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Tutorial for Oracle Coherence

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Oracle Coherence Tutorial for Oracle Coherence, Release 3.7.1

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Preface

Oracle Coherence (Coherence) is an in-memory data grid solution that enables organizations to predictably scale mission-critical applications by providing fast access to frequently used data. Data grid software is a middleware that reliably manages data objects in memory across many servers. By automatically and dynamically partitioning data, Coherence enables continuous data availability and transactional integrity, even in the event of a server failure.

Developers can easily take advantage of the features of Coherence using the standard Java collections API to access and modify data, and use the standard JavaBeans event model to receive data change notifications.

> **Note:** The examples in this tutorial have been run with the 3.7 release of Oracle Coherence. Running the examples with the 3.7.1 release of Coherence will produce the same results.

Audience

This tutorial is intended for software developers, architects, and administrators. It describes how to develop applications for the Oracle Coherence data grid

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Related Documents

For more information, see the following in the Oracle Coherence documentation set:

- *Oracle Coherence Getting Started Guide*
- *Oracle Coherence Developer's Guide*

- *Oracle Coherence Client Guide*
- *Oracle Coherence User's Guide for Oracle Coherence*Web*
- *Oracle Coherence Integration Guide*
- *Oracle Coherence Management Guide*
- *Oracle Coherence Administrator's Guide*
- *Oracle Coherence Security Guide*
- *Integration Guide for Oracle TopLink with Coherence Grid*

Conventions

The following text conventions are used in this tutorial:

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

1

Installing and Configuring Coherence

This chapter describes how to install and set up your environment for running Oracle Coherence Release 3.7.1 (Coherence).

> **Note:** This tutorial uses the Eclipse Helios 3.6.2 release with Oracle Enterprise Pack for Eclipse (OEPE) 11*g*R1 (11.1.1.7). For information about configuring Eclipse and OEPE for Coherence-based projects, see Chapter 2, "Installing and Configuring Eclipse and OEPE with Coherence"
>
> The examples in this tutorial have been run with the 3.7 release of Coherence. Running the examples with the 3.7.1 release of Coherence will produce the same results.

You must have the privileges to install software and set system environment variables as the `oracle` user, an understanding of how to use a terminal window, including setting environment variables, and creating and moving between directories. You must have a working installation of Java SE (JDK) version 1.6 or higher. You must also be running one of the following Microsoft Windows operating systems: XP, Vista, 2000, 2003, or 2008.

This chapter contains the following sections:

Installing Coherence

To download and install Coherence:

1. Download Coherence to your desktop.

   Coherence (Java edition) ships as a single zip file, typically called `coherence-`*`<version>`*`.zip`. You can download Coherence from the following URL:

   `http://www.oracle.com/technology/products/coherence/index.html`

2. Extract the contents of the zip file to a folder named `C:\oracle\product`.

   The zip file contains the `coherence` folder with these subfolders:

   - `bin`, which contains command scripts
   - `doc`, which contains the product documentation

- `lib`, which contains the required library files

Testing a Coherence Installation

In this exercise, you test whether your Coherence installation can cluster Java processes. This ensures that Coherence-based applications that ship with Coherence will run as expected. If Coherence is not capable of clustering on a single machine, then you must reconfigure your network and firewall settings.

To complete this exercise, you must have Oracle Coherence (Java Edition) Release 3.7.1 installed. See "Installing Coherence" on page 1-1 for more information.

Coherence uses a variety of network addresses and ports to enable communication between clustered processes. If these addresses and ports are unavailable due to other applications using them, or because of a firewall, then Coherence may be unreliable, may fail to cluster, or may not work at all. By default, Coherence assumes that the network addresses and ports listed in Table 1–1 are available:

Table 1–1 Network Addresses and Ports Used by Coherence

Address / Port / Type	Purpose
`224.`*version* / *version* / `Multicast`	Cluster member discovery and broadcast. The variable *version* represents the release version of Coherence. For example, the multicast address for the 3.7.0.0 release is `224.3.7.0`. The port number also reflects the release version. For example, for the 3.7.0.0 release, the port number is `37000`. Designing the address in this way ensures that different versions of Coherence do not cluster with each other by default.
`localhost` / `8088+` / `Unicast`	Interprocess communication between cluster members. (`localhost` is the local IP address and not the loop back address.)

Coherence ships with two simple command-line (shell-based) applications that can be used to determine whether Coherence operates correctly.

- The *cache server* is a simple application that hosts and manages data on behalf of other applications in a cluster.
- The *cache client* is a simple application that enables a developer to access, process, and update cached data within a cluster. It also provides information about the cluster. By executing these applications either on a single host or on several hosts, you can determine whether Coherence is operating correctly locally or across a network.

  When an application uses Coherence as shipped, objects placed into Coherence caches are typically stored and managed in-process within the application. However, to increase object availability, Coherence can manage objects in memory but out of the application process. This enables objects to survive possible application outages (either deliberate or accidental). To manage objects in this way, Coherence uses cache servers. The purpose of a Coherence cache server is to manage the application state in a cluster outside the application process. It is similar to a database server, but without the requirement for storage.

To Test a Coherence Installation—Main Steps

Follow these steps to test a Coherence Installation. The steps are described in detail in the following sections.

1. Configure and Run the Sample Cache Server Application
2. Configure and Run the Sample Cache Client Application
3. Exercise the Sample Cache Client Application
4. Troubleshooting Cache Server Clustering

Configure and Run the Sample Cache Server Application

To set up and run the sample cache server application:

1. Open a terminal window and verify that the `PATH` environment variable is set to include the Java JDK (for example, `\oracle\product\jdk160_14_R27.6.5-32\bin`). If the `PATH` environment variable does not include the JDK `\bin` folder, then set it as follows:

   a. Set the `JAVA_HOME` environment variable to the base of the JDK installation.

   ```
   set JAVA_HOME=\oracle\product\jdk160_14_R27.6.5-32
   ```

   b. Include `JAVA_HOME\bin` in the `PATH` environment variable.

   ```
   set PATH=%JAVA_HOME%\bin;%PATH%
   ```

2. Navigate to the folder where Coherence is installed. Edit the `cache-server.cmd` file and set the `COHERENCE_HOME` variable to point to the Coherence installation folder.

   ```
   cd C:\oracle\product\coherence\bin
   ```

   In the `cache-server.cmd` file, set the `COHERENCE_HOME` environment variable:

   ```
   COHERENCE_HOME=C:\oracle\product\coherence
   ```

   Example 1–1 illustrates the `cache-server.cmd` file with the edited value of the `COHERENCE_HOME` environment variable.

Example 1–1 cache-server.cmd File with an Edited COHERENCE_HOME

```
@echo off
@
@rem This will start a cache server
@
setlocal

:config
@rem specify the Coherence installation directory
set coherence_home=c:\oracle\product\coherence

@rem specify the JVM heap size
set memory=512m

:start
if not exist "%coherence_home%\lib\coherence.jar" goto instructions

if "%java_home%"=="" (set java_exec=java) else (set java_exec=%java_
home%\bin\java)

:launch

set java_opts="-Xms%memory% -Xmx%memory%"
```

```
"%java_exec%" -server -showversion "%java_opts%" -cp "%coherence_
home%\lib\coherence.jar" com.tangosol.net.DefaultCacheServer %1

goto exit

:instructions

echo Usage:
echo   ^<coherence_home^>\bin\cache-server.cmd
goto exit

:exit
endlocal
@echo on
```

3. Execute the cache server application that is located in the `coherence\bin` folder.

   ```
   C:\oracle\product\coherence\bin>cache-server.cmd
   ```

   When you start the first cache server, there is a slight delay because the cache server looks for an existing cluster. When the cache server determines that there are no clusters to join, it starts one. On start-up, the cache server produces output similar to the text in Example 1–2.

   Several important features are highlighted in the example:

   - The Java JDK version number.
   - Information about how configuration files are loaded. The default is to load from the `coherence.jar` file:

     ```
     Loaded operational configuration from resource
     "jar:file:/C:/oracle/product/coherence/lib/coherence.
     jar!/tangosol-coherence.xml"
     ```

   - The Coherence release number: `Oracle Coherence 3.7.0.0...`
   - The Coherence edition: `Grid Edition: Development mode`
   - The multicast address. This address changes with each Coherence version. Note the `3.7.0` in the address for Coherence Release 3.7.1: `Group{Address=224.3.7.0, Port=37000, TTL=4}`
   - The Member ID indicates the number of members in your cluster. For the purpose of this exercise, the value should be 1. `ThisMember=Member(Id=1...`

Example 1–2 Output from Starting a Coherence Cache Server

```
C:\oracle\product\coherence\bin>cache-server.cmd
java version "1.6.0_14"
Java(TM) SE Runtime Environment (build 1.6.0_14-b08)
Java HotSpot(TM) Server VM (build 14.0-b16, mixed mode)

2011-03-14 16:16:30.998/1.531 Oracle Coherence 3.7.0.0 <Info> (thread=main, member=n/a): Loaded
operational configuration from "jar:file:/C:/oracle/product/coherence/lib/coherence.jar!/tangosol-
coherence.xml"
2011-03-14 16:16:31.342/1.875 Oracle Coherence 3.7.0.0 <Info> (thread=main, member=n/a): Loaded
operational overrides from "jar:file:/C:/oracl
e/product/coherence/lib/coherence.jar!/tangosol-coherence-override-dev.xml"
2011-03-14 16:16:31.357/1.890 Oracle Coherence 3.7.0.0 <D5> (thread=main, member=n/a): Optional
configuration override "/tangosol-coherence-override.xml" is not specified
```

```
2011-03-14 16:16:31.373/1.906 Oracle Coherence 3.7.0.0 <D5> (thread=main, member=n/a): Optional
configuration override "/custom-mbeans.xml" is not specified

Oracle Coherence Version 3.7.0.0 Build 22913
 Grid Edition: Development mode
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2011-03-14 16:16:32.638/3.171 Oracle Coherence GE 3.7.0.0 <Info> (thread=main, member=n/a): Loaded
cache configuration from "jar:file:/C:/oracle/product/coherence/lib/coherence.jar!/coherence-cache-
config.xml"
2011-03-14 16:16:33.295/3.828 Oracle Coherence GE 3.7.0.0 <D4> (thread=main, member=n/a): TCMP
bound to /130.35.99.213:8088 using SystemSocketProvider
2011-03-14 16:16:36.873/7.406 Oracle Coherence GE 3.7.0.0 <Info> (thread=Cluster, member=n/a):
Created a new cluster "cluster:0x96AB" with Member(Id=1, Timestamp=2011-03-14 16:16:33.295,
Address=130.35.99.213:8088, MachineId=49877, Location=site:URL, machine_name,process:1920,
Role=CoherenceServer, Edition=Grid Edition, Mode=Development, CpuCount=2, SocketCount=1)
UID=0x822363D50000012E4FDFD80FC2D51F98
2011-03-14 16:16:36.873/7.406 Oracle Coherence GE 3.7.0.0 <Info> (thread=main, member=n/a): Started
cluster Name=cluster:0x96AB

Group{Address=224.3.7.0, Port=37000, TTL=4}

MasterMemberSet
  (
  ThisMember=Member(Id=1, Timestamp=2011-03-14 16:16:33.295, Address=130.35.99.213:8088,
MachineId=49877, Location=site:URL, machine_name,process:1920, Role=CoherenceServer)
  OldestMember=Member(Id=1, Timestamp=2011-03-14 16:16:33.295, Address=130.35.99.213:8088,
MachineId=49877, Location=site:URL, machine_name,process:1920, Role=CoherenceServer)
  ActualMemberSet=MemberSet(Size=1, BitSetCount=2
    Member(Id=1, Timestamp=2011-03-14 16:16:33.295, Address=130.35.99.213:8088, MachineId=49877,
Location=site:URL, machine_name,process:1920, Role=CoherenceServer)
    )
  RecycleMillis=1200000
  RecycleSet=MemberSet(Size=0, BitSetCount=0
    )
  )

TcpRing{Connections=[]}
IpMonitor{AddressListSize=0}

2011-03-14 16:16:36.935/7.468 Oracle Coherence GE 3.7.0.0 <D5> (thread=Invocation:Management,
member=1): Service Management joined the cluster with senior service member 1
2011-03-14 16:16:37.217/7.750 Oracle Coherence GE 3.7.0.0 <D5> (thread=DistributedCache, member=1):
Service DistributedCache joined the cluster with senior service member 1
2011-03-14 16:16:37.295/7.828 Oracle Coherence GE 3.7.0.0 <D5> (thread=ReplicatedCache, member=1):
Service ReplicatedCache joined the cluster with senior service member 1
2011-03-14 16:16:37.310/7.843 Oracle Coherence GE 3.7.0.0 <D5> (thread=OptimisticCache, member=1):
Service OptimisticCache joined the cluster with senior service member 1
2011-03-14 16:16:37.310/7.843 Oracle Coherence GE 3.7.0.0 <D5>
(thread=Invocation:InvocationService, member=1): Service InvocationService joined the cluster with
senior service member 1
2011-03-14 16:16:37.326/7.859 Oracle Coherence GE 3.7.0.0 <Info> (thread=main, member=1):
Services
  (
  ClusterService{Name=Cluster, State=(SERVICE_STARTED, STATE_JOINED), Id=0, Version=3.7,
OldestMemberId=1}
  InvocationService{Name=Management, State=(SERVICE_STARTED), Id=1, Version=3.1, OldestMemberId=1}
  PartitionedCache{Name=DistributedCache, State=(SERVICE_STARTED), LocalStorage=enabled,
PartitionCount=257, BackupCount=1, AssignedPartitions=257, BackupPartitions=0}
```

```
  ReplicatedCache{Name=ReplicatedCache, State=(SERVICE_STARTED), Id=3, Version=3.0,
OldestMemberId=1}
  Optimistic{Name=OptimisticCache, State=(SERVICE_STARTED), Id=4, Version=3.0, OldestMemberId=1}
  InvocationService{Name=InvocationService, State=(SERVICE_STARTED), Id=5, Version=3.1,
OldestMemberId=1}
  )

Started DefaultCacheServer...
```

Note: By default, Coherence is configured to use multicast to join a cluster and to distribute cluster events. Multicast can also be used to distribute a message efficiently to multiple nodes in the cluster. You can configure Coherence to disable multicast.

The output of the `cache-server.cmd` file indicates whether you have one or more members in your cluster. The value of `Member Id` should be equal to 1:

```
...
In MasterMemberSet
ThisMember=Member(Id should be equal to 1)
...
```

If `ThisMember` has an `Id` greater than one, it means that your cache server has joined a pre-existing cluster in your network. For the purposes of these exercises, the cluster should contain only one member. Follow the steps in "Restricting Coherence to Your Own Host" on page 1-13 to restrict Coherence to your own host.

Configure and Run the Sample Cache Client Application

To set up and run the sample cache client application:

1. Open another terminal window to start the cache client.

   Verify that the `PATH` environment variable is set to include the `%JAVA_HOME%\bin` folder. If the `PATH` environment variable does not include the `%JAVA_HOME%\bin` folder, then set the variable as described in "Configure and Run the Sample Cache Server Application" on page 1-3.

2. Navigate to the `\oracle\product\coherence\bin` folder. Edit the `query.cmd` file to set the `COHERENCE_HOME` variable to point to the Coherence installation folder.

   The `query.cmd` file includes a reference to the JLine JAR file (`jline.jar`). JLine is a Java library that simplifies working with console commands.

   Example 1–3 illustrates the `query.cmd` file, with `COHERENCE_HOME=\oracle\product\coherence`. `JLINE_HOME` is set to `%jline_home%\lib`.

Example 1–3 query.cmd File with an Edited COHERENCE_HOME

```
@echo off
@
@rem This will start a console application
@rem demonstrating the functionality of the Coherence(tm) API
@
setlocal
```

```
:config
@rem specify the Coherence installation directory
set coherence_home=c:\oracle\product\coherence

@rem specify the jline installation directory
set jline_home=%coherence_home%\lib

@rem specify if the console will also act as a server
set storage_enabled=false

@rem specify the JVM heap size
set memory=64m


:start
if not exist "%coherence_home%\lib\coherence.jar" goto instructions

if "%java_home%"=="" (set java_exec=java) else (set java_exec=%java_
home%\bin\java)


:launch

if "%storage_enabled%"=="true" (echo ** Starting storage enabled console **) else
(echo ** Starting storage disabled console **)

set java_opts="-Xms%memory% -Xmx%memory% -Dtangosol.coherence.distributed.
localstorage=%storage_enabled%"

"%java_exec%" -server -showversion "%java_opts%" -cp "%coherence_
home%\lib\coherence.jar;%jline_home%\jline.jar" com.tangosol.coherence.dslquery.
QueryPlus %*

goto exit

:instructions

echo Usage:
echo   ^<coherence_home^>\bin\query.cmd
goto exit

:exit
endlocal
@echo on
```

3. Execute the `query.cmd` file to start the cache client.

   ```
   query.cmd
   ```

   The output of starting the cache client, illustrated in Example 1–4, displays the basic distributed cache functionality that is built into Coherence. At the end of the output, the `CohQL>` prompt is displayed.

Example 1–4 Output from Starting the Coherence Cache Client

```
C:\coherence360\coherence\bin>query.cmd
** Starting storage disabled console **
java version "1.6.0_14"
Java(TM) SE Runtime Environment (build 1.6.0_14-b08)
Java HotSpot(TM) Server VM (build 14.0-b16, mixed mode)
```

```
Coherence Command Line Tool

CohQL>
```

Exercise the Sample Cache Client Application

Exercise the cache client application by entering various commands and examining the output.

1. Execute the following Coherence commands in the cache client:
   - Enter `help` to see the list of commands that are available.
   - Enter `create cache "products"` to create a cache named `products`.

     The cache `products` implements the `com.tangosol.net.NamedCache` interface. A cluster can have many named caches.

     Example 1–5 illustrates that by using the default configuration file (`coherence-cache-config.xml`) within the supplied `coherence.jar` file, a `NamedCache` called `products` is created using the distributed scheme.

Example 1–5 Output from Starting a Coherence Cache

```
CohQL> create cache "products"
2011-03-14 16:49:09.217/109.469 Oracle Coherence 3.7.0.0 <Info> (thread=main, member=n/a): Loaded
operational configuration from "jar:file:/C:/oracle/product/coherence/lib/coherence.jar!/tangosol-
coherence.xml"
2011-03-14 16:49:09.482/109.734 Oracle Coherence 3.7.0.0 <Info> (thread=main, member=n/a): Loaded
operational overrides from "jar:file:/C:/oracle/product/coherence/lib/coherence.jar!/tangosol-
coherence-override-dev.xml"
2011-03-14 16:49:09.482/109.734 Oracle Coherence 3.7.0.0 <D5> (thread=main, member=n/a): Optional
configuration override "/tangosol-coherence-override.xml" is not specified
2011-03-14 16:49:09.482/109.734 Oracle Coherence 3.7.0.0 <D5> (thread=main, member=n/a): Optional
configuration override "/custom-mbeans.xml" is not specified

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 Grid Edition: Development mode
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2011-03-14 16:49:10.498/110.750 Oracle Coherence GE 3.7.0.0 <Info> (thread=main, member=n/a):
Loaded cache configuration from "jar:file:/C:/oracle/product/coherence/lib/coherence.
jar!/coherence-cache-config.xml"
2011-03-14 16:49:11.185/111.437 Oracle Coherence GE 3.7.0.0 <D4> (thread=main, member=n/a): TCMP
bound to /130.35.99.213:8090 using SystemSocketProvider
2011-03-14 16:49:11.701/111.953 Oracle Coherence GE 3.7.0.0 <Info> (thread=Cluster, member=n/a):
This Member(Id=2, Timestamp=2011-03-14 16:49:11.645, Address=130.35.99.213:8090, MachineId=49877,
Location=site:URL, machine_name,process:4900, Role=TangosolCoherenceQueryPlus,Edition=Grid Edition,
Mode=Development, CpuCount=2, SocketCount=1) joined cluster "cluster:0x96AB" with senior
Member(Id=1, Timestamp=2011-03-14 16:16:33.295, Address=130.35.99.213:8088, MachineId=49877,
Location=site:URL, machine_name,process:1920, Role=CoherenceServer, Edition=Grid Edition,
Mode=Development, CpuCount=2, SocketCount=1)
2011-03-14 16:49:11.732/111.984 Oracle Coherence GE 3.7.0.0 <D5> (thread=Cluster, member=n/a):
Member 1 joined Service Cluster with senior member 1
2011-03-14 16:49:11.732/111.984 Oracle Coherence GE 3.7.0.0 <D5> (thread=Cluster, member=n/a):
Member 1 joined Service Management with senior member 1
2011-03-14 16:49:11.732/111.984 Oracle Coherence GE 3.7.0.0 <D5> (thread=Cluster, member=n/a):
Member 1 joined Service DistributedCache with senior member 1
2011-03-14 16:49:11.732/111.984 Oracle Coherence GE 3.7.0.0 <D5> (thread=Cluster, member=n/a):
Member 1 joined Service ReplicatedCache with senior member 1
```

```
2011-03-14 16:49:11.732/111.984 Oracle Coherence GE 3.7.0.0 <D5> (thread=Cluster, member=n/a):
Member 1 joined Service OptimisticCache with senior member 1
2011-03-14 16:49:11.732/111.984 Oracle Coherence GE 3.7.0.0 <D5> (thread=Cluster, member=n/a):
Member 1 joined Service InvocationService with senior member 1
2011-03-14 16:49:11.732/111.984 Oracle Coherence GE 3.7.0.0 <Info> (thread=main, member=n/a):
Started cluster Name=cluster:0x96AB

Group{Address=224.3.7.0, Port=37000, TTL=4}

MasterMemberSet
  (
  ThisMember=Member(Id=2, Timestamp=2011-03-14 16:49:11.645, Address=130.35.99.213:8090,
MachineId=49877, Location=site:URL, machine_name,process:4900, Role=TangosolCoherenceQueryPlus)
  OldestMember=Member(Id=1, Timestamp=2011-03-14 16:16:33.295, Address=130.35.99.213:8088,
MachineId=49877, Location=site:URL, machine_name,process:1920, Role=CoherenceServer)
  ActualMemberSet=MemberSet(Size=2, BitSetCount=2
    Member(Id=1, Timestamp=2011-03-14 16:16:33.295, Address=130.35.99.213:8088, MachineId=49877,
Location=site:URL, machine_name,process:1920, Role=CoherenceServer)
    Member(Id=2, Timestamp=2011-03-14 16:49:11.645, Address=130.35.99.213:8090, MachineId=49877,
Location=site:URL, machine_name,process:4900, Role=TangosolCoherenceQueryPlus)
    )
  RecycleMillis=1200000
  RecycleSet=MemberSet(Size=0, BitSetCount=0
    )
  )

TcpRing{Connections=[1]}
IpMonitor{AddressListSize=0}

2011-03-14 16:49:11.779/112.031 Oracle Coherence GE 3.7.0.0 <D5> (thread=Invocation:Management,
member=2): Service Management joined the cluster with senior service member 1
2011-03-14 16:49:12.060/112.312 Oracle Coherence GE 3.7.0.0 <D5> (thread=DistributedCache,
member=2): Service DistributedCache joined the cluster with senior service member 1

CohQL>
```

2. Execute the following commands at the `CohQL>` prompt in the cache client. For definitions of these commands, see "Using Coherence Query Language" in *Developer's Guide for Oracle Coherence*.

   - Create a cache named `products`:

     ```
     create cache "products"
     ```

   - Insert an entry (key-value pair) into the cache:

     ```
     insert into "products" key "television" value "ID-5070"
     ```

   - Change the value of the key:

     ```
     update "products" set value() = "ID-5080" where key() like "television
     ```

   - Retrieve the values in the cache:

     ```
     select * from "products"
     ```

   - Retrieve the value of a key that does not exist. An empty result set will be returned:

     ```
     select key(), value() from "products" where key() is "radio"
     ```

   - Delete an existing key in the cache. An empty result set will be returned:

```
delete from "products" where key() = "television"
```

- Delete the contents of the `products` cache. An empty result set will be returned:

```
delete from "products"
```

- Destroy the products cache:

```
drop cache "products"
```

- Re-create the products cache:

```
create cache "products"
```

- Insert more entries into the cache:

```
insert into "products" key "television" value "ID-5080"
insert into "products" key "radio" value "ID-5090"
insert into "products" key "MP3 Player" value "ID-5100"
insert into "products" key "laptop" value "ID-5110"
```

- Retrieve the keys and values in the `products` cache:

```
select key(), value() from "products"
```

- Save a serialized representation of the cache in a file:

```
backup cache "products" to "products.bkup"
```

- Delete a key from the cache:

```
delete from "products" where key() = "television"
```

- Retrieve the cache contents again, notice that the deleted key and value will not be present:

```
select key(), value() from "products"
```

- Delete the contents of the cache:

```
delete from "products"
```

- Retrieve the contents of the cache. An empty result set will be returned:

```
select * from "products"
```

- Restore the cache contents from the backup file:

```
restore cache "products" from file "products.bkup"
```

- Retrieve the cache contents. Note that all of the entries will be restored and returned:

```
select key(), value() from "products"
```

- Destroy the products cache:

```
drop cache "products"
```

- Exit the command-line tool:

```
bye
```

Example 1–6 illustrates the output of each of these commands.

Example 1–6 Exercising Coherence Commands

```
CohQL> create cache "products"

CohQL> insert into "products" key "television" value "ID-5070"

CohQL> update "products" set value() = "ID-5080" where key() like "television
Results
television: true

CohQL> select * from "products"
Results
ID-5080

CohQL> select key(), value() from "products" where key() is "radio"
Results

CohQL> delete from "products" where key() = "television"
Results

CohQL> delete from "products"
Results

CohQL> drop cache "products"

CohQL> create cache "products"

CohQL> insert into "products" key "television" value "ID-5080"

CohQL> insert into "products" key "radio" value "ID-5090"

CohQL> insert into "products" key "MP3 Player" value "ID-5100"

CohQL> insert into "products" key "laptop" value "ID-5110"

CohQL> select key(), value() from "products"
Results
"television", "ID-5080"
"radio", "ID-5090"
"MP3 Player", "ID-5100"
"laptop", "ID-5110"

CohQL> backup cache "products" to "products.bkup"
WARNING: The backup command should not be used on active data set,
as it makes no provisions that ensure data consistency during the backup.
Please see the documentation for more detailed information.

CohQL> delete from "products" where key() = "television"
Results

CohQL> select key(), value() from "products"
Results
"radio", "ID-5090"
"MP3 Player", "ID-5100"
"laptop", "ID-5110"

CohQL> delete from "products"
Results

CohQL> select * from "products"
Results
```

```
CohQL> restore cache "products" from file "products.bkup"

CohQL> select key(), value() from "products"
Results
"television", "ID-5080"
"radio", "ID-5090"
"MP3 Player", "ID-5100"
"laptop", "ID-5110"

CohQL> drop cache "products"

CohQL> bye

2011-03-14 16:54:41.638/441.890 Oracle Coherence GE 3.7.0.0 <D5>
(thread=Invocation:Management, member=2): Service Management left the cluster
2011-03-14 16:54:41.638/441.890 Oracle Coherence GE 3.7.0.0 <D5>
(thread=DistributedCache, member=2): Service DistributedCache left the cluster
2011-03-14 16:54:41.654/441.906 Oracle Coherence GE 3.7.0.0 <D5> (thread=Cluster,
member=2): Service Cluster left the cluster

C:\oracle\product\coherence\bin>
```

3. Open another terminal window and set the `PATH` environment variable to include `%JAVA_HOME%` and `%JAVA_HOME%\bin`. Enter the `query.cmd` command in the new terminal window to start an instance of the cache client.
4. Restart the first client with the `query.cmd` command. Enter the `create cache "products"` command. The terminal window displays a message similar to the following that describes where the first client is running. `member 1` is the cache server and `member 3` is the restarted first client.

   ```
   2011-03-14 17:51:26.701/17.688 Oracle Coherence GE 3.7.0.0 <D5>
   (thread=Invocation:Management, member=3): Service Management joined the cluster
   with senior service member 1
   2011-03-14 17:51:27.138/18.125 Oracle Coherence GE 3.7.0.0 <D5>
   (thread=DistributedCache, member=3): Service DistributedCache joined the
   cluster with senior service member 1

   CohQL>
   ```

5. Enter the `create cache "products"` command in the new terminal window to connect to the `products` cache. Try to get and put values in different sessions. Notice that each client can observe changes made by the other client.
6. Terminate one of the `query.cmd` shells (`bye`). Note that the other shell displays a message indicating that the member has left the cluster, for example:

   ```
   2011-03-14 17:56:22.920/313.907 Oracle Coherence GE 3.7.0.0 <D5>
   (thread=Cluster, member=2): Member 3 left service Management with senior member
   1
   2011-03-14 17:56:22.935/313.922 Oracle Coherence GE 3.7.0.0 <D5>
   (thread=Cluster, member=2): Member 3 left service DistributedCache with senior
   member 1
   2011-03-14 17:56:22.967/313.954 Oracle Coherence GE 3.7.0.0 <D5>
   (thread=Cluster, member=2): TcpRing disconnected from Member(Id=3,
   Timestamp=2011-03-14 17:55:21.803, Address=130.35.99.213:8092, MachineId=49877,
   Location=site:URL, machine_name,process:1008, Role=TangosolCoherenceQueryPlus)
   due to a peer departure; removing the member.
   2011-03-14 17:56:22.982/313.969 Oracle Coherence GE 3.7.0.0 <D5>
   (thread=Cluster, member=2): Member(Id=3, Timestamp=2011-03-14 17:56:22.982,
   ```

```
Address=130.35.99.213:8092, MachineId=49877, Location=site:URL, machine_
name,process:1008, Role=TangosolCoherenceQueryPlus) left Cluster with senior
member 1
```

7. If you terminate each of the cache clients (`bye`), and then restart them, note that data from the previous session is still available. This is because the data is held in the cache server.
8. If you start another Coherence cache server, and then terminate the initial one that was started (using `Ctrl+C` or by closing the command window), note that the data is still available.
9. Terminate both the `query.cmd` shells and `cache-server.cmd` shell. Restart `query.cmd`. Create a cache called `test` using the command `create cache test`. Try to put a value into the cache, as before. Because the cache client is configured to start in storage-disabled mode, you will receive a response similar to the following:

   ```
   com.tangosol.net.RequestPolicyException: No storage-enabled nodes exist for
   service DistributedCache
   ```

10. Start a cache server by running the `cache-server.cmd` file. Try to insert a value again. This time, the value will be accepted.
11. Terminate all cache servers.

Troubleshooting Cache Server Clustering

If the value of Member ID in the `cache-server.cmd` output is anything other than 1, then this indicates that the cache server has clustered with one or more other cache servers or processes running Coherence. These servers or processes can be running on the network or running locally on your host. Though this is the default behavior for Coherence—to cluster with other processes running Coherence locally or on a network—it is strongly advised that while you perform this tutorial, you restrict Coherence to your own host.

> **Note:** To restrict Coherence to a single host, the cache server and cache client executable files used in this tutorial use the `tangosol.coherence.clusterport` command line property set to `3155`.

Restricting Coherence to Your Own Host

The value of the Member ID in the output of the `cache-server.cmd` cache server command indicates whether you have one or more members in your cluster. For the purpose of this tutorial, the value of Member ID must be equal to 1:

```
...
In MasterMemberSet
ThisMember=Member(Id should be equal to 1)
...
```

If the value of Member ID is greater than 1, it means that multiple clusters are being formed in your subnet.

There are several ways to restrict Coherence to your own host. The easiest way is to use the `tangosol.coherence.clusterport` system property to declare a unique cluster port value in your cache server startup file. For example, add the following Java option to your `cache-server.cmd` file. The value assigned to the system

property can be any unique value, such as the last four digits of your telephone number.

```
-Dtangosol.coherence.clusterport=3155
```

Advanced Steps to Restrict Coherence to Your Own Host

If you follow the steps in "Restricting Coherence to Your Own Host" on page 1-13 and the `cache-server.cmd` command still fails to return a Member Id value of 1, then there might be additional problems to resolve.

Disconnect from the network or disable networking on your host. If errors or exceptions occur when starting the cache server, your network settings might need to be modified. Try each of the following one at a time, restarting the cache server after each attempt:

- If connected to a Virtual Private Network (VPN), then disconnect from it. By default, most VPN are not configured to permit multicast and some unicast traffic. In this environment, Coherence might not work, if left in the configuration in which it was shipped. Coherence can be configured to run across a VPN, but this requires some advanced settings.
- If you run a firewall, configure it to enable the specified addresses and ports.
- If you still experience problems, disconnect from all networks. This includes wireless and wired networks.
- If all the preceding options fail, set up Coherence to run on a single host.

2

Installing and Configuring Eclipse and OEPE with Coherence

This chapter describes how to set up the Helios release of the Eclipse IDE for Java EE Developers (Eclipse) and Oracle Enterprise Pack for Eclipse (OEPE) 11*g*R1 (11.1.1.7) to build and run Coherence-based Java applications.

This chapter contains the following sections:

Installing Eclipse and OEPE

You can download an "all-in-one" version of OEPE 11gR1 (11.1.1.7) that bundles a preconfigured version of Eclipse Helios and the OEPE plug-ins. Oracle recommends installing the "all-in-one" version.

As an alternative, you can download the OEPE distribution by itself and install it into an existing Eclipse Helios installation. The OEPE installer includes Oracle WebLogic Server, Oracle Coherence, and the Oracle ADF Runtime.

To download either version, select the **Downloads** tab on the Oracle Enterprise Pack for Eclipse page:

`http://www.oracle.com/technetwork/developer-tools/eclipse/overview/index.html`

Follow the instructions in the installer. You can also find installation instructions at this URL:

`http://download.oracle.com/docs/cd/E15315_07/help/oracle.eclipse.tools.common.doc/html/install.html`

This tutorial assumes that you will be installing Eclipse into an `eclipse` folder that you have created at the file system root, for example:

```
C:\eclipse\*
```

Configuring Eclipse and OEPE for Coherence

To start and configure Eclipse for use with Coherence:

1. Open a terminal window and verify that the `PATH` environment variable is set to include the Java JDK, for example: `\oracle\product\jdk160_14_R27.6.5-32\bin`. Note that you must have a working installation of Java SE (JDK) version 1.6 or higher.

   If the `PATH` environment variable does not include the Java JDK `\bin` folder, then set the variable as follows:

   a. Set the `JAVA_HOME` environment variable to the base of the JDK installation, for example:

   ```
   set JAVA_HOME=\oracle\product\jdk160_14_R27.6.5-32
   ```

   b. Include `%JAVA_HOME%\bin` in the `PATH` environment variable, for example:

   ```
   set PATH=%JAVA_HOME%\bin;%PATH%
   ```

2. Start Eclipse.

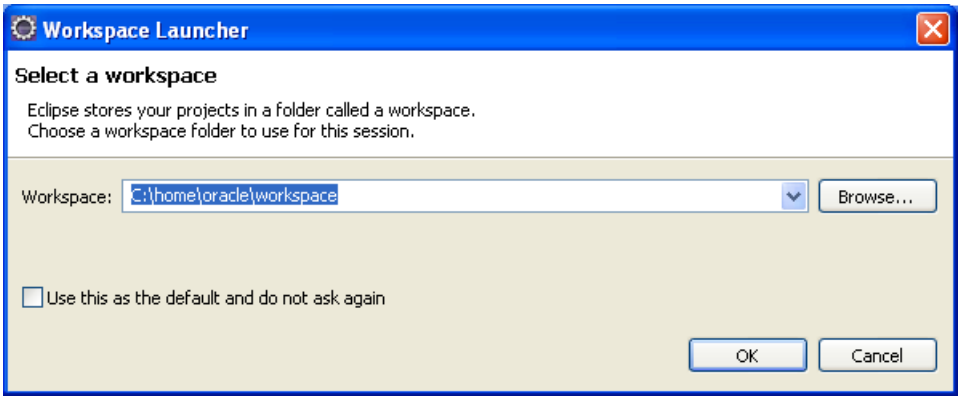
   The eclipse executable is `eclipse.exe`. If you extracted Eclipse into a directory called `eclipse`, you will find `eclipse.exe` here:

   ```
   C:\eclipse\eclipse.exe
   ```

3. If Eclipse prompts you to set or select a workspace in the **Workspace Launcher** dialog box, enter `C:\home\oracle\workspace`.

   Figure 2–1 illustrates the **Workspace Launcher** dialog box with the path `C:\home\oracle\workspace` selected.

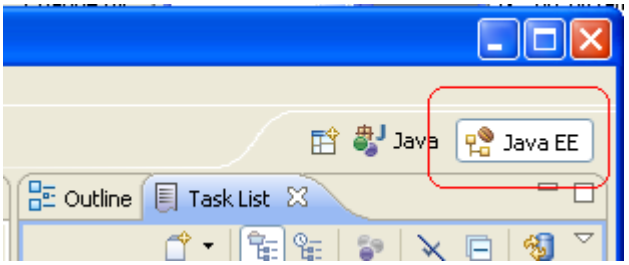
Figure 2–1 Workspace Launcher Dialog Box



4. After Eclipse starts, select the Java EE perspective in the menu bar.

   Figure 2–2 illustrates the location of the Java EE perspective button.

Figure 2–2 The Java EE Perspective in the Menu Bar

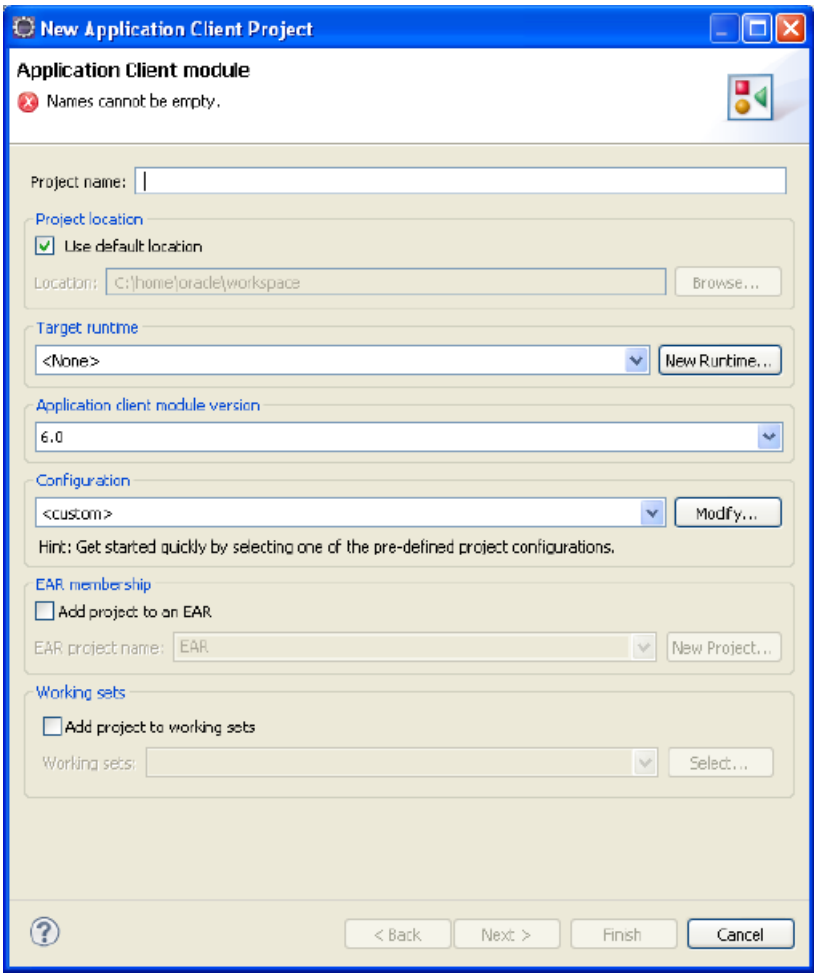


Creating a New Project in the Eclipse IDE

To create a new project in the Eclipse IDE:

1. Select **File** then **New** then **Application Client Project**.
2. In the **New Application Client Project** dialog box, enter a value, **Coherence** for example, as the **Project name**.

Figure 2–3 New Application Client Project Dialog Box

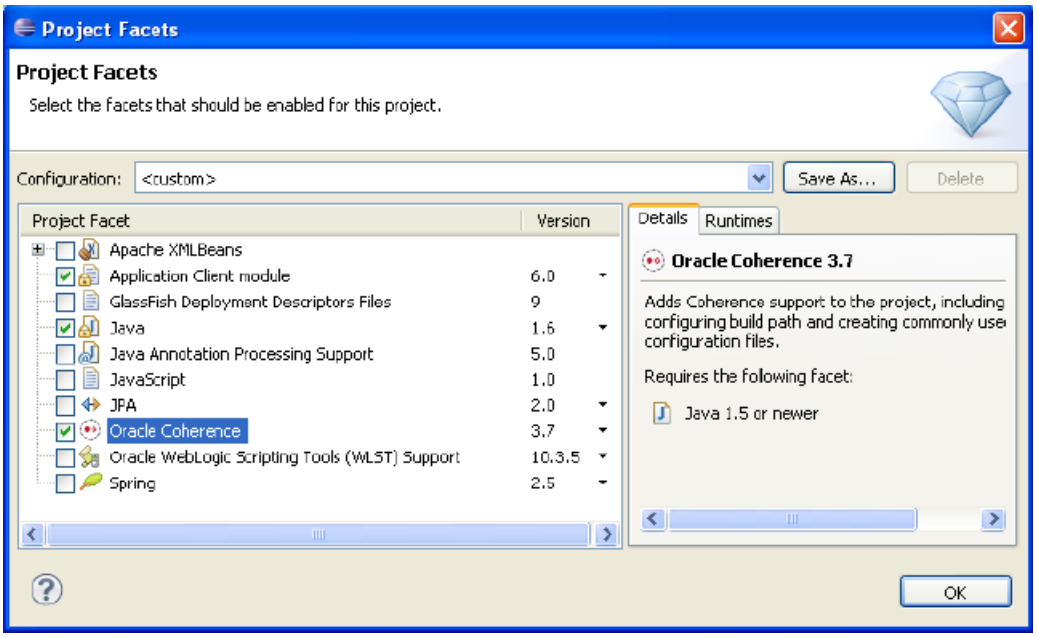


3. In the **Configuration** section, click **Modify**. In the **Project Facets** dialog box, select the **Oracle Coherence** check box. Select version **3.7** from the drop-down list if it is not already displayed.

   Adding the Oracle Coherence facet automatically adds the `coherence.jar` to your project class path. It also makes these commonly used configuration files available in the **Project Explorer**:

   - `coherence-cache-config.xml`, the default cache configuration file.
   - `pof-config.xml`, the configuration file for Portable Object Format serialization.
   - `tangosol-coherence-override.xml`, the override file for operational and runtime settings used by Oracle Coherence.

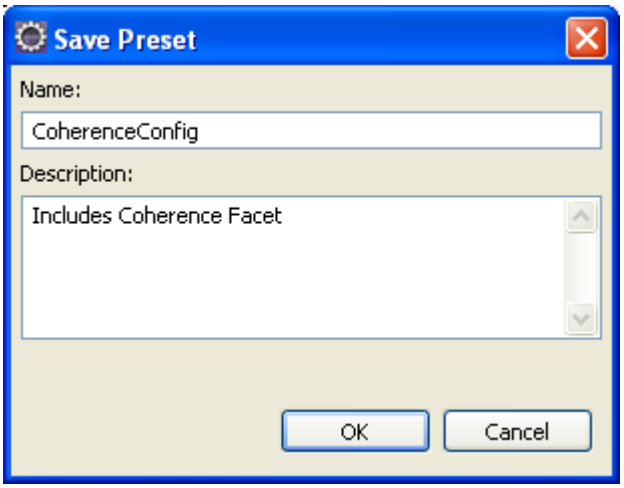
Figure 2–4 Selecting Oracle Coherence in the Project Facets Dialog Box



4. Click **Save As** to enter a name for the configuration in the **Save Preset** dialog box. For example, enter `CoherenceConfig` in the **Name** field and `Includes Coherence Facet` in the **Description** field.

   Figure 2–5 illustrates the **Save Preset** dialog box.

Figure 2–5 Specifying a Configuration Name in the Save Preset Dialog Box



   Click **OK** to close the **Save Preset** dialog box. Click **OK** to close the **Project Facets** dialog box.

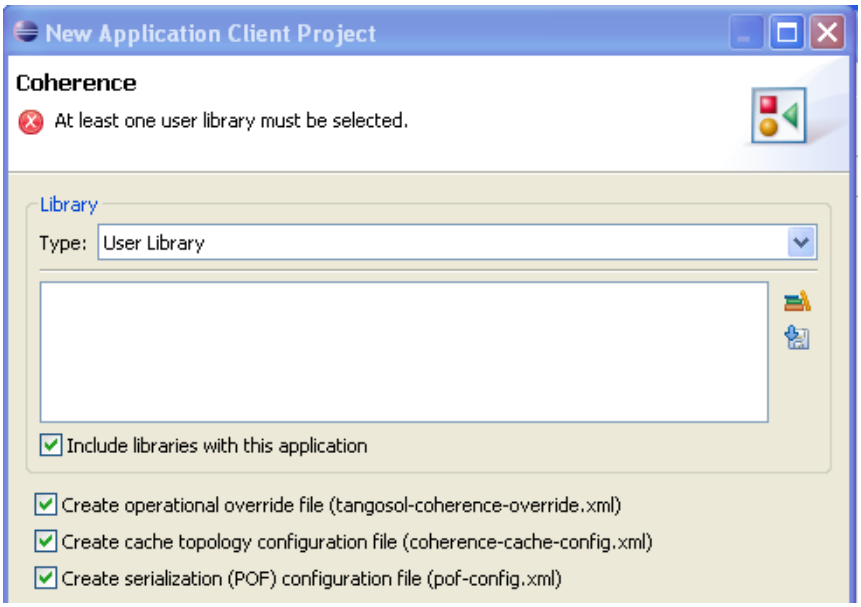
5. Click **Next** in the **Application Client Module** page of the **New Application Client Project** dialog box.

6. Click **Next** in the **Java** page of the **New Application Client Project** dialog box to accept the defaults.

7. Deselect the **Create a default Main class** in the **Application Client Module** page of the **New Application Client Project** dialog box. Click **Next**.

8. In the **Coherence** page, illustrated in Figure 2–6, add the Coherence 3.7 library as a User Library to the project.

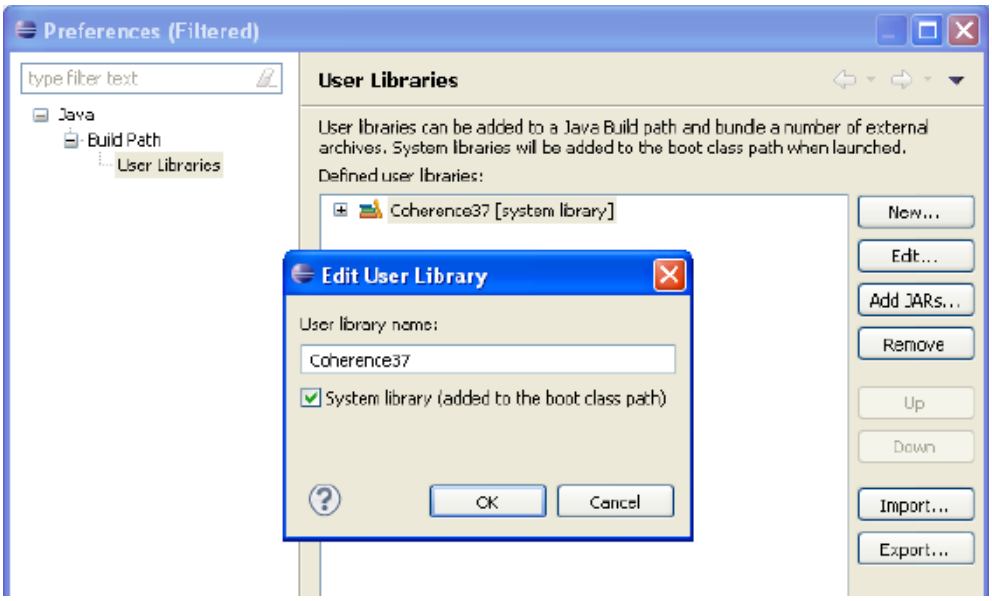
Figure 2–6 Creating a Coherence User Library



a. Click the **Manage Library** icon, then click **New** in the **Preferences** dialog box.

b. Enter **Coherence37** in the **New User Library** dialog box, as illustrated in Figure 2–7. Select the **System library (added to the boot class path)** check box.

Figure 2–7 Naming the Coherence Library



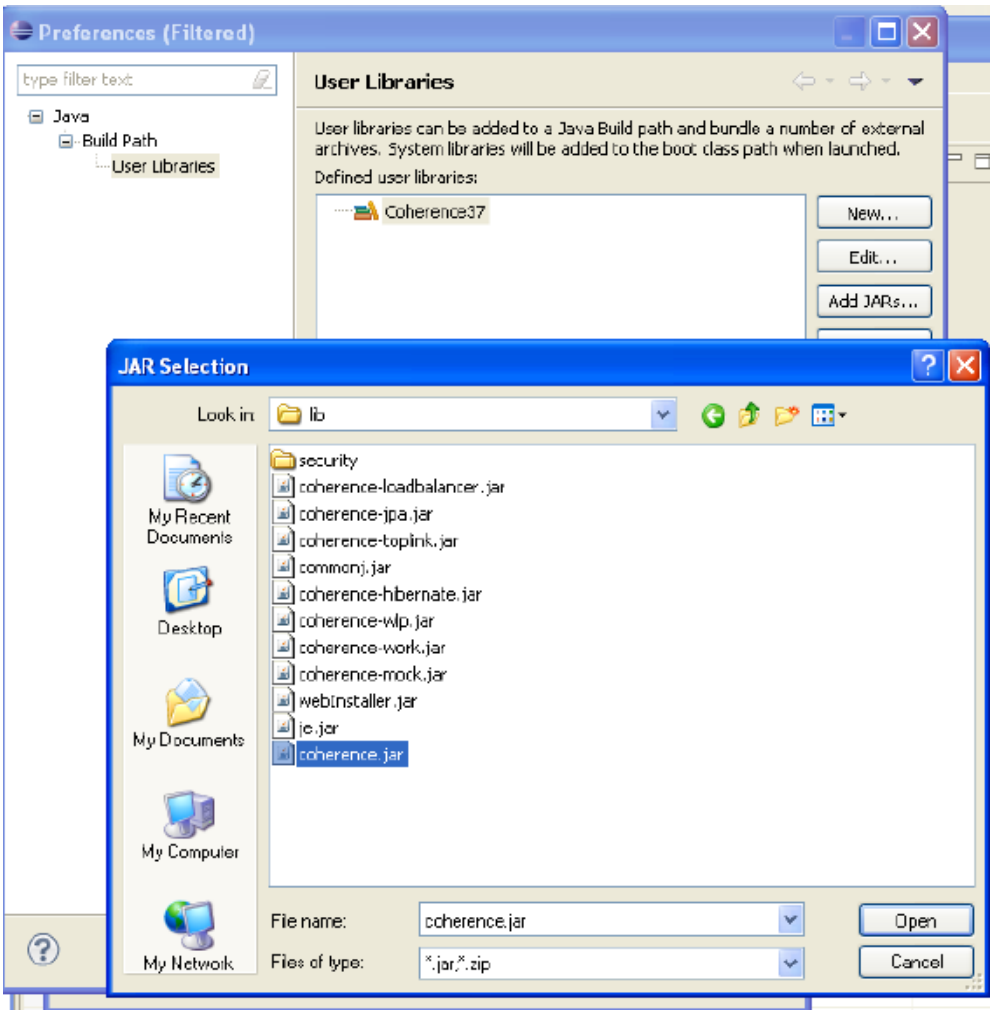
c. Click **OK** to close the **New User Library** dialog box.

d. In the **Preferences** dialog box, click **Add JARs** to add the `coherence.jar` file to the library. Navigate to the location of the `coherence.jar` file in the

Coherence distribution that you downloaded to your file system in "Installing Coherence" on page 1-1.

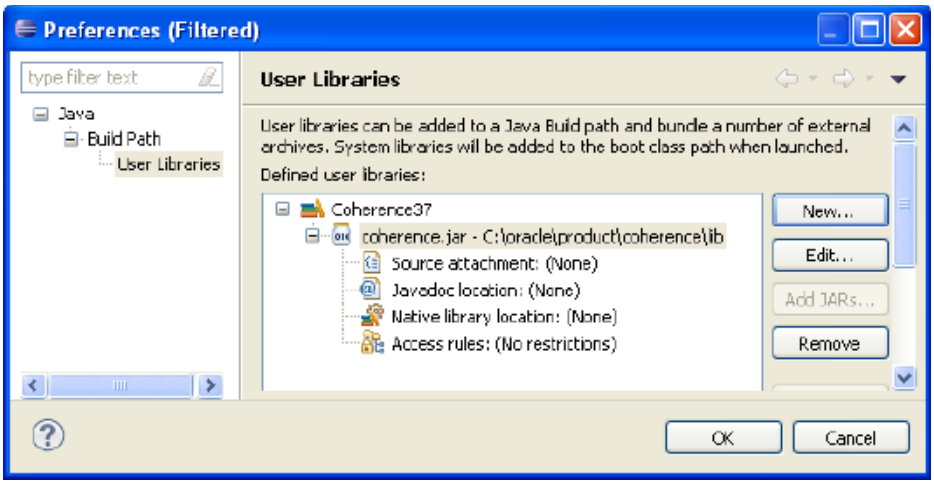
Figure 2–8 illustrates the **JAR Selection** dialog box with the `coherence.jar` file selected.

Figure 2–8 Adding coherence.jar File to the Coherence User Library



e. the **Preferences** dialog box should look similar to Figure 2–9. Click **OK** to close the **Preferences** dialog box.

Figure 2–9 The coherence.jar File Defined in the Coherence User Library



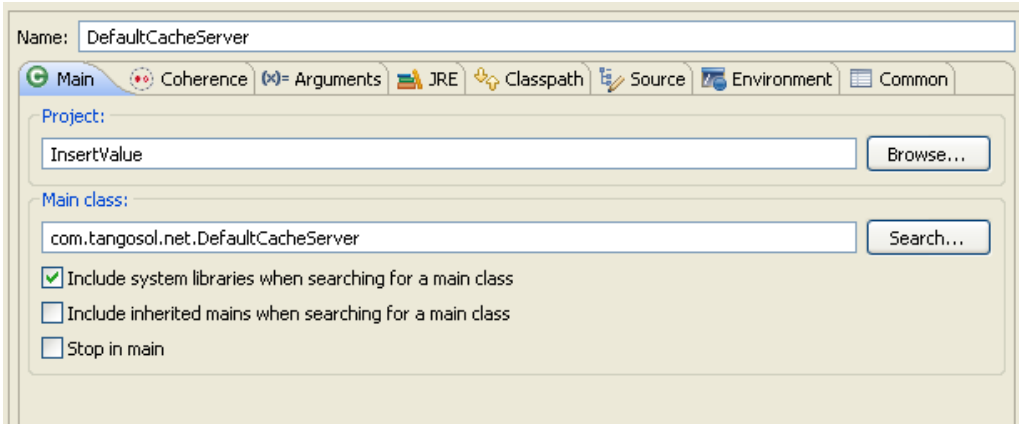
9. Select the **Coherence37** library in the **Coherence** page and click **Finish**.

The new project and its associated files appear in the **Project Explorer** window in the Eclipse IDE.

Launching a Cache Server in the Eclipse IDE

1. Right click the project in the Eclipse IDE. Select **Run As** then **Run Configurations**. In the **Run Configurations** dialog box, select **Oracle Coherence** then the **New launch configuration** icon. Enter `DefaultCacheServer` as the name for the cache server configuration.
2. Under **Project**, click **Browse** and select the name of the project from the **Project Selection** dialog box.
3. Under **Main class**, select the **Include system libraries when searching for a main class** checkbox. Click the **Search** button and enter `DefaultCacheServer` in the **Select Main Type** dialog box. Select **com.tangosol.net.DefaultCacheServer** and click **OK**. Click **Apply**. The **Main** tab should look similar to Figure 2–10.

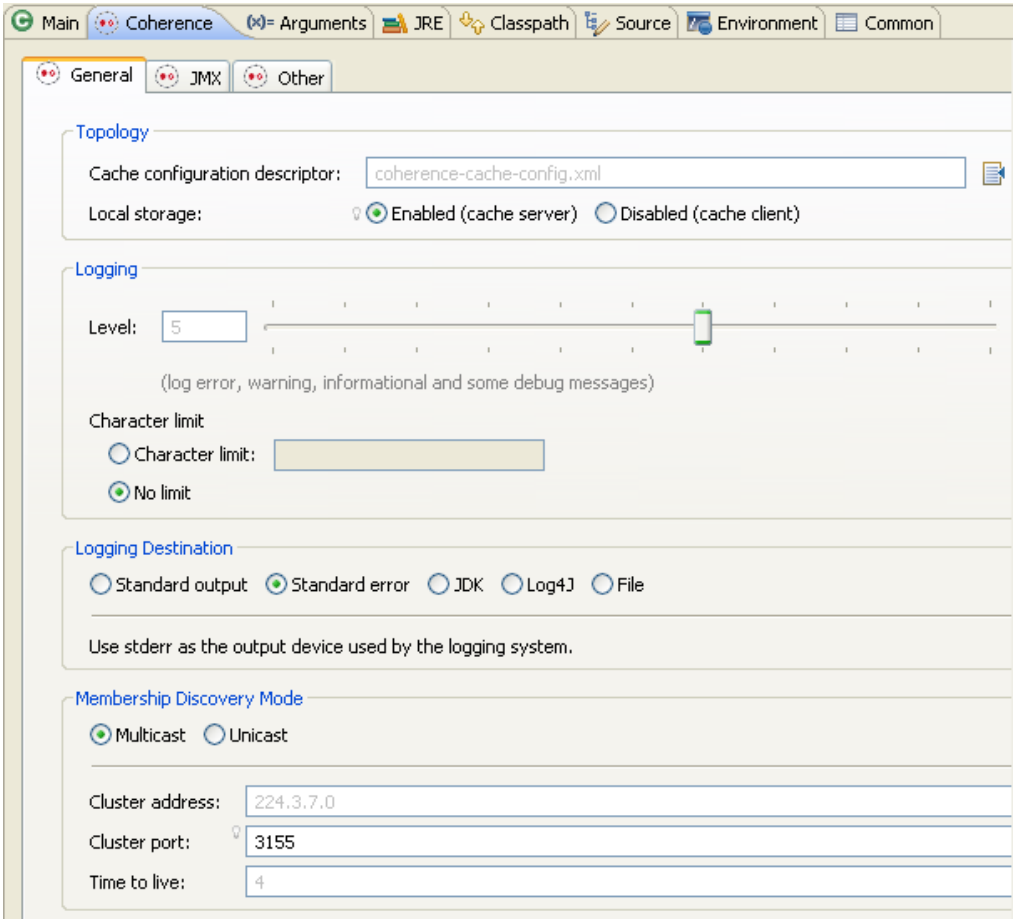
Figure 2–10 Main Tab in the Run Configurations Dialog Box



4. In the **Coherence** tab, select the **General** tab. Click the **Browse** icon to navigate to the cache configuration file. Select local storage to be enabled (cache server). Enter

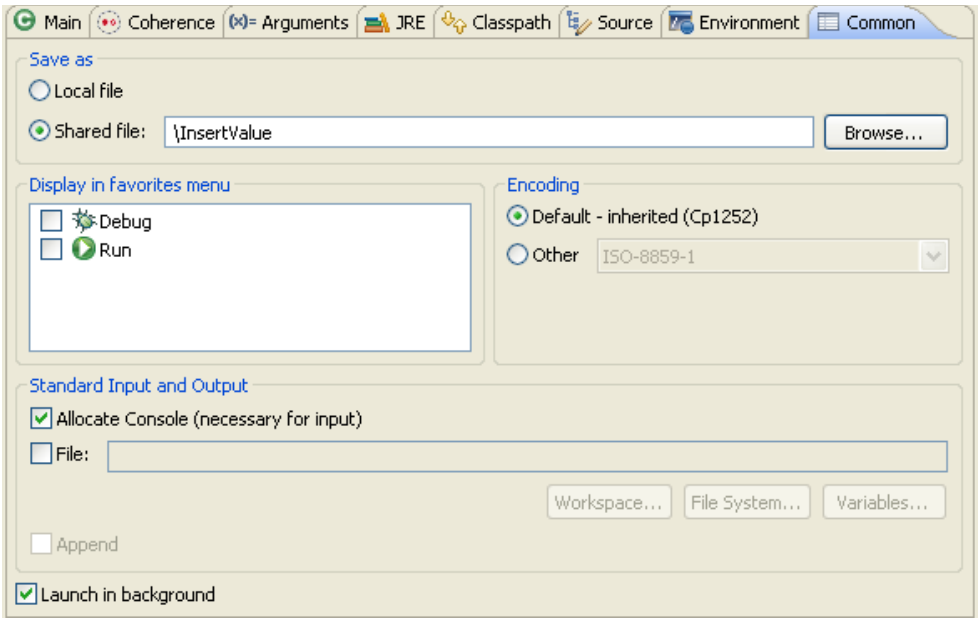
a unique value, such as `3155` for the **Cluster port**. Click **Apply**. The **Coherence** tab should look similar to Figure 2–11.

Figure 2–11 Coherence Tab of the Run Configurations Dialog Box



5. Open the **Arguments** tab. Enter `-showversion` in the **VM Arguments** field. Click **Apply**.
6. Open the **Common** tab of the dialog box. Click the **Shared file** radio button and click **Browse** to navigate to the project. Click **Apply**. The **Common** tab should look similar to Figure 2–12.

Figure 2–12 Common Tab of the Run Configurations Dialog Box



7. Click **Run** to start the cache server. The cache server should start and display output similar to Example 2–1.

Example 2–1 Cache Server Output in the Eclipse Console Window

```
java version "1.6.0_14"
Java(TM) SE Runtime Environment (build 1.6.0_14-b08)
Java HotSpot(TM) Client VM (build 14.0-b16, mixed mode)
2011-03-14 17:08:24.053/0.281 Oracle Coherence 3.7.0.0 <Info> (thread=main, member=n/a): Loaded
operational configuration from "jar:file:/C:/oracle/product/coherence/lib/coherence.
jar!/tangosol-coherence.xml"
2011-03-14 17:08:24.116/0.344 Oracle Coherence 3.7.0.0 <Info> (thread=main, member=n/a): Loaded
operational overrides from "jar:file:/C:/oracle/product/coherence/lib/coherence.
jar!/tangosol-coherence-override-dev.xml"
2011-03-14 17:08:24.147/0.375 Oracle Coherence 3.7.0.0 <Info> (thread=main, member=n/a): Loaded
operational overrides from
"file:/C:/home/oracle/workspace/InsertValue/build/classes/tangosol-coherence-override.xml"
2011-03-14 17:08:24.147/0.375 Oracle Coherence 3.7.0.0 <D5> (thread=main, member=n/a): Optional
configuration override "/custom-mbeans.xml" is not specified

Oracle Coherence Version 3.7.0.0 Build 22913
 Grid Edition: Development mode
Copyright (c) 2000, 2010, Oracle and/or its affiliates. All rights reserved.

2011-03-14 17:08:24.397/0.625 Oracle Coherence GE 3.7.0.0 <Info> (thread=main, member=n/a): Loaded
cache configuration from "jar:file:/C:/oracle/product/coherence/lib/coherence.
jar!/coherence-cache-config.xml"
2011-03-14 17:08:24.600/0.828 Oracle Coherence GE 3.7.0.0 <D4> (thread=main, member=n/a): TCMP
bound to /130.35.99.213:8088 using SystemSocketProvider
2011-03-14 17:08:28.116/4.344 Oracle Coherence GE 3.7.0.0 <Info> (thread=Cluster, member=n/a):
Created a new cluster "cluster:0x96AB" with Member(Id=1, Timestamp=2011-03-14 17:08:24.6,
Address=130.35.99.213:8088, MachineId=49877, Location=site:URL, machine_name,process:2412,
Role=CoherenceServer, Edition=Grid Edition, Mode=Development, CpuCount=2, SocketCount=1)
UID=0x822363D50000012EB6D79318C2D51F98
2011-03-14 17:08:28.116/4.344 Oracle Coherence GE 3.7.0.0 <Info> (thread=main, member=n/a): Started
cluster Name=cluster:0x96AB
```

```
Group{Address=224.3.7.0, Port=3155, TTL=4}

MasterMemberSet
  (
  ThisMember=Member(Id=1, Timestamp=2011-03-14 17:08:24.6, Address=130.35.99.213:8088,
MachineId=49877, Location=site:URL, machine_name,process:2412, Role=CoherenceServer)
  OldestMember=Member(Id=1, Timestamp=2011-03-14 17:08:24.6, Address=130.35.99.213:8088,
MachineId=49877, Location=site:URL, machine_name,process:2412, Role=CoherenceServer)
  ActualMemberSet=MemberSet(Size=1, BitSetCount=2
    Member(Id=1, Timestamp=2011-03-14 17:08:24.6, Address=130.35.99.213:8088, MachineId=49877,
Location=site:URL, machine_name,process:2412, Role=CoherenceServer)
    )
  RecycleMillis=1200000
  RecycleSet=MemberSet(Size=0, BitSetCount=0
    )
  )

TcpRing{Connections=[]}
IpMonitor{AddressListSize=0}

2011-03-14 17:08:28.163/4.391 Oracle Coherence GE 3.7.0.0 <D5> (thread=Invocation:Management,
member=1): Service Management joined the cluster with senior service member 1
2011-03-14 17:08:28.319/4.547 Oracle Coherence GE 3.7.0.0 <D5> (thread=DistributedCache, member=1):
Service DistributedCache joined the cluster with senior service member 1
2011-03-14 17:08:28.350/4.578 Oracle Coherence GE 3.7.0.0 <D5> (thread=ReplicatedCache, member=1):
Service ReplicatedCache joined the cluster with senior service member 1
2011-03-14 17:08:28.413/4.641 Oracle Coherence GE 3.7.0.0 <D5> (thread=OptimisticCache, member=1):
Service OptimisticCache joined the cluster with senior service member 1
2011-03-14 17:08:28.413/4.641 Oracle Coherence GE 3.7.0.0 <D5>
(thread=Invocation:InvocationService, member=1): Service InvocationService joined the cluster with
senior service member 1
2011-03-14 17:08:28.413/4.641 Oracle Coherence GE 3.7.0.0 <Info> (thread=main, member=1):
Services
  (
  ClusterService{Name=Cluster, State=(SERVICE_STARTED, STATE_JOINED), Id=0, Version=3.7,
OldestMemberId=1}
  InvocationService{Name=Management, State=(SERVICE_STARTED), Id=1, Version=3.1, OldestMemberId=1}
  PartitionedCache{Name=DistributedCache, State=(SERVICE_STARTED), LocalStorage=enabled,
PartitionCount=257, BackupCount=1, AssignedPartitions=257, BackupPartitions=0}
  ReplicatedCache{Name=ReplicatedCache, State=(SERVICE_STARTED), Id=3, Version=3.0,
OldestMemberId=1}
  Optimistic{Name=OptimisticCache, State=(SERVICE_STARTED), Id=4, Version=3.0, OldestMemberId=1}
  InvocationService{Name=InvocationService, State=(SERVICE_STARTED), Id=5, Version=3.1,
OldestMemberId=1}
  )

Started DefaultCacheServer...
```

Learning Eclipse IDE Basics

This section describes common tasks that are a part of building projects in the Eclipse IDE.

