that you have a basic knowledge of SQL syntax and database functions.

Composing a SELECT Statement

General SELECT Statement Considerations

- Before composing an SQL statement, you should have in front of you the ERD of the tables involved in that SQL. You should make sure you fully understand the relationships between the tables.
- As you may know, an SQL may return a single record or a set of records as its result set. When a set is to be returned, it is managed by a cursor that loops through that set and issues a separate database call for each record in the set.
- Therefore, when you design your SQL, think carefully if the task can be easily achieved in a single SQL or rather that the nature of task is such that a row-by-row processing would make more sense. Examples for the latter could be a list processing or simply because the calculation per row is too complicated to be handled by the database.

Selection List

- If a list of fields is to be returned, specify them prefixed by their table's alias name as specified in the From Clause.
- Use the DISTINCT option when the result list of records may contain duplicate rows in respect to the specified list of fields AND only one copy of the duplicated rows is needed.
- For top-level batch programs, always specify the WITH HOLD keyword on the main SQL of a cursor-based processing. This is to keep the cursor open after a commit or rollback. Without this, main cursor will be closed and fetch of the next record or restart processing will fail (specific to DB2) with SQL error 501.

Database-specific Features

Oracle

Oracle supports the cost-based optimizer only. It is recommended not to use rules based in your extensions.

FROM Clause

- Any table that has least one of its fields specified in the Selection List and/or any table that is directly referred to in the Where Clause (excluding sub-selects if any) must be specified in this section.
- Label each table with a meaningful short alias and use this alias to reference the table anywhere in the SQL.

WHERE Clause

General WHERE Clause Considerations

- All tables specified in the From Clause must participate in a join statement with another table. Table left not joined, would cause a Cartesian join to be applied for this table and any other table on the list, resulting in an incorrect result list let alone very poor performance.
- Note that there is no such thing as "conditional" join where the only join statement for a table is under a condition. In cases where the condition is not met and thus the join is not performed, one would end up with the same problem described previously.
- The final result set is built up by taking the full population of the tables involved and applying the restricting criteria to it one after another where the intermediate result population of one step is the input for the next step. Therefore, it is recommended to specify the most restrictive criteria first so that at the end of one step, lesser records are processed in the next step.
- This is of course a very schematic and simplified way to describe the internal process. This is not necessarily how the database is processing the statements. However, setting up the criteria as described would direct the database to use the right path.

Use of Sub-Selects

- When you need to further test each processed record in the Where clause for meeting an additional condition, AND that condition can NOT be checked directly on the Where clause level, you probably need a sub-select.
- As it is performed once for each outer level record it is considered as quite an expensive tool. Therefore, if the criteria checked in a sub-select can be moved to the outer where clause level, it is preferable. If you still need to use a sub-select, it is very important to restrict the outer where clause population to the very minimum possible so that lesser records would need to be further checked for the sub-select condition.
- When no value needs to be returned from the sub-select query but rather simply use it to check if a certain condition is true or false, use the EXISTS function as follows:

  ```
  Select ...
  From ...
  Where ... AND EXISTS (<sub-select>)
  ```

- A sub-select query may refer to any value of the outer level record as its input parameters. Notice that if your sub-select does NOT refer to any of the processed record fields, it means that the result set of the sub-select would be the same for ALL the processed records.
- Note that this could, but not necessarily, be an indication that your sub-select is set up wrong. One case where it is definitely wrong is when the sub-select result is input to an EXISTS function.

Use of in Function

- Whenever a field needs to be tested against a list of valid values it is recommended to use the IN function and not compare the field against each and every value.
- Wrong way:
  - Select ...
  - From ...
  - Where ... (A = '10' or A='20' or A='30')
- Right way:
  - Select ...
  - From ...
  - Where ... A IN ('10','20','30')

Use of Database Functions

- Not all database functions available for one database are valid for others. Make sure that when you do use a database function the SQL works properly on every database supported by the product.
- Avoid using LIKE as this will cause table scans. To achieve the 'LIKE' function where the first part of the string is specified, e.g., "CM%", BETWEEN may be used with the input criteria padded with high and low values.

Other

Depending on the data distribution, searching on optional index columns is likely to cause time out. For example:

```
Select BSEG_ID
From CI_BSEG
Where MASTER_BSEG_ID = &IN.MASTER-BSEG-ID
```

For such cases, consider additional restrictions or recreate the index to become composite – `MASTER_BSEG_ID + BSEG_ID`.

Sort Order

- When a result list should be displayed in a specific order, sorting should take place on the database level and NOT on the client. This is especially important in cases when the list cannot be returned in full but rather in batches of records. Sorting each batch of records separately would not guarantee the sort order between records of different batches.
- Columns in the sort order list must be specified in the selection list.
- Prefix each field used in this clause with its table's alias name.
- Explicitly specify whether sorting should be ascending or descending and do not rely on database defaults.

Grouping

- When a set of records needs to be grouped together by a simple and straightforward condition, it is recommended to use the database Group By Clause. In this case only the final summarized records are to be returned to the client resulting in a lesser number of database calls as opposed to processing the full list let alone a simpler program without any special grouping logic.

Existence Checks

- The common technique used to check whether a certain condition is met or not, obviously when no data needs to be returned, is simply COUNT how many records match that condition. A zero number indicates that no record has met that condition.
- Notice that this is not very efficient, as we are asking the database to scan the records for an accurate number that we do not really care about. All we really want to know if there is at least one such record and NOT how many they are.
- When the tables involved are of low-volume there should be no problem using this technique. It is very simple and uses common SQL syntax to all databases.
- However, when that condition is checked against a high-volume table that many of its records meet that condition, scanning all the matching records to get a count we don't need should be avoided.
- In this case use the EXISTS function as follows:

```
Select 'x'
From <The main table of the searched field, where it is defined as the PK of that tab
Where <search field> = <search value> and
EXISTS
(<sub-select with the desired condition. This is the high volume table>);
For example :
Select 'x'
From CI_UOM
Where UOM_CD = input UOM_CD and
EXISTS (select 'x'
From CI_BSEG_CALC_LN
Where UOM_CD = input UOM_CD);
```

- If this does not work for your special case, use the following option:

```
Select 'x'
From CI_INSTALLATION
Where EXISTS
```

```
(<sub-select with the desired condition>) ;
```

- Remember: This type of existence check using the Installation Options record should only be used in rare cases and should be consulted with the DBA first before implementation.
- Note that we use `CI_INSTALLATION`, since this table has only one row.

SQL statements to avoid

Decimal Delimiter

In Europe the decimal delimiter is often set to be comma character. DB2 database configured this way will return SQL syntax error in the following cases:

- select ....,1,
- insert ....values(...1,2,3...)
- insert ....values(...1 ,2,...)
- order by 1,2,3
- order by 1 ,2
- update...set abc=1,def='XX'
- case (? as varchar(50),12

To avoid this problem, surround the comma with spaces.

Testing SQL Statements

Result Data

Once your SQL is ready, it is essential to test that it returns the expected result.

Create sample data for each condition checked by your SQL. Then execute the SQL and make sure it returns the expected result for each case.

Performance Testing - Oracle Only

Overview

An SQL may perform reasonably well even if not efficiently written in cases where the volume of processed data is low, like in a development environment. However, the same SQL may perform very poorly when executed in a real high-volume environment. Therefore, any SQL should be carefully checked to make sure it would provide reasonable performance at execution time.

Obviously there could be many reasons for an SQL to perform poorly and not all of them are easy to predict or track.

In general, these could be subcategorized into two main groups:

- Basic issues related to the SQL code. These may be missing JOIN statements, inefficient path to the desired data, inefficient use of database functions, and so on.
- More complicated issues having to do with lack of indexes, database tuning and handling of high volume of data, efficiency of I/O system, and so on.

The latter group of issues may only be truly tested on a designated environment simulating a real production configuration. These performance tests are typically conducted by a team of database and operating system experts as part of a thorough performance testing of a predefined set of process.

It is the first group of issues that can and should be tested by the programmer at this stage. This is done by analysis of the SQL's **Explain Plan** result.

What is an Explain Plan?

An explain plan is a representation of the access path that is taken when an SQL is executed within Oracle.

The optimal access path for an SQL is determined by the database optimizer component. With the **Rule Based Optimizer** (RBO) it uses a set of heuristics to determine access path. With the **Cost Based Optimizer** (CBO) we use statistics to analyze the relative costs of accessing objects.

Since the Cost Based optimizer relies on actual data volume statistics to determine the access path, to generate an accurate Explain Plan using the cost based optimizer requires a database set up with the proper statistics of a real high volume data environment.

Note: A cost-based optimizer Explain Plan generated on an inadequate database, would be totally inaccurate and misleading!

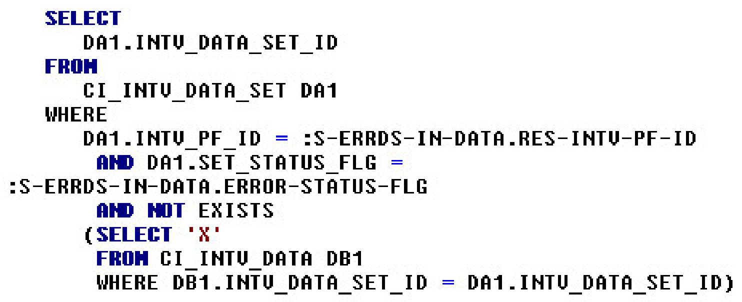
Obviously, our development database does not qualify as an optimal environment of cost-based optimizations. Since the Rule Based optimizer is not data dependent it would provide a more reliable Explain Plan for this database.

Note: An efficient rule-based Explain Plan does not guarantee an efficient cost based one when the SQL is finally executed on the real target database. However, a poor rule based Explain Plan would most probably remain such on a database with a higher volume of data.

Note: When the SQL is complicated and mainly designed to process high-volume tables it is recommended to also analyze its Explain Plan on an appropriate high-volume database.

Generate the SQL's Explain Plan

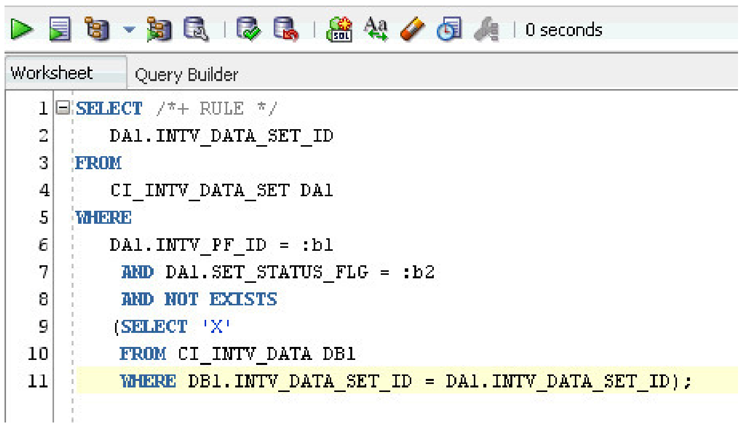
- Let's assume this is the SQL to be checked



```
   SELECT
      DA1.INTV_DATA_SET_ID
   FROM
      CI_INTV_DATA_SET DA1
   WHERE
      DA1.INTV_PF_ID = :S-ERRDS-IN-DATA.RES-INTV-PF-ID
       AND DA1.SET_STATUS_FLG =
:S-ERRDS-IN-DATA.ERROR-STATUS-FLG
       AND NOT EXISTS
      (SELECT 'X'
       FROM CI_INTV_DATA DB1
       WHERE DB1.INTV_DATA_SET_ID = DA1.INTV_DATA_SET_ID)
```

SQL To Check

- Adjust the SQL Statement:
  - Extract the tested SQL into the SQL Developer editor.
  - Replace the COBOL name of each **Host Variable** with the equivalent database identifier **:b<n>** where n is a unique number identifying that host variable. If the same variable appears more than one in the SQL use the same database host variable id in all occurrences.
  - Force the database to analyze the SQL in **Rule Base** mode by introducing the RULE database hint phrase.

