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Preface

*Integrating Oracle Coherence* describes how to integrate Oracle Coherence with Coherence*Web, EclipseLink JPA, Hibernate, Spring, memcached adapters, and Coherence GoldenGate HotCache.

This preface includes the following sections:

- Audience
- Documentation Accessibility
- Related Documents
- Conventions

**Audience**

This guide is for software developers and architects who will be integrating Coherence with TopLink-Grid, JPA, Hibernate, Spring, memcached adapters, and Coherence GoldenGate HotCache.

**Documentation Accessibility**

For information about Oracle's commitment to accessibility, visit the Oracle Accessibility Program website at http://www.oracle.com/pls/topic/lookup?ctx=acc&id=docacc.

**Access to Oracle Support**

Oracle customers that have purchased support have access to electronic support through My Oracle Support. For information, visit http://www.oracle.com/pls/topic/lookup?ctx=acc&id=info or visit http://www.oracle.com/pls/topic/lookup?ctx=acc&id=trs if you are hearing impaired.

**Related Documents**

For more information about Oracle Coherence, see the following:

- *Administering HTTP Session Management with Oracle Coherence*Web
- *Administering Oracle Coherence*
- *Developing Applications with Oracle Coherence*
- *Developing Remote Clients for Oracle Coherence*
- *Installing Oracle Coherence*
- *Managing Oracle Coherence*
Conventions

The following text conventions are used in this document:

<table>
<thead>
<tr>
<th>Convention</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>boldface</strong></td>
<td>Boldface type indicates graphical user interface elements associated with an action, or terms defined in text or the glossary.</td>
</tr>
<tr>
<td><em>italic</em></td>
<td>Italic type indicates book titles, emphasis, or placeholder variables for which you supply particular values.</td>
</tr>
<tr>
<td><code>monospace</code></td>
<td>Monospace type indicates commands within a paragraph, URLs, code in examples, text that appears on the screen, or text that you enter.</td>
</tr>
</tbody>
</table>
What's New in This Guide

This preface includes the following sections:

- **New and Changed Features**
  New and changed features in *Integrating Oracle Coherence* that are organized by release.

- **Other Significant Changes in this Document**
  Other significant changes in *Integrating Oracle Coherence* that are organized by release.

## New and Changed Features

New and changed features in *Integrating Oracle Coherence* that are organized by release.

### New and Changed Features for 12c (12.2.1.3)

Oracle Coherence 12c (12.2.1.3) includes the following new and changed features for this document:

- HotCache Multitenant mode, which allows caches to be refreshed based on a tenant identifier. See Using HotCache Multitenant Mode.
- HotCache JMX management, which provides insight into how HotCache is performing. See Managing HotCache.
- HotCache multi-threading, which uses multiple threads to apply trail file operations. See Configuring Multi-Threading in HotCache.

### New and Changed Features for 12c (12.2.1.2)

Oracle Coherence 12c (12.2.1.2) includes the following new and changed features for this document:

- Added HotCache JPA properties. See Configuring HotCache JPA Properties.
- Added instructions for warming caches with HotCache. See Warming Caches with HotCache.
- Added instructions for SDO_GEOMETRY and XML type support in HotCache. See Support for Oracle Data Types.

### New and Changed Features for 12c (12.2.1.1)

Oracle Coherence 12c (12.2.1.1) does not contain any new and changed features for this document.
New and Changed Features for 12c (12.2.1)

Oracle Coherence 12c (12.2.1) includes the following new and changed features for this document.

- Support for GoldenGate HotCach has been updated. See Integrating with Oracle Coherence GoldenGate HotCache.

Other Significant Changes in this Document

Other significant changes in Integrating Oracle Coherence that are organized by release.

Other Significant Changes in This Document for 12c (12.2.1.3)

For 12c (12.2.1.3), this guide has been updated in several ways. Following are the sections that have been added or changed.

- Updated GoldenGate HotCache instructions to use replicat process instead of extract process.
- TopLink Grid is deprecated and all instructions (previously chapter 1) have been removed.
- The "Integrating JPA Using the Coherence API" chapter has been renamed to "Using JPA with Coherence" and now describes how to use the pre-defined JPA cache store implementations.

Other Significant Changes in This Document for 12c (12.2.1.2)

For 12c (12.2.1.2), no other significant changes have been made to this guide.

Other Significant Changes in This Document for 12c (12.2.1.1)

For 12c (12.2.1.1), no other significant changes have been made to this guide.

Other Significant Changes in This Document for 12c (12.2.1)

For 12c (12.2.1), this guide has been updated in several ways. Following are the sections that have been added or changed.

- Support for the Toplink cache store and cache loader has been removed.
Using JPA with Coherence

Coherence provides native, entity-based implementations of the CacheStore and CacheLoader interfaces that use the Java Persistence API (JPA) to load and store objects to a database. Before using JPA with Coherence, you should be familiar with the CacheStore and CacheLoader interfaces. These interfaces are used to cache data sources. See Caching Data Sources.

Note:
Only resource-local and bootstrapped entity managers can be used with Coherence and JPA. Container-managed entity managers and those that use Java Transaction Architecture (JTA) transactions are not currently supported.

This chapter includes the following sections:

- **Overview of the JPA CacheStore and CacheLoader Implementations**
- **Obtain a JPA Provider Implementation**
  A JPA provider allows you to work directly with Java objects, rather than with SQL statements. You map, store, update and retrieve data, and the provider performs the translation between database entities and Java objects.
- **Configure a Coherence JPA Cache Store**
  Using JPA with Coherence requires configuring persistence properties and defining a cache that uses the JpaCacheStore implementation.

1.1 Overview of the JPA CacheStore and CacheLoader Implementations

Oracle Coherence provides two implementations of the CacheStore and CacheLoader interfaces which can be used with JPA: a generic JPA implementation and an EclipseLink-specific implementation. For both implementations, the entities must be mapped to the data store and a JPA persistence unit configuration must exist. A JPA persistence unit is defined as a logical grouping of user-defined entity classes that can be persisted and their settings. The JPA run-time configuration file, persistence.xml, and the default JPA Object-Relational mapping file, orm.xml, are typically provided as part of a JPA solution.

Table 1-1 describes the JPA implementations provided by Coherence.
Table 1-1  JPA-Related CacheStore and CacheLoader API Included with Coherence

<table>
<thead>
<tr>
<th>Class Name</th>
<th>Location</th>
<th>Description</th>
</tr>
</thead>
</table>
| JpaCacheStore       | COHERENCE_HOME\lib\coherence-jpa.jar         | A JPA implementation of the Coherence CacheStore interface. Use this class as a full load and store implementation. It can use any JPA implementation to load and store entities to and from a data store.  
**Note:** The persistence unit is assumed to be set to use RESOURCE_LOCAL transactions. |
| JpaCacheLoader      |                                                | A JPA implementation of the Coherence CacheLoader interface. Use this class as a load-only implementation. It can use any JPA implementation to load entities from a data store.  
Use the JpaCacheStore class for a full load and store implementation. |
| EclipseLinkJPACacheStore | ORACLE_HOME\oracle_common\modules\oracle.toplink_version\toplink-grid.jar | An EclipseLink specific JPA implementation of the Coherence CacheStore interface. This implementation is intended to be used where the application uses Coherence directly and the cache store and loader is used behind the scene to persist and load data.  
**Note:** To use this implementation, make sure no cache interceptors or query redirectors from the EclipseLink-Coherence integration are set within the persistence unit for the specific class. |
| EclipseLinkJPACacheLoader |                                              | An EclipseLink specific JPA implementation of the Coherence CacheLoader interface.  
**Note:** To use this implementation, make sure no cache interceptors or query redirectors from the EclipseLink-Coherence integration are set within the persistence unit for the specific class. |

1.2 Obtain a JPA Provider Implementation

A JPA provider allows you to work directly with Java objects, rather then with SQL statements. You map, store, update and retrieve data, and the provider performs the translation between database entities and Java objects.

Oracle recommends using EclipseLink JPA– the reference implementation for the JPA 2.0 specification and also the JPA provider used in Oracle TopLink. EclipseLink provides a high-performance JPA implementation with many advanced features for caching, threading, and overall performance.

The EclipseLink JAR files (eclipselink.jar) is included in the Coherence installation and can be found in the ORACLE_HOME\oracle_common\modules\oracle.toplink_version folder.

1.3 Configure a Coherence JPA Cache Store

Using JPA with Coherence requires configuring persistence properties and defining a cache that uses the JpaCacheStore implementation.

This section includes the following topics:
1.3.1 Map the Persistent Classes

Map the entity classes to the database. This will allow you to load and store objects through the JPA cache store. JPA mappings are standard, and can be specified in the same way for all JPA providers.

You can map entities either by annotating the entity classes or by adding an `orm.xml` or other XML mapping file. See the JPA provider documentation for more information about how to map JPA entities.

1.3.2 Configure JPA

Edit the `persistence.xml` file to create the JPA configuration. This file contains the properties that dictate run-time operation.