- Creating a Java Class
- Creating a Runtime Configuration
- Stopping Cache Servers

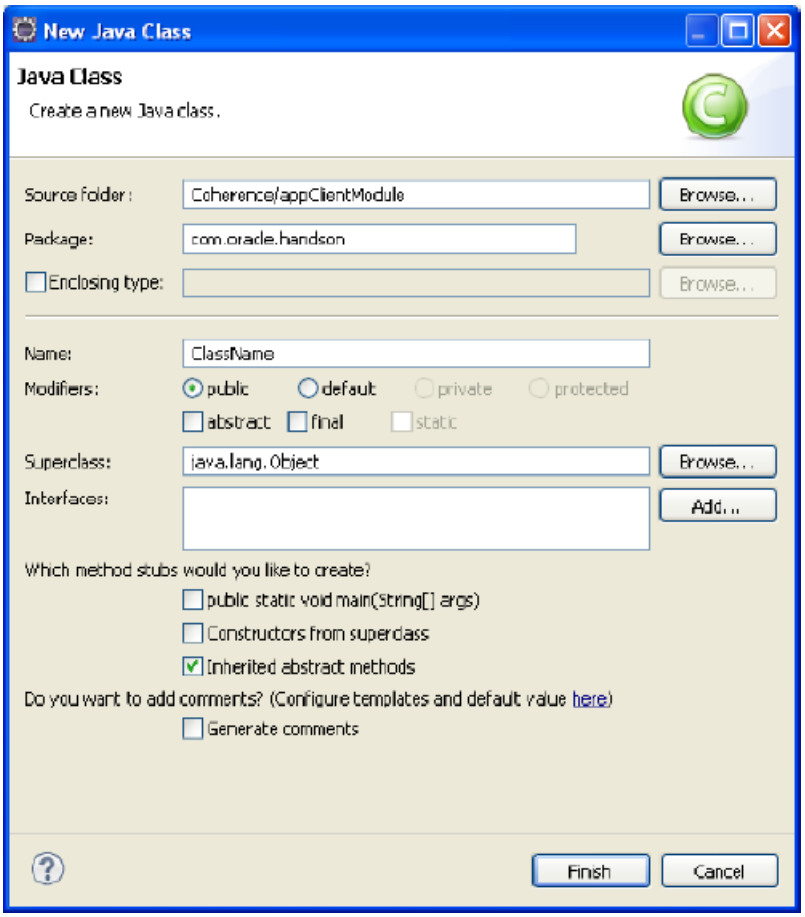
Creating a Java Class

To create a new Java class in the Eclipse IDE:

1. Right-click the project entry in the **Project Explorer** window. Select **New** then **Class**.
2. In the **New Java Class** dialog box, enter a package name. In this tutorial, the value will typically be `com.oracle.handson`.
3. Enter the name of the class in the **Name** field.
4. Under **Which method stubs would you like to create?**:
   - Select the **public static void main(String[]args)** if you want the file to be runnable.
   - Select **Constructors from superclass** check box if you want stubs of the constructors from the new class's superclass to be added.
   - **Inherited abstract methods** should be selected by default. This option adds stubs of any abstract methods from superclasses or methods of interfaces that need to be implemented.
5. Click **OK** to create the Java class.

Figure 2–13 illustrates the **New Java Class** dialog box.

Figure 2–13 Defining a New Java Class



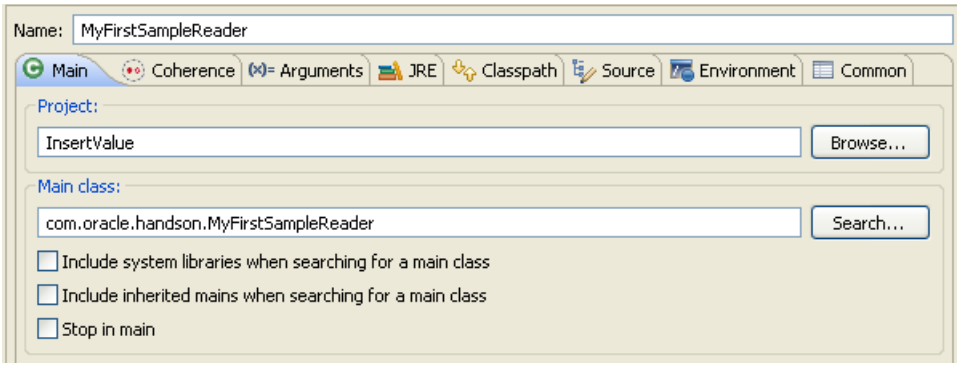
Creating a Runtime Configuration

To create a runtime configuration for a runnable file:

1. Right click the name of the runnable file in the **Project Explorer** window. Select **Run As** then **Run Configurations**.
2. Click **Oracle Coherence**, then the **New Launch Configuration** icon. Select the **Java Application** node. Click the **New Launch Configuration** button.
3. Enter a name for the new configuration. Under **Project** in the **Main** tab, click the **Browse** button to navigate to the name of the current project. Click the **Search** button to navigate to the name of the runnable file for which you are creating the runtime configuration. Click **Apply**.

   This figure illustrates the **Main** tab of the **Run Configurations** dialog box.

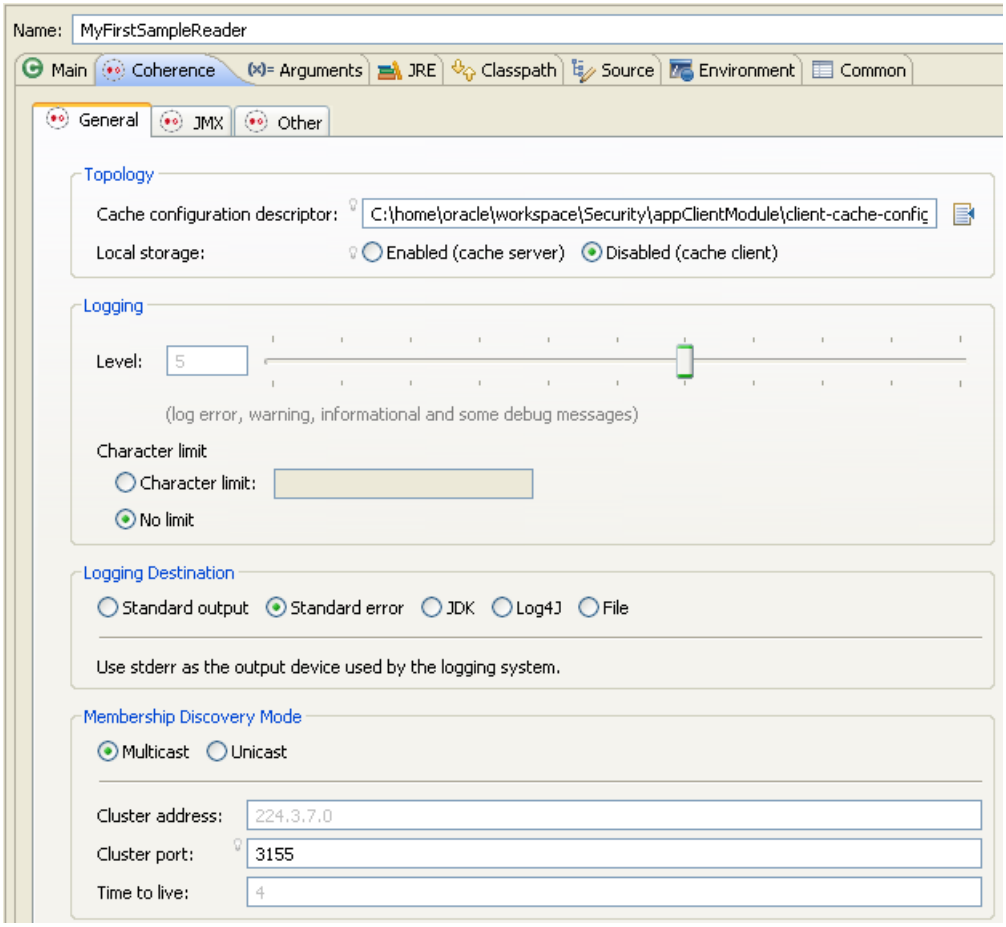
Figure 2–14 Defining a Launch Configuration for a Runnable File



4. Click the **Coherence** tab. Under the **General** tab, you can set many of the more commonly used VM runtime arguments for the configuration. Examples of runtime arguments include the path to the cache configuration descriptor, and the local storage, log level, and cluster port values.

   Figure 2–15 illustrates the **General** tab of the **Coherence** tab in the **Run Configurations** dialog box.

Figure 2–15 Setting Runtime Arguments for the Launch Configuration



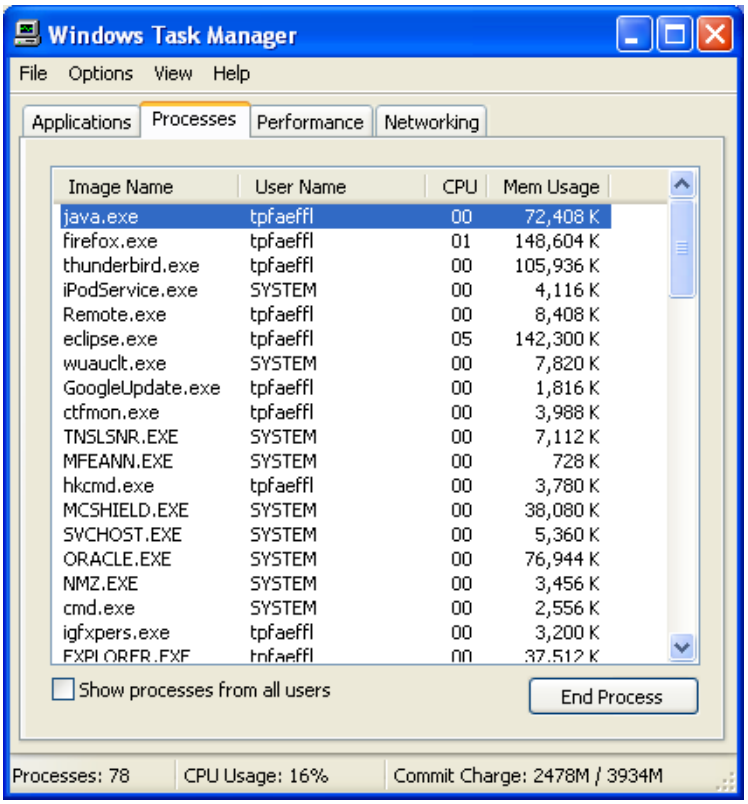
Stopping Cache Servers

In the Eclipse IDE, you can stop any running cache server or client by clicking the **Terminate** and **Remove all terminated launches** icons in the Eclipse Console.

However, if you look in the Windows Task Manager window, you might notice that the Java process (`java.exe`) associated with the server or client is still running. To prevent any errors being thrown when the server or client is restarted, you must delete its associated Java process. Select the Java process in the Windows Task Manager window and click **End Process**.

Figure 2–16 illustrates the Windows Task Manager window with the Java process selected.

Figure 2–16 Java Process in the Windows Task Manager



3

Accessing the Data Grid from Java

In this exercise, you develop a simple, Java console-based application to access, update, and remove simple types of information from a Coherence clustered cache. You also are introduced to the Coherence Java APIs. Using the Eclipse IDE, you will perform the following tasks:

- Create a new project
- Create a new named cache (`NamedCache` object)
- Put information into the cache and then retrieve it
- Retrieve information about the cache

This chapter contains the following sections:

Introduction

All Coherence caches are named, have a lifetime scoped by the cluster instance in which they exist, and implement the `com.tangosol.net.NamedCache` interface. The `NamedCache` interface is an extension of the `java.util.Map` interface and holds data and resources that are shared among the cluster members. Each `NamedCache` object holds data as key/value pairs. Keys and values can be both simple and complex object types. The `NamedCache` interface provides extensions to the `Map` interface, such as locking and synchronization, storage integration, queries, event aggregations, and transactions. Table 3–1 describes some of the commonly used methods within the `NamedCache` interface.

Table 3–1 Methods in the NamedCache Interface

Method Name	Description
`void clear()`	Removes all entries from the `NamedCache` object.
`boolean containsKey(Object key)`	Returns `true` if the `NamedCache` object contains an entry for the key.
`boolean containsValue(Objectvalue)`	Returns `true` if there is at least one entry with this value in the `NamedCache` object.
`Object get(Object key)`	Gets the entry from the `NamedCache` object for that key.
`Object put(Object key,Objectvalue)`	Puts an object in the cache and returns the previous value (if any).

Table 3–1 (Cont.) Methods in the NamedCache Interface

Method Name	Description
`Object remove(Object key)`	Removes the mapping for this `key` from this map if present. Inherited from the `ConcurrentMap` interface.
`Set entrySet()`	Returns a set of key/value pairs.
`Collection values()`	Gets all values back as a collection.
`CacheService getCacheService()`	Returns the `CacheService` to which this `NamedCache` belongs.

The `com.tangosol.net.CacheFactory` class is typically used to get an instance of a `NamedCache` object. Table 3–2 describes some of the more commonly used methods in the `CacheFactory` class.

Table 3–2 Methods in the CacheFactory Class

Method Name	Description
`static Cluster ensureCluster()`	Obtains a cluster object running Coherence services.
`static void shutdown()`	Shuts down all clustered services.
`static NamedCache getCache(String cache)`	Returns an instance of a cache. Either joins an existing cache in the cluster or creates the cache if this is the first member.

For a full list of methods in the `NamedCache` interface and the `CacheFactory` class, see the Javadoc in `C:\oracle\product\coherence\doc`.

Creating Your First Coherence-Based Java Program

This section describes how to create a Java program that enables you to access, update, and remove simple types of information from a Coherence clustered cache.

1. Create a Program to Put Values in the Cache
2. Create a Program to Get Values from the Cache

Create a Program to Put Values in the Cache

To create a Coherence Java-based application:

1. Create a new Application Client Project in Eclipse. Name the project `InsertValue`. Ensure that the folder is `C:\home\oracle\workspace\InsertValue`.

   In the **Configuration** section of the **New Application Client Project** dialog box, click **Modify**. In the **Project Facets** dialog box, select **CoherenceConfig** from the **Configuration** drop down list.

   See "Creating a New Project in the Eclipse IDE" on page 2-3 for detailed instructions.

2. Create your first Coherence Java program. Name the class `MyFirstSample` and select the **public static void main(String[] args)** check box in the **New Java Class dialog box**.

   See "Creating a Java Class" on page 2-11 for detailed information.

3. In the Eclipse editor, write the code to create a `NamedCache` object, enter a value in the cache, and then verify the value that you entered. Example 3–1 illustrates a sample program.

Example 3–1 Creating a NamedCache Object: Inserting and Verifying Values

```
package com.oracle.handson;

import com.tangosol.net.CacheFactory;
import com.tangosol.net.NamedCache;

public class MyFirstSample {
    public MyFirstSample() {
    }

    public static void main(String[] args) {

       // create or get a named cache called mycache
       NamedCache myCache = CacheFactory.getCache("mycache");

       // put key, value pair into the cache.
       myCache.put("Name","Gene Smith");

       System.out.println("Value in cache is " + myCache.get("Name"));

    }
}
```

4. Stop any running cache servers. See "Stopping Cache Servers" on page 2-13 for detailed information.

5. Run the program in the Eclipse IDE: right-click the `MyFirstSample.java` class in the editor and select **Run As** then **Run Configuration**. Double-click Oracle Coherence to create a Coherence configuration. Enter `MyFirstSample` in the **Name** field of the **Run Configuration** dialog box.

   In the **Main** tab, enter `InsertValue` in the **Project** field and `com.oracle.handson.MyFirstSample` in the **Main class** field.

   In the **Coherence** tab, enter a unique value, such as 3155, in the **Cluster port** field to ensure that Coherence is limited to your own host. Select **Enabled (cache server)** under **Local storage**.

   Note that in the **Classpath** tab, the `coherence.jar` file should be present in the **Bootstrap Entries** list. Click **Apply**, then **Run**.

   Messages similar to Example 3–2 are displayed:

Example 3–2 Output of MyFirstSample Program

```
2011-03-14 17:01:25.443/0.297 Oracle Coherence 3.7.0.0 <Info> (thread=main, member=n/a): Loaded
operational configuration from "jar:file:/C:/oracle/product/coherence/lib/coherence.
jar!/tangosol-coherence.xml"
2011-03-14 17:01:25.490/0.344 Oracle Coherence 3.7.0.0 <Info> (thread=main, member=n/a): Loaded
operational overrides from "jar:file:/C:/oracle/product/coherence/lib/coherence.
jar!/tangosol-coherence-override-dev.xml"
2011-03-14 17:01:25.537/0.391 Oracle Coherence 3.7.0.0 <Info> (thread=main, member=n/a): Loaded
operational overrides from
"file:/C:/home/oracle/workspace/InsertValue/build/classes/tangosol-coherence-override.xml"
2011-03-14 17:01:25.537/0.391 Oracle Coherence 3.7.0.0 <D5> (thread=main, member=n/a): Optional
configuration override "/custom-mbeans.xml" is not specified
```

```
Oracle Coherence Version 3.7.0.0 Build 22913
 Grid Edition: Development mode
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2011-03-14 17:01:25.771/0.625 Oracle Coherence GE 3.7.0.0 <Info> (thread=main, member=n/a): Loaded
cache configuration from "jar:file:/C:/oracle/product/coherence/lib/coherence.
jar!/coherence-cache-config.xml"
2011-03-14 17:01:25.975/0.829 Oracle Coherence GE 3.7.0.0 <D4> (thread=main, member=n/a): TCMP
bound to /130.35.99.213:8088 using SystemSocketProvider
2011-03-14 17:01:29.490/4.344 Oracle Coherence GE 3.7.0.0 <Info> (thread=Cluster, member=n/a):
Created a new cluster "cluster:0x96AB" with Member(Id=1, Timestamp=2011-03-14 17:01:25.975,
Address=130.35.99.213:8088, MachineId=49877, Location=site:URL, machine_name,process:5000,
Role=OracleHandsonMyFirstSample, Edition=Grid Edition, Mode=Development, CpuCount=2, SocketCount=1)
UID=0x822363D50000012E552F4A57C2D51F98
2011-03-14 17:01:29.490/4.344 Oracle Coherence GE 3.7.0.0 <Info> (thread=main, member=n/a): Started
cluster Name=cluster:0x96AB

Group{Address=224.3.7.0, Port=3155, TTL=4}

MasterMemberSet
  (
  ThisMember=Member(Id=1, Timestamp=2011-03-14 17:01:25.975, Address=130.35.99.213:8088,
MachineId=49877, Location=site:URL, machine_name,process:5000, Role=OracleHandsonMyFirstSample)
  OldestMember=Member(Id=1, Timestamp=2011-03-14 17:01:25.975, Address=130.35.99.213:8088,
MachineId=49877, Location=site:URL, machine_name,process:5000, Role=OracleHandsonMyFirstSample)
  ActualMemberSet=MemberSet(Size=1, BitSetCount=2
    Member(Id=1, Timestamp=2011-03-14 17:01:25.975, Address=130.35.99.213:8088, MachineId=49877,
Location=site:URL, machine_name,process:5000, Role=OracleHandsonMyFirstSample)
    )
  RecycleMillis=1200000
  RecycleSet=MemberSet(Size=0, BitSetCount=0
    )
  )

TcpRing{Connections=[]}
IpMonitor{AddressListSize=0}

2011-03-14 17:01:29.521/4.375 Oracle Coherence GE 3.7.0.0 <D5> (thread=Invocation:Management,
member=1): Service Management joined the cluster with senior service member 1
2011-03-14 17:01:29.600/4.454 Oracle Coherence GE 3.7.0.0 <D5> (thread=DistributedCache, member=1):
Service DistributedCache joined the cluster with senior service member 1
Value in cache is Gene Smith
```

Create a Program to Get Values from the Cache

To create a Java class that gets the value from your cache, instead of using a `put` and then a `get` method:

1. Create another Java class with a `main` method named `MyFirstSampleReader`. See "Creating a Java Class" on page 2-11 for detailed information. Example 3–3 illustrates a sample program.

Example 3–3 Getting a Value from the Cache

```
package com.oracle.handson;

import com.tangosol.net.CacheFactory;
import com.tangosol.net.NamedCache;
```

```
public class MyFirstSampleReader {

    public MyFirstSampleReader() {
    }

    public static void main(String[] args) {
        // ensure we are in a cluser
        CacheFactory.ensureCluster();

        // create or get a named cache called mycache
        NamedCache myCache = CacheFactory.getCache("mycache");

        System.out.println("Value in cache is " + myCache.get("Name"));
    }
}
```

2. Run the `MyFirstSampleReader` class in the Eclipse IDE: right-click the `MyFirstSampleReader.java` class in the editor and select **Run As** then **Run Configuration**.

   Enter `MyFirstSampleReader` in the **Name** field of the **Run Configuration** dialog box. Ensure that `InsertValue` appears in the **Project** field in the **Main** tab and that local storage is enabled in the **Coherence** tab. Click **Apply**, then **Run**.

   Example 3–4 illustrates the output from the program. Note that a null value is returned. Although the `MyFirstSample` program successfully created and populated the `NamedCache` cache, it only existed within the `MyFirstSample` process memory. When the `MyFirstSample` program terminated so did the cache.

Example 3–4 Output of the MyFirstSampleReader Program

```
2011-03-14 17:06:17.115/0.281 Oracle Coherence 3.7.0.0 <Info> (thread=main, member=n/a): Loaded
operational configuration from "jar:file:/C:/oracle/product/coherence/lib/coherence.
jar!/tangosol-coherence.xml"
2011-03-14 17:06:17.162/0.328 Oracle Coherence 3.7.0.0 <Info> (thread=main, member=n/a): Loaded
operational overrides from "jar:file:/C:/oracle/product/coherence/lib/coherence.
jar!/tangosol-coherence-override-dev.xml"
2011-03-14 17:06:17.193/0.359 Oracle Coherence 3.7.0.0 <Info> (thread=main, member=n/a): Loaded
operational overrides from
"file:/C:/home/oracle/workspace/InsertValue/build/classes/tangosol-coherence-override.xml"
2011-03-14 17:06:17.193/0.359 Oracle Coherence 3.7.0.0 <D5> (thread=main, member=n/a): Optional
configuration override "/custom-mbeans.xml" is not specified

Oracle Coherence Version 3.7.0.0 Build 22913
 Grid Edition: Development mode
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2011-03-14 17:06:17.568/0.734 Oracle Coherence GE 3.7.0.0 <D4> (thread=main, member=n/a): TCMP
bound to /130.35.99.213:8088 using SystemSocketProvider
2011-03-14 17:06:21.115/4.281 Oracle Coherence GE 3.7.0.0 <Info> (thread=Cluster, member=n/a):
Created a new cluster "cluster:0x96AB" with Member(Id=1, Timestamp=2011-03-14 17:06:17.568,
Address=130.35.99.213:8088, MachineId=49877, Location=site:URL, machine_name,process:216,
Role=OracleHandsonMyFirstSampleReader, Edition=Grid Edition, Mode=Development, CpuCount=2,
SocketCount=1) UID=0x822363D50000012E5533BD60C2D51F98
2011-03-14 17:06:21.115/4.281 Oracle Coherence GE 3.7.0.0 <Info> (thread=main, member=n/a): Started
cluster Name=cluster:0x96AB

Group{Address=224.3.7.0, Port=3155, TTL=4}
```

```
MasterMemberSet
  (
  ThisMember=Member(Id=1, Timestamp=2011-03-14 17:06:17.568, Address=130.35.99.213:8088,
MachineId=49877, Location=site:URL, machine_name,process:216,
Role=OracleHandsonMyFirstSampleReader)
  OldestMember=Member(Id=1, Timestamp=2011-03-14 17:06:17.568, Address=130.35.99.213:8088,
MachineId=49877, Location=site:URL, machine_name,process:216,
Role=OracleHandsonMyFirstSampleReader)
  ActualMemberSet=MemberSet(Size=1, BitSetCount=2
    Member(Id=1, Timestamp=2011-03-14 17:06:17.568, Address=130.35.99.213:8088, MachineId=49877,
Location=site:URL, machine_name,process:216, Role=OracleHandsonMyFirstSampleReader)
    )
  RecycleMillis=1200000
  RecycleSet=MemberSet(Size=0, BitSetCount=0
    )
  )

TcpRing{Connections=[]}
IpMonitor{AddressListSize=0}

2011-03-14 17:06:21.162/4.328 Oracle Coherence GE 3.7.0.0 <D5> (thread=Invocation:Management,
member=1): Service Management joined the cluster with senior service member 1
2011-03-14 17:06:21.350/4.516 Oracle Coherence GE 3.7.0.0 <Info> (thread=main, member=1): Loaded
cache configuration from "jar:file:/C:/oracle/product/coherence/lib/coherence.
jar!/coherence-cache-config.xml"
2011-03-14 17:06:21.412/4.578 Oracle Coherence GE 3.7.0.0 <D5> (thread=DistributedCache, member=1):
Service DistributedCache joined the cluster with senior service member 1
Value in cache is null
2011-03-14 17:06:21.521/4.687 Oracle Coherence GE 3.7.0.0 <D4> (thread=ShutdownHook, member=1):
ShutdownHook: stopping cluster node
2011-03-14 17:06:21.521/4.687 Oracle Coherence GE 3.7.0.0 <D5> (thread=Cluster, member=1): Service
Cluster left the cluster
```

3. Start the `DefaultCacheServer` that you created in "Launching a Cache Server in the Eclipse IDE" on page 2-7. Ensure that `InsertValue` appears in the **Project** field in the **Main** tab and that local storage is enabled in the **Coherence** tab. Click **Apply**, then **Run**.
4. Run `MyFirstSample` to put the value in the `NamedCache`, and then run `MyFirstSampleReader` to read the value from the cache. Note the output illustrated in Example 3–5. The `Gene Smith` value stored by `MyFirstSample` is returned by `MyFirstSampleReader`.

Example 3–5 Output of MyFirstSampleReader Program with a Running Cache Server

```
2011-03-14 17:18:01.678/0.282 Oracle Coherence 3.7.0.0 <Info> (thread=main, member=n/a): Loaded
operational configuration from "jar:file:/C:/oracle/product/coherence/lib/coherence.
jar!/tangosol-coherence.xml"
2011-03-14 17:18:01.725/0.329 Oracle Coherence 3.7.0.0 <Info> (thread=main, member=n/a): Loaded
operational overrides from "jar:file:/C:/oracle/product/coherence/lib/coherence.
jar!/tangosol-coherence-override-dev.xml"
2011-03-14 17:18:01.756/0.360 Oracle Coherence 3.7.0.0 <Info> (thread=main, member=n/a): Loaded
operational overrides from
"file:/C:/home/oracle/workspace/InsertValue/build/classes/tangosol-coherence-override.xml"
2011-03-14 17:18:01.771/0.375 Oracle Coherence 3.7.0.0 <D5> (thread=main, member=n/a): Optional
configuration override "/custom-mbeans.xml" is not specified

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 Grid Edition: Development mode
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```

```
2011-03-14 17:18:02.131/0.735 Oracle Coherence GE 3.7.0.0 <D4> (thread=main, member=n/a): TCMP
bound to /130.35.99.213:8090 using SystemSocketProvider
2011-03-14 17:18:02.631/1.235 Oracle Coherence GE 3.7.0.0 <Info> (thread=Cluster, member=n/a): This
Member(Id=3, Timestamp=2011-03-14 17:18:02.459, Address=130.35.99.213:8090, MachineId=49877,
Location=site:URL, machine_name,process:424, Role=OracleHandsonMyFirstSampleReader, Edition=Grid
Edition, Mode=Development, CpuCount=2, SocketCount=1) joined cluster "cluster:0x96AB" with senior
Member(Id=1, Timestamp=2011-03-14 17:16:43.021, Address=130.35.99.213:8088, MachineId=49877,
Location=site:URL, machine_name,process:2692, Role=CoherenceServer, Edition=Grid Edition,
Mode=Development, CpuCount=2, SocketCount=1)
2011-03-14 17:18:02.631/1.235 Oracle Coherence GE 3.7.0.0 <D5> (thread=Cluster, member=n/a): Member
1 joined Service Cluster with senior member 1
2011-03-14 17:18:02.631/1.235 Oracle Coherence GE 3.7.0.0 <D5> (thread=Cluster, member=n/a): Member
1 joined Service Management with senior member 1
2011-03-14 17:18:02.631/1.235 Oracle Coherence GE 3.7.0.0 <D5> (thread=Cluster, member=n/a): Member
1 joined Service DistributedCache with senior member 1
2011-03-14 17:18:02.631/1.235 Oracle Coherence GE 3.7.0.0 <D5> (thread=Cluster, member=n/a): Member
1 joined Service ReplicatedCache with senior member 1
2011-03-14 17:18:02.631/1.235 Oracle Coherence GE 3.7.0.0 <D5> (thread=Cluster, member=n/a): Member
1 joined Service OptimisticCache with senior member 1
2011-03-14 17:18:02.631/1.235 Oracle Coherence GE 3.7.0.0 <D5> (thread=Cluster, member=n/a): Member
1 joined Service InvocationService with senior member 1
2011-03-14 17:18:02.631/1.235 Oracle Coherence GE 3.7.0.0 <Info> (thread=main, member=n/a): Started
cluster Name=cluster:0x96AB

Group{Address=224.3.7.0, Port=3155, TTL=4}

MasterMemberSet
  (
  ThisMember=Member(Id=3, Timestamp=2011-03-14 17:18:02.459, Address=130.35.99.213:8090,
MachineId=49877, Location=site:URL, machine_name,process:424,
Role=OracleHandsonMyFirstSampleReader)
  OldestMember=Member(Id=1, Timestamp=2011-03-14 17:16:43.021, Address=130.35.99.213:8088,
MachineId=49877, Location=site:URL, machine_name,process:2692, Role=CoherenceServer)
  ActualMemberSet=MemberSet(Size=2, BitSetCount=2
    Member(Id=1, Timestamp=2011-03-14 17:16:43.021, Address=130.35.99.213:8088, MachineId=49877,
Location=site:URL, machine_name,process:2692, Role=CoherenceServer)
    Member(Id=3, Timestamp=2011-03-14 17:18:02.459, Address=130.35.99.213:8090, MachineId=49877,
Location=site:URL, machine_name,process:424, Role=OracleHandsonMyFirstSampleReader)
    )
  RecycleMillis=1200000
  RecycleSet=MemberSet(Size=0, BitSetCount=0
    )
  )

TcpRing{Connections=[1]}
IpMonitor{AddressListSize=0}

2011-03-14 17:18:02.662/1.266 Oracle Coherence GE 3.7.0.0 <D5> (thread=Invocation:Management,
member=3): Service Management joined the cluster with senior service member 1
2011-03-14 17:18:02.756/1.360 Oracle Coherence GE 3.7.0.0 <Info> (thread=main, member=3): Loaded
cache configuration from "jar:file:/C:/oracle/product/coherence/lib/coherence.
jar!/coherence-cache-config.xml"
2011-03-14 17:18:02.818/1.422 Oracle Coherence GE 3.7.0.0 <D5> (thread=DistributedCache, member=3):
Service DistributedCache joined the cluster with senior service member 1
Value in cache is Gene Smith
2011-03-14 17:18:02.850/1.454 Oracle Coherence GE 3.7.0.0 <D4> (thread=ShutdownHook, member=3):
ShutdownHook: stopping cluster node
```

This should not be the case for a process that joins the cluster only to perform an operation, such as entering a value and then terminating, like `MyFirstSample`. By default, all processes start as storage-enabled. The process can store data as part of the cluster. Modify the process so that it is not storage-enabled.

a. Right click the `MyFirstSample` class, select **Run As** then **Run Configurations**. See "Creating a Runtime Configuration" on page 2-12 for detailed information.

b. In the Coherence tab, select **Disabled (cache client)** under **Local storage**.

This similar to setting the Java parameter `-Dtangosol.coherence.distributed.localstorage=false`.

5. Shut down any running cache servers and rerun your `MyFirstSample` class.

You will receive a message similar to the one in Example 3–6 indicating that storage is not enabled on the cluster, because you have set this member to be storage-disabled.

Example 3–6 Output of the MyFirstSample Class with Cache Storage Disabled

```
2011-03-14 17:23:46.896/0.296 Oracle Coherence 3.7.0.0 <Info> (thread=main, member=n/a): Loaded
operational configuration from "jar:file:/C:/oracle/product/coherence/lib/coherence.
jar!/tangosol-coherence.xml"
2011-03-14 17:23:46.959/0.359 Oracle Coherence 3.7.0.0 <Info> (thread=main, member=n/a): Loaded
operational overrides from "jar:file:/C:/oracle/product/coherence/lib/coherence.
jar!/tangosol-coherence-override-dev.xml"
2011-03-14 17:23:46.990/0.390 Oracle Coherence 3.7.0.0 <Info> (thread=main, member=n/a): Loaded
operational overrides from
"file:/C:/home/oracle/workspace/InsertValue/build/classes/tangosol-coherence-override.xml"
2011-03-14 17:23:46.990/0.390 Oracle Coherence 3.7.0.0 <D5> (thread=main, member=n/a): Optional
configuration override "/custom-mbeans.xml" is not specified

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 Grid Edition: Development mode
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2011-03-14 17:23:47.256/0.656 Oracle Coherence GE 3.7.0.0 <Info> (thread=main, member=n/a): Loaded
cache configuration from "jar:file:/C:/oracle/product/coherence/lib/coherence.
jar!/coherence-cache-config.xml"
2011-03-14 17:23:47.443/0.843 Oracle Coherence GE 3.7.0.0 <D4> (thread=main, member=n/a): TCMP
bound to /130.35.99.213:8088 using SystemSocketProvider
2011-03-14 17:23:50.975/4.375 Oracle Coherence GE 3.7.0.0 <Info> (thread=Cluster, member=n/a):
Created a new cluster "cluster:0x96AB" with Member(Id=1, Timestamp=2011-03-14 17:23:47.459,
Address=130.35.99.213:8088, MachineId=49877, Location=site:URL, machine_name,process:2736,
Role=OracleHandsonMyFirstSample, Edition=Grid Edition, Mode=Development, CpuCount=2, SocketCount=1)
UID=0x822363D50000012E5543C283C2D51F98
2011-03-14 17:23:50.990/4.390 Oracle Coherence GE 3.7.0.0 <Info> (thread=main, member=n/a): Started
cluster Name=cluster:0x96AB

Group{Address=224.3.7.0, Port=3155, TTL=4}

MasterMemberSet
  (
  ThisMember=Member(Id=1, Timestamp=2011-03-14 17:23:47.459, Address=130.35.99.213:8088,
MachineId=49877, Location=site:URL, machine_name,process:2736, Role=OracleHandsonMyFirstSample)
  OldestMember=Member(Id=1, Timestamp=2011-03-14 17:23:47.459, Address=130.35.99.213:8088,
MachineId=49877, Location=site:URL, machine_name,process:2736, Role=OracleHandsonMyFirstSample)
  ActualMemberSet=MemberSet(Size=1, BitSetCount=2
```

```
    Member(Id=1, Timestamp=2011-03-14 17:23:47.459, Address=130.35.99.213:8088, MachineId=49877,
Location=site:URL, machine_name,process:2736, Role=OracleHandsonMyFirstSample)
    )
  RecycleMillis=1200000
  RecycleSet=MemberSet(Size=0, BitSetCount=0
    )
  )

TcpRing{Connections=[]}
IpMonitor{AddressListSize=0}

2011-03-14 17:23:51.037/4.437 Oracle Coherence GE 3.7.0.0 <D5> (thread=Invocation:Management,
member=1): Service Management joined the cluster with senior service member 1
2011-03-14 17:23:51.178/4.578 Oracle Coherence GE 3.7.0.0 <D5> (thread=DistributedCache, member=1):
Service DistributedCache joined the cluster with senior service member 1
Exception in thread "main" com.tangosol.net.RequestPolicyException: No storage-enabled nodes exist
for service DistributedCache
   at com.tangosol.coherence.component.util.daemon.queueProcessor.service.grid.partitionedService.
PartitionedCache$BinaryMap.onMissingStorage(PartitionedCache.CDB:27)
   at com.tangosol.coherence.component.util.daemon.queueProcessor.service.grid.partitionedService.
PartitionedCache$BinaryMap.ensureRequestTarget(PartitionedCache.CDB:48)
   at com.tangosol.coherence.component.util.daemon.queueProcessor.service.grid.partitionedService.
PartitionedCache$BinaryMap.put(PartitionedCache.CDB:24)
   at com.tangosol.coherence.component.util.daemon.queueProcessor.service.grid.partitionedService.
PartitionedCache$BinaryMap.put(PartitionedCache.CDB:1)
   at com.tangosol.util.ConverterCollections$ConverterMap.put(ConverterCollections.java:1673)
   at com.tangosol.coherence.component.util.daemon.queueProcessor.service.grid.partitionedService.
PartitionedCache$ViewMap.put(PartitionedCache.CDB:1)
   at com.tangosol.coherence.component.util.SafeNamedCache.put(SafeNamedCache.CDB:1)
   at com.oracle.handson.MyFirstSample.main(MyFirstSample.java:16)
2011-03-14 17:23:51.193/4.593 Oracle Coherence GE 3.7.0.0 <D4> (thread=ShutdownHook, member=1):
ShutdownHook: stopping cluster node
```

6. Restart the `DefaultCacheServer` cache server and run `MyFirstSample` and `MyFirstSampleReader` again. You should now see that the data is persisted between running the two Java examples.

Creating Your First Coherence-Based Java Application

In this exercise, you develop a simple Java console-based application to access, update, and remove simple types of information from a Coherence clustered cache.

To perform this exercise, you must complete "Testing a Coherence Installation" on page 1-2.

Unlike client/server applications, in which client applications typically connect and disconnect from a server application, Coherence-based clustered applications simply ensure they are in a cluster, after which they can use the services of the cluster. Coherence-based applications typically do not connect to a cluster of applications; they become part of the cluster.

1. Create the Console Application
2. Run the Console Application

Create the Console Application

To create a Java console-based application to access, update, and remove simple types of information from a Coherence clustered cache:

1. Examine the methods in the `CacheFactory` class using the Coherence Java documentation (Javadoc) that is shipped in the `C:\oracle\product\coherence\doc` folder.
2. Write a simple Java console application (Java class) called `YourFirstCoherenceApplication` that uses the `CacheFactory` class to join a cluster (using the `ensureCluster` method), and then leave the cluster (using the `shutdown` method). See "Creating a Java Class" on page 2-11 for detailed information on creating a Java class.
   a. Examine the methods that are available in the `NamedCache` interface using the Javadoc.
   b. Extend your application to use the `CacheFactory` method `getCache` to acquire a `NamedCache` for the cache called `mycache` (the same cache name used in the exercise "Testing a Coherence Installation" on page 1-2).
   c. With the `NamedCache` instance, use the `get` method to retrieve the value for the key `message` (the same key used in the exercise "Testing a Coherence Installation" on page 1-2).
   d. Write the value to standard output using the `System.out.println(....)` method.

      Example 3–7 illustrates a sample Coherence-based Java application:

Example 3–7 A Coherence-Based Java Application

```
package com.oracle.handson;

import com.tangosol.net.CacheFactory;
import com.tangosol.net.NamedCache;

public class YourFirstCoherenceApplication {
public YourFirstCoherenceApplication() {
}

   public static void main(String[] args) {

      CacheFactory.ensureCluster();

      NamedCache myCache = CacheFactory.getCache("mycache");

      String message = (String)myCache.get("message");

      System.out.println(message);

      CacheFactory.shutdown();
YourFirstCoherenceApplication yourfirstcoherenceapplication = new
YourFirstCoherenceApplication();
   }

}
```

Run the Console Application

To run the Coherence application.

1. Start the `DefaultCacheServer` cache server that you created in "Launching a Cache Server in the Eclipse IDE" on page 2-7.

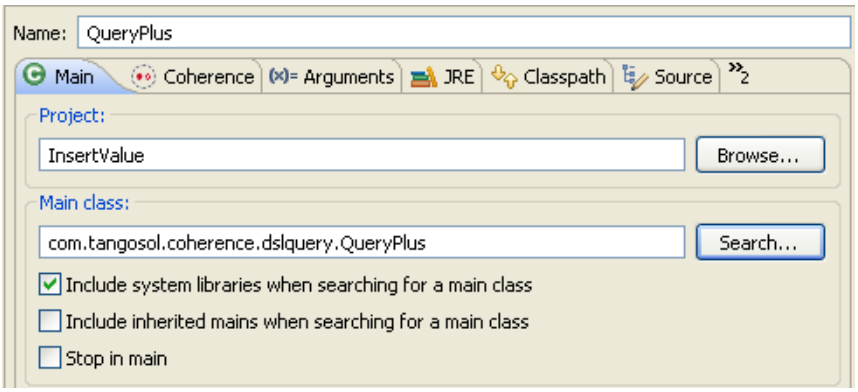
2. Create a run configuration for a cache client that uses Coherence Query Language and the `QueryHelper` API. Right click the project and select **Run As** then **Run Configurations**.

   Note: For more information about Coherence Query Language, see "Using Coherence Query Language" in *Developer's Guide for Oracle Coherence*.

   a. In the **Run Configurations** dialog box click **Oracle Coherence** then the **New launch configuration** icon. Enter `QueryPlus` as the **Name** of the configuration.

   b. In the **Main** tab, under **Project** click the **Browse** button and select the **InsertValue** project. Under **Main class**, select **Include system libraries when searching for a main class** and click the **Search** button. In the Select Main Type dialog box, enter `QueryPlus` and select **QueryPlus - com.tangosol.coherence.dslquery**. Click **OK**. The **Main** tab should look similar to Figure 3–1.

Figure 3–1 Main Tab for the Query Client Configuration



   c. In the **Coherence** tab, select **Disabled (cache client)** under **Local storage**. Enter a unique value for the **Cluster port** (the value must be the same as the value defined for the cache server you defined in the previous section).

   d. In the **Arguments** tab, enter `-showversion` in the **VM arguments** field.

   e. In the **Common** tab, select **Shared file** and click the **Browse** button to navigate to the **\InsertValue** project name. Ensure that the **Allocate console** checkbox is selected. Click **Apply**.

3. Click **Run** to start the `QueryPlus` client. You should see output similar to Example 3–8 in the Eclipse Console.

Example 3–8 Output for the QueryPlus Cache Client

```
java version "1.6.0_14"
Java(TM) SE Runtime Environment (build 1.6.0_14-b08)
Java HotSpot(TM) Client VM (build 14.0-b16, mixed mode)
Coherence Command Line Tool

CohQL>
```

4. At the `CohQL>` prompt, enter the following command to create a cache named `mycache` and to connect to it.

   ```
   CohQL> create cache "mycache"
   ```

5. Create a run configuration for `YourFirstCoherenceApplication`. In the **Run Configurations** dialog box, enter `YourFirstCoherenceApplication` in the **Name** field. In the **Main** tab, enter `InsertValue` in the **Project** field and `com.oracle.handson.YourFirstCoherenceApplication` as the **Main** class.

   In the Coherence tab, select **Disabled (cache client)** under **Local storage**, and enter a unique value for the **Cluster port** (this must be the same value that you used for the cache server and cache client).

6. Execute `YourFirstCoherenceApplication` from the Eclipse IDE and view the result.

   Example 3–9 illustrates the output from `YourFirstCoherenceApplication`. The output indicates that there is no data in the cache for the `message` key.

Example 3–9 Output of the YourFirstCoherenceApplication Class

```
...
TcpRing{Connections=[2]}
IpMonitor{AddressListSize=0}

2011-03-14 18:01:15.271/1.312 Oracle Coherence GE 3.7.0.0 <D5> (thread=Invocation:Management,
member=4): Service Management joined the cluster with senior service member 1
2011-03-14 18:01:15.381/1.422 Oracle Coherence GE 3.7.0.0 <Info> (thread=main, member=4): Loaded
cache configuration from "jar:file:/C:/oracle/product/coherence/lib/coherence.
jar!/coherence-cache-config.xml"
2011-03-14 18:01:15.443/1.484 Oracle Coherence GE 3.7.0.0 <D5> (thread=DistributedCache, member=4):
Service DistributedCache joined the cluster with senior service member 1
null
2011-03-14 18:01:15.475/1.516 Oracle Coherence GE 3.7.0.0 <D5> (thread=Invocation:Management,
member=4): Service Management left the cluster
2011-03-14 18:01:15.475/1.516 Oracle Coherence GE 3.7.0.0 <D5> (thread=DistributedCache, member=4):
Service DistributedCache left the cluster
2011-03-14 18:01:15.506/1.547 Oracle Coherence GE 3.7.0.0 <D5> (thread=Cluster, member=4): Service
Cluster left the cluster
```

7. Using the running `QueryPlus` cache client in the Eclipse Console, change the key `message`. For example, enter the following at the `CohQL>` prompt:

   ```
   CohQL> insert into "mycache" key "message" value "hello"
   ```

   Rerun `YourFirstCoherenceApplication` from the Eclipse IDE to see the changed values. Example 3–10 illustrates that the cache now holds the value `hello` for the key `message`.

Example 3–10 Output of the YourFirstCoherenceApplication Class with a New Key Value

```
...
TcpRing{Connections=[2]}
IpMonitor{AddressListSize=0}

2011-03-14 18:07:21.537/1.344 Oracle Coherence GE 3.7.0.0 <D5> (thread=Invocation:Management,
member=5): Service Management joined the cluster with senior service member 1
2011-03-14 18:07:21.631/1.438 Oracle Coherence GE 3.7.0.0 <Info> (thread=main, member=5): Loaded
cache configuration from "jar:file:/C:/oracle/product/coherence/lib/coherence.
jar!/coherence-cache-config.xml"
```

```
2011-03-14 18:07:21.693/1.500 Oracle Coherence GE 3.7.0.0 <D5> (thread=DistributedCache, member=5):
Service DistributedCache joined the cluster with senior service member 1
hello
2011-03-14 18:07:21.725/1.532 Oracle Coherence GE 3.7.0.0 <D5> (thread=Invocation:Management,
member=5): Service Management left the cluster
2011-03-14 18:07:21.725/1.532 Oracle Coherence GE 3.7.0.0 <D5> (thread=DistributedCache, member=5):
Service DistributedCache left the cluster
2011-03-14 18:07:21.756/1.563 Oracle Coherence GE 3.7.0.0 <D5> (thread=Cluster, member=5): Service
Cluster left the cluster
```

8. In the run configuration for `YourFirstCoherenceApplication`, change the value of the **Local storage** from **Enabled** to **Disabled**. Notice that the output is the same as the previous run.
9. Shut down your cache server and cache client instances. Restart the cache server and then rerun `YourFirstCoherenceApplication` (with the new value for **Local storage**). Note the output is now `null`.
10. If you change the value of the `message` key in your application (using the `put` method), verify that the new value available through the cache client.
    a. For example, comment out the `get` method and add the `put` method.

    ```
    //String message = (String)myCache.get("message");
      String message = (String)myCache.put("message", "bye");
    ```

    b. Run `YourFirstCoherenceApplication`.
    c. Run the `get` command in the `QueryPlus` cache client.

    ```
    select key(), value() from "mycache" where key() is "message"
    ```

    The output `bye` is displayed.

4

Working with Complex Objects

In this chapter, you work with complex objects located in the cache. Using Eclipse, you create a new `Contact` class, and then store and retrieve `Contact` objects in the cache using Portable Object Format (POF) serialization.

This chapter contains the following sections:

Introduction

Until now, you have been putting and getting `String` objects as the value in a `NamedCache` cache. Many of the implementations of the `get` and `put` methods in the Coherence Java API define the values and keys to be of type `Object`, for example:

```
public java.lang.Object get(java.lang.Object oKey)
public void put(java.lang.Object oKey, java.lang.Object oValue)
```

Any object can be used as a value or key. This enables you to store complex objects as values in the cache.

Because Coherence might send the object across the wire, the object must be serializable. Object serialization is the process of saving an object's state into a sequence of bytes, and then rebuilding (deserializing) the bytes into an active object at a future time. For example, objects that implement the `java.io.Serializable` interface are serializable.

As an alternative to using the Java `java.io.Serializable` interface, you can improve performance by using Coherence's own class for high-performance serialization, `com.tangosol.io.pof.PortableObject`. `PortableObject` format is up to six times faster than the standard `Serializable` and the serialized result set is smaller.

The `PortableObject` interface provides two simple methods, `readExternal` and `writeExternal`, that permit you to explicitly read and write serialized object attributes from the provided `PofReader` and `PofWriter` streams respectively. By taking control over the serialization format, Coherence provides a way to improve the performance of the process. Using POF reduces the size of the resulting binary file. The size of the binary file is often 5 to 10 times smaller, and the conversion to or from the binary file can be between 5 and 20 times faster, depending on the size of the object.

Creating and Caching Complex Objects

In this exercise, you create a `Contact` object that contains names, addresses, dates of birth, and telephone numbers for employees. You also use POF serialization to put the objects in the cache and retrieve them by implementing the `PortableObject` interface.

1. Create the Data Objects
2. Create the Complex Object
3. Create the Driver Class
4. Create the POF and Cache Configuration Files
5. Run the Sample Project

Create the Data Objects

This section describes how to create two data objects that will later be incorporated into another data object. An `Address` object will provide employee address information and a `PhoneNumber` object will provide telephone contact information.

1. Create an `Address` object to store address information for an employee.

   a. Create a new Application Client Project in Eclipse called `Contacts`. Ensure that the `CoherenceConfig` is selected in the **Configuration** field on the opening page and the **Create a default main** is *not* selected on the Application Client module page.

      See "Creating a New Project in the Eclipse IDE" on page 2-3 for detailed information.

   b. Create a new Java class called `Address`. Ensure that the **Default Package** is `com.oracle.handson`. Do not select the **Main Method** check box. See "Creating a Java Class" on page 2-11 for detailed information.

   c. Write the class to use the `PortableObject` interface for data serialization. In the Eclipse code editor, change your generated `Address` class to implement `com.tangosol.io.pof.PortableObject`. Add an `import` statement for the `PortableObject` interface.

   d. Import the `com.tangosol.io.pof.PofReader`, `com.tangosol.io.pof.PofWriter` and `java.io.IOException` classes required by the `PortableObject` interface.

   e. Add the default public constructor for `Address` that is required by the `PortableObject` interface.

   f. Enter the following private attributes for your `Address` class. You can add others if you like.

      — `String Street1`

      — `String Street2`

      — `String City`

      — `String State`

      — `String Country`

      At this point, the `Address` class should look similar to the following:

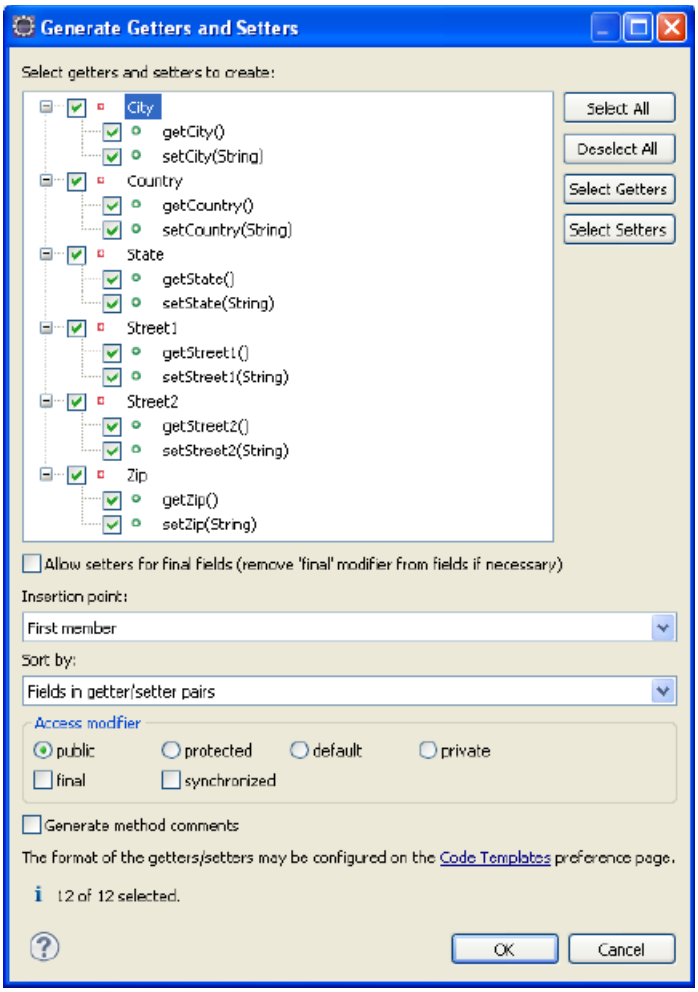
      ```
      package com.oracle.handson;
      ```

```
import com.tangosol.io.pof.PofReader;
import com.tangosol.io.pof.PortableObject;
import com.tangosol.io.pof.PofWriter;

import java.io.IOException;

public class Address  implements PortableObject
{
           private String Street1;
           private String Street2;
           private String City;
           private String State;
           private String Zip;
           private String Country;
    /**
    * Default constructor (necessary for PortableObject implementation).
    */
    public Address()
        {
        }
}
```

g. Eclipse can generate the default `get` and `set` methods for your attributes. From the **Source** menu, select **Generate Getters and Setters**. Click **Select All** to select all of the attributes in the class. All of the attributes are now automatically selected. Click **OK** to continue.

Figure 4–1 illustrates the **Generate Getters and Setters** dialog box with the generated accessors for the `Address` class.

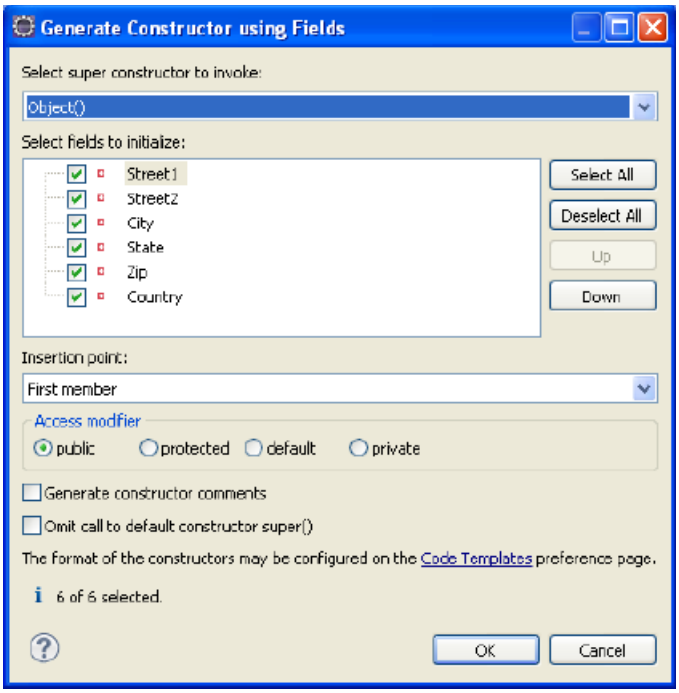
Figure 4–1 Generate Getters and Setters Dialog Box



h. You can also generate the default constructor and `equals` methods automatically. From the **Source** menu, select **Generate Constructor using Fields**, click **Select All**, and then click **OK**.

Figure 4–2 illustrates the **Generate Constructor using Fields** dialog box with the `Street1`, `Street2`, `City`, `State`, `Zip`, and `Country` fields selected.

Figure 4–2 Generate Constructors using Fields Dialog Box



Add "`this`" to the members of the generated constructor. The generated constructor should then look similar to the following:

```
    public Address(String Street1, String Street2, String City, String
State, String Zip, String Country) {
        super();
        this.Street1 = Street1;
        this.Street2 = Street2;
        this.City = City;
        this.State = State;
        this.Zip = Zip;
        this.Country = Country;
    }
```

i. Implement the `readExternal` and `writeExternal` methods as required by the `PortableObject` interface. For example, the following implementation of the `readExternal` method enables the values for the street, city, state, and country to be read as POF objects.