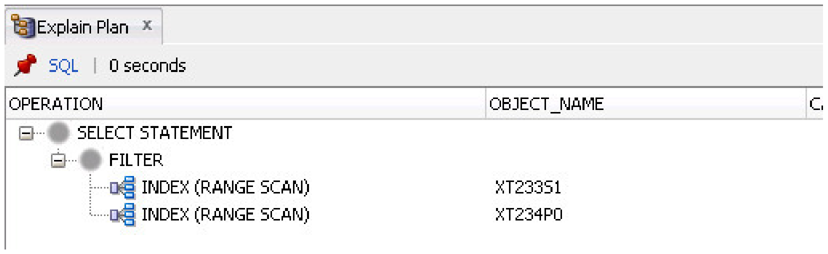


```
SELECT /*+ RULE */
   DA1.INTV_DATA_SET_ID
FROM
   CI_INTV_DATA_SET DA1
WHERE
   DA1.INTV_PF_ID = :b1
    AND DA1.SET_STATUS_FLG = :b2
    AND NOT EXISTS
   (SELECT 'X'
    FROM CI_INTV_DATA DB1
    WHERE DB1.INTV_DATA_SET_ID = DA1.INTV_DATA_SET_ID);
```

Adjust the SQL Statement

- Generate the **Explain Plan:**
  - Position the cursor on the SQL statement.

- Run the Explain Plan by hitting F10(or right-click anywhere on the SQL statement and click **Explain Plan...** from the context menu).
- The generated plan will appear in the output tab.



OPERATION	OBJECT_NAME
SELECT STATEMENT	
FILTER	
INDEX (RANGE SCAN)	XT233S1
INDEX (RANGE SCAN)	XT234P0

Explain Plan

Analyzing the Explain Plan

Access Methods

Oracle finds the data to read by using the following methods:

- **Full Table Scan** (FTS). Using this method the whole table is read.
- **Index Lookup** (unique & non-unique). Using this method, data is accessed by looking up key values in an index and returning rowids where a rowid uniquely identifies an individual row in a particular data block.
- **Rowid.** This is the quickest access method available. Oracle simply retrieves the block specified and extracts the rows it is interested in. Most frequently seen in explain plans as Table access by Rowid.

Common Issues to Be Aware of

Cartesian Product

- A Join is a predicate that attempts to combine 2 row sources. Cartesian Product is created when there are no join conditions between 2 row sources and there is no alternative method of accessing the data. Typically this is caused by a coding mistake where a join has been left out. The CARTESIAN keyword in the Explain Plan indicates this situation.

Full Table Scan

- A Full Table Scan, e.g. TABLE ACCESS FULL phrase, found in the Explain Plan usually indicates an inefficient access path. This means that the only way the database found to get to the desired data is by reading every single row in the table.
- Notice that if the logic indeed requires reading all data, then this database decision is indeed correct. However, if you intended to get a small subset of rows from a large table and ended up reading all of it this is definitely not efficient and should be fixed. If this is the case, try and find a better SQL structure that would avoid a full table access. If you can't find such, please consult a DBA as this SQL may require an additional Index to be created for the table.
- Sometimes there would be a proper index on a particular table but still a full table scan would be chosen for the access path of that table. This may be as result of an inefficient Join Order. Please see details below.

Join Order

A Join is a predicate that attempts to combine 2 row sources. We only ever join 2 row sources together. Join steps are always performed serially even though underlying row sources may have been accessed in parallel. The join order makes a significant difference to the way in which the query is executed. By accessing particular row sources first, certain predicates may be satisfied that are not satisfied by with other join orders. This may prevent certain access paths from being taken.

- Make sure the join between 2 tables is done via indexed fields as much as possible.
- Also, if such an index exists, make sure you specify fields in the order they are defined by that index.

Nested Loops

This is a common type of processing a join between 2 row sources. First we return all the rows from row source 1, then we probe row source 2 once for each row returned from row source 1.

Row source 1

Row 1 -------------- -- Probe -> Row source 2

Row 2 -------------- -- Probe -> Row source 2

Row 3 -------------- -- Probe -> Row source 2

Row source 1 is known as the **outer table.** Row source 2 is known as the **inner table.** Accessing row source 2 is known a probing the inner table. For nested loops to be efficient it is important that the first row source returns as few rows as possible as this directly controls the number of probes of the second row source. Also it helps if the access method for row source 2 is efficient as this operation is being repeated once for every row returned by row source 1.

Sort

Sorts are expensive operations especially on large tables where the rows do not fit in memory and spill to disk.

There are a number of different operations that promote sorts:

- Order by clauses
- Group by
- Sort merge join

Note that if the row source is already appropriately sorted then no sorting is required. In other words, if the fields you sort by happen to be defined by an Index in that particular order then sort operation is avoided. Therefore, whenever you see that an explicit sort operation has taken place, check if it can be avoided by using an index or sometimes just by making sure your are using an index's fields in the right order.

If no such index exists and the number of rows to be sorted is of high volume, please consult a DBA as this may justify adding a new index.

More Extensive Performance Testing

Special attention should be paid to background processes that are designed to process high volume tables. A thorough performance testing exercise in a benchmark format may be called upon.

SQL Development and Tuning Best Practices

- Length of the DataType Matters.

  For example if you define a column with VARCHAR2(4000) (just the maximum limit) then you may outflow you array as given in the example below.

Varchar2(n) where *n* is "right sized"	**Varchar2(4000) for *everything* (just in case)**
Assume 10 columns, average width is 40 characters (some are 80, some are 10...).	Assume 10 columns, average, minimum, maximum width is 4000.
400 bytes per row on a fetch.	40,000 bytes per row on a fetch.
Assume array fetch of 100 rows, so array fetch buffer or 40,000 bytes.	Assume array fetch of 100 rows, so array fetch buffer or 4,000,000 bytes.
Assume 25 open cursors, so 1,000,000 bytes of array fetch buffers.	Assume 25 open cursors, so 100,000,000 bytes.
Assume connection pool with 30 connections — 30MB.	Assume connection pool with 30 connections — 3GB.

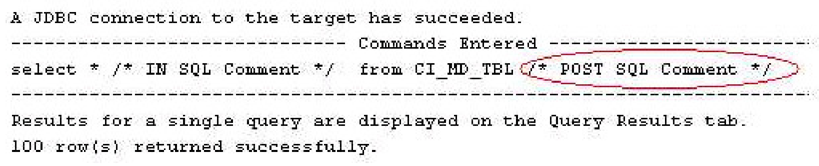
- NOT Null columns should be preferred over Null able columns. The reason is if you have an Index on a Null able column then it would not be used by the SQL as the optimizer thinks that it would not find any values in some of the columns so prefer a full scan.

  As a workaround for columns with NULL data types the Index create SQL should look like:

  ```
  Create INDEX ABC ON TAB1 (COLUMN1, 0);
  ```

This will make sure that in case the Column1 is null the optimizer will consider the value as 0 and leads to index scan as compared to Full scans.

- Always try to substitute the Bind Variables in a SQL with the actual constant value if there is only one possible. Having too much Bind variables sometimes confuses the Optimizer to take the right access path. So this is good for the stability of the SQL plans.
- Fields which are foreign keys to other tables and are used in SQLs for the Join criterion are good candidates for creating Indexes on.
- Do not create any objects in the database of which the name may collide with any SQL reserved words.
- Views are generally used to show specific data to specific users based on their interest. Views are also used to restrict access to the base tables by granting permission only on views. Yet another significant use of views is that they simplify your queries. Incorporate your frequently required, complicated joins and calculations into a view so that you don't have to repeat those joins/calculations in all your queries. Instead, just select from the view.
- Avoid creating views within views as it affects the performance.
- Offload tasks, like string manipulations, concatenations, row numbering, case conversions, type conversions etc., to the front-end applications if these operations are going to consume more CPU cycles on the database server. Also try to do basic validations in the front-end itself during data entry. This saves unnecessary network roundtrips.
- Always be consistent with the usage of case in your code. On a case insensitive server, your code might work fine, but it will fail on a case-sensitive server if your code is not consistent in case.
- Make sure you normalize your data at least to the 3rd normal form. At the same time, do not compromise on query performance. A little bit of denormalization helps queries perform faster.
- Consider indexing those columns if they are frequently used in the ORDER clause of SQL statements.
- Use tools like Tkprofs and AWR Report for measuring the Performance of your SQLs.
- In the SQL Explain Plans, usage of Nested Loops are good when there are table joins involved.
- Always looks for Autotrace to measure the SQL plan as it is closer to the plan which the optimizer takes during the actual execution of the SQL. This can be get easily through SQL Developer and other database monitoring tools.
- While looking at the Autotrace Plans look for consistent gets and make sure they are low. The other thing reported by the Autotrace is COST. Do not worry too much about cost if the Consistent gets is low and you are getting a desirable Plan.
- Make sure that the Statistics are current and not stale while you are trying to Tune a SQL.
- Having Secondary Unique Indexes help in achieving Index Unique scans. This will eliminate the Table scans. It is worth trying and see if that makes a difference.
- Oracle Optimizer executes the explain plans of a SQL from Inner to the outer area and from bottom to the top. So make sure that the cardinality of the inner most Join criterion should be low.
- Always keep in mind the usage of the SQL in a real production scenario where the data in the tables can go exponentially. Make sure that the SQLs can handle it and the Explain plan should be accordingly tuned.
- Usage of <<, != make the Index NOT to be used. Instead of this use the greater than or less than statements.
- If you wrap a column a column with some functions like TO_DATE, TO_CHAR, SUBSTR and so on then the Index on the Column would not be used.
- Avoid using UNION and make sure you use UNION ALL if possible. This will boost performance.
- Using EXISTS , NOT EXISTS are better than using IN , NOT IN statements respectively.
- When writing comments within SQL statements make sure that the comments are not added at the beginning because DB2 will not be able to parse it. You can instead put the Comments at the end and it will work. For Oracle this is not an issue.



```
A JDBC connection to the target has succeeded.
------------------------------ Commands Entered ------------------------
select * /* IN SQL Comment */  from CI_MD_TBL /* POST SQL Comment */
------------------------------------------------------------------------
Results for a single query are displayed on the Query Results tab.
100 row(s) returned successfully.
```

Additional Resources

Additional information on optimizing SQL in your OUAF applications can be found in the *Oracle Utilities Application Framework - Technical Best Practices* whitepaper available on the My Oracle Support (MOS) Knowledge Base (article 560367.1).

Database Design

The objective of this document is to provide a standard for database objects (such as tables, columns, and indexes) for products using Oracle Utilities Application Framework. This standard is introduced to insure clean database design, to promote communications, and to reduce errors leading to smooth integration and upgrade processes. Just as Oracle Utilities Application Framework goes thorough innovation in every release of the software, it is also inevitable that the product will take advantage of various database vendors' new features in each release. The recommendations in the database installation section include only the ones that have been proved by vigorous QA processes, field tests and benchmarks.

Database Object Standard

This section discusses the rules applied to naming database objects and the attributes that are associated with these objects.