Set the transaction type to `RESOURCE_LOCAL` and provide the required JDBC properties for your JPA provider (such as `driver`, `url`, `user`, and `password`) with the appropriate values for connecting and logging into your database. List the classes that are mapped using JPA annotations in `<class>` elements. Example 1-1 illustrates a sample `persistence.xml` file with the typical properties that you can set.

Example 1-1  Sample persistence.xml File for JPA

```xml
<persistence xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" version="1.0"
xmlns="http://java.sun.com/xml/ns/persistence">
  <persistence-unit name="EmpUnit" transaction-type="RESOURCE_LOCAL">
    <provider>
      org.eclipse.persistence.jpa.PersistenceProvider
    </provider>
    <class>com.oracle.coherence.handson.Employee</class>
    <properties>
      <property name="eclipselink.jdbc.driver" value="oracle.jdbc.OracleDriver"/>
      <property name="eclipselink.jdbc.url" value="jdbc:oracle:thin:@localhost:1521:XE"/>
      <property name="eclipselink.jdbc.user" value="scott"/>
      <property name="eclipselink.jdbc.password" value="tiger"/>
    </properties>
  </persistence-unit>
</persistence>
```

1.3.3 Configure a Coherence Cache for JPA

Create a `coherence-cache-config.xml` file to override the default Coherence settings and define a caching scheme. The caching scheme includes a `<cachestore-scheme>` element that lists the JPA implementation class and includes the following parameters.

- **The entity name of the entity being stored.** Unless it is explicitly overridden in JPA, this is the unqualified name of the entity class. Example 1-2 uses the built-in Coherence macro `{cache-name}` that translates to the name of the cache that is
constructing and using the cache store. This works because a separate cache must be used for each type of persistent entity and Coherence ensures that the name of each cache is set to the name of the entity that is being stored in it.

- The fully qualified name of the entity class. If the classes are all in the same package and use the default JPA entity names, then you can again use the `{cache-name}` macro for the part that is variable across the different entity types. In this way, the same caching scheme can be used for all of the entities that are cached within the same persistence unit.

- The persistence unit name. This should be the same as the name specified in the persistence.xml file.

The various named caches are then directed to use the JPA caching scheme. Example 1-2 is a sample coherence-cache-config.xml file that defines a cache named Employee that caches instances of the Employee class. The cache is configured to use the JpaCacheStore implementation. To define additional entity caches for more classes, add more `<cache-mapping>` elements to the file.

Example 1-2  Assigning Named Caches to a JPA Caching Scheme

```
<cache-config>
  <caching-scheme-mapping>
    <cache-mapping>
      <!-- Set the name of the cache to be the entity name. -->
      <cache-name>Employee</cache-name>
      <!-- Configure this cache to use the following defined scheme. -->
      <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>
          <internal-cache-scheme>
            <local-scheme/>
          </internal-cache-scheme>
          <!-- Define the cache scheme. -->
          <cachestore-scheme>
            <class-scheme>
              <class-name>com.tangosol.coherence.jpa.JpaCacheStore</class-name>
              <init-params>
                <!-- This param is the entity name. -->
                <init-param>
                  <param-type>java.lang.String</param-type>
                  <param-value>{cache-name}</param-value>
                </init-param>
                <!-- This param is the fully qualified entity class. -->
                <init-param>
                  <param-type>java.lang.String</param-type>
                  <param-value>com.acme.{cache-name}</param-value>
                </init-param>
                <!-- This param should match the value of the -->
                <!-- persistence unit name in persistence.xml. -->
              </init-params>
            </class-scheme>
          </cachestore-scheme>
        </read-write-backing-map-scheme>
      </backing-map-scheme>
    </distributed-scheme>
  </caching-schemes>
</cache-config>
```
1.3.4 Configure the Persistence Unit

When using a JPA cache store or loader implementation, configure the persistence unit to ensure that no changes are made to entities when they are inserted or updated. Any changes made to entities by the JPA provider are not reflected in the Coherence cache. This means that the entity in the cache will not match the database contents. In particular, entities should not use ID generation, for example, @GeneratedValue, to obtain an ID. IDs should be assigned in application code before an object is put into Coherence. The ID is typically the key under which the entity is stored in Coherence.

Optimistic locking (for example, @Version) should not be used because it might lead to the failure of a database transaction commit transaction.

When using a JPA cache store or loader implementation, L2 (shared) caching should be disabled in your persistence unit. See the documentation for your provider. In EclipseLink, this can be specified on an individual entity with @Cache(shared=false) or as the default in the persistence.xml file with the following property:

```xml
<property name="eclipselink.cache.shared.default" value="false"/>
```
Integrating with Oracle Coherence GoldenGate HotCache

Applications that use Coherence caches can leverage the Oracle Coherence GoldenGate HotCache (HotCache) integration to allow external changes to a database to be propagated to objects in Coherence caches. A detailed description of Oracle GoldenGate is beyond the scope of this documentation. If you are new to GoldenGate, see:

- Installing Oracle GoldenGate in *Installing and Configuring Oracle GoldenGate for Oracle Database*
- Installing Oracle GoldenGate Application Adapters
- Understanding Oracle GoldenGate Adapters in *Administering Oracle GoldenGate Application Adapters*

**Note:**

To use HotCache, you must have licenses for Oracle GoldenGate and Coherence Grid Edition. HotCache can be used with Oracle GoldenGate for Big Data 12c (12.3.1.1.0 or higher) and Oracle GoldenGate 11gR1, 11gR2, and 12c releases.

This chapter includes the following sections:

- Overview of Oracle Coherence GoldenGate HotCache
- How Does HotCache Work
- Prerequisites
- Configuring GoldenGate
- Configuring HotCache
- Configuring the GoldenGate Java Adapter
- Configuring the Coherence Cache Servers
- Using Portable Object Format with HotCache
- Configuring HotCache JPA Properties
- Warming Caches with HotCache
- Implementing High Availability for HotCache
- Support for Oracle Data Types
- Configuring Multi-Threading in HotCache
- Using HotCache Multitenant Mode
- Managing HotCache
2.1 Overview of Oracle Coherence GoldenGate HotCache

Third-party updates to the database can cause Coherence applications to work with data which could be stale and out-of-date. HotCache solves this problem by monitoring the database and pushing any changes into the Coherence cache. HotCache employs an efficient push model which processes only stale data. Low latency is assured because the data is pushed when the change occurs in the database.

HotCache can be added to any Coherence application. Standard JPA is used to capture the mappings from database data to Java objects. The configuration can be captured in XML exclusively or in XML with annotations.

The following scenario describes how HotCache could be used to work with the database and with applications that use Coherence caches. Figure 2-1 illustrates the scenario.

1. Start GoldenGate. See Starting the Application in Administering Oracle GoldenGate Application Adapters. GoldenGate monitors the transaction log for changes of interest. These changes will be placed into a "trail file".
2. Start the Coherence cache server and warm the cache, if required.
3. Start HotCache so that it can propagate changes in the trail file into the cache. If changes occur during cache warming, then they will be applied to the cache once HotCache is started so no changes are lost.
4. Start an application client. As part of its operation, assume that the application performs repeated queries on the cache.
5. A third-party application performs a direct database update.
6. GoldenGate detects the database change which is then propagated to the Coherence cache by HotCache.
7. The application client detects the change in cache.

Figure 2-1  How HotCache Propagates Database Changes to the Cache
### 2.2 How Does HotCache Work

Before implementing a HotCache solution, take some time to understand HotCache fundamentals and supported features. This section includes the following topics:

- Overview of How HotCache Works
- How the GoldenGate Java Adapter uses JPA Mapping Metadata
- Supported Database Operations
- JPA Relationship Support

#### 2.2.1 Overview of How HotCache Works

HotCache processes database change events delivered by GoldenGate and maps those changes onto the affected objects in the Coherence cache. It is able to do this through the use of Java Persistence API (JPA) mapping metadata. JPA is the Java standard for object-relational mapping in Java and it defines a set of annotations (and corresponding XML) that describe how Java objects are mapped to relational tables. As Example 2-1 illustrates, instances of an Employee class could be mapped to rows in an EMPLOYEE table with the following annotations.

**Example 2-1     Mapping Instances of Employee Class to Rows with Java Code**

```java
@Entity
@Table(name="EMPLOYEE")
public class Employee {
    @Id
    @Column(name="ID")
    private int id;
    @Column(name="FIRSTNAME")
    private String firstName;
    ...
}
```

The @Entity annotation marks the Employee class as being persistent and the @Id annotation identifies the id field as containing its primary key. In the case of Coherence cached objects, the @Id field must also contain the value of the key under which the object is cached. The @Table and @Column annotations associate the class with a named table and a field with a named column, respectively.

For simplification, JPA assumes a number of default mappings such as table name=class name and column name=field name so many mappings need only be specified when the defaults are not correct. In Example 2-1, both the table and field names match the Java names so the @Table and @Column can be removed to make the code more compact, as illustrated in Example 2-2.