```
public void readExternal(PofReader reader)
        throws IOException
     {
     setStreet1(reader.readString(0));
     setStreet2(reader.readString(1));
     setCity(reader.readString(2));
     setState(reader.readString(3));
     setZip(reader.readString(4));
     setCountry(reader.readString(5));
}
```

j. Implement the `equals`, `hashCode`, and `toString` object methods.

Note: Cache keys and values must be serializable (for example, `java.io.Serializable`). Cache keys must also provide an implementation of the `hashCode()` and `equals()` methods, and those methods must return consistent results across cluster nodes. This implies that the implementation of `hashCode()` and `equals()` must be based solely on the object's serializable state (that is, the object's nontransient fields); most built-in Java types, such as `String`, `Integer` and `Date`, meet this requirement. Some cache implementations (specifically the partitioned cache) use the serialized form of the key objects for equality testing, which means that keys for which the `equals()` method returns `true` must serialize identically; most built-in Java types meet this requirement.

To support these methods, import the `com.tangosol.util.Base` and `com.tangosol.util.HashHelper` classes. The `Base` class provides support for the `equals` method. The `HashHelper` class contains helper functions for calculating hash code values for any group of Java intrinsics.

The following code illustrates a sample implementation of the `equals()` method:

```
public boolean equals(Object oThat)
    {
    if (this == oThat)
        {
        return true;
        }
    if (oThat == null)
        {
        return false;
        }

    Address that = (Address) oThat;
    return Base.equals(getStreet1(), that.getStreet1()) &&
           Base.equals(getStreet2(), that.getStreet2()) &&
           Base.equals(getCity(),    that.getCity())    &&
           Base.equals(getState(),   that.getState())   &&
           Base.equals(getZip(),     that.getZip())     &&
           Base.equals(getCountry(), that.getCountry());
    }
```

The following code illustrates a sample implementation of the `hashCode()` method:

```
public int hashCode()
    {
    return HashHelper.hash(getStreet1(),
           HashHelper.hash(getStreet2(),
           HashHelper.hash(getZip(), 0)));
    }
```

The following code illustrates a sample implementation of the `toString()` method:

```
public String toString()
    {
    return  getStreet1() + "\n" +
            getStreet2() + "\n" +
```

```
                        getCity() + ", " + getState() + " "  + getZip() + "\n" +
                        getCountry();
                }
```

k. The resulting class should look similar to Example 4–1.

Example 4–1 Implementation of an Address Class

```
package com.oracle.handson;

import com.tangosol.io.pof.PofReader;
import com.tangosol.io.pof.PortableObject;
import com.tangosol.io.pof.PofWriter;

import com.tangosol.util.Base;
import com.tangosol.util.HashHelper;

import java.io.IOException;

public class Address  implements PortableObject
           {
           private String Street1;
           private String Street2;
           private String City;
           private String State;
           private String Zip;
           private String Country;
    /**
    * Default constructor (necessary for PortableObject implementation).
    */
    public Address() {
        }

    public Address(String Street1, String Street2, String City, String State,
                   String Zip, String Country)
       {
        super();
        this.Street1 = Street1;
        this.Street2 = Street2;
        this.City    = City;
        this.State   = State;
        this.Zip     = Zip;
        this.Country = Country;
    }

    //------------ accessors--------------------------------

    public void setStreet1(String Street1)
        {
        this.Street1 = Street1;
        }

    public String getStreet1()
        {
        return Street1;
        }

    public void setStreet2(String Street2)
        {
        this.Street2 = Street2;
```

```
    }

public String getStreet2()
    {
    return Street2;
    }

public void setCity(String City)
    {
    this.City = City;
    }

public String getCity()
    {
    return City;
    }

public void setState(String State)
    {
    this.State = State;
    }

public String getState()
    {
    return State;
    }

public void setZip(String Zip)
    {
    this.Zip = Zip;
    }

public String getZip()
    {
    return Zip;
    }

public void setCountry(String Country)
    {
    this.Country = Country;
    }

public String getCountry()
    {
    return Country;
    }
// -------- PortableObject Interface------------------------------

public void readExternal(PofReader reader)
        throws IOException
    {
    setStreet1(reader.readString(0));
    setStreet2(reader.readString(1));
    setCity(reader.readString(2));
    setState(reader.readString(3));
    setZip(reader.readString(4));
    setCountry(reader.readString(5));
    }

public void writeExternal(PofWriter writer)
```

```
            throws IOException
        {
        writer.writeString(0, getStreet1());
        writer.writeString(1, getStreet2());
        writer.writeString(2, getCity());
        writer.writeString(3, getState());
        writer.writeString(4, getZip());
        writer.writeString(5, getCountry());
        }
    // ----- Object methods ---------------------------------------------------


    public boolean equals(Object oThat)
        {
        if (this == oThat)
            {
            return true;
            }
        if (oThat == null)
            {
            return false;
            }

        Address that = (Address) oThat;
        return Base.equals(getStreet1(), that.getStreet1()) &&
               Base.equals(getStreet2(), that.getStreet2()) &&
               Base.equals(getCity(),    that.getCity())    &&
               Base.equals(getState(),   that.getState())   &&
               Base.equals(getZip(),     that.getZip())     &&
               Base.equals(getCountry(), that.getCountry());
        }


    public int hashCode()
        {
        return HashHelper.hash(getStreet1(),
               HashHelper.hash(getStreet2(),
               HashHelper.hash(getZip(), 0)));
        }


    public String toString()
        {
        return  getStreet1() + "\n" +
                getStreet2() + "\n" +
                getCity() + ", " + getState() + " "  + getZip() + "\n" +
                getCountry();
        }
}
```

2. Create a `PhoneNumber` class to store telephone contact data.

   a. Create a new Java class called `PhoneNumber`. Do not include a `main` method.

      See "Creating a Java Class" on page 2-11 for detailed information.

   b. Use the `PortableObject` interface for data serialization. In the Eclipse code editor, change your generated `PhoneNumber` class to implement `PortableObject`. Add an `import` statement for the `com.tangosol.io.pof.PortableObject` interface.

c. Import the `com.tangosol.io.pof.PofReader`, `com.tangosol.io.pof.PofWriter`, and `java.io.IOException` classes required by the `PortableObject` interface.

d. Add the default public constructor for the `PhoneNumber` class that is required by the `PortableObject` interface.

e. Enter the following private attributes for your `PhoneNumber` class. You can add others.

—`short AccessCode`

—`short CountryCode`

—`short AreaCode`

—`int LocalNumber`

f. Eclipse can generate the default `get` and `set` methods for your attributes. From the **Source** menu, select **Generate Getters and Setters**. Click **Select All** to select all of the attributes in the class. All of the attributes are now automatically selected. Click **OK** to continue.

g. You can also generate the default constructor and `equals` methods automatically. From the **Source** menu, select **Generate Constructor using Fields**, click **Select All**, and then click **OK**.

Add "`this`" to the members of the generated constructor. The generated constructor then looks similar to the following:

```
public PhoneNumber(short AccessCode, short CountryCode, short AreaCode,
             int LocalNumber) {
    super();
    this.AccessCode = AccessCode;
    this.CountryCode = CountryCode;
    this.AreaCode = AreaCode;
    this.LocalNumber = LocalNumber;
    }
```

h. Implement the `readExternal` and `writeExternal` methods as required by the `PortableObject` interface.

i. Implement the `equals`, `hashCode` and `toString` object methods.

j. The resulting class looks similar to Example 4–2.

Example 4–2 Implementation of a PhoneNumber Class

```
package com.oracle.handson;

import com.tangosol.io.pof.PofReader;
import com.tangosol.io.pof.PofWriter;
import com.tangosol.io.pof.PortableObject;

import com.tangosol.util.HashHelper;

import java.io.IOException;

public class PhoneNumber implements PortableObject
{

    private short AccessCode;
    private short CountryCode;
    private short AreaCode;
```

```
private int LocalNumber;


//------------ constructors --------------------------------

/**
* Default constructor (necessary for PortableObject implementation).
*/
public PhoneNumber() {
}

public PhoneNumber(short AccessCode, short CountryCode, short AreaCode,
             int LocalNumber)
    {
    super();
    this.AccessCode = AccessCode;
    this.CountryCode = CountryCode;
    this.AreaCode = AreaCode;
    this.LocalNumber = LocalNumber;
    }

//------------ accessors--------------------------------

public void setAccessCode(short AccessCode)
    {
    this.AccessCode = AccessCode;
    }

public short getAccessCode()
    {
    return AccessCode;
    }

public void setCountryCode(short CountryCode)
    {
    this.CountryCode = CountryCode;
    }

public short getCountryCode()
    {
    return CountryCode;
    }

public void setAreaCode(short AreaCode)
    {
    this.AreaCode = AreaCode;
    }

public short getAreaCode()
    {
    return AreaCode;
    }

public void setLocalNumber(int LocalNumber)
    {
    this.LocalNumber = LocalNumber;
    }

public int getLocalNumber()
   {
```

```
    return LocalNumber;
    }
// -------- PortableObject Interface------------------------------

public void readExternal(PofReader reader)
        throws IOException
    {
    setAccessCode(reader.readShort(0));
    setCountryCode(reader.readShort(1));
    setAreaCode(reader.readShort(2));
    setLocalNumber(reader.readInt(3));
    }


public void writeExternal(PofWriter writer)
        throws IOException
    {
    writer.writeShort(0, getAccessCode());
    writer.writeShort(1, getCountryCode());
    writer.writeShort(2, getAreaCode());
    writer.writeInt(3, getLocalNumber());
    }
// ----- Object methods ---------------------------------------------------

/**
* {@inheritDoc}
*/
public boolean equals(Object oThat)
    {
    if (this == oThat)
        {
        return true;
        }
    if (oThat == null)
        {
        return false;
        }

    PhoneNumber that = (PhoneNumber) oThat;
    return getAccessCode()  == that.getAccessCode()  &&
           getCountryCode() == that.getCountryCode() &&
           getAreaCode()    == that.getAreaCode()    &&
           getLocalNumber() == that.getLocalNumber();
    }

/**
* {@inheritDoc}
*/
public int hashCode()
    {
    return HashHelper.hash(getAreaCode(),
           HashHelper.hash(getLocalNumber(), 0));
    }

/**
* {@inheritDoc}
*/
public String toString()
    {
    return "+" + getAccessCode() + " " + getCountryCode() + " "
```

```
                    + getAreaCode()   + " " + getLocalNumber();
        }
}
```

Create the Complex Object

The `Contact` object provides the name, address, and telephone information of employees by incorporating the `Address` and `PhoneNumber` data objects.

1. Create a new Java class called `Contact`. Do not include a `main` method.

   See "Creating a Java Class" on page 2-11 for more information.

2. Because the class uses the `PortableObject` interface for data serialization, change your generated `Contact` class to implement `PortableObject` in the Eclipse code editor. Add an `import` statement for the `com.tangosol.io.pof.PortableObject` interface.

3. Import the `com.tangosol.io.pof.PofReader` and `com.tangosol.io.pof.PofWriter` and `java.io.IOException` classes required by `PortableObject`.

4. Add the default public constructor for `Contact` that is required by `PortableObject`.

5. Enter the following private attributes for your `Contact` class. You can add others.

   - `String FirstName`
   - `String LastName`
   - `Address HomeAddress`
   - `Address WorkAddress`
   - `Map TelephoneNumbers`
   - `java.sql.Date BirthDate`

6. Eclipse can generate the default `get` and `set` methods for your attributes. From the **Source** menu, select **Generate Getters and Setters**. Click **Select All** to select all of the attributes in the class. Click **OK** to continue.

7. Create an accessor, `getAge`, to calculate the age of an employee:

   ```
   public int getAge()
           {
           return (int) ((System.currentTimeMillis() - BirthDate.getTime()) /
   MILLIS_IN_YEAR);
           }
   ```

8. Add a definition for `MILLIS_IN_YEAR`.

   ```
   public static final long MILLIS_IN_YEAR = 1000L * 60L * 60L * 24L * 365L;
   ```

9. You can generate the default constructor automatically. From the **Source** menu, select **Generate Constructor using Fields**, click **Select All**, and then click **OK**.

   The generated constructor looks similar to the following:

   ```
   public Contact(String FirstName, String LastName, Address HomeAddress,
                  Address WorkAddress, Map TelephoneNumbers, Date BirthDate) {
       super();
       this.FirstName = FirstName;
       this.LastName = LastName;
       this.HomeAddress = HomeAddress;
       this.WorkAddress = WorkAddress;
   ```

```
        this.TelephoneNumbers = TelephoneNumbers;
        this.BirthDate = BirthDate;
    }
```

10. Implement the `readExternal` and `writeExternal` methods as required by the `PortableObject` interface.
11. Implement the `equals`, `hashCode`, and `toString` object methods.
12. The resulting class looks similar to Example 4–3.

Example 4–3 Sample Contact Class

```
package com.oracle.handson;

import com.tangosol.io.pof.PortableObject;

import com.tangosol.io.pof.PofReader;
import com.tangosol.io.pof.PofWriter;

import java.io.IOException;

import java.sql.Date;

import java.util.Iterator;
import java.util.Map;

public class Contact implements PortableObject
       {
       private String FirstName;
       private String LastName;
       private Address HomeAddress;
       private Address WorkAddress;
       private Map TelephoneNumbers;
       private java.sql.Date BirthDate;

    // ----- constructors ---------------------------------------------------

    /**
    * Default constructor (necessary for PortableObject implementation).
    */
    public Contact()
        {
        }

    public Contact(String FirstName, String LastName, Address HomeAddress,
                   Address WorkAddress, Map TelephoneNumbers, Date BirthDate)
        {
        super();
        this.FirstName = FirstName;
        this.LastName = LastName;
        this.HomeAddress = HomeAddress;
        this.WorkAddress = WorkAddress;
        this.TelephoneNumbers = TelephoneNumbers;
        this.BirthDate = BirthDate;
        }

    // -------- accessors ------------------------------------------

    public void setFirstName(String FirstName)
        {
```

```
    this.FirstName = FirstName;
    }

public String getFirstName()
    {
    return FirstName;
    }

public void setLastName(String LastName)
    {
    this.LastName = LastName;
    }

public String getLastName()
    {
    return LastName;
    }

public void setHomeAddress(Address HomeAddress)
    {
    this.HomeAddress = HomeAddress;
    }

public Address getHomeAddress()
    {
    return HomeAddress;
    }

public void setWorkAddress(Address WorkAddress)
    {
    this.WorkAddress = WorkAddress;
    }

public Address getWorkAddress()
    {
    return WorkAddress;
    }

public void setTelephoneNumbers(Map TelephoneNumbers)
    {
    this.TelephoneNumbers = TelephoneNumbers;
    }

public Map getTelephoneNumbers()
    {
    return TelephoneNumbers;
    }

public void setBirthDate(Date BirthDate)
    {
    this.BirthDate = BirthDate;
    }

public Date getBirthDate()
    {
    return BirthDate;
    }
/**
* Get age.
*
```

```
* @return age
*/
public int getAge()
    {
    return (int) ((System.currentTimeMillis() - BirthDate.getTime()) /
            MILLIS_IN_YEAR);
    }


// ----- PortableObject interface ---------------------------------------

/**
* {@inheritDoc}
*/
public void readExternal(PofReader reader)
        throws IOException
    {
    setFirstName(reader.readString(0));
    setLastName(reader.readString(1));
    setHomeAddress((Address) reader.readObject(2));
    setWorkAddress((Address) reader.readObject(3));
    setTelephoneNumbers(reader.readMap(4, null));
    setBirthDate(new Date(reader.readLong(5)));
    }

/**
* {@inheritDoc}
*/
public void writeExternal(PofWriter writer)
        throws IOException
    {
    writer.writeString(0, getFirstName());
    writer.writeString(1, getLastName());
    writer.writeObject(2, getHomeAddress());
    writer.writeObject(3, getWorkAddress());
    writer.writeMap(4, getTelephoneNumbers());
    writer.writeLong(5, getBirthDate().getTime());
    }


// ----- Object methods -------------------------------------------------

/**
* {@inheritDoc}
*/
public String toString()
    {
    StringBuffer sb = new StringBuffer(getFirstName())
            .append(" ")
            .append(getLastName())
            .append("\nAddresses")
            .append("\nHome: ").append(getHomeAddress())
            .append("\nWork: ").append(getWorkAddress())
            .append("\nTelephone Numbers");

    for (Iterator iter = TelephoneNumbers.entrySet().iterator();
         iter.hasNext(); )
        {
        Map.Entry entry = (Map.Entry) iter.next();
        sb.append("\n")
```

```
                .append(entry.getKey()).append(": ").append(entry.getValue());
            }
        return sb.append("\nBirth Date: ").append(getBirthDate()).toString();
        }
    /**
    * Approximate number of millis in a year ignoring things such as leap
    * years. Suitable for example use only.
    */
    public static final long MILLIS_IN_YEAR = 1000L * 60L * 60L * 24L * 365L;

}
```

Create the Driver Class

Create a driver class called `ContactDriver` to put `Contact` entries into the cache and retrieve them.

1. Create a new Java class called `ContactDriver` in the `Contacts` project. Ensure that it includes a `main` method.

   See "Creating a Java Class" on page 2-11 for detailed information.

2. In the `ContactDriver` class, create a new `NamedCache` called `contact` and put a new instance of the `Contact` object in it. Get the `Contact` object from the cache and ensure that the two objects are identical. Example 4–4 illustrates a sample implementation of this class.

Example 4–4 Sample ContactDriver Class

```
package com.oracle.handson;

import com.tangosol.net.CacheFactory;
import com.tangosol.net.NamedCache;

import java.sql.Date;

import java.util.Map;
import java.util.HashMap;

public class ContactDriver {

    public ContactDriver()
    {
    }

    public static void main(String[] args) {
       NamedCache contact = CacheFactory.getCache("contact");

       Address homeAddress = new Address ("4157 Wash Ave", "Suite 4",
                                  "Burlingame", "CA", "94407", "USA");
       Address workAddress = new Address ("500 Oracle Pkwy", "MS989",
                                  "Redwood Shores", "CA", "94065", "USA");
       Date date = new Date(2009, 04, 01);
       PhoneNumber phonenumber = new PhoneNumber ((short)11, (short)650,
(short)506, 7000);
       Map map = new HashMap();
       map.put("home", phonenumber);

       Contact con1 = new Contact("Tom", "Dunn", homeAddress, workAddress,
                                    map, date);
```

```
        contact.put(con1.getFirstName(),con1);

        Contact con2 = (Contact)contact.get(con1.getFirstName());

        if (con2.getFirstName().equals(con1.getFirstName()))
        {
        System.out.println("They are the same!!");
        }
    }
}
```

Create the POF and Cache Configuration Files

To use POF serialization, you must register your user-defined objects in a POF configuration file. The configuration associates the class of a user-defined object with a numeric value. You must also specify POF serialization and the name of the POF configuration file in the cache configuration file.

1. Create a POF configuration file for the `Contact`, `Address`, and `PhoneNumber` objects.
   a. To create a POF configuration file for your data types, use the `pof-config.xml` file that was created with your project.
   b. Define `<user-type>` elements for the `Contact`, `Address`, and `PhoneNumber` objects, assign type IDs `1001`, `1002`, and `1003` to them and provide their full class names. The file must include the `coherence-pof-config.xml` file which reserves the first 1000 IDs for Coherence data types.
   c. Rename the file in the **Project Explorer** and save it as `contacts-pof-config.xml` (it will be saved to the `C:\home\oracle\workspace\Contacts\appClientModule` folder). Example 4–5 illustrates a sample `contacts-pof-config.xml` file.

Example 4–5 POF Configuration File

```
<?xml version="1.0"?>
<pof-config xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
             xmlns="http://xmlns.oracle.com/coherence/coherence-pof-config"
             xsi:schemaLocation="http://xmlns.oracle.com/coherence/coherence-pof-
config coherence-pof-config.xsd">

  <user-type-list>

    <!-- coherence POF user types -->
    <include>coherence-pof-config.xml</include>

    <!-- com.tangosol.examples package -->
    <user-type>
      <type-id>1001</type-id>
      <class-name>com.oracle.handson.Contact</class-name>
    </user-type>
    <user-type>
      <type-id>1002</type-id>
      <class-name>com.oracle.handson.Address</class-name>
    </user-type>
    <user-type>
        <type-id>1003</type-id>
      <class-name>com.oracle.handson.PhoneNumber</class-name>
    </user-type>
  </user-type-list>
```

```
  <allow-interfaces>true</allow-interfaces>
  <allow-subclasses>true</allow-subclasses>
</pof-config>
```

2. Create a cache configuration file. You can use the `coherence-cache-config.xml` file in the **Project Explorer**, which is based on the `coherence-cache-config.xsd` file. You can also find a copy of `coherence-cache-config.xml` file in the `coherence.jar` file.

   a. Use `ExamplesPartitionedPocScheme` as the `scheme-name` and `PartitionedPofCache` as the `service-name`.

   b. The `serializer` section is responsible for mapping a POF serialized object to an appropriate serialization routine which is either a `PofSerializer` or by calling through the `PortableObject` interface. In this case, use the `com.tangosol.io.pof.ConfigurablePofContext` class.

   c. Use the `<init-param>` section to point to the name of the POF configuration file, in this case `contacts-pof-config.xml`.

   d. Rename the file in the **Project Explorer** and save it as `contacts-cache-config.xml` (it will be saved to the `C:\home\oracle\workspace\Contacts\appClientModule` folder). Example 4–6 illustrates a sample `contacts-cache-config.xml` file.

Example 4–6 Cache Configuration File

```
<?xml version="1.0"?>

<cache-config xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
              xmlns="http://xmlns.oracle.com/coherence/coherence-cache-config"
              xsi:schemaLocation="http://xmlns.oracle.com/coherence/coherence-
cache-config coherence-cache-config.xsd">

  <caching-scheme-mapping>
    <cache-mapping>
      <cache-name>*</cache-name>
      <scheme-name>ExamplesPartitionedPofScheme</scheme-name>
    </cache-mapping>
  </caching-scheme-mapping>

  <caching-schemes>
    <distributed-scheme>
      <scheme-name>ExamplesPartitionedPofScheme</scheme-name>
      <service-name>PartitionedPofCache</service-name>
      <serializer>
       <instance>
        <class-name>com.tangosol.io.pof.ConfigurablePofContext</class-name>
          <init-params>
            <init-param>
              <param-type>String</param-type>
              <param-value>contacts-pof-config.xml</param-value>
            </init-param>
          </init-params>
       </instance>
      </serializer>
      <backing-map-scheme>
        <local-scheme>
          <!-- each node will be limited to 250MB -->
          <high-units>250M</high-units>
          <unit-calculator>binary</unit-calculator>
```

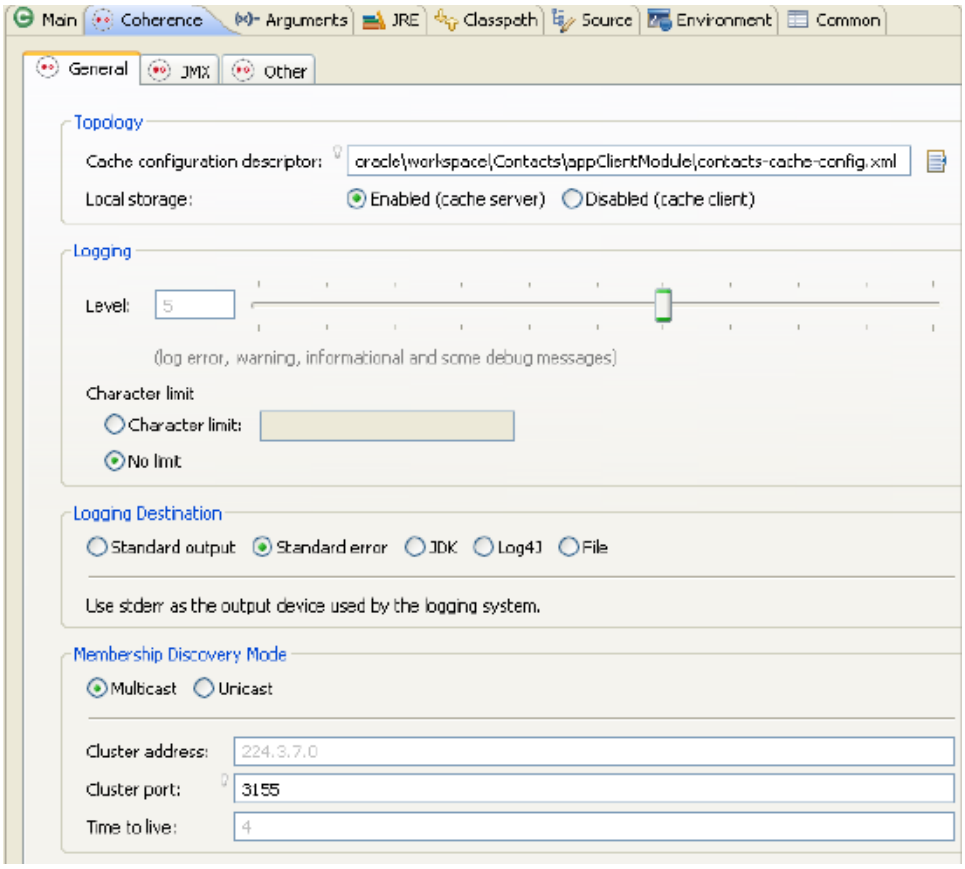
```
        </local-scheme>
      </backing-map-scheme>
      <autostart>true</autostart>
    </distributed-scheme>
  </caching-schemes>
</cache-config>
```

Run the Sample Project

The contacts project requires a cache server to be running. The cache server and the application must reference the same POF and cache configuration files. This section describes how to create run configurations for the cache server and the application.

1. Stop any cache servers that are running. See "Stopping Cache Servers" on page 2-13 for detailed information.
2. Create an executable file to start the cache server.
   a. Right click the project and select **Run As** then **Run Configurations**. In the **Run Configurations** dialog box, enter `ContactsCacheServer` in the **Name** field.
   b. In the Main tab, ensure that **Contacts** appears in the **Project** field. Select the **Include system libraries when searching for a main class** checkbox and click the **Search** button. In the **Select Main Type** dialog box, enter `DefaultCacheServer` and select the **DefaultCacheServer - com.tangosol.net** class. Click **OK** in the **Select Main Type** dialog box, then **Apply** in the **Run Configurations** dialog box.
   c. In the **General** tab of the **Coherence** tab, select **Absolute File Path** in the **Topology** field and browse to the `contacts-cache-config.xml` file in the `C:\home\oracle\workspace\Contacts\appClientModule` directory. Ensure that **Enabled (cache server)** is selected. Enter a unique value for the **Cluster port**. Click **Apply**. The **General** tab should look similar to Figure 4–3.

Figure 4–3 Coherence Tab for the Contacts Cache Server Executable



d. In the **Other** tab of the **Coherence** tab, scroll down to the `tangosol.pof.config` item. Enter the path to the POF configuration file: `C:\home\oracle\workspace\Contacts\appClientModule\contacts-pof-config.xml`.

e. In the **Arguments** tab, enter `-showversion` under **VM Arguments**.

f. In the **Classpath** tab, ensure that the **Contacts** project appears under **User Entries**.

g. In the **Common** tab, select **Shared file** and browse for the **\Contacts** project.

h. Click **Run** to start the `Contacts` cache server. The output should be similar to Example 4–7.

Example 4–7 Output from the Contacts Cache Server

```
java version "1.6.0_14"
Java(TM) SE Runtime Environment (build 1.6.0_14-b08)
Java HotSpot(TM) Client VM (build 14.0-b16, mixed mode)
2011-03-15 15:30:10.095/0.125 Oracle Coherence 3.7.0.0 <Info> (thread=main, member=n/a): Loaded
operational configuration from "jar:file:/C:/oracle/product/coherence/lib/coherence.jar!/tangosol-
coherence.xml"
2011-03-15 15:30:10.095/0.125 Oracle Coherence 3.7.0.0 <Info> (thread=main, member=n/a): Loaded
operational overrides from "jar:file:/C:/oracle/product/coherence/lib/coherence.jar!/tangosol-
coherence-override-dev.xml"
2011-03-15 15:30:10.095/0.125 Oracle Coherence 3.7.0.0 <Info> (thread=main, member=n/a): Loaded
operational overrides from "file:/C:/home/oracle/workspace/Contacts/build/classes/tangosol-
coherence-override.xml"
```

```
2011-03-15 15:30:10.095/0.125 Oracle Coherence 3.7.0.0 <D5> (thread=main, member=n/a): Optional
configuration override "/custom-mbeans.xml" is not specified

Oracle Coherence Version 3.7.0.0 Build 22913
 Grid Edition: Development mode
Copyright (c) 2000, 2010, Oracle and/or its affiliates. All rights reserved.

2011-03-15 15:30:10.267/0.297 Oracle Coherence GE 3.7.0.0 <Info> (thread=main, member=n/a): Loaded
cache configuration from "file:/C:/home/oracle/workspace/Contacts/appClientModule/contacts-cache-
config.xml"
2011-03-15 15:30:10.455/0.485 Oracle Coherence GE 3.7.0.0 <D4> (thread=main, member=n/a): TCMP
bound to /130.35.99.213:8088 using SystemSocketProvider
2011-03-15 15:30:13.970/4.000 Oracle Coherence GE 3.7.0.0 <Info> (thread=Cluster, member=n/a):
Created a new cluster "cluster:0x96AB" with Member(Id=1, Timestamp=2011-03-15 15:30:10.47,
Address=130.35.99.213:8088, MachineId=49877, Location=site:URL, machine_name,process:4780,
Role=CoherenceServer, Edition=Grid Edition, Mode=Development, CpuCount=2, SocketCount=1)
UID=0x822363D50000012EBBA3FF26C2D51F98
2011-03-15 15:30:13.970/4.000 Oracle Coherence GE 3.7.0.0 <Info> (thread=main, member=n/a): Started
cluster Name=cluster:0x96AB

Group{Address=224.3.7.0, Port=3155, TTL=4}

MasterMemberSet
  (
  ThisMember=Member(Id=1, Timestamp=2011-03-15 15:30:10.47, Address=130.35.99.213:8088,
MachineId=49877, Location=site:URL, machine_name,process:4780, Role=CoherenceServer)
  OldestMember=Member(Id=1, Timestamp=2011-03-15 15:30:10.47, Address=130.35.99.213:8088,
MachineId=49877, Location=site:URL, machine_name,process:4780, Role=CoherenceServer)
  ActualMemberSet=MemberSet(Size=1, BitSetCount=2
    Member(Id=1, Timestamp=2011-03-15 15:30:10.47, Address=130.35.99.213:8088, MachineId=49877,
Location=site:URL, machine_name,process:4780, Role=CoherenceServer)
    )
  RecycleMillis=1200000
  RecycleSet=MemberSet(Size=0, BitSetCount=0
    )
  )

TcpRing{Connections=[]}
IpMonitor{AddressListSize=0}

2011-03-15 15:30:14.017/4.047 Oracle Coherence GE 3.7.0.0 <D5> (thread=Invocation:Management,
member=1): Service Management joined the cluster with senior service member 1
2011-03-15 15:30:14.189/4.219 Oracle Coherence GE 3.7.0.0 <Info>
(thread=DistributedCache:PartitionedPofCache, member=1): Loaded POF configuration from
"file:/C:/home/oracle/workspace/Contacts/build/classes/contacts-pof-config.xml"
2011-03-15 15:30:14.189/4.219 Oracle Coherence GE 3.7.0.0 <Info>
(thread=DistributedCache:PartitionedPofCache, member=1): Loaded included POF configuration from
"jar:file:/C:/oracle/product/coherence/lib/coherence.jar!/coherence-pof-config.xml"
2011-03-15 15:30:14.220/4.250 Oracle Coherence GE 3.7.0.0 <D5>
(thread=DistributedCache:PartitionedPofCache, member=1): Service PartitionedPofCache joined the
cluster with senior service member 1
2011-03-15 15:30:14.252/4.282 Oracle Coherence GE 3.7.0.0 <Info> (thread=main, member=1):
Services
  (
  ClusterService{Name=Cluster, State=(SERVICE_STARTED, STATE_JOINED), Id=0, Version=3.7pre,
OldestMemberId=1}
  InvocationService{Name=Management, State=(SERVICE_STARTED), Id=1, Version=3.1, OldestMemberId=1}
  PartitionedCache{Name=PartitionedPofCache, State=(SERVICE_STARTED), LocalStorage=enabled,
PartitionCount=257, BackupCount=1, AssignedPartitions=257, BackupPartitions=0}
  )
```

```
Started DefaultCacheServer...
```

3. Create a run configuration for the `ContactDriver` executable.
   - Right click the `ContactDriver.java` file in the **Project Explorer** and select **Run As** then **Run Configurations**.
   - In the **Run Configurations** dialog box, double-click the Oracle Coherence node. Enter `ContactsDriver` in the **Name** field. In the **Main** tab, browse for `Contacts` in the **Project** field, and `com.oracle.handson.ContactDriver` in the **Main class** field. Click **Apply**.
   - In the **General** tab of the **Coherence** tab, browse for the absolute path to the `contacts-cache-config.xml` file in the **Cache configuration descriptor** field. Select the **Disable (cache client)** radio button. In the **Cluster port** field, enter `3155`
   - In the **Other** tab of the **Coherence** tab, scroll down to the **tangosol.pof.config** field and replace the value with the absolute path to the `contacts-pof-config.xml` POF configuration file.
   - In the **Classpath** tab, ensure that **Coherence37** appears under **Bootstrap Entries**. Ensure that **Contacts (default classpath)** appears under **User Entries**.
4. Click **Run** to run the `ContactDriver` configuration. The output of the `Contacts` example should look similar to Example 4–8.

   In this example, the `Contact` object is converted to POF at run time. Using POF provides significant performance improvements in CPU time and the size of the generated binary file.

Example 4–8 Output of the Contacts Example in the Eclipse IDE

```
2011-03-15 15:31:50.970/0.125 Oracle Coherence 3.7.0.0 <Info> (thread=main, member=n/a): Loaded
operational configuration from "jar:file:/C:/oracle/product/coherence/lib/coherence.jar!/tangosol-
coherence.xml"
2011-03-15 15:31:50.970/0.125 Oracle Coherence 3.7.0.0 <Info> (thread=main, member=n/a): Loaded
operational overrides from "jar:file:/C:/oracle/product/coherence/lib/coherence.jar!/tangosol-
coherence-override-dev.xml"
2011-03-15 15:31:50.970/0.125 Oracle Coherence 3.7.0.0 <Info> (thread=main, member=n/a): Loaded
operational overrides from "file:/C:/home/oracle/workspace/Contacts/build/classes/tangosol-
coherence-override.xml"
2011-03-15 15:31:50.986/0.141 Oracle Coherence 3.7.0.0 <D5> (thread=main, member=n/a): Optional
configuration override "/custom-mbeans.xml" is not specified

Oracle Coherence Version 3.7.0.0 Build 22913
 Grid Edition: Development mode
Copyright (c) 2000, 2010, Oracle and/or its affiliates. All rights reserved.

2011-03-15 15:31:51.142/0.297 Oracle Coherence GE 3.7.0.0 <Info> (thread=main, member=n/a): Loaded
cache configuration from "file:/C:/home/oracle/workspace/Contacts/appClientModule/contacts-cache-
config.xml"
2011-03-15 15:31:51.345/0.500 Oracle Coherence GE 3.7.0.0 <D4> (thread=main, member=n/a): TCMP
bound to /130.35.99.213:8090 using SystemSocketProvider
2011-03-15 15:31:51.799/0.954 Oracle Coherence GE 3.7.0.0 <Info> (thread=Cluster, member=n/a): This
Member(Id=2, Timestamp=2011-03-15 15:31:51.619, Address=130.35.99.213:8090, MachineId=49877,
Location=site:URL, machine_name,process:5720, Role=OracleHandsonContactDriver, Edition=Grid
Edition, Mode=Development, CpuCount=2, SocketCount=1) joined cluster "cluster:0x96AB" with senior
Member(Id=1, Timestamp=2011-03-15 15:30:10.47, Address=130.35.99.213:8088, MachineId=49877,
```

```
Location=site:URL, machine_name,process:4780, Role=CoherenceServer, Edition=Grid Edition,
Mode=Development, CpuCount=2, SocketCount=1)
2011-03-15 15:31:51.799/0.954 Oracle Coherence GE 3.7.0.0 <D5> (thread=Cluster, member=n/a): Member
1 joined Service Cluster with senior member 1
2011-03-15 15:31:51.799/0.954 Oracle Coherence GE 3.7.0.0 <D5> (thread=Cluster, member=n/a): Member
1 joined Service Management with senior member 1
2011-03-15 15:31:51.799/0.954 Oracle Coherence GE 3.7.0.0 <D5> (thread=Cluster, member=n/a): Member
1 joined Service PartitionedPofCache with senior member 1
2011-03-15 15:31:51.814/0.969 Oracle Coherence GE 3.7.0.0 <Info> (thread=main, member=n/a): Started
cluster Name=cluster:0x96AB

Group{Address=224.3.7.0, Port=3155, TTL=4}

MasterMemberSet
  (
  ThisMember=Member(Id=2, Timestamp=2011-03-15 15:31:51.619, Address=130.35.99.213:8090,
MachineId=49877, Location=site:URL, machine_name,process:5720, Role=OracleHandsonContactDriver)
  OldestMember=Member(Id=1, Timestamp=2011-03-15 15:30:10.47, Address=130.35.99.213:8088,
MachineId=49877, Location=site:URL, machine_name,process:4780, Role=CoherenceServer)
  ActualMemberSet=MemberSet(Size=2, BitSetCount=2
    Member(Id=1, Timestamp=2011-03-15 15:30:10.47, Address=130.35.99.213:8088, MachineId=49877,
Location=site:URL, machine_name,process:4780, Role=CoherenceServer)
    Member(Id=2, Timestamp=2011-03-15 15:31:51.619, Address=130.35.99.213:8090, MachineId=49877,
Location=site:URL, machine_name,process:5720, Role=OracleHandsonContactDriver)
    )
  RecycleMillis=1200000
  RecycleSet=MemberSet(Size=0, BitSetCount=0
    )
  )

TcpRing{Connections=[1]}
IpMonitor{AddressListSize=0}

2011-03-15 15:31:51.830/0.985 Oracle Coherence GE 3.7.0.0 <D5> (thread=Invocation:Management,
member=2): Service Management joined the cluster with senior service member 1
2011-03-15 15:31:51.924/1.079 Oracle Coherence GE 3.7.0.0 <Info>
(thread=DistributedCache:PartitionedPofCache, member=2): Loaded POF configuration from
"file:/C:/home/oracle/workspace/Contacts/build/classes/contacts-pof-config.xml"
2011-03-15 15:31:51.924/1.079 Oracle Coherence GE 3.7.0.0 <Info>
(thread=DistributedCache:PartitionedPofCache, member=2): Loaded included POF configuration from
"jar:file:/C:/oracle/product/coherence/lib/coherence.jar!/coherence-pof-config.xml"
2011-03-15 15:31:51.970/1.125 Oracle Coherence GE 3.7.0.0 <D5>
(thread=DistributedCache:PartitionedPofCache, member=2): Service PartitionedPofCache joined the
cluster with senior service member 1
They are the same!!
```

5. If you go back and look at the cache server output, you can see messages reporting Contacts cache client joining the cluster, completing its work, then leaving the cluster. See Example 4–9.

Example 4–9 Contacts Cache Server Displaying the Arrival and Departure of the Contacts Client

```
...
Started DefaultCacheServer...

2011-03-15 15:31:51.799/101.829 Oracle Coherence GE 3.7.0.0 <D5> (thread=Cluster, member=1):
Member(Id=2, Timestamp=2011-03-15 15:31:51.619, Address=130.35.99.213:8090, MachineId=49877,
Location=site:URL, machine_name,process:5720, Role=OracleHandsonContactDriver) joined Cluster with
senior member 1
```

```
2011-03-15 15:31:51.845/101.875 Oracle Coherence GE 3.7.0.0 <D5> (thread=Cluster, member=1): Member
2 joined Service Management with senior member 1
2011-03-15 15:31:51.986/102.016 Oracle Coherence GE 3.7.0.0 <D5> (thread=Cluster, member=1): Member
2 joined Service PartitionedPofCache with senior member 1
2011-03-15 15:31:52.033/102.063 Oracle Coherence GE 3.7.0.0 <D5> (thread=Cluster, member=1):
TcpRing disconnected from Member(Id=2, Timestamp=2011-03-15 15:31:51.619, Address=130.35.99.
213:8090, MachineId=49877, Location=site:URL, machine_name,process:5720,
Role=OracleHandsonContactDriver) due to a peer departure; removing the member.
2011-03-15 15:31:52.033/102.063 Oracle Coherence GE 3.7.0.0 <D5> (thread=Cluster, member=1): Member
2 left service Management with senior member 1
2011-03-15 15:31:52.033/102.063 Oracle Coherence GE 3.7.0.0 <D5> (thread=Cluster, member=1): Member
2 left service PartitionedPofCache with senior member 1
2011-03-15 15:31:52.033/102.063 Oracle Coherence GE 3.7.0.0 <D5> (thread=Cluster, member=1):
Member(Id=2, Timestamp=2011-03-15 15:31:52.033, Address=130.35.99.213:8090, MachineId=49877,
Location=site:URL, machine_name,process:5720, Role=OracleHandsonContactDriver) left Cluster with
senior member 1
```

5

Loading Data Into a Cache

In this chapter, you learn how to populate a Coherence cache with domain objects that are read from text files.

This chapter contains the following sections:

Introduction

Until now, you put objects into the cache and retrieved them individually. Each call to the `put` method can result in increased network traffic, especially for partitioned and replicated caches. Additionally, each call to a `put` method returns the object it just replaced in the cache, which adds more unnecessary overhead. By using the `putAll` method, loading the cache can be made much more efficient.

To perform the tasks in this chapter, you must first complete the project described in Chapter 4, "Working with Complex Objects." You must also be familiar with using `java.io.BufferedReader` to read text files, `java.lang.String.split` method to parse text files, and `java.text.SimpleDateFormat` to parse dates.

Populating a Cache with Domain Objects

This exercise shows you how to create a console application that populates a Coherence cache with domain objects. The application will use the Coherence `com.tangosol.io.pof.PortableObject` implementation to serialize the objects into Portable Object format (POF).

In the exercise, you create a key that helps to get the `Contact` object, a generator to provide data for the cache, and a loader to load the cache.

Create a Class with the Key for the Domain Objects

To create a class that contains the key for the a domain object:

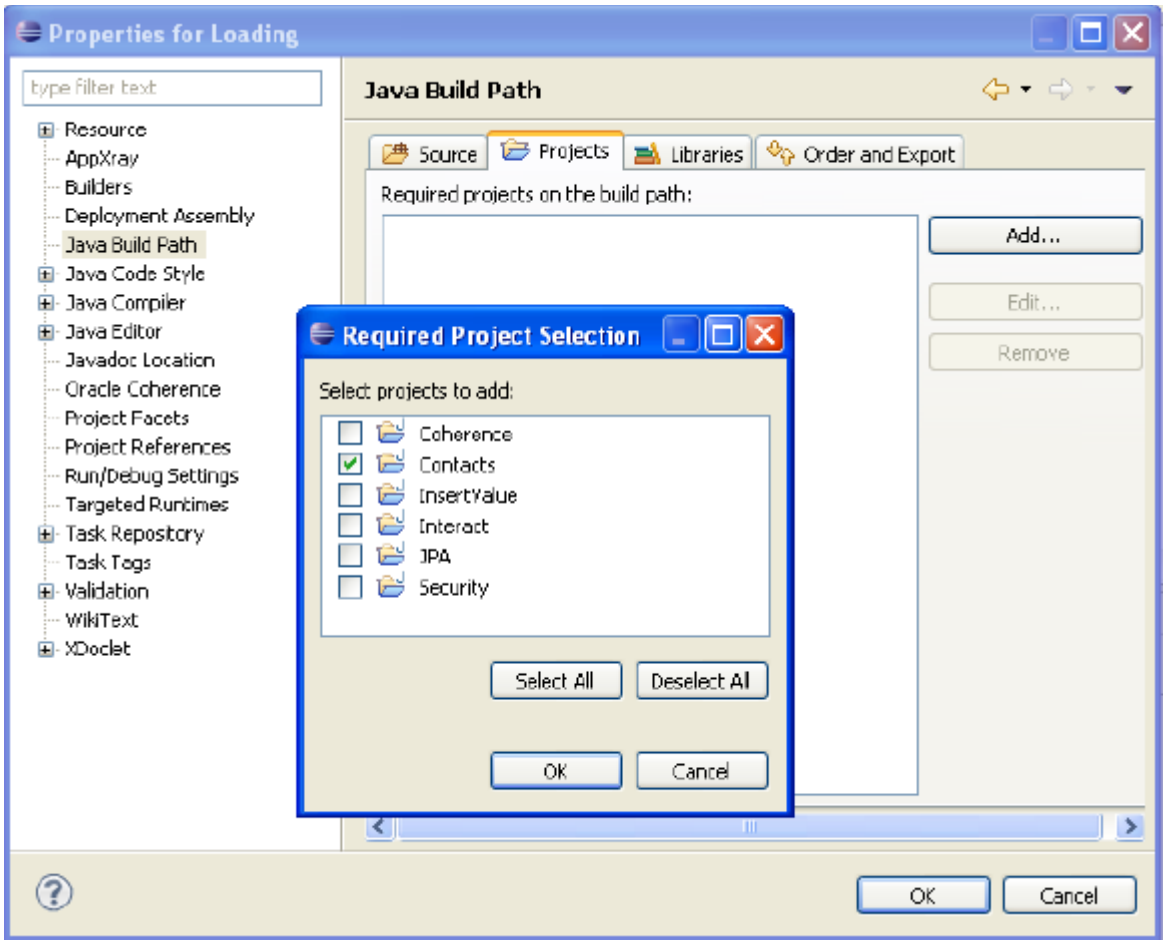
1. Create a new Application Client Project called `Loading`. Select **CoherenceConfig** from the **Configuration** drop-down list. In the Application Client Module page of the New Application Client Project wizard, deselect the Create a default Main class checkbox.

   See "Creating and Caching Complex Objects" on page 4-2 for information on creating a new project.

2. Add the classes and files related to the `Address`, `PhoneNumber`, and `Contact` classes that you created in an earlier exercise (`Contacts`). These files can be found in `c:\home\oracle\workspace\Contacts\appClientModule` and `c:\home\oracle\workspace\Contacts\build\classes` directories.

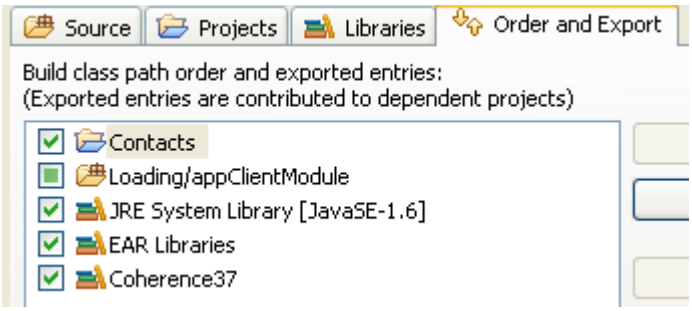
   Right click the Loading project in the **Project Explorer** and select **Properties**. In the **Properties for Loading** dialog box, select **Java Build Path**. In the **Projects** tab, click **Add**. Select the **Contacts** project from the **Required Project Selection** dialog box, as illustrated in Figure 5–1.

Figure 5–1 Adding Folders to the Project Build Path



In the **Order and Export** tab, use the **Up** and **Down** buttons to move **Contacts** to the top of the list. The contents of the tab should look similar to Figure 5–2.

Figure 5–2 Contents of the Order and Export Tab for the Loading Project



3. Create a `ContactID` class that provides a key to the employee for whom information is tracked. See "Creating a Java Class" on page 2-11 for detailed information on creating a Java class.

   Create the contact ID based on the employee's first name and last name. This object acts as the key to get the `Contact` object.

   Because this class uses POF serialization, it must implement the `PortableObject` interface, the `writeExternal` and `readExternal` `PortableObject` methods, and the `equals`, `hashCode`, and `toString` object methods.

   Note: Cache keys and values must be serializable (for example, `java.io.Serializable`). Cache keys must also provide an implementation of the `hashCode` and `equals` methods, and those methods must return consistent results across cluster nodes. This implies that the implementation of the `hashCode` and `equals` object methods must be based solely on the object's serializable state (that is, the object's non-transient fields). Most built-in Java types, such as String, Integer and Date, meet this requirement. Some cache implementations (specifically the partitioned cache) use the serialized form of the key objects for equality testing, which means that keys for which the `equals` method returns true must serialize identically; most built-in Java types meet this requirement.

   Example 5–1 illustrates a possible implementation of the `ContactId` class.

Example 5–1 Simple Contact ID Class

```
package com.oracle.handson;

import com.tangosol.io.pof.PofReader;
import com.tangosol.io.pof.PofWriter;
import com.tangosol.io.pof.PortableObject;

import com.tangosol.util.Base;
import com.tangosol.util.HashHelper;

import java.io.IOException;

/**
* ContactId is a key to the person for whom information is
* tracked.
*/
public class ContactId implements PortableObject
```

```
{
// ----- constructors ---------------------------------------------------

/**
* Default constructor (necessary for PortableObject implementation).
*/
public ContactId()
    {
    }

/**
* Construct a contact person.
*
*/
public ContactId(String FirstName, String LastName)
    {
    super();
    this.FirstName = FirstName;
    this.LastName  = LastName;
    }

// ----- accessors ------------------------------------------------------

/**
* Return the first name.
*
*/
public String getFirstName()
    {
    return FirstName;
    }

/**
* Return the last name.
*
*/
public String getLastName()
    {
    return LastName;
    }

// ----- PortableObject interface ---------------------------------------

public void readExternal(PofReader reader)
        throws IOException
    {
    FirstName = reader.readString(0);
    LastName = reader.readString(1);
    }

public void writeExternal(PofWriter writer)
        throws IOException
    {
    writer.writeString(0, FirstName);
    writer.writeString(1, LastName);
    }

// ----- Object methods -------------------------------------------------

public boolean equals(Object oThat)
```

```
        {
        if (this == oThat)
            {
            return true;
            }
        if (oThat == null)
            {
            return false;
            }

        ContactId that = (ContactId) oThat;
        return Base.equals(getFirstName(), that.getFirstName()) &&
               Base.equals(getLastName(),  that.getLastName());
        }

    public int hashCode()
        {
        return HashHelper.hash(getFirstName(),
               HashHelper.hash(getLastName(), 0));
        }

    public String toString()
        {
        return getFirstName() + " " + getLastName();
        }

    // ----- data members ---------------------------------------------------

    /**
    * First name.
    */
    private String FirstName;

    /**
    * Last name.
    */
    private String LastName;
    }
```

Edit the POF Configuration File

Edit the POF configuration file. Add a `<user-type>` entry for the `ContactId` class to the `contacts-pof-config.xml` file. The file looks similar to Example 5–2.

Example 5–2 POF Configuration File with the ContactId Entry

```
<?xml version="1.0"?>

<pof-config xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
             xmlns="http://xmlns.oracle.com/coherence/coherence-pof-config"
             xsi:schemaLocation="http://xmlns.oracle.
com/coherence/coherence-pof-config coherence-pof-config.xsd">
  <user-type-list>

    <!-- coherence POF user types -->
    <include>coherence-pof-config.xml</include>

    <!-- com.tangosol.examples package -->
    <user-type>
      <type-id>1001</type-id>
```

```
      <class-name>com.oracle.handson.Contact</class-name>
    </user-type>
    <user-type>
      <type-id>1002</type-id>
      <class-name>com.oracle.handson.Address</class-name>
    </user-type>
    <user-type>
        <type-id>1003</type-id>
      <class-name>com.oracle.handson.PhoneNumber</class-name>
    </user-type>
    <user-type>
     <type-id>1004</type-id>
      <class-name>com.oracle.handson.ContactId</class-name>
    </user-type>
   </user-type-list>
  <allow-interfaces>true</allow-interfaces>
  <allow-subclasses>true</allow-subclasses>
</pof-config>
```

Create the Data Generator

Create a Java class named `DataGenerator` to generate random employee contact names and addresses. See "Creating a Java Class" on page 2-11 for detailed information.

Use the `Address`, `PhoneNumber`, and `Contact` classes that you created in an earlier exercise. Use `java.util.Random` to generate some random names, addresses, telephone numbers, and ages.

Example 5–3 illustrates a possible implementation of the data generator. This implementation creates a text file, `contacts.cvs`, that contains the employee contact information.

Example 5–3 Sample Data Generation Class

```
package com.oracle.handson;

import com.oracle.handson.Address;
import com.oracle.handson.Contact;
import com.oracle.handson.PhoneNumber;
import com.tangosol.util.Base;

import java.io.BufferedWriter;
import java.io.FileOutputStream;
import java.io.IOException;
import java.io.OutputStream;
import java.io.OutputStreamWriter;
import java.io.PrintWriter;

import java.sql.Date;

import java.util.Collections;
import java.util.Random;


/**
* DataGenerator is a generator of sample contacts.
*/
public class DataGenerator
    {
```

```
// ----- static methods ---------------------------------------------

/**
* Generate contacts.
*/
public static void main(String[] asArg)
        throws IOException
    {
    String       sFile = asArg.length > 0 ? asArg[0] : FILENAME;
    int          cCon  = asArg.length > 1 ? Integer.parseInt(asArg[1]) : 1000;
    OutputStream out   = new FileOutputStream(sFile);

    generate(out, cCon);
    out.close();
    }

/**
* Generate the contacts and write them to a file.
*/
public static void generate(OutputStream out, int cContacts)
        throws IOException
    {
    PrintWriter writer = new PrintWriter(new BufferedWriter(
            new OutputStreamWriter(out)));

    for (int i = 0; i < cContacts; ++i)
        {
        StringBuffer sb = new StringBuffer(256);

        //contact person
        sb.append("John,")
          .append(getRandomName())
          .append(',');

        // home and work addresses
        sb.append(Integer.toString(Base.getRandom().nextInt(999)))
          .append(" Beacon St.,,") /*street1,empty street2*/
          .append(getRandomName()) /*random city name*/
          .append(',')
          .append(getRandomState())
          .append(',')
          .append(getRandomZip())
          .append(",US,Yoyodyne Propulsion Systems,")
          .append("330 Lectroid Rd.,Grover's Mill,")
          .append(getRandomState())
          .append(',')
          .append(getRandomZip())
          .append(",US,");

        // home and work telephone numbers
        sb.append("home,")
          .append(Base.toDelimitedString(getRandomPhoneDigits(), ","))
          .append(",work,")
          .append(Base.toDelimitedString(getRandomPhoneDigits(), ","))
          .append(',');

        // random birth date in millis before or after the epoch
        sb.append(getRandomDateInMillis());

        writer.println(sb);
```

```
        }
    writer.flush();
    }

/**
* Return a random name.
*
*/
private static String getRandomName()
    {
    Random rand = Base.getRandom();
    int    cCh  = 4 + rand.nextInt(7);
    char[] ach  = new char[cCh];

    ach[0] = (char) ('A' + rand.nextInt(26));
    for (int of = 1; of < cCh; ++of)
        {
        ach[of] = (char) ('a' + rand.nextInt(26));
        }
    return new String(ach);
    }

/**
* Return a random phone muber.
* The phone number includes access, country, area code, and local
* number.
*
*/
private static int[] getRandomPhoneDigits()
    {
    Random rand = Base.getRandom();
    return new int[]
        {
        11,                   // access code
        rand.nextInt(99),     // country code
        rand.nextInt(999),    // area code
        rand.nextInt(9999999) // local number
        };
    }

/**
* Return a random Phone.
*
*/
private static PhoneNumber getRandomPhone()
    {
    int[] anPhone = getRandomPhoneDigits();

    return new PhoneNumber((short)anPhone[0], (short)anPhone[1],
            (short)anPhone[2], anPhone[3]);

    }
/**
* Return a random Zip code.
*
*/
private static String getRandomZip()
    {
    return Base.toDecString(Base.getRandom().nextInt(99999), 5);
    }
```

```
/**
* Return a random state.
*
*/
private static String getRandomState()
    {
    return STATE_CODES[Base.getRandom().nextInt(STATE_CODES.length)];
    }

/**
* Return a random date in millis before or after the epoch.
*
*/
private static long getRandomDateInMillis()
    {
    return (Base.getRandom().nextInt(40) - 20) * Contact.MILLIS_IN_YEAR;
    }

/**
* Generate a Contact with random information.
*
*/
public static Contact getRandomContact()
    {
    return new Contact("John",
            getRandomName(),
            new Address("1500 Boylston St.", null, getRandomName(),
                getRandomState(), getRandomZip(), "US"),
            new Address("8 Yawkey Way", null, getRandomName(),
                getRandomState(), getRandomZip(), "US"),
            Collections.singletonMap("work", getRandomPhone()),
            new Date(getRandomDateInMillis()));
    }

// ----- constants ------------------------------------------------------

/**
* US Postal Service two letter postal codes.
*/
private static final String[] STATE_CODES =
    {
        "AL", "AK", "AS", "AZ", "AR", "CA", "CO", "CT", "DE", "OF", "DC",
        "FM", "FL", "GA", "GU", "HI", "ID", "IL", "IN", "IA", "KS", "KY",
        "LA", "ME", "MH", "MD", "MA", "MI", "MN", "MS", "MO", "MT", "NE",
        "NV", "NH", "NJ", "NM", "NY", "NC", "ND", "MP", "OH", "OK", "OR",
        "PW", "PA", "PR", "RI", "SC", "SD", "TN", "TX", "UT", "VT", "VI",
        "VA", "WA", "WV", "WI", "WY"
    };
/**
* Default contacts file name.
*/
public static final String FILENAME = "contacts.csv";
}
```

The `DataGenerator` class generates, at random, information about an employee. The information includes the employee's name, home address, work address, home telephone number, work telephone number, and the employee's age. The information is stored in a CSV-formatted file named `contacts.csv`. This file follows the standard

rules for a CSV-formatted file, where there is one record per line, and individual fields within the record are separated by commas.

Example 5–4 illustrates the first few entries of the `contacts.csv` file.

Example 5–4 Contents of the contacts.csv File

```
John,Dvcqbvcp,669 Beacon St.,,Tetuvusz,CA,68457,US,Yoyodyne Propulsion Systems,330 Lectroid Rd.
,Grover's Mill,KS,30344,US,home,11,98,183,8707139,work,11,96,425,1175949,63072000000
John,Fxsr,549 Beacon St.,,Jutaswmaby,MI,16315,US,Yoyodyne Propulsion Systems,330 Lectroid Rd.
,Grover's Mill,CT,60309,US,home,11,20,40,3662989,work,11,41,187,3148474,-189216000000
John,Gmyrolvfyd,73 Beacon St.,,Lpnztf,AR,82667,US,Yoyodyne Propulsion Systems,330 Lectroid Rd.
,Grover's Mill,NY,42297,US,home,11,22,17,8579970,work,11,35,338,9286245,-567648000000
John,Efmpjlbj,85 Beacon St.,,Wyswpb,AK,29590,US,Yoyodyne Propulsion Systems,330 Lectroid Rd.
,Grover's Mill,NJ,06219,US,home,11,20,744,4331451,work,11,39,911,9104590,-157680000000
...
```

Create a Console Application to Load the Cache

Create a Java class called `LoaderExample`. See "Creating a Java Class" on page 2-11 for detailed information.

Implement the class to load the cache with employee data generated by the program described in "Create the Data Generator" on page 5-6. Use input streams and buffered readers to load the employee information in the `contacts.csv` file into a single Coherence cache.

Add code to parse the employee information in the data file. After you have this information, create the individual contacts to put into the cache. To conserve processing effort and minimize network traffic, use the `putAll` method to load the cache.

Example 5–5 illustrates a possible implementation of the `LoaderExample` class.

Example 5–5 Sample Cache Loading Program

```
package com.oracle.handson;

import com.tangosol.net.CacheFactory;
import com.tangosol.net.NamedCache;

import com.oracle.handson.ContactId;
import com.oracle.handson.Address;
import com.oracle.handson.PhoneNumber;
import com.oracle.handson.Contact;

import java.io.BufferedReader;
import java.io.FileInputStream;
import java.io.IOException;
import java.io.InputStream;
import java.io.InputStreamReader;

import java.sql.Date;

import java.util.HashMap;
import java.util.Map;


/**
* LoaderExample loads contacts into the cache from a file.
*
```

```
*/
public class LoaderExample
    {
    // ----- static methods ---------------------------------------------------

    /**
    * Load contacts.
    */
    public static void main (String[] asArg)
            throws IOException
        {
        String sFile  = asArg.length > 0 ? asArg[0] : DataGenerator.FILENAME;
        String sCache = asArg.length > 1 ? asArg[1] : CACHENAME;

        System.out.println("input file: " + sFile);
        System.out.println("cache name: " + sCache);

        new LoaderExample().load(CacheFactory.getCache(sCache),
                new FileInputStream(sFile));
        CacheFactory.shutdown();
        }

    /**
    * Load cache from stream.
    *
    */
    public void load(NamedCache cache, InputStream in)
            throws IOException
        {
        BufferedReader reader   = new BufferedReader(new InputStreamReader(in));
        Map            mapBatch = new HashMap(1024);
        String         sRecord;
        int            cRecord  = 0;

        while ((sRecord = reader.readLine()) != null)
            {
            // parse record
            String[]      asPart     = sRecord.split(",");
            int           ofPart     = 0;
            String        sFirstName =  asPart[ofPart++];
            String        sLastName  =  asPart[ofPart++];
            ContactId          id    = new ContactId(sFirstName, sLastName);
            Address       addrHome   = new Address(
                                          /*streetline1*/ asPart[ofPart++],
                                          /*streetline2*/ asPart[ofPart++],
                                          /*city*/        asPart[ofPart++],
                                          /*state*/       asPart[ofPart++],
                                          /*zip*/         asPart[ofPart++],
                                          /*country*/     asPart[ofPart++]);
            Address       addrWork   = new Address(
                                          /*streetline1*/ asPart[ofPart++],
                                          /*streetline2*/ asPart[ofPart++],
                                          /*city*/        asPart[ofPart++],
                                          /*state*/       asPart[ofPart++],
                                          /*zip*/         asPart[ofPart++],
                                          /*country*/     asPart[ofPart++]);
            Map           mapTelNum  = new HashMap();

            for (int c = asPart.length - 1; ofPart < c; )
                {
```

```
                    mapTelNum.put(/*type*/ asPart[ofPart++], new PhoneNumber(
                        /*access code*/  Short.parseShort(asPart[ofPart++]),
                        /*country code*/ Short.parseShort(asPart[ofPart++]),
                        /*area code*/    Short.parseShort(asPart[ofPart++]),
                        /*local num*/    Integer.parseInt(asPart[ofPart++])));
                    }
                Date dtBirth = new Date(Long.parseLong(asPart[ofPart]));

                // Construct Contact and add to batch
                Contact con1 = new Contact(sFirstName, sLastName, addrHome,
                                           addrWork, mapTelNum, dtBirth);
                System.out.println(con1);
                mapBatch.put(id, con1);

                ++cRecord;
                if  (cRecord % 1024 == 0)
                    {
                    // load batch
                    cache.putAll(mapBatch);
                    mapBatch.clear();
                    System.out.print('.');
                    System.out.flush();
                    }
                }

                if (!mapBatch.isEmpty())
                   {
                   // load final batch
                   cache.putAll(mapBatch);
                   }

            System.out.println("Added " + cRecord + " entries to cache");
            }


        // ----- constants ------------------------------------------------------

        /**
        * Default cache name.
        */
        public static final String CACHENAME = "ContactsCache";

    }
```

Run the Cache Loading Example

To run the cache loading example:

1. Stop any running cache servers. See "Stopping Cache Servers" on page 2-13 for detailed information.
2. Start a cache server with the `ContactsCacheServer` file.
   a. Right click the project and select **Run As** then **Run Configurations** to edit the `ContactsCacheServer` configuration. In the **Main** tab, click **Browse** and select the **Loading** project.
   b. In the **Classpath** tab, select **User Entries** and click **Add Projects**. In the **Project Selection** dialog box, select the **Loading** project. Click **OK**.
   c. In the **Common** tab, click **Shared file** and browse for the **Loading** project.

d. Click **Apply**, then **Run**.

3. Create a run configuration for `DataGenerator`. Right click `DataGenerator` in the **Project Explorer** and select **Run As**. In the **Run Configurations** dialog box select **Oracle Coherence** and click the **New Configuration** icon.

   a. In the **Name** field, enter `DataGenerator`.

   b. In the **Project** field in the **Main** tab, enter `Loading`. In the **Main class** field, enter `com.oracle.handson.DataGenerator`.

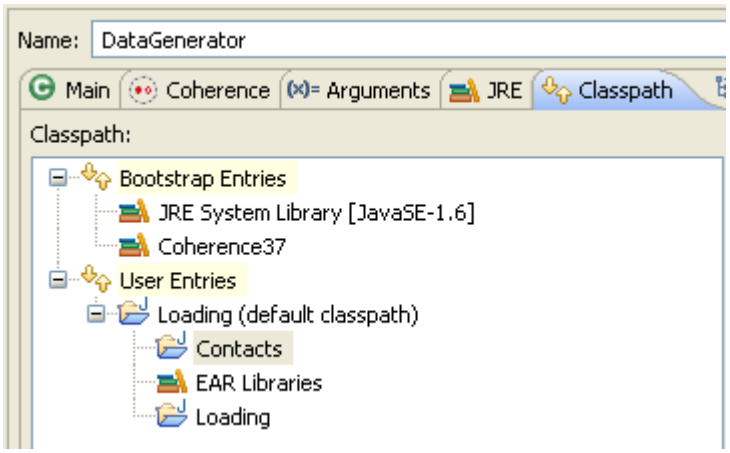
   c. In the **General** tab of the **Coherence** tab, browse to the `c:\home\oracle\workspace\Contacts\appClientModule\coherence-cache-config.xml` file in the **Cache configuration descriptor** field. Select the **Disabled (cache client)** button. Enter `3155` in the **Cluster port** field. Click **Apply**.

      In the **Other** tab, scroll down to the **tangosol.pof.config** field. Enter the absolute path to the POF configuration file `contacts-pof-config.xml`. Click **Apply**.

   d. In the **Common** tab, select **Shared file** and browse for the **Loading** directory.

   e. Examine the contents of **Loading** in the **Classpath** tab. **Contacts** should appear as one of the entries under **Loading**, as in Figure 5–3.

Figure 5–3 Classpath for the DataGenerator Program

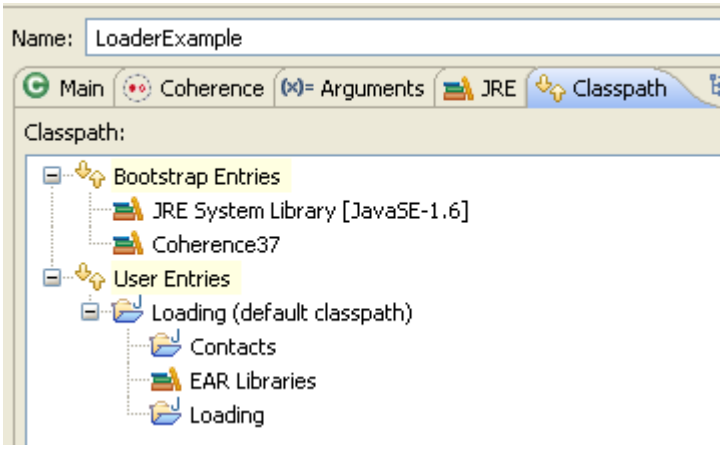


4. Create a run configuration for `LoaderExample`.

   - In the **Name** field, enter `LoaderGenerator`
   - In the **Project** field in the **Main** tab, enter `Loading`. In the **Main class** field, enter `com.oracle.handson.LoaderExample`.
   - In the **General** tab of the **Coherence** tab, browse to the `c:\home\oracle\workspace\Contacts\appClientModule\coherence-cache-config.xml` file in the **Cache configuration descriptor** field. Select the **Disabled (cache client)** button. Enter `3155` in the **Cluster port** field. Click **Apply**.

     In the **Other** tab, scroll down to the **tangosol.pof.config** field. Enter the absolute path to the POF configuration file `contacts-pof-config.xml`. Click **Apply**.
   - Examine the contents of the **Classpath** tab. **Contacts** should appear as one of the entries under **Loading**, as in Figure 5–4.

Figure 5–4 Classpath for the LoaderExample Program



5. Run the `DataGenerator` configuration from the **Run Configurations** dialog box. Then run the `LoaderExample` configuration.

   The `DataGenerator` run configuration generates a data file; you should not see any output or response in the Eclipse console window. The `LoaderExample` run configuration sends a stream of employee contact information, similar to Example 5–6, to the Eclipse console window.

Example 5–6 Output from the Sample Cache Loading Program

```
...
2011-03-15 17:07:51.413/2.266 Oracle Coherence GE 3.7.0.0 <D5> (thread=Invocation:Management,
member=2): Service Management joined the cluster with senior service member 1
2011-03-15 17:07:51.413/2.266 Oracle Coherence GE 3.7.0.0 <Info> (thread=Cluster, member=2): Loaded
POF configuration from
"file:/C:/home/oracle/workspace/Contacts/appClientModule/contacts-pof-config.xml"
2011-03-15 17:07:51.413/2.266 Oracle Coherence GE 3.7.0.0 <Info> (thread=Cluster, member=2): Loaded
included POF configuration from "jar:file:/C:/coherence360/coherence/lib/coherence.
jar!/coherence-pof-config.xml"
2011-03-15 17:07:51.413/2.266 Oracle Coherence GE 3.7.0.0 <D5>
(thread=DistributedCache:PartitionedPofCache, member=2): Service PartitionedPofCache joined the
cluster with senior service member 1
2011-03-15 17:07:51.413/2.266 Oracle Coherence GE 3.7.0.0 <D4>
(thread=DistributedCache:PartitionedPofCache, member=2): Asking member 1 for 128 primary partitions
John Hwolru
Addresses
Home: 742 Beacon St.

Icymz, OH 74135
US
Work: Yoyodyne Propulsion Systems
330 Lectroid Rd.
Grover's Mill, WY 20222
US
Telephone Numbers
work: +11 50 928 2637858
home: +11 72 403 7946780
Birth Date: 1981-12-28

...

John Unglg
```

```
Addresses
Home: 973 Beacon St.

Cgarhej, MI 10517
US
Work: Yoyodyne Propulsion Systems
330 Lectroid Rd.
Grover's Mill, GA 81835
US
Telephone Numbers
work: +11 8 925 5233805
home: +11 95 108 2947077
Birth Date: 1965-01-01
John Lkkwgw
Addresses
Home: 806 Beacon St.