Naming Standards

The following naming standards must be applied to database objects.

Table

Table names are prefixed with the owner flag value of the product. For customer modification **CM** must prefix the table name. The length of the table names must be less than or equal to 30 characters. A language table should be named by suffixing **_L** to the main table. The key table name should be named by suffixing **_K** to the main table.

It is recommended to start a table name with the 2-3 letter acronym of the subsystem name that the table belongs to. For example, **MD** stands for meta-data subsystem and all meta data table names start with **CI_MD**.

Some examples are:

- CI_ADJ_TYPE
- CI_ADJ_TYPE_L

Note: A language table stores language sensitive columns such as a description of a code. The primary key of a language table consists of the primary key of the code table plus language code (LANGAGUE_CD).

Note: A key table accompanies a table with a surrogate key column. A key value is stored with the environment id that the key value resides in the key table.

Note: The tables prior to V2.0.0 are prefixed with CI_ or SC_.

Columns

The length of a column name must be less than or equal to 30 characters. The following conventions apply when you define special types of columns in the database.

Use the suffix **FLG** to define a lookup table field. Flag columns must be CHAR(4). Choose lookup field names carefully as these column names are defined in the lookup table (CI_LOOKUP_FLD) and must be prefixed by the product owner flag value.

Use the suffix **CD** to define user-defined codes. User-defined codes are primarily found as the key column of the admin tables.

Use the suffix **ID** to define system assigned key columns.

Use the suffix **SW** to define Boolean columns. The valid values of the switches are 'Y' or 'N'. The switch columns must be CHAR(1)

Use the suffix **DT** to define Date columns.

Use the suffix **DTTM** to define Date Time columns.

Use the suffix **TM** to define Time columns.

Some examples are:

- ADJ_STATUS_FLG
- CAN_RSN_CD

Indexes

Index names are composed of the following parts:

[X][C/M/T]NNN[P/S]

X - letter **X** is used as a leading character of all base index names prior to Version 2.0.0. Now the first character of product owner flag value should be used instead of letter X. For client specific implementation index in **Oracle**, use **CM.**

C/M/T - The second character can be either **C** or **M** or **T**. **C** is used for control tables (Admin tables). **M** is for the master tables. **T** is reserved for the transaction tables.

NNN - A three-digit number that uniquely identifies the table on which the index is defined.

P/S/C - **P** indicates that this index is the primary key index. **S** is used for indexes other than primary keys. Use **C** to indicate a client specific implementation index in **DB2** implementation.

Some examples are:

- XC001P0
- XT206S1
- XT206C2
- CM206S2

Warning: Do not use index names in the application as the names can change due to unforeseeable reasons.

Sequence

The base sequence name must be prefixed with the owner flag value of the product.

Trigger

The base trigger name must be prefixed with the owner flag value of the product.

Note: When implementers add database objects, such as tables, triggers and sequences, the name of the objects should be prefixed by **CM.** For example, Index names in base product are prefixed by **X;** the Implementers' index name must not be prefixed with **X.**

Column Data Type and Constraints

User Define Code

User Defined Codes are defined as CHAR type. The length can vary by the business requirements but a minimum of eight characters is recommended. You will find columns defined in less than eight characters but with internationalization in mind new columns should be defined as CHAR(10) or CHAR(12). Also note that when the code is referenced in the application the descriptions are shown to users in most cases.

System Assigned Identifier

System assigned random numbers is defined as CHAR type. The length of the column varies to meet the business requirements. Number type key columns are used when a sequential key assignment is allowed or number type is required to interface with external software. For example, Notification Upload Staging ID is a Number type because most EDI software uses a sequential key assignment mechanism. For sequential key assignment implementation, the DBMS sequence generator is used in conjunction with Number Type ID columns.

Date/Time/Timestamp

Date, Time and Timestamp columns are defined physically as DATE in Oracle. In DB2 the DATE, TIME and TIMESTAMP column types, respectively, are used to implement them. Non-null constraints are implemented only for the required columns.

Number

Numeric columns are implemented as NUMBER type in Oracle and DECIMAL type in DB2. The precision of the number should always be defined. The scale of the number might be defined. Non-null constraints are implemented for all number columns.

Fixed Length/Variable Length Character Columns

When a character column is a part of the primary key of a table define the column in CHAR type. For the non-key character columns, the length should be the defining factor. If the column length should be greater than 10, use VARCHAR2 type in Oracle and VARCHAR type in DB2.

Null Constraints

The Non-null constraints are implemented for all columns except optional DATE, TIME or TIMESTAMP columns.

Default Value Setting

The rule to set the database default value is the following:

- When a predefined default value is not available, set the default value of Non-null CHAR or VARCHAR columns to blank except the primary key columns.
- When a predefined default value is not available, set the default value Non-null Number columns to 0 (zero) except the primary key columns.
- No database default values should be assigned to the Non Null Date, Time, and Timestamp columns.

Foreign Key Constraints

Referential Integrity is enforced by the application. In database, do not define FK constraints. Indexes are created on most of Foreign Key columns to increase performance.

Standard Columns

Owner Flag

Owner Flag (OWNER_FLG) columns exist on the system tables that are shared by multiple products. Oracle Utilities Application Framework limits the data modification of the tables that have owner flag to the data owned by the product.

Version

The **Version** column is used to for optimistic concurrency control in the application code. Add the **Version** column to all tables that are maintained by a Row Maintenance program.

System Table Guide

Key components of products built on the Oracle Application Framework are the system tables. The data in those tables controls many aspects of the application. There are standards required for these tables to support the installation, development, configuration and customization of the Oracle Utilities products. Implementations add their own records to the system tables. Adhering to the data standards is a prerequisite for seamless upgrade to the next release of the product(s). Please refer to the Oracle Utilities Application Framework System Table Guide section of your product's Database Administration Guide for details about the system tables and the standards to follow.

Key Generation

Key generation is performed for tables that have sequential or system generated prime key. This is performed automatically for Java instances via the OUAF enTegrity.

Tables with a system-generated key contain their own unique key that is replicated in a related 'key table' suffixed with '_K'. The purpose of the key table is to store the table identifier as well as the identifier of the environment in which the data row exists. An example is the Account table containing the Account identifier and the Account Key table containing the Account identifier and the Environment identifier.

These key tables support the Content Migration Assistant functionality by ensuring that a key will be unique across environments.

Metadata for Key Generation

The required table metadata that is used by the key generator indicates:

- The type of key, e.g. whether it is system-generated or sequential
- The key table in which key values are stored
- The length of the inherited portion of the key.

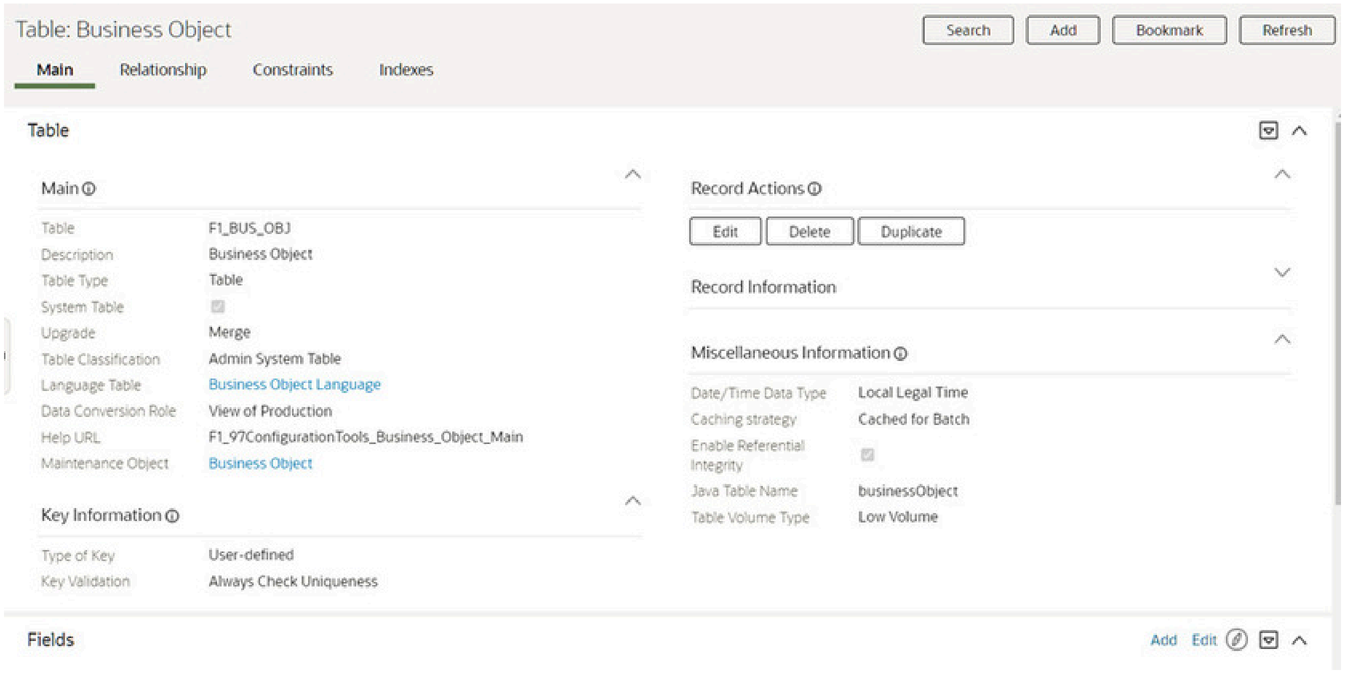


Table	F1_BUS_OBJ
Description	Business Object
Table Type	Table
System Table	☐
Upgrade	Merge
Table Classification	Admin System Table
Language Table	Business Object Language
Data Conversion Role	View of Production
Help URL	F1_97ConfigurationTools_Business_Object_Main
Maintenance Object	Business Object

Type of Key	User-defined
Key Validation	Always Check Uniqueness

Date/Time Data Type	Local Legal Time
Caching strategy	Cached for Batch
Enable Referential Integrity	☐
Java Table Name	businessObject
Table Volume Type	Low Volume

Example Table Metadata Key Information

In the Service Agreement table metadata example above, the metadata key information is shown by the values in the fields Key Table, Type of Key and Inherited Key Prefix Length.

The primary key constraint is used to retrieve the name of the key field for the table from the field metadata.

The field metadata provides the field data type and length.

Note: Key Types. Although there are more types of keys indicated in metadata drop-down list, the only types currently supported by the key generator in the Oracle Utilities Application Framework are system-generated and sequential.

Note: Special Annotation. If a table's inherited key prefix length is non-zero, a special entry "clusteringParentProperty" must be in the business entity annotation for this table.

Development Performance Guidelines

This document includes information, guidelines, and strategies to help designers and developers understand performance impacts when developing a feature using the Oracle Utilities Application Framework.

Object-Relational Mapping: Background

OUAF uses an Object-Relational Mapping (ORM) engine, which maps tables to entities using the system's table, table/field, field, and constraint metadata to guide the creation of mapping definitions during artifact generation.

Entities represent database tables. They are created as Java objects during a database "session", which has the lifetime of a single DB transaction.

DONT: Once the session that created them has ended, entities are not safe to use for reference, calling methods, and so on. For example, don't copy entities into application caches.