**Example 2-2    Simplified Java Code for Mapping Instances of Employee Class to Rows**

```java
@Entity
public class Employee {
    @Id int id;
    private String firstName;
    ...
}
```
Note that the Java code in the previous examples can also be expressed as XML. Example 2-3 illustrates the XML equivalent of the Java code in Example 2-1.

**Example 2-3  Mapping Instances of Employee Class to Rows with XML**

```xml
<entity class="Employee">
  <table name="EMPLOYEE"/>
  <attributes>
    <id name="id">
      <column name="ID"/>
    </id>
    <basic name="firstName">
      <column name="FIRSTNAME"/>
    </basic>
    ...
  </attributes>
</entity>
```

Similarly, Example 2-4 illustrates the XML equivalent for the simplified Java code in Example 2-2.

**Example 2-4 Simplified XML for Mapping Instances of Employee Class to Rows**

```xml
<entity class="Employee">
  <attributes>
    <id name="id"/>
    <basic name="firstName"/>
    ...
  </attributes>
</entity>
```

### 2.2.2 How the GoldenGate Java Adapter uses JPA Mapping Metadata

JPA mapping metadata provides mappings from object to relational; however, it also provides the inverse relational to object mappings which HotCache can use. Given the Employee example, consider an update to the FIRSTNAME column of a row in the EMPLOYEE table. Figure 2-2 illustrates the EMPLOYEE table before the update, where the first name John is associated with employee ID 1, and the EMPLOYEE table after the update where first name Bob is associated with employee ID 1.
With GoldenGate monitoring changes to the EMPLOYEE table and HotCache configured on the appropriate trail file, the adapter processes an event indicating the FIRSTNAME column of the EMPLOYEE row with primary key 1 has been changed to Bob. The adapter will use the JPA mapping metadata to first identify the class associated with the EMPLOYEE table, Employee, and then determine the column associated with an Employee's ID field, ID. With this information, the adapter can extract the ID column value from the change event and update the firstName field (associated with the FIRSTNAME column) of the Employee cached under the ID column value.

2.2.3 Supported Database Operations

Database INSERT, UPDATE, and DELETE operations are supported by the GoldenGate Java Adapter. INSERT operations into a mapped table result in the addition of a new instance of the associated class populated with the data from the newly inserted row. Changes applied through an UPDATE operation are propagated to the corresponding cached object. If the cache does not contain an object corresponding to the updated row, then the cache is unchanged by default. To change the default behavior, see HonorRedundantInsert Property. A DELETE operation results in the removal of the corresponding object from the cache, if one exists.

2.2.4 JPA Relationship Support

HotCache does not support the JPA relationship mappings one-to-one, one-to-many, many-to-one, and many-to-many. However HotCache does support JPA embeddable classes and JPA element collections. Embeddable classes and element collections can be used with HotCache to model relationships between domain objects. Domain objects used with HotCache may also refer to each other by an identifier (analogous to foreign keys in a relational database).
As a performance optimization, when using JPA element collections with HotCache, it is suggested to configure GoldenGate with an ADD TRANDATA command specifying the column in the element collection table that is the foreign key to the parent table. The optimization allows HotCache to efficiently find the cache entry to update when a row in the element collection table changes.

2.3 Prerequisites

Make sure you complete the prerequisites prior to using Oracle Coherence GoldenGate HotCache. The instructions assume that you have set up your database to work with GoldenGate.

Setting up a database includes:

- creating a database and tables
- granting user permissions
- enabling logging
- provisioning the tables with data

Example 2-5 illustrates a list of sample commands for the Oracle Database that creates a user named csdemo and grants user permissions to the database.

Note the ALTER DATABASE ADD SUPPLEMENTAL LOG DATA command. When supplemental logging is enabled, all columns are specified for extra logging. At the very least, minimal database-level supplemental logging must be enabled for any change data capture source database. If the values of primary key columns in a database table can change, it is important to include the following commands for Oracle Database: ALTER DATABASE ADD SUPPLEMENTAL LOG DATA (PRIMARY KEY) COLUMNS; and ALTER DATABASE ADD SUPPLEMENTAL LOG DATA (UNIQUE) COLUMNS;.

Example 2-5 Sample Commands to Create a User, Grant Permissions, and Enable Logging

```
CREATE USER csdemo IDENTIFIED BY csdemo;
GRANT DBA TO csdemo;
grant alter session to csdemo;
grant create session to csdemo;
grant flashback any table to csdemo;
grant select any dictionary to csdemo;
grant select any table to csdemo;
grant select any transaction to csdemo;
grant unlimited tablespace to csdemo;
ALTER DATABASE ADD SUPPLEMENTAL LOG DATA;
```

The instructions also assume that you have installed Oracle GoldenGate and started the manager. This includes the following tasks:

- downloading and installing Oracle GoldenGate
- running ggsci to create the GoldenGate subdirectories
- creating a manager parameter (mgr.prm) file, specifying the listener port
- adding JVM libraries to the libraries path
- starting the manager

A detailed description of these tasks is beyond the scope of this documentation. See Installing Oracle GoldenGate in *Installing and Configuring Oracle GoldenGate for*
Oracle Database, Installing Oracle GoldenGate Application Adapters, and Understanding Oracle GoldenGate Adapters in Administering Oracle GoldenGate Application Adapters.

Note:
It is important to use the generic build of Oracle GoldenGate when installing Oracle GoldenGate Application Adapters. Do not use a non-generic instance of Oracle GoldenGate.

2.4 Configuring GoldenGate

Updating a cache from a GoldenGate trail file requires configuring GoldenGate and HotCache. You then enable HotCache by configuring the GoldenGate Java Adapter. This section includes the following topics:

• Monitor Table Changes
• Filter Changes Made by the Current User

2.4.1 Monitor Table Changes

Indicate the table that you want to monitor for changes by using the ADD TRANDATA command. The ADD TRANDATA command can be used on the command line or as part of a ggsci script. For example, to monitor changes to tables in the csdemo schema, use the following command:

```
ADD TRANDATA csdemo.*
```

Example 2-6 illustrates a sample ggsci script named cs-cap.ggsci.

• The script starts the manager and logs into the database. It stops and deletes any running extract named cs-cap.
• The ADD TRANDATA command instructs the extract that tables named csdemo* should be monitored for changes.
• The SHELL command deletes all trail files in the dirdat directory to ensure that if the extract is being recreated, there will be no old trail files. Note that the rm -f command is platform-specific. An extract named cs-cap is created using parameters from the dirprm/cs-cap.prm file. A trail is added at dirdat/cs from the extract cs-cap file.
• The start command starts the cs-cap.ggsci script.
• The ADD EXTRACT Command automatically uses the cs-cap.prm file as the source of parameters, so a PARAMS dirprm/cs-cap.prm, statement is not necessary.

Example 2-6  Sample GoldenGate Java Adapter ggsci Script to Monitor Table Changes

```
start mgr
DBLOGIN USERID csdemo, PASSWORD csdemo
STOP EXTRACT cs-cap
DELETE EXTRACT cs-cap
ADD TRANDATA csdemo.*
```
2.4.2 Filter Changes Made by the Current User

Configure GoldenGate to ignore changes made by the user that the Coherence CacheStores are logged in as. This avoids GoldenGate processing any changes made to the database by Coherence that are already in the cache.

The TranLogOptions excludeUSER Command can be used on the command line or in a ggsci script. For example, the following command instructs GoldenGate extract process to ignore changes to the database tables made by the Coherence CacheStore user logged in as csdemo.

```
TRANLOGOPTIONS excludeUser csdemo
```

Example 2-7 illustrates a sample extract .prm file named cs-cap.prm. The user that the Coherence CacheStore is logged in as is csdemo. The recoveryOptions OverwriteMode line indicates that the extract overwrites the existing transaction data in the trail after the last write-checkpoint position, instead of appending the new data. The EXTRAIL parameter identifies the trail as dirdat/cs. The BR BROFF parameter controls the Bounded Recovery (BR) feature. The BROFF value turns off Bounded Recovery for the run and for recovery. The GETUPDATEBEFORES parameter indicates that the before images of updated columns are included in the records that are processed by Oracle GoldenGate. The TABLE parameter identifies csdemo.* as the tables that should be monitored for changes. The TranLogOptions excludeUSER parameter indicates that GoldenGate should ignore changes to the tables made by the Coherence CacheStore user logged in as csdemo.

Note: The OverwriteMode option is not applicable in Oracle GoldenGate for Big Data.