Zlpft, GU 55786
US
Work: Yoyodyne Propulsion Systems
330 Lectroid Rd.
Grover's Mill, WV 88125
US
Telephone Numbers
work: +11 45 321 6385646
home: +11 87 371 2109053
Birth Date: 1987-12-27
Added 1000 entries to cache
2011-03-15 17:07:51.413/2.266 Oracle Coherence GE 3.7.0.0 <D5> (thread=Invocation:Management,
member=2): Service Management left the cluster
2011-03-15 17:07:51.413/2.266 Oracle Coherence GE 3.7.0.0 <D5>
(thread=DistributedCache:PartitionedPofCache, member=2): Service PartitionedPofCache left the
cluster
2011-03-15 17:07:51.444/2.297 Oracle Coherence GE 3.7.0.0 <D5> (thread=Cluster, member=2): Service
Cluster left the cluster
```

Querying and Aggregating Data in the Cache

This exercise introduces querying and aggregating data in a cache. This exercise shows you how to:

- Query the cache for specific data
- Aggregate information within the cache

After putting complex objects in the named caches, you can query and aggregate information within the grid. The `com.tangosol.util.QueryMap` interface provides methods for managing the values or keys within a cache. You can use filters to restrict your results. You can also define indexes to optimize your queries.

Because Coherence serializes information when storing it, you also have the overhead of deserializing when querying information. When indexes are added, the *values* kept in the index itself are deserialized and, therefore, are quicker to access. The *objects* that are indexed are always kept serialized.

Some of the often-used methods in the `QueryMap` interface are:

- `Set entrySet(Filterfilter)`, which returns a set of entries that are contained in the map that satisfy the filter

- `addIndex(ValueExtractorextractor,booleanfOrdered, Comparator comparator)`, which adds an index
- `Set keySet(Filter filter)`, which is similar to `entrySet`, but returns keys, not values

It is important to note that filtering occurs at Cache Entry Owner level. In a partitioned topology, filtering can be performed in parallel because it is the primary partitions that do the filtering. The `QueryMap` interface uses the `Filter` classes. You can find more information on these classes in the API for the `com.tangosol.util.filter` package.

All Coherence `NamedCache` objects implement the `com.tangosol.util.QueryMap` interface. This enables `NamedCache` objects to support searching for keys or entries in a cache that satisfy a specified condition. The condition can be represented as an object that implements the `com.tangosol.util.Filter` interface.

The `com.tangosol.util.filter` package contains several predefined classes that provide implementations of standard query expressions. Examples of these classes include `GreaterFilter`, `GreaterEquals`, `LikeFilter`, `NotEqualsFilter`, `InFilter`, and so on. You can use these filters to construct object-based equivalents of most SQL `WHERE` clause expressions.

Note: Coherence does not provide a `SQLFilter` because it is unlikely that the objects placed in a cache are modeled in a relational manner, that is, using rows and columns (as they are typically represented in a database). Additionally, it is common that objects placed in a cache are not easily modeled using relational models, for example, large BLOBS.

The `Filter` classes use standard Java method reflection to represent test conditions. For example, the following filter represents the condition where the value returned from the `getHomeAddress.getState` method on an object in a cache is for Massachusetts (`MA`):

```
(new EqualsFilter("getHomeAddress.getState", "MA");
```

If the object tested with this filter does not have a `get` method, then the test fails.

Here are additional examples of using the `Filter` classes:

- Return a set of people who live in a city whose name begins with the letter `S`:

```
Set sPeople = cache.entrySet(new LikeFilter("getHomeAddress.getCity","S%");
```

- Return a set containing people over the age of 42:

```
final int nAge = 42;
// Find all contacts who are older than nAge
Set sSeniors = cache.entrySet(new GreaterFilter("getAge", nAge));
```

In addition to the `entrySet` and `keySet` methods defined by the `QueryMap` interface, Coherence lets you define indexes to improve query performance by using the `addIndex` method. Unlike relational database systems, where indexes are defined according to well-known and strictly enforced collections of named columns (that is, a schema), Coherence does not have a schema. Because there is no schema, you define indexes differently from a traditional database.

To define the values that are to be indexed for each object placed in a cache, Coherence introduces the concept of a value extractor. The `com.tangosol.util.`

`ValueExtractor` interface defines an `extract` method. If given an object parameter, a `ValueExtractor` implementation returns a value based on the parameter.

A simple example of a `ValueExtractor` implementation is the `com.tangosol.util.extractor.ReflectionExtractor` interface, which uses reflection to return the result of a method call on an object, for example:

```
new ReflectionExtractor("getCity")
```

You can use value extractors throughout the Coherence API. Typically, however, they are used to define indexes.

An especially useful type of extractor is the `ChainedExtractor`. This is a composite `ValueExtractor` implementation based on an array of extractors. Extractors in the array are applied sequentially, from left to right. The result of a previous extractor becomes the target object for a next extractor, for example:

```
new ChainedExtractor(new ReflectionExtractor("getHomeAddress"), new
ReflectionExtractor("getState"))
```

This example assumes that the `HomeAddress` and `State` objects belong to a complex `Contact` object. `ChainedExtractor` first uses reflection to call the `getHomeAddress` method on each cached `Contact` object, and then uses reflection to call the `getState` method on the set of returned `HomeAddress` objects.

1. Create the Class to Query Cache Data
2. Run the Query Example
3. Edit the Query Example to Perform Aggregations
4. Run the Query and Aggregation Example

Create the Class to Query Cache Data

Create a new Java class called `QueryExample` to perform your queries. Ensure that the class has a `main` method. See "Creating a Java Class" on page 2-11 for detailed information.

Use the `entrySet` method to get the employee contact information for:

- All employees who live in Massachusetts:

  ```
  cache.entrySet(new EqualsFilter("getHomeAddress.getState", "MA"));
  ```

- All employees who live in Massachusetts and work elsewhere:

  ```
  cache.entrySet(new AndFilter(
          new EqualsFilter("getHomeAddress.getState", "MA"),
          new NotEqualsFilter("getWorkAddress.getState", "MA")));
  ```

- All employees whose city name begins with an `S`:

  ```
  cache.entrySet(new LikeFilter("getHomeAddress.getCity", "S%"));
  ```

- All employees whose last name begins with an `S` and live in Massachusetts. Use both the key and value in the query. Note that the cache entries use `ContactId` objects as the keys. You can use the `KeyExtractor` to get these values. `KeyExtractor` is a specialized value extractor that indicates that a query be run against the key objects, rather than the values:

  ```
  cache.entrySet(new AndFilter(
  ```

```
        new LikeFilter(new KeyExtractor("getLastName"), "S%",
            (char) 0, false),
        new EqualsFilter("getHomeAddress.getState", "MA")));
```

- All employees who are older than a specified age. Hint:

```
final int nAge = 42;
    setResults = cache.entrySet(new GreaterFilter("getAge", nAge));
```

Use indexes to improve performance. Hint: Find the `addIndex` method in the Javadoc for the `QueryMap` interface.

Example 5–7 illustrates a possible implementation of the `QueryExample` class.

Example 5–7 Sample QueryExample Class

```
package com.oracle.handson;

import com.tangosol.net.CacheFactory;
import com.tangosol.net.NamedCache;

import com.tangosol.util.extractor.ChainedExtractor;
import com.tangosol.util.extractor.KeyExtractor;
import com.tangosol.util.extractor.ReflectionExtractor;

import com.tangosol.util.filter.AlwaysFilter;
import com.tangosol.util.filter.AndFilter;
import com.tangosol.util.filter.EqualsFilter;
import com.tangosol.util.filter.GreaterFilter;
import com.tangosol.util.filter.LikeFilter;
import com.tangosol.util.filter.NotEqualsFilter;

import java.util.Iterator;
import java.util.Set;


/**
* QueryExample runs sample queries for contacts.
*
*/
public class QueryExample{

    // ----- QueryExample methods ---------------------------------------

    public static void main(String[] args) {
      NamedCache cache = CacheFactory.getCache("ContactsCache");
       query(cache);
    }
    /**
    * Perform the example queries
    *
    */
     public static void query(NamedCache cache)
        {
         // Add indexes to make queries more efficient
        ReflectionExtractor reflectAddrHome =
                new ReflectionExtractor("getHomeAddress");

        // Add an index for the age
        cache.addIndex(new ReflectionExtractor("getAge"), true, null);
```

```
    // Add index for state within home address
   cache.addIndex(new ChainedExtractor(reflectAddrHome,
            new ReflectionExtractor("getState")), true, null);

    // Add index for state within work address
    cache.addIndex(new ChainedExtractor(
            new ReflectionExtractor("getWorkAddress"),
            new ReflectionExtractor("getState")), true, null);

    // Add index for city within home address
    cache.addIndex(new ChainedExtractor(reflectAddrHome,
            new ReflectionExtractor("getCity")), true, null);

    // Find all contacts who live in Massachusetts
    Set setResults = cache.entrySet(new EqualsFilter(
            "getHomeAddress.getState", "MA"));
    printResults("MA Residents", setResults);

    // Find all contacts who live in Massachusetts and work elsewhere
    setResults = cache.entrySet(new AndFilter(
            new EqualsFilter("getHomeAddress.getState", "MA"),
            new NotEqualsFilter("getWorkAddress.getState", "MA")));
    printResults("MA Residents, Work Elsewhere", setResults);

    // Find all contacts whose city name begins with 'S'
    setResults = cache.entrySet(new LikeFilter("getHomeAddress.getCity",
            "S%"));
    printResults("City Begins with S", setResults);

    final int nAge = 42;
    // Find all contacts who are older than nAge
    setResults = cache.entrySet(new GreaterFilter("getAge", nAge));
    printResults("Age > " + nAge, setResults);

    // Find all contacts with last name beginning with 'S' that live
    // in Massachusetts. Uses both key and value in the query.
    setResults = cache.entrySet(new AndFilter(
            new LikeFilter(new KeyExtractor("getLastName"), "S%",
                           (char) 0, false),
            new EqualsFilter("getHomeAddress.getState", "MA")));
    printResults("Last Name Begins with S and State Is MA", setResults);

    }

/**
* Print results of the query
*
* @param sTitle      the title that describes the results
* @param setResults  a set of query results
*/
private static void printResults(String sTitle, Set setResults)
    {
    System.out.println(sTitle);
    for (Iterator iter = setResults.iterator(); iter.hasNext(); )
        {
        System.out.println(iter.next());
        }
    }
}
```

Run the Query Example

To run the query example:

1. Stop all running cache servers. See "Stopping Cache Servers" on page 2-13 for more information.
2. Create a run configuration for the `QueryExample` class.
   a. Right click `QueryExample` in the **Project Navigator** and select **Run As** then **Run Configurations**. Select **Oracle Coherence** and click the **New launch configuration** icon.
   b. In the **Name** field, enter `QueryExample`.
   c. In the **Project** field in the **Main** tab, enter `Loading`. In the **Main class** field, enter `com.oracle.handson.QueryExample`.
   d. In the **General** tab of the **Coherence** tab, browse to the `c:\home\oracle\workspace\Contacts\appClientModule\coherence-cache-config.xml` file in the **Cache configuration descriptor** field. Select the **Disabled (cache client)** button. Enter `3155` in the **Cluster port** field. Click **Apply**.

      In the **Other** tab, scroll down to the **tangosol.pof.config** field. Enter the absolute path to the POF configuration file `contacts-pof-config.xml`. Click **Apply**.
   e. Examine the contents of the **Classpath** tab. The **Contacts** project should appear under the **Loading** project in **User Entries**.
3. Restart the `ContactsCacheServer`.
4. Run the `DataGenerator` class, the `LoaderExample` class, then the `QueryExample` class.

After printing all of the contact information in the cache, the `QueryExample` file displays the results of the queries. The results should look similar to Example 5–8.

Example 5–8 Results of the QueryExample Program

```
...
MasterMemberSet
  (
  ThisMember=Member(Id=3, Timestamp=2011-03-15 17:36:07.335, Address=130.35.99.
213:8090, MachineId=49877, Location=site:URL, machine_name,process:188,
Role=OracleHandsonQueryExample)
  OldestMember=Member(Id=1, Timestamp=2011-03-15 17:35:09.585, Address=130.35.99.
213:8088, MachineId=49877, Location=site:URL, machine_name,process:5704,
Role=CoherenceServer)
  ActualMemberSet=MemberSet(Size=2, BitSetCount=2
    Member(Id=1, Timestamp=2011-03-15 17:35:09.585, Address=130.35.99.213:8088,
MachineId=49877, Location=site:URL, machine_name,process:5704,
Role=CoherenceServer)
    Member(Id=3, Timestamp=2011-03-15 17:36:07.335, Address=130.35.99.213:8090,
MachineId=49877, Location=site:URL, machine_name,process:188,
Role=OracleHandsonQueryExample)
    )
  RecycleMillis=1200000
  RecycleSet=MemberSet(Size=0, BitSetCount=0
    )
  )

TcpRing{Connections=[1]}
IpMonitor{AddressListSize=0}
```

```
2011-03-15 17:36:07.553/1.296 Oracle Coherence GE 3.7.0.0 <D5>
(thread=Invocation:Management, member=3): Service Management joined the cluster
with senior service member 1
2011-03-15 17:36:07.647/1.390 Oracle Coherence GE 3.7.0.0 <Info>
(thread=DistributedCache:PartitionedPofCache, member=3): Loaded POF configuration
from "file:/C:/home/oracle/workspace/Contacts/appClientModule/contacts-pof-config.
xml"
2011-03-15 17:36:07.663/1.406 Oracle Coherence GE 3.7.0.0 <Info>
(thread=DistributedCache:PartitionedPofCache, member=3): Loaded included POF
configuration from "jar:file:/C:/oracle/product/coherence/lib/coherence.
jar!/coherence-pof-config.xml"
2011-03-15 17:36:07.710/1.453 Oracle Coherence GE 3.7.0.0 <D5>
(thread=DistributedCache:PartitionedPofCache, member=3): Service
PartitionedPofCache joined the cluster with senior service member 1
MA Residents
ConverterEntry{Key="John Ueccc", Value="John Ueccc
Addresses
Home: 285 Beacon St.

Oxtqwisgti, MA 41063
US
Work: Yoyodyne Propulsion Systems
330 Lectroid Rd.
Grover's Mill, VA 28107
US
Telephone Numbers
work: +11 48 835 1876678
home: +11 78 482 1247744
Birth Date: 1972-12-30"}
...
MA Residents, Work Elsewhere
ConverterEntry{Key="John Ueccc", Value="John Ueccc
Addresses
Home: 285 Beacon St.

Oxtqwisgti, MA 41063
US
Work: Yoyodyne Propulsion Systems
330 Lectroid Rd.
Grover's Mill, VA 28107
US
Telephone Numbers
work: +11 48 835 1876678
home: +11 78 482 1247744
Birth Date: 1972-12-30"}
...
City Begins with S
ConverterEntry{Key="John Frepojf", Value="John Frepojf
Addresses
Home: 851 Beacon St.

Swnsfng, PR 00734
US
Work: Yoyodyne Propulsion Systems
330 Lectroid Rd.
Grover's Mill, AR 97794
US
Telephone Numbers
work: +11 10 474 781020
```

```
home: +11 29 575 9284939
Birth Date: 1985-12-27"}
...
Age > 42
ConverterEntry{Key="John Qghbguyn", Value="John Qghbguyn
Addresses
Home: 49 Beacon St.

Dvftzpq, PR 34220
US
Work: Yoyodyne Propulsion Systems
330 Lectroid Rd.
Grover's Mill, MD 28247
US
Telephone Numbers
work: +11 39 563 7113013
home: +11 58 910 4667915
Birth Date: 1961-01-02"}
...
Last Name Begins with S and State Is MA
ConverterEntry{Key="John Smnfg", Value="John Smnfg
Addresses
Home: 178 Beacon St.

Hbpeak, MA 64081
US
Work: Yoyodyne Propulsion Systems
330 Lectroid Rd.
Grover's Mill, OK 92191
US
Telephone Numbers
work: +11 56 322 7307404
home: +11 33 928 3075361
Birth Date: 1978-12-29"}
...
2011-03-15 17:36:08.350/2.093 Oracle Coherence GE 3.7.0.0 <D4>
(thread=ShutdownHook, member=3): ShutdownHook: stopping cluster node
```

Edit the Query Example to Perform Aggregations

Add code to the `QueryExample.java` file to perform aggregations on the cache data. An entry aggregator (`com.tangosol.util.InvocableMap.EntryAggregator`) enables you to perform operations on all or a specific set of objects and return an aggregation. `EntryAggregator` instances are agents that execute services in parallel against the data within the cluster. Aggregations are performed in parallel and can benefit from the addition of cluster members.

There are two ways of aggregating: aggregate over a collection of keys or by specifying a filter. Example 5–9 illustrates the `EntryAggregator` methods that perform these tasks.

Example 5–9 Methods to Aggregate Over Keys or by Specifying Filters

```
Object aggregate(Collection keys, InvocableMap.entryAggregator agg)

Object aggregate(Filter filter, InvocableMap.entryAggregator agg)
```

To add aggregations to return data for filtering:

1. Using aggregations, write code in the `QueryExample` class to calculate the following:

   - The number of employees that are older than a specified age. Use the `GreaterFilter` and the `Count` class:

     ```
     cache.aggregate(new GreaterFilter("getAge", nAge), new Count())
     ```

   - Lowest age in the set of employees. Use the `AlwaysFilter` and the `LongMin` class:

     ```
     cache.aggregate(AlwaysFilter.INSTANCE, new LongMin("getAge"))
     ```

   - Highest age in the set of employees. Use the `AlwaysFilter` and the `LongMax` class:

     ```
     cache.aggregate(AlwaysFilter.INSTANCE, new LongMax("getAge"))
     ```

   - Average age of employees. Use the `AlwaysFilter` and the `DoubleAverage` class:

     ```
     cache.aggregate(AlwaysFilter.INSTANCE, new DoubleAverage("getAge")
     ```

2. Import the `Count`, `DoubleAverage`, `LongMax`, and `LongMin` aggregator classes.

   ```
   import com.tangosol.util.aggregator.Count;
   import com.tangosol.util.aggregator.DoubleAverage;
   import com.tangosol.util.aggregator.LongMax;
   import com.tangosol.util.aggregator.LongMin;
   ```

   The `QueryExample.java` file looks similar to Example 5–10.

Example 5–10 QueryExample with Aggregation

```
package com.oracle.handson;

import com.tangosol.net.CacheFactory;
import com.tangosol.net.NamedCache;

import com.tangosol.util.aggregator.Count;
import com.tangosol.util.aggregator.DoubleAverage;
import com.tangosol.util.aggregator.LongMax;
import com.tangosol.util.aggregator.LongMin;

import com.tangosol.util.extractor.ChainedExtractor;
import com.tangosol.util.extractor.KeyExtractor;
import com.tangosol.util.extractor.ReflectionExtractor;

import com.tangosol.util.filter.AlwaysFilter;
import com.tangosol.util.filter.AndFilter;
import com.tangosol.util.filter.EqualsFilter;
import com.tangosol.util.filter.GreaterFilter;
import com.tangosol.util.filter.LikeFilter;
import com.tangosol.util.filter.NotEqualsFilter;

import java.util.Iterator;
import java.util.Set;

/**
* QueryExample runs sample queries for contacts.
*/
public class QueryExample{
```

```
// ----- QueryExample methods -------------------------------------

public static void main(String[] args) {
  NamedCache cache = CacheFactory.getCache("ContactsCache");
   query(cache);
}
/**
* Perform the example queries
*
*/
 public static void query(NamedCache cache)
    {
     // Add indexes to make queries more efficient
    ReflectionExtractor reflectAddrHome =
            new ReflectionExtractor("getHomeAddress");

    cache.addIndex(new ReflectionExtractor("getAge"), true, null);
    cache.addIndex(new ChainedExtractor(reflectAddrHome,
            new ReflectionExtractor("getState")), true, null);
    cache.addIndex(new ChainedExtractor(
            new ReflectionExtractor("getWorkAddress"),
            new ReflectionExtractor("getState")), true, null);
    cache.addIndex(new ChainedExtractor(reflectAddrHome,
            new ReflectionExtractor("getCity")), true, null);

    // Find all contacts who live in Massachusetts
    Set setResults = cache.entrySet(new EqualsFilter(
            "getHomeAddress.getState", "MA"));
    printResults("MA Residents", setResults);

    // Find all contacts who live in Massachusetts and work elsewhere
    setResults = cache.entrySet(new AndFilter(
            new EqualsFilter("getHomeAddress.getState", "MA"),
            new NotEqualsFilter("getWorkAddress.getState", "MA")));
    printResults("MA Residents, Work Elsewhere", setResults);

    // Find all contacts whose city name begins with 'S'
    setResults = cache.entrySet(new LikeFilter("getHomeAddress.getCity",
            "S%"));
    printResults("City Begins with S", setResults);

    final int nAge = 42;
    // Find all contacts who are older than nAge
    setResults = cache.entrySet(new GreaterFilter("getAge", nAge));
    printResults("Age > " + nAge, setResults);

    // Find all contacts with last name beginning with 'S' that live
    // in Massachusetts. Uses both key and value in the query.
    setResults = cache.entrySet(new AndFilter(
            new LikeFilter(new KeyExtractor("getLastName"), "S%",
                           (char) 0, false),
            new EqualsFilter("getHomeAddress.getState", "MA")));
    printResults("Last Name Begins with S and State Is MA", setResults);

   // Count contacts who are older than nAge
    System.out.println("count > " + nAge + ": "+ cache.aggregate(
            new GreaterFilter("getAge", nAge), new Count()));

    // Find minimum age
```

```
        System.out.println("min age: " + cache.aggregate(AlwaysFilter.INSTANCE,
                new LongMin("getAge")));

        // Calculate average age
        System.out.println("avg age: " + cache.aggregate(AlwaysFilter.INSTANCE,
                new DoubleAverage("getAge")));

        // Find maximum age
        System.out.println("max age: " + cache.aggregate(AlwaysFilter.INSTANCE,
                new LongMax("getAge")));
        }

    /**
    * Print results of the query
    *
    */
    private static void printResults(String sTitle, Set setResults)
        {
        System.out.println(sTitle);
        for (Iterator iter = setResults.iterator(); iter.hasNext(); )
            {
            System.out.println(iter.next());
            }
        }
    }
```

Run the Query and Aggregation Example

To query the cache and aggregate the results:

1. Stop the `Contacts` cache server, `ContactsCacheServer`. See "Stopping Cache Servers" on page 2-13 for more information.
2. Restart `ContactsCacheServer`.
3. Run the `DataGenerator`, `LoaderExample`, and `QueryExample` applications.

   The output should look similar to Example 5–11 in the Eclipse Console.

Example 5–11 Output from the Aggregators

```
...
Last Name Begins with S and State Is MA
ConverterEntry{Key="John Sqmyas", Value="John Sqmyas
Addresses
Home: 594 Beacon St.

Jxaxt, MA 10081
US
Work: Yoyodyne Propulsion Systems
330 Lectroid Rd.
Grover's Mill, NJ 95236
US
Telephone Numbers
work: +11 70 837 4723938
home: +11 2 227 6816592
Birth Date: 1977-12-29"}
count > 42: 482
min age: 22
avg age: 41.627
max age: 61
```

```
2011-03-15 17:47:26.663/2.078 Oracle Coherence GE 3.7.0.0 <D4>
(thread=ShutdownHook, member=3): ShutdownHook: stopping cluster node
2011-03-15 17:47:26.663/2.078 Oracle Coherence GE 3.7.0.0 <D5> (thread=Cluster,
member=3): Service Cluster left the cluster
2011-03-15 17:47:26.663/2.078 Oracle Coherence GE 3.7.0.0 <D5>
(thread=Invocation:Management, member=3): Service Management left the cluster
```

6

Simplifying Cache Calls and Aggregations

In Chapter 5, "Loading Data Into a Cache," you created a file, `QueryExample.java`, that used a variety of filters, such as `AlwaysFilter`, `LikeFilter`, and `EqualsFilter`, to pull and aggregate information from the cache. The file also created indexes on the data by using a variety of specialized `ValueExtractors`: `ChainedExtractors`, `KeyExtractors`, and `ReflectionExtractors`. This created some verbose Java statements. These statements can be simplified by using the `QueryHelper` API.

This chapter contains the following sections:

Introduction

To simplify filter and extractor statements, and the way in which you interact with the Coherence caches, Oracle Coherence provides the `QueryHelper` API. `QueryHelper` (`com.tangosol.util.QueryHelper`) is a utility class that provides a set of `createFilter` and `createExtractor` factory methods that can build instances of `Filter` and `ValueExtractor`. The methods in the class accept a String data type that specifies the creation of rich Filters in a format that is familiar to anyone who understands SQL `WHERE` clauses.

For example, the following statement uses `createFilter(String s)` to construct a filter for employees who live in Massachusetts but work in another state.

```
..
QueryHelper.createFilter("homeAddress.state = 'MA' and workAddress.state !=
'MA'")
...
```

This statement is more simple and easier to read than the equivalent filter and extractor statement using the Coherence API:

```
new AndFilter(new EqualsFilter("getHomeAddress.getState", "MA"),
      new NotEqualsFilter("getWorkAddress.getState", "MA"))
```

For more information, see the Javadoc for the `QueryHelper` API. For information on the syntax of the `WHERE` clause within the Coherence Query Language, see "Using Coherence Query Language" in *Developer's Guide for Oracle Coherence*.

Simplifying the Query Example

This section describes how you can simplify the indexes, cache calls, and aggregations in the `QueryExample.java` file that you created in the previous chapter.

1. Import the `QueryHelper` API into the `QueryExample.java` file as a static class.

   ```
   import static com.tangosol.util.QueryHelper.*;
   ```

2. Comment out the imports for the `ChainedExtractor`, `KeyExtractor`, and `ReflectionExtractor` classes.
3. Comment out the imports for the `AlwaysFilter`, `AndFilter`, `EqualsFilter`, `GreaterFilter`, `LikeFilter`, and `NotEqualsFilter` classes.
4. In the `cache.addIndex` statements, replace instances of `ReflectionExtractor` with `createExtractor` from the QueryHelper API.

   Table 6–1 lists the `ReflectionExtractor` instances and their `createExtractor` equivalents.

Table 6–1 ReflectionExtractors and Their Equivalent createExtractor Statements

Replace This ReflectionExtractor Statement ...	With the Equivalent createExtractor Statement ...
`cache.addIndex(new ReflectionExtractor("getAge"), true, null);`	`cache.addIndex(createExtractor("age"), true, null);`
`cache.addIndex(new ChainedExtractor(reflectAddrHome, new ReflectionExtractor("getState")), true, null);`	`cache.addIndex(createExtractor("homeAddress.state"), false, null);`
`cache.addIndex(new ChainedExtractor(new ReflectionExtractor("getWorkAddress"), new ReflectionExtractor("getState")), true, null);`	`cache.addIndex(createExtractor("workAddress.state"),false, null);`
`cache.addIndex(new ChainedExtractor(reflectAddrHome, new ReflectionExtractor("getCity")), true, null);`	`cache.addIndex(createExtractor("homeAddress.city"), true, null);`

5. Replace the calls to the `*Filter` methods in the `setResults` statements with calls to `createFilter` with the appropriate Coherence Query Language.

   Table 6–2 lists the `*Filter` instances and their `createFilter` equivalents.

Table 6–2 *Filter Statements and Their Equivalent createFilter Statements in Queries

Replace This *Filter Statement ...	With the Equivalent createFilter Statement ...
`Set setResults = cache.entrySet(new EqualsFilter("getHomeAddress.getState", "MA"));`	`Set setResults = cache.entrySet(createFilter("homeAddress.state = 'MA'"));`
`Set setResults = cache.entrySet(new AndFilter(new EqualsFilter("getHomeAddress.getState", "MA"), new NotEqualsFilter("getWorkAddress.getState", "MA")));`	`setResults = cache.entrySet( createFilter("homeAddress.state is 'MA' and workAddress is not 'MA'"));`

*Table 6–2 (Cont.) *Filter Statements and Their Equivalent createFilter Statements in Queries*

Replace This *Filter Statement ...	With the Equivalent createFilter Statement ...
`Set setResults = cache.entrySet(new LikeFilter("getHomeAddress.getCity", "S%"));`	`Set setResults = cache.entrySet(createFilter("homeAddress .city like 'S%'"));`

`Set setResults = cache.entrySet(new GreaterFilter("getAge", nAge));`	`// Initialize nAge and aEnv`
	`final int nAge = 42;`
	`Object[] aEnv = new Object[] {new Integer(nAge)};`
	`...`
	`Set setResults = cache.entrySet(createFilter("age > ?1",aEnv));`

`Set setResults = cache.entrySet(new AndFilter(new LikeFilter(new KeyExtractor("getLastName"), "S%", (char) 0, false), new EqualsFilter("getHomeAddress.getState", "MA")));`	`Set setResults = cache.entrySet(createFilter("key(lastNam e) like 'S%' and homeAddress.state = 'MA'"));`

6. Replace the calls to the `*Filter` methods in the `aggregate` statements with calls to `createFilter` with the appropriate Coherence Query Language.

   Table 6–3 lists the `*Filter` instances and their `createFilter` equivalents.

Table 6–3 Filter Statements and Their Equivalent createFilter Statements in Aggregations

Replace This *Filter Statement ...	With the Equivalent createFilter Statement ...
`System.out.println("count > " + nAge + ": "+ cache.aggregate(new GreaterFilter("getAge", nAge), new Count()));`	`System.out.println("count > " + nAge + ": " + cache.aggregate(createFilter("age > ?1", aEnv), new Count()));`
`System.out.println("min age: " + cache.aggregate(AlwaysFilter.INSTANCE, new LongMin("getAge")));`	`Filter always = createFilter("true");` `System.out.println("min age: " + cache.aggregate(always, new LongMin("getAge")));`
`System.out.println("avg age: " + cache.aggregate(AlwaysFilter.INSTANCE, new DoubleAverage("getAge")));`	`System.out.println("avg age: " + cache.aggregate(always, new DoubleAverage("getAge")));`
`System.out.println("max age: " + cache.aggregate(AlwaysFilter.INSTANCE, new LongMax("getAge")));`	`System.out.println("max age: " + cache.aggregate(always, new LongMax("getAge")));`

When you are finished with the code replacements, `QueryExample.java` looks similar to Example 6–1.

Example 6–1 Edited QueryExample File

```
package com.oracle.handson;

import com.tangosol.net.CacheFactory;
import com.tangosol.net.NamedCache;

import com.tangosol.util.Filter;
import static com.tangosol.util.QueryHelper.*;
```

```
import com.tangosol.util.aggregator.Count;
// import com.tangosol.util.extractor.ChainedExtractor;
// import com.tangosol.util.extractor.KeyExtractor;
// import com.tangosol.util.extractor.ReflectionExtractor;

// import com.tangosol.util.aggregator.Count;
import com.tangosol.util.aggregator.DoubleAverage;
import com.tangosol.util.aggregator.LongMax;
import com.tangosol.util.aggregator.LongMin;


// import com.tangosol.util.filter.AlwaysFilter;
// import com.tangosol.util.filter.AndFilter;
// import com.tangosol.util.filter.EqualsFilter;
// import com.tangosol.util.filter.GreaterFilter;
// import com.tangosol.util.filter.LikeFilter;
// import com.tangosol.util.filter.NotEqualsFilter;

import java.util.Iterator;
import java.util.Set;


/**
* QueryExample runs sample queries for contacts.
*
*/
public class QueryExample{

    // ----- QueryExample methods ---------------------------------------

    public static void main(String[] args) {
      NamedCache cache = CacheFactory.getCache("ContactsCache");
       query(cache);
    }
    /**
    * Perform the example queries
    *
    */
     public static void query(NamedCache cache)
        {
        // Add indexes to make queries more efficient
        // ReflectionExtractor reflectAddrHome =
        //     new ReflectionExtractor("getHomeAddress");

        // Add an index for the age
        // cache.addIndex(new ReflectionExtractor("getAge"), true, null);
        cache.addIndex(createExtractor("age"), true, null);

        // Add index for state within home address
        // cache.addIndex(new ChainedExtractor(reflectAddrHome,
        //        new ReflectionExtractor("getState")), true, null);
        cache.addIndex(createExtractor("homeAddress.state"), false, null);

        // Add index for state within work address
        // cache.addIndex(new ChainedExtractor(
        //        new ReflectionExtractor("getWorkAddress"),
        //        new ReflectionExtractor("getState")), true, null);
        cache.addIndex(createExtractor("workAddress.state"),false, null);
```

```
        // Add index for city within home address
        // cache.addIndex(new ChainedExtractor(reflectAddrHome,
        //        new ReflectionExtractor("getCity")), true, null);
        cache.addIndex(createExtractor("homeAddress.city"), true,  null);

        // Find all contacts who live in Massachusetts
        // Set setResults = cache.entrySet(new EqualsFilter(
        //         "getHomeAddress.getState", "MA"));
        Set setResults = cache.entrySet(createFilter("homeAddress.state = 'MA'"));
            printResults("MA Residents", setResults);

        // Find all contacts who live in Massachusetts and work elsewhere
        // setResults = cache.entrySet(new AndFilter(
        //        new EqualsFilter("getHomeAddress.getState", "MA"),
        //        new NotEqualsFilter("getWorkAddress.getState", "MA")));
        setResults = cache.entrySet(createFilter("homeAddress.state is 'MA' and
workAddress is not 'MA'"));
            printResults("MA Residents, Work Elsewhere", setResults);

        // Find all contacts whose city name begins with 'S'
        // setResults = cache.entrySet(new LikeFilter("getHomeAddress.getCity",
        //         "S%"));
        setResults = cache.entrySet(createFilter("homeAddress.city like 'S%'"));
            printResults("City Begins with S", setResults);

        final int nAge = 42;
        Object[] aEnv  =  new Object[] {new Integer(nAge)};
        // Find all contacts who are older than nAge
        // setResults = cache.entrySet(new GreaterFilter("getAge", nAge));
        setResults = cache.entrySet(createFilter("age > ?1",aEnv));
             printResults("Age > " + nAge, setResults);

        // Find all contacts with last name beginning with 'S' that live
        // in Massachusetts. Uses both key and value in the query.
        // setResults = cache.entrySet(new AndFilter(
        //     new LikeFilter(new KeyExtractor("getLastName"), "S%",
        //   (char) 0, false),
        //         new EqualsFilter("getHomeAddress.getState", "MA")));
        setResults = cache.entrySet(createFilter("key(lastName) like 'S%' and
homeAddress.state = 'MA'"));
        setResults = cache.entrySet(createFilter("key().lastName like 'S%' and
homeAddress.state = 'MA'"));
            printResults("Last Name Begins with S and State Is MA", setResults);

        // Count contacts who are older than nAge
        // System.out.println("count > " + nAge + ": "+
        //  cache.aggregate(new GreaterFilter("getAge", nAge), new Count()));
        System.out.println("count > " + nAge + ": " + cache.aggregate(
                    createFilter("age > ?1", aEnv), new Count()));

        // Find minimum age
        // System.out.println("min age: " + cache.aggregate(AlwaysFilter.INSTANCE,
new LongMin("getAge")));
        Filter always = createFilter("true");
        System.out.println("min age: " + cache.aggregate(always, new
LongMin("getAge")));

        // Calculate average age
        // System.out.println("avg age: " + cache.aggregate(AlwaysFilter.INSTANCE,
new DoubleAverage("getAge")));
```

```
        System.out.println("avg age: " + cache.aggregate(always, new
DoubleAverage("getAge")));

        // Find maximum age
        // System.out.println("max age: " +
        // cache.aggregate(AlwaysFilter.INSTANCE, new LongMax("getAge")));
        System.out.println("max age: " + cache.aggregate(always, new
LongMax("getAge")));

 System.out.println("------QueryLanguageExample completed------");

        }

    /**
    * Print results of the query
    *
    * @param sTitle      the title that describes the results
    * @param setResults  a set of query results
    */
    private static void printResults(String sTitle, Set setResults)
        {
        System.out.println(sTitle);
        for (Iterator iter = setResults.iterator(); iter.hasNext(); )
            {
            System.out.println(iter.next());
            }
        }
    }
```

Rerunning the Query Example

To rerun the query example:

1. Stop any running cache servers. See "Stopping Cache Servers" on page 2-13 for more information.
2. Restart the `ContactsCacheServer`.
3. Run the `DataGenerator`, `LoaderExample`, and `QueryExample` files.
4. After printing all of the contact information in the cache, it displays the results of the queries. The results should look similar to the following examples.

Example 6–2 illustrates the output of the MA Residents filter.

Example 6–2 Output of the MA Residents Filter

```
...
MA Residents
ConverterEntry{Key="John Hwdrrls", Value="John Hwdrrls
Addresses
Home: 369 Beacon St.

Fetggv, MA 24372
US
Work: Yoyodyne Propulsion Systems
330 Lectroid Rd.
Grover's Mill, NE 84499
US
Telephone Numbers
work: +11 88 331 2307913
```

```
home: +11 64 86 2489621
Birth Date: 1976-12-29"}
...
```

Example 6–3 illustrates the output of the MA Residents, Work Elsewhere filter.

Example 6–3 Output of the MA Residents, Work Elsewhere Filter

```
...
MA Residents, Work Elsewhere
ConverterEntry{Key="John Hwdrrls", Value="John Hwdrrls
Addresses
Home: 369 Beacon St.

Fetggv, MA 24372
US
Work: Yoyodyne Propulsion Systems
330 Lectroid Rd.
Grover's Mill, NE 84499
US
Telephone Numbers
work: +11 88 331 2307913
home: +11 64 86 2489621
Birth Date: 1976-12-29"}
...
```

Example 6–4 illustrates the output of the City Begins with S filter.

Example 6–4 Output of the City Begins with S Filter

```
...
City Begins with S
ConverterEntry{Key="John Pzek", Value="John Pzek
Addresses
Home: 309 Beacon St.

Saqrgy, OH 81353
US
Work: Yoyodyne Propulsion Systems
330 Lectroid Rd.
Grover's Mill, CT 78117
US
Telephone Numbers
work: +11 28 790 2035988
home: +11 61 470 7634708
Birth Date: 1971-12-31"}
...
```

Example 6–5 illustrates the output of the age greater than 42 filter.

Example 6–5 Output of the Age Greater than 42 Filter

```
...
Age > 42
ConverterEntry{Key="John Gddurqqziy", Value="John Gddurqqziy
Addresses
Home: 613 Beacon St.

Cxyskdo, DE 28968
US
Work: Yoyodyne Propulsion Systems
```

```
330 Lectroid Rd.
Grover's Mill, SD 07959
US
Telephone Numbers
work: +11 31 768 5136041
home: +11 87 22 3851589
Birth Date: 1958-01-03"}
...
```

Example 6–6 illustrates the output of the Last Name Begins with S and State is MA filter and the output of the aggregators.

Example 6–6 Output of the State and Age Aggregators

```
Last Name Begins with S and State Is MA
ConverterEntry{Key="John Syaqlojl", Value="John Syaqlojl
Addresses
Home: 810 Beacon St.

Rgtaljwph, MA 07471
US
Work: 200 Newbury St.
Yoyodyne, Ltd.
Boston, MA 02116
US
Telephone Numbers
work: +11 37 18 1767648
home: +11 98 155 1073866
Birth Date: 1974-12-30"}
...
count > 42: 446
min age: 22
avg age: 41.126
max age: 61
```

7

Listening for Changes and Modifying Data

In this chapter, you set up listeners to observe data changes within a Coherence cache. You also learn how entry processors can be used to modify and process entries in the Coherence cache.

This chapter contains the following sections:

Introduction

The `com.tangosol.util.ObservableMap` interface enables you to observe and act on the changes made to cache entries. It extends `java.util.EventListener` and uses the standard JavaBeans event model. All types of `NamedCache` instances implement this interface. To listen for an event, you register a `MapListener` (`com.tangosol.util.MapListener`) instance on the cache. `MapListener` instances are called on the client; that is, the listener code is executed in your client process.

There are multiple ways to listen for events:

- Listen for all events
- Listen for all events that satisfy a filter
- Listen for events on a particular object key

These listener tasks can be performed on a `NamedCache` by the `addMapListener` methods listed in Example 7–1.

Example 7–1 Listener Methods on a NamedCache

```
void addMapListener(MapListener listener)

void addMapListener(MapListener listener, Filter filter, boolean fLite)

void addMapListener(MapListener listener, Object oKey, boolean fLite)
```

The `com.tangosol.util.MapEvent` class captures the object key, and the old and new values. You can specify a *Lite* event, in which the new and old values might not be present. Example 7–2 describes a pattern for registering these methods against a `NamedCache`. This has been done as an anonymous class. You can use the `getOldValue` or `getNewValue` methods in the `MapEvent` class to get the entry for which the event gets fired.

Example 7–2 Code Pattern for Registering an Event

```
namedCache.addMapListener(new MapListener() {
public void entryDeleted(MapEvent mapEvent)
    {
    // TODO... handle deletion event
    }
public void entryInserted(MapEvent mapEvent)
    {
    // TODO... handle inserted event
    }
public void entryUpdated(MapEvent mapEvent)
    {
     // TODO... handle updated event } }
    )
```

Creating a Cache Listener

This section describes how to create a Java class that listens on a `NamedCache` and responds to any changes it detects.

1. Create a Class to Listen for Changes in the Cache
2. Run the Cache Listener Example

Create a Class to Listen for Changes in the Cache

In the `Loading` project, create the class that will listen for a new `Contact` object entry. Name the class `ObserverExample` and ensure that it has a `main` method. See "Creating a Java Class" on page 2-11 for detailed information.

Within this class, add a listener to display a message whenever a new `Contact` is updated to the cache. For example, use the following code to keep the Java process running until you read from the console. Otherwise, your program will immediately exit.

```
BufferedReader console = new BufferedReader(new InputStreamReader(System.in));
String text = console.readLine();
```

Within the class, create an inner class to extend `AbstractMapListner`. Implement the methods to insert, update, and delete the cache values. In this case, most of the work should be done in the `entryUpdated` method, based on the old and new values contained in a `MapEvent`.

Example 7–3 illustrates a possible implementation of a listener class.

Example 7–3 Sample Listener Class

```
package com.oracle.handson;

import com.tangosol.net.NamedCache;

import com.tangosol.util.AbstractMapListener;
import com.tangosol.util.MapEvent;

import com.oracle.handson.Contact;

import com.tangosol.net.CacheFactory;

import java.io.IOException;
```

```
/**
 * ObserverExample observes changes to contacts.
 */
public class ObserverExample
    {

    public ObserverExample()
    {
    }
    // ----- ObserverExample methods ---------------------------------

    public static void main(String[] args) {
      NamedCache cache = CacheFactory.getCache("ContactsCache");
      new ObserverExample().observe(cache);
        try {
            System.in.read();
        } catch (IOException e) {
        }
    }
    /**
    * Observe changes to the contacts.
    *
    * @param cache  target cache
    */
    public void observe(NamedCache cache)
        {
        cache.addMapListener(new ContactChangeListener());
        }

    // ----- inner class: ContactChangeListener ------------------------

    public class ContactChangeListener
            extends AbstractMapListener
        {
        // ----- MapListener interface -----------------------------------------

        public void entryInserted(MapEvent event)
            {
            System.out.println(event);
            }

        public void entryUpdated(MapEvent event)
            {
            Contact contactOld = (Contact)event.getOldValue();
            Contact contactNew = (Contact)event.getNewValue();
            StringBuffer sb  = new StringBuffer();

            if (!contactOld.getHomeAddress().equals(
                    contactNew.getHomeAddress()))
                {
                sb.append("Home address ");
                }
            if (!contactOld.getWorkAddress().equals(
                    contactNew.getWorkAddress()))
                {
                sb.append("Work address ");
                }
            if (!contactOld.getTelephoneNumbers().equals(
                    contactNew.getTelephoneNumbers()))
```

```
                {
                sb.append("Telephone ");
                }
            if (contactOld.getAge() != contactNew.getAge())
                {
                sb.append("Birthdate ");
                }
            sb.append("was updated for ").append(event.getKey());
            System.out.println(sb);
            }

        public void entryDeleted(MapEvent event)
            {
            System.out.println(event.getKey());
            }
        }
    }
```

Run the Cache Listener Example

To run the Cache Listener example:

1. Create a run configuration for `ObserverExample`. Right click `ObserverExample` in the **Project Explorer** and select **Run As**. In the **Run Configurations** dialog box select **Oracle Coherence** and click the **New Configuration** icon.
   a. In the **Name** field, enter `ObserverExample`.
   b. In the **Project** field in the **Main** tab, enter `Loading`. In the **Main class** field, enter `com.oracle.handson.ObserverExample`.
   c. In the **General** tab of the **Coherence** tab, browse to the `c:\home\oracle\workspace\Contacts\appClientModule\coherence-cache-config.xml` file in the **Cache configuration descriptor** field. Select the **Disabled (cache client)** button. Enter `3155` in the **Cluster port** field. Click **Apply**.

      In the **Other** tab, scroll down to the **tangosol.pof.config** field. Enter the absolute path to the POF configuration file `contacts-pof-config.xml`. Click **Apply**.
   d. In the **Common** tab, select **Shared file** and browse for the **Loading** directory.
2. Check that the classes for the `Loading` project (`C:\home\oracle\workspace\Loading\build\classes`) and the path to the configuration files (`C:\home\oracle\workspace`) are present in the `contacts-cache-server.cmd` file.
3. Stop any running cache servers. See "Stopping Cache Servers" on page 2-13 for more information.
4. Start the `ContactsCacheServer`.
5. Load the cache by running the `LoaderExample` program from Eclipse. If you now run the `ObserverExample`, the program waits for input, as illustrated in Example 7–4.

   In "Responding to Changes in the Cache" on page 7-5, you create a program that modifies entries in the cache and returns the changed records.

Example 7–4 Listener Program Waiting for Events

```
...
MasterMemberSet
```

```
  (
  ThisMember=Member(Id=3, Timestamp=2011-03-15 11:57:03.569, Address=130.35.99.213:8090,
MachineId=49877, Location=site:URL, machine_name,process:792, Role=OracleHandsonObserverExample)
  OldestMember=Member(Id=1, Timestamp=2011-03-15 11:56:32.959, Address=130.35.99.213:8088,
MachineId=49877, Location=site:URL, machine_name,process:4864, Role=CoherenceServer)
  ActualMemberSet=MemberSet(Size=2, BitSetCount=2
    Member(Id=1, Timestamp=2011-03-15 11:56:32.959, Address=130.35.99.213:8088, MachineId=49877,
Location=site:URL, machine_name,process:4864, Role=CoherenceServer)
    Member(Id=3, Timestamp=2011-03-15 11:57:03.569, Address=130.35.99.213:8090, MachineId=49877,
Location=site:URL, machine_name,process:792, Role=OracleHandsonObserverExample)
    )
  RecycleMillis=1200000
  RecycleSet=MemberSet(Size=0, BitSetCount=0
    )
  )

TcpRing{Connections=[1]}
IpMonitor{AddressListSize=0}

2011-03-15 11:57:03.803/1.297 Oracle Coherence GE 3.7.0.0 <D5> (thread=Invocation:Management,
member=3): Service Management joined the cluster with senior service member 1
2011-03-15 11:57:03.897/1.391 Oracle Coherence GE 3.7.0.0 <Info>
(thread=DistributedCache:PartitionedPofCache, member=3): Loaded POF configuration from
"file:/C:/home/oracle/workspace/Contacts/appClientModule/contacts-pof-config.xml"
2011-03-15 11:57:03.913/1.407 Oracle Coherence GE 3.7.0.0 <Info>
(thread=DistributedCache:PartitionedPofCache, member=3): Loaded included POF configuration from
"jar:file:/C:/oracle/product/coherence/lib/coherence.jar!/coherence-pof-config.xml"
2011-03-15 11:57:03.959/1.453 Oracle Coherence GE 3.7.0.0 <D5>
(thread=DistributedCache:PartitionedPofCache, member=3): Service PartitionedPofCache joined the
cluster with senior service member 1
```

Responding to Changes in the Cache

In this section, you will create a Java class to modify entries in the cache and return the changed records.

Until now, to perform actions on the entries in a cache, you used the `put` and `get` operations. However, there is a better way to perform operations on data that ensure consistent behavior when concurrent data access is required. Entry processors (`com.tangosol.util.InvocableMap.EntryProcessor`) are agents that perform processing against entries. The entries are processed directly where the data is being held. The processing you perform can change the data: it can create, update, remove data, or only perform calculations. The processing can occur in parallel in a partitioned cache with multiple nodes, so it is scalable. Processing in the cache also saves I/O expense because data is not pulled to the client for processing.

Entry processors that work on the same key are logically queued. This allows lock-free (high performance) processing. The `com.tangosol.util.InvocableMap` interface (which the `NamedCache` implements) has the following methods for operating on data:

- `Object invoke(Object oKey, InvocableMap.EntryProcessor processor)`, which invokes the passed `EntryProcessor` against an individual object and returns the result of the invocation.
- `Map invokeAll(Collection keys, InvocableMap.EntryProcessor processor)`, which invokes the `EntryProcessor` against the collection of keys and returns the result for each invocation.

- `Map invokeAll(Filter filter, InvocableMap.EntryProcessor processor)`, which invokes the `EntryProcessor` against the entries that match the filter and returns the result for each invocation.

> **Note:** `EntryProcessor` classes must be available in the class path for each cluster node.

To create an entry process, you can extend `com.tangosol.util.processes.AbstractProcessor` and implement the `process()` method. For example, the following code creates an `EntryProcessor` instance to change the work address of employees in the `Contacts` data set:

```
public static class OfficeUpdater extends AbstractProcessor
        implements PortableObject
  ...
    public Object process(InvocableMap.Entry entry)
        {
        Contact contact = (Contact) entry.getValue();
        contact.setWorkAddress(m_addrWork);
        entry.setValue(contact);
        return null;
        }
```

To invoke the `OfficeUpdater` class, you can use the `invokeAll` method with the name of the `OfficeUpdater` class as one of its arguments.

```
cache.invokeAll(new EqualsFilter("getHomeAddress.getState", "MA"),
             new OfficeUpdater(addrWork));
```

In this exercise, you create a Java class with `EntryProcessor` instances that update entries in the cache. The `ObserverExample` class created in "Create a Class to Listen for Changes in the Cache" on page 7-2 will detect these changes and display the changed records.

1. Create a Class to Update Entries in the Cache
2. Edit the POF Configuration File
3. Run the Cache Update Example

Create a Class to Update Entries in the Cache

To create a file to update entries in the cache:

1. Create a class that updates entries in the cache.

   In the `Loading` project, create a class called `ProcessorExample` with a `main` method that updates the address of a `Contact` object in the cache. See "Creating a Java Class" on page 2-11 for detailed information.

2. Write code to find the records of the `Contacts` object that live in Massachusetts and update their work addresses to an in-state office.

   Include an inner class that implements the `PortableObject` interface (for serializing and deserializing data from the cache) and contains an `EntryProcessor` instance to set the work addresses. Use methods from the `Filter` class to isolate the `Contacts` members whose home addresses are in Massachusetts.

Example 7–5 illustrates a possible implementation of the `ProcessorExample` class.

Example 7–5 Sample Program to Update an Object in the Cache

```
package com.oracle.handson;

import com.tangosol.net.NamedCache;

import com.tangosol.util.filter.EqualsFilter;
import com.tangosol.util.processor.AbstractProcessor;
import com.tangosol.util.InvocableMap;

import com.tangosol.io.pof.PortableObject;
import com.tangosol.io.pof.PofReader;
import com.tangosol.io.pof.PofWriter;

import com.oracle.handson.Address;
import com.oracle.handson.Contact;

import com.tangosol.net.CacheFactory;

import java.io.IOException;

/**
* ProcessorExample executes an example EntryProcessor.
*
*/
public class ProcessorExample
    {
    public ProcessorExample()
    {
    }
        public static void main(String[] args)
          {
          NamedCache cache = CacheFactory.getCache("ContactsCache");
          new ProcessorExample().execute(cache);
          }
    // ----- ProcessorExample methods ---------------------------------

    public void execute(NamedCache cache)
        {
        // People who live in Massachusetts moved to an in-state office
        Address addrWork = new Address("200 Newbury St.", "Yoyodyne, Ltd.",
                "Boston", "MA", "02116", "US");

        cache.invokeAll(new EqualsFilter("getHomeAddress.getState", "MA"),
                new OfficeUpdater(addrWork));
        }
    // ----- nested class: OfficeUpdater ------------------------------------

    /**
    * OfficeUpdater updates a contact's office address.
    */
    public static class OfficeUpdater
            extends AbstractProcessor
            implements PortableObject
        {
        // ----- constructors ---------------------------------------------
```

```
        /**
        * Default constructor (necessary for PortableObject implementation).
        */
        public OfficeUpdater()
            {
            }

        public OfficeUpdater(Address addrWork)
           {
            m_addrWork = addrWork;
            }

        // ----- InvocableMap.EntryProcessor interface ------------------

        public Object process(InvocableMap.Entry entry)
            {
            Contact contact = (Contact) entry.getValue();

            contact.setWorkAddress(m_addrWork);
            entry.setValue(contact);
            System.out.println("Work address was updated for " + contact.
getFirstName() + " " + contact.getLastName());
            return null;
            }

        // ----- PortableObject interface -------------------------------

        public void readExternal(PofReader reader)
                throws IOException
            {
            m_addrWork = (Address) reader.readObject(0);
            }

        public void writeExternal(PofWriter writer)
                throws IOException
            {
            writer.writeObject(0, m_addrWork);
            }

        // ----- data members -------------------------------------------

        private Address m_addrWork;
        }
    }
```

Edit the POF Configuration File

Edit the `contacts-pof-config.xml` file to add a user type ID for the `OfficeUpdater` entries. In this case, add the type ID `106` for the `ProcessorExample$OfficeUpdater` class.

```
...
<user-type>
       <type-id>1006</type-id>
      <class-name>com.oracle.handson.
 ProcessorExample$OfficeUpdater</class-name>
</user-type>
...
```

Run the Cache Update Example

To run the cache update example.

1. Create a run configuration for `ProcessorExample`. Right click `ObserverExample` in the **Project Explorer** and select **Run As**. In the **Run Configurations** dialog box select **Oracle Coherence** and click the **New Configuration** icon
   - In the **Name** field, enter `ProcessorExample`.
   - In the **Project** field in the **Main** tab, enter `Loading`. In the **Main class** field, enter `com.oracle.handson.ProcessorExample`.
   - In the **General** tab of the **Coherence** tab, browse to the `c:\home\oracle\workspace\Contacts\appClientModule\coherence-cache-config.xml` file in the **Cache configuration descriptor** field. Select the **Disabled (cache client)** button. Enter `3155` in the **Cluster port** field. Click **Apply**.

     In the **Other** tab, scroll down to the **tangosol.pof.config** field. Enter the absolute path to the POF configuration file `contacts-pof-config.xml`. Click **Apply**.
   - In the **Common** tab, select **Shared file** and browse for the **Loading** directory.
2. Perform the following steps to test the `ObserverExample` and `ProcessorExample` classes.
   a. Stop any running cache servers. See "Stopping Cache Servers" on page 2-13 for more information.
   b. Restart the `ContactsCacheServer`.
   c. Run the `LoaderExample` class to load the cache.
   d. Run the `ObserverExample` class.
   e. Run the `ProcessorExample` to update records in the cache.

      You should see messages in the cache server console window, that are similar to Example 7–6, indicating that the work addresses for the specified employees were updated.

Example 7–6 Output from the ObserverExample and ProcessorExample Classes

```
...
Group{Address=224.3.7.0, Port=3155, TTL=4}

MasterMemberSet
  (
  ThisMember=Member(Id=3, Timestamp=2011-03-15 12:20:17.538, Address=130.35.99.213:8090,
MachineId=49877, Location=site:URL, machine_name,process:4396, Role=OracleHandsonObserverExample)
  OldestMember=Member(Id=1, Timestamp=2011-03-15 12:17:47.491, Address=130.35.99.213:8088,
MachineId=49877, Location=site:URL, machine_name,process:1980, Role=CoherenceServer)
  ActualMemberSet=MemberSet(Size=2, BitSetCount=2
    Member(Id=1, Timestamp=2011-03-15 12:17:47.491, Address=130.35.99.213:8088, MachineId=49877,
Location=site:URL, machine_name,process:1980, Role=CoherenceServer)
    Member(Id=3, Timestamp=2011-03-15 12:20:17.538, Address=130.35.99.213:8090, MachineId=49877,
Location=site:URL, machine_name,process:4396, Role=OracleHandsonObserverExample)
    )
  RecycleMillis=1200000
  RecycleSet=MemberSet(Size=0, BitSetCount=0
    )
  )
```

```
TcpRing{Connections=[1]}
IpMonitor{AddressListSize=0}

2011-03-15 12:20:17.772/1.313 Oracle Coherence GE 3.7.0.0 <D5> (thread=Invocation:Management,
member=3): Service Management joined the cluster with senior service member 1
2011-03-15 12:20:17.866/1.407 Oracle Coherence GE 3.7.0.0 <Info>
(thread=DistributedCache:PartitionedPofCache, member=3): Loaded POF configuration from
"file:/C:/home/oracle/workspace/Contacts/appClientModule/contacts-pof-config.xml"
2011-03-15 12:20:17.881/1.422 Oracle Coherence GE 3.7.0.0 <Info>
(thread=DistributedCache:PartitionedPofCache, member=3): Loaded included POF configuration from
"jar:file:/C:/oracle/product/coherence/lib/coherence.jar!/coherence-pof-config.xml"
2011-03-15 12:20:17.928/1.469 Oracle Coherence GE 3.7.0.0 <D5>
(thread=DistributedCache:PartitionedPofCache, member=3): Service PartitionedPofCache joined the
cluster with senior service member 1
2011-03-15 12:20:33.850/17.391 Oracle Coherence GE 3.7.0.0 <D5> (thread=Cluster, member=3):
Member(Id=4, Timestamp=2011-03-15 12:20:33.647, Address=130.35.99.213:8092, MachineId=49877,
Location=site:URL, machine_name,process:4400, Role=OracleHandsonProcessorExample) joined Cluster
with senior member 1
2011-03-15 12:20:33.913/17.454 Oracle Coherence GE 3.7.0.0 <D5> (thread=Cluster, member=3): Member
4 joined Service Management with senior member 1
2011-03-15 12:20:34.084/17.625 Oracle Coherence GE 3.7.0.0 <D5> (thread=Cluster, member=3): Member
4 joined Service PartitionedPofCache with senior member 1
Work address was updated for John Yuoo
Work address was updated for John Dikkx
Work address was updated for John Kwtkvp
Work address was updated for John Tdqpyncf
Work address was updated for John Bophtnbxig
Work address was updated for John Sqyiohnpcj
Work address was updated for John Vjfdqs
Work address was updated for John Cudpahnugc
Work address was updated for John Wovzeja
Work address was updated for John Woyy
Work address was updated for John Peladt
Work address was updated for John Nuetsjd
Work address was updated for John Oueywut
Work address was updated for John Uanwypjz
Work address was updated for John Xfazifx
Work address was updated for John Qdnod
Work address was updated for John Sgiephelfq
Work address was updated for John Oajpabav
2011-03-15 12:20:34.272/17.813 Oracle Coherence GE 3.7.0.0 <D5> (thread=Cluster, member=3):
MemberLeft notification for Member(Id=4, Timestamp=2011-03-15 12:20:33.647, Address=130.35.99.
213:8092, MachineId=49877, Location=site:URL, machine_name,process:4400,
Role=OracleHandsonProcessorExample) received from Member(Id=1, Timestamp=2011-03-15 12:17:47.491,
Address=130.35.99.213:8088, MachineId=49877, Location=site:URL, machine_name,process:1980,
Role=CoherenceServer)
2011-03-15 12:20:34.272/17.813 Oracle Coherence GE 3.7.0.0 <D5> (thread=Cluster, member=3): Member
4 left service Management with senior member 1
2011-03-15 12:20:34.272/17.813 Oracle Coherence GE 3.7.0.0 <D5> (thread=Cluster, member=3): Member
4 left service PartitionedPofCache with senior member 1
2011-03-15 12:20:34.272/17.813 Oracle Coherence GE 3.7.0.0 <D5> (thread=Cluster, member=3):
Member(Id=4, Timestamp=2011-03-15 12:20:34.272, Address=130.35.99.213:8092, MachineId=49877,
Location=site:URL, machine_name,process:4400, Role=OracleHandsonProcessorExample) left Cluster with
senior member 1
```

8

Using JPA with Coherence

In this chapter, you learn how to use Java Persistence API (JPA) to perform object-relational mapping. This chapter contains the following sections:

- Introduction
- Mapping Relational Data to Java Objects with JPA

You must have a working version of the Oracle Database Express Edition (also known as the OracleXE database) installed on your system. If you do not have the database, you can download it from this URL:

```
http://www.oracle.com/technetwork/database/database-technologies
/express-edition/downloads/index.html
```

Introduction

A major enhancement in Enterprise JavaBeans (EJB) technology is the addition of JPA, which simplifies the entity persistence model and adds capabilities, such as persistence for Java SE, that were not in earlier EJB technologies.

JPA defines how relational data is mapped to Java objects (persistent entities), the way that these objects are stored in a relational database so that they can be accessed at a later time, and the continued existence of an entity's state even after the application that uses it ends. In addition to simplifying the entity persistence model, the JPA standardizes object-relational mapping.

To determine how data is stored within a Coherence cluster, a backing map is used. By default, Coherence uses a memory-based backing map. To persist data, there are several backing map implementations.

The JPA implementation used in this exercise provides Object Relational Mapping (ORM) from the Java world to the database world. It also allows you to use standard Coherence `get` and `put` methods, and have Coherence calls translated into database calls using JPA and Oracle TopLink (based on the open source EclipseLink project).

Mapping Relational Data to Java Objects with JPA

In this exercise, you use Eclipse to perform the following tasks:

- Create a connection to the `HR` schema in the OracleXE database.
- Automatically generate JPA objects for the `EMPLOYEES` table.
- Modify the `cache-server.cmd` file to point to the sample JPA `cache-config.xml` file.

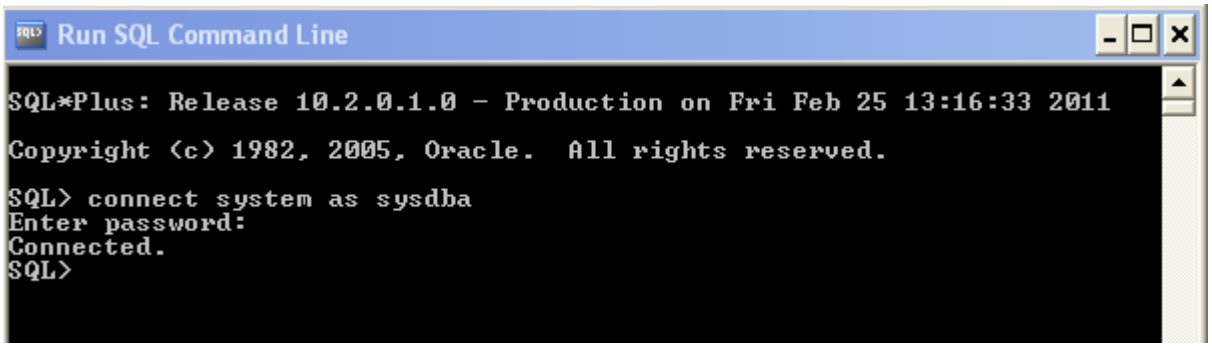
Unlock the OracleXE Database

Unlock the `HR` account in your pre-installed OracleXE database.

You must have the OracleXE database installed on your system and be able to access the HR schema. To unlock the HR account, follow these steps:

1. Navigate to **Start** then **All Programs** then **Oracle Database Express Edition** then **Run SQL Command Line**.
2. Enter `connect system as sysdba`, and then enter `welcome1` when prompted for the password. (Note: your user name is `system` and your password is `welcome1`.)

Figure 8–1 Connecting to the Database



3. Enter the command to unlock the account:

```
alter user hr identified by hr account unlock;
```

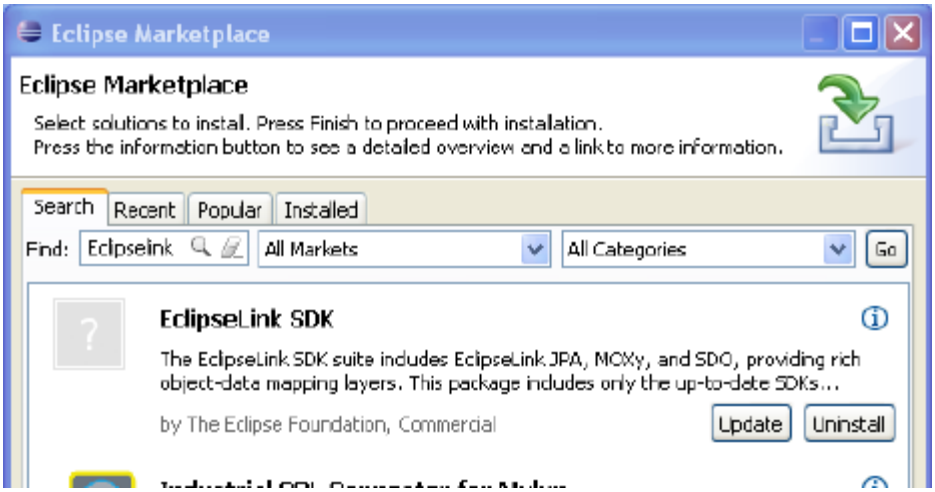
Figure 8–2 Unlocking the Database Account

Download the JPA Libraries

This exercise requires the `org.eclipse.persistence.*` and the `javax.persistence` files to be present in your system. You can obtain these files through the Eclipse IDE.

1. Select **Help** then **Eclipse Marketplace**.
2. In the **Eclipse Marketplace** dialog box, enter `EclipseLink` in the **Find** field and click **Go**.
3. Select the EclipseLink SDK, as illustrated in Figure 8–3, and follow installation instructions. The required persistence files will be installed in the `eclipse\plugins` directory.

Figure 8–3 EclipseLink SDK in the Eclipse Marketplace

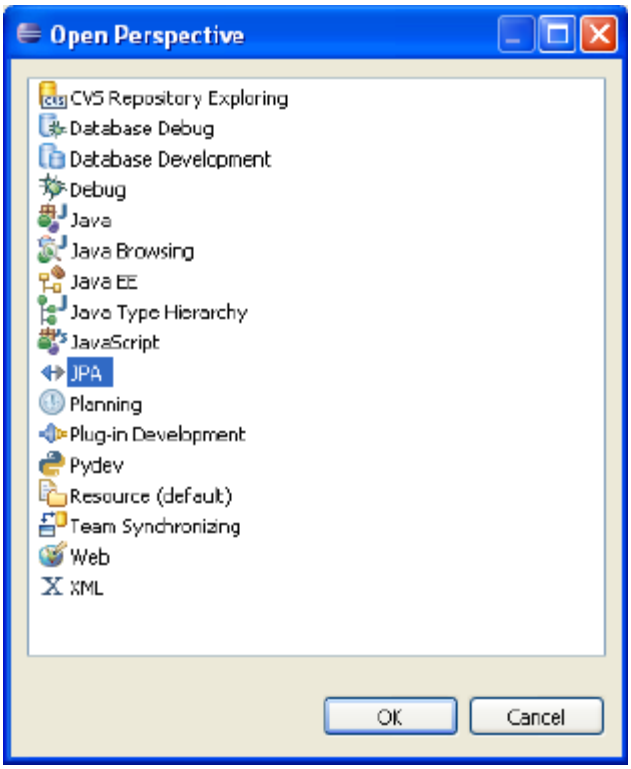


Configure the Project for JPA

Create a new project in Eclipse IDE called `JPA`. See "Creating a New Project in the Eclipse IDE" on page 2-3 for detailed information.

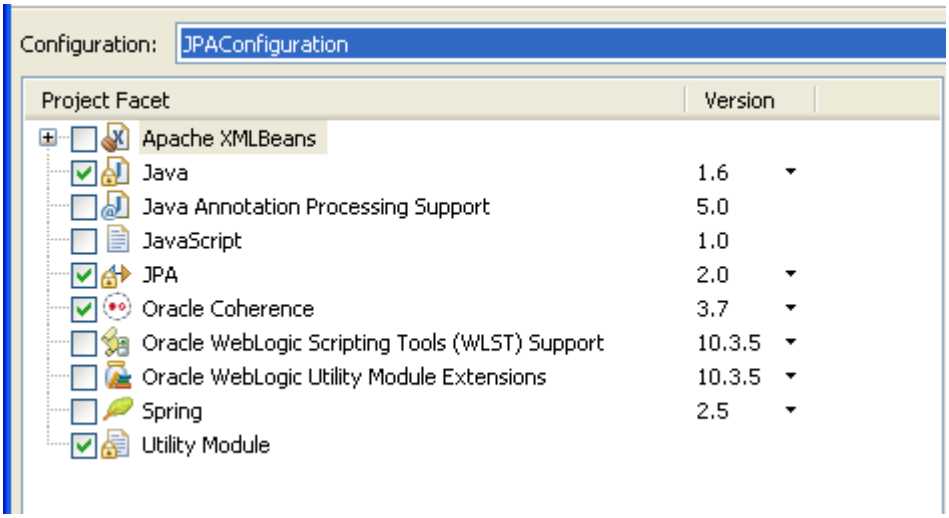
1. In the Eclipse IDE, click **Window** then **Open Perspective** then **Other** to open the **Open Perspective** dialog box. Select the **JPA** perspective, as illustrated in Figure 8–4.

Figure 8–4 Selecting the JPA Perspective in the Open Perspective Dialog Box



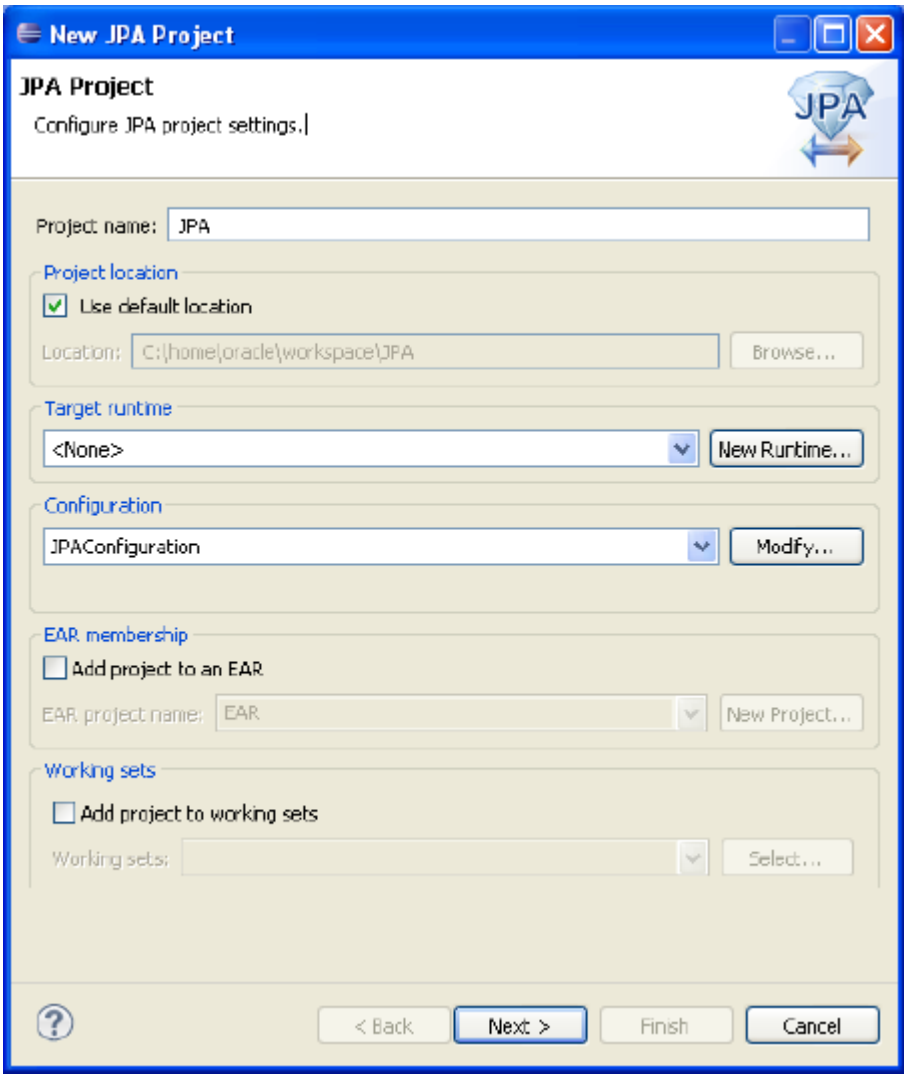
2. Select **File** then **New** then **JPA Project**. Enter `JPA` as the project name. Ensure that the default location points to `home\oracle\workspace\JPA`. Click **Modify** in the **Configuration** field to open the **Project Facets** dialog box.
3. Select the **Oracle Coherence** facet. The **JPA** facet should already be selected.
4. Click **Save As** in the **Configuration** field. Enter `JPAConfiguration` in the **Save Preset** dialog box and click **OK**. The contents of the **Project Facets** dialog box should look similar to Figure 8–5.

Figure 8–5 Project Facets for a JPA Project



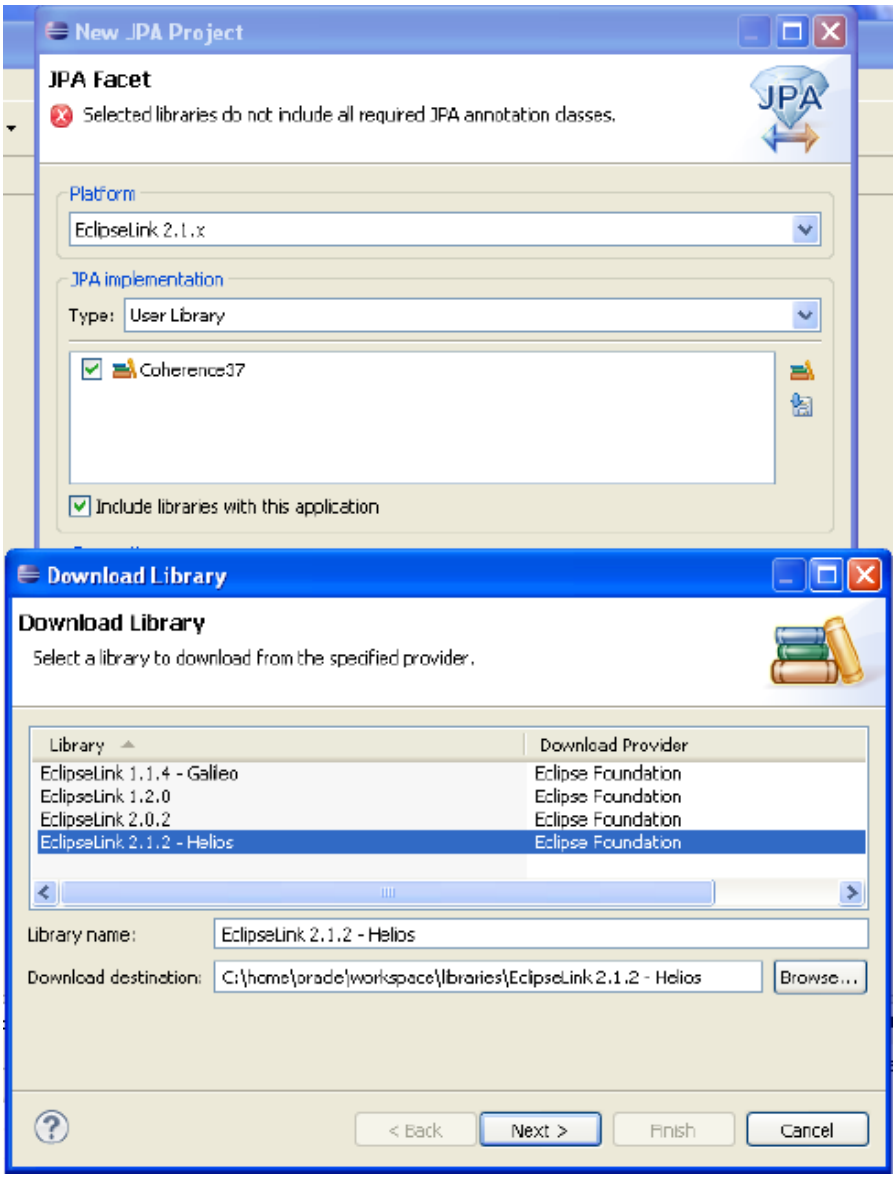
The contents of the **New JPA Project** dialog box should look similar to Figure 8–6. Click **Next** to go to the **Java** page.

Figure 8–6 Contents of the New JPA Project Dialog Box



5. Click **Next** in the **Java** page to accept the default output folder location.
6. The **Coherence37** user library should already be selected in the **Coherence** page. Click **Next**.
7. In the **JPA Facet** page, select **EclipseLink 2.1.x** in the **Platform** drop-down list. Click the Download library icon to download the EclipseLink files. In the Download Library dialog box, select **EclipseLink 2.1.2 - Helios**, as illustrated by Figure 8–7.

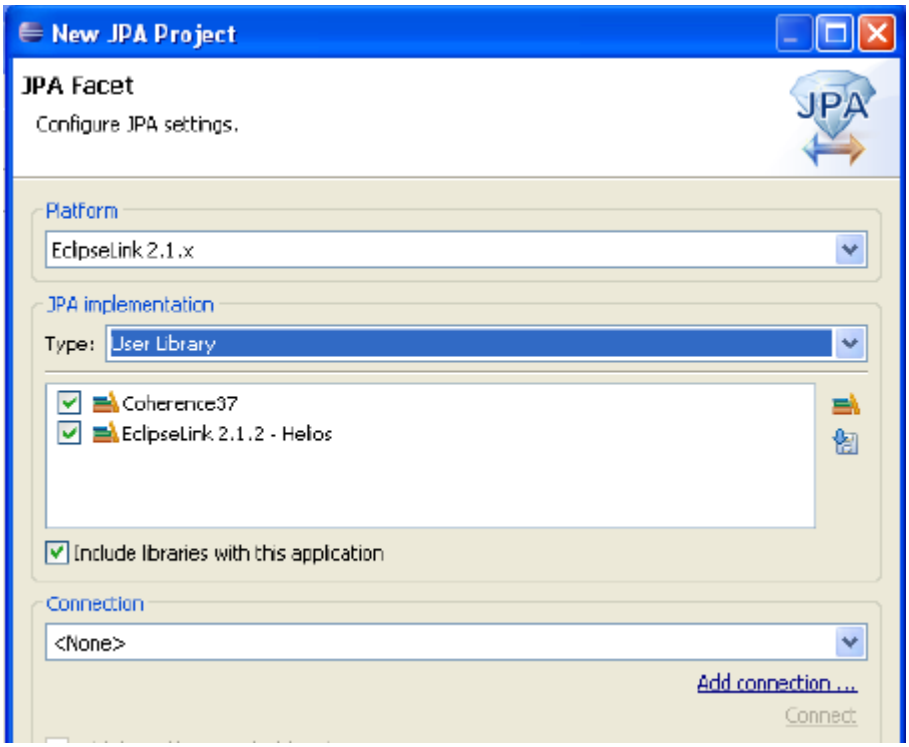
Figure 8–7 Downloading the EclipseLink JPA Library



8. Click **Next** to accept the license agreement, then click **Finish**.

   After downloading the library, the JPA Facet page should look similar to

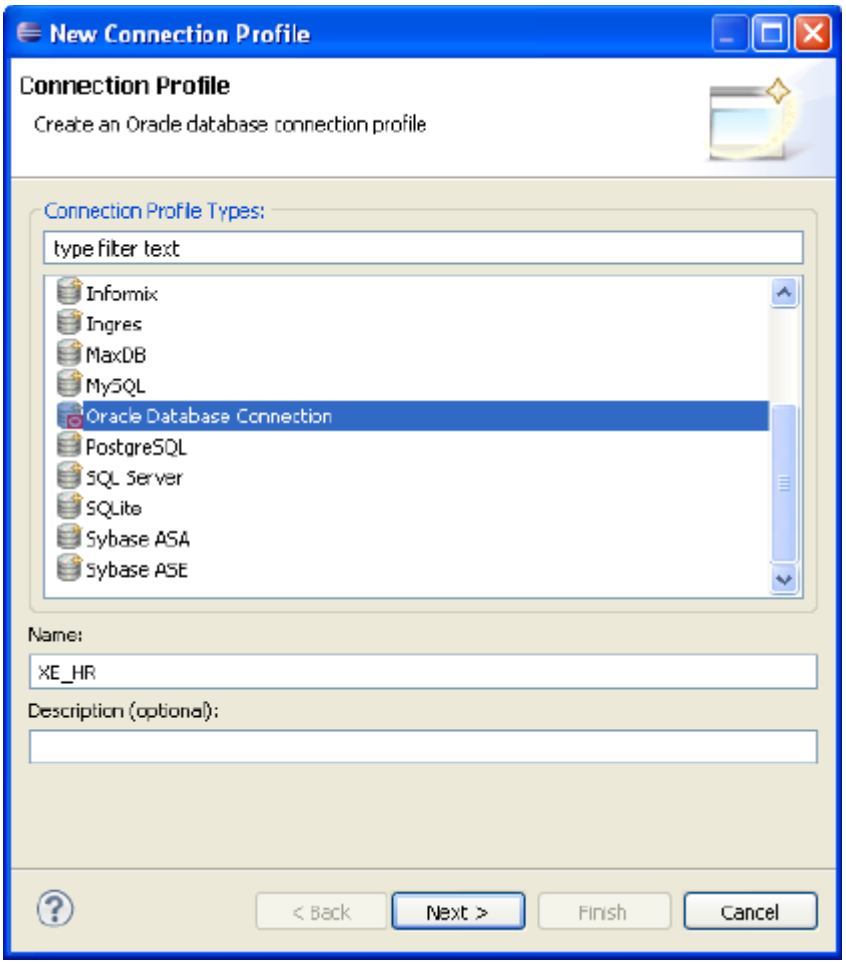
Figure 8–8 EclipseLink Libraries Added to the JPA Facet Page



9. Create a connection to the Oracle XE Database. Click **Add connection**.

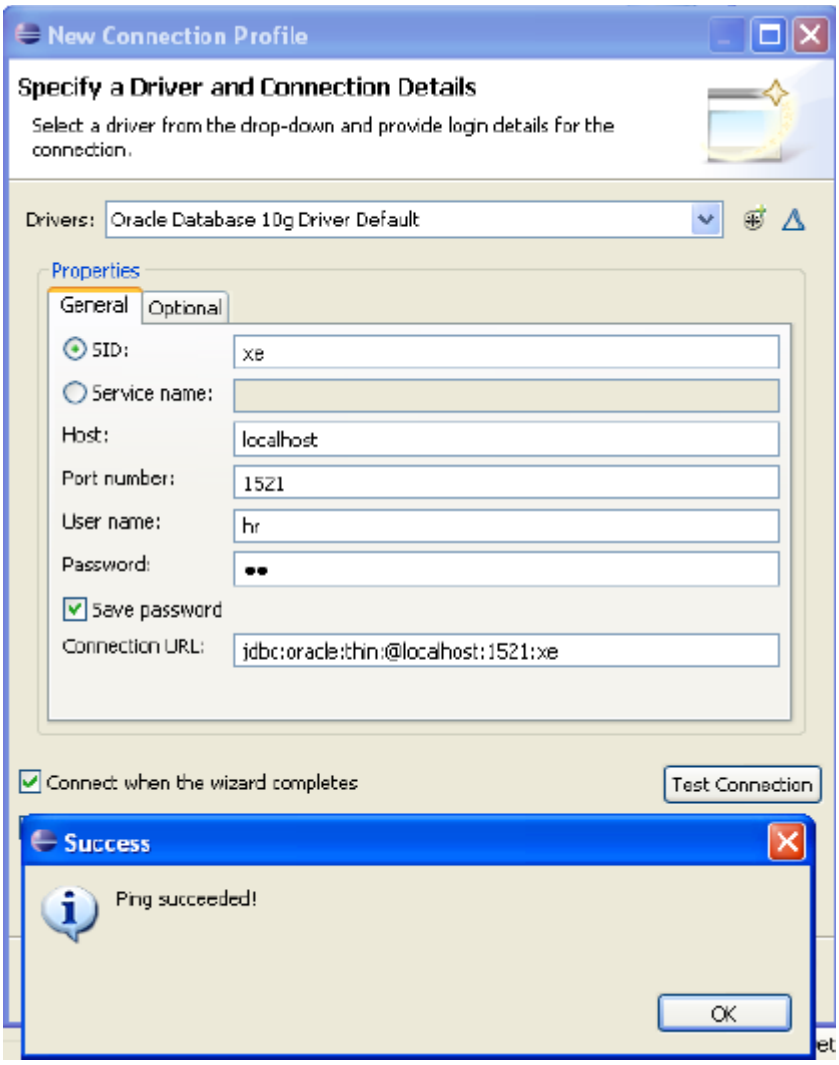
   a. In **Connection Profile** dialog box, select **Oracle Database Connection**. and enter `XE_HR` in the **Name** field, as illustrated in Figure 8–9. Click **Next**.

Figure 8–9 Connection Profile Page



b. Select **Oracle Database 10g Driver Default** in the Drivers field. Edit the **General** tab. Enter `hr` in the **User name** field and `hr` in the **Password** field. Select the **Save Password** check box. Enter `localhost` in the **Host** field. Select the **Connect when the wizard completes** check box. Click **Test Connection** button. The test should return an alert box with a success message, as illustrated in Figure 8–10. Click **OK**, then **Next**.

Figure 8–10 The New Connection Profile Dialog Box and the Success Message



c. In the **JPA Facet** page, click **Add driver library to build path**, then click **Finish**.

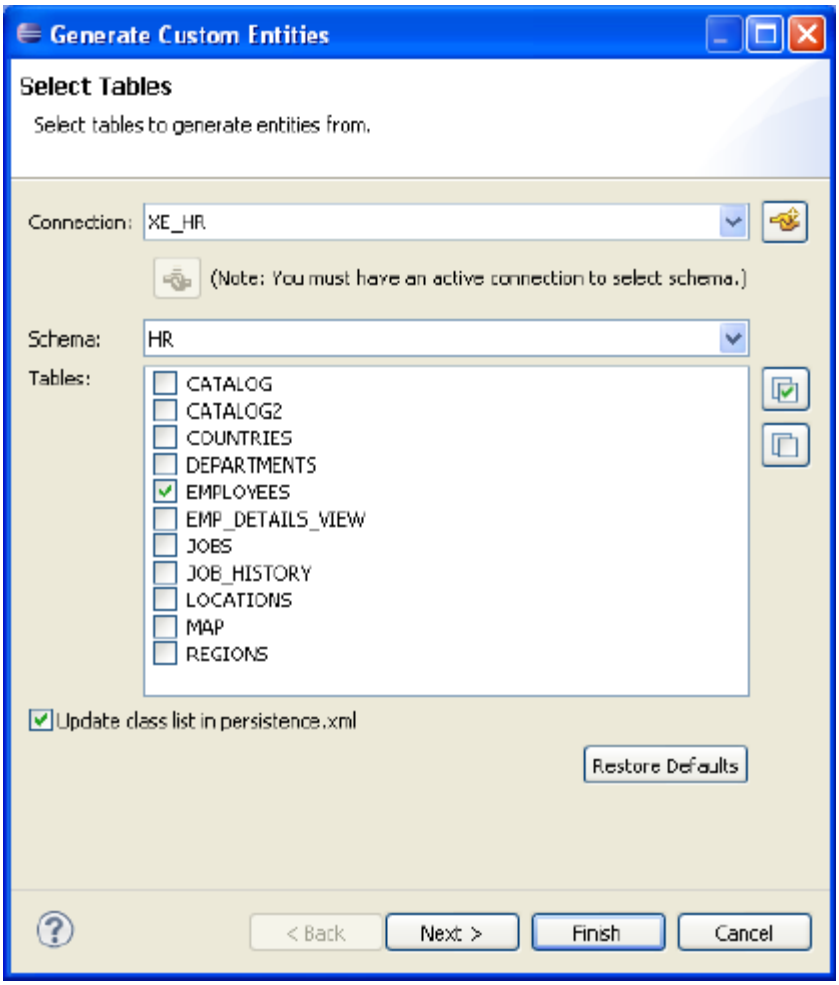
Create the JPA Persistence Unit and Entity Beans

A persistence unit provides an easy way to identify the set of metadata files, classes, and JARs that contain all classes that need to be persisted as a group. The name of the persistence unit is used to identify it. Entity beans are Enterprise Java beans that contain persistent data, and that can be saved in persistent data stores. The JPA entity bean can belong to a persistence unit. The persistence unit is described by the `persistence.xml` file.

To create the JPA persistence unit and the JPA entity beans:

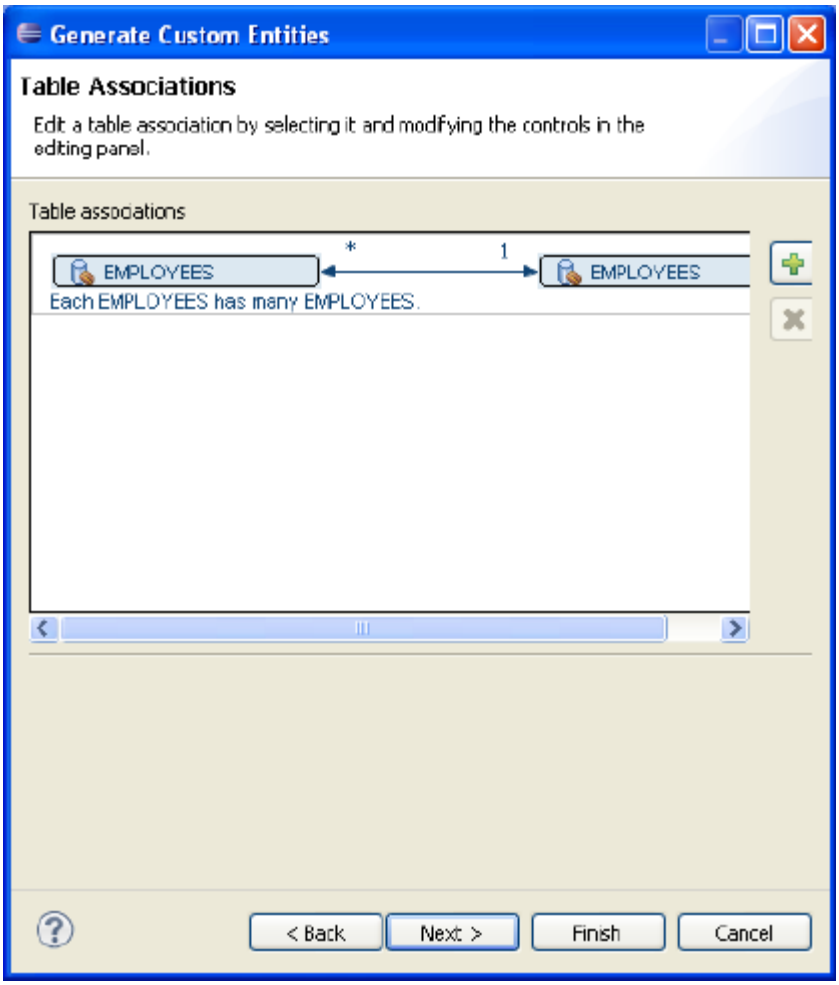
1. Right-click the `JPA` project and select **New** then select **Entities from Tables**. The Select Tables dialog box opens.
2. Select the `EMPLOYEES` table, as illustrated in Figure 8–11 and click **Next**.

Figure 8–11 Selecting the Database Tables



3. In the **Table Associations** page, illustrated in Figure 8–12, click **Next** to accept the defaults.

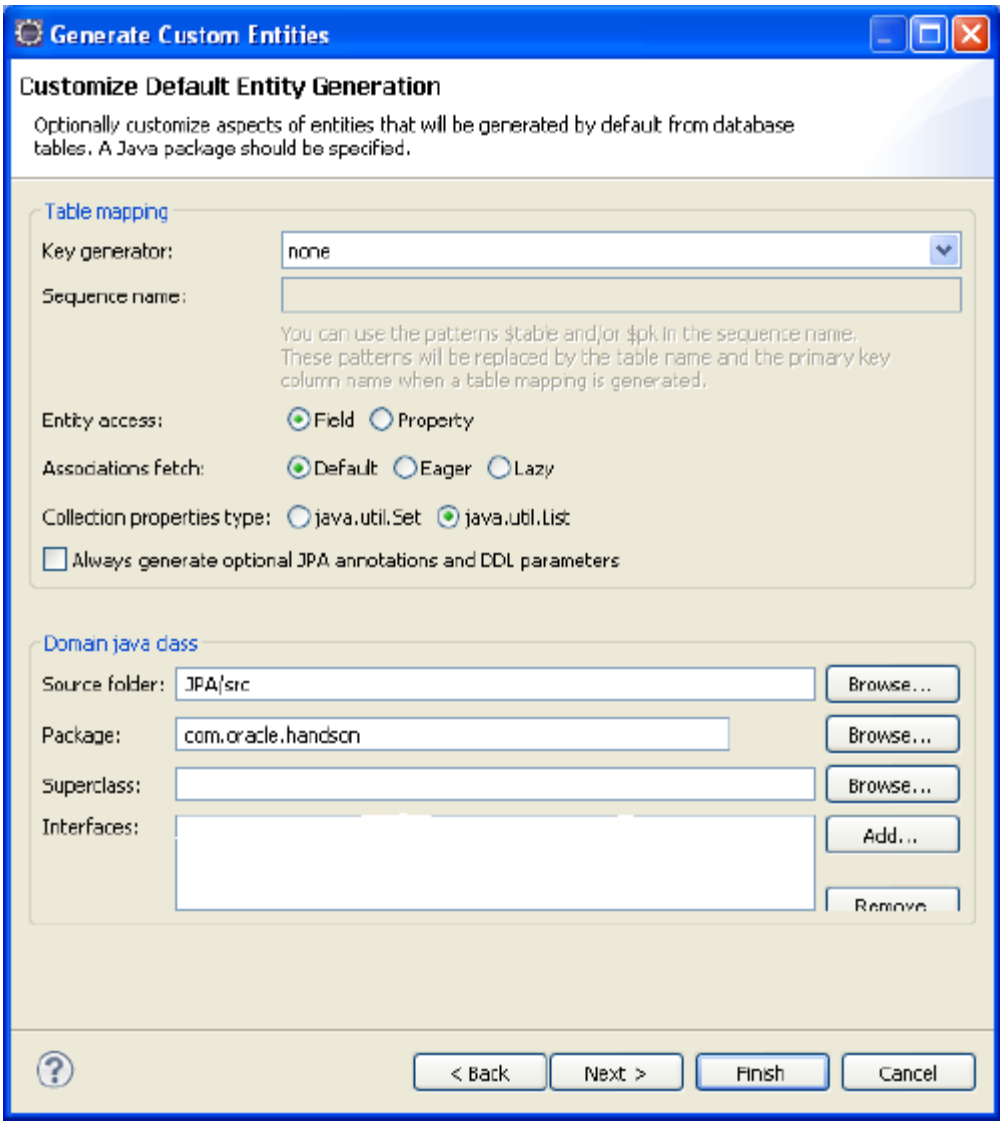
Figure 8–12 Associations for the EMPLOYEES Table



4. In the Customize Default Entity Generation page, select **Collection properties type** `java.uitil.List`, Enter `com.oracle.handson` in the **Package** field.

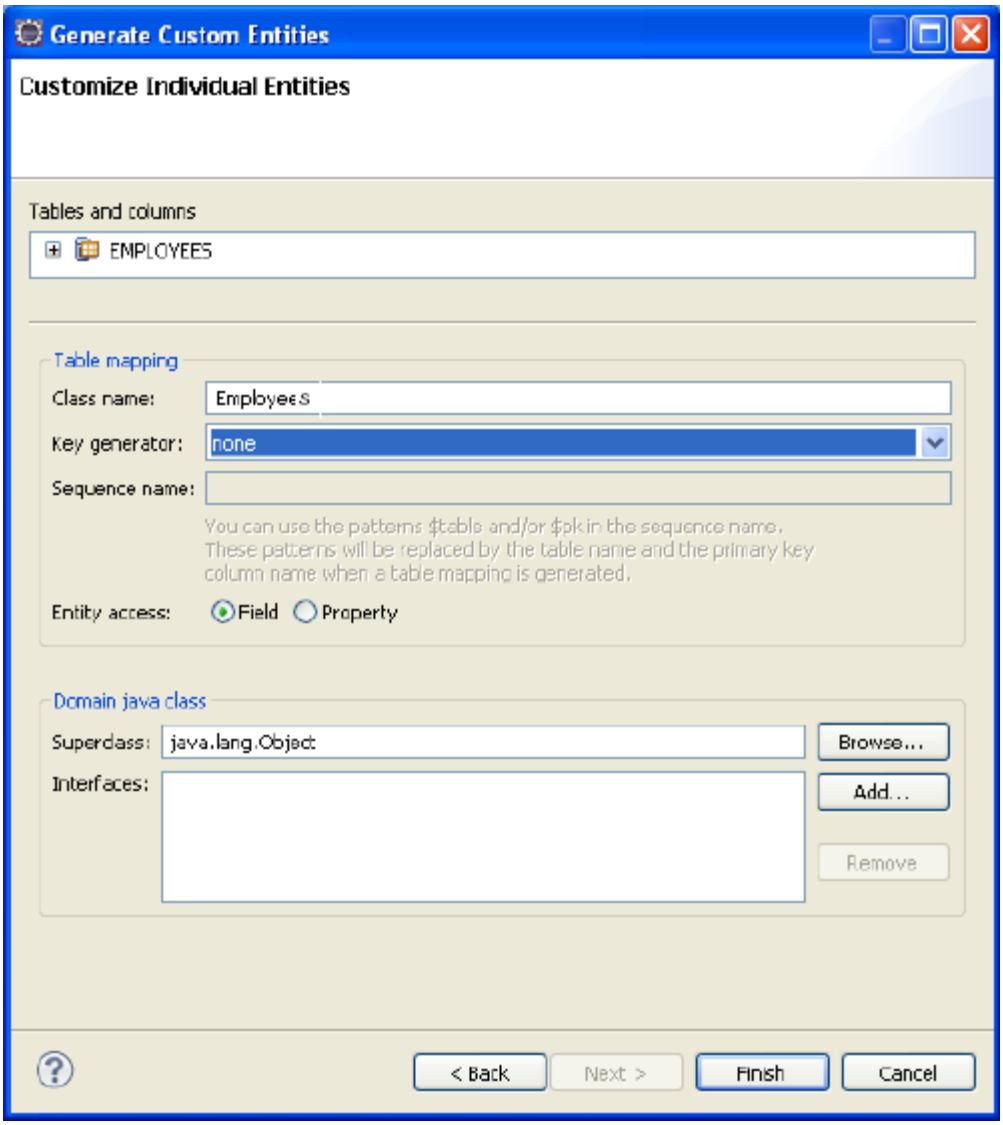
   When you are finished, the **Customize Default Entity Generation** page should look similar to Figure 8–13. Click **Next**.

Figure 8–13 Customize Default Entity Generation Page



5. In the **Customize Individual Entities** page, accept the defaults as illustrated in and click **Finish** to generate the JPA Entities.

Figure 8–14 Customize Individual Entities Page

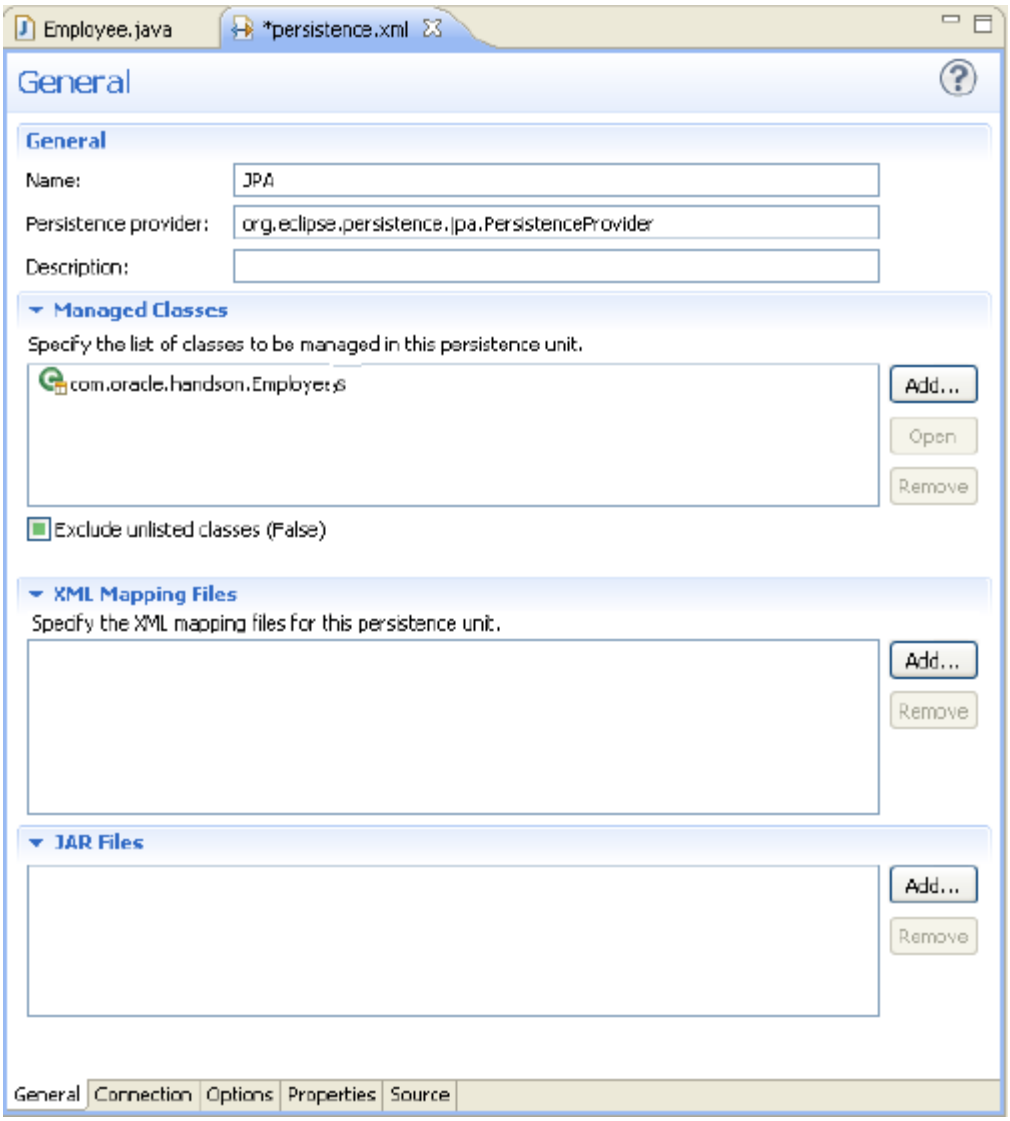


Edit the persistance.xml File

The `persistence.xml` file defines one or more persistence units. Use the **persistence.xml Editor** tool in the Eclipse IDE to edit the `persistence.xml` file.

1. Open the `persistence.xml` file in the Eclipse editor.
2. Click the **General** tab. Enter the name of the persistence provider. This will be `org.eclipse.persistence.jpa.PersistenceProvider`.

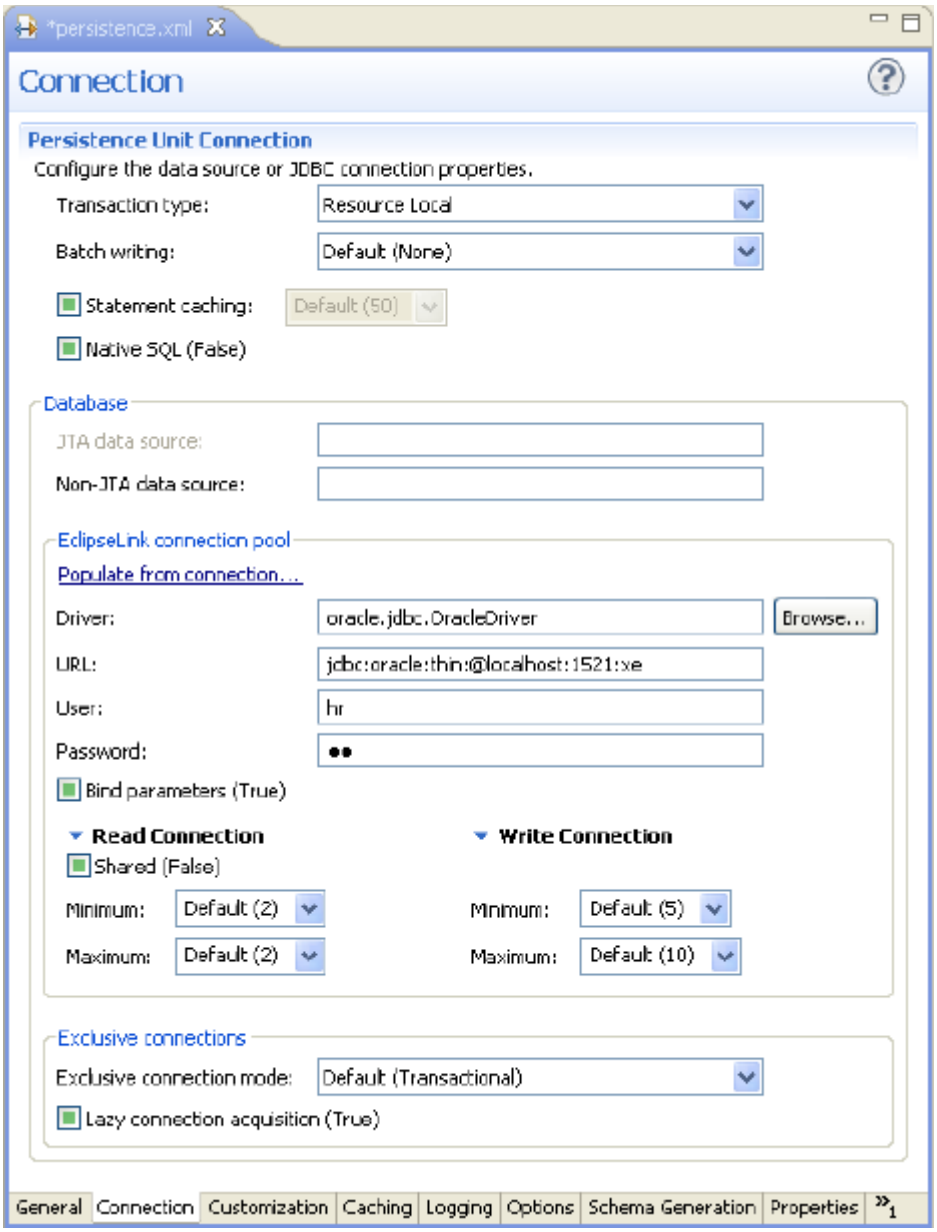
Figure 8–15 General Tab in the persistence.xml Editor



3. In the **Connection** tab, select **Resource Local** from the **Transaction type** drop down list.

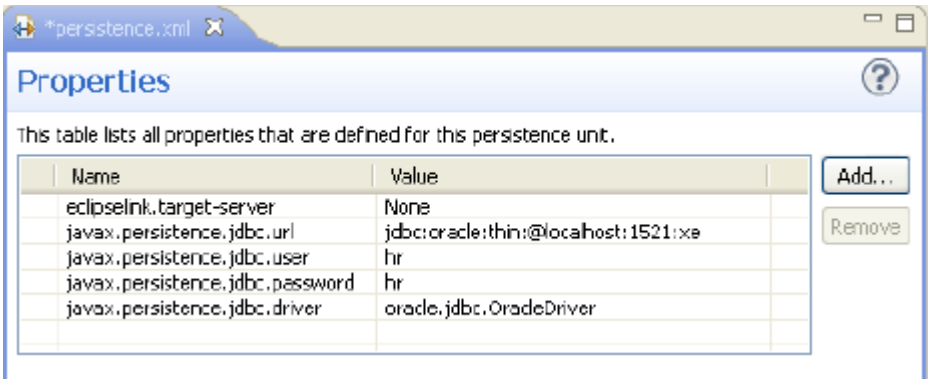
   In **JDBC connection properties** section, click **Populate from connection** link. The values in this field will be provided from the database connection you defined in "Configure the Project for JPA" on page 8-3. The Connection Properties tab should look similar to Figure 8–16.

Figure 8–16 Connection Properties Tab in the persistence.xml Editor



4. Inspect the **Properties** tab. The contents should look similar to Figure 8–17.

Figure 8–17 Properties Tab in the persistence.xml Editor



5. Open the **Source** tab. The `persistence.xml` file should look similar to Example 8–1.

Example 8–1 Generated persistence.xml File

```
<?xml version="1.0" encoding="UTF-8"?>
<persistence version="2.0" xmlns="http://java.sun.com/xml/ns/persistence"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xsi:schemaLocation="http://java.sun.com/xml/ns/persistence
http://java.sun.com/xml/ns/persistence/persistence_2_0.xsd">
  <persistence-unit name="JPA" transaction-type="RESOURCE_LOCAL">
    <provider>org.eclipse.persistence.jpa.PersistenceProvider</provider>
    <class>com.oracle.handson.Employees</class>
    <properties>
      <property name="eclipselink.target-server" value="None"/>
      <property name="javax.persistence.jdbc.url"
value="jdbc:oracle:thin:@localhost:1521:xe"/>
      <property name="javax.persistence.jdbc.user" value="hr"/>
      <property name="javax.persistence.jdbc.password" value="hr"/>
      <property name="javax.persistence.jdbc.driver"
value="oracle.jdbc.OracleDriver"/>
    </properties>
  </persistence-unit>
</persistence>
```

Create the Cache Configuration File for JPA

Create a cache configuration file for the JPA project.

1. Right click `coherence-cache-config.xml` file and select **Open**.
2. Enter the code illustrated in Example 8–2. Use **Save As** to save the file as `jpa-cache-config.xml`. The file will be saved to the `home\oracle\workspace\JPA\src` folder.

Example 8–2 Cache Configuration for JPA

```
<?xml version="1.0" encoding="windows-1252" ?>
<cache-config>
  <caching-scheme-mapping>
    <cache-mapping>
      <!-- Set the name of the cache to be the entity name  -->
      <cache-name>Employees</cache-name>
      <!-- Configure this cache to use the scheme defined below  -->
      <scheme-name>jpa-distributed</scheme-name>
```

```
    </cache-mapping>
  </caching-scheme-mapping>
  <caching-schemes>
    <distributed-scheme>
      <scheme-name>jpa-distributed</scheme-name>
      <service-name>JpaDistributedCache</service-name>
      <backing-map-scheme>
        <read-write-backing-map-scheme>
          <!--
      Define the cache scheme
      -->
          <internal-cache-scheme>
            <local-scheme/>
          </internal-cache-scheme>
          <cachestore-scheme>
            <class-scheme>
              <class-name>com.tangosol.coherence.jpa.JpaCacheStore</class-name>
              <init-params>
                <!--
              This param is the entity name
              This param is the fully qualified entity class
              This param should match the value of the
              persistence unit name in persistence.xml
              -->
                  <init-param>
                    <param-type>java.lang.String</param-type>
                    <param-value>{cache-name}</param-value>
                  </init-param>
                  <init-param>
                    <param-type>java.lang.String</param-type>
                    <param-value>com.oracle.handson.{cache-name}</param-value>
                  </init-param>
                  <init-param>
                    <param-type>java.lang.String</param-type>
                    <param-value>JPA</param-value>
                  </init-param>
                </init-params>
              </class-scheme>
            </cachestore-scheme>
          </read-write-backing-map-scheme>
        </backing-map-scheme>
        <autostart>true</autostart>
      </distributed-scheme>
    </caching-schemes>
</cache-config>
```

3. Delete the original `coherence-cache-config.xml` file from the **Project Explorer**.

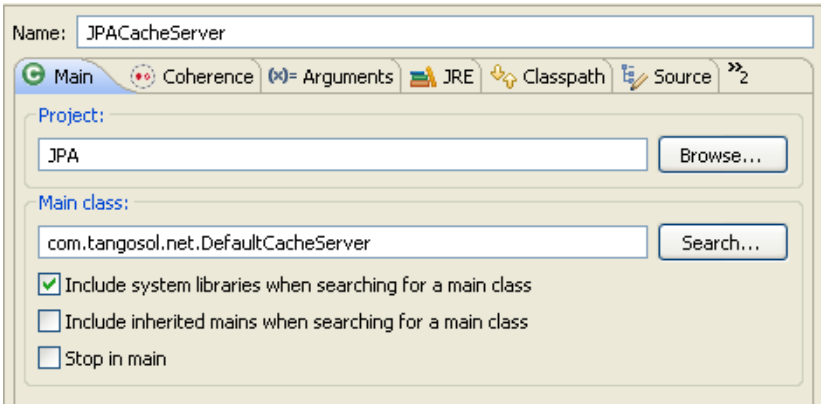
Create a Cache Server Start-Up Configuration

Create a configuration to start the cache server for the JPA project.

1. Right click the project and select **Run As** then **Run Configurations**. In the **Run Configurations** dialog box, Enter `JPACacheServer` in the **Name** field.
2. In the **Main** tab, click **Browse** in the **Project** field and select the **JPA** project in the **Project Selection** dialog box. Select the **Include system libraries when searching for a main class** checkbox and click **Search**. Enter `DefaultCacheServer` in the

Select Type field and select **com.tangosol.net.DefaultCacheServer**. Click **OK**. The **Main** tab should look similar to Figure 8–18.

Figure 8–18 Main Tab for the JPA Cache Server



3. In the **General** tab of the **Coherence** tab, identify the path to the cache configuration file under **Topology**. Click the **Browse** button to navigate to the **Absolute file path** of the JPA cache configuration file `C:\home\oracle\workspace\JPA\src\jpa-cache-config.xml`. Select **Enabled (cache server)** under **Local storage**. Enter a unique value, such as `3155`, for the **Cluster port**.

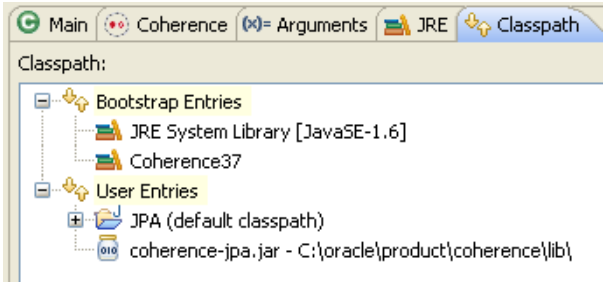
   In the **Other** tab, ensure that the **tangosol.pof.config** item is set to the default `pof-config.xml`.

4. In the **Common** tab, select **Shared file** and browse to the **\JPA** project.

5. In the **Classpath** tab, click **User Entries** then **Add External JARs** to add the **coherence-jpa.jar** file to the list. Click **Apply**.

   The **Classpath** tab should look similar to Figure 8–19.

Figure 8–19 Classpath Tab for the JPA Cache Server Executable



Create a Class to Interact with the Data Object

Create a new class in the `JPA` project to interact with the `Employees` object. The objective of the class will be to change the value of an employee's salary.

1. Create a new class with a `main` method called `RunEmployeeExample`. See "Creating a Java Class" on page 2-11 for detailed information.

2. Create the code to perform the following:

a. Get an employee using the `EMPLOYEE_ID` attribute. `EMPLOYEE_ID` is a `long` data type.

b. Display the salary.

c. Give the employee a 10% pay raise.

d. Get the value again to confirm the pay raise.

Example 8–3 illustrates a possible implementation of the `RunEmployeeExample` class.

Example 8–3 Sample Employee Class File

```
package com.oracle.handson;

import com.tangosol.net.CacheFactory;
import com.tangosol.net.NamedCache;
import java.math.BigDecimal;

public class RunEmployeeExample
    {
    public RunEmployeeExample()
    {
    }

    public static void main(String[] args)
        {
        long empId = 190L;  // emp 190 - Timothy Gates

        NamedCache employees = CacheFactory.getCache("Employees");

        Employees emp = (Employees)employees.get(empId);

        System.out.println("Employee " + emp.getFirstName() + " " +
                        emp.getLastName() + ", salary = $" + emp.getSalary() );

        // give them a 10% pay rise
        emp.setSalary(emp.getSalary().multiply(BigDecimal.valueOf(1.1)));

        employees.put(empId, emp);

        Employees emp2 = (Employees)employees.get(empId);

        System.out.println("New Employee details are " + emp2.getFirstName() + " "
+ emp2.getLastName() + ", salary = $" + emp2.getSalary() );
       }
}
```

Create a Run Configuration for RunEmployeeExample

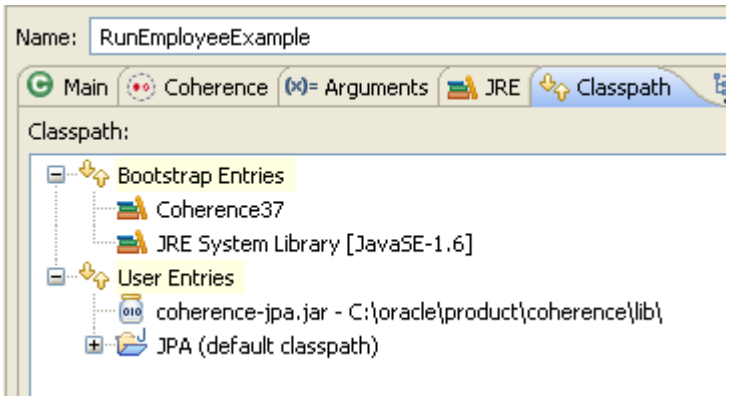
To create a run configuration, modify the run-time properties and edit the class path in Eclipse.

1. Right click `RunEmployeeExample.java` in the **Project Explorer** and choose **Run As** then **Run Configurations**. In the **Run Configurations** dialog box, click **New launch configurations** icon. Enter `RunEmployeeExample` in the **Name** field.
2. In the **Main** tab, click **Browse** and select the `JPA` project. In the **Main class** field, click **Search** and choose `com.oracle.handson.RunEmployeeExample`. Click **Apply**.

3. In the **General** tab of the **Coherence** tab, browse to the `C:\home\oracle\workspace\JPA\src\jpa-cache-config.xml` file in the **Cache configuration descriptor** field. Select the **Disabled (cache client)** button. Enter `3155` in the **Cluster port** field. Click **Apply**.
4. In the **Other** tab, ensure that the default `pof-config.xml` appears in the `tangosol.pof.config` field.
5. In the **Classpath** tab, click **Add External JARs** to add the `coherence-jpa.jar` file to **User Entries**.
6. Use the **Up** and **Down** buttons to move **Coherence37** to the top of **Bootstrap Entries**. Click **Apply**.

   The **Classpath** tab should look similar to Figure 8–20.

Figure 8–20 Classpath Tab for the RunEmployeeExample Program



Run the JPA Example

Now that the `Employees` class has been annotated to persist to the database using JPA, and you have included the `persistence.xml` file to tell JPA where your database is, Coherence employs a `CacheStore` implementation that uses JPA to load and store objects in the database. When you use the `get(Object key)` method, the following happens:

- Coherence looks for the entry with the key.
- if the entry is not already in the cache, or if it is expired from the cache, then coherence calls the backing map, which uses jpa and eclipselink, to retrieve the data.
- if the entry is in the cache, coherence returns the entry directly to the application without going through eclipselink. when you use the `put(object key,object value)` method, coherence uses jpa through eclipselink to persist any changes to the database.

Click **Run** to run the `RunEmployeeExample` configuration. The output from the program should look similar to Example 8–4.

Example 8–4 Output from the RunEmployeeExample Program

```
...
TcpRing{Connections=[1]}
IpMonitor{AddressListSize=0}
```

```
2011-03-15 19:29:10.307/1.296 Oracle Coherence GE 3.7.0.0 <D5> (thread=Invocation:Management,
member=2): Service Management joined the cluster with senior service member 1
2011-03-15 19:29:10.401/1.390 Oracle Coherence GE 3.7.0.0 <D5>
(thread=DistributedCache:JpaDistributedCache, member=2): Service JpaDistributedCache joined the
cluster with senior service member 1
Employee Timothy Gates, salary = $17736.19
New Employee details are Timothy Gates, salary = $19509.809
...
```

The response from the cache server displays a successful login to retrieve information from the database, as illustrated in Example 8–5.

Example 8–5 Cache Server Response to Logging In to the Database

```
2011-03-15 19:28:54.573/5.203 Oracle Coherence GE 3.7.0.0 <D5> (thread=Invocation:Management,
member=1): Service Management joined the cluster with senior service member 1
2011-03-15 19:28:54.839/5.469 Oracle Coherence GE 3.7.0.0 <D5>
(thread=DistributedCache:JpaDistributedCache, member=1): Service JpaDistributedCache joined the
cluster with senior service member 1
2011-03-15 19:28:54.886/5.516 Oracle Coherence GE 3.7.0.0 <Info> (thread=main, member=1):
Services
  (
  ClusterService{Name=Cluster, State=(SERVICE_STARTED, STATE_JOINED), Id=0, Version=3.7,
OldestMemberId=1}
  InvocationService{Name=Management, State=(SERVICE_STARTED), Id=1, Version=3.1, OldestMemberId=1}
  PartitionedCache{Name=JpaDistributedCache, State=(SERVICE_STARTED), LocalStorage=enabled,
PartitionCount=257, BackupCount=1, AssignedPartitions=257, BackupPartitions=0}
  )

Started DefaultCacheServer...