DO: Instead, let the application cache do the data retrieval and return the data to the session. `Id` objects are safe to store across sessions. Note in the following example that the entity `AlgorithmType` is not stored:

```
public class AlgorithmTypeInfoCache implements ApplicationCache {
  private static final AlgorithmTypeInfoCache INSTANCE = new AlgorithmTypeInfoCache();
  private final ConcurrentMap<AlgorithmType_Id, AlgorithmTypeInfo> algorithmTypeInfoByIc
  protected AlgorithmTypeInfoCache() {  ContextHolder.getContext().registerCache(this);
  public String getName() {  return "AlgorithmTypeInfoCache";    }
  public void flush() {algorithmTypeInfoById.clear();    }
  public static AlgorithmTypeInfo getAlgorithmTypeInfo(AlgorithmType_Id algTypeId) {
    return INSTANCE.privateGetAlgorithmTypeInfo(algTypeId);
  }

  private AlgorithmTypeInfo privateGetAlgorithmTypeInfo(AlgorithmType_Id algTypeId) {
    AlgorithmTypeInfo algTypeInfo = algorithmTypeInfoById.get(algTypeId);
    if (algTypeInfo != null) return algTypeInfo;
    AlgorithmType type = algTypeId.getEntity();
    if (type == null) return null;
    AlgorithmTypeInfo info = new AlgorithmTypeInfo(type);
    AlgorithmTypeInfo prev = algorithmTypeInfoById.putIfAbsent(algTypeId, info);
    if (prev != null) return prev;
    return info;
  }
}
```

DO: it is safe to use XML documents (to be consumed by BOs, BSs, or SSs) for moving data between sessions.

Every entity has a unique corresponding `Id` class, for example: `BatchControl` has `BachControlId`. The ORM framework automatically generates correct SQL to perform the following essential tasks:

- Read, update, insert, delete one entity (row) from the database.
- Navigate between related entities as per their key/constraint relationships. For example, from a parent entity to a collection of children.

The ORM defers database calls for performance

The ORM tries to be as "lazy" as possible; its basic stance is to avoid loading any data from the DB until the last possible moment. Let's use the following example to describe how the data is only loaded at last moment possible:

```
BatchControl someBatchControl = batchControlId.getEntity();
BatchControlParameters parms = someBatchControl.getParameters();
for (BatchControlParameter each : parms) {
String name = each.getBatchParameterName();
}
```

In the above example, the `getEntity()` call only retrieves the parent ID as a proxy. The `someBatchControl` is not fully "hydrated" until some other property is accessed. "Hydrating Entities" is the process of taking a row from the database and turning it into an entity.

The `getParameters()` call only retrieves the child IDs, again as proxies.

Only when the getBatchParameterName() is called, is a row (the child row) actually retrieved.

ID Objects

- When you create an ID, the ID object will not be null. After you use an ID to retrieve an entity (using getEntity()), that is when you find out if the entity actually exists. Just because an ID exists, doesn't mean the entity itself exists! DO: So you must check for null before attempting to use the entity you retrieved. For example:

```
BatchControlId id = ...
BatchControl batchControl = id.getEntity();
if (batchControl == null) { /* oh oh */ }
```

Counting a collection

DO: If you want to count the number of batch control parameters that belong to a parent batch control, use the size() method as in the following example:

```
BatchControl someBatchControl = ...;
BatchControlParameters parms = someBatchControl.getParameters();
int count = parms.size();
```

The framework implementation code has an optimized implementation of the size() method, which either counts the existing in-memory collection elements, if they are already present, or issues a SQL count(*) query, if they aren't.

Avoid unnecessary work

DON'T: In the example, below, the call to listSize() is unnecessary. In most cases, you shouldn't need to write something to loop over a collection:

```
if(query.listSize() > 0) {
while (iter.next()) { .... }
}
```

The call to `listSize()` will make an unnecessary call to "select count(*)". Let the iterator do the work. Avoid the extra call to the database.

ORM 'Navigation' is your friend

Don't be tempted to hand-write queries that are equivalent to navigations between entities:

```
BatchControlId batchControlId = ...
Query<BatchControlParameter> query = createQuery("from BatchControlParameter parm where
query.bindId("parentId", batchControlId);
List<BatchControlParameter> list = query.list();
```

DO: Use this instead - it'll use the cache and will almost certainly be faster:

```
BatchControl batchControl = id.getEntity();
if (batchControl == null) { /* oh oh */ }
```

```
BatchControlParameters list = batchControl.getParameters();
```

How to Pre-load Entities Using Fetch

This technique is for performance intensive jobs that are doing too many single-row SQL retrieves. The *fetch* command will pre-load the entities, resulting in one fewer database calls.

Write a query using "left join fetch" to select all data. The ORM will fetch the associated collection for every retrieved table into the session cache. Subsequent navigation to the underlying collection is then an in-memory operation with no database IO. Again, PREFER code that performs standard navigation.

- As a general strategy:
  - For most jobs, navigation is just fine.
  - Write code using navigation first, then ADD the fetch query later, only if it's needed.

Refer to the Hibernate documentation on Improving Performance.

Session Cache

In most cases, if an entity is retrieved previously within a session, it does not have to be retrieved again, since it is stored in the session cache.

As a result, multiple BO reads against Java-backed MOs do not re-execute SQL.

Level 2 Cache Applicable for Batch

Hibernate's Level 2 cache is a second level of caching that allows sharing of data between sessions. This is useful for static, admin data like rates, type codes, etc., since objects that are added to this cache cannot be updated. The caching is enabled per entity on the Table transaction's Caching Regime Flag with values of "Not Cached" and "Cached for Batch." By default, the product is not configured to have Log and Language tables as *not* cached.

Flushing - COBOL and Save Points

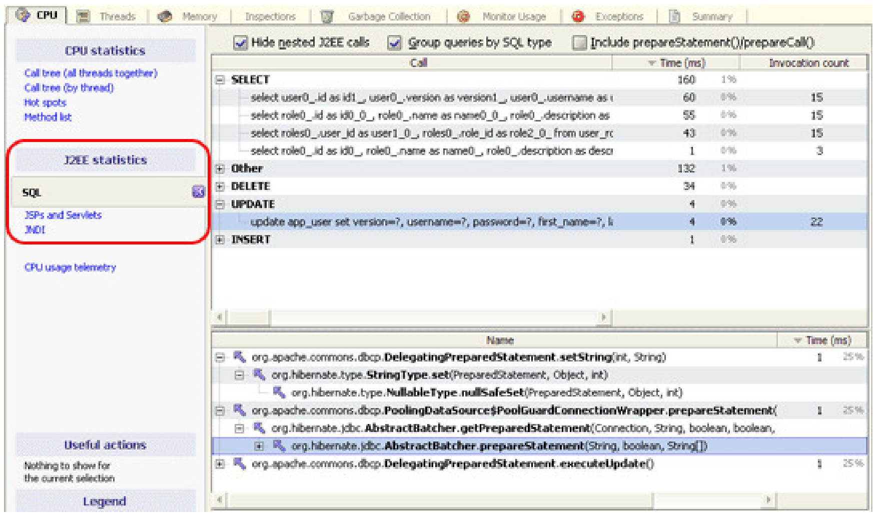
Flushing means writing the changes to the database. It syncs the database with the session cache. Flushing is expensive but necessary to maintain data integrity. The system flushes under the following conditions:

- Before commit
- Before raw SQL queries
- Before most HQL queries
- When specifically requested
- Savepoints

Avoid Extra SQL

Inspect generated SQL for extra calls. Tools like Oracle's tkprof, Yourkit java profiler, or debug application logs can help identify extra database calls. The screen capture below shows how Yourkit is able to reveal SQL statements behind PreparedStatement calls.

Yourkit Demo: http://www.yourkit.com/docs/demo/JavaEE/JavaEE.htm



Call	Time (ms)		Invocation count
⊟ SELECT	160	1%	
select user0_.id as id1_, user0_.version as version1_, user0_.username as	60	0%	15
select role0_.id as id0_0_, role0_.name as name0_0_, role0_.description as	55	0%	15
select roles0_.user_id as user1_0_, roles0_.role_id as role2_0_ from user_r	43	0%	15
select role0_.id as id0_, role0_.name as name0_, role0_.description as desc	1	0%	3
⊞ Other	132	1%	
⊞ DELETE	34	0%	
⊟ UPDATE	4	0%	
update app_user set version=?, username=?, password=?, first_name=?, l	4	0%	22
⊞ INSERT	1	0%	

Name	Time (ms)	
⊟ org.apache.commons.dbcp.**DelegatingPreparedStatement.setString**(int, String)	1	25%
⊟ org.hibernate.type.**StringType.set**(PreparedStatement, Object, int)		
org.hibernate.type.**NullableType.nullSafeSet**(PreparedStatement, Object, int)		
⊟ org.apache.commons.dbcp.**PoolingDataSource$PoolGuardConnectionWrapper.prepareStatement**(	1	25%
⊟ org.hibernate.jdbc.**AbstractBatcher.getPreparedStatement**(Connection, String, boolean, boolean,		
⊞ org.hibernate.jdbc.**AbstractBatcher.prepareStatement**(String, boolean, String[])		
⊞ org.apache.commons.dbcp.**DelegatingPreparedStatement.executeUpdate**()	1	25%

Prepared statement - use binding

DON'T: Never concatenate values - DO: use binding instead. Besides helping to reduce security concerns with SQL injection, concatenation results in reparsing of SQL statements by the database. You could also lose the benefits of any PreparedStatement caching by the jdbc drivers.

Service Script vs. Java Services

Service Scripts perform slower than java services. There is an overhead on scripting that comes from xml manipulation and xpath evaluation. Lots of moves, complicated XPath - proportional to amount of XPath. Here are some tips:

- One complicated XPath expression should be faster than several smaller ones - the overhead is in the setup.
- Smaller documents will process faster - think about that when designing script schemas - only send what you need.

Java Performance Patterns

- Loop over entryset of a hashmap, not the entities
- Concatenate strings using StringBuilder
- **Use Findbugs** - it will help expose patterns to be avoided.

Batch Performance

Commit Considerations

DON'T: Do not commit too frequently. For example, we do not commit ever record since each commit has overhead at the database; however, sessions with lots of objects in the cache should commit more frequently. Adjust your default value accordingly.

Data Explorer

It is important to understand that Data Explorers process ALL records returned from the database, even if they are not displayed. For example, FK ref info strings, BS calls, SS calls, Inhibit Row in Explorers - all can cause per-row processing even if they are not displayed.

Data Explorers are rendered using JavaScript. They are not designed to display many records, and trying to do so will result in possibly unacceptable performance. DO: Consider limiting the results returned and asking Users to add additional filter criteria to narrow down the results. DON'T: Don't try to display hundreds of records.

Zone Configuration

- DO: Consider limiting the number of rows retrieved by the database limiting the query size. Specify this on the zone parameter and the query will use the *rownum* technique to restrict the number of rows returned.
- DO: As a rule-of-thumb: 10 columns (even if not visible) in a data explorer zone should be an alert to really think about performance implications.
- DO: Try to perform all processing in the SQL instead of fkInfo, BS, or SS calls in other columns. As described earlier, these would be additional processes run on a per-row basis. If a description exists, consider using the description and a Navigation Option instead of the Foreign Key. For example, replace the Person fkRef with Person Name and its Navigation Option.

Table Indices and SQL

Here are some more common patterns to look out for. (This is not meant to be a complete SQL tuning guide.)