Example 2-7 Sample Extract .prm File for the GoldenGate Java Adapter

```
EXTRACT cs-cap
USERID csdemo, PASSWORD csdemo
RecoveryOptions OverwriteMode
EXTRAIL dirdat/cs
BR BROFF
GETUPDATEBEFORES
TABLE csdemo.*;
TRANLOGOPTIONS excludeUser csdemo --ignore changes made by csuser
```
The following sections describe the properties needed to configure HotCache and provide details about connecting with Coherence*Extend:

- Create a Properties File with GoldenGate for Java Properties
- Add JVM Boot Options to the Properties File
- Provide Coherence*Extend Connection Information

2.5.1 Create a Properties File with GoldenGate for Java Properties

Create a text file with the filename extension `.properties`. In the file, enter the configuration for HotCache. A minimal configuration should contain the list of event handlers and the fully-qualified Java class of the event handler.

Note:
The path to the `.properties` file must be set in the HotCache replicat TARGETDB parameter in a .prm file, for example:

```
TARGETDB LIBFILE libggjava.so SET property=/home/oracle/gg/hotcache.properties
```

See Edit the HotCache Replicat Parameter File.

Example 2-8 illustrates a `.properties` file that contains the minimal configuration for a HotCache project. The following properties are used in the file:

- `gg.handlerlist=hotcache`
  The `gg.handlerlist` property specifies a comma-separated list of active handlers. This example defines the logical name `hotcache` as database change event handler. The name of a handler can be defined by the user, but it must match the name used in the `gg.handler.{name}.type` property in the following bullet.

- `gg.handler.hotcache.type=[oracle.toplink.goldengate.CoherenceAdapter|oracle.toplink.goldengate.CoherenceAdapter1220]`
  The `gg.handler.{name}.type` property defines the handler for HotCache. The `{name}` field should be replaced with the name of an event handler listed in the `gg.handlerlist` property. The only handlers that can be set for HotCache are `oracle.toplink.goldengate.CoherenceAdapter` or `oracle.toplink.goldengate.CoherenceAdapter1220`. Use `oracle.toplink.goldengate.CoherenceAdapter1220` with GoldenGate Application Adapters release 12.2.0 or later. Use `oracle.toplink.goldengate.CoherenceAdapter` with GoldenGate Application Adapters releases earlier than 12.2.0.

There are many other properties that can be used to control the behavior of the GoldenGate Java Adapter. See Using Oracle GoldenGate Application Adapters Properties in Administering Oracle GoldenGate Adapters.

Example 2-8  `.properties` File for a HotCache Project

```
# ====================================================================
# List of active event handlers
# ====================================================================

#gg.handlerlist=hotcache
```

```bash
Example 2-8  .properties File for a HotCache Project
```

```bash
# List of active event handlers
# ====================================================================

gg.handlerlist=hotcache
```
2.5.2 Add JVM Boot Options to the Properties File

This section describes the properties that must appear in the JVM boot options section of the .properties file. These options are defined by using the jvm.bootoptions property. A sample jvm.bootoptions listing is illustrated in JVM boot options section of Example 2-8.

This section includes the following topics:

- Java Classpath Files
- HotCache-related Properties
- Coherence-related Properties
- Logging Properties

2.5.2.1 Java Classpath Files

The following is a list of directories and JAR files that should be included in the Java classpath. The directories and JAR files are defined with the java.class.path property.

- dirprm – the GoldenGate dirprm directory
- ggjava.jar – contains the GoldenGate Java adapter libraries
- ojdbc6.jar – contains the JDBC driver classes for the source database
- coherence.jar – contains the Oracle Coherence libraries
- coherence-hotcache.jar – contains the Oracle Coherence GoldenGate HotCache libraries
- javax.persistence.jar – contains the Java persistence libraries
- eclipselink.jar – contains the EclipseLink libraries
- toplink-grid.jar – contains the Oracle TopLink libraries required by HotCache
- domain classes – the JAR file or directory containing the user classes cached in Coherence that are mapped with JPA for use in HotCache. Also, the Coherence configuration files, persistence.xml file, and any orm.xml file.
2.5.2.2 HotCache-related Properties

The `toplink.goldengate.persistence-unit` property is required as it identifies the persistence unit defined in `persistence.xml` file that HotCache should load. The persistence unit contains information such as the list of participating domain classes, configuration options, and optionally, database connection information.

The `toplink.goldengate.on-error` property is optional. It controls how the adapter responds to errors while processing a change event. This response applies to both expected optimistic lock exceptions and to unexpected exceptions. This property is optional, as its value defaults to "Refresh". Refresh causes the adapter to attempt to read the latest data for a given row from the database and update the corresponding object in the cache. Refresh requires a database connection to be specified in the `persistence.xml` file. This connection will be established during initialization of HotCache. If a connection cannot be made, then an exception is thrown and HotCache will fail to start.

The other on-error strategies do not require a database connection. They are:

- **Ignore**—Log the exception only. The cache may be left with stale data. Depending on application requirements and cache eviction policies this may be acceptable.
- **Evict**—Log a warning and evict the object corresponding to the change database row from the cache
- **Fail**—Throw an exception and exit HotCache

2.5.2.3 Coherence-related Properties

Any Coherence property can be passed as a system property in the Java boot options. The `coherence.distributed.localstorage` system property with a value of `false` is the only Coherence property that is required to be passed in the Java boot options. Like all Coherence properties, precede the property name with the `-D` prefix in the `jvm.bootoptions` statement, for example:

```
-Dcoherence.distributed.localstorage=false
```

2.5.2.4 Logging Properties

The following logging properties can be defined for HotCache.

The `-Dlog4j.configuration=default-log4j.properties` property specifies the default Log4J configuration file. Example properties are located in `$GOLDEN_GATE_HOME/ggjava/resources/classes/` directory. You can merge these with your existing Log4J configuration.

The Log4J properties file that is bundled with GoldenGate for Java is for demonstration purposes only. The file can be used as-is, or you can merge its contents with the existing Log4J properties.

If the file is used as-is, then it should be copied into the `dirprm` directory, given a new name, and specified with the `-Dlog4j.configuration` property. For example, the following line specifies the user-defined `my-log4j.properties` file in the `dirprm` directory (note the `dirprm` directory is already on the classpath):

```
-Dlog4j.configuration=my-log4j.properties
```
Using the default properties file in its current location can cause problems during upgrades: your changes will lost when a new distribution is installed.

To allow HotCache to log warnings, add the following line to the property file:

```
log4j.logger.oracle.toplink.goldengate=WARN, stdout, rolling
```

To allow HotCache to log errors, add the following line to the property file you use:

```
-Dlog4j.logger.oracle.toplink.goldengate=DEBUG, stdout, rolling
```

**Note:**

A Coherence Log4J configuration can co-exist with the GoldenGate Log4J configuration. Both can be included in the same file that is configured on the jvm.bootoptions path.

### 2.5.3 Provide Coherence*Extend Connection Information

The connection between HotCache and the Coherence cluster can be made with Coherence*Extend. For more information on Coherence*Extend, see *Developing Remote Clients for Oracle Coherence*.

The Coherence configuration files must be in a directory referenced by the jvm.bootoptions=-Djava.class.path= ... entry in the .properties file. For an example, see the jvm.bootoptions entry in Example 2-8.

**Example 2-9** illustrates the section of a client cache configuration file that uses Coherence*Extend to connect to the Coherence cluster. In the client cache configuration file, Coherence*Extend is configured in the `<remote-cache-scheme>` section. By default, the connection port for Coherence*Extend is 9099.

**Example 2-9  Coherence*Extend Section of a Client Cache Configuration File**

```xml
<cache-config>
  ...
  <caching-schemes>
    <remote-cache-scheme>
      <scheme-name>CustomRemoteCacheScheme</scheme-name>
      <service-name>CustomExtendTcpCacheService</service-name>
      <initiator-config>
        <tcp-initiator>
          <remote-addresses>
            <socket-address>
              <address>localhost</address>
              <port>9099</port>
            </socket-address>
          </remote-addresses>
        </tcp-initiator>
        <outgoing-message-handler>...
        </outgoing-message-handler>
      </initiator-config>
    </remote-cache-scheme>
  ...
</cache-config>
```
Example 2-10 illustrates the section of a server cache configuration file that listens for Coherence*Extend connections. In the server cache configuration file, Coherence*Extend is configured in the `<proxy-scheme>` section. By default, the listener port for Coherence*Extend is 9099.

Example 2-10  Coherence*Extend Section of a Server Cache Configuration File

```xml
<cache-config>
  ...
  <caching-schemes>
    ...
    <proxy-scheme>
      <scheme-name>CustomProxyScheme</scheme-name>
      <service-name>CustomProxyService</service-name>
      <thread-count>2</thread-count>
      <acceptor-config>
        <tcp-acceptor>
          <local-address>
            <address>localhost</address>
            <port>9099</port>
          </local-address>
        </tcp-acceptor>
      </acceptor-config>
      <load-balancer>proxy</load-balancer>
      <autostart>true</autostart>
    </proxy-scheme>
  </caching-schemes>
</cache-config>
```

2.6 Configuring the GoldenGate Java Adapter

The GoldenGate Java adapter provides a way to process GoldenGate data change events in Java by configuring an event handler class. The configuration for the GoldenGate Java adapter allows it to monitor an a trail file and to pass data change events to HotCache. The configuration is provided in a replicat parameter and is described in this section.