2011-03-15 19:29:10.261/20.891 Oracle Coherence GE 3.7.0.0 <D5> (thread=Cluster, member=1):
Member(Id=2, Timestamp=2011-03-15 19:29:10.065, Address=130.35.99.213:8090, MachineId=49877,
Location=site:URL, machine_name,process:896, Role=OracleHandsonRunEmployeeExample) joined Cluster
with senior member 1
2011-03-15 19:29:10.307/20.937 Oracle Coherence GE 3.7.0.0 <D5> (thread=Cluster, member=1): Member
2 joined Service Management with senior member 1
2011-03-15 19:29:10.417/21.047 Oracle Coherence GE 3.7.0.0 <D5> (thread=Cluster, member=1): Member
2 joined Service JpaDistributedCache with senior member 1
[EL Info]: 2011-03-15 19:29:13.151--ServerSession(33017287)--EclipseLink, version: Eclipse
Persistence Services - 2.1.2.v20101206-r8635
[EL Info]: 2011-03-15
19:29:13.589--ServerSession(33017287)--file:/C:/home/oracle/workspace/JPA/build/classes/_JPA login
successful
2011-03-15 19:29:15.073/25.703 Oracle Coherence GE 3.7.0.0 <D5> (thread=Cluster, member=1): TcpRing
disconnected from Member(Id=2, Timestamp=2011-03-15 19:29:10.065, Address=130.35.99.213:8090,
MachineId=49877, Location=site:URL, machine_name,process:896, Role=OracleHandsonRunEmployeeExample)
due to a peer departure; removing the member.
2011-03-15 19:29:15.073/25.703 Oracle Coherence GE 3.7.0.0 <D5> (thread=Cluster, member=1): Member
2 left service Management with senior member 1
2011-03-15 19:29:15.073/25.703 Oracle Coherence GE 3.7.0.0 <D5> (thread=Cluster, member=1): Member
2 left service JpaDistributedCache with senior member 1
2011-03-15 19:29:15.073/25.703 Oracle Coherence GE 3.7.0.0 <D5> (thread=Cluster, member=1):
Member(Id=2, Timestamp=2011-03-15 19:29:15.073, Address=130.35.99.213:8090, MachineId=49877,
Location=site:URL, machine_name,process:896, Role=OracleHandsonRunEmployeeExample) left Cluster
with senior member 1
```

9

Interacting with the Cache and the Database

In this chapter, you will create and configure an Oracle Coherence cache in Eclipse. In this exercise you will create these items:

- A Java class that creates a `NamedCache` instance and can put and get cache entries.
- A cache configuration file to define the mapping for cache names, cache types, and naming patterns.
- A Java class that creates a connection to Oracle Database and can retrieve and store table data.
- A database cache. This class will add cache entries, query the database cache, and retrieve entries.

This chapter contains the following sections:

Introduction

A Coherence cache is a collection of data objects that acts as an intermediary between the database and the client applications. Database data can be loaded into a cache and made available to different applications. Thus, Coherence caches reduce load on the database and provide faster access to database data.

Coherence caches provide higher availability through database isolation and data replication. Modifications made to a cache can be synchronized with the database whenever the database is available. Even if the database or an application server node is not available, database updates are still reliable due to the lazy load and lazy write mechanism used by a Coherence cache and due to the failover and fail back provided by Oracle Coherence.

Coherence caches provide distributed processing not only across a cluster of application server nodes but also across the data objects in the cache, because data modification operations can be performed on the data objects.

Oracle Coherence also provides event-based processing. The state of data objects in a cache can be monitored and actions invoked on other processes such as the start of a business process execution language (BPEL) process.

Oracle Coherence supports different types of caches:

- Replicated caches, where data is replicated to each of the application server nodes in the cluster. This type of cache is recommended if faster read access is required but not suitable for write operations, because data must be written to each of the nodes. The drawback of replicated caches is that they require a large amount of memory because every node has a copy of every object.
- Distributed (or *partitioned*) caches, where data is distributed (load-balanced) across different nodes. Failover is implemented in a distributed cache using backups, which are also distributed across the cluster nodes.

Oracle Coherence is implemented by using services such as the cluster service, the distributed cache service, and the replicated cache service. Whichever type of cache is used, an application uses the same API to access and store data.

A cache configuration deployment descriptor is used to configure a cache. The root element of the cache configuration file is `cache-config`. Cache names and name patterns are mapped to cache types in the `caching-scheme-mapping` element using the subelement `cache-mapping`. Cache types are defined in the `caching-schemes` element. Table 9–1 describes some of the cache types commonly used by Coherence.

Table 9–1 Descriptions of Cache Types

Cache Type	Description
distributed scheme	Defines a distributed cache in which data is stored across a cluster of nodes.
replicated scheme	Defines a cache in which cache entries are replicated across all the cluster nodes.
read-write-backing-map scheme	Defines a map, which provides a cache of a persistent store such as a relational database.
external scheme	Defines an external cache such as a disk.
class scheme	Defines a custom cache implementation, which is required to implement the `java.util.Map` interface.

Creating a Cache Application

This section describes how to create and run an application that puts data into the cache and retrieves it.

1. Create an Application that Constructs a Cache
2. Create a Cache Configuration File
3. Configure the Project Properties
4. Create the Cache Server Start-Up Configuration
5. Run the Cache Creation Application

Create an Application that Constructs a Cache

To create a Java class that constructs a Coherence cache:

1. Create a project in Eclipse.
   a. Use the JPA perspective in Eclipse to create a JPA Project called `Interact`. Select the `JPAConfiguration` you created in the previous chapter.
   b. In the Coherence page, select **Coherence37** and **EclipseLink2.1.2 - Helios**.

c. In the JPA Facet page, ensure that **EclipseLink 2.1.x** appears in the **Platform** field. In the **Connection** field, select the connection you created in "Configure the Project for JPA" on page 8-3 (XE_HR), from the **Connection** drop down list. Click the **Connect** link to connect to the Oracle XE Database. Click **Finish**. (Note, this assumes that the database connection that you created is still running.)

2. Create a Java class, `CoherenceCache`, that will be used to create a Coherence cache. Include a `main` method in the class. See "Creating a Java Class" on page 2-11 for detailed information on creating a class.

   a. Create a cache in the `CoherenceCache` Java class. Import the `CacheFactory` class and the `NamedCache` interface.

   ```
   import com.tangosol.net.CacheFactory;
   import com.tangosol.net.NamedCache;
   ```

   b. Create the cache (`NamedCache`) instance by using the `CacheFactory.getCache` method. Use the cache name `VirtualCache`, which is mapped to a distributed caching scheme.

   ```
   NamedCache cache = CacheFactory.getCache ( "VirtualCache");
   ```

   c. A `NamedCache` is a `java.util.Map` instance that holds resources that are shared across nodes in a cluster. Add a cache entry by using the `put` method.

   ```
   cache.put (key, "Hello Cache");
   ```

   d. Retrieve a cache entry by using the `get` method.

   ```
   System.out.println((String)cache.get("hello"));
   ```

   Example 9–1 illustrates a possible implementation of `CoherenceCache` class. You can copy the code to the `CoherenceCache` application in Eclipse.

Example 9–1 Implementation of a Coherence Cache

```
package com.oracle.handson;

import com.tangosol.net.CacheFactory;
import com.tangosol.net.NamedCache;

public class CoherenceCache
    {
    NamedCache cache;
    public CoherenceCache()
    {
    }
    public void putCache()
        {
        cache = CacheFactory.getCache ( "VirtualCache");
        String key = "hello";
        cache.put (key, "Hello Cache");
        }

       public void retrieveCache()
           {
           System.out.println((String)cache.get("hello"));
           }

        public static void main (String [] args)
```

```
        {
        CoherenceCache cache = new CoherenceCache();
        cache.putCache();
        cache.retrieveCache();
        }
}
```

Create a Cache Configuration File

Create an XML document, `cache-config.xml`, as the cache configuration deployment descriptor. Save the file to the `C:\home\oracle\workspace` folder.

In the cache configuration file:

- Define mappings for cache names and naming patterns with the `cache-mapping` elements in the `caching-scheme-mapping` element.
- Map the cache name `VirtualCache` to cache type `default-distributed`.
- Define the distributed caching scheme with the `distributed-scheme` element using the `DistributedCache` service.

The cache configuration file is illustrated in Example 9–2. Copy the contents of this example to the `cache-config.xml`.

Example 9–2 Cache Configuration File

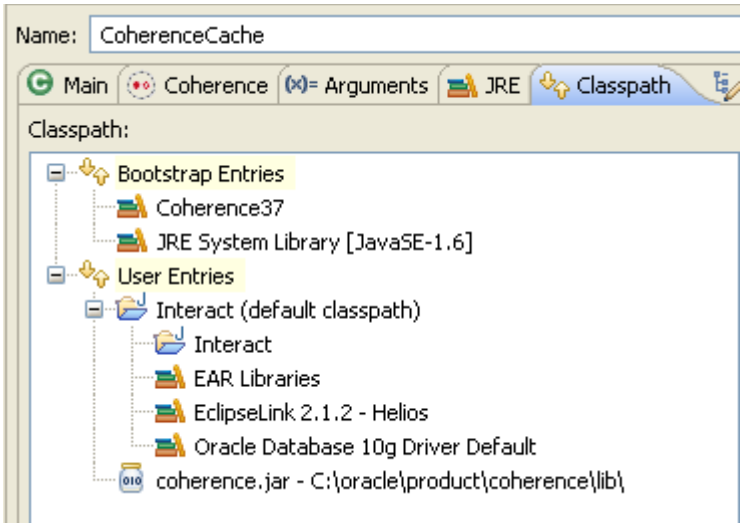
```
<?xml version="1.0"?>
<cache-config xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
              xmlns="http://xmlns.oracle.com/coherence/coherence-cache-config"
              xsi:schemaLocation="http://xmlns.oracle.com/coherence/coherence-
cache-config coherence-cache-config.xsd">
    <caching-scheme-mapping>

        <cache-mapping>
            <cache-name>VirtualCache</cache-name>
            <scheme-name>default-distributed</scheme-name>
        </cache-mapping>
    </caching-scheme-mapping>
    <caching-schemes>
        <!--
        Default Distributed caching scheme.
        -->
        <distributed-scheme>
            <scheme-name>default-distributed</scheme-name>
            <service-name>DistributedCache</service-name>
            <backing-map-scheme>
                <class-scheme>
                    <scheme-ref>default-backing-map</scheme-ref>
                </class-scheme>
            </backing-map-scheme>
        </distributed-scheme>
         <class-scheme>
            <scheme-name>default-backing-map</scheme-name>
            <class-name>com.tangosol.util.SafeHashMap</class-name>
         </class-scheme>
  <autostart>true</autostart>
 </caching-schemes>
</cache-config>
```

Configure the Project Properties

Create a run configuration for the application to add the cache configuration file as a run-time Java option.

1. Right click `CoherenceCache.java` in the **Project Explorer** and choose **Run As** then **Run Configurations**. In the **Run Configurations** dialog box, click the **New launch configuration** icon.
2. Enter `CoherenceCache` in the **Name** field. Ensure that `Interact` is in the **Project** field and `com.oracle.handson.CoherenceCache` is in the **Main class** field.
3. In the Coherence tab, enter the path to the cache configuration file, `C:\home\oracle\workspace\cache-config.xml`. Select the **Enabled (cache server)** button. Enter a unique value, such as `3155`, in the **Cluster port** field. Click **Apply**.
4. In the **Classpath** tab, Use the **Add External JARs** button to add the `coherence.jar` file to **User Entries**. When you are finished, the **Classpath** tab should look similar to Figure 9–1.

Figure 9–1 Classpath for the CoherenceCache Program

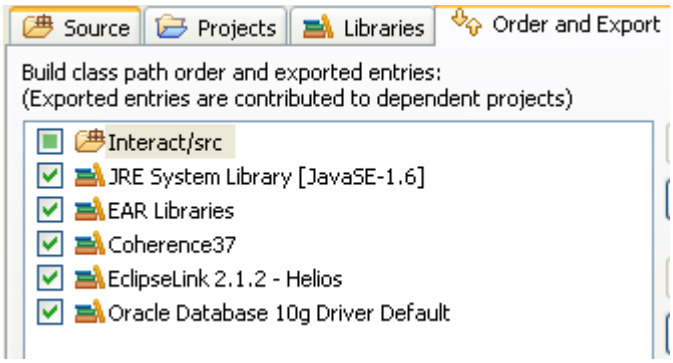


Create the Cache Server Start-Up Configuration

To create a cache sever start-up configuration for the Interact project:

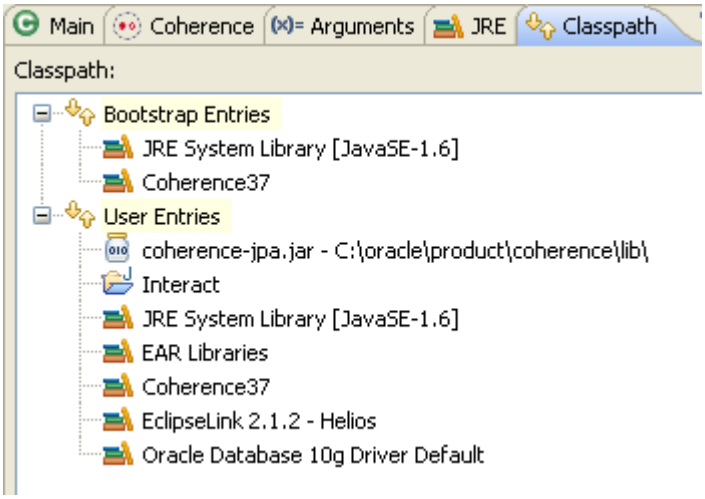
1. Right click the **Interact** project and select **Properties**. In the **Properties for Interact** dialog box, select **Java Build Path**. In the **Order and Export** tab, the Interact project and the JRE, EAR, Coherence37, EclipseLink 2.1.2 - Helios, and the Oracle Database 10g Driver Default libraries should be present. Click **Select All**. The **Order and Export** tab should look similar to Figure 9–2.

Figure 9–2 Order and Export Tab for Libraries for the Java Build Path



2. Edit the JPA cache server start-up configuration (`JPACacheServer`) that you created in Chapter 8, "Using JPA with Coherence".
3. Right click the **Interact** project and select **Run As** then **Run Configurations**. In the **Main** tab click **Browse** and select the **Interact** project from the **Project Selection** dialog box.
4. In the **General** tab of the **Coherence** tab, replace the name and path of the configuration file with `C:\home\oracle\workspace\cache-config.xml`.
5. In the **Classpath** tab, remove the **JPA (default classpath)** folder. Click **Add Project** to add the **Interact** project. The **Classpath** tab should look similar to Figure 9–3.

Figure 9–3 Classpath for the Interact Project Cache Server



6. In the **Shared file** field of the **Common** tab, click **Browse** to select the **Interact** project. Click **Apply**, then **Close**.

Run the Cache Creation Application

To run the cache creation application `CoherenceCache.java`:

1. Stop any running cache servers. See "Stopping Cache Servers" on page 2-13 for more information.
2. Run the `jpa-cache-server.cmd` file to start the cache server.

3. Right-click the Oracle Coherence application `CoherenceCache.java` and click **Run As** then **Run Configurations**. Select the `CoherenceCache` configuration and click **Run**. The Eclipse console window displays the output:
   - The operational configuration is loaded from the `tangosol-coherence.xml` file. This file specifies the operational and run-time settings used by Coherence for its clustering, communication, and data management services.
   - The cache configuration is loaded from the `cache-config.xml` file.
   - A new cluster is created and the `DistributedCache` service joins the cluster.
   - The output of the `CoherenceCache.java` program, `Hello Cache` is displayed.

Example 9–3 Output of the Coherence Cache Application

```
2011-03-15 13:03:17.202/0.313 Oracle Coherence 3.7.0.0 <Info> (thread=main, member=n/a): Loaded
operational configuration from "jar:file:/C:/oracle/product/coherence/lib/coherence.jar!/tangosol-
coherence.xml"
2011-03-15 13:03:17.249/0.360 Oracle Coherence 3.7.0.0 <Info> (thread=main, member=n/a): Loaded
operational overrides from "jar:file:/C:/oracle/product/coherence/lib/coherence.jar!/tangosol-
coherence-override-dev.xml"
2011-03-15 13:03:17.280/0.391 Oracle Coherence 3.7.0.0 <Info> (thread=main, member=n/a): Loaded
operational overrides from "file:/C:/home/oracle/workspace/Interact/build/classes/tangosol-
coherence-override.xml"
2011-03-15 13:03:17.280/0.391 Oracle Coherence 3.7.0.0 <D5> (thread=main, member=n/a): Optional
configuration override "/custom-mbeans.xml" is not specified

Oracle Coherence Version 3.7.0.0 Build 22913
 Grid Edition: Development mode
Copyright (c) 2000, 2010, Oracle and/or its affiliates. All rights reserved.

2011-03-15 13:03:17.436/0.547 Oracle Coherence GE 3.7.0.0 <Info> (thread=main, member=n/a): Loaded
cache configuration from "file:/C:/home/oracle/workspace/cache-config.xml"
2011-03-15 13:03:17.624/0.735 Oracle Coherence GE 3.7.0.0 <D4> (thread=main, member=n/a): TCMP
bound to /130.35.99.213:8088 using SystemSocketProvider
2011-03-15 13:03:21.202/4.313 Oracle Coherence GE 3.7.0.0 <Info> (thread=Cluster, member=n/a):
Created a new cluster "cluster:0x96AB" with Member(Id=1, Timestamp=2011-03-15 13:03:17.639,
Address=130.35.99.213:8088, MachineId=49877, Location=site:URL, machine_name,process:2084,
Role=OracleHandsonCoherenceCache, Edition=Grid Edition, Mode=Development, CpuCount=2,
SocketCount=1) UID=0x822363D50000012E733B6C87C2D51F98
2011-03-15 13:03:21.217/4.328 Oracle Coherence GE 3.7.0.0 <Info> (thread=main, member=n/a): Started
cluster Name=cluster:0x96AB

Group{Address=224.3.7.0, Port=3155, TTL=4}

MasterMemberSet
  (
  ThisMember=Member(Id=1, Timestamp=2011-03-15 13:03:17.639, Address=130.35.99.213:8088,
MachineId=49877, Location=site:URL, machine_name,process:2084, Role=OracleHandsonCoherenceCache)
  OldestMember=Member(Id=1, Timestamp=2011-03-15 13:03:17.639, Address=130.35.99.213:8088,
MachineId=49877, Location=site:URL, machine_name,process:2084, Role=OracleHandsonCoherenceCache)
  ActualMemberSet=MemberSet(Size=1, BitSetCount=2
    Member(Id=1, Timestamp=2011-03-15 13:03:17.639, Address=130.35.99.213:8088, MachineId=49877,
Location=site:URL, machine_name,process:2084, Role=OracleHandsonCoherenceCache)
    )
  RecycleMillis=1200000
  RecycleSet=MemberSet(Size=0, BitSetCount=0
    )
  )
```

```
TcpRing{Connections=[]}
IpMonitor{AddressListSize=0}

2011-03-15 13:03:21.264/4.375 Oracle Coherence GE 3.7.0.0 <D5> (thread=Invocation:Management,
member=1): Service Management joined the cluster with senior service member 1
2011-03-15 13:03:21.405/4.516 Oracle Coherence GE 3.7.0.0 <D5> (thread=DistributedCache, member=1):
Service DistributedCache joined the cluster with senior service member 1
Hello Cache
```

Creating a Database Cache

In this section, create a cache backed by Oracle Database. This is also referred to as an Oracle Database cache.

1. Create an Oracle Database Cache
2. Create a Class to Define a Custom Cache Store
3. Modify the Cache Configuration File
4. Create a Class to Construct the Database Cache
5. Run the Database Cache Application

Create an Oracle Database Cache

To use SQL*Plus and the Oracle Database Express Edition (Oracle XE) to create an Oracle Database cache follow these steps. You must have the database installed on your system.

1. Invoke SQL*Plus.

   Navigate to **Start** then **All Programs** then **Oracle Database Express Edition** and then **Run SQL Command Line**.

2. Connect as `hr` user with `hr` as the password.

   ```
   connect hr/hr;
   ```

3. Create an Oracle Database table.

   Open a text editor and copy the following SQL code. Save it as a file named `dbscript.sql` in the `/home/oracle/workspace/` folder.

Example 9–4 SQL Script for Creating a Database Table

```
CREATE TABLE HR.CATALOG(id VARCHAR(25) PRIMARY KEY, value VARCHAR(96));
INSERT INTO HR.CATALOG VALUES('catalog1', 'Tuning Undo Tablespace');
INSERT INTO HR.CATALOG VALUES('catalog2', 'Tuning Your View Objects');
```

4. Run the SQL script.

   Example 9–5 illustrates the output from the script.

Example 9–5 Running the SQL Script for Creating a Database Table

```
SQL*Plus: Release 10.2.0.1.0 - Production on Tue March 1 13:38:59 2011
Copyright (c) 1982, 2005, Oracle.  All rights reserved.

SQL> connect hr/hr;
Connected.
SQL> @/home/oracle/workspace/dbscript.sql
```

```
Table created

1 row created

1 row created
```

Create a Class to Define a Custom Cache Store

To create a Java class that connects to the database and retrieves table data:

1. Create a Java class `DBCacheStore` in Eclipse. See "Creating a Java Class" on page 2-11 for detailed information.
2. Create the code to connect to the database and get table data.

   Example 9–6 illustrates a possible implementation of the `DBCacheStore` class. Copy the code to the `DBCacheStore` application in the Eclipse IDE. The `DBCacheStore` application uses Java Database Connectivity (JDBC) to access Oracle Database, but you could use another mechanism, such as Hibernate or Java Data Objects (JDO), instead.

Example 9–6 Database Cache Store Implementation

```
package com.oracle.handson;

import com.tangosol.net.cache.CacheStore;
import com.tangosol.util.Base;

import java.sql.DriverManager;
import java.sql.Connection;
import java.sql.PreparedStatement;
import java.sql.ResultSet;
import java.sql.SQLException;
import java.util.Collection;
import java.util.Iterator;
import java.util.LinkedList;
import java.util.List;
import java.util.Map;

public class DBCacheStore

        extends Base
        implements CacheStore {

        protected Connection m_con;
        protected String m_sTableName;
        private static final String DB_DRIVER   = "oracle.jdbc.OracleDriver";


            private static final String DB_URL      =
"jdbc:oracle:thin:@localhost:1521:XE";
            private static final String DB_USERNAME = "hr";
            private static final String DB_PASSWORD = "hr";

    public DBCacheStore(String sTableName)
        {
        m_sTableName = sTableName;

        configureConnection();
        }
```

```
protected void configureConnection()
    {
    try
        {
        Class.forName("oracle.jdbc.OracleDriver");
        m_con = DriverManager.getConnection(DB_URL, DB_USERNAME, DB_PASSWORD);
        m_con.setAutoCommit(true);
        }
    catch (Exception e)
        {
        throw ensureRuntimeException(e, "Connection failed");
        }
    }

public String getTableName()
    {
    return m_sTableName;
    }

public Connection getConnection()
    {
    return m_con;
    }

public Object load(Object oKey)
    {
    Object     oValue = null;
    Connection con    = getConnection();
    String     sSQL   = "SELECT id, value FROM " + getTableName()
                + " WHERE id = ?";
    try
        {
        PreparedStatement stmt = con.prepareStatement(sSQL);

        stmt.setString(1, String.valueOf(oKey));
        ResultSet rslt = stmt.executeQuery();
        if (rslt.next())
            {
            oValue = rslt.getString(2);
            if (rslt.next())
                {
                throw new SQLException("Not a unique key: " + oKey);
                }
            }
        stmt.close();
        }
    catch (SQLException e)
        {
        throw ensureRuntimeException(e, "Load failed: key=" + oKey);
        }
    return oValue;
    }

  public void store(Object oKey, Object oValue)
    {
    Connection con     = getConnection();
    String     sTable  = getTableName();
    String     sSQL;

    if (load(oKey) != null)
```

```
            {

            sSQL = "UPDATE " + sTable + " SET value = ? where id = ?";
            }
        else
            {

            sSQL = "INSERT INTO " + sTable + " (value, id) VALUES (?,?)";
            }
        try
            {
            PreparedStatement stmt = con.prepareStatement(sSQL);
            int i = 0;
            stmt.setString(++i, String.valueOf(oValue));
            stmt.setString(++i, String.valueOf(oKey));
            stmt.executeUpdate();
            stmt.close();
            }
        catch (SQLException e)
            {
            throw ensureRuntimeException(e, "Store failed: key=" + oKey);
            }
        }
    public void erase(Object oKey)
        {
        Connection con  = getConnection();
        String     sSQL = "DELETE FROM " + getTableName() + " WHERE id=?";
        try
            {
            PreparedStatement stmt = con.prepareStatement(sSQL);

            stmt.setString(1, String.valueOf(oKey));
            stmt.executeUpdate();
            stmt.close();
            }
        catch (SQLException e)
            {
            throw ensureRuntimeException(e, "Erase failed: key=" + oKey);
            }
        }
    public void eraseAll(Collection colKeys)
        {
        throw new UnsupportedOperationException();
        }

    public Map loadAll(Collection colKeys)
        {
        throw new UnsupportedOperationException();
        }

    public void storeAll(Map mapEntries)
        {
        throw new UnsupportedOperationException();
        }

    public Iterator keys()
        {
        Connection con  = getConnection();
        String     sSQL = "SELECT id FROM " + getTableName();
        List       list = new LinkedList();
```

```
        try
            {
            PreparedStatement stmt = con.prepareStatement(sSQL);
            ResultSet         rslt = stmt.executeQuery();
            while (rslt.next())
                {
                Object oKey = rslt.getString(1);
                list.add(oKey);
                }
            stmt.close();
            }
        catch (SQLException e)
            {
            throw ensureRuntimeException(e, "Iterator failed");
            }

        return list.iterator();
        }

    }
```

Modify the Cache Configuration File

Modify the cache configuration file (`cache-config.xml`) that you created earlier for the database cache. To connect a cache to a database, you must configure the `cachestore-scheme` element with a custom class that implements either the `com.tangosol.net.cache.CacheLoader` or `com.tangosol.net.cache.CacheStore` interface.

Replace the code in the existing `cache-config.xml` file in Eclipse with the cache configuration code for the database cache in Example 9–7.

Example 9–7 Database Cache Configuration File

```
<?xml version="1.0" encoding="UTF-8" ?>
<cache-config>
    <caching-scheme-mapping>

  <!--
    Caches with names that start with 'DBBacked' will be created
    as distributed-db-backed.
    -->
  <cache-mapping>
   <cache-name>DBBacked*</cache-name>
   <scheme-name>distributed-db-backed</scheme-name>
  </cache-mapping>
 </caching-scheme-mapping>
 <caching-schemes>
  <!--
    DB Backed Distributed caching scheme.
    -->
  <distributed-scheme>
   <scheme-name>distributed-db-backed</scheme-name>
   <service-name>DistributedCache</service-name>
   <backing-map-scheme>
    <read-write-backing-map-scheme>
     <internal-cache-scheme>
      <class-scheme>
       <class-name>com.tangosol.util.ObservableHashMap</class-name>
```

```
      </class-scheme>
     </internal-cache-scheme>
     <cachestore-scheme>
      <class-scheme>
       <class-name>com.oracle.handson.DBCacheStore</class-name>
       <init-params>
        <init-param>
         <param-type>java.lang.String</param-type>
         <param-value>CATALOG</param-value>
        </init-param>
       </init-params>
      </class-scheme>
     </cachestore-scheme>
     <read-only>false</read-only>
     <!--
        To make this a write-through cache just change the value below to 0 (zero)
        -->
     <write-delay-seconds>0</write-delay-seconds>
    </read-write-backing-map-scheme>
   </backing-map-scheme>
   <listener/>
   <autostart>true</autostart>
  </distributed-scheme>
 </caching-schemes>
</cache-config>
```

In the cache configuration file, you have done the following:

- Defined a cache name pattern `DBBacked*`, which is mapped to a distributed caching scheme `distributed-db-backed`.
- Specified the `CacheStore` scheme in the distributed scheme using the class `coherence.DBCacheStore`, which implements the `CacheStore` interface.
- Specified for the `DBCacheStore` class an `init` parameter for the database table that is at the back end of the cache. The table name is specified in the `init-param` element. The `DBCacheStore` class performs database operations such as reading and writing cache entries.
- Specified a `read-write-backing-map-scheme` as the backing map. This scheme defines a backing map, which provides a size-limited cache of a persistent store. Here, by setting the `write-delay-seconds` parameter to 0, you specify the write-through mechanism.

  Table 9–2 describes the types of read/write caching that you can use with Oracle Coherence.

Table 9–2 Types of Read/Write Caching Supported by Coherence

Types of Read/Write Caching	Action
read-through	A cache entry is read into a cache from the database when required and made available to an application.
write-through	Updates to cache entries are synchronized with the database without a delay.
refresh-ahead	Cache entries are refreshed periodically.
write-behind	Updates to cache entries are asynchronously written to a database after a delay specified in the `write-delay-seconds` element in the cache configuration file.

Create a Class to Construct the Database Cache

Create a Java class `DatabaseCache` for the database cache in Eclipse. The class must contain a `main` method. See "Creating a Java Class" on page 2-11 for detailed information.

In the class file, provide the code to add a cache entry, query a database cache, and retrieve a cache entry. Add the following methods: `createCache()`, `addEntry()`, `retrieveEntry()`, `eraseEntry()`, and `queryCache()`. Example 9–8 illustrates a possible implementation.

Example 9–8 Implementation for the Database Cache Class File

```
package com.oracle.handson;

import com.tangosol.net.CacheFactory;
import com.tangosol.net.NamedCache;
import com.tangosol.net.cache.ContinuousQueryCache;
import com.tangosol.util.Filter;
import com.tangosol.util.extractor.IdentityExtractor;
import com.tangosol.util.filter.LikeFilter;

import java.util.HashSet;

import java.util.Iterator;
import java.util.Map;
import java.util.Set;

public class DatabaseCache {
    NamedCache cache;
    public DatabaseCache() {
    }

    public void createCache()
         {
         cache = CacheFactory.getCache("DBBackedCache");
         }

    public void addEntry()
        {
        cache.put(new String("catalog3"), new String("Tuning Grid Management"));
        cache.put(new String("catalog4"), new String("Tuning Coherence"));
        cache.put(new String("catalog5"), new String("Tuning Database"));
        }

    public void retrieveEntry()
        {
        System.out.println((String) cache.get( "catalog3"));
        }

    public void eraseEntry()
       {
       cache.remove(new String("catalog3"));
       }

    public void queryCache()
       {
       Filter filter = new LikeFilter(IdentityExtractor.INSTANCE, "Tuning%", '\\',
true);
       HashSet hashSet=new HashSet();
       hashSet.add(new String("catalog3"));
```

```
        hashSet.add(new String("catalog4"));
        hashSet.add(new String("catalog5"));

        Map map=cache.getAll(hashSet);
        Set results = cache.entrySet(filter);

            for (Iterator i = results.iterator(); i.hasNext();)
                {
                Map.Entry e = (Map.Entry) i.next();
                System.out.println("Catalog ID: "+e.getKey() + ", Title: "+e.
getValue());
                }
         }

    public static void main(String[] args)
        {
        DatabaseCache databaseCache = new DatabaseCache();
        databaseCache.createCache();
        databaseCache.addEntry();
        databaseCache.queryCache();
        }
}
```

Note the following features of the database cache class file:

- A `NamedCache` object is created using the `getCache` method of the `CacheFactory` class in the `createCache` method.

  ```
  NamedCache cache = CacheFactory.getCache("DBBackedCache");
  ```

- The `DBBackedCache` matches the cache pattern `DBBacked*` and is, therefore, mapped to a distributed caching scheme `distributed-db-backed` in the `cache-config.xml` file. Add a cache entry using the `put()` method of the `NamedCache` object.

  ```
  cache.put(new String("catalog3"), new String("Tuning Grid Management"));
  ```

- Because the write-through mechanism is used, the new cache entry gets synchronized with the database; a new row is added to the `CATALOG` table. Comment out all the methods except the `createCache` and `addEntry` methods.
- When the `put` method is invoked, the `store` method, which maps the new cache entry to the database table `CATALOG` using JDBC, gets invoked in the `DBCacheStore` class. The output from the Oracle Coherence application is displayed in the Log window and a new cache entry is added. The output shows that the operational configuration deployment descriptor is loaded, the cache configuration is loaded, a new cluster is created, and the `DistributedCache` service has joined the cluster.
- The new cache entry can be removed with the `remove` method of the `NamedCache` object.

  ```
  cache.remove(new String("catalog3"));
  ```

- Bulk uploading of cache entries is performed using the `putAll` method.
- A cache entry is retrieved using the `get` method of the `NamedCache` object. For example, retrieving the cache entry for ID `catalog1`:

  ```
  System.out.println((String) cache.get("catalog1"));
  ```

- When the `get()` method is invoked, the `load` method, which retrieves database table data using JDBC, gets invoked in the `DBCacheStore` class.
- Bulk retrieval is performed using the `getAll` method of the `NamedCache` object.
- Oracle Coherence supports searching for cache entries based on a search criteria using filters. Coherence filters are available in the `com.tangosol.util.filter` package. In Oracle Coherence Enterprise Edition and Grid Edition, indexes can be added to the Coherence cache to improve performance. You query the database cache using a `LikeFilter` filter, which matches cache entries with a specified pattern. To query a database cache, the cache entries must be created before querying, and the cache entries must be retrieved into the cache using the `get()` or `getAll()` method before a query using a filter can be performed. Therefore, you can retrieve database data and create a collection of cache entries using the `getAll()` method.

```
HashSet hashSet=new HashSet();
hashSet.add(new String("catalog1"));
hashSet.add(new String("catalog2"));
hashSet.add(new String("catalog3"));
Map map=cache.getAll(hashSet);
```

- Create a `LikeFilter` filter to search for cache entries starting with `Tuning`.

```
Filter filter = new LikeFilter(IdentityExtractor.INSTANCE, "Tuning%", '\\',
true);
```

- Query the database cache using the `entrySet()` method with the `LikeFilter` filter.

```
Set results = cache.entrySet(filter);
```

- Iterate over the results of the query. Display the key and value of the cache entries that are retrieved.

```
for (Iterator i = results.iterator(); i.hasNext();)
   {
   Map.Entry e = (Map.Entry) i.next();
   System.out.println("Catalog ID: "+e.getKey() + ", Title: "+e.getValue());
   }
```

- Oracle Coherence supports continuous query using the `com.tangosol.net.cache.ContinuousQueryCache` class. A continuous query is a query that is kept up-to-date using a continuous query cache. In a `ContinuousQueryCache`, the results of a query are updated using event listeners on events that could change the results of the query. Create a `ContinuousQueryCache` object using the `NamedCache` object and the `LikeFilter` object.

```
ContinuousQueryCache queryCache = new ContinuousQueryCache(cache, filter );
```

- Create a result set by using the `entrySet()` method.

```
Set results = queryCache.entrySet(filter);
```

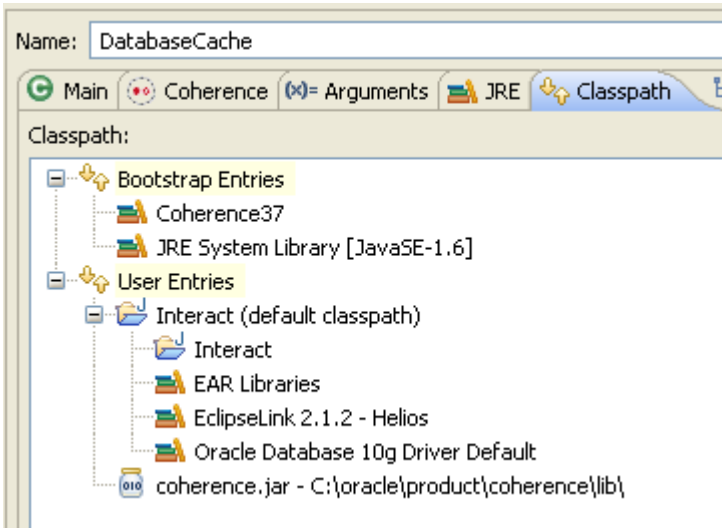
Run the Database Cache Application

To run the Oracle Database cache application:

1. Stop any running cache servers. See "Stopping Cache Servers" on page 2-13 for more information.

2. Start the cache server (`JPACacheServer`). Right click the project and select **Run As** then **Run Configurations**. In the **Run Configurations** dialog box, select **JPACacheServer** to display its configuration. Click **Run**.
3. Create a run configuration for the `DatabaseCache` program.
   a. In the **Run Configurations** dialog box, click the **New launch configuration** icon.
   b. Enter `DatabaseCache` in the **Name** field. Ensure that `Interact` is in the **Project** field and `com.oracle.handson.DatabaseCache` is in the **Main class** field.
   c. In the **Coherence** tab, enter the path to the cache configuration file in the **Cache configuration descriptor** field: `C:\home\oracle\workspace\cache-config.xml`. Select **Local storage**: **Disabled (cache client)**. Enter a unique value, such as `3155`, in the **Cluster port** field.
   d. In the **Classpath** tab, use the **Add External JARs** button to add the `coherence.jar` file to **User Entries**. The **Classpath** tab should look similar to Figure 9–4.

Figure 9–4 Classpath for the DatabaseCache Program



   e. Click **Apply** then **Run**.

   Example 9–9 illustrates the expected results.

Example 9–9 Output of the DatabaseCache Program

```
...
2011-03-15 13:47:59.374/0.329 Oracle Coherence 3.7.0.0 <Info> (thread=main, member=n/a): Loaded
operational configuration from "jar:file:/C:/oracle/product/coherence/lib/coherence.jar!/tangosol-
coherence.xml"
2011-03-15 13:47:59.420/0.375 Oracle Coherence 3.7.0.0 <Info> (thread=main, member=n/a): Loaded
operational overrides from "jar:file:/C:/oracle/product/coherence/lib/coherence.jar!/tangosol-
coherence-override-dev.xml"
2011-03-15 13:47:59.452/0.407 Oracle Coherence 3.7.0.0 <Info> (thread=main, member=n/a): Loaded
operational overrides from "file:/C:/home/oracle/workspace/Interact/build/classes/tangosol-
coherence-override.xml"
```

```
2011-03-15 13:47:59.467/0.422 Oracle Coherence 3.7.0.0 <D5> (thread=main, member=n/a): Optional
configuration override "/custom-mbeans.xml" is not specified

Oracle Coherence Version 3.7.0.0 Build 22913
 Grid Edition: Development mode
Copyright (c) 2000, 2010, Oracle and/or its affiliates. All rights reserved.

2011-03-15 13:47:59.624/0.579 Oracle Coherence GE 3.7.0.0 <Info> (thread=main, member=n/a): Loaded
cache configuration from "file:/C:/home/oracle/workspace/cache-config.xml"
2011-03-15 13:47:59.811/0.766 Oracle Coherence GE 3.7.0.0 <D4> (thread=main, member=n/a): TCMP
bound to /130.35.99.213:8090 using SystemSocketProvider
2011-03-15 13:48:00.327/1.282 Oracle Coherence GE 3.7.0.0 <Info> (thread=Cluster, member=n/a): This
Member(Id=2, Timestamp=2011-03-15 13:48:00.17, Address=130.35.99.213:8090, MachineId=49877,
Location=site:URL, machine_name,process:5076, Role=OracleHandsonDatabaseCache, Edition=Grid
Edition, Mode=Development, CpuCount=2, SocketCount=1) joined cluster "cluster:0x96AB" with senior
Member(Id=1, Timestamp=2011-03-15 13:33:58.514, Address=130.35.99.213:8088, MachineId=49877,
Location=site:URL, machine_name,process:3524, Role=CoherenceServer, Edition=Grid Edition,
Mode=Development, CpuCount=2, SocketCount=1)
2011-03-15 13:48:00.342/1.297 Oracle Coherence GE 3.7.0.0 <D5> (thread=Cluster, member=n/a): Member
1 joined Service Cluster with senior member 1
2011-03-15 13:48:00.342/1.297 Oracle Coherence GE 3.7.0.0 <D5> (thread=Cluster, member=n/a): Member
1 joined Service Management with senior member 1
2011-03-15 13:48:00.342/1.297 Oracle Coherence GE 3.7.0.0 <D5> (thread=Cluster, member=n/a): Member
1 joined Service DistributedCache with senior member 1
2011-03-15 13:48:00.342/1.297 Oracle Coherence GE 3.7.0.0 <Info> (thread=main, member=n/a): Started
cluster Name=cluster:0x96AB

Group{Address=224.3.7.0, Port=3155, TTL=4}

MasterMemberSet
  (
  ThisMember=Member(Id=2, Timestamp=2011-03-15 13:48:00.17, Address=130.35.99.213:8090,
MachineId=49877, Location=site:URL, machine_name,process:5076, Role=OracleHandsonDatabaseCache)
  OldestMember=Member(Id=1, Timestamp=2011-03-15 13:33:58.514, Address=130.35.99.213:8088,
MachineId=49877, Location=site:URL, machine_name,process:3524, Role=CoherenceServer)
  ActualMemberSet=MemberSet(Size=2, BitSetCount=2
    Member(Id=1, Timestamp=2011-03-15 13:33:58.514, Address=130.35.99.213:8088, MachineId=49877,
Location=site:URL, machine_name,process:3524, Role=CoherenceServer)
    Member(Id=2, Timestamp=2011-03-15 13:48:00.17, Address=130.35.99.213:8090, MachineId=49877,
Location=site:URL, machine_name,process:5076, Role=OracleHandsonDatabaseCache)
    )
  RecycleMillis=1200000
  RecycleSet=MemberSet(Size=0, BitSetCount=0
    )
  )

TcpRing{Connections=[1]}
IpMonitor{AddressListSize=0}

2011-03-15 13:48:00.436/1.391 Oracle Coherence GE 3.7.0.0 <D5> (thread=Invocation:Management,
member=2): Service Management joined the cluster with senior service member 1
2011-03-15 13:48:00.514/1.469 Oracle Coherence GE 3.7.0.0 <D5> (thread=DistributedCache, member=2):
Service DistributedCache joined the cluster with senior service member 1
Catalog ID: catalog3, Title: Tuning Grid Management
Catalog ID: catalog4, Title: Tuning Coherence
Catalog ID: catalog5, Title: Tuning Database
```

Example 9–10 illustrates the cache server response to the `DatabaseCache` program.

Example 9–10 Cache Server Response to the DatabaseCache Program

```
...
Started DefaultCacheServer...

2011-03-15 13:48:00.327/843.922 Oracle Coherence GE 3.7.0.0 <D5> (thread=Cluster, member=1):
Member(Id=2, Timestamp=2011-03-15 13:48:00.17, Address=130.35.99.213:8090, MachineId=49877,
Location=site:URL, machine_name,process:5076, Role=OracleHandsonDatabaseCache) joined Cluster with
senior member 1
2011-03-15 13:48:00.436/844.031 Oracle Coherence GE 3.7.0.0 <D5> (thread=Cluster, member=1): Member
2 joined Service Management with senior member 1
2011-03-15 13:48:00.545/844.156 Oracle Coherence GE 3.7.0.0 <D5> (thread=Cluster, member=1): Member
2 joined Service DistributedCache with senior member 1
2011-03-15 13:48:02.842/846.437 Oracle Coherence GE 3.7.0.0 <D5> (thread=Cluster, member=1):
TcpRing disconnected from Member(Id=2, Timestamp=2011-03-15 13:48:00.17, Address=130.35.99.
213:8090, MachineId=49877, Location=site:URL, machine_name,process:5076,
Role=OracleHandsonDatabaseCache) due to a peer departure; removing the member.
2011-03-15 13:48:02.842/846.437 Oracle Coherence GE 3.7.0.0 <D5> (thread=Cluster, member=1): Member
2 left service Management with senior member 1
2011-03-15 13:48:02.842/846.437 Oracle Coherence GE 3.7.0.0 <D5> (thread=Cluster, member=1): Member
2 left service DistributedCache with senior member 1
2011-03-15 13:48:02.842/846.437 Oracle Coherence GE 3.7.0.0 <D5> (thread=Cluster, member=1):
Member(Id=2, Timestamp=2011-03-15 13:48:02.842, Address=130.35.99.213:8090, MachineId=49877,
Location=site:URL, machine_name,process:5076, Role=OracleHandsonDatabaseCache) left Cluster with
senior member 1
```

If you receive any exceptions, such as the following:

```
java.lang.IllegalArgumentException: No scheme for cache: "cachename,
```

You may be able to remove them by editing the `cache-config.xml` file and replacing `DBBacked*` in the `<cache-name>` element with `*`. Re-run the `DatabaseCache` application in Eclipse. You should not see any exceptions.

4. Note that because you are using a write-through cache, the database table is also updated. From the SQL prompt, enter the following code:

```
select * from hr.catalog;
```

Example 9–11 illustrates the results.

Example 9–11 Output from the SELECT Statement

```
....
select * from hr.catalog;
ID
-------------------------
VALUE
--------------------------------------------------------------------------------
catalog3
Tuning Grid Management

catalog4
Tuning Coherence

catalog5
Tuning Database

ID
-------------------------
VALUE
--------------------------------------------------------------------------------
```

```
catalog1
Tuning Undo Tablespace

catalog2
Tuning Your View Objects
```

10

Working with Security

This chapter describes how to apply security to a Coherence*Extend client. Coherence*Extend allows a wide range of access to Coherence caches. These include desktop applications, remote servers, and machines located across wide area network (WAN) connections.

This chapter contains the following sections:

Introduction

Coherence*Extend consists of an extend client running outside the cluster and a proxy service running inside the cluster, hosted by one or more cache servers. The client APIs route all requests to the proxy. The proxy responds to client requests by delegating to Coherence clustered services, such as a partitioned or replicated cache service or an invocation service.

Because the extend client exists outside of the cluster, the issue of securing access to the cluster takes on greater importance. This chapter describes three techniques that you can use to secure access between the client and the cluster. The techniques include using identity token-based passwords, an entitled cache service, and an invocation service.

A detailed discussion of these security techniques and extend clients is beyond the scope of this tutorial. For more information on these topics, see the *Oracle Coherence Security Guide*.

Enabling Token-Based Security

You can implement token-based security to enable access between an extend client and an extend proxy in the cluster. To enable access between the extend client and an extend proxy the following files are typically required:

- Client application files, which describe the functionality that will access the cluster
- Cache configuration files, where the extend client and the extend proxy each have their own cache configuration
- Operational override file, which overrides the operational and run-time settings in the default operational deployment descriptor

- Server start-up files, where there is a start-up file for the extend proxy and for the cache server in the cluster
- POF configuration deployment descriptor, which specifies custom data types when using POF to serialize objects

To add token-based security, you must also provide identity transformer and asserter implementations. The transformer generates the token on the client side and the asserter validates it on the cluster side.

The following steps describe how to create and run an application for an extend client that uses token-based security to access the cluster.

1. Use a Security Helper File
2. Create an Identity Transformer
3. Create an Identity Asserter
4. Create the Password File
5. Enable the Identity Transformer and Asserter
6. Create a Cache Configuration File for the Extend Client
7. Create a Cache Configuration File for the Extend Proxy
8. Create a Start-Up Configuration for a Cache Server with a Proxy Service
9. Create a Start-Up Configuration for a Cache Server
10. Run the Password Example

Use a Security Helper File

The examples in this chapter reference a security helper file that defines role-based security policies and access control to the cache. For the purpose of these examples, a file with simplified mappings is provided for you.

Cache access is determined by a user's role. The security helper file defines several roles: `role_reader`, `role_writer`, and `role_admin`. It defines the mappings of various users to the roles, such as `BuckarooBanzai` to `ROLE_ADMIN`. It defines the mappings of roles to integer IDs, such as `ROLE_ADMIN` to `9`. The helper file also defines the cache name and the invocation service name used in the examples.

The key features of this file are the `login` and `checkAccess` methods. The `login` method takes a user name and constructs a simplified distinguished name (DN). It then associates a role with the name. `PofPrincipal` provides the `Principal` implementation.

The `checkAccess` method shows where the authorization code is placed. It determines whether the user can access the cache based on a provided user role.

To create a new project and the security helper file:

1. In Eclipse IDE, select the Java EE perspective and create a new Application Client Project called `Security`. Select **CoherenceConfig** from the **Configuration** drop-down list. Ensure that the **Create a default main** is *not* selected on the Application Client module page.

   In the Coherence page, select *only* **Coherence37**.

   See "Creating a New Project in the Eclipse IDE" on page 2-3 for detailed information on creating a project.

2. Create a new Java file named `SecurityExampleHelper.java`. Ensure that the package path is `com.oracle.handson`.

   See "Creating a Java Class" on page 2-11 for detailed information on creating a Java class.

3. Copy the code illustrated in Example 10–1 into the file.

Example 10–1 A Security Helper File

```
package com.oracle.handson;

import com.tangosol.io.pof.PofPrincipal;

import com.tangosol.net.security.SecurityHelper;

import java.util.HashMap;
import java.util.HashSet;
import java.util.Iterator;
import java.util.Map;
import java.util.Set;

import java.security.Principal;

import javax.security.auth.Subject;


/**
* This class provides extremely simplified role based policies and access control.
*
*/
public class SecurityExampleHelper
    {
    // ----- static methods ---------------------------------------------------

    /**
    * Login the user.
    *
    * @param sName  the user name
    *
    * @return the authenticated user
    */
    public static Subject login(String sName)
        {
        // For simplicity, just create a Subject. Normally, this would be
        // done using JAAS.
        String sUserDN       = "CN=" + sName + ",OU=Yoyodyne";
        Set setPrincipalUser = new HashSet();

        setPrincipalUser.add(new PofPrincipal(sUserDN));
        // Map the user to a role
        setPrincipalUser.add(new PofPrincipal((String) s_mapUserToRole.
get(sName)));

        return new Subject(true, setPrincipalUser, new HashSet(), new HashSet());
        }


    /**
     * Assert that a Subject is associated with the calling thread with a
     * Principal representing the required role.
```

```
     *
     * @param sRoleRequired  the role required for the operation
     *
     * @throws SecurityException if a Subject is not associated with the
     *         calling thread or does not have the specified role Principal
     */
    public static void checkAccess(String sRoleRequired)
        {
        checkAccess(sRoleRequired, SecurityHelper.getCurrentSubject());
        }

    /**
    * Assert that a Subject contains a Principal representing the required
    * role.
    *
    * @param sRoleRequired  the role required for the operation
    *
    * @param subject        the Subject requesting access
    *
    * @throws SecurityException if a Subject is null or does not have the
    * specified role Principal
    */
    public static void checkAccess(String sRoleRequired, Subject subject)
        {
        if (subject == null)
            {
            throw new SecurityException("Access denied, authentication
required");
            }

        Map     mapRoleToId   = s_mapRoleToId;
        Integer nRoleRequired = (Integer) mapRoleToId.get(sRoleRequired);

        for (Iterator iter = subject.getPrincipals().iterator(); iter.hasNext();)
            {
            Principal principal = (Principal) iter.next();
            String    sName     = principal.getName();

            if (sName.startsWith("role_"))
                {
                Integer nRolePrincipal = (Integer) mapRoleToId.get(sName);

                if (nRolePrincipal == null)
                    {
                    // invalid role
                    break;
                    }

                if (nRolePrincipal.intValue() >= nRoleRequired.intValue())
                    {
                    return;
                    }
                }
            }

        throw new SecurityException("Access denied, insufficient privileges");
        }


    // ----- constants  -----------------------------------------------------
```

```
    public static final String ROLE_READER = "role_reader";

    public static final String ROLE_WRITER = "role_writer";

    public static final String ROLE_ADMIN  = "role_admin";

    /**
     * The cache name for security examples
     */
     public static final String SECURITY_CACHE_NAME = "security";

    /**
    * The name of the InvocationService used by security examples.
    */
    public static String INVOCATION_SERVICE_NAME = "ExtendTcpInvocationService";


    // ----- static data  ---------------------------------------------------

    /**
    * The map keyed by user name with the value being the user's role.
    * Represents which user is in which role.
    */
    private static Map s_mapUserToRole = new HashMap();

    /**
    * The map keyed by role name with the value the role id.
    * Represents the numeric role identifier.
    */
    private static Map s_mapRoleToId = new HashMap();


    // ----- static initializer ---------------------------------------------

    static
        {
        // User to role mapping
        s_mapUserToRole.put("BuckarooBanzai", ROLE_ADMIN);
        s_mapUserToRole.put("JohnWhorfin", ROLE_WRITER);
        s_mapUserToRole.put("JohnBigboote", ROLE_READER);

        // Role to Id mapping
        s_mapRoleToId.put(ROLE_ADMIN, Integer.valueOf(9));
        s_mapRoleToId.put(ROLE_WRITER, Integer.valueOf(2));
        s_mapRoleToId.put(ROLE_READER, Integer.valueOf(1));
        }
}
```

Create an Identity Transformer

An identity transformer (`com.tangosol.net.security.IdentityTransformer`) is a client-side component that converts a subject or principal into an identity token. The token must be a type that Coherence can serialize. Coherence automatically serializes the token at run time and sends it as part of the connection request to the proxy.

To create an identity transformer implementation:

1. Create a new Java class in the `Security` project named `PasswordIdentityTransformer`.

   See "Creating a Java Class" on page 2-11 for detailed information.

2. Import the `IdentityTransformer` interface. Ensure that the `PasswordIdentityTransformer` class implements the `IdentityTransformer` interface.

3. Implement the `transformIdentity` method so that it performs the following tasks:

   - Tests whether the subject exists and is complete
   - Gets the principal names from the subject and saves them in a `String` array
   - Constructs the token, as a combination of the password plus the principal names, that can be serialized as POF types

Example 10–2 illustrates a possible implementation of the `PasswordIdentityTransformer` class.

Example 10–2 Sample Identity Transformer Implementation

```
package com.oracle.handson;


import com.tangosol.net.security.IdentityTransformer;

import java.security.Principal;
import java.util.Iterator;
import java.util.Set;

import javax.security.auth.Subject;

/**
* PasswordIdentityTransformer creates a security token that contains the
* required password and then adds a list of Principal names.
*
*/
public class PasswordIdentityTransformer
        implements IdentityTransformer

    {
    // ----- IdentityTransformer interface ------------------------------------

    /**
    * Transform a Subject to a token that asserts an identity.
    *
    * @param subject the Subject representing a user.
    *
    * @return the token that asserts identity.
    *
    * @throws SecurityException if the identity transformation fails.
    */
    public Object transformIdentity(Subject subject, Service service)
            throws SecurityException
        {
  // The service is not needed so the service argument is being ignored.
  // It could be used, for example, if there were different token types
  // required per service.
```

```
        if (subject == null)
            {
            throw new SecurityException("Incomplete Subject");
            }

        Set setPrincipals = subject.getPrincipals();

        if (setPrincipals.isEmpty())
            {
            throw new SecurityException("Incomplete Subject");
            }

        String[] asPrincipalName = new String[setPrincipals.size() + 1];
        int      i               = 0;

        asPrincipalName[i++] = System.getProperty("coherence.password",
                "secret-password");

        for (Iterator iter = setPrincipals.iterator(); iter.hasNext();)
            {
            asPrincipalName[i++] = ((Principal) iter.next()).getName();
            }

        // The token consists of the password plus the principal names as an
        // array of pof-able types, in this case strings.
        return asPrincipalName;
        }
    }
```

Create an Identity Asserter

An identity asserter (`com.tangosol.net.security.IdentityAsserter`) is a cluster-side component on the cache server that hosts an extend proxy service. The asserter validates that the token created by the identity transformer on the extend client contains the required credentials to access the cluster.

To create an identity asserter implementation:

1. Create a new Java class in the `Security` project named `PasswordIdentityAsserter`.

   See "Creating a Java Class" on page 2-11 for detailed information.

2. Import the `IdentityAsserter` interface. Ensure that the `PasswordIdentityAsserter` class implements the `IdentityAsserter` interface.

3. Implement the `assertIdentity` method such that it:

   - Validates that the token contains the correct password and that the password is the first name in the token

Example 10–3 illustrates a a possible implementation of the `PasswordIdentityAsserter` class.

Example 10–3 Sample Identity Asserter Implementation

```
package com.oracle.handson;


import com.tangosol.io.pof.PofPrincipal;
```

```
import com.tangosol.net.security.IdentityAsserter;

import java.util.HashSet;
import java.util.Set;

import javax.security.auth.Subject;


/**
* PasswordIdentityAsserter asserts that the security token contains the
* required password and then constructs a Subject based on a list of
* Principal names.
*
*/
public class PasswordIdentityAsserter
        implements IdentityAsserter
    {
    // ----- IdentityAsserter interface -------------------------------------

    /**
    * Asserts an identity based on a token-based identity assertion.
    *
    * @param oToken the token that asserts identity.
    *
    * @return a Subject representing the identity.
    *
    * @throws SecurityException if the identity assertion fails.
    */
    public Subject assertIdentity(Object oToken, Service service)
            throws SecurityException
        {
    // The service is not needed so the service argument is being ignored.
    // It could be used, for example, if there were different token types
    // required per service.
        if (oToken instanceof Object[])
            {
            String   sPassword       = System.getProperty(
                    "coherence.password", "secret-password");
            Set      setPrincipalUser = new HashSet();
            Object[] asName          = (Object[]) oToken;

            // first name must be password
            if (((String) asName[0]).equals(sPassword))
                {
                // prints the user name to server shell to ensure we are
                // communicating with it and to ensure user is validated
                System.out.println("Password validated for user: " + asName[1]);
                for (int i = 1, len = asName.length; i < len; i++)
                    {
                    setPrincipalUser.add(new PofPrincipal((String)asName[i]));
                    }

                return new Subject(true, setPrincipalUser, new HashSet(),
                        new HashSet());
                }
            }
        throw new SecurityException("Access denied");
        }
    }
```

Create the Password File

Create a Java file that requires a password to get a reference to a cache. Use the `SecurityExampleHelper.login("BuckarooBanzai")` to call the `login` method in the `SecurityExampleHelper` file to generate a token. At run time, the user name is associated with its subject defined in the `SecurityExampleHelper` class. A token is generated from this subject by the `PasswordIdentityTransformer` class and validated by the `PasswordIdentityAsserter` class as part of the connection request. If the validation succeeds, then a connection to the proxy and a reference to the cache is granted. Use the `Subject.doas` method to make the subject available in the security context.

1. Create a new Java class with a `main` method in the `Security` project named `PasswordExample`.

   See "Creating a Java Class" on page 2-11 for detailed information.

2. Implement the `main` method to get a reference to the cache.
3. Use the `SecurityExampleHelper.login` method to get a subject for user `BuckarooBanzai`
4. Implement the `doAs` method to make the subject part of the Java security context. The subject will be available to any subsequent code. In this case, the `doAs` method is implemented to validate whether the user can access the cache based on its defined role.

Example 10–4 illustrates a possible implementation of `PasswordExample`.

Example 10–4 Sample Implementation to Run the Password Example

```
package com.oracle.handson;

import com.tangosol.net.CacheFactory;
import com.tangosol.net.NamedCache;

import java.io.IOException;

import java.security.PrivilegedExceptionAction;

import javax.security.auth.Subject;


/**
* This class shows how a Coherence Proxy can require a password to get a
* reference to a cache.
* <p>
* The PasswordIdentityTransformer will generate a security token that
* contains the password. The PasswordIdentityAsserter will validate the
* security token to enforce the password. The token generation and
* validation occurs automatically when a connection to the proxy is made.
*
*/
public class PasswordExample
    {
    // ----- static methods ---------------------------------------------------

    /**
    * Get a reference to the cache. Password will be required.
    */
    public static void main (String[] args){
```

```
        getCache();
          }
    public static void getCache()
      {
      System.out.println("------password example begins------");

      Subject subject = SecurityExampleHelper.login("BuckarooBanzai");

      try
          {
          NamedCache cache = (NamedCache) Subject.doAs(
                  subject, new PrivilegedExceptionAction()
              {
              public Object run()
                      throws Exception
                  {
                  NamedCache cache;

                  cache = CacheFactory.getCache(
                          SecurityExampleHelper.SECURITY_CACHE_NAME);
                  System.out.println("------password example succeeded------");
                  return cache;
                  }
              });
          }
      catch (Exception e)
          {
          // get exception if the password is invalid
          System.out.println("Unable to connect to proxy");
          e.printStackTrace();
          }
      System.out.println("------password example completed------");
      }

}
```

Enable the Identity Transformer and Asserter

Configure an operational override file (`tangosol-coherence-override.xml`) to identify the classes that define the identity transformer (the class that transforms a `Subject` to a token on the extend client) and the identity asserter (the class that validates the token on the cluster).

1. Open the `tangosol-coherence-override.xml` file from the Project Explorer window. You can find the file under `Security/appClientModule`.
2. Use the `identity-transformer` and `identity-asserter` elements within the `security-config` stanza to identify the full path to the `PasswordIdentityTransformer` and `PasswordIdentityAsserter` implementation classes, respectively. Set the `subject-scope` parameter to `true` to associate the identity from the current security context with the cache and remote invocation service references that are returned to the client.

Example 10–5 illustrates a possible implementation of the `tangosol-coherence-override.xml` file.

Example 10–5 Specifying an Identity Transformer and an Asserter

```
<?xml version='1.0'?>
<coherence  xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
```

```
            xmlns="http://xmlns.oracle.com/coherence/coherence-operational-config"
            xsi:schemaLocation="http://xmlns.oracle.com/coherence/coherence-
operational-config coherence-operational-config.xsd"
            xml-override="/tangosol-coherence-override.xml">
  <security-config>
    <identity-transformer>
      <class-name>com.oracle.handson.PasswordIdentityTransformer</class-name>
    </identity-transformer>
    <identity-asserter>
      <class-name>com.oracle.handson.PasswordIdentityAsserter</class-name>
    </identity-asserter>
    <subject-scope>true</subject-scope>
  </security-config>
</coherence>
```

Create a Cache Configuration File for the Extend Client

The cache configuration file for the extend client routes cache operations to an extend proxy in the cluster. At run time, cache operations are not executed locally; instead, they are sent to the extend proxy service.

To create a cache configuration file for an extend client:

1. Open the `coherence-cache-config.xml` file from the Project explorer window. You can find the file under `Security/appClientModule`.
2. Save the file as `client-cache-config.xml`.
3. Write the extend client cache configuration. The following list highlights some key elements:
   - Use the `cache-name` element to define `security` as the name of the cache. Note that there must be a cache defined in the cluster-side cache configuration that is also named `security`.
   - Use the `remote-cache-scheme` stanza to define the details about the remote cache.
   - Use the `address` and `port` elements in the `tcp-initiator` stanza to identify the extend proxy service that is listening on the `localhost` address at port `9099`.
   - Use `defaults` and `serializer` with a value of `pof` to call the serializer for the custom POF configuration file (which you will create later in this chapter).

Example 10–6 illustrates a possible implementation for the `client-cache-config.xml` file.

Example 10–6 Sample Extend Client Cache Configuration File

```
<?xml version="1.0"?>
<cache-config xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
              xmlns="http://xmlns.oracle.com/coherence/coherence-cache-config"
              xsi:schemaLocation="http://xmlns.oracle.com/coherence/coherence-
cache-config coherence-cache-config.xsd">
  <defaults>
    <serializer>pof</serializer>
  </defaults>

  <caching-scheme-mapping>
    <cache-mapping>
      <cache-name>security</cache-name>
```

```
      <scheme-name>examples-remote</scheme-name>
    </cache-mapping>
  </caching-scheme-mapping>

  <caching-schemes>
    <remote-cache-scheme>
      <scheme-name>examples-remote</scheme-name>
      <service-name>ExtendTcpCacheService</service-name>
      <initiator-config>
        <tcp-initiator>
          <remote-addresses>
            <socket-address>
              <address system-property="tangosol.coherence.proxy.
address">localhost</address>
              <port system-property="tangosol.coherence.proxy.port">9099</port>
            </socket-address>
          </remote-addresses>
        </tcp-initiator>
      </initiator-config>
    </remote-cache-scheme>

    <remote-invocation-scheme>
      <scheme-name>remote-invocation-scheme</scheme-name>
      <service-name>ExtendTcpInvocationService</service-name>
      <initiator-config>
        <tcp-initiator>
          <remote-addresses>
            <socket-address>
              <address system-property="tangosol.coherence.proxy.
address">localhost</address>
              <port system-property="tangosol.coherence.proxy.port">9099</port>
            </socket-address>
          </remote-addresses>
          <connect-timeout>2s</connect-timeout>
        </tcp-initiator>
        <outgoing-message-handler>
          <request-timeout>5s</request-timeout>
        </outgoing-message-handler>
      </initiator-config>
    </remote-invocation-scheme>
  </caching-schemes>
</cache-config>
```

Create a Cache Configuration File for the Extend Proxy

To create a cache configuration file for the extend proxy service:

1. Open the `coherence-cache-config.xml` file from the Project explorer window. You can find the file under `Security/appClientModule`.
2. Save the file as `examples-cache-config.xml`.
3. Configure the extend proxy cache configuration file. The following list highlights some key elements:
   - Use the `cache-name` element to define `security` as the name of the cache. Note that there must be a cache defined in the extend client cache configuration that is also named `security`.

- Use the `address` and `port` elements in the `acceptor-config` stanza to identify the extend proxy service that is listening on the `localhost` address at port `9099`
- Use the `autostart` element with the `tangosol.coherence.extend.enabled` system property to prevent the cache server from running a proxy service.
- Use `defaults` and `serializer` with a value of `pof` to call the serializer for the custom POF configuration file (which you will create later in this chapter)

Example 10–7 illustrates a possible implementation for the `examples-cache-config.xml` file.

Example 10–7 Sample Cache Configuration File for the Proxy Server

```
<?xml version="1.0"?>

<cache-config xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
              xmlns="http://xmlns.oracle.com/coherence/coherence-cache-config"
              xsi:schemaLocation="http://xmlns.oracle.com/coherence/coherence-
cache-config coherence-cache-config.xsd">
  <defaults>
    <serializer>pof</serializer>
  </defaults>

  <caching-scheme-mapping>
    <cache-mapping>
      <cache-name>security</cache-name>
      <scheme-name>ExamplesPartitionedPofScheme</scheme-name>
    </cache-mapping>
  </caching-scheme-mapping>

  <caching-schemes>
    <distributed-scheme>
      <scheme-name>ExamplesPartitionedPofScheme</scheme-name>
      <service-name>PartitionedPofCache</service-name>
      <backing-map-scheme>
        <local-scheme>
          <!-- each node will be limited to 32MB -->
          <high-units>32M</high-units>
          <unit-calculator>binary</unit-calculator>
        </local-scheme>
      </backing-map-scheme>
      <autostart>true</autostart>
    </distributed-scheme>

    <!--
    Proxy Service scheme that allows remote clients to connect to the
    cluster over TCP/IP.
    -->
    <proxy-scheme>
      <scheme-name>secure-proxy</scheme-name>
      <service-name>ProxyService</service-name>

      <thread-count system-property="tangosol.coherence.extend.threads">2</thread-
count>

      <acceptor-config>
        <tcp-acceptor>
          <local-address>
```

```
            <address system-property="tangosol.coherence.extend.
address">localhost</address>
            <port system-property="tangosol.coherence.extend.port">9099</port>
          </local-address>
        </tcp-acceptor>
      </acceptor-config>

       <autostart system-property="tangosol.coherence.extend.
enabled">false</autostart>
    </proxy-scheme>
  </caching-schemes>
</cache-config>
```

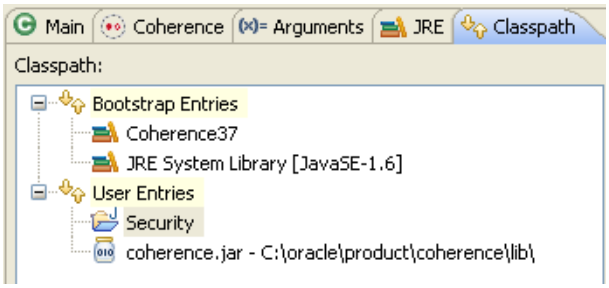
Create a Start-Up Configuration for a Cache Server

Create a start-up configuration for a cache server cluster node. The configuration must include the system properties to designate a proxy service and the cluster-side cache configuration file. You must also include the application class files and the XML configuration files on the class path.

To create a start-up file for a cache server:

1. Create a start-up configuration in Eclipse. Right-click the `Security` project and select **Run As** then **Run Configurations**. In the Name field, enter `SecurityCacheServer`.
2. In the **Main** tab, click **Browse** in the **Project** field to select the **Security** project. Select the **Include system libraries when searching for a main class** and click the **Search** button in the **Main class** field. Enter `DefaultCacheServer` in the **Select type** field of the **Select Main Type** dialog box. Select **DefaultCacheServer - com.tangosol.net** and click **OK**. Click **Apply**.
3. In the **Coherence** tab, enter the name and absolute path to the cluster-side cache configuration file (in this case, `C:\home\oracle\workspace\Security\appClientModule\examples-cache-config.xml`). Select **Enabled (cache server)** in the **Local storage** field. Enter a unique value (such as `3155`) in the **Cluster port** field. Click **Apply**.
4. In the **Classpath** tab, click **User Entries** then **Add External JARs** to add the **coherence.jar** file to the list. Click **Apply**. The **Classpath** tab should look similar to Figure 10–1.

Figure 10–1 Class Path for the Security Cache Server



Note: Ensure that the XML configuration files (in the `C:\home\oracle\workspace\Security` and `Security\build\classes` folders) appear before the `coherence.jar` file on the class path. The classloader must encounter the custom POF configuration file (which must be named `pof-config.xml` and will be created later in this chapter) before it references the one in the `coherence.jar` file.

5. In the **Common** tab, click **Browse** in the **Shared file** field to select the **Security** project. Click **Apply**.

Create a Start-Up Configuration for a Cache Server with a Proxy Service

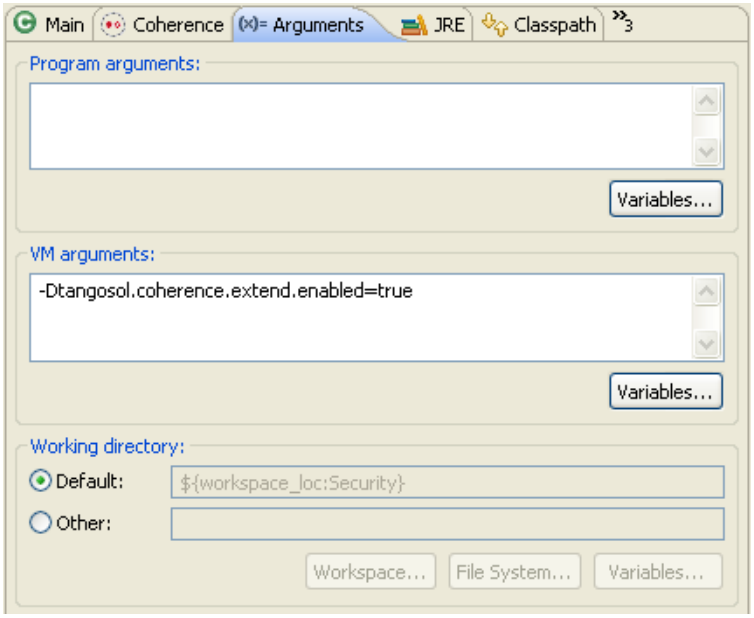
Create a configuration to start an extend proxy service on a cache server in the cluster. The extend client connects to this service. The configuration must include the system properties to designate a proxy service and the cluster-side cache configuration file. You must also include the application class files and the XML configuration files on the class path.

For these examples, the cache server with proxy service start-up configuration will have the same configuration as the cache server start-up configuration, but it will include the system property to enable the extend proxy.

To create a start-up file for a cache server with a proxy service:

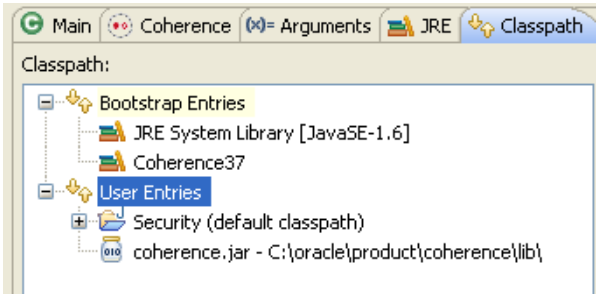
1. Create a start-up configuration in Eclipse. Right-click the `Security` project and select **Run As** then **Run Configurations**. In the Name field, enter `SecurityRunProxy`.
2. In the **Main** tab, click **Browse** in the **Project** field to select the **Security** project. Select the **Include system libraries when searching for a main class** and click the **Search** button in the **Main class** field. Enter `DefaultCacheServer` in the **Select type** field of the **Select Main Type** dialog box. Select **DefaultCacheServer - com.tangosol.net** and click **OK**. Click **Apply**.
3. In the **Coherence** tab, enter the name and absolute path to the cluster-side cache configuration file (in this case, `C:\home\oracle\workspace\Security\appClientModule\examples-cache-config.xml`). Select **Enabled (cache server)** in the **Local storage** field. Enter a unique value (such as `3155`) in the **Cluster port** field. Click **Apply**.
4. In the **Arguments** tab, enter the system property `-Dtangosol.coherence.extend.enabled=true` to designate a proxy service in the **VM arguments** field.

Figure 10–2 Arguments Tab for the Security Proxy Server



5. In the **Classpath** tab, click **User Entries** then **Add External JARs** to add the **coherence.jar** file to the list. Click **Apply**. The **Classpath** tab should look similar to Figure 10–3.

Figure 10–3 Class Path for the Proxy Server



Note: Ensure that the XML configuration files (in the `C:\home\oracle\workspace\Security` and `Security\build\classes` folders) appear before the `coherence.jar` file on the class path. The classloader must encounter the custom POF configuration file (which must be named `pof-config.xml` and will be created later in this chapter) before it references the one in the `coherence.jar` file.

---

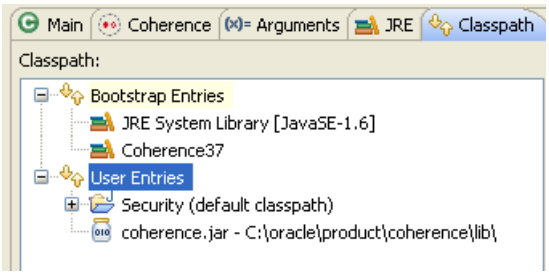
6. In the **Common** tab, click **Browse** in the **Shared file** field to select the **Security** project. Click **Apply**.

Run the Password Example

Run the password example to generate and validate the token, and pass it to the proxy service.

1. Create a run configuration for the `PasswordExample.java` file.
   a. Right click `PasswordExample.java` in the **Project Explorer**, and select **Run As** then **Run Configurations**.
   b. Click the **New launch configuration** icon. Ensure that `PasswordExample` appears in the **Name** field, `Security` appears in the **Project** field, and `com.oracle.handson.PasswordExample` appears in the **Main class** field. Click **Apply**.
   c. In the **Coherence** tab, enter the path to the client cache configuration file, `C:\home\oracle\workspace\Security\appClientModule\client-cache-config.xml` in the **Cache configuration descriptor** field. Select **Disabled (cache client)** in the **Local cache** field. Enter a unique value, such as `3155`, in the **Cluster port** field.
   d. In the **Classpath** tab, click **Add External JARs** to add the `coherence.jar` file to **User Entries**. Use the **Up** and **Down** buttons to move the **Security** folder to the top of **User Entries**. When you are finished, the **Classpath** tab should look similar to Figure 10–4.

Figure 10–4 Classpath Tab for the PasswordExample Program



2. Stop any running cache servers. See "Stopping Cache Servers" on page 2-13 for more information.
3. Run the security proxy server, the security cache server then the `PasswordExample.java` program.
   a. Right click the project and select **Run As** then **Run Configurations**. Run the `SecurityRunProxy` configuration from the **Run Configurations** dialog box.
   b. Right click the project and select **Run As** then **Run Configurations**. Run the `SecurityCacheServer` configuration from the **Run Configurations** dialog box.
   c. Right click the `PasswordExample.java` file in the **Project Explorer** and select **Run As** then **Run Configurations**. Select **PasswordExample** in the **Run Configurations** dialog box and click **Run**.

The output of the `PasswordExample` program should be similar to Example 10–8 in the Eclipse console. It indicates the start of the password example, the opening of the socket to the proxy server, and the completion of the example.

Example 10–8 Password Example Output in the Eclipse Console

```
------password example begins------
2011-03-15 11:37:48.484/0.296 Oracle Coherence 3.7.0.0 <Info> (thread=main, member=n/a): Loaded
operational configuration from "jar:file:/C:/oracle/product/coherence/lib/coherence.jar!/tangosol-
coherence.xml"
```

```
2011-03-15 11:37:48.531/0.343 Oracle Coherence 3.7.0.0 <Info> (thread=main, member=n/a): Loaded
operational overrides from "jar:file:/C:/oracle/product/coherence/lib/coherence.jar!/tangosol-
coherence-override-dev.xml"
2011-03-15 11:37:48.547/0.359 Oracle Coherence 3.7.0.0 <Info> (thread=main, member=n/a): Loaded
operational overrides from "file:/C:/home/oracle/workspace/Security/build/classes/tangosol-
coherence-override.xml"
2011-03-15 11:37:48.547/0.359 Oracle Coherence 3.7.0.0 <D5> (thread=main, member=n/a): Optional
configuration override "/custom-mbeans.xml" is not specified

Oracle Coherence Version 3.7.0.0 Build 22913
 Grid Edition: Development mode
Copyright (c) 2000, 2010, Oracle and/or its affiliates. All rights reserved.