- Put Indexes on the most used criteria. If there is no proper index, the optimizer does a full table scan. Consider:
  - Primary keys, foreign keys, ORDER BY fields.
  - Secondary Unique Indexes
- DO: Use a JOIN instead of EXISTS. This is faster for unique scan indexes.
- DO: Use EXISTS instead of IN when working with ID fields, use '=' instead of LIKE. Using LIKE on a system-generated key is not recommended.
- CONSIDER: Using functions like `TO_DATE()`, `SUBSTR()`, and so on means indexes on those fields will not be used. Use only when necessary.
- DO: Use the power of optional filters - and not just in the WHERE clause.

```
FROM d1_tou_map tm, d1_tou_map_l tml
FROM d1_tou_map tm,  [(F1) d1_tou_map_l tml,]
```

- DO: Only include necessary tables:

```
SELECT A.usg_grp_cd, A.usg_rule_cd, A.exe_seq,A.referred_usg_grp_cd,A.usg_rule_cat_fl
FROM D1_USG_RULE A, d1_usg_rule_elig_crit B, d1_usg_rule_elig_crit_l C
WHERE A.usg_grp_cd= :H1
AND A.usg_grp_cd = B.usg_grp_cd
AND A.usg_rule_cd = B.usg_rule_cd
AND b.usg_grp_cd = C.usg_grp_cd
AND b.usg_rule_cd = C.usg_rule_cd
AND b.crit_seq = C.crit_seq
AND C.language_cd= :language
```

  Note that Table B is not necessary; you could instead simply link directly from A to C.
- Off load tasks, like string manipulations, concatenations, row numbering, case conversions, type conversions, and so on, to the front-end applications.
- Do basic validations in the front-end during data entry. This saves unnecessary network roundtrips.
- Avoid using UNION - use UNION ALL if it is possible.
- Operators <> and != will NOT use the index! Also the word "NOT" Use the Greater Than or Less Than operators.

```
select * from ci_scr_step where  (scr_cd <> 'ZZCW03') has cost 68
select * from ci_scr_step where (scr_cd > 'ZZCW03' or scr_cd < 'ZZCW03') has cost 1!!
```

UI Maps and BPAs

UI maps will not be able to display many rows very quickly. DONT display hundreds of rows in a UI Map. Alternatively, the zone type "SERVICE" can display numerous records faster.

DO: Ensure that the html code is proper. Malformed HTML in UI maps (for example, opening a <div> and not closing it) can cause significant performance degradations at the browser. It is possible to copy and paste HTML into Eclipse to check its validity. There are also various tools like html tidy that can help to identify bad html.

DO: Minimize browser-to-server calls. Namely, invokeBO/BS/SS will perform a call to a server to retrieve the data, which can be slow. Many of these such calls on load of the UI Map will result in slow performance.

- Use service script instead of BPA if multiple calls need to be made to BO, BS, SS.
- Create a "bulk" processing service script instead of calling the same one multiple times. Instead of multiple invokeBS calls on load of a UI map, write a pre-processing service script instead.

Diagnosing Performance Issues

Execution times can be obtained in several ways:

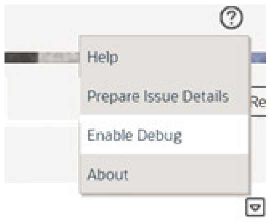
Fiddler

In a UI-oriented scenario, the first recommended analysis tool is to use an http logger like fiddler (http://www.fiddler2.com). This tool should make it apparent if there are excessive calls from the client browser to the server and the server response times as seen from the browser. The timings can then be categorized as server-side or client-side calls. When using fiddler be sure to enable the following:

- "Time-to-Last-Byte"
- "Response Timestamp"

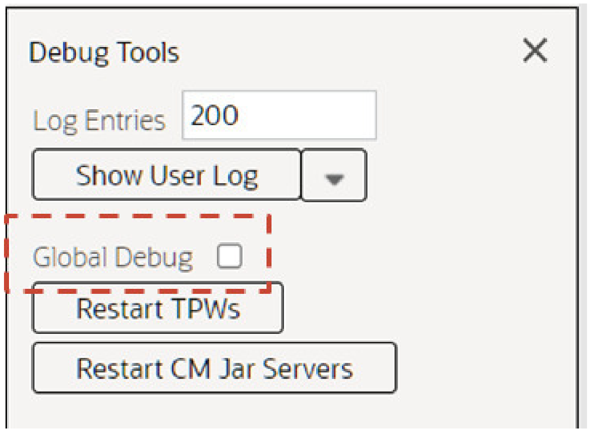
OUAF 'Show Trace' button

1. Enable debug mode by adding `debug=true` to the url or enabling debug from the help icon.



2. Click the bug icon.

3. Check the **Global Debug** checkbox.



Note: The Restart TPWs and Restart CM Jar Servers work on the Oracle Utilities Cloud Services only.

Log Service times in spl_service.log

In log4j2 properties, add the following, including adding `serviceDispatcher` to the comma-separated named loggers, to log service execution times:

```
logger.serviceDispatcher.name = com.splwg.base.api.service.ServiceDispatcher
logger.serviceDispatcher.appenderRef.userLog.ref = userLog
logger.serviceDispatcher.level = debug
logger.serviceDispatcher.additivity = false
```

Optimization and Performance Profiling

To squeeze every second of a given program for mission critical optimizations, it may be necessary to craft a repeatable unit test and profile the results using a profiling tool such as YourKit (www.yourkit.com). This section will include some code samples to log execution times. Attaching a profiler could give clues to optimization points. A common pattern to follow in testing code is to allow the System to "warm up," for example to load up the necessary application caches which are only done once and are not relevant to the code being optimized.

Basic Logging

The following code can be placed in a junit test to log execution times:

```
long start = logger.debugStart("Starting process");
//... code for process
logger.debugTime("End process", start);
```

Timing code ('shootout'):

The code below will run a BO Update 100 times and report the amount of time taken. Note the 5 "warmup" executions before the repeated 100 runs.

```
    public void testMultiplePluginScripts() throws Exception {
        String docString1 = "<DR_ShortCreateIntervalRecords><factId>219250542869</
factId><longDescr>REEE</longDescr></DR_ShortCreateIntervalRecords>";
        Document doc1 = DocumentHelper.parseText(docString1);

        String docString2 = "<DR_ShortCreateIntervalRecords2><factId>219250542869</
factId><longDescr>REEE</longDescr></DR_ShortCreateIntervalRecords2>";
        Document doc2 = DocumentHelper.parseText(docString2);

        // warmups
        for (int i = 0; i < 5; i++) {
            BusinessObjectDispatcher.execute(doc1, BusinessObjectActionLookup.constants
            rollbackAndContinue();
            BusinessObjectDispatcher.execute(doc2, BusinessObjectActionLookup.constants
            rollbackAndContinue();
        }

        long totalElapsed = 0;
        // speed
        for (int i = 0; i < 100; i++) {
            long start = System.nanoTime();
            BusinessObjectDispatcher.execute(doc1, BusinessObjectActionLookup.constants
            flush();
            totalElapsed += System.nanoTime() - start;
            rollbackAndContinue();
        }
        System.out.println("Script (100): " + totalElapsed / 1000000 + "ms");
        totalElapsed = 0;
        for (int i = 0; i < 100; i++) {
            long start = System.nanoTime();
            BusinessObjectDispatcher.execute(doc2, BusinessObjectActionLookup.constants.
            flush();
            totalElapsed += System.nanoTime() - start;
            rollbackAndContinue();
        }
        System.out.println("Java (100): " + totalElapsed / 1000000 + "ms");
}
```

Using PerformanceTestResult helpers

A performance helper suite of classes was introduced, allowing *shootouts* to be simpler:

```

          Callable<Void> exprCallable = new Callable<Void>() {
            @Override
            public Void call() throws Exception {
                expression.value(context);
                return null;
            }
        };
        Callable<Void> javaCallable = new Callable<Void>() {
            @Override
            public Void call() throws Exception {
                function(x);
                return null;
            }
        };
        PerformanceTestCallable exprPerfCallable = new PerformanceTestCallable("Express
                + expression.getExpressionString(), exprCallable);
        PerformanceTestCallable javaPerfCallable = new PerformanceTestCallable("Java", j

        PerformanceTestResult compareResult = PerformanceTestHelper.compare(20, 200000,
                javaPerfCallable);
        compareResult.printResults();
```

The API is `com.splwg.base.api.testers.performance.PerformanceTestHelper`:

```

    public static PerformanceTestResult compare(int warmups, int reps, PerformanceTestCa
            throws Exception {
```

Each of the performance callables is treated the same. It gets a series of warmup executions to populate caches, and to allow hotspot JVM optimizations of any methods. Then the accurate system nano timing (for example, `System.nanoTime()`) is called around the loop of the given number of reps.

Profiling

The code below uses YourKit's controll classes to create a snapshot.

```

    public void testProfilePluginScripts() throws Exception {
        String docString = "<DR_ShortCreateIntervalRecords><factId>219250542869</
factId><longDescr>REEE</longDescr></DR_ShortCreateIntervalRecords>";
        Document doc = DocumentHelper.parseText(docString);

        // warmups
        for (int i = 0; i < 5; i++) {
            BusinessObjectDispatcher.execute(doc, BusinessObjectActionLookup.constants.
            rollbackAndContinue();
        }

        Controller controller = new Controller();
        controller.forceGC();
        controller.startCPUProfiling(ProfilingModes.CPU_SAMPLING, Controller.DEFAULT_FI
        for (int i = 0; i < 500; i++) {
            BusinessObjectDispatcher.execute(doc, BusinessObjectActionLookup.constants.
            rollbackAndContinue();
        }
        controller.captureSnapshot(ProfilingModes.SNAPSHOT_WITHOUT_HEAP);
    }
```

PerformanceTestHelper API

As before, the `PerformanceTestHelper` helps by providing a seamless interface into the yourkit profiler, for various options of sampling, tracing, monitoring threads or timing in threads:

```
    public static PerformanceTestCallableResult profileSample(int warmups, int reps, Pe
            throws Exception {
    public static PerformanceTestCallableResult profileTrace(int warmups, int reps, Per
            throws Exception {

    public static PerformanceTestCallableResult monitor(int warmups, int reps, int numTh
            PerformanceTestCallable callable) throws Exception {

    public static PerformanceTestCallableResult timeInThreads(int warmups, int reps, int
            PerformanceTestCallable callable) throws Exception {
```

The `PerformanceTestHelper` utility class uses reflection to know whether the yourkit library is available or not. If it is not available (such as on the build server), the behavior reverts to simple timing protocols of the corresponding callable iterations. If it is available (such as on a developer's workstation, and they want to profile a test), then the yourkit profiler is connected. This would require running the test under a profile session, else an error is produced.

Profiling a callable is somewhat similar to the simple timing of a callable, except for some added steps:

1. Performs some warmups.
2. Forces garbage collection via the yourkit API.
3. Starts the given profile type (sample vs trace)- the test should be run without automatically starting the profiler.
4. Wrap the repetition loop in a timer.
5. Capture a snapshot.

This design approach allows profile/performance tests to be checked into version control, for re-profiling at a later point, and for documentation examples of how to profile code, and so on.

References and Additional Resources

Batch programs and strategies:

For details on writing batch programs, using threads for performance improvements, and other batch-related information, see the *Batch Best Practices* whitepaper available on the My Oracle Support (MOS) Knowledge Base (article 836362.1).

Yourkit profiling demo:

http://www.yourkit.com/docs/demo/JavaEE/JavaEE.htm

Packaging Guide

CM Packaging Utilities Cookbook

This document describes the installation, configuration, and operation of the packaging utilities provided with the Software Development Kit. These utilities enable developers to prepare releases of their custom modifications (called CM releases) to the products. Releases prepared using these utilities may be installed on top of an existing base product environment.

Note: CM releases will correspond to a specific base product version and can be installed on base product environments of that version only. Customers installing a CM release must first verify the corresponding base product version with the Implementation team.