This section includes the following topic:

- Edit the HotCache Replicat Parameter File

2.6.1 Edit the HotCache Replicat Parameter File

This section describes the parameters that can be defined in the replicat .prm file for a GoldenGate Java adapter. The parameters that are illustrated in Example 2-11 constitute a minimal configuration for a HotCache project.

For a complete list of parameters, see Summary of Replicat Parameters in Reference for Oracle GoldenGate for Windows and UNIX.

- TARGETDB LIBFILE libggjava.so SET property=’/home/oracle/gg/hotcache.properties
- GROUPTRANSOPS 1

The GROUPTRANSOPS parameter controls transaction grouping by the GoldenGate replicat process. A value of 1 tells the GoldenGate replicat process to honor source database transaction boundaries in the trail file. A value greater than 1 tells the GoldenGate replicat process to group operations from multiple source
database transactions into a single target transaction. See GROUPTRANSOPS in Reference for Oracle GoldenGate for Windows and UNIX

- MAP scott.*, TARGET scott.*;

The MAP parameter tells the GoldenGate replicat process how to map source database tables to the replication target. The parameter syntax assumes the replication target is a relational database. For HotCache it is appropriate to specify an identical mapping. See TABLE and MAP Options in Reference for Oracle GoldenGate for Windows and UNIX

Example 2-11 illustrates a sample .prm file for a GoldenGate Java adapter.

Example 2-11 Sample .prm Parameter File for a GoldenGate Java Adapter

REPLICAT hotcache
TARGETDB LIBFILE libggjava.so SET property=/home/user/project/hotcache.properties
GROUPTRANSOPS 1
MAP scott.*, TARGET scott.*;

2.7 Configuring the Coherence Cache Servers

You must modify the classpaths of all Coherence cache server JVMs that contain caches that are refreshed by HotCache. Place the following JAR files, included in the Coherence installation, on each cache server classpath:

- coherence-hotcache.jar – contains the Oracle Coherence GoldenGate HotCache libraries
- javax.persistence.jar – contains the Java persistence libraries
- eclipselink.jar – contains the EclipseLink libraries
- topplink-grid.jar – contains the Oracle TopLink libraries required by HotCache
- domain classes – the JAR file or directory containing the user classes cached in Coherence that are mapped with JPA for use in HotCache.

2.8 Using Portable Object Format with HotCache

Serialization is the process of encoding an object into a binary format. It is a critical component to working with Coherence as data must be moved around the network. Portable Object Format (also known as POF) is a language-agnostic binary format. POF was designed to be very efficient in both space and time and has become a cornerstone element in working with Coherence. POF serialization can be used with HotCache but requires a small update to the POF configuration file (pfo-config.xml) to allow for HotCache and TopLink Grid framework classes to be registered. The pof-config.xml file must include the coherence-hotcache-pof-config.xml file and must register the TopLinkGridPortableObject user type and TopLinkGridSerializer as the serializer. The <type-id> for each class must be unique and must match across all cluster instances. See Registering POF Objects in Developing Applications with Oracle Coherence.

The <allow-interfaces> element must be set to true to allow you to register a single class for all implementors of the TopLinkGridPortableObject interface.

Example 2-12 illustrates a sample pof-config.xml file for HotCache. The value integer_value represents a unique integer value greater than 1000.
Example 2-12 Sample POF Configuration File for HotCache

```xml
<?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>
    <include>coherence-hotcache-pof-config.xml</include>
    <!-- User types must be above 1000 -->
    ...
    <user-type>
      <type-id><integer_value/></type-id>
      <class-name>oracle.eclipselink.coherence.integrated.cache.TopLinkGridPortableObject</class-name>
      <serializer>
        <class-name>oracle.eclipselink.coherence.integrated.cache.TopLinkGridSerializer</class-name>
      </serializer>
    </user-type>
    ...
  </user-type-list>
  <allow-interfaces>true</allow-interfaces>
  ...
</pof-config>
```

### 2.9 Configuring HotCache JPA Properties

You can customize HotCache using a number of custom JPA properties that can be configured per JPA entity type. These properties can be configured either by an @Property annotation on the JPA entity class or by a <property> element in the persistence.xml file. The latter takes precedence in the event of conflicting configuration.

This section includes the following topics:

- **EnableUpsert Property**
- **HonorRedundantInsert Property**
- **SyntheticEvent Property**
- **eclipselink.cache.shared.default Property**

#### 2.9.1 EnableUpsert Property

**EnableUpsert**

The EnableUpsert property controls whether HotCache inserts a cache entry when an update operation is received in the GoldenGate trail file but no corresponding cache entry is present in cache at the entity key. By default, HotCache ignores updates to absent entities. Set this property to true if you want HotCache to insert missing entities into the cache when update operations are received in the trail file. The default value of this property is false.

Setting this property to true can facilitate warming caches in an event-driven manner if it is likely that entities will be accessed from the cache after their corresponding records are updated in the underlying database.
Note:

There are risks to consider when using this property:

- The entity to insert is read from the database, as the trail file may not contain values for all fields of the entity to be inserted. This can reduce the throughput of the HotCache process by waiting on database reads.
- Cache capacity can be exhausted if more rows in the DB are updated than the number of entities in the cache for which capacity was provisioned.

Entity Class Annotation

```java
@Property(name = "EnableUpsert", value = "false", valueType = boolean.class)
```

Persistence XML Property

```xml
<property name="[fully qualified entity class name].EnableUpsert" value="[true|false]"/>
```

2.9.2 HonorRedundantInsert Property

HonorRedundantInsert

The **HonorRedundantInsert** property controls whether HotCache honors an insert operation in the GoldenGate trail file when a cache entry at that key is already present. By default, HotCache ignores a redundant insert operation. However, when a JPA entity is mapped to a complex materialized view in Oracle Database and a row is updated in a table underlying that materialized view (thus updating one or more rows of the materialized view), Oracle Database inserts a new row into the materialized view with the same PK as an existing row but with a new rowid and deletes the existing row. Therefore, HotCache sees a redundant insert operation that really represents an update to the cached JPA entity. Users in this situation should also consider suppressing replication of delete operations on that materialized view through the use of GoldenGate configuration; otherwise, the cached entity is deleted by HotCache. The default value of this property is `false`.

Entity Class Annotation

```java
@Property(name = "HonorRedundantInsert", value = "false", valueType = boolean.class)
```

Persistence XML Property

```xml
<property name="[fully qualified entity class name].HonorRedundantInsert" value="[true|false]"/>
```

2.9.3 SyntheticEvent Property

SyntheticEvent

The **SyntheticEvent** property controls whether cache writes by HotCache are synthetic or not. Synthetic writes to Coherence caches do not trigger events in Coherence; they do not engage Federated Caching; and they do not call Coherence CacheStore implementations. Set this property to `false` for a JPA entity class if you want cache writes by HotCache for that class to be non-synthetic so that events are triggered,
Federated Caching is engaged, and CacheStore implementations are called (if any of those are configured for the entity class cache). The default value of this property is true for every entity class.

**Note:**

There is a risk of infinite replication loops if the SyntheticEvent is set to true for an entity class and a CacheStore implementation is configured on that entity class cache and writing to the same database HotCache is replicating to Coherence. This risk can be mitigated by filtering transactions by database user. See Filter Changes Made by the Current User.

**Entity Class Annotation**

@Property(name = "SyntheticEvent", value = "[true|false]", valueType = boolean.class)

**Persistence XML Property**

<property name="[fully qualified entity class name].SyntheticEvent" value="[true|false]"/>

### 2.9.4 eclipselink.cache.shared.default Property

**eclipselink.cache.shared.default**

The eclipselink.cache.shared.default property is used to enable the EclipseLink internal shared cache. It is important to disable the internal shared cache in the HotCache JVM by setting the property to false in the persistence.xml file.

**Persistence XML Property**

<property name="eclipselink.cache.shared.default" value="false"/>

### 2.10 Warming Caches with HotCache

HotCache can be used to warm caches by loading an initial dataset. This approach eliminates the need to write custom cache warming programs because it leverages GoldenGate and HotCache for initial cache warming. This section includes the following topics:

- Create and Run an Initial Load Extract
- Create and Run a Cache Warmer Replicat
- Capturing Changed Data While Warming Caches

#### 2.10.1 Create and Run an Initial Load Extract

To create and run an initial load extract:

1. Create a GoldenGate extract parameter file named initload.prm as shown below and save it to GG_HOME/dirprm. Note that the extract files cannot have filenames longer than eight characters. A GoldenGate extract process that is run with this parameter file selects records from the source database (as opposed to
capturing changes from the database's transaction log) and writes them to a trail
file in canonical format.