2011-03-15 11:37:48.719/0.531 Oracle Coherence GE 3.7.0.0 <Info> (thread=main, member=n/a): Loaded
cache configuration from "file:/C:/home/oracle/workspace/Security/appClientModule/client-cache-
config.xml"
2011-03-15 11:37:48.844/0.656 Oracle Coherence GE 3.7.0.0 <Info>
(thread=ExtendTcpCacheService:TcpInitiator, member=n/a): Loaded POF configuration from
"jar:file:/C:/oracle/product/coherence/lib/coherence.jar!/pof-config.xml"
2011-03-15 11:37:48.875/0.687 Oracle Coherence GE 3.7.0.0  <Info>
(thread=ExtendTcpCacheService:TcpInitiator, member=n/a): Loaded included POF configuration from
"jar:file:/C:/oracle/product/coherence/lib/coherence.jar!/coherence-pof-config.xml"
2011-03-15 11:37:48.922/0.734 Oracle Coherence GE 3.7.0.0 <D5>
(thread=ExtendTcpCacheService:TcpInitiator, member=n/a): Started:
TcpInitiator{Name=ExtendTcpCacheService:TcpInitiator, State=(SERVICE_STARTED), ThreadCount=0,
Codec=Codec(Format=POF), Serializer=com.tangosol.io.pof.ConfigurablePofContext, PingInterval=0,
PingTimeout=30000, RequestTimeout=30000, ConnectTimeout=30000, SocketProvider=SystemSocketProvider,
RemoteAddresses=[/130.35.99.213:9099], SocketOptions{LingerTimeout=0, KeepAliveEnabled=true,
TcpDelayEnabled=false}}
2011-03-15 11:37:48.922/0.734 Oracle Coherence GE 3.7.0.0 <D5> (thread=main, member=n/a):
Connecting Socket to 130.35.99.213:9099
2011-03-15 11:37:48.938/0.750 Oracle Coherence GE 3.7.0.0 <Info> (thread=main, member=n/a):
Connected Socket to 130.35.99.213:9099
------password example succeeded------
------password example completed------
```

The response in the proxy server shell should be similar to Example 10–9. It lists the `CN` and `OU` values from the distinguished name and whether the password was validated.

Example 10–9 Response from the Cache Server Running the Proxy Service Shell

```
...
Started DefaultCacheServer...

2011-03-15 11:37:33.797/21.250 Oracle Coherence GE 3.7.0.0 <D5> (thread=Cluster, member=1):
Member(Id=2, Timestamp=2011-03-15 11:37:33.649, Address=130.35.99.213:8090, MachineId=49877,
Location=site:URL, machine_name,process:4160, Role=CoherenceServer) joined Cluster with senior
member 1
2011-03-15 11:37:33.844/21.297 Oracle Coherence GE 3.7.0.0 <D5> (thread=Cluster, member=1): Member
2 joined Service Management with senior member 1
2011-03-15 11:37:34.313/21.766 Oracle Coherence GE 3.7.0.0 <D5> (thread=Cluster, member=1): Member
2 joined Service PartitionedPofCache with senior member 1
2011-03-15 11:37:34.344/21.797 Oracle Coherence GE 3.7.0.0 <D5>
(thread=DistributedCache:PartitionedPofCache, member=1): 3> Transferring primary PartitionSet{0, 1,
2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28,
29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53,
54, 55, 56, 57, 58, 59, 60, 61, 62, 63, 64, 65, 66, 67, 68, 69, 70, 71, 72, 73, 74, 75, 76, 77, 78,
79, 80, 81, 82, 83, 84, 85, 86, 87, 88, 89, 90, 91, 92, 93, 94, 95, 96, 97, 98, 99, 100, 101, 102,
103, 104, 105, 106, 107, 108, 109, 110, 111, 112, 113, 114, 115, 116, 117, 118, 119, 120, 121, 122,
123, 124, 125, 126, 127} to member 2 requesting 128
```

```
2011-03-15 11:37:34.375/21.828 Oracle Coherence GE 3.7.0.0 <D4>
(thread=DistributedCache:PartitionedPofCache, member=1): 1> Transferring 129 out of 129 partitions
to a node-safe backup 1 at member 2 (under 129)
2011-03-15 11:37:34.406/21.859 Oracle Coherence GE 3.7.0.0 <D5>
(thread=DistributedCache:PartitionedPofCache, member=1): Transferring 0KB of backup[1] for
PartitionSet{128, 129, 130, 131, 132, 133, 134, 135, 136, 137, 138, 139, 140, 141, 142, 143, 144,
145, 146, 147, 148, 149, 150, 151, 152, 153, 154, 155, 156, 157, 158, 159, 160, 161, 162, 163, 164,
165, 166, 167, 168, 169, 170, 171, 172, 173, 174, 175, 176, 177, 178, 179, 180, 181, 182, 183, 184,
185, 186, 187, 188, 189, 190, 191, 192, 193, 194, 195, 196, 197, 198, 199, 200, 201, 202, 203, 204,
205, 206, 207, 208, 209, 210, 211, 212, 213, 214, 215, 216, 217, 218, 219, 220, 221, 222, 223, 224,
225, 226, 227, 228, 229, 230, 231, 232, 233, 234, 235, 236, 237, 238, 239, 240, 241, 242, 243, 244,
245, 246, 247, 248, 249, 250, 251, 252, 253, 254, 255, 256} to member 2
Password validated for user: CN=BuckarooBanzai,OU=Yoyodyne
Password validated for user: CN=BuckarooBanzai,OU=Yoyodyne
Password validated for user: CN=BuckarooBanzai,OU=Yoyodyne
```

Including Role-Based Access Control to the Cluster

This section describes how to create an example that uses role-based policies to access the cluster. The code logs in to get a subject with a user ID assigned to a particular role. It gets a cache reference running in the context of the subject and then attempt various cache operations. Depending on the role granted to the user, the cache operation is allowed or denied. Note that the role mapping and role-based authorization in the example is simplified and not intended for real security use.

For example, a user with a writer role can use the `put` and `get` methods. A user with a reader role can use the `get` method, but not the `put` method. A user with a writer role cannot destroy a cache; however, a user with an admin role can.

Note that when the cache reference is created in the context of a subject that identity is permanently associated with that reference. Any use of that cache reference is on behalf of that identity.

The example will use the `PasswordIdentityTransformer` and `PasswordIdentityAsserter` classes that you created in the previous section. The `PasswordIdentityTransformer` class generates a security token that contains the password, the user ID, and the roles. The `PasswordIdentityAsserter` class (running in the proxy) validates the security token to enforce the password and construct a subject with the proper user ID and roles. The production and assertion of the security token happens automatically.

To create the example:

1. Define Which User Roles Are Entitled to Access Cache Methods
2. Apply the Entitlements to the Cache Service
3. Create the Access Control Example Program
4. Edit the Cluster-Side Cache Configuration File
5. Run the Access Control Example

Define Which User Roles Are Entitled to Access Cache Methods

Create a Java file that enables access to cache methods on the basis of a user's role. To do this, you can apply access permissions to a wrapped `NamedCache` using the `Subject` object passed from the client by using Coherence*Extend. The implementation allows only clients with a specified role to access the wrapped `NamedCache`.

The class that you create in this section extends the `com.tangosol.net.cache.WrapperNamedCache` class. This class is a convenience function that enables you to secure the methods on the `NamedCache` interface.

To determine which user role can access a cache method, include a call to the `SecurityExampleHelper.checkAccess` method in each cache method's implementation. As the argument to `checkAccess`, provide the user role that is permitted to access the method. Close the implementation with a call to `super`.

For example, the following code indicates that users with the `admin` role can destroy the cache.

```
public void destroy()
    {
    SecurityExampleHelper.checkAccess(SecurityExampleHelper.ROLE_ADMIN);
    super.destroy();
    }
```

In this example, users with the `reader` role can call the `aggregate` method.

```
public Object aggregate(Filter filter, EntryAggregator agent)
    {
    SecurityExampleHelper.checkAccess(SecurityExampleHelper.ROLE_READER);
    return super.aggregate(filter, agent);
    }
```

To create a file that determines which user role can call cache methods:

1. Create a new Java class named `EntitledNamedCache` in the Security project.

   See "Creating a Java Class" on page 2-11 if you need detailed information.

2. Ensure that the class imports and extends `WrapperNamedCache`.

3. Import the `Filter`, `MapListener`, `ValueExtractor`, `Collection`, `Comparator`, `Map`, and `Set` classes. The methods in `WrapperNamedCache` (and by extension, `EntitledNamedCache`) use arguments with these types.

4. Implement the methods in `EntitledNamedCache` such that only a user with a specific role can call the method.

Example 10–10 illustrates a possible implementation of `EntitledNamedCache`.

Example 10–10 Entitled Named Cache

```
package com.oracle.handson;

import com.tangosol.net.NamedCache;
import com.tangosol.net.security.SecurityHelper;

import com.tangosol.net.cache.WrapperNamedCache;

import com.tangosol.util.Filter;
import com.tangosol.util.MapEvent;
import com.tangosol.util.MapListener;
import com.tangosol.util.ValueExtractor;

import java.util.Collection;
import java.util.Comparator;
import java.util.Map;
import java.util.Set;

import javax.security.auth.Subject;
```

```
/**
* Example WrapperNamedCache that demonstrates how entitlements can be applied
* to a wrapped NamedCache using the Subject passed from the client through
* Coherence*Extend. This implementation only allows clients with a specified
* role to access the wrapped NamedCache.
*
*/
public class EntitledNamedCache
        extends WrapperNamedCache
    {
    /**
    * Create a new EntitledNamedCache.
    *
    * @param cache  the wrapped NamedCache
    */
    public EntitledNamedCache(NamedCache cache)
        {
        super(cache, cache.getCacheName());
        }


    // ----- NamedCache interface ---------------------------------------------

    /**
    * {@inheritDoc}
    */
    public void release()
        {
        SecurityExampleHelper.checkAccess(SecurityExampleHelper.ROLE_READER);
        super.release();
        }

    /**
    * {@inheritDoc}
    */
    public void destroy()
        {
        SecurityExampleHelper.checkAccess(SecurityExampleHelper.ROLE_ADMIN);
        super.destroy();
        }

    /**
    * {@inheritDoc}
    */
    public Object put(Object oKey, Object oValue, long cMillis)
        {
        SecurityExampleHelper.checkAccess(SecurityExampleHelper.ROLE_WRITER);
        return super.put(oKey, oValue, cMillis);
        }

    /**
    * {@inheritDoc}
    */
    public void addMapListener(MapListener listener)
        {
        SecurityExampleHelper.checkAccess(SecurityExampleHelper.ROLE_READER);
        super.addMapListener(new EntitledMapListener(listener));
        }
```

```
/**
* {@inheritDoc}
*/
public void removeMapListener(MapListener listener)
    {
    SecurityExampleHelper.checkAccess(SecurityExampleHelper.ROLE_WRITER);
    super.removeMapListener(listener);
    }

/**
* {@inheritDoc}
*/
public void addMapListener(MapListener listener, Object oKey, boolean fLite)
    {
    SecurityExampleHelper.checkAccess(SecurityExampleHelper.ROLE_READER);
    super.addMapListener(new EntitledMapListener(listener), oKey, fLite);
    }

/**
* {@inheritDoc}
*/
public void removeMapListener(MapListener listener, Object oKey)
    {
    SecurityExampleHelper.checkAccess(SecurityExampleHelper.ROLE_WRITER);
    super.removeMapListener(listener, oKey);
    }

/**
* {@inheritDoc}
*/
public void addMapListener(MapListener listener, Filter filter, boolean fLite)
    {
    SecurityExampleHelper.checkAccess(SecurityExampleHelper.ROLE_READER);
    super.addMapListener(new EntitledMapListener(listener), filter, fLite);
    }

/**
* {@inheritDoc}
*/
public void removeMapListener(MapListener listener, Filter filter)
    {
    SecurityExampleHelper.checkAccess(SecurityExampleHelper.ROLE_WRITER);
    super.removeMapListener(listener, filter);
    }

/**
* {@inheritDoc}
*/
public int size()
    {
    SecurityExampleHelper.checkAccess(SecurityExampleHelper.ROLE_READER);
    return super.size();
    }

/**
* {@inheritDoc}
*/
public void clear()
    {
```

```
    SecurityExampleHelper.checkAccess(SecurityExampleHelper.ROLE_WRITER);
    super.clear();
    }

/**
* {@inheritDoc}
*/
public boolean isEmpty()
    {
    SecurityExampleHelper.checkAccess(SecurityExampleHelper.ROLE_READER);
    return super.isEmpty();
    }

/**
* {@inheritDoc}
*/
public boolean containsKey(Object oKey)
    {
    SecurityExampleHelper.checkAccess(SecurityExampleHelper.ROLE_READER);
    return super.containsKey(oKey);
    }

/**
* {@inheritDoc}
*/
public boolean containsValue(Object oValue)
    {
    SecurityExampleHelper.checkAccess(SecurityExampleHelper.ROLE_READER);
    return super.containsValue(oValue);
    }

/**
* {@inheritDoc}
*/
public Collection values()
    {
    SecurityExampleHelper.checkAccess(SecurityExampleHelper.ROLE_READER);
    return super.values();
    }

/**
* {@inheritDoc}
*/
public void putAll(Map map)
    {
    SecurityExampleHelper.checkAccess(SecurityExampleHelper.ROLE_WRITER);
    super.putAll(map);
    }

/**
* {@inheritDoc}
*/
public Set entrySet()
    {
    SecurityExampleHelper.checkAccess(SecurityExampleHelper.ROLE_READER);
    return super.entrySet();
    }

/**
* {@inheritDoc}
```

```
*/
public Set keySet()
    {
    SecurityExampleHelper.checkAccess(SecurityExampleHelper.ROLE_READER);
    return super.keySet();
    }

/**
* {@inheritDoc}
*/
public Object get(Object oKey)
    {
    SecurityExampleHelper.checkAccess(SecurityExampleHelper.ROLE_READER);
    return super.get(oKey);
    }

/**
* {@inheritDoc}
*/
public Object remove(Object oKey)
    {
    SecurityExampleHelper.checkAccess(SecurityExampleHelper.ROLE_WRITER);
    return super.remove(oKey);
    }

/**
* {@inheritDoc}
*/
public Object put(Object oKey, Object oValue)
    {
    SecurityExampleHelper.checkAccess(SecurityExampleHelper.ROLE_WRITER);
    return super.put(oKey, oValue);
    }

/**
* {@inheritDoc}
*/
public Map getAll(Collection colKeys)
    {
    SecurityExampleHelper.checkAccess(SecurityExampleHelper.ROLE_READER);
    return super.getAll(colKeys);
    }

/**
* {@inheritDoc}
*/
public boolean lock(Object oKey, long cWait)
    {
    SecurityExampleHelper.checkAccess(SecurityExampleHelper.ROLE_WRITER);
    return super.lock(oKey, cWait);
    }

/**
* {@inheritDoc}
*/
public boolean lock(Object oKey)
    {
    SecurityExampleHelper.checkAccess(SecurityExampleHelper.ROLE_WRITER);
    return super.lock(oKey);
    }
```

```
    /**
    * {@inheritDoc}
    */
    public boolean unlock(Object oKey)
        {
        SecurityExampleHelper.checkAccess(SecurityExampleHelper.ROLE_WRITER);
        return super.unlock(oKey);
        }

    /**
    * {@inheritDoc}
    */
    public Set keySet(Filter filter)
        {
        SecurityExampleHelper.checkAccess(SecurityExampleHelper.ROLE_READER);
        return super.keySet(filter);
        }

    /**
    * {@inheritDoc}
    */
    public Set entrySet(Filter filter)
        {
        SecurityExampleHelper.checkAccess(SecurityExampleHelper.ROLE_READER);
        return super.entrySet(filter);
        }

    /**
    * {@inheritDoc}
    */
    public Set entrySet(Filter filter, Comparator comparator)
        {
        SecurityExampleHelper.checkAccess(SecurityExampleHelper.ROLE_READER);
        return super.entrySet(filter, comparator);
        }

    /**
    * {@inheritDoc}
    */
    public void addIndex(ValueExtractor extractor, boolean fOrdered, Comparator
comparator)
        {
        SecurityExampleHelper.checkAccess(SecurityExampleHelper.ROLE_WRITER);
        super.addIndex(extractor, fOrdered, comparator);
        }

    /**
    * {@inheritDoc}
    */
    public void removeIndex(ValueExtractor extractor)
        {
        SecurityExampleHelper.checkAccess(SecurityExampleHelper.ROLE_WRITER);
        super.removeIndex(extractor);
        }

    /**
    * {@inheritDoc}
    */
    public Object invoke(Object oKey, EntryProcessor agent)
```

```
    {
    SecurityExampleHelper.checkAccess(SecurityExampleHelper.ROLE_WRITER);
    return super.invoke(oKey, agent);
    }

/**
* {@inheritDoc}
*/
public Map invokeAll(Collection collKeys, EntryProcessor agent)
    {
    SecurityExampleHelper.checkAccess(SecurityExampleHelper.ROLE_WRITER);
    return super.invokeAll(collKeys, agent);
    }

/**
* {@inheritDoc}
*/
public Map invokeAll(Filter filter, EntryProcessor agent)
    {
    SecurityExampleHelper.checkAccess(SecurityExampleHelper.ROLE_WRITER);
    return super.invokeAll(filter, agent);
    }

/**
* {@inheritDoc}
*/
public Object aggregate(Collection collKeys, EntryAggregator agent)
    {
    SecurityExampleHelper.checkAccess(SecurityExampleHelper.ROLE_READER);
    return super.aggregate(collKeys, agent);
    }

/**
* {@inheritDoc}
*/
public Object aggregate(Filter filter, EntryAggregator agent)
    {
    SecurityExampleHelper.checkAccess(SecurityExampleHelper.ROLE_READER);
    return super.aggregate(filter, agent);
    }

// ----- inner class ------------------------------------------------------

/**
* Example MapListener that adds authorization to map events.
*/
public class EntitledMapListener
        implements MapListener
    {
    // ----- constructors -----------------------------------------------

    /**
    * Construct an EntitledMapListener with the current subject.
    * The subject will not be available in the security context
    * when events are received by the proxy at runtime.
    *
    * @param  listener  the MapListener
    */
    public EntitledMapListener(MapListener listener)
        {
```

```
    m_listener = listener;
    m_subject  = SecurityHelper.getCurrentSubject();
    }


// ----- MapListener interface --------------------------------

/**
* {@inheritDoc}
*/
public void entryInserted(MapEvent mapEvent)
    {
    try
        {
        SecurityExampleHelper.checkAccess(
            SecurityExampleHelper.ROLE_WRITER, m_subject);

        }
    catch (SecurityException e)
        {
        System.out.println("Access denied for entryInserted");
        return;
        }
    m_listener.entryInserted(mapEvent);
    }

/**
* {@inheritDoc}
*/
public void entryUpdated(MapEvent mapEvent)
    {
    try
        {
        SecurityExampleHelper.checkAccess(
            SecurityExampleHelper.ROLE_WRITER, m_subject);

        }
    catch (SecurityException e)
        {
        System.out.println("Access denied for entryUpdated");
        return;
        }
    m_listener.entryUpdated(mapEvent);
    }

/**
* {@inheritDoc}
*/
public void entryDeleted(MapEvent mapEvent)
    {
    try
        {
        SecurityExampleHelper.checkAccess(
            SecurityExampleHelper.ROLE_WRITER, m_subject);

        }
    catch (SecurityException e)
        {
        System.out.println("Access denied for entryDeleted");
        return;
```

```
            }
        m_listener.entryDeleted(mapEvent);
        }


    //  ----- data members ---------------------------------------

    /**
    * Subject from security context when the MapListener was registered
    */
    private Subject m_subject;

    /**
    * Registered listener
    */
    private MapListener m_listener;
    }

// ----- helper methods ------------------------------------------------

/**
* Return the wrapped NamedCache.
*
* @return  the wrapped CacheService
*/
public NamedCache getNamedCache()
    {
    return (NamedCache) getMap();
    }
}
```

Apply the Entitlements to the Cache Service

Create a file that demonstrates how access entitlements can be applied to a wrapped `CacheService` using the `Subject` passed from the client through Coherence*Extend. The implementation delegates access control for cache operations to the `EntitledNamedCache` you created in the previous section.

The class that you create extends the `com.tangosol.net.WrapperCacheService` class. This is a convenience function that allows you to secure the methods on the `CacheService`. It also provides a mechanism to delegate between the cache service on the proxy and the client request.

Implement the methods `ensureCache`, `releaseCache`, and `destroyCache` to ensure that only users with specific roles can use them. In the implementations, include a call to the `SecurityExampleHelper.checkAccess` method with a specific user role as its argument. For example, the following code ensures that only users with the role `admin` can destroy the cache.

```
public void destroyCache(NamedCache map)
    {
    if (map instanceof EntitledNamedCache)
        {
        EntitledNamedCache cache =  (EntitledNamedCache) map;
        SecurityExampleHelper.checkAccess(SecurityExampleHelper.ROLE_ADMIN);
        map = cache.getNamedCache();
        }
    super.destroyCache(map);
    }
```

To create a file that applies entitlements to access the cache service:

1. Create a new Java class named `EntitledCacheService` in the `Security` project.
2. Ensure that the class imports and extends the `WrapperCacheService` class.
3. Implement the `ensureCache`, `releaseCache`, and `destroyCache` methods to ensure that only users with specific roles can use them.

Example 10–11 illustrates a possible implementation of `EntitledCacheService`.

Example 10–11 Entitled Cache Service

```
package com.oracle.handson;

import com.tangosol.net.CacheService;
import com.tangosol.net.NamedCache;
import com.tangosol.net.WrapperCacheService;

/**
* Example WrapperCacheService that demonstrates how entitlements can be
* applied to a wrapped CacheService using the Subject passed from the
* client through Coherence*Extend. This implementation delegates access control
* for cache operations to the EntitledNamedCache.
*
*/
public class EntitledCacheService
        extends WrapperCacheService
    {
    /**
    * Create a new EntitledCacheService.
    *
    * @param service     the wrapped CacheService
    */
    public EntitledCacheService(CacheService service)
        {
        super(service);
        }


    // ----- CacheService interface -----------------------------------------

    /**
    * {@inheritDoc}
    */
    public NamedCache ensureCache(String sName, ClassLoader loader)
        {
        SecurityExampleHelper.checkAccess(SecurityExampleHelper.ROLE_READER);
        return new EntitledNamedCache(super.ensureCache(sName, loader));
        }

    /**
    * {@inheritDoc}
    */
    public void releaseCache(NamedCache map)
        {
        if (map instanceof EntitledNamedCache)
            {
            EntitledNamedCache cache =  (EntitledNamedCache) map;
            SecurityExampleHelper.checkAccess(SecurityExampleHelper.ROLE_READER);
            map = cache.getNamedCache();
```

```
            }
        super.releaseCache(map);
        }

    /**
    * {@inheritDoc}
    */
    public void destroyCache(NamedCache map)
        {
        if (map instanceof EntitledNamedCache)
            {
            EntitledNamedCache cache =  (EntitledNamedCache) map;
            SecurityExampleHelper.checkAccess(SecurityExampleHelper.ROLE_ADMIN);
            map = cache.getNamedCache();
            }
        super.destroyCache(map);
        }
    }
```

Create the Access Control Example Program

Create a file to run the access control example. The role policies are defined in the `SecurityExampleHelper` class. The `EntitledCacheService` and `EntitledNamedCache` classes enforce the policies.

The program should specify various users as arguments to the `SecurityHelperFile.login` method, and then attempt to perform cache read, write, and destroy operations. Based on the entitlement policies defined in the `EntitledCacheService` and `EntitledNamedCache` classes, the operations succeed or fail.

1. Create a new Java class with a `main` method in the `Security` project named `AccessControlExample`.

   See "Creating a Java Class" on page 2-11 for detailed information.

2. Implement the `main` method to access the cache.
3. Specify users defined in the `SecurityExampleHelper` file as arguments to its `login` method.
4. For each user, execute read (`get`), write (`put`), and `destroy` operations on the cache and provide success or failure messages in response.

Example 10–12 illustrates a possible implementation of the `AccessControlExample.java` class.

Example 10–12 Sample Program to Run the Access Control Example

```
package com.oracle.handson;

import com.tangosol.net.CacheFactory;
import com.tangosol.net.InvocationService;
import com.tangosol.net.NamedCache;

import com.tangosol.util.MapEvent;
import com.tangosol.util.MapListener;

import java.security.PrivilegedExceptionAction;

import javax.security.auth.Subject;
```

```
/**
* This class demonstrates simplified role based access control.
* <p>
* The role policies are defined in SecurityExampleHelper. Enforcmenent
* is done by EntitledCacheService and EntitledNamedCache.
*
*/
public class AccessControlExample
    {
    // ----- static methods ---------------------------------------------------

     public static void main (String[] args){
           accessCache();
            }
    /**
    * Demonstrate role based access to the cache.
    */
    public static void accessCache()
        {
        System.out.println("------cache access control example begins------");

        Subject subject = SecurityExampleHelper.login("JohnWhorfin");

        // Someone with writer role can write and read
        try
            {
            NamedCache cache = (NamedCache) Subject.doAs(
                    subject, new PrivilegedExceptionAction()
                {
                public Object run()
                        throws Exception
                    {
                    return CacheFactory.getCache(SecurityExampleHelper.SECURITY_
CACHE_NAME);
                    }
                });
            cache.put("myKey", "myValue");
            cache.get("myKey");
            System.out.println("    Success: read and write allowed");
            }
        catch (Exception e)
            {
            // get exception if not allowed to perform the operation
            e.printStackTrace();
            }

        // Someone with reader role can read but not write
        subject = SecurityExampleHelper.login("JohnBigboote");
        try
            {
            NamedCache cache = (NamedCache) Subject.doAs(
                    subject, new PrivilegedExceptionAction()
                {
                public Object run()
                        throws Exception
                    {
                    return CacheFactory.getCache(SecurityExampleHelper.SECURITY_
CACHE_NAME);
                    }
                });
```

```
                cache.get("myKey");
                System.out.println("    Success: read allowed");
                cache.put("anotherKey", "anotherValue");
                }
            catch (Exception e)
                {
                // get exception if not allowed to perform the operation
                System.out.println("    Success: Correctly cannot write");
                }

            // Someone with writer role cannot call destroy
            subject = SecurityExampleHelper.login("JohnWhorfin");
            try
                {
                NamedCache cache = (NamedCache) Subject.doAs(
                        subject, new PrivilegedExceptionAction()
                    {
                    public Object run()
                            throws Exception
                        {
                        return CacheFactory.getCache(SecurityExampleHelper.SECURITY_
CACHE_NAME);
                        }
                    });
                cache.destroy();
                }
            catch (Exception e)
                {
                // get exception if not allowed to perform the operation
                System.out.println("    Success: Correctly cannot " +
                        "destroy the cache");
                }

            // Someone with admin role can call destroy
            subject = SecurityExampleHelper.login("BuckarooBanzai");
            try
                {
                NamedCache cache = (NamedCache) Subject.doAs(
                        subject, new PrivilegedExceptionAction()
                    {
                    public Object run()
                            throws Exception
                        {
                        return CacheFactory.getCache(SecurityExampleHelper.SECURITY_
CACHE_NAME);
                        }
                    });
                cache.destroy();
                System.out.println("    Success: Correctly allowed to " +
                        "destroy the cache");
                }
            catch (Exception e)
                {
                // get exception if not allowed to perform the operation
                e.printStackTrace();
                }
            System.out.println("------cache access control example completed------");
            }
        }
```

Edit the Cluster-Side Cache Configuration File

Edit the cluster-side cache configuration file `examples-cache-config.xml`. Specify the full path of the class name of the cache service in the `cache-service-proxy` stanza under `proxy-config`. The `cache-service-proxy` stanza contains the configuration information for a cache service proxy managed by a proxy service.

In this case, the cache service class name is `com.oracle.handson.EntitledCacheService` proxy and the `param-type` is `com.tangosol.net.CacheService`.

Example 10–13 illustrates the XML code to add to the configuration.

Example 10–13 Cache Service Proxy Configuration for a Cluster-Side Cache Configuration

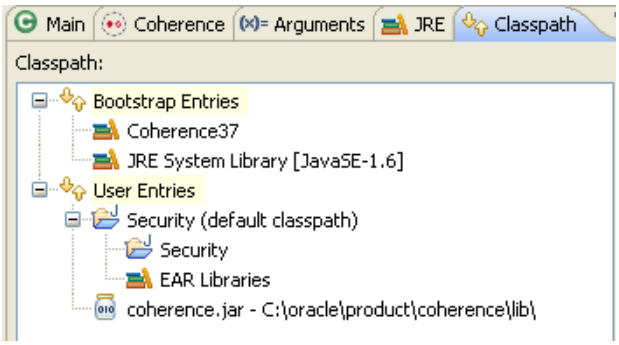
```
...
      <proxy-config>
        <cache-service-proxy>
          <class-name>com.oracle.handson.EntitledCacheService</class-name>
          <init-params>
            <init-param>
              <param-type>com.tangosol.net.CacheService</param-type>
              <param-value>{service}</param-value>
            </init-param>
          </init-params>
        </cache-service-proxy>
      </proxy-config>
...
```

Run the Access Control Example

Run the access control example to demonstrate how access to the cache can be granted or denied, based on a user's role.

1. Create a run configuration for the `AccessControlExample.java`.
   a. Right click `AccessControlExample` in the **Project Explorer**. Select **Run As** then **Run Configurations**.
   b. Click **Oracle Coherence** then **New launch configuration** icon. Ensure that `AccessControlExample` appears in the **Name** field, `Security` appears in the **Project** field, and `com.oracle.handson.AccessControlExample` appears in the **Main class** field. Click **Apply**.
   c. In the **Coherence** tab, enter the path to the `client-cache-config.xml` file in the **Cache configuration descriptor** field. Select **Disabled (cache client)** in the **Local storage** field.
   d. In the **Classpath** tab, click **Add External JARs** to add the `coherence.jar` file to **User Entries**. The **Classpath** tab should look similar to Figure 10–5. Click **Apply** then **Close**.

Figure 10–5 Classpath Tab for the AccessControlExample Program



2. Stop any running cache servers. See "Stopping Cache Servers" on page 2-13 for more information.
3. Run the security proxy server, the security cache server then the `AccessControlExample.java` program.
   a. Right click the project and select **Run As** then **Run Configurations**. Run the `SecurityRunProxy` configuration from the **Run Configurations** dialog box.
   b. Right click the project and select **Run As** then **Run Configurations**. Run the `SecurityCacheServer` configuration from the **Run Configurations** dialog box.
   c. Right click the `AccessControlExample.java` file in the **Project Explorer** and select **Run As** then **Run Configurations**. Run the `AccessControlExample` configuration from the **Run Configurations** dialog box.

The output is similar to Example 10–14 in the Eclipse console. The messages correspond to the various users specified in `AccessControlExample` executing read, write, and destroy operations on the cache.

- The `Success: read and write allowed` message corresponds to the user with role `writer` attempting to read from and write to the cache
- The `Success: read allowed` message corresponds to the user with role `reader` attempting to read from the cache
- The `Success: Correctly cannot write` message corresponds to the user with role `reader` attempting to write to the cache
- The `Success: Correctly cannot destroy the cache` message corresponds to the user with role `writer` attempting to destroy the cache
- The `Success: Correctly allowed to destroy the cache` message corresponds to the user with role `admin` attempting to destroy the cache

Example 10–14 Access Control Example Output in the Eclipse Console

```
------cache access control example begins------
2011-03-15 14:05:12.953/0.313 Oracle Coherence 3.7.0.0 <Info> (thread=main, member=n/a): Loaded
operational configuration from "jar:file:/C:/oracle/product/coherence/lib/coherence.jar!/tangosol-
coherence.xml"
2011-03-15 14:05:13.000/0.360 Oracle Coherence 3.7.0.0 <Info> (thread=main, member=n/a): Loaded
operational overrides from "jar:file:/C:/oracle/product/coherence/lib/coherence.jar!/tangosol-
coherence-override-dev.xml"
```

```
2011-03-15 14:05:13.000/0.360 Oracle Coherence 3.7.0.0 <Info> (thread=main, member=n/a): Loaded
operational overrides from "file:/C:/home/oracle/workspace/Security/appClientModule/tangosol-
coherence-override.xml"
2011-03-15 14:05:13.000/0.360 Oracle Coherence 3.7.0.0 <D5> (thread=main, member=n/a): Optional
configuration override "/custom-mbeans.xml" is not specified

Oracle Coherence Version 3.7.0.0 Build 22913
 Grid Edition: Development mode
Copyright (c) 2000, 2010, Oracle and/or its affiliates. All rights reserved.

2011-03-15 14:05:13.156/0.516 Oracle Coherence GE 3.7.0.0 <Info> (thread=main, member=n/a): Loaded
cache configuration from "file:/C:/home/oracle/workspace/Security/appClientModule/client-cache-
config.xml"
2011-03-15 14:05:13.281/0.641 Oracle Coherence GE 3.7.0.0 <Info>
(thread=ExtendTcpCacheService:TcpInitiator, member=n/a): Loaded POF configuration from
"jar:file:/C:/oracle/product/coherence/lib/coherence.jar!/pof-config.xml"
2011-03-15 14:05:13.312/0.672 Oracle Coherence GE 3.7.0.0 <Info>
(thread=ExtendTcpCacheService:TcpInitiator, member=n/a): Loaded included POF configuration from
"jar:file:/C:/oracle/product/coherence/lib/coherence.jar!/coherence-pof-config.xml"
2011-03-15 14:05:13.359/0.719 Oracle Coherence GE 3.7.0.0 <D5>
(thread=ExtendTcpCacheService:TcpInitiator, member=n/a): Started:
TcpInitiator{Name=ExtendTcpCacheService:TcpInitiator, State=(SERVICE_STARTED), ThreadCount=0,
Codec=Codec(Format=POF), Serializer=com.tangosol.io.pof.ConfigurablePofContext, PingInterval=0,
PingTimeout=30000, RequestTimeout=30000, ConnectTimeout=30000, SocketProvider=SystemSocketProvider,
RemoteAddresses=[/130.35.99.213:9099], SocketOptions{LingerTimeout=0, KeepAliveEnabled=true,
TcpDelayEnabled=false}}
2011-03-15 14:05:13.375/0.735 Oracle Coherence GE 3.7.0.0 <D5> (thread=main, member=n/a):
Connecting Socket to 130.35.99.213:9099
2011-03-15 14:05:13.375/0.735 Oracle Coherence GE 3.7.0.0 <Info> (thread=main, member=n/a):
Connected Socket to 130.35.99.213:9099
    Success: read and write allowed
2011-03-15 14:05:13.484/0.844 Oracle Coherence GE 3.7.0.0 <D5>
(thread=ExtendTcpCacheService:TcpInitiator, member=n/a): Started:
TcpInitiator{Name=ExtendTcpCacheService:TcpInitiator, State=(SERVICE_STARTED), ThreadCount=0,
Codec=Codec(Format=POF), Serializer=com.tangosol.io.pof.ConfigurablePofContext, PingInterval=0,
PingTimeout=30000, RequestTimeout=30000, ConnectTimeout=30000, SocketProvider=SystemSocketProvider,
RemoteAddresses=[/130.35.99.213:9099], SocketOptions{LingerTimeout=0, KeepAliveEnabled=true,
TcpDelayEnabled=false}}
2011-03-15 14:05:13.484/0.844 Oracle Coherence GE 3.7.0.0 <D5> (thread=main, member=n/a):
Connecting Socket to 130.35.99.213:9099
2011-03-15 14:05:13.484/0.844 Oracle Coherence GE 3.7.0.0 <Info> (thread=main, member=n/a):
Connected Socket to 130.35.99.213:9099
    Success: read allowed
    Success: Correctly cannot write
    Success: Correctly cannot destroy the cache
2011-03-15 14:05:13.546/0.906 Oracle Coherence GE 3.7.0.0 <D5>
(thread=ExtendTcpCacheService:TcpInitiator, member=n/a): Started:
TcpInitiator{Name=ExtendTcpCacheService:TcpInitiator, State=(SERVICE_STARTED), ThreadCount=0,
Codec=Codec(Format=POF), Serializer=com.tangosol.io.pof.ConfigurablePofContext, PingInterval=0,
PingTimeout=30000, RequestTimeout=30000, ConnectTimeout=30000, SocketProvider=SystemSocketProvider,
RemoteAddresses=[/130.35.99.213:9099], SocketOptions{LingerTimeout=0, KeepAliveEnabled=true,
TcpDelayEnabled=false}}
2011-03-15 14:05:13.546/0.906 Oracle Coherence GE 3.7.0.0 <D5> (thread=main, member=n/a):
Connecting Socket to 130.35.99.213:9099
2011-03-15 14:05:13.546/0.906 Oracle Coherence GE 3.7.0.0 <Info> (thread=main, member=n/a):
Connected Socket to 130.35.99.213:9099
    Success: Correctly allowed to destroy the cache
------cache access control example completed------
```

Example 10–15 lists the output in the shell where the cache server is running the proxy service. Notice that the security exceptions in the output correspond to the `Success: Correctly cannot write` and `Success: Correctly cannot destroy the cache` messages in the Eclipse console.

Example 10–15 Output for the Cache Server Running the Proxy Service

```
Started DefaultCacheServer...

2011-03-15 14:04:53.296/20.781 Oracle Coherence GE 3.7.0.0 <D5> (thread=Cluster, member=1):
Member(Id=2, Timestamp=2011-03-15 14:04:53.147, Address=130.35.99.213:8090, MachineId=49877,
Location=site:URL, machine_name,process:3456, Role=CoherenceServer) joined Cluster with senior
member 1
2011-03-15 14:04:53.359/20.844 Oracle Coherence GE 3.7.0.0 <D5> (thread=Cluster, member=1): Member
2 joined Service Management with senior member 1
2011-03-15 14:04:53.796/21.281 Oracle Coherence GE 3.7.0.0 <D5> (thread=Cluster, member=1): Member
2 joined Service PartitionedPofCache with senior member 1
2011-03-15 14:04:53.859/21.344 Oracle Coherence GE 3.7.0.0 <D5>
(thread=DistributedCache:PartitionedPofCache, member=1): 3> Transferring primary PartitionSet{0, 1,
2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28,
29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53,
54, 55, 56, 57, 58, 59, 60, 61, 62, 63, 64, 65, 66, 67, 68, 69, 70, 71, 72, 73, 74, 75, 76, 77, 78,
79, 80, 81, 82, 83, 84, 85, 86, 87, 88, 89, 90, 91, 92, 93, 94, 95, 96, 97, 98, 99, 100, 101, 102,
103, 104, 105, 106, 107, 108, 109, 110, 111, 112, 113, 114, 115, 116, 117, 118, 119, 120, 121, 122,
123, 124, 125, 126, 127} to member 2 requesting 128
2011-03-15 14:04:53.890/21.375 Oracle Coherence GE 3.7.0.0 <D4>
(thread=DistributedCache:PartitionedPofCache, member=1): 1> Transferring 129 out of 129 partitions
to a node-safe backup 1 at member 2 (under 129)
2011-03-15 14:04:53.906/21.391 Oracle Coherence GE 3.7.0.0 <D5>
(thread=DistributedCache:PartitionedPofCache, member=1): Transferring 0KB of backup[1] for
PartitionSet{128, 129, 130, 131, 132, 133, 134, 135, 136, 137, 138, 139, 140, 141, 142, 143, 144,
145, 146, 147, 148, 149, 150, 151, 152, 153, 154, 155, 156, 157, 158, 159, 160, 161, 162, 163, 164,
165, 166, 167, 168, 169, 170, 171, 172, 173, 174, 175, 176, 177, 178, 179, 180, 181, 182, 183, 184,
185, 186, 187, 188, 189, 190, 191, 192, 193, 194, 195, 196, 197, 198, 199, 200, 201, 202, 203, 204,
205, 206, 207, 208, 209, 210, 211, 212, 213, 214, 215, 216, 217, 218, 219, 220, 221, 222, 223, 224,
225, 226, 227, 228, 229, 230, 231, 232, 233, 234, 235, 236, 237, 238, 239, 240, 241, 242, 243, 244,
245, 246, 247, 248, 249, 250, 251, 252, 253, 254, 255, 256} to member 2
Password validated for user: role_writer
Password validated for user: role_writer
Password validated for user: role_writer
Password validated for user: role_reader
Password validated for user: role_reader
Password validated for user: role_reader
2011-03-15 14:05:13.500/40.985 Oracle Coherence GE 3.7.0.0 <D5>
(thread=Proxy:ProxyService:TcpAcceptorWorker:1, member=1): An exception occurred while processing a
PutRequest for Service=Proxy:ProxyService:TcpAcceptor: java.lang.SecurityException: Access denied,
insufficient privileges
   at com.oracle.handson.SecurityExampleHelper.checkAccess(SecurityExampleHelper.java:104)
   at com.oracle.handson.SecurityExampleHelper.checkAccess(SecurityExampleHelper.java:58)
   at com.oracle.handson.EntitledNamedCache.put(EntitledNamedCache.java:69)
   at com.tangosol.coherence.component.net.extend.proxy.NamedCacheProxy.put$Router(NamedCacheProxy.
CDB:1)
   at com.tangosol.coherence.component.net.extend.proxy.NamedCacheProxy.put(NamedCacheProxy.CDB:2)
   at com.tangosol.coherence.component.net.extend.messageFactory.NamedCacheFactory$PutRequest.
onRun(NamedCacheFactory.CDB:6)
   at com.tangosol.coherence.component.net.extend.message.Request.run(Request.CDB:4)
   at com.tangosol.coherence.component.net.extend.proxy.NamedCacheProxy.onMessage(NamedCacheProxy.
CDB:11)
   at com.tangosol.coherence.component.net.extend.Channel$MessageAction.run(Channel.CDB:13)
   at java.security.AccessController.doPrivileged(Native Method)
```

```
   at javax.security.auth.Subject.doAs(Subject.java:337)
   at com.tangosol.coherence.component.net.extend.Channel.execute(Channel.CDB:29)
   at com.tangosol.coherence.component.net.extend.Channel.receive(Channel.CDB:26)
   at com.tangosol.coherence.component.util.daemon.queueProcessor.service.
Peer$DaemonPool$WrapperTask.run(Peer.CDB:9)
   at com.tangosol.coherence.component.util.DaemonPool$WrapperTask.run(DaemonPool.CDB:32)
   at com.tangosol.coherence.component.util.DaemonPool$Daemon.onNotify(DaemonPool.CDB:63)
   at com.tangosol.coherence.component.util.Daemon.run(Daemon.CDB:42)
   at java.lang.Thread.run(Thread.java:619)

2011-03-15 14:05:13.515/41.000 Oracle Coherence GE 3.7.0.0 <D5>
(thread=Proxy:ProxyService:TcpAcceptorWorker:0, member=1): An exception occurred while processing a
DestroyCacheRequest for Service=Proxy:ProxyService:TcpAcceptor: java.lang.SecurityException: Access
denied, insufficient privileges
   at com.oracle.handson.SecurityExampleHelper.checkAccess(SecurityExampleHelper.java:104)
   at com.oracle.handson.SecurityExampleHelper.checkAccess(SecurityExampleHelper.java:58)
   at com.oracle.handson.EntitledCacheService.destroyCache(EntitledCacheService.java:63)
   at com.tangosol.coherence.component.net.extend.messageFactory.
CacheServiceFactory$DestroyCacheRequest.onRun(CacheServiceFactory.CDB:6)
   at com.tangosol.coherence.component.net.extend.message.Request.run(Request.CDB:4)
   at com.tangosol.coherence.component.net.extend.proxy.serviceProxy.CacheServiceProxy.
onMessage(CacheServiceProxy.CDB:9)
   at com.tangosol.coherence.component.net.extend.Channel$MessageAction.run(Channel.CDB:13)
   at java.security.AccessController.doPrivileged(Native Method)
   at javax.security.auth.Subject.doAs(Subject.java:337)
   at com.tangosol.coherence.component.net.extend.Channel.execute(Channel.CDB:29)
   at com.tangosol.coherence.component.net.extend.Channel.receive(Channel.CDB:26)
   at com.tangosol.coherence.component.util.daemon.queueProcessor.service.
Peer$DaemonPool$WrapperTask.run(Peer.CDB:9)
   at com.tangosol.coherence.component.util.DaemonPool$WrapperTask.run(DaemonPool.CDB:32)
   at com.tangosol.coherence.component.util.DaemonPool$Daemon.onNotify(DaemonPool.CDB:63)
   at com.tangosol.coherence.component.util.Daemon.run(Daemon.CDB:42)
   at java.lang.Thread.run(Thread.java:619)

Password validated for user: CN=BuckarooBanzai,OU=Yoyodyne
Password validated for user: CN=BuckarooBanzai,OU=Yoyodyne
Password validated for user: CN=BuckarooBanzai,OU=Yoyodyne
```

Including Role-Based Access Control to an Invocable Object

An invocation service cluster service enables extend clients to execute invocable objects on the cluster. This example demonstrates how you can use role-based policies to determine which users can run the invocable objects.

For example, a user with a writer role can run an invocable object. A user with a reader role cannot.

In this example, you create a simple invocable object that can be called from a client program. Since the invocable object will be serializable, you must also list it in a POF configuration file. You also create an invocation service program that tests whether a user can execute methods on the service based on the user's role.

As in the previous example, this example uses the `PasswordIdentityTransformer` class to generate a security token that contains the password, the user ID, and the roles. The `PasswordIdentityAsserter` (running in the proxy) will be used to validate the security token to enforce the password and construct a subject with the proper user ID and roles. The production and assertion of the security token happens automatically.

To create the example:

1. Create an Invocable Object
2. Create an Entitled Invocation Service
3. Create the Access Invocation Service Example Program
4. Edit the Cluster-Side Cache Configuration File
5. Create a POF Configuration File
6. Edit the Run Configurations for the Servers
7. Run the Access Invocation Service Example

Create an Invocable Object

Create an implementation of a simple invocable object that will be used by an entitled invocation service. For example, the invocable object can be written to increment and return an integer.

To create an invocable object:

1. Create a new Java class named `ExampleInvocable` in the `Security` project.

   See "Creating a Java Class" on page 2-11 for detailed information.

2. Import the `Invocable` and `InvocationService` interfaces. Because this class will be working with serializable objects, import the `PortableObject`, `PofReader` and `PofWriter` classes.
3. Ensure that the `ExampleInvocable` class implements `Invocable` and `PortableObject`.
4. Implement the `ExampleInvocable` class to increment an integer and return the result.
5. Implement the `PofReader.readExternal` and `PofWriter.writeExternal` methods.

Example 10–16 illustrates a possible implementation of `ExampleInvocable.java`.

Example 10–16 A Sample Invocable Object

```
package com.oracle.handson;


import com.tangosol.io.pof.PortableObject;
import com.tangosol.io.pof.PofReader;
import com.tangosol.io.pof.PofWriter;

import com.tangosol.net.Invocable;
import com.tangosol.net.InvocationService;

import java.io.IOException;


/**
 * Invocable implementation that increments and returns a given integer.
 */
public class ExampleInvocable
        implements Invocable, PortableObject
    {
    // ----- constructors ---------------------------------------------
```

```
/**
 * Default constructor.
 */
public ExampleInvocable()
    {
    }


// ----- Invocable interface --------------------------------------

/**
 * {@inheritDoc}
 */
public void init(InvocationService service)
    {
    m_service = service;
    }

/**
 * {@inheritDoc}
 */
public void run()
    {
    if (m_service != null)
        {
        m_nValue++;
        }
    }

/**
 * {@inheritDoc}
 */
public Object getResult()
    {
    return new Integer(m_nValue);
    }


// ----- PortableObject interface ---------------------------------

/**
 * {@inheritDoc}
 */
public void readExternal(PofReader in)
        throws IOException
    {
    m_nValue = in.readInt(0);
    }

/**
 * {@inheritDoc}
 */
public void writeExternal(PofWriter out)
        throws IOException
    {
    out.writeInt(0, m_nValue);
    }


// ----- data members ---------------------------------------------
```

```
/**
 * The integer value to increment.
 */
private int m_nValue;

/**
 * The InvocationService that is executing this Invocable.
 */
private transient InvocationService m_service;
}
```

Create an Entitled Invocation Service

This example shows how a remote invocation service can be wrapped to provide access control. Access entitlements can be applied to a wrapped `InvocationService` using the `Subject` passed from the client by using Coherence*Extend. This implementation enables only clients with a specified role to access the wrapped invocation service.

The class that you create should extend the `com.tangosol.net.WrapperInvocationService` class. This is a convenience function that enables you to secure the methods on `InvocationService`. It also provides a mechanism to delegate between the invocation service on the proxy and the client request.

To create an entitled invocation service:

1. Create a new Java class named `EntitledInvocationService` in the `Security` project.
2. Import the `Invocable`, `InvocationObserver`, `InvocationService`, `WrapperInvocationService`, `Map`, and `Set` interfaces. Ensure that the `EntitledInvocationService` class extends the `WrapperInvocationService` class.
3. Implement the `query` and `execute` methods. In the implementations, include a call to the `SecurityExampleHelper.checkAccess` method to determine whether a specified user role, in this case, `ROLE_WRITER`, can access these operations.

Example 10–17 illustrates a possible implementation of `EntitledInvocationService.java`.

Example 10–17 A Sample Entitled Invocation Service

```
package com.oracle.handson;


import com.tangosol.net.Invocable;
import com.tangosol.net.InvocationObserver;
import com.tangosol.net.InvocationService;
import com.tangosol.net.WrapperInvocationService;

import java.util.Map;
import java.util.Set;


/**
* Example WrapperInvocationService that demonstrates how entitlements can be
* applied to a wrapped InvocationService using the Subject passed from the
* client through Coherence*Extend. This implementation only allows clients with a
```

```
* specified role to access the wrapped InvocationService.
*
*/
public class EntitledInvocationService
        extends WrapperInvocationService
    {
    /**
    * Create a new EntitledInvocationService.
    *
    * @param service  the wrapped InvocationService
    */
    public EntitledInvocationService(InvocationService service)
        {
        super(service);
        }


    // ----- InvocationService interface ------------------------------------

    /**
    * {@inheritDoc}
    */
    public void execute(Invocable task, Set setMembers, InvocationObserver
observer)
        {
        SecurityExampleHelper.checkAccess(SecurityExampleHelper.ROLE_WRITER);
        super.execute(task, setMembers, observer);
        }

    /**
    * {@inheritDoc}
    */
    public Map query(Invocable task, Set setMembers)
        {
        SecurityExampleHelper.checkAccess(SecurityExampleHelper.ROLE_WRITER);
        return super.query(task, setMembers);
        }
    }
```

Create the Access Invocation Service Example Program

Create a program to run the access invocation service example. The objective of the program is to test whether various users defined in the `SecurityExampleHelper` class are able to access and run an invocable object. The enforcement of the role-based policies is provided by the `EntitledInvocationService` class.

To create a program to run the Access Invocation Service example:

1. Create a Java class with a `main` method in the `Security` project named `AccessInvocationServiceExample.java`.

   See "Creating a Java Class" on page 2-11 for detailed information.

2. Among other classes, import `ExampleInvocable`, `CacheFactory`, and `InvocationService`.

3. Implement the `main` method to invoke the `accessInvocationService` method.

4. Implement the `accessInvocationService` class so that various users defined in the `SecurityExampleHelper` class attempt to log in to the service and run

the object defined in `ExampleInvocable`. Use the `SecurityExampleHelper.login` method to test whether various users can access the invocable service.

Example 10–18 illustrates a possible implementation of `AccessInvocationServiceExample.java`.

Example 10–18 Sample Program to Run the Access Invocation Service Example

```
package com.oracle.handson;

import com.oracle.handson.ExampleInvocable;

import com.tangosol.net.CacheFactory;
import com.tangosol.net.InvocationService;

import java.security.PrivilegedExceptionAction;

import javax.security.auth.Subject;


/**
* This class demonstrates simplified role based access control for the
* invocation service.
* <p>
* The role policies are defined in SecurityExampleHelper. Enforcmenent
* is done by EntitledInvocationService.
*
*/
public class AccessInvocationServiceExample
    {
    /**
    * Invoke the example
    *
    * @param asArg  command line arguments (ignored in this example)
    */
    public static void main(String[] asArg)
        {
        accessInvocationService();
        }

    /**
    * Access the invocation service
    */
    public static void accessInvocationService()
        {
        System.out.println("------InvocationService access control example " +
                "begins------");

        // Someone with writer role can run invocables
        Subject subject = SecurityExampleHelper.login("JohnWhorfin");

        try
            {
            InvocationService service = (InvocationService) Subject.doAs(
                    subject, new PrivilegedExceptionAction()
                {
                public Object run()
                    {
                    return CacheFactory.getService(
                            SecurityExampleHelper.INVOCATION_SERVICE_NAME);
                    }
```

```
            });
         service.query(new ExampleInvocable(), null);
         System.out.println("    Success: Correctly allowed to " +
                "use the invocation service");
        }
    catch (Exception e)
        {
        // get exception if not allowed to perform the operation
        e.printStackTrace();
        }

    // Someone with reader role cannot cannot run invocables
    subject = SecurityExampleHelper.login("JohnBigboote");
    try
        {
        InvocationService service = (InvocationService) Subject.doAs(
                subject, new PrivilegedExceptionAction()
            {
            public Object run()
                {
                return CacheFactory.getService(
                        SecurityExampleHelper.INVOCATION_SERVICE_NAME);
                }
            });
        service.query(new ExampleInvocable(), null);
        }
    catch (Exception ee)
        {
        System.out.println("    Success: Correctly unable to " +
                "use the invocation service");
        }
    System.out.println("------InvocationService access control example " +
            "completed------");
    }
}
```

Edit the Cluster-Side Cache Configuration File

Edit the `examples-cache-config.xml` file to add the full path to the invocation service to the `invocation-service-proxy` stanza under the `proxy-config`. The `invocation-service-proxy` stanza contains the configuration information for an invocation service proxy managed by a proxy service.

In this case, the invocation service class name is `com.oracle.handson.EntitledInvocationService` and its `param-type` is `com.tangosol.net.InvocationService`.

Example 10–19 Invocation Service Proxy Configuration for a Cluster-Side Cache

```
...
   <proxy-config>
    ...
    <invocation-service-proxy>
      <class-name>com.oracle.handson.EntitledInvocationService</class-name>
      <init-params>
        <init-param>
          <param-type>com.tangosol.net.InvocationService</param-type>
          <param-value>{service}</param-value>
        </init-param>
      </init-params>
```

```
        </invocation-service-proxy>
      </proxy-config>
...
```

Create a POF Configuration File

Create a POF configuration file to declare `ExampleInvocable` as a user type.

1. Locate the `pof-config.xml` file under `Security\appClientModule` in the **Project Explorer** and open it in the Eclipse IDE.
2. Enter the code to declare `ExampleInvocable` as a user type and save the file.

   The contents of the file should look similar to Example 10–20. The file will be saved to the `C:\home\oracle\workspace\Security\appClientModule` folder.

Example 10–20 POF Configuration File with ExampleInvocable User Type

```
<?xml version="1.0"?>
<pof-config xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
              xmlns="http://xmlns.oracle.com/coherence/coherence-pof-config"
              xsi:schemaLocation="http://xmlns.oracle.com/coherence/coherence-pof-
config coherence-pof-config.xsd">
  <user-type-list>

    <!-- coherence POF user types -->
    <include>coherence-pof-config.xml</include>

    <!-- com.tangosol.examples package -->
    <user-type>
      <type-id>1007</type-id>
      <class-name>com.oracle.handson.ExampleInvocable</class-name>
    </user-type>

  </user-type-list>

  <allow-interfaces>true</allow-interfaces>
  <allow-subclasses>true</allow-subclasses>
</pof-config>
```

Edit the Run Configurations for the Servers

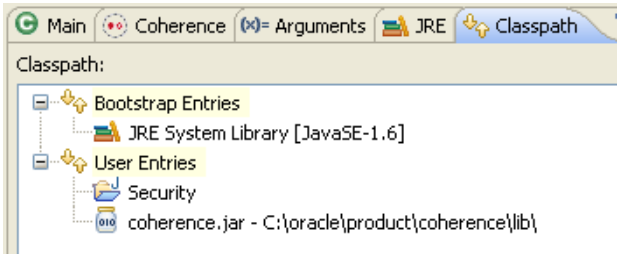
The classloader must encounter the custom POF configuration file (which must be named `pof-config.xml`) before it references the one in the `coherence.jar` file. If it does not, then the custom POF configuration file will be ignored and the default file in the `coherence.jar` file will be used instead.

To ensure that the XML configuration files in the `C:\home\oracle\workspace\Security\appModule` are used, delete the Coherence37 library from the **Bootstrap Entries** section of the servers' class path. Also, position the `coherence.jar` file after the Security folder in the **User Entries** section.

1. Right click the project in the **Project Explorer** and select **Run As** then **Run Configurations**.
2. Select **SecurityRunProxy**. In the **Classpath** tab, *remove* **Coherence37** from the list of **Bootstrap Entries**. Click **Apply**.
3. Select **SecurityCacheServer**. In the **Classpath** tab, *remove* **Coherence37** from the list of **Bootstrap Entries**. Click **Apply**.

When you are finished, the **Classpath** tab for `SecurityRunProxy` and `SecurityCacheServer` should look similar to Figure 10–6.

Figure 10–6 Class Path for the Cache Server and the Server Running the Proxy Service

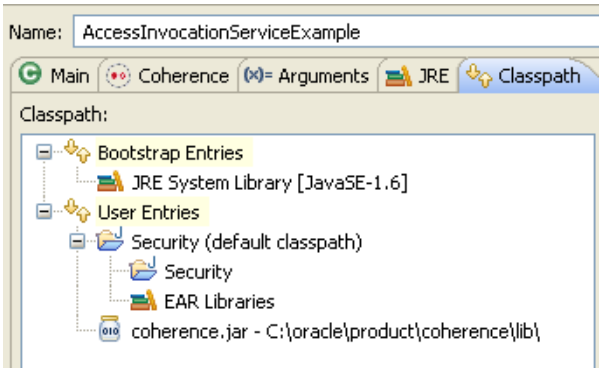


Run the Access Invocation Service Example

Run the access invocation service example to demonstrate how access to the invocable object can be granted or denied, based on a user's role.

1. Create a run configuration for the `AccessInvocationServiceExample.java` file.
   a. Right click `AccessInvocationServiceExample.java` in the **Project Explorer** and select **Run As** then **Run Configurations**.
   b. Click **Oracle Coherence**, then the **New launch configuration** icon. Ensure that `AccessInvocationServiceExample` appears in the **Name** field, `Security` appears in the **Project** field, and `com.oracle.handson.AccessInvocationServiceExample.java` appears in the **Main class** field. Click **Apply**.
   c. In the **Coherence** tab, enter the path to the `client-cache-config.xml` file in the **Cache configuration descriptor** field. Select **Disabled (cache client)** in the **Local storage** field.
   d. In the **Classpath** tab, *remove* **Coherence37** from the **Bootstrap Entries** list. Click **Add External JARs** to add the `coherence.jar` file to **User Entries**. Move the `Security` folder to the top of **User Entries** followed by the `coherence.jar` file. When you are finished, the **Classpath** tab should look similar to Figure 10–7. Click **Apply** then **Close**.

Figure 10–7 Classpath Tab for the AccessInvocationServiceExample Program



2. Stop any running cache servers. See "Stopping Cache Servers" on page 2-13 for more information.

3. Run the security proxy server, the security cache server then the `AccessInvocationServiceExample.java` program.

   a. Right click the project and select **Run As** then **Run Configurations**. Run the `SecurityRunProxy` configuration from the **Run Configurations** dialog box.

   b. Right click the project and select **Run As** then **Run Configurations**. Run the `SecurityCacheServer` configuration from the **Run Configurations** dialog box.

   c. Right click the `AccessInvocationServiceExample.java` file in the **Project Explorer** and select **Run As** then **Run Configurations**. Select `AccessControlExample` in the **Run Configurations** dialog box and click **Run**.

The output is similar to Example 10–21 in the Eclipse console. The messages correspond to the users specified in the `AccessInvocationServiceExample` class that are trying to run the invocable object `ExampleInvocable`.

- The message `Success: Correctly allowed to use the invocation service` corresponds to the user with role `writer` attempting to run `ExampleInvocable`.
- The message `Success: Correctly unable to use the invocation service` corresponds to the user with role `reader` attempting to run `ExampleInvocable`.

Example 10–21 Client Program Response in the Eclipse Console

```
------InvocationService access control example begins------
2011-03-15 17:54:40.468/0.453 Oracle Coherence 3.7.0.0 <Info> (thread=main, member=n/a): Loaded
operational configuration from "jar:file:/C:/oracle/product/coherence/lib/coherence.jar!/tangosol-
coherence.xml"
2011-03-15 17:54:40.515/0.500 Oracle Coherence 3.7.0.0 <Info> (thread=main, member=n/a): Loaded
operational overrides from "jar:file:/C:/oracle/product/coherence/lib/coherence.jar!/tangosol-
coherence-override-dev.xml"
2011-03-15 17:54:40.515/0.500 Oracle Coherence 3.7.0.0 <Info> (thread=main, member=n/a): Loaded
operational overrides from "file:/C:/home/oracle/workspace/Security/appClientModule/tangosol-
coherence-override.xml"
2011-03-15 17:54:40.515/0.500 Oracle Coherence 3.7.0.0 <D5> (thread=main, member=n/a): Optional
configuration override "/custom-mbeans.xml" is not specified

Oracle Coherence Version 3.7.0.0 Build 22913
 Grid Edition: Development mode
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2011-03-15 17:54:40.750/0.735 Oracle Coherence GE 3.7.0.0 <Info> (thread=main, member=n/a): Loaded
cache configuration from "file:/C:/home/oracle/workspace/Security/appClientModule/client-cache-
config.xml"
2011-03-15 17:54:40.968/0.953 Oracle Coherence GE 3.7.0.0 <Info>
(thread=ExtendTcpInvocationService:TcpInitiator, member=n/a): Loaded POF configuration from
"file:/C:/home/oracle/workspace/Security/appClientModule/pof-config.xml"
2011-03-15 17:54:40.984/0.969 Oracle Coherence GE 3.7.0.0 <Info>
(thread=ExtendTcpInvocationService:TcpInitiator, member=n/a): Loaded included POF configuration
from "jar:file:/C:/oracle/product/coherence/lib/coherence.jar!/coherence-pof-config.xml"
2011-03-15 17:54:41.062/1.047 Oracle Coherence GE 3.7.0.0 <D5>
(thread=ExtendTcpInvocationService:TcpInitiator, member=n/a): Started:
TcpInitiator{Name=ExtendTcpInvocationService:TcpInitiator, State=(SERVICE_STARTED), ThreadCount=0,
Codec=Codec(Format=POF), Serializer=com.tangosol.io.pof.ConfigurablePofContext, PingInterval=0,
PingTimeout=5000, RequestTimeout=5000, ConnectTimeout=2000, SocketProvider=SystemSocketProvider,
```

```
RemoteAddresses=[/130.35.99.213:9099], SocketOptions{LingerTimeout=0, KeepAliveEnabled=true,
TcpDelayEnabled=false}}
2011-03-15 17:54:41.078/1.063 Oracle Coherence GE 3.7.0.0 <D5> (thread=main, member=n/a):
Connecting Socket to 130.35.99.213:9099
2011-03-15 17:54:41.078/1.063 Oracle Coherence GE 3.7.0.0 <Info> (thread=main, member=n/a):
Connected Socket to 130.35.99.213:9099
    Success: Correctly allowed to use the invocation service
2011-03-15 17:54:41.140/1.125 Oracle Coherence GE 3.7.0.0 <D5>
(thread=ExtendTcpInvocationService:TcpInitiator, member=n/a): Started:
TcpInitiator{Name=ExtendTcpInvocationService:TcpInitiator, State=(SERVICE_STARTED), ThreadCount=0,
Codec=Codec(Format=POF), Serializer=com.tangosol.io.pof.ConfigurablePofContext, PingInterval=0,
PingTimeout=5000, RequestTimeout=5000, ConnectTimeout=2000, SocketProvider=SystemSocketProvider,
RemoteAddresses=[/130.35.99.213:9099], SocketOptions{LingerTimeout=0, KeepAliveEnabled=true,
TcpDelayEnabled=false}}
2011-03-15 17:54:41.156/1.141 Oracle Coherence GE 3.7.0.0 <D5> (thread=main, member=n/a):
Connecting Socket to 130.35.99.213:9099
2011-03-15 17:54:41.156/1.141 Oracle Coherence GE 3.7.0.0 <Info> (thread=main, member=n/a):
Connected Socket to 130.35.99.213:9099
    Success: Correctly unable to use the invocation service
------InvocationService access control example completed------
```

Example 10–22 lists the output in the shell where the cache server is running the proxy service. Notice that the security exception in the output corresponds to the `Success: Correctly unable to use the invocation service` message in the Eclipse console, where the user with role `reader` attempts to run `ExampleInvocable`.

Example 10–22 Proxy Service Response in the Eclipse Console

```
...
Started DefaultCacheServer...