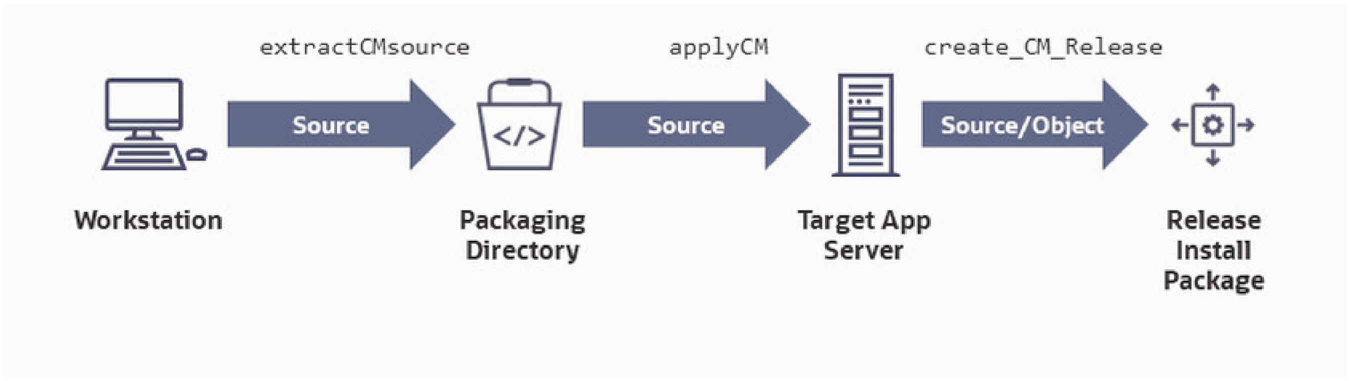
Note: This document describes CM packaging utilities operation for Oracle database only. The application server can be Unix or Windows/DOS operating system. In Unix you must execute the script with **`.sh`** suffix, in window the script with **`.cmd`** suffix. They both will execute the same Perl script with **`.plx`** suffix. For instance:

- `applyCM.sh`: Unix driver script
- `applyCM.cmd`: Windows driver script
- `applyCM.plx`: Perl script

All the examples in this document are related to Unix. If you are in Windows/DOS simply execute the same scripts, but using **`.cmd`** extension instead **`.sh`**.

App Server CM Packaging Overview

The following diagram describes the app server CM packaging procedure.

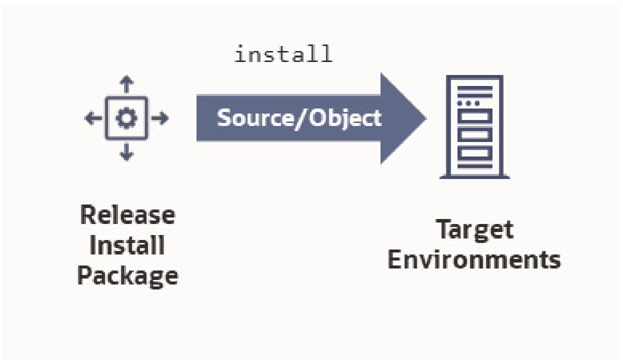


The starting point of packaging the app server component is the **project repository**. The tool `extractCMSource` is used to get the source from the project repository into the **packaging directory**.

Note: The packaging directory must not be used for any other purpose except for storing the extracts. Mixing other files into the packaging directory will result in errors in succeeding processes.

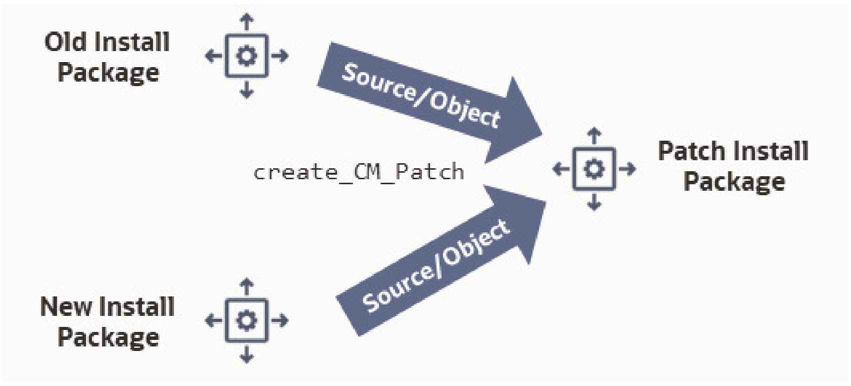
`applyCM` copies the extracted source to the **packaging app server**. It then does all the necessary steps like generate, compile, etc., to update the packaging app server runtime based on the extracted source.

`create_CM_Release` is then used to create CM **release install package** from the packaging app server. The CM release install package contains all CM code that has been applied to the packaging app server.



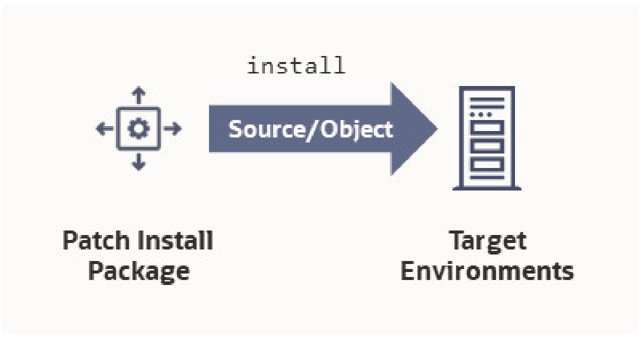
The **install** tool applies the CM release install files to all target environments on an individual basis.

Note: Release install packages are usually applied only to fresh environments. For example, to apply the first batch of CM code or when upgrading to a new version of the product. To install additional code to an existing environment, patch install packages (described next) are used.



CM patch install packages are used to update an existing installation with the changes since it was last updated. A patch install package is created by **create_CM_Patch** as the difference between two CM release install packages (a newer one and an older one). For example, for a monthly update schedule, CM release install packages are created monthly, and every month, a cm patch install package is created using the release install packages from the previous and the current month.

To create a patch install package, a new release install package must be created first. Note that a release (not patch) install package must be available for the previous period. Executing `create_CM_Patch` with the two CM release install packages as input creates the patch install package.



Refer to the Software Configuration Management Series (Doc Id: 560401.1) available from My Oracle Support for additional advice.

Developing Off-site

When developing off-site, there may be no available environments on the target platform. In this case, development and QA must be done off-site, but packaging and QA must be re-done on-site using environments on the target platform.

Off-site Process

Development and QA (and the packaging) is done using the same procedure as on-site except for the following:

- Packaging and QA are done on environments that may not match the target platform.
- Instead of sending a release or patch install package to the implementation site, only the source from the install package is sent. This package is called the release/patch source package. It is created by executing `extractCMSource` with the **data** directory of the install package as the source directory.

On-site Process

Upon receiving the release/patch source package, the on-site team proceeds with the regular packaging procedure starting from the applyCM step using the release/patch source package as the source directory.

Guidelines

Applying a CM patch install package to QA or production app servers is the same as for release install package. That is, it is done simply by executing the install tool from the the package directory.

By using these scripts, implementation developers can prepare an installation package containing the contents of their custom modifications.

Developers need to build a packaging environment on a server of the same operating system platform as used by the target environment to create CM release packages. A version number must be used to identify each custom modifications (CM) release version. Once developers select a version number format, the version number must be stored on the environment in the file `$SPLEBASE/etc/CMVERSION.txt`, to achieve this place `CMVERSION.txt` file in `etc` subdirectory in your patch directory.

Implementers are strongly recommended to use CM packaging utilities for implementation delivery to customer site. It will ensure the correct installation complying with base product rules and will keep an environment upgradable.

Note: Web files can be packaged also in archive war format (if `$isExpanded` environment variable is set to `false`), in which case it is not possible to just manually copy changes to the directories.

App Server CM Packaging Tools

The following utilities are provided in this package for maintaining the packaging environment and creating release versions of customer modifications (CM):

- `extractCMSource` utility, used to extract source from an app server or from a release or patch install package.
- `applyCM` utility, used to apply a CM patch to a packaging environment.
- `create_CM_Release` utility, used to create a full CM release version.
- `create_CM_Patch` utility, used to create CM patch release version utility.

Instructions for using these utilities are described in the following sections.

Post Install Setup

After the CM Packaging Tools installation, it is required to copy the proper `spl-tools-<VERSION>.jar` to the actual jar location. For example:

```
cp <CM script dir>/tools/spl-tools-<version>.jar <CM script dir>/lib/
```

Using the extractCMSource.plx Utility

This utility, written in perl, extracts source code from an app server, typically the project repository, or from a release or patch install package.

Note: `extractCMSource.plx` is a Windows-only utility.

Display Usage

To display the usage information, execute the utility without any parameters from the Windows command prompt.

```
perl extractCMSource.plx

 extractCMSource.plx -s sourceDirectory -d destinationDirectory -v Version
         [ -n subDirectoryName ] [-m CmOwner ]
    -v Version
        The Version Number to attach to this release of
        the Customer Modifications.
    -s sourceDirectory
        sourceDirectory is the location to extract from.
    -d destinationDirectory
        destinationDirectory is the location in which the extracted files
        are placed. The program then creates a subdirectory under the
        destinationDirectory to hold the patch.
    -n subDirectoryName
        Subdirectory under "Directory" in which this patch will be placed.
        If this parameter is not provided, an automatic directory name
        is generated based on the environment name and date/time.
    -m CmOwner
        Used for a Multi-CM jar enhancement, this optional parameter
        specifies the CM owner that needs to be extracted from the
        project directory (e.g., "cm01"). If not specified, the script
        uses the default "cm".
```

Extract From an App Server

To extract the source from a development app server, specify the app server directory as the source directory. For example, the following invocation extracts source from an app server named `CM_PROJ1` in the `C:\oracle` directory into `C:\CMExtarct` and marks the extract as version `CM1.0`:

```
perl extractCMSource.plx -s C:\oracle\CM_PROJ1 -d C:\CMExtract -v CM1.0
```

Extract From Release/Patch Install Package

To extract the source from a release or patch install package, specify the **data** directory in the install package as the source directory. For example, the following invocation extracts source from a patch install package named `CM1.0_1` in the `C:\CMInstall` directory into `C:\CMExtract` and marks the extract as version `CM1.0_1`:

```
perl extractCMSource.plx -s C:\CMInstall\CM1.0_1\CMCCB\data
     -d C:\CMExtract -v CM1.0_1
```

FW Utility to extract CM sources from Unix environments

The following utility, delivered with the Oracle Utility Application Framework, is to extract CM sources from a Unix environment (note that **`extractCMSource.plx`** is the Window only utility):

`$SPLEBASE/bin/extractCMSourceUNIX.sh`

Usage:

`-v <version>`

The Version Number to attach to this release of the Customer Modifications. (Example: `CM001`)

`-t <target directory>`

Target Directory is where the extracted files will be placed. This program will then create a subdirectory for the patch under that directory, adding a timestamp.

Using the applyCM Utility

After an implementation team has completed CM development on a Windows server or prepared a fix in a development environment, they will need to copy and apply the CM modules to a packaging environment on the same platform as the target (production or testing, for example). In other words, if the target system is a Unix platform, the packaging environment must be on Unix as well.

The **`applyCM.sh`** utility (**`applyCM.cmd`** for Windows installations) serves this need. It can be used to copy and apply all CM development modules to a packaging environment or any specific extract (patch) of CM development. The script needs to be executed using the full pathname (this is necessary because you need to be located in a different folder, see below). In addition, you need to be set to a target environment (such as packaging environment).