-- This is an initial load extract initload
-- SOURCEISTABLE parameter indicates source is a table, not redo logs
SOURCEISTABLE
USERID <user>, PASSWORD <password>
-- EXTFILE parameter indicates path and prefix of data files
-- Note: set MEGABYTES parameter to a maximum file size relative
-- to the amount of source data being extracted
EXTFILE GG_HOME/dirdat/IL, maxfiles 9999, MEGABYTES 5, PURGE
TABLE <schema>*.

2. Using the above extract parameters file, run a GoldenGate initial load extract
process directly from the command line as shown in the following example.

    cd GG_HOME
    extract paramfile GG_HOME/dirprm/initload.prm reportfile GG_HOME/dirrpt/
                      initload.rpt

After running the extract process, there will be one or more trail files named IL0001,
IL0002, etc... in the GG_HOME/dirdat directory. If no files are generated, then
review the GG_HOME/dirrpt/initload.rpt file.

2.10.2 Create and Run a Cache Warmer Replicat

To create and run a cache warmer replicat:

1. Create a GoldenGate replicat parameter file named warmcach.prm as shown in the
   example below. A GoldenGate replicat process that is run with this parameter file
   reads the initial load dataset from the trail files. See Create and Run an Initial Load
   Extract.

   REPLICAT warmcach
   TARGETDB LIBFILE libggjava.so SET property=/home/user/project/warmcach.properties
   MAP <schema>.*, TABLE <schema>.*

2. Since the replicat parameter file uses the GoldenGate Java Adapter, create a
   corresponding warmcach.properties file in GG_HOME/dirprm as shown in the
   example below.

    #============================================================
    # List of active event handlers
    gg.handlerlist=hotcache
    #============================================================
    # HotCache handler
    gg.handler.hotcache.type=oracle.toplink.goldengate.CoherenceAdapter1220
    #============================================================
    # Options for the HotCache JVM.
    # Obviously the persistence unit name, classpath, and other
    # options will vary between users and environments. The classpath
    # must include $GG_HOME/dirprm, $GG_HOME/ggjava/ggjava.jar, and
    # coherence.jar, coherence-hotcache, jar, eclipselink.jar,
    # javax.persistence.jar, and toplink-grid.jar from a Coherence
    # installation, as well as a JDBC driver jar for your database,
    # and a jar with your cache key and value classes in it.
    # Other system properties may override Coherence operational
    # configuration elements for cluster addresses and names,
    # paths to configuration files, etc. You may also wish to provide
    # non-default JVM heap sizes, log4j configuration, etc.
    jvm.bootoptions= -Dtoplink.goldengate.persistence-unit=pu_name -
                    Djava.class.path=jvm_class_path
3. Register the `warmcach` replicat process with the GoldenGate installation using the GoldenGate GGSCI command-line interface as shown in the following example.

```bash
cd $GG_HOME
./ggsci
add replicat warmcach, exttrail GG_HOME/dirrpt/IL
```

The replicat parameter file and properties file above are used by the GoldenGate `warmcach` process that reads the trail files created by the initial load extract process.

4. Run the GoldenGate `warmcach` replicat process by issuing the following commands through the GoldenGate GGSCI command-line interface.

```bash
cd $GG_HOME
./ggsci
start mgr
start replicat warmcach
```

After the `warmcach` replicat process has finished running, the contents of the initial load trail files will have been transformed into JPA entities and put into Coherence caches.

5. Stop and unregister the `warmcach` replicat, using the following GGSCI commands.

```bash
stop replicat warmcach
delete replicat warmcach
```

### 2.10.3 Capturing Changed Data While Warming Caches

HotCache was developed to refresh Coherence caches as underlying database transactions occur. Using HotCache for initial cache warming is an added benefit. It is possible to capture changed data in the database while initial cache warming takes place and refresh Coherence caches with that changed data by following a carefully sequenced procedure. The necessary sequence of operations is as follows:

1. Start the normal source extract process that captures change data from the database's redo logs, but do not start the normal HotCache replicat process that refreshes Coherence caches with that change data.
2. Start the initial load extract process to select the initial data set from the database.
3. Run the cache warming replicat process to warm Coherence caches with the initial data set.
4. Verify that the initial load has completed correctly by comparing the number of rows extracted from the database by GoldenGate (see `initload.rpt`) with the number of entries in the target Coherence caches according to Coherence MBeans or command-line interface commands.
5. Start the normal HotCache replicat process to refresh Coherence caches with change data.

### 2.11 Implementing High Availability for HotCache

HotCache is a client of Coherence cache services and invokes the services to insert, update, or evict cache entries in response to transactions in an underlying database. As a cache client, HotCache can be configured either as a Coherence cluster member or as a Coherence*Extend client connecting to a Coherence proxy service in the cluster.
In best-practice deployments, Coherence cache services and proxy services are already highly available due to redundancy of service members (for example, multiple cache server processes and multiple proxy server processes) and due to built-in automatic failover capabilities within Coherence. For example, if a proxy server should fail, then Coherence*Extend clients that are using the proxy server automatically fail over to another proxy server. Likewise, if a cache server should fail then another cache server assumes responsibility for its data and client interactions with that data automatically redirect to the new cache server owning the data.

Making the HotCache client itself highly available relies on standard GoldenGate HA techniques since the HotCache JVM runs embedded in a GoldenGate process.

GoldenGate implements “single server” HA through `AUTOSTART` and `AUTORESTART` parameters enforced by the Manager process in a GoldenGate installation. The Manager process automatically starts registered GoldenGate processes configured with `AUTOSTART`. It also detects the death of (and automatically restarts), registered GoldenGate processes configured with `AUTORESTART`.

To protect against failure of the Manager process itself or the host on which it runs or the network connecting that host, GoldenGate relies on Oracle Clusterware to detect the death of the active GoldenGate installation and fail over to a passive GoldenGate installation.

GoldenGate high availability, including GoldenGate processes that embed HotCache JVMs, is discussed in the *Oracle GoldenGate High Availability Using Oracle Clusterware* white paper.

### 2.12 Support for Oracle Data Types

HotCache uses EclipseLink as its JPA provider. It is reasonable to expect HotCache to support Oracle-specific data types supported by EclipseLink. For example, EclipseLink supports data types specific to Oracle Database, such as `SDO_GEOMETRY` from the Oracle Spatial and Graph option for Oracle Database and `XMLType` in all Oracle Database editions.

It is important to understand that data is presented to EclipseLink differently when used in HotCache than when used in the typical JPA scenario. In the typical JPA scenario, EclipseLink interacts with the database through a JDBC connection and EclipseLink consumes data as presented by the JDBC API and driver-specific extensions (for example an `SDO_GEOMETRY` column is represented as an instance of `java.sql.Struct`). Whereas in HotCache, data is read from a GoldenGate trail file; there is no JDBC connection involved. Therefore EclipseLink consumes the GoldenGate representation of data as opposed to the JDBC representation of data. For example, GoldenGate represents an `SDO_GEOMETRY` column as an XML document and not as an instance of `java.sql.Struct`.

These differences in data representation may necessitate the use of HotCache-specific EclipseLink converters when using EclipseLink within HotCache that take the place of standard EclipseLink converters used in typical JPA scenarios. See `@Converter` in *Java Persistence API (JPA) Extensions Reference for EclipseLink*. The following sections describe HotCache support for specific Oracle Database data types supported by EclipseLink and how to configure EclipseLink within HotCache to use those data types.

- **Support for `SDO_GEOMETRY`**
- **Support for `XMLType`**
2.12.1 Support for SDO_GEOMETRY

EclipseLink supports the Oracle Spatial and Graph option of Oracle Database by mapping SDO_GEOMETRY columns to instances of oracle.spatial.geometry.JGeometry (the Java class shipped with the Oracle Spatial and Graph option). See Using Oracle Spatial and Graph in Solutions Guide for EclipseLink.

Therefore, HotCache supports mapping columns of type SDO_GEOMETRY to instances of oracle.spatial.geometry.JGeometry bound to fields of JPA entities. This support requires configuring a HotCache-specific EclipseLink Converter of class oracle.toplink.goldengate.spatial.GoldenGateJGeometryConverter as shown in the following example.

```java
import javax.persistence.Access;
import javax.persistence.AccessType;
import javax.persistence.Convert;
import javax.persistence.Converter;
import javax.persistence.Entity;
import oracle.spatial.geometry.JGeometry;
import oracle.toplink.goldengate.spatial.GoldenGateJGeometryConverter;

@Entity
@Converter(name="JGeometry", converterClass= GoldenGateJGeometryConverter.class)
public class SpatialEntity {
    private JGeometry geometry;

    @Access(AccessType.PROPERTY)
    @Convert("JGeometry")
    public JGeometry getGeometry() { return geometry; }
}
```

This converter converts the GoldenGate XML representation of an SDO_GEOMETRY column into an instance of oracle.spatial.geometry.JGeometry bound to a field of a JPA entity. The GoldenGateJGeometryConverter class is contained in coherence-hotcache.jar which should already be on the classpath of the HotCache JVM and Coherence cache server JVMs used in HotCache deployments (along with the eclipselink.jar file on which it depends). However the JGeometry class is contained in sdoapi.jar from an installation of Oracle Spatial and Graph option. The sdoapi.jar file must be on the classpath of the HotCache JVM, and any other JVM where the JPA entity containing a JGeometry field will be deserialized.