2011-03-15 17:54:08.375/37.750 Oracle Coherence GE 3.7.0.0 <D5> (thread=Cluster, member=1):
Member(Id=2, Timestamp=2011-03-15 17:54:08.226, Address=130.35.99.213:8090, MachineId=49877,
Location=site:URL, machine_name,process:5340, Role=CoherenceServer) joined Cluster with senior
member 1
2011-03-15 17:54:08.437/37.812 Oracle Coherence GE 3.7.0.0 <D5> (thread=Cluster, member=1): Member
2 joined Service Management with senior member 1
2011-03-15 17:54:08.890/38.265 Oracle Coherence GE 3.7.0.0 <D5> (thread=Cluster, member=1): Member
2 joined Service PartitionedPofCache with senior member 1
2011-03-15 17:54:08.921/38.296 Oracle Coherence GE 3.7.0.0 <D5>
(thread=DistributedCache:PartitionedPofCache, member=1): 3> Transferring primary PartitionSet{0, 1,
2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28,
29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53,
54, 55, 56, 57, 58, 59, 60, 61, 62, 63, 64, 65, 66, 67, 68, 69, 70, 71, 72, 73, 74, 75, 76, 77, 78,
79, 80, 81, 82, 83, 84, 85, 86, 87, 88, 89, 90, 91, 92, 93, 94, 95, 96, 97, 98, 99, 100, 101, 102,
103, 104, 105, 106, 107, 108, 109, 110, 111, 112, 113, 114, 115, 116, 117, 118, 119, 120, 121, 122,
123, 124, 125, 126, 127} to member 2 requesting 128
2011-03-15 17:54:08.968/38.343 Oracle Coherence GE 3.7.0.0 <D4>
(thread=DistributedCache:PartitionedPofCache, member=1): 1> Transferring 129 out of 129 partitions
to a node-safe backup 1 at member 2 (under 129)
2011-03-15 17:54:09.000/38.375 Oracle Coherence GE 3.7.0.0 <D5>
(thread=DistributedCache:PartitionedPofCache, member=1): Transferring 0KB of backup[1] for
PartitionSet{128, 129, 130, 131, 132, 133, 134, 135, 136, 137, 138, 139, 140, 141, 142, 143, 144,
145, 146, 147, 148, 149, 150, 151, 152, 153, 154, 155, 156, 157, 158, 159, 160, 161, 162, 163, 164,
165, 166, 167, 168, 169, 170, 171, 172, 173, 174, 175, 176, 177, 178, 179, 180, 181, 182, 183, 184,
185, 186, 187, 188, 189, 190, 191, 192, 193, 194, 195, 196, 197, 198, 199, 200, 201, 202, 203, 204,
205, 206, 207, 208, 209, 210, 211, 212, 213, 214, 215, 216, 217, 218, 219, 220, 221, 222, 223, 224,
225, 226, 227, 228, 229, 230, 231, 232, 233, 234, 235, 236, 237, 238, 239, 240, 241, 242, 243, 244,
245, 246, 247, 248, 249, 250, 251, 252, 253, 254, 255, 256} to member 2
Password validated for user: role_writer
```

```
Password validated for user: role_writer
Password validated for user: role_reader
Password validated for user: role_reader
2011-03-15 17:54:41.156/70.531 Oracle Coherence GE 3.7.0.0 <D5>
(thread=Proxy:ProxyService:TcpAcceptorWorker:1, member=1): An exception occurred while processing a
InvocationRequest for Service=Proxy:ProxyService:TcpAcceptor: java.lang.SecurityException: Access
denied, insufficient privileges
   at com.oracle.handson.SecurityExampleHelper.checkAccess(SecurityExampleHelper.java:104)
   at com.oracle.handson.SecurityExampleHelper.checkAccess(SecurityExampleHelper.java:58)
   at com.oracle.handson.EntitledInvocationService.query(EntitledInvocationService.java:50)
   at com.tangosol.coherence.component.net.extend.messageFactory.
InvocationServiceFactory$InvocationRequest.onRun(InvocationServiceFactory.CDB:12)
   at com.tangosol.coherence.component.net.extend.message.Request.run(Request.CDB:4)
   at com.tangosol.coherence.component.net.extend.proxy.serviceProxy.InvocationServiceProxy.
onMessage(InvocationServiceProxy.CDB:9)
   at com.tangosol.coherence.component.net.extend.Channel$MessageAction.run(Channel.CDB:13)
   at java.security.AccessController.doPrivileged(Native Method)
   at javax.security.auth.Subject.doAs(Subject.java:337)
   at com.tangosol.coherence.component.net.extend.Channel.execute(Channel.CDB:29)
   at com.tangosol.coherence.component.net.extend.Channel.receive(Channel.CDB:26)
   at com.tangosol.coherence.component.util.daemon.queueProcessor.service.
Peer$DaemonPool$WrapperTask.run(Peer.CDB:9)
   at com.tangosol.coherence.component.util.DaemonPool$WrapperTask.run(DaemonPool.CDB:32)
   at com.tangosol.coherence.component.util.DaemonPool$Daemon.onNotify(DaemonPool.CDB:63)
   at com.tangosol.coherence.component.util.Daemon.run(Daemon.CDB:42)
   at java.lang.Thread.run(Thread.java:619)
```

11

Caching Sessions with Coherence and WebLogic Server

This chapter describes how to cache session information for Web application instances that are deployed across WebLogic Server instances.

This chapter has the following sections:

Introduction

WebLogic Server includes features that enable deployed applications to use Coherence data caches and seamlessly incorporate Coherence*Web for session management and TopLink Grid as an object-to-relational persistence framework. Collectively, these features are referred to as *ActiveCache*.

ActiveCache is employed by applications running on WebLogic Server and provides replicated and distributed caching services that make an application's data available to all servers in a Coherence data cluster. Applications can obtain direct access to data caches either through resource injection or component-based JNDI lookup. You can display, monitor, create, and configure Coherence clusters using the WebLogic Server Administration Console and WLST.

Using ActiveCache with WebLogic Server instances enables you to create a data tier dedicated to caching application data and storing replicated session state. This is separate from the application tier, where the WebLogic Server instances are dedicated to running the application.

Using Coherence*Web with ActiveCache enables you to provide Coherence-based HTTP session state persistence to applications running on WebLogic Server. Coherence*Web enables HTTP session sharing and management across different Web applications, domains, and heterogeneous application servers. Session data can be stored in data caches outside of the application server, thus freeing application server heap space and enabling server restarts without losing session data.

Coherence and Coherence*Web are included in the default installation of WebLogic Server 11g Release 1 (10.3.4). If you do not already have WebLogic Server 11g Release 1 (10.3.4) on your system, you can get it at the following URL:

```
http://www.oracle.
com/technology/software/products/middleware/index.html
```

For more information on the integration of Oracle WebLogic Server, Coherence, and Coherence*Web, see *Using ActiveCache* and *User's Guide for Oracle Coherence*Web*.

Caching Session Information for Web Application Instances

The following example demonstrates how to use ActiveCache to cache session information for Web application instances that are deployed across WebLogic Server instances. To do this, you will create a Web application and deploy it to two server instances. The application is a simple counter that stores the current count as a session attribute. Coherence*Web automatically serializes and replicates the attribute across both server instances. A browser is used to access each application instance to demonstrate that the same session attribute is used among the instances.

1. Ensure That You are Using Coherence 3.7 with WebLogic Server 10.3.4
2. Start a Cache Server
3. Configure and Start the WebLogic Server
4. Create a Machine
5. Create the WebLogic Servers
6. Create a Coherence Cluster
7. Deploy the Shared Library Files
8. Create the Counter Web Application
9. Deploy the Application
10. Start the Node Manager and the WebLogic Servers
11. Verify the Example

Ensure That You are Using Coherence 3.7 with WebLogic Server 10.3.4

By default, the installation of WebLogic Server 11*g* release 1 (10.3.4) installs Coherence 3.6 in the `coherence_3.6` folder. To complete this example, ensure that your server start-up files and class paths continue to point to the Coherence 3.7 files you have already installed. Also, ensure that when you are deploying files (such as `coherence.jar` and `coherence-web-spi.war`) later in this example, that you are deploying release 3.7 versions.

Start a Cache Server

Start a Coherence cache server. Example 11–1 illustrates a sample script to start the cache server. In this example, `tangosol.coherence.clusterport=7777` is the default multicast listen port of a Coherence cluster and `tangosol.coherence.clusteraddress=231.1.1.1` is the default multicast listener address.

> **New for 3.7.1:** The `session-cache-config.xml` file has been moved from the `coherence-web-spi.war` file to the `coherence-web.jar` file. The `coherence-web.jar` file can be found in the `coherence\lib` directory.

Example 11–1 Script to Start the Cache Server

```
setlocal

set COHERENCE_HOME=c:\oracle\product\coherence

set COH_OPTS=%COH_OPTS% -server -cp %COHERENCE_HOME%\lib\coherence.jar;%COHERENCE_
HOME%\lib\coherence-web.jar;
```

```
set COH_OPTS=%COH_OPTS% -Dtangosol.coherence.management.remote=true -Dtangosol.
coherence.cacheconfig=session-cache-config.xml -Dtangosol.coherence.distributed.
localstorage=true -Dtangosol.coherence.clusterport=7777 -Dtangosol.coherence.
clusteraddress=231.1.1.1 -Dtangosol.coherence.session.localstorage=true

java %COH_OPTS% -Xms512m -Xmx512m -XX:MaxPermSize=256m com.tangosol.net.
DefaultCacheServer

:exit
```

Note: If you define and start the Coherence cache server using the WebLogic Administration Console, you must indicate the location of the cache configuration file, and set distributed local storage and session local storage to true in the **Arguments** field of the **Server Start** tab. For example:

```
-Dtangosol.coherence.
cacheconfig=session-cache-config.xml -Dtangosol.
coherence.distributed.localstorage=true -Dtangosol.
coherence.session.localstorage=true
```

Configure and Start the WebLogic Server

To configure and start a Coherence cluster:

1. Run the Oracle WebLogic Configuration Wizard (**Start** then **All Programs** then **Oracle WebLogic** then **WebLogic Server 11gR1** then **Tools** then **Configuration Wizard**) to create a new WebLogic Server domain called `test_domain`.

   Before exiting the wizard, select the **Start Admin Server** check box and click **Done**. The Configuration Wizard automatically starts the Administration Server.

2. Start the WebLogic Server Administration Console.

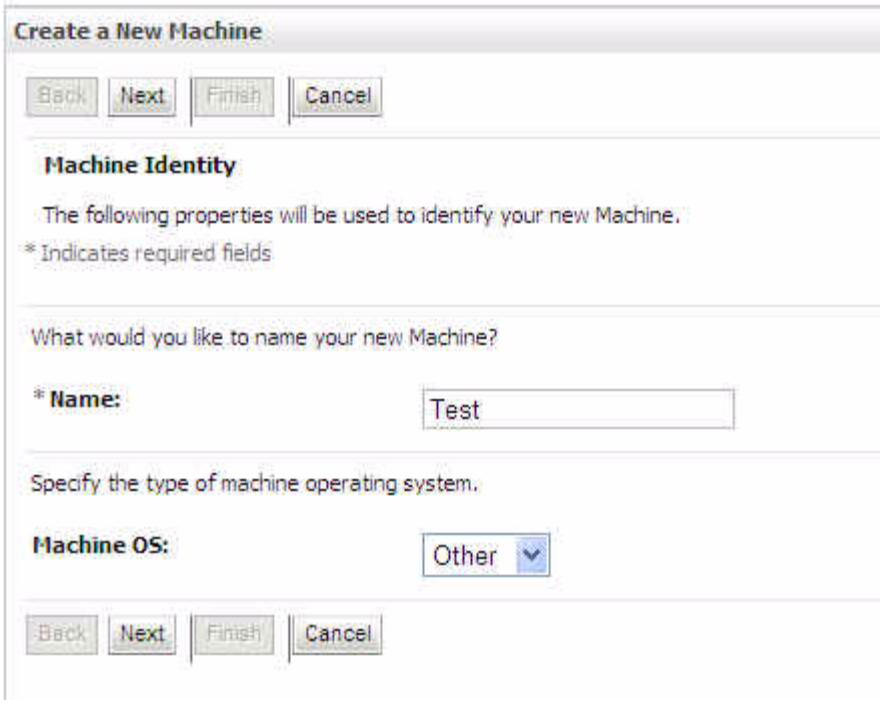
   From the browser, log in to the Oracle WebLogic Server Administration Console using the following URL:`http://`*`hostname`*`:7001/console`. The Console starts and the domain home page displays.

Create a Machine

To create a Machine on which to host WebLogic Server instances:

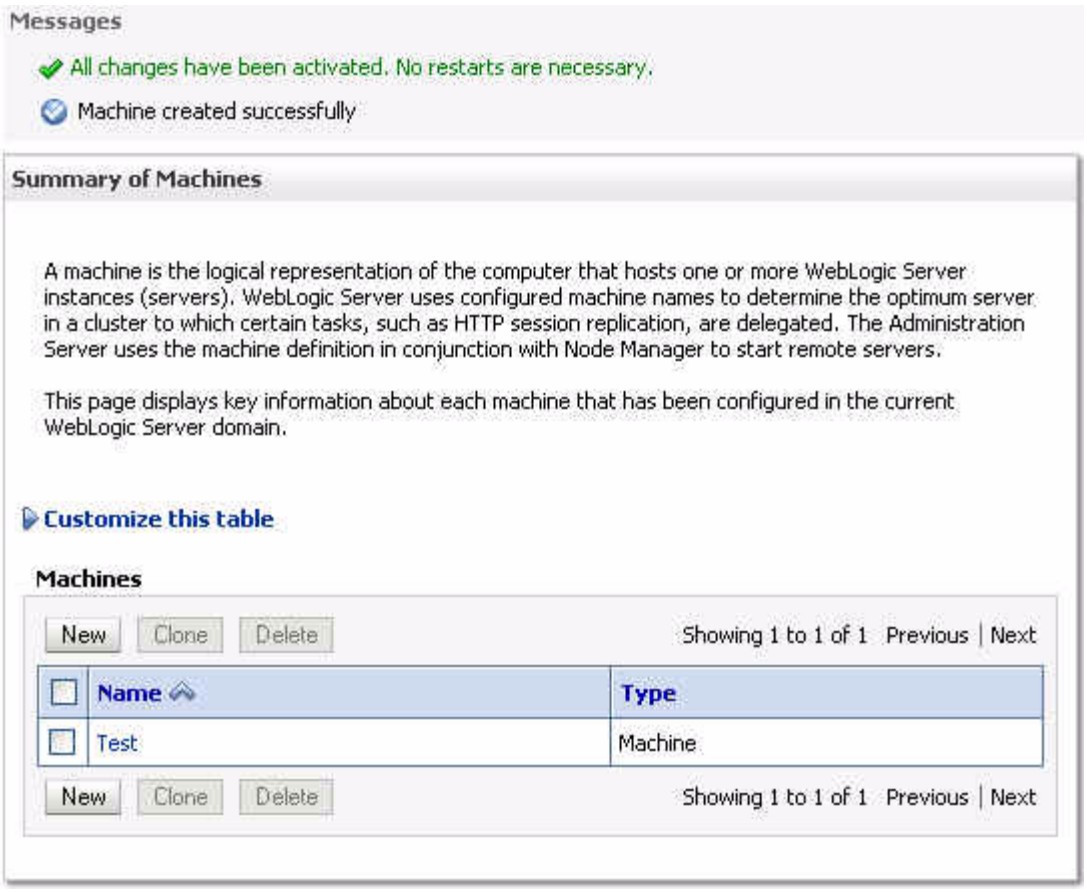
From the **Domain Structure** window, select **Environment** and then **Machines**. Click **New**. The **Create a New Machine** page displays. Enter a name for the Machine (in this case, **Test**) and click **Next**. Click Finish on the following page. Figure 11–1 illustrates the **Create a New Machine** page.

Figure 11–1 Creating a New Machine



The **Summary of Machines** page should look similar to Figure 11–2.

Figure 11–2 Summary of Machines



Create the WebLogic Servers

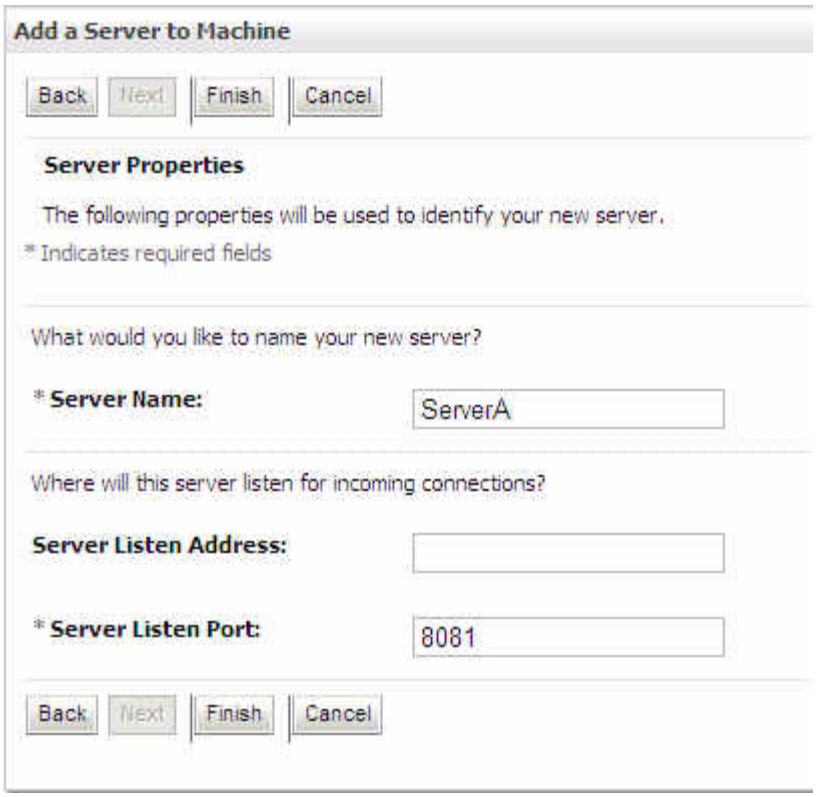
Create two server instances associated with the Machine. The application will be deployed to these servers in a later step.

To create server instances:

1. Click the name of the Machine in the **Summary of Machines** page to open the **Settings for *machine*** page. Click the **Servers** tab and then click **Add** to create a server.
2. Select **Create a new server and associate it with this machine** in the **Add a Server to Machine** page, and click **Next**.
3. Provide details about the server in the **Create a New Server** page.

   Enter `ServerA` as the **Server Name** and `8081` as the **Server Listen Port**. Enter the appropriate value for the **Server Listen Address**. This is illustrated in Figure 11–3. Click **Finish**.

Figure 11–3 Adding a Server to a Machine



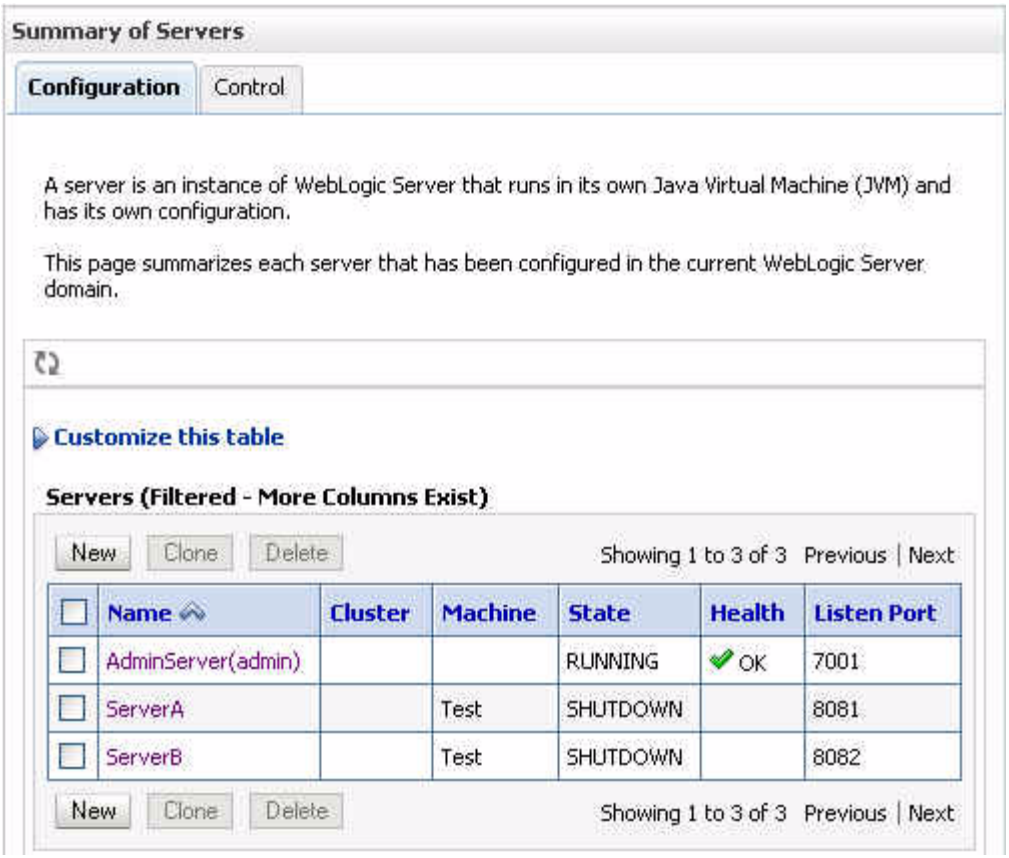
4. When you are returned to the **Settings for** ***machine*** page, click **Add**, and repeat the previous three steps to create a second server.

   Enter `ServerB` as the **Server Name** and `8082` as the **Server Listen Port**. Enter the appropriate value for the **Server Listen Address**. Click **Finish**.

5. Expand **Environment** in the **Domain Structure** menu and click **Servers**.

   The **Summary of Servers** page displays and is similar to Figure 11–4.

Figure 11–4 Summary of Servers Page



Create a Coherence Cluster

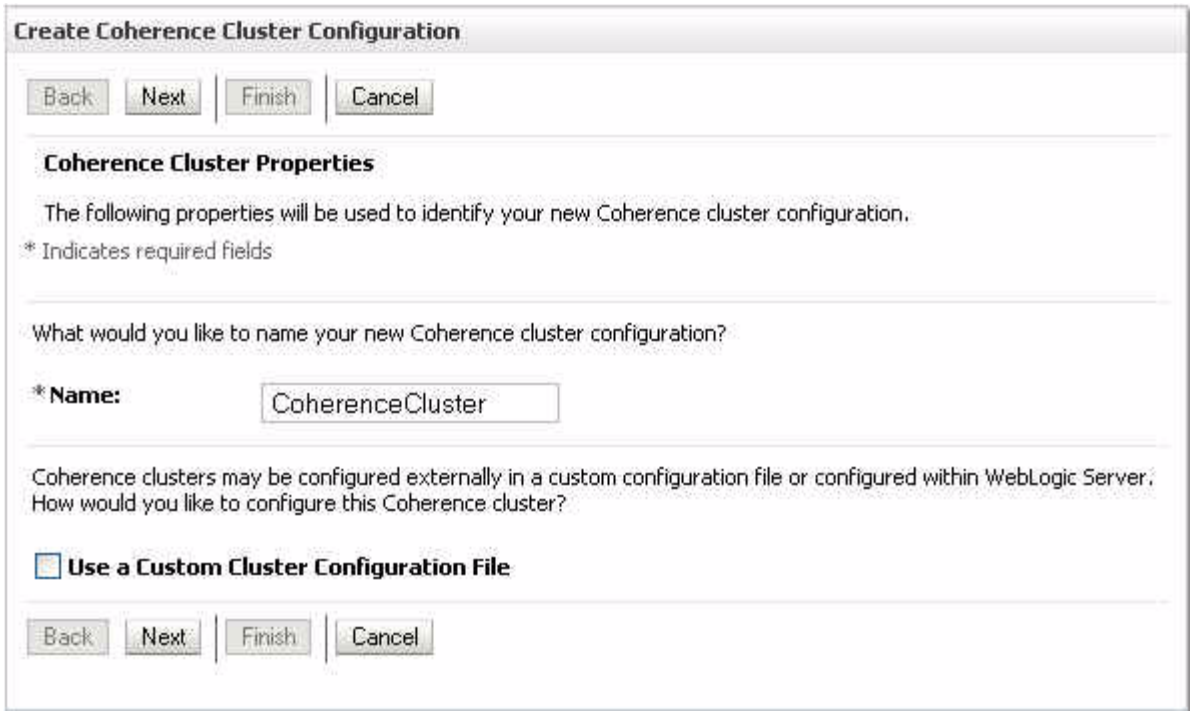
A Coherence cluster is a group of Coherence nodes that share a group address which allows them to communicate. Coherence clusters consist of nodes formed by applications, modules, or application servers (WebLogic Server instances or cache servers).

To create a Coherence Cluster:

1. Click **Environment** in the domain **Structure Window** and then click **Coherence Clusters**. In the **Summary of Coherence Clusters** page, click **New**. In the **Coherence Cluster Properties** page of the **Create Coherence Cluster Configuration** wizard, enter `CoherenceCluster` in the **Name** field, then click **Next**.

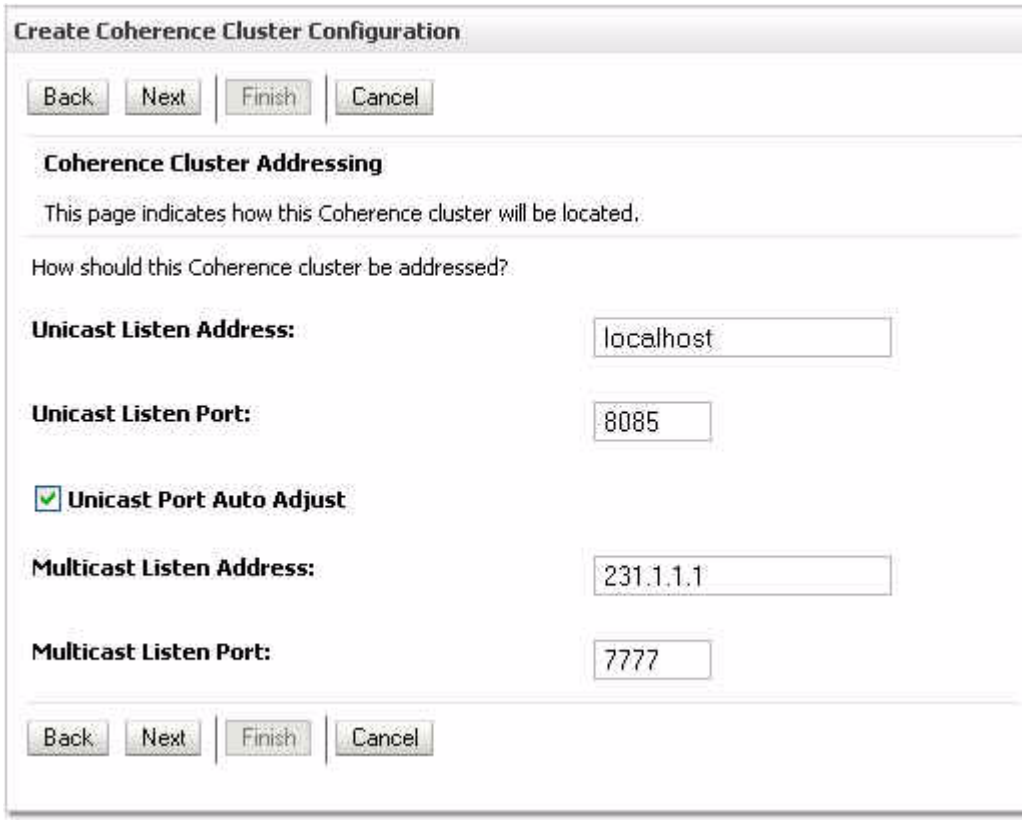
   Figure 11–5 illustrates the **Create Coherence Cluster Configuration** page.

Figure 11–5 Creating a Coherence Cluster



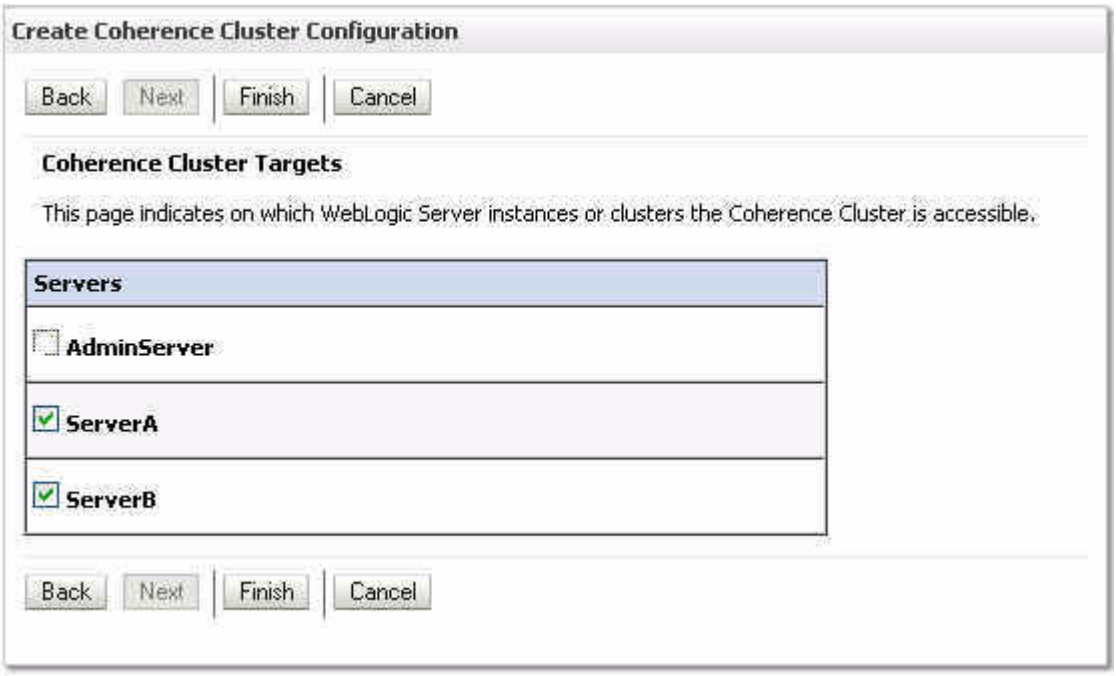
2. Enter a value such as `8085`, in the **Unicast Listen Port** field. Do not change any of the other values and click **Next**.

Figure 11–6 Specifying a Unicast Listen Port for a Coherence Cluster



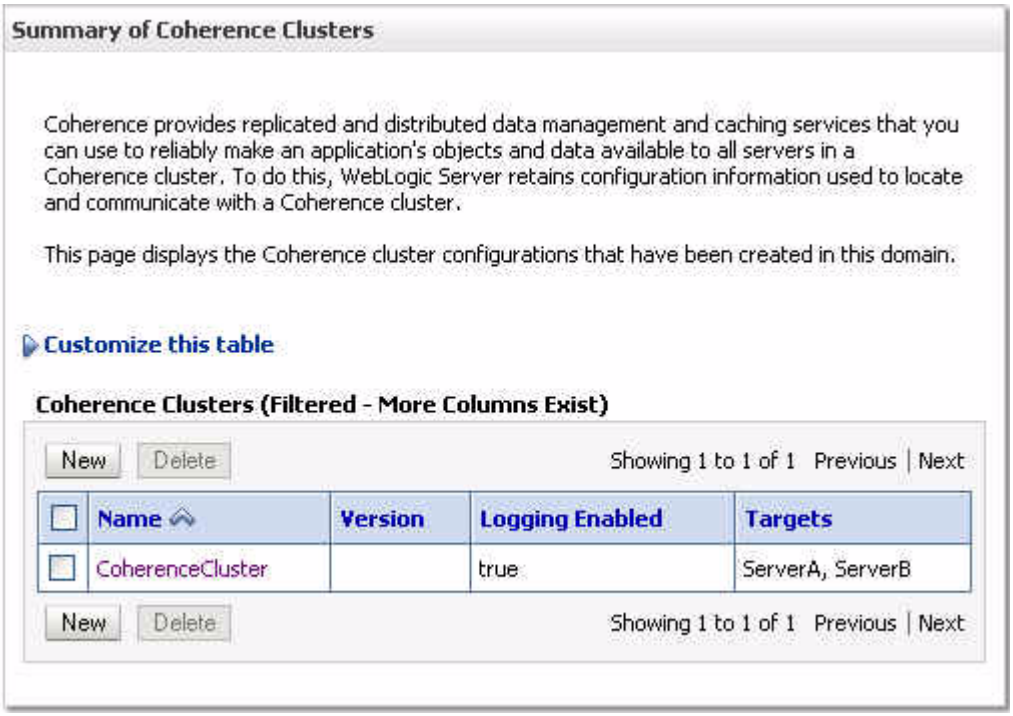
3. In the **Coherence Cluster Targets** page of the **Create Coherence Cluster Configuration** wizard, select **ServerA** and **ServerB** as the targets. Click **Finish**.

Figure 11–7 Choosing Coherence Cluster Targets



The **Summary of Coherence Clusters** page looks similar to Figure 11–8.

Figure 11–8 Summary of Coherence Clusters



Deploy the Shared Library Files

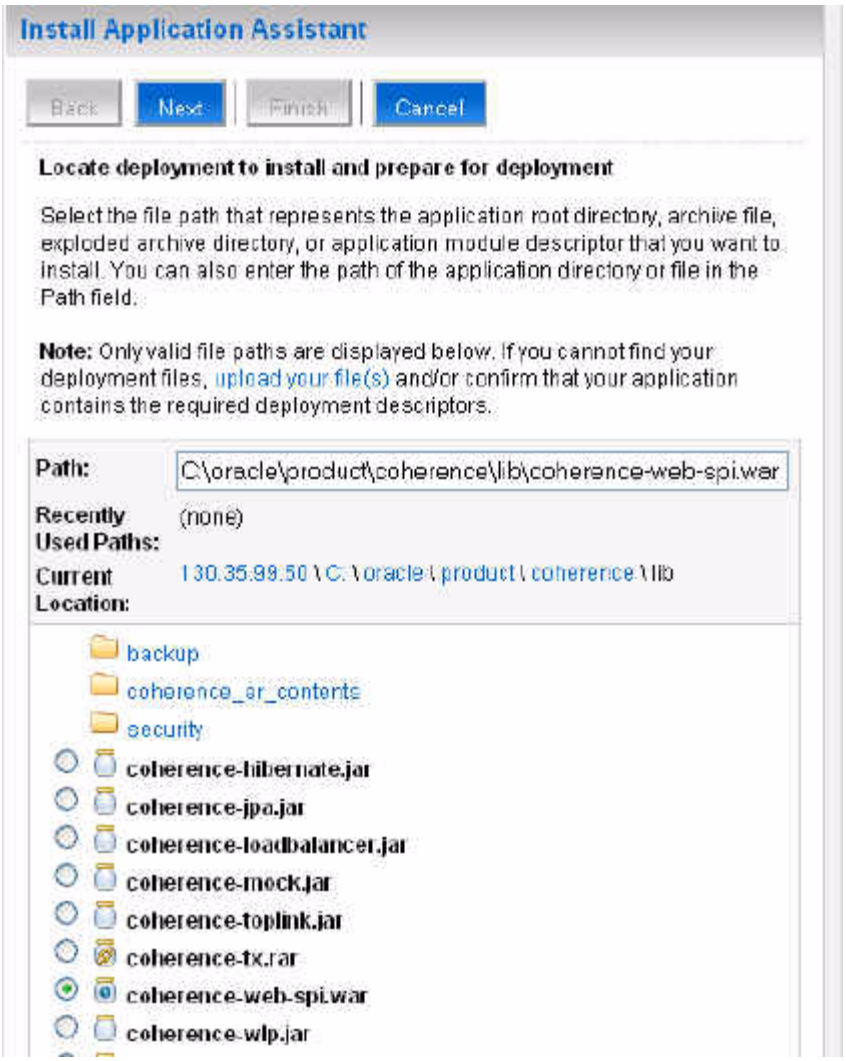
In addition to the `coherence.jar` file, Coherence provides a deployable shared library, `coherence-web-spi.war`, that contains a native plug-in to WebLogic Server's HTTP Session Management interface. Coherence also provides the `active-cache-1.0.jar` file that contains the classes that enable WebLogic Server to interact with Coherence.

You do not have to deploy `coherence.jar` for this example. It will be bundled with the application in a later step.

To deploy the `coherence-web-spi.war` and `active-cache-1.0.jar` files:

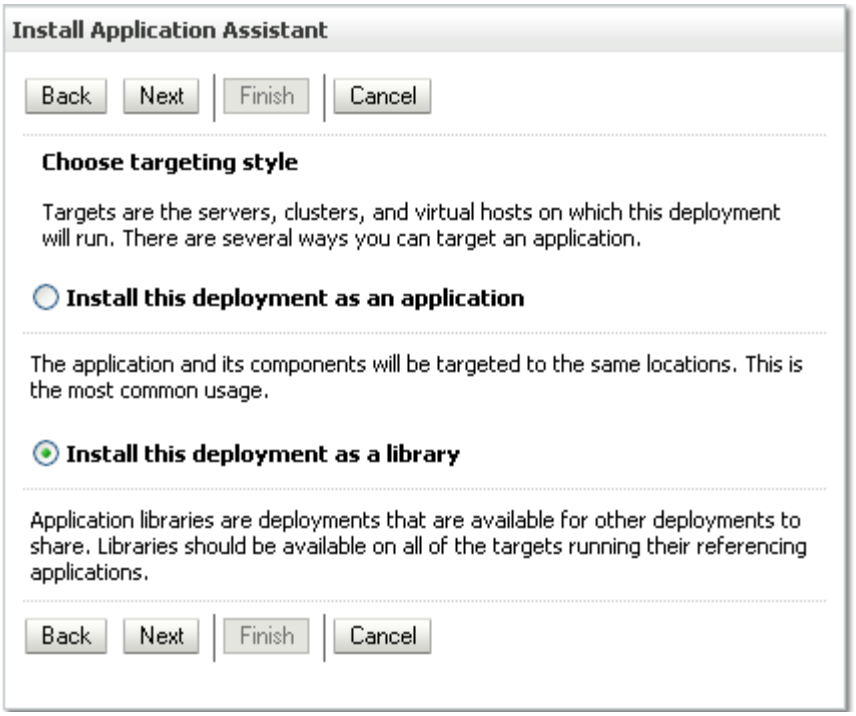
1. From the **Domain Structure** menu, click **Deployments**. The **Summary of Deployments** page displays.
2. Click **Install**. The **Install Application Assistant** window displays.
3. Use the **Install Application Assistant** to deploy `coherence-web-spi.war` as a library to `ServerA` and `ServerB`.
    a. Locate and select the `coherence-web-spi.war` file as illustrated in Figure 11–9. The WAR file can be found in the `coherence\lib` folder of the Coherence installation. Click **Next**.

Figure 11–9 Selecting the coherence-web-spi.war File for Deployment



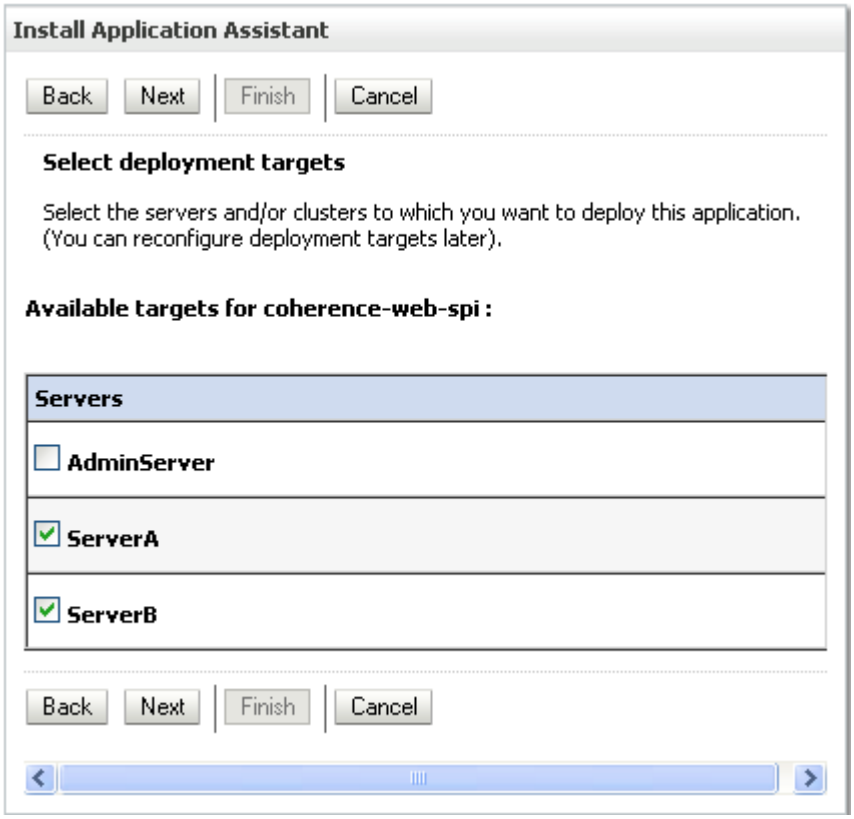
b. In the **Choose targeting style** page, ensure that **Install this deployment as a library** is selected, as illustrated in Figure 11–10. Click **Next**.

Figure 11–10 Installing the Deployment as a Library



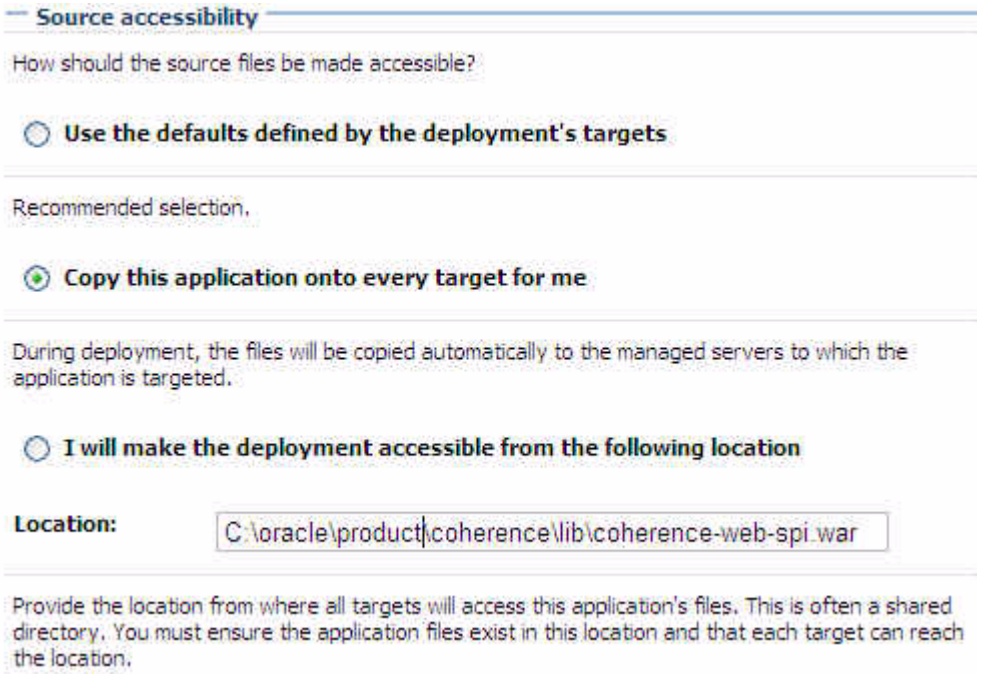
c. Select **ServerA** and **ServerB** as the deployment targets (do not deploy `coherence-web-spi.war` to **AdminServer**) as illustrated in Figure 11–11. Click **Next**.

Figure 11–11 Selecting Deployment Targets



d. In the **Optional Settings** page, select the **Copy this application onto every target for me** option in the **Source accessibility** section.

Figure 11–12 Copying Files to Targets



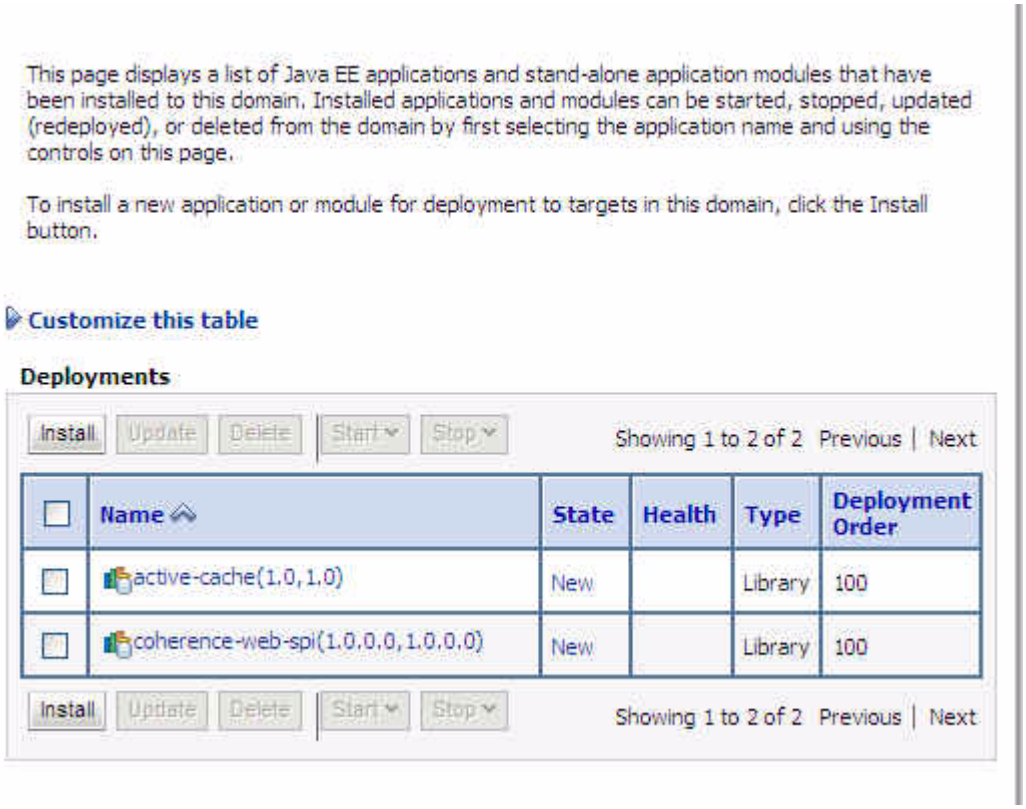
e. You can click **Finish** to skip the rest of the steps in the **Install Application Assistant**. The **Summary of Deployments** page displays after the application is deployed.

4. Repeat Steps 1 through 3 to deploy `active-cache-1.0.jar` to `ServerA` and `ServerB` (do not deploy `active-cache-1.0.jar` to the `AdminServer`).

   When you reach the **Optional Settings** page, select the **I will make the deployment accessible from the following location** option. This will mimic the `nostage` WLST option.

   Enter the path to the `active-cache-1.0.jar` file. The file is included in the WebLogic Server installation. Assuming that you installed the WebLogic Server at `C:\oracle\product`, you will find the file in the `C:\oracle\product\wls1033\wlserver_10.3\common\deployable-libraries` folder.

Figure 11–13 Summary of Deployments Page



Create the Counter Web Application

The Counter Web application is a simple counter implemented as a JSP. The counter is stored as an HTTP session attribute and increments each time the page is accessed.

To create the Counter Web application:

1. Create a standard Web application folder as follows:

```
/
/WEB-INF
```

2. Copy the following code to a text file and save it as a file named `web.xml` in the `/WEB-INF` folder.

```
<?xml version = '1.0' encoding = 'windows-1252'?>
<web-app xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
 xsi:schemaLocation="http://java.sun.com/xml/ns/j2ee http://java.sun.
com/xml/ns/j2ee/web-app_2_4.xsd"
 xmlns="http://java.sun.com/xml/ns/j2ee" version="2.5">
   <description>Empty web.xml file for Web Application</description>
</web-app>
```

3. Create a `weblogic.xml` file in the `/WEB-INF` folder.
   - Add a library reference for the `coherence-web-spi.war` file.
   - Reference the Coherence Cluster in a `coherence-cluster-ref` stanza.

   Example 11–2 illustrates a sample `weblogic.xml` file.

Example 11–2 Sample weblogic.xml File

```
<weblogic-web-app xmlns="http://xmlns.oracle.com/weblogic/weblogic-web-app"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xsi:schemaLocation="http://xmlns.oracle.com/weblogic/weblogic-web-app http://www.
oracle.com/technology/weblogic/weblogic-web-app/1.1/weblogic-web-app.xsd">
      <library-ref>
           <library-name>coherence-web-spi</library-name>
      </library-ref>
     <coherence-cluster-ref>
        <coherence-cluster-name>CoherenceCluster</coherence-cluster-name>
     </coherence-cluster-ref>
</weblogic-web-app>
```

4. Bundle the `coherence.jar` file with the application: copy `coherence.jar` from the `coherence\lib` folder of the Coherence 3.7 installation to the `WEB-INF/lib` folder.

5. Copy the following code for the `counter` JSP to a text file and save the file as `counter.jsp` in the root of the Web application folder.

```
<html>
    <body>

<h3>
      Counter :
      <%
         Integer counter = new Integer(1);
         HttpSession httpsession = request.getSession(true);
         if (httpsession.isNew()) {
                httpsession.setAttribute("count", counter);
                out.println(counter);
         } else {
                int count = ((Integer) httpsession.getAttribute("count")).
intValue();
                httpsession.setAttribute("count", new Integer(++count));
                out.println(count);
         }
      %>
      </h3>

    </body>
</html>
```

6. Create a `manifest.mf` file in the `META-INF` folder. Add references to the `active-cache` JAR file. Example 11–3 illustrates a sample `manifest.mf` file.

Example 11–3 Sample manifest.mf File

```
Extension-List: active-cache
active-cache-Extension-Name: active-cache
active-cache-Specification-Version: 1.0
active-cache-Implementation-Version: 1.0
```

7. The structure of the Web application folder should appears as follows:

```
/
/counter.jsp
/META-INF/manifest.mf
/WEB-INF/web.xml
/WEB-INF/weblogic.xml
/WEB-INF/lib/coherence.jar
```

8. ZIP or JAR the Web application folder and save the file as `counter.war`.

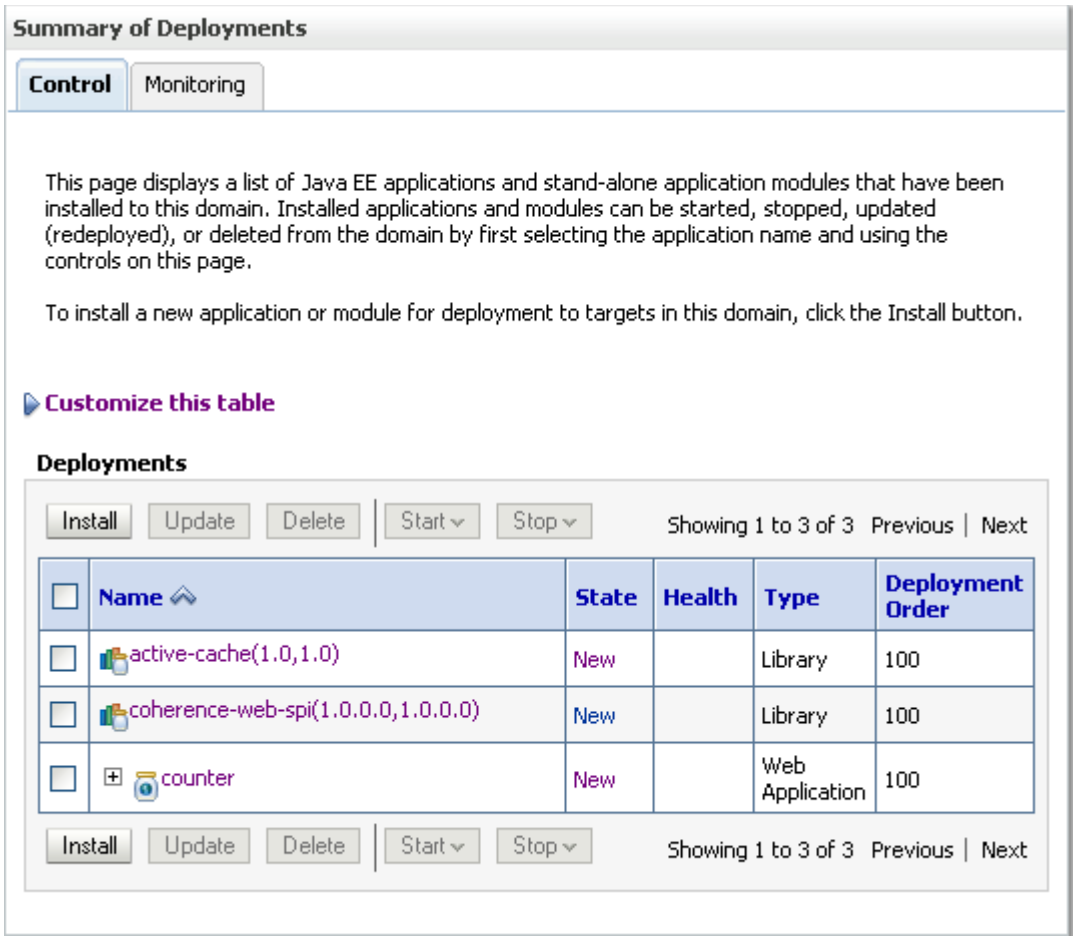
Deploy the Application

To deploy the `counter.war` application:

1. Open the **Summary of Deployments** page by clicking **Deployments** in the **Domain Structure** menu in the Oracle WebLogic Server Administration Console.
2. Click **Install**. The **Install Application Assistant** wizard opens.
3. Use the **Install Application Assistant** to deploy the `counter.war` file to `ServerA` and `ServerB`. In the **Optional Settings** page, select the **Copy this application onto every target for me** option in the **Source accessibility** section.

   The **Summary of Deployments** page displays after the application is deployed. Figure 11–14 illustrates the page with the deployed `active-cache.jar`, `coherence-web-spi.war`, and `counter.war` files.

Figure 11–14 Summary of Deployments Page with Deployed Files



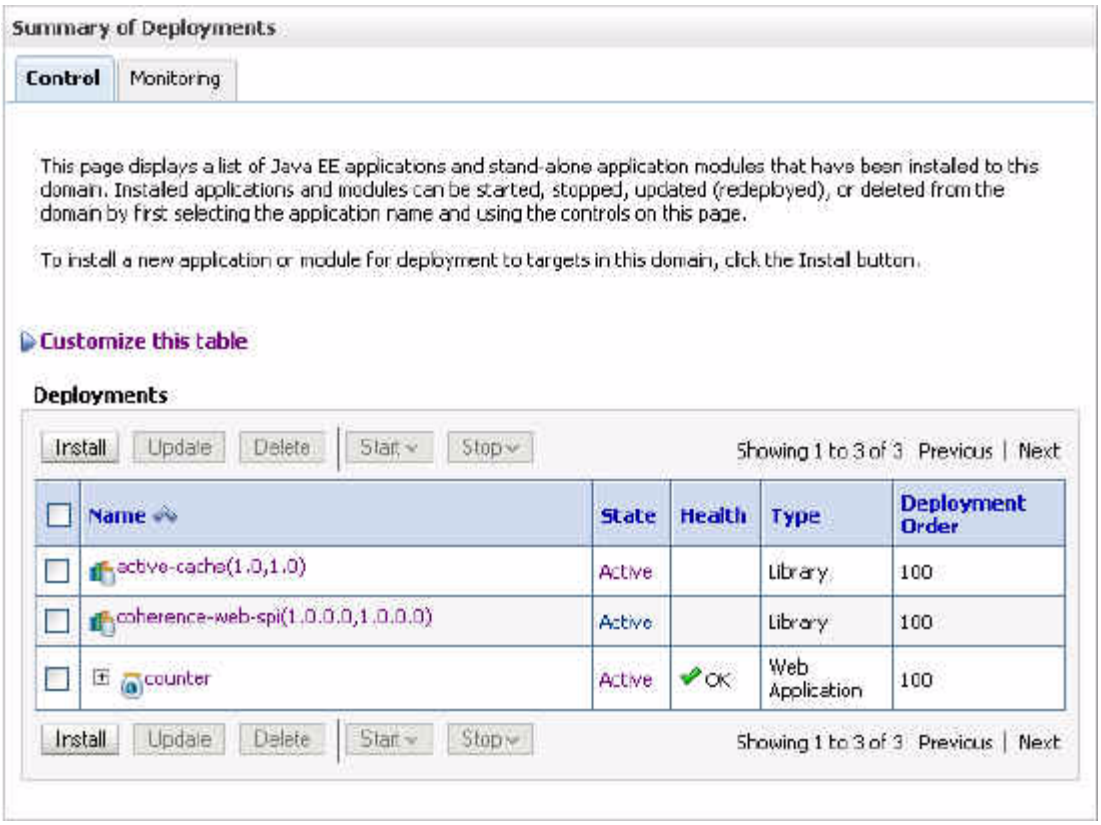
Start the Node Manager and the WebLogic Servers

Start the Node Manager then start the WebLogic Server instances from the WebLogic Server Administration Console. The Node Manager is a Java utility that runs as a separate process from Oracle WebLogic Server, and enables you to perform common operations for a Managed Server, regardless of its location with respect to its Administration Server.

1. To start the Node Manager, go to **Start**, then **All Programs,** then **Oracle WebLogic**, then **WebLogic Server 11gR1,** then **Tools,** and then **Node Manager**.
2. Click **Environment** then **Servers** in the domain **Structure Window**. From the **Summary of Servers** page in the WebLogic Server Administration Console, click the **Control** tab and start both server instances.

   Figure 11–15 illustrates the deployments table after the servers have been started.

Figure 11–15 Deployments Window Showing the Deployed Application and Libraries



Verify the Example

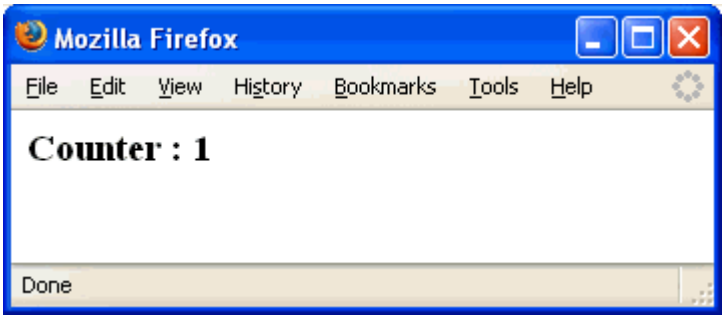
To verify the example:

1. Open a browser and access the `ServerA` counter instance using the following URL:

   `http://host:8081/counter/counter.jsp`

   The counter page displays and the counter is set to 1 as illustrated in Figure 11–16.

Figure 11–16 Counter Page with Counter Set to 1

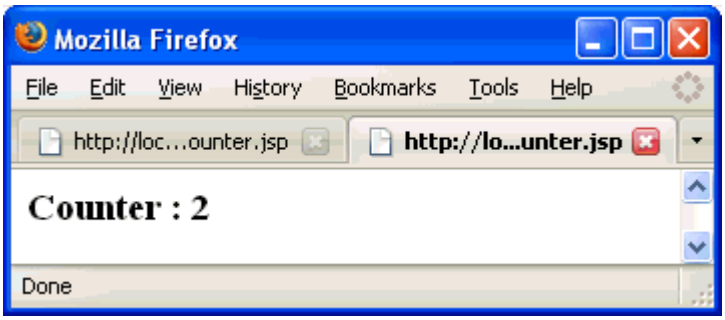


2. In a new browser (or new browser tab), access the `ServerB` counter instance using the following URL:

   `http://host:8082/counter/counter.jsp`

The counter page displays and the counter increments to 2 based on the session data as illustrated in Figure 11–17.

Figure 11–17 Counter Page with Counter Set to 2



3. If you refresh the page, the counter increments to 3. Return to the original browser (or browser tab), refresh the instance, and the counter displays 4.

Index