Script: `<CM scripts>/applyCM.sh`

Usage:

`(no options)`

Apply the patch on top of the existing base product and possibly CM integration environment. This mode will add new CM files from the patch to the environment and replace the changed ones. But it will not delete the previously existing in the environment CM modules that are not part of the patch.

It needs to be executed from the source root folder.

`-d`

Remove all previous CM modules from the environment and apply patch on clean base product environment. This option is useful when needed to create the CM integration environment from scratch.

It needs to be executed from the source root folder.

`-b`

Recompile the existing sources in current environemnt. Usually it is used to execute full recompile a development environment.

It needs to be executed from the application folder root. For example: `$SPLEBASE`.

`-n`

It will not stop/start automatically the target environment.

The input for `applyCM.sh` utility is the current folder (source root folder), which contains the following subfolders:

- java
- scripts
- etc
- services
- splapp

These subdirectories contain only CM modules created according to the rules of the document "Naming conventions for tailoring application implemetation" (see the *Installation Guide* of the product). This directory structure should be prepared and filled with relevant CM modules on development Windows server, then copied over to the server that hosts a packaging environment by ftp utility. After that, you can apply the patch to the packaging environment. **Modules that are not created using these conventions will be ignored by `applyCM.sh` utility.** You have to reside in the patch directory to apply the patch. `ApplyCM` utility will generate and compile java code and create a java jar file (`cm.jar`), which is required for customer implementation platform.

Using the create_CM_Release Utility

The **`create_CM_Release.sh`** utility is used to create a CM full release package that will contain only customer modification (CM) files. This is used to install a full set of customizations on top of the base product environment.

To build a CM release version that is compatible with the target platform, you need a packaging environment on the same operating system as the one on which the receiving product is installed. The target environment for installing the release version on a customer site can either be a pure base product environment, or an environment that already contains previous CM versions. In the second case, all previous CM modules will be removed by the **install** utility at the beginning of the installation process.

It is **mandatory** that every implementation version is identified by **its own release version number.** This number may be in any free standard and must be recorded in the `$SPLEBASE/etc/CMVERSION.txt` file on the environment.

Here are the detailed instructions for creating the full release version for CMs:

1. Log in to the server with the administrator user id and initialize a packaging environment. You will use this environment to create the CM release version.
2. Change the directory to the directory that contains the Developers Tool Suite utilities (`CM_packaging`).
3. Execute the utility using the following command:

   ```
   ./create_CM_Release.sh -e $SPLENVIRON -v $VERNO -d $RELEASEHOME,
   ```

   Where:

   `$SPLENVIRON` is the target packaging environment

   `$VERNO` is the CM version number (the content of the file **CMVERSION.txt**)

   `$RELEASEHOME` is the name of the directory on the server where you want to place the resulting CM release package.

For example:

```
./create_CM_Release.sh -e M4_Q1_SUNDB2 -v M.4.0.0 -d /versions
```

Tar and zip the resulting CM release directory for Unix platform or zip it for Windows platform and ship it to your customer.

The customer who wishes to install the delivered package onsite must follow these instructions:

1. Decompress and untar the installation media to a temporary directory for the Unix server or unzip it for Windows server.
2. Change directory to the target directory.
3. Log in and initialize the target environment.
4. Change to the Installation directory using the following command

   ```
   cd CMCCB.$VERNO
   ```

   Where:

   `$VERNO` is the version number (the content of the file `CMVERSION.txt`)
5. Run the following script:

   ```
   ./install.sh - for Unix
   ```

   ```
   install.cmd - for Windows
   ```

Using the create_CM_Patch Utility

The utility **`create_CM_Patch.sh`** is used to create a patch release of CMs. A patch release version is created as a difference between a previous CM version and a new CM version. This type of release may be useful if the implementation team wants to ship only an update of the previously released version by preparing a smaller package that can be delivered easily by email or ftp to the customer.

Fastpath: Before executing the utility, be sure that both packages are available in the same directory on the server. During the installation process at the customer site, the patch install utility will not remove the previous version of CM modules and will only install the patch content on top of the previous CM version.

Here is the process for creating a patch release CM version:

1. Log in to the server with the administrator user id.
2. Change directory to the name of the directory that contains the SDK packaging utilities (`CM_packaging`).
3. Execute the utility by entering the following command:

   ```
   ./create_CM_Patch.sh -d $RELEASEHOME
   ```

   Where:

   `$RELEASEHOME` is the directory that currently holds your CM full release packages - and where you also want to put your new patch package.

Tar and zip the resulting CM patch directory for Unix platform or zip it for Windows platform and ship it to your customer. The customer who wishes to install the delivered package onsite must follow these instructions:

1. Decompress and untar the installation media (on Unix) or unzip (on Windows) to a temporary directory.
2. Change directory to that directory.
3. Log in and initialize the target environment.
4. Change to the Installation directory by using the following command

   ```
   cd CMCCB.$VERNO
   ```

   Where:

   `$VERNO` is the version number (the content of the file `CMVERSION.txt`)
5. Run the following script:

   ```
   ./install.sh - on Unix
   ```

   ```
   install.cmd - on Windows
   ```

Multi-CM Application Functionality

Note: For additional information, refer to Multiple CM Development (Doc Id: 1901471.1), available from My Oracle Support.

The Multi-CM Jar functionality allows multiple teams to develop features of the application separately.

Each team is identified by a CM application owner. For example, a team in one geographic location may be identified by CM application owner **cm01**, whereas another team will be **cm02**.

Teams can have independent project repositories, packaging directories, packaging app servers, releases, and patches.

The different CM application releases/patches are then installed into a target QA or production app server so that they contain all cm applications, for example, a target environment will contain *cm01*, *cm02*, *cm3*, and so on.

The Multi-CM application is activated by using the `-m` option when running `extractCMSource.plx`. With this option, only the source code for the given CM application owner is extracted from the project repository. It creates a file (`etc/cm_owner.txt`) in the packaging directory identifying the CM application owner.

If the `cm_owner.txt` file exists, all subsequent utilities, namely, `applyCM`, `create_CM_release`, `create_CM_patch`, and `install` operate using the designated CM application owner. The installation of the final CM package removes the previously installed CM application owner's files and modules, replaces them with the ones from the installation package, and, finally, appends the owner to the existing `cm_owner.txt` file in the target environment.

If the Multi-CM application is activated, the applyCM script applies to the packaging environment all the jar files extracted from development (excluding `<CmOwner>.jar`, which is compiled and created by `applyCM`). Such jar files are added to the Classpath for the Java compilation. The `create_CM_release`, in case the Multi-CM application is activated, copies only the `<CmOwner>.jar` to the installable package:

```
perl extractCMSource.plx -s C:\SPL\CM_PROJ1 -d C:\CMExtract -v CM1.0 -m cm01
```

Each CM owner development requires separate CM jar structures. For example: `structures/cm01_jars_structure.xml`.

Each CM owner development can also contain customized user exits, and if there are additional templates, each must be defined in the relevant structure:

```
templates/cm01_web.xml.exit_end.include
structures/cm01_template_structure.xml
```

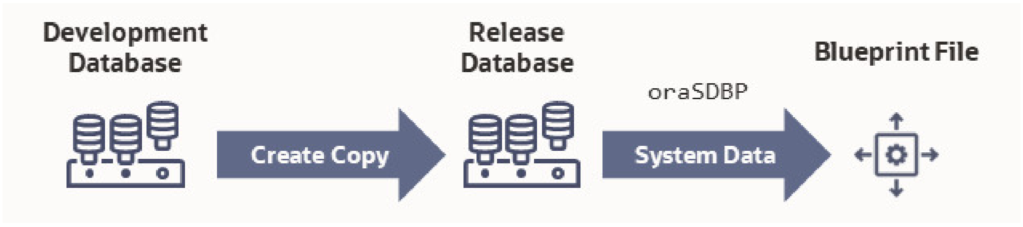
CM System Data Packaging Tools

CM System Data Packaging Overview

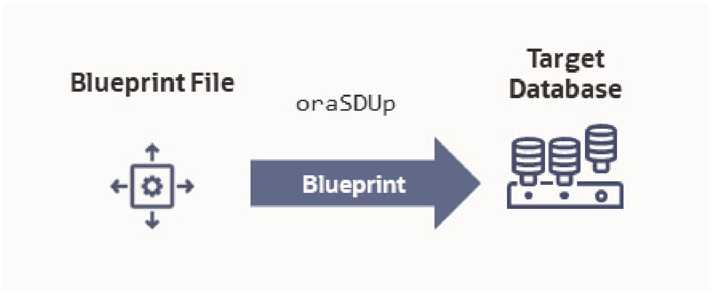
CM System Data Packaging Tools allow implementers to extract and package Customer Modification ('CM') system data from their databases and deliver it to their customers.

The following example uses the Oracle database platform to illustrate the extract and upload process.

As a standard release process, the implementers can add the CM system and Meta data records to the base product database or change base product system and Meta data records according to the specific rules (see "System Table Guide" document in the *Installation Guide* of the product). Implementers can then choose to migrate the CM data to a customer database as a full extract of CM data, or incremental differences between the current version of the system data on the customer site and the new version of the implementation development database.



Packaging CM system data starts by creating a copy of the **project dev database** into a **project release database**. A **blueprint file** of the system data is then created by running the **GenSysdataBP** java utility from `OraGenBP.jar`.



To apply the latest changes to a **QA** or **production database**, run **OraSDUpg** java utility in `OraDBI.jar` with the blueprint file as input and then specifying the target database.

Extract Process

Extract process involves extracting CM system data based on the rules defined in a parameter file, and packaging it in a binary file (blueprint). This file can then be used as an input source by the data upload process.

The following example uses the Oracle database platform to illustrate the extract and upload process.

`GenSysdataBP` java utility in `OraGenBP.jar`, included in this package, is the extract utility that reads an input parameter file for the list of Oracle database tables, extracts data from these tables and compresses it into a binary file.

A sample extract parameter file `extract_cmsystbls.lst` is included in this package to provide the implementers a starting point. This parameter file, as can be seen, defines rules for the tool to extract CM data based on their key definition. However, in some cases, CM data may be stored on 'CI' rows. The column `user_exit_pgm` on `CI_MD_PRG_COM` table is one such case. For cases like these, the implementers can choose to change the extraction rules in this file to match their requirements.

To extract your data, make a copy of `extract_cmsystbls.lst` file and edit it to match your requirements. Execute the extract process from a command-window and provide it with the required parameter when prompted.

The data in input parameter must match the following format:

```
CI_ALG_TYPE_L;LANGUAGE_CD = 'ENG';VERSION
```

Here, the first field stores the table name, the second field stores the selection criteria (where clause is used for selecting data) and the third field stores the list of columns to be ignored during extraction. The character semi-colon is used as the field separator. If there are multiple columns that need to be ignored (not included in the data being extracted), comma can be used in the third field as the separator.

`GenSysdataBP` accepts the following parameters:

- `-d <Connect String>`

  Where the Connect String contains:
- Schema owner name (say `CISADM`).
- Password for schema owner.
- Database name.

  This is a mandatory parameter. If not entered, the utility will prompt the user to build the connect string.

  Connect String should be entered in the following format:

  `CISADM,CISADMPSWD,DBNAME`

  (Comma-separated and no space).
- `-i <Input Parameter file name>`.