The oracle.spatial.geometry.JGeometry class implements java.io.Serializable, so JPA entities with JGeometry fields cached in Coherence can be serialized with java.io.Serializable without any additional configuration. To use Coherence’s Portable Object Format (POF) to serialize a JPA entity with a JGeometry field, the JGeometrySerializer must be added to the POF configuration file used in the Coherence deployment, as in the following example.

```xml
<user-type>
    <type-id>1001</type-id><!--use a type-id value above 1000 that doesn’t conflict with other POF type-ids-->
    <class-name>oracle.spatial.geometry.JGeometry</class-name>
    <serializer>
```

---

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Support for Oracle Data Types
The `oracle.spatial.geometry.JGeometryPofSerializer` class is contained in `coherence-hotcache.jar`, which must be on the classpath of any JVM that will serialize or deserialize a JPA entity with a `JGeometry` field using POF.

### 2.12.2 Support for XMLType

EclipseLink supports the Oracle Database XMLType data type by mapping XMLType columns to instances of `java.lang.String` or `org.w3c.dom.Document` (depending on the type of the mapped field in the JPA entity). See DirectToXMLTypeMapping in EclipseLink API Reference and Mapping XMLTYPE in the On Persistence blog.

Therefore, HotCache supports mapping columns of type XMLType to instances of `java.lang.String` or `org.w3c.dom.Document` bound to fields of JPA entities. This support requires configuring a standard EclipseLink DirectToXMLTypeMapping.

GoldenGate must be configured to use integrated capture mode for support of XMLType columns. See Summary of Supported Oracle Data Types and Objects Per Capture Mode and Deciding Which Capture Method to Use in Installing and Configuring Oracle GoldenGate for Oracle Database.

### 2.13 Configuring Multi-Threading in HotCache

HotCache can use multiple threads to apply trail file operations to Coherence caches. Multiple threads can increase the throughput of a HotCache process as compared to using a single thread to apply trail file operations. Before configuring multi-threading, evaluate whether concurrently applying trail file operations poses data correctness risks in the Coherence caches and the system using HotCache.

Transactions and their operations appear in the trail file in the order in which they were committed in the source database. By default, HotCache applies operations one at a time on a single thread to ensure the operations are applied to the cache in the exact same order in which they were applied to the source database. When using multi-threading, operations can be applied in a different order than that in which they were applied to the source database tables and can result in correctness risks.

When determining the potential risk, consider the following examples:

- If one database transaction inserts a row in a table and the next database transaction deletes that row, then applying operations out of order can leave an object in the cache whose corresponding database row is deleted.
- If one database transaction updates a column to an older value and the next database transaction updates that column to a newer value, then applying operations out of order can leave the older value in the cached object instead of the newer value. (You can use the JPA optimistic locking features, which are supported by HotCache, to mitigate this particular update risk).

If you determine that using multiple threads to apply trail file operations to Coherence caches poses no data correctness risks in the system using HotCache, then HotCache can be configured to use multi-threading as follows:

1. Edit the GoldenGate Java Adapter properties file and configure the HotCache event handler to use transaction mode:
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Configuring Multi-Threading in HotCache

By default, GoldenGate Java Adapter event handlers use operation mode. In operation mode (op), event handlers process operations one at a time. In transaction mode (tx), event handlers process all operations in a transaction at a time.

2. Edit the GoldenGate Java Adapter properties file and set the coherence.hotcache.concurrency system property on the HotCache JVM with a value between one and eight times the number of cores on the JVM host, inclusive (as reported by java.lang.Runtime.getAvailableProcessors()). For example:

```
jvm.bootoptions=-Dcoherence.hotcache.concurrency=16
```

The value of this property determines the number of threads HotCache uses to concurrently apply trail file operations to Coherence caches.

3. Edit the HotCache replicat .prm file and set the GROUPTRANOPS property. A value of 1 causes source database transaction boundaries to be honored. A value greater than 1 causes transaction grouping within the GoldenGate replicat. The default value is 1000.

Summary of Hot Cache Thread Behavior

Assuming HotCache is run in a GoldenGate replicat process as recommended, the risks stemming from conflicting source database transactions only materialize if the GROUPTRANOPS property is configured to a value other than one. A value of 1 causes the source database transaction boundaries and sequencing to be honored by the HotCache replicat. Therefore, the operations in one transaction are applied in parallel followed by the operations in the next transaction and so on. The GROUPTRANOPS property default is 1000, which groups trail file operations from multiple successive source database transactions into one target transaction of at least 1,000 operations. The likelihood of data correctness risks materializing when the GROUPTRANOPS parameter is set to greater than one is equivalent to the likelihood of conflicting operations within the grouped source database transactions, given the magnitude of the GROUPTRANOPS property value and the write rate and volume of the source database. See GROUPTRANSOPS in Reference for Oracle GoldenGate for Windows and UNIX.

The following table summarizes HotCache thread behavior depending on the values of the GoldenGate Java Adapter mode property and the coherence.hotcache.concurrency property.

<table>
<thead>
<tr>
<th>Mode</th>
<th>Concurrency</th>
<th>Behavior</th>
</tr>
</thead>
<tbody>
<tr>
<td>op</td>
<td>N/A</td>
<td>In op mode, HotCache applies trail file operations one at a time on a single thread (the GoldenGate Java Adapter thread) as each operation is read from the trail file. This is the HotCache default behavior. The value of the concurrency property is not considered in operation mode.</td>
</tr>
</tbody>
</table>
Table 2-1  (Cont.) Hot Cache Thread Behavior

<table>
<thead>
<tr>
<th>Mode</th>
<th>Concurrency</th>
<th>Behavior</th>
</tr>
</thead>
<tbody>
<tr>
<td>tx</td>
<td>1</td>
<td>In tx mode with a concurrency property value of 1, HotCache iterates and applies a transaction worth of trail file operations on a single thread (the GoldenGate Java Adapter thread). The group of operations comprising the transaction is determined by the value of the GoldenGate replicat GROUPTRANOPS property. The default value of the concurrency property is 1. This configuration may exhibit greater throughput than the operation mode configuration, even though it is still single-threaded and therefore poses no data correctness risks.</td>
</tr>
<tr>
<td>tx</td>
<td>&gt;1</td>
<td>In tx mode with a concurrency property value greater than 1, HotCache applies a transaction worth of operations in parallel on multiple HotCache threads. The group of operations comprising the transaction is determined by the value of the GoldenGate replicat GROUPTRANOPS property. This configuration should exhibit greater throughput than single-threaded configurations and throughput generally increases with the number of threads configured to a maximum of eight times the number of cores on the HotCache host.</td>
</tr>
</tbody>
</table>

2.14 Using HotCache Multitenant Mode

HotCache can refresh caches for specific tenants. In Multitenant mode, a tenant identifier is used in conjunction with a Coherence scope name to ensure that HotCache only refreshes caches for a specified tenant. The GoldenGate trail file is assumed to include data for a single tenant, and must be configured to include data for a single tenant. If you want to refresh caches for multiple tenants, then a different HotCache process must be used for each tenant. If you are using Oracle Database and have not already done so, configure GoldenGate multitenant support before completing these instructions. See Configuring Oracle GoldenGate in a Multitenant Container Database in Installing and Configuring Oracle GoldenGate for Oracle Database.

To use HotCache multitenant mode:

1. Edit the HotCache properties file and include a coherence.hotcache.tenantid system property, within the JVM boot options section, that is set to the database tenant identifier. For example:

   ```
   -Dcoherence.hotcache.tenantid=oracle
   ```

2. Edit the Coherence cache configuration file to include a scope name for the configuration. For example

   ```xml
   <?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
coherece-cache-config.xsd">
   <defaults>
   <scope-name>accounts</scope-name>
   </defaults>
   ...
   ```
Note:
Given the above tenant identifier and scope name, the cache service name changes to oracle/accounts:serviceName.

2.15 Managing HotCache

You can manage HotCache to ensure that cache update operations are performed within acceptable time limits. HotCache uses JMX to collect management data, which is viewed using either a JMX browser, a Coherence report, or the Coherence-Java VisualVM plug-in. Management data includes statistics for the GoldenGate HotCache adapter as a whole in addition to statistics for specific caches and operation types. This section includes the following topics:

- CoherenceAdapterMXBean
- Understanding the HotCache Report
- Monitoring HotCache Using the Coherence-JVisualVM Plug-In

2.15.1 CoherenceAdapterMXBean

The CoherenceAdapterMXBean MBean represents a Golden Gate HotCache adapter and provides operational and performance statistics. Zero or more instances of this managed bean are created: one managed bean instance for each adapter instance.

The object name of the MBean is:

```
Type=CoherenceAdapter,name=replicat name,member=member name
```

To view the CoherenceAdapterMXBean MBean from an MBean browser, you must enable Coherence management. If you are new to Coherence JMX management, see Using JMX to Manage Oracle Coherence.

Attributes

Table 2-2 describes the attributes for CacheMBean.

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Type</th>
<th>Access</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>CacheNames</td>
<td>String[]</td>
<td>read-only</td>
<td>The names of the caches that were refreshed by the CoherenceAdapter</td>
</tr>
<tr>
<td>ExecutionTimePerOperationStatistics</td>
<td>LongSummaryStatistics</td>
<td>read-only</td>
<td>Summary statistics about the execution time for each operation in nanoseconds since the statistics were last reset</td>
</tr>
<tr>
<td>ExecutionTimePerTransactionStatistics</td>
<td>LongSummaryStatistics</td>
<td>read-only</td>
<td>Summary statistics about the execution time for each transaction in nanoseconds since the statistics were last reset</td>
</tr>
<tr>
<td>InvocationsPerOperationStatistics</td>
<td>IntSummaryStatistics</td>
<td>read-only</td>
<td>Summary statistics about the number of invocations for each operation since the statistics were last reset</td>
</tr>
<tr>
<td>Attribute</td>
<td>Type</td>
<td>Access</td>
<td>Description</td>
</tr>
<tr>
<td>-----------------------------------</td>
<td>-----------------------</td>
<td>---------</td>
<td>-----------------------------------------------------------------------------</td>
</tr>
<tr>
<td>LastExecutionTimePerOperationStatistic</td>
<td>LongSummaryStatistics</td>
<td>read-only</td>
<td>Summary statistics about the execution time for each operation in nanoseconds since this method was last called</td>
</tr>
<tr>
<td>LastOperationReplicationLagStatistics</td>
<td>LongSummaryStatistics</td>
<td>read-only</td>
<td>Summary statistics about operation replication lag in milliseconds since this method was last called</td>
</tr>
<tr>
<td>NumberOfOperationsProcessed</td>
<td>Long</td>
<td>read-only</td>
<td>The aggregate number of operations processed since the statistics were last reset</td>
</tr>
<tr>
<td>OperationReplicationLagStatistics</td>
<td>LongSummaryStatistics</td>
<td>read-only</td>
<td>Summary statistics about operation replication lag in milliseconds since the statistics were last reset</td>
</tr>
<tr>
<td>OperationsPerTransactionStatistics</td>
<td>IntSummaryStatistics</td>
<td>read-only</td>
<td>Summary statistics about the number of operations for each transaction since the statistics were last reset</td>
</tr>
<tr>
<td>PerCacheStatistics</td>
<td>Map</td>
<td>read-only</td>
<td>Execution time summary statistics in nanoseconds for each cache for each operation type</td>
</tr>
<tr>
<td>StartTime</td>
<td>Date</td>
<td>read-only</td>
<td>The time at which the CoherenceAdapter was started</td>
</tr>
<tr>
<td>TrailFileName</td>
<td>String</td>
<td>read-only</td>
<td>The name of the trail file currently being read</td>
</tr>
<tr>
<td>TrailFilePosition</td>
<td>String</td>
<td>read-only</td>
<td>The position in the trail file of the last successfully-processed operation</td>
</tr>
</tbody>
</table>

Operations

The **CoherenceAdapterMXBean** MBean includes a **resetStatistics** operation that resets all cache statistics.

### 2.15.2 Understanding the HotCache Report

The HotCache report includes operational settings and performance statistics. The statistical data is collected from the **CoherenceAdapterMXBean** MBean and presented over time making it ideal for discovering performance trends and troubleshooting potential performance issues. The name of the HotCache report is `timestamp-hotcache.txt` where the timestamp is in `YYYYMMDDHH` format. For example, a file named `2009013101-hotcache.txt` represents a HotCache report for January 31, 2009 at 1:00 a.m.

To view the HotCache report, you must enable Coherence reporting and you must configure the report-all report group. If you are new to Coherence reporting, see Using Oracle Coherence Reporting.

**Table 2-3** describes the contents of the HotCache report.
### Table 2-3  Contents of the HotCache Report

<table>
<thead>
<tr>
<th>Column</th>
<th>Data Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Batch Counter</td>
<td>Long</td>
<td>A sequential counter to help integrate information between related files. This value resets when the reporter restarts, and is not consistent across members. However, it is helpful when trying to integrate files.</td>
</tr>
<tr>
<td>Report Time</td>
<td>Date</td>
<td>A timestamp for each report refresh</td>
</tr>
<tr>
<td>Handler Name</td>
<td>String</td>
<td>The user-given name of the HotCache event handler from the GoldenGate HotCache properties file</td>
</tr>
<tr>
<td>Member Name</td>
<td>String</td>
<td>The Coherence member name where the HotCache adapter runs</td>
</tr>
<tr>
<td>Start Time</td>
<td>Date</td>
<td>The time when the Coherence HotCache adapter started</td>
</tr>
<tr>
<td>Operations Processed</td>
<td>Long</td>
<td>The number of transaction operations processed</td>
</tr>
<tr>
<td>Trail File Name</td>
<td>String</td>
<td>The name of the Golden Gate trail file that contains transaction operations</td>
</tr>
<tr>
<td>Trail File Position</td>
<td>String</td>
<td>The position in the trail file of the last successfully-processed operation</td>
</tr>
<tr>
<td>Operations per Transaction Average</td>
<td>IntSummaryStatistics</td>
<td>The average number of operations processed for each transaction</td>
</tr>
<tr>
<td>Operations per Transaction Maximum</td>
<td>IntSummaryStatistics</td>
<td>The maximum number of operations processed for each transaction</td>
</tr>
<tr>
<td>Operations per Transaction Minimum</td>
<td>IntSummaryStatistics</td>
<td>The minimum number of operations processed for each transaction</td>
</tr>
<tr>
<td>Invocations per Operation Average</td>
<td>IntSummaryStatistics</td>
<td>The average number of entry processor invocations that are performed for each operation</td>
</tr>
<tr>
<td>Invocations per Operation Maximum</td>
<td>IntSummaryStatistics</td>
<td>The maximum number of entry processor invocations that are performed for each operation</td>
</tr>
<tr>
<td>Invocations per Operation Minimum</td>
<td>IntSummaryStatistics</td>
<td>The minimum number of entry processor invocations that are performed for each operation</td>
</tr>
<tr>
<td>Last Execution Time per Operation Average (ns)</td>
<td>LongSummaryStatistics</td>
<td>The average execution time for each operation since the last sample in nanoseconds</td>
</tr>
<tr>
<td>Execution Time per Operation Average (ns)</td>
<td>LongSummaryStatistics</td>
<td>The average execution time for each operation in nanoseconds</td>
</tr>
<tr>
<td>Execution Time per Operation Maximum (ns)</td>
<td>LongSummaryStatistics</td>
<td>The maximum execution time for each operation in nanoseconds</td>
</tr>
<tr>
<td>Execution Time per Operation Minimum (ns)</td>
<td>LongSummaryStatistics</td>
<td>The minimum execution time for each operation in nanoseconds</td>
</tr>
<tr>
<td>Execution Time per Transaction Average (ns)</td>
<td>LongSummaryStatistics</td>
<td>The average execution time for each transaction in nanoseconds</td>
</tr>
</tbody>
</table>
Table 2-3  (Cont.) Contents of the HotCache Report

<table>
<thead>
<tr>
<th>Column</th>
<th>Data Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Execution Time per Transaction Maximum (ns)</td>
<td>LongSummaryStatistics</td>
<td>The maximum execution time for each transaction in nanoseconds</td>
</tr>
<tr>
<td>Execution Time per Transaction Minimum (ns)</td>
<td>LongSummaryStatistics</td>
<td>The maximum execution time for each transaction in nanoseconds</td>
</tr>
<tr>
<td>Last Operation Replication Lag Average (ms)</td>
<td>LongSummaryStatistics</td>
<td>The average time in milliseconds between the commit of the database transaction and the processing of the last operation by the HotCache adapter</td>
</tr>
<tr>
<td>Operation Replication Lag Average (ms)</td>
<td>LongSummaryStatistics</td>
<td>The average time in milliseconds between the commit of the database transaction and the processing of the operation by the HotCache adapter</td>
</tr>
<tr>
<td>Operation Replication Lag Maximum (ms)</td>
<td>LongSummaryStatistics</td>
<td>The average time in milliseconds between the commit of the database transaction and the processing of the operation by the HotCache adapter since the last sample</td>
</tr>
<tr>
<td>Operation Replication Lag Minimum (ms)</td>
<td>LongSummaryStatistics</td>
<td>The minimum time in milliseconds between the commit of the database transaction and the processing of the operation by the HotCache adapter</td>
</tr>
</tbody>
</table>

2.15.3 Monitoring