  Name of the input parameter file that the utility reads to get the list of tables and their selection criteria. This parameter is optional. The default input parameter file name is CDXSdBp.Inp.
- `-o <Output File Name>`.

  This is the name of the binary file that the utility creates. This parameter is optional. The default output file name is `OraSdBp` (without extension).
- `-c <NLS characterset of the target database>`.

  The utility uses this parameter to set the `NLS_LANG` parameter on the client side. This parameter is then validated against the character set of the source database and is saved in the blueprint. This is mandatory parameter and is prompted for, if not set by, the user.
- `-s`

  Specify to generate object level SQL files. Optional.
- For help (to list all the accepted parameters with a brief description), execute the utility without any parameters.

Upload Process

Data upload process compares the data included in the blueprint file (generated by the extract process) with that extracted from a target database and generates output SQL to synchronize them.

The java utility `OraSdUpg` in `OraDBI.jar`, included in this package, is used by the process utility to compare and synchronize the data in the target database with that in the input blueprint file.

`OraSdUpg` reads an input parameter file for the list of the tables to be upgraded along with the selection criteria and upgrade rules for each table.

Each table has a corresponding record in the file with following 6 fields separated by semi-colon:

- Table Name
- The instance of the table. This number should be always set to 1. The cases where more than one instances of a table are processed are extremely rare and are not discussed here.
- Selection Criteria for the table.
- Insert allowed indicator (T/F): Whether records should be inserted into the target database table if they are missing in the database but exist in the binary file.
- Update allowed indicator (T/F): Whether records should be updated in the table if they have different values than in the binary file.
- Delete allowed indicator (T/F): Whether there is obsolete data in the table in the target database. Obsolete records exist in target database but not in the binary file.
- Fresh Install Indicator (T/F): Whether the table should be seeded during the very first install. This indicator is only used when the utility is invoked with a `-f` switch.
- List of columns not updated can be specified in the sixth field. Use a comma to separate the column names if multiple columns are to be ignored during updates. These columns will be inserted but will not be updated during the data synchronization process.

Following is the example of how these records should look like in the file:

```
CI_LOOKUP;1;LANGUAGE_CD = 'ENG';T;T;F;T;DESCR
```

A sample file `upload_cmsystbls.lst` has been included in this package. Implementer can make a copy of this file and edit it to match their requirements.

Before making connection to the target database, the utility reads the header from the blueprint and sets `NLS_LANG` environment variable on the client machine. It then validates this character set setting to the character set of the target db after making a connection and warns user if there is a mismatch.

The utility can be executed in verification and modification modes. In verification modes, the action SQL statements are simply written to the log file but in modification mode they are applied the target database.

It is very important to note that the primary requirement for `OraSdUpg` is definition (column and primary key) of tables being upgraded in the target database, which should be the same as in the database from which the binary file was extracted.

Be careful while selecting the table and the selection criteria; to compare the data and the utility for each table first loads the data from the binary file and the database in the memory, so if a table has a significant amount of data and selection criteria set, the handling of this data may cause the memory to run out.

To avert the unique key constraint violation error that can be caused by improper sequence of data deletion and insertion on a table and also the foreign key issues, the utility first gathers all the generated action statements for all the tables before executing them. The execution of all the generated statements is done in multiple iterations. After each iteration, all the failed statements during that iteration are collected and executed again in the next iteration. The iterations are repeated until either all the statements in iteration are executed successfully, or fail.

The utility disables and enables all the triggers on the tables being upgraded before and after applying database changes. No triggers get executed during the system data upgrade.

`OraSdUpg` accepts the following parameters:

- `-d <Connect String>`

Where the Connect String contains:

- Schema owner name (say `CISADM`).
- Password for schema owner.
- Database name.

  This is a mandatory parameter. If not entered, the utility will prompt the user to build the connect string.

  Connect String should be entered in the following format:

  `CISADM,CISADMPSWD,DBNAME`

  (Comma-separated and no space).
- `-b` bypass the database character set validation.

  Before upgrading data in database, the utility validates character set stored in the blueprint by `OraSDBp` against that of the target database. The user can bypass this validation step by setting this switch.
- `-p <Input Parameter file name>`.

  Name of the input parameter file that the utility reads to get the list of tables and their selection criteria. This parameter is mandatory.
- `-i <Input Binary File>`.

  This is the name of the binary file that the utility reads to extract the data that it then uses to upgrade the target database. This is a mandatory parameter.
- `-f`

  Treats the data synchronize process as a new install. When set, the flag forces `OraSdUpg` to use "fresh install indicator" for the tables where `INSERT` indicator is set to `false` and compels it to insert missing records in all of them. Optional.
- `-u`

  Makes `OraSdUpg` run in the modification mode. Optional.
- `- q`

  Provide to run in silent mode (non-interactive mode). Optional.
- `-m`

  If it is provided, the DB triggers are not disabled. Optional.
- `-l <Log File Name>`.

  This is the name of the file that `OraSdUpg` creates (if it is missing), and starts appending the information to about the action it is performing.
- `-h` Help.

  This option will list all the accepted parameters, along with a brief description.

Note: It is recommended that the implementers execute the upload process first in the verification mode and review the SQL before running the tool in the modification mode.

Tailoring Your Oracle Utilities Application Implementation

This document describes the naming conventions and processes that must be followed to ensure a successful upgrade of the Oracle Utilities application base product release-on-release. The implementation team responsible for tailoring the Oracle Utilities application to meet specific customer needs must follow this guide to preserve their changes and ensure successful upgrades. Only the changes described in this document are considered as permitted for the tailoring of the base product. Any changes that do not conform to these rules may be overridden by the install utility during a base product upgrade.

Some naming conventions used in this document:

- `$SPLEBASE` (for UNIX) and `%SPLEBASE%` (for Windows) is the generic Oracle Utilities environment directory name.
- `$SPLENVIRON` (for UNIX) and `%SPLEBASE%` (for Windows) is the generic Oracle Utilities environment name.
- `$SPLDB` (for UNIX) and `%SPLDB%` (for Windows) is the database type.

Preserving Customer Changes

For any kind of a customer modification, the file's directory structure and naming conventions are defined in this section. The implementation team must follow these conventions to preserve the results of their work during a subsequent base product upgrade.

- The configuration parameters of the environment being upgraded are displayed (as default parameters) during the configuration stage of the install process. These parameters may be changed if new settings are preferred.
- The base product is shipped with examples of different kinds of modules that may be used by implementation teams. The examples can be found in the following directories:
  - `$SPLEBASE/splapp/applications/root/cm_templates` contains Oracle Utilities Application Framework Web file examples.
  - `$SPLEBASE/splapp/applications/root/<application product code>/cm_templates`. This directory contains Oracle Utilities application product Web file examples. The <application product code> varies by product; for example, the Oracle Utilities Customer Care and Billing, the <application product code> is `c1`.
  - `$SPLEBASE/scripts/cm_examples`. For batch script examples, this directory has two subdirectories: `FW` for Oracle Utilities Application Framework examples, and <application product code> for Oracle Utilities application product examples (for example, `CCB` for Oracle Utilities Customer Care and Billing).

Note: For simplicity, this document generally uses UNIX platform naming conventions. To apply these names to the Windows platform, use the Windows naming conventions "%" sign instead of the "$" sign, and backslashes ("\") instead of forward slashes ("/") as directory separators (e.g., `%SPLEBASE%\splapp\applications\root\cm_templates`).

Tailoring Web Files

Base product UI files are in the directory `$SPLEBASE/splapp/applications/root`. Implementers may develop their own UI files under the directory `$SPLEBASE/splapp/applications/root/cm`. No specific naming conventions are enforced under this directory.

The root directory may be deployed in war file format for runtime environment (`SPLApp.war`). Use provided utilities to incorporate your **cm** directory into the `SPLApp.war` file.

Tailoring the CM Java Application

Implementers may write their own Java classes to extend the Oracle Utilities application functionality. All Java files should belong to the `com.splwg.cm` package. The CM Java application should be compiled into a jar file named `cm.jar`. The SDK Customer Modification packaging utilities will help build this file. The `cm.jar` is typically deployed into the following directories:

```
$SPLEBASE/splapp/applications/root/WEB-INF/lib
$SPLEBASE/splapp/applications/XAIApp/WEB-INF/lib
$SPLEBASE/splapp/businessapp/lib
$SPLEBASE/splapp/standalone/lib
```

Additional third-party jar files can be deployed by following the `cm*.jar` naming standard. Customers may use this option to deploy any additional functionality, interfaces with other applications, and so on. These will not be built by the SDK Customer Modification packaging utilities, but will be deployed into the application once it is supplied in jar format.

The root directory may be deployed in a war file format for the runtime environment (`SPLApp.war`). Use the provided utilities to incorporate your `/cm` directory into `SPLApp.war` file.

Important: All `cm*.jar` files that need to be applied must be defined in `$SPLEBASE/structures/cm_jars_structure.xml`. If the file does not exist in the target environment, the sample `cm_jars_structure.xml.example` file can be copied from the SDK packaging's `/etc` folder.

Manual cm.jar deployment

The `cm.jar` file is usually deployed as part of the CM packaging process (`extractCMsource`, `applyCM`, `create_CM_release`, and so on.), but in some cases it may be desirable to manually deploy the `cm.jar` file to one or more target environments.

CAUTION: This should be done with care and should only be considered if the `cm.jar` components are self-contained and have no external dependencies.

To manually deploy `cm.jar`:

1. The SPLEBASE/structures/cm_jars_structure.xml must exist and should have at least the following:

```
<?xml version="1.0" encoding="UTF-8"?>
<jar_structure>
   <cm.jar>
  <source_dir_jar>@SPLEBASE@/etc/lib</source_dir_jar>
  <dest_folders>
 <dest_folder_1>@SPLEBASE@/splapp/applications/XAIApp/WEB-INF/lib</
dest_folder_1>
 <dest_folder_2>@SPLEBASE@/splapp/applications/root/WEB-INF/lib</
dest_folder_2>
 <dest_folder_3>@SPLEBASE@/splapp/businessapp/lib</dest_folder_3>
 <dest_folder_4>@SPLEBASE@/splapp/standalone/lib</dest_folder_4>
  </dest_folders>
  <child_jvm_path>@SPLEBASE@/splapp/standalone/lib</child_jvm_path>
   </cm.jar>
</jar_structure>
```

   The `<cm.jar>` element identifies the jar file name, usually `cm.jar`, as defined here.

   Element `<source_dir_jar>` defines the source location of the above mentioned jar. The directory in this example should work for most cases.

   The `dest_folder_`*n* elements point to the target locations where the jar will be placed. The directories in this example should work for all.
2. Manually copy the `cm.jar` to the directory specified in the `<source_dir_jar>` element, typically `$SPLEBASE/etc/lib`.
3. Run `initialSetup.sh` (or `.bat` on Windows) to do the rest. This will copy the `cm.jar` to the specified target locations and rebuild the war and ear files.

Positioning Custom Scripts

Customers and implementers may put their scripts under the directory `$SPLEBASE/scripts/cm`.

Using the Implementation Version File

Implementers may keep the implementation version number in the `CMVERSION.txt` file in the `$SPLEBASE/etc` directory. This file is preserved by the install utility.

Tailoring Templates and User Exits

The templates delivered under the folder `$SPLEBASE/templates` can be overridden by the application by creating a copy of the template file with the same name but prefixed by `cm.`. The `cm` copy will be customized.

Since the templates can contain user exits (special statements that allow to import external files during the template processing). Those user exits can be overridden by creating a copy of the user exit file with the same name but prefixed by `cm_`. The `cm` copy will be customized.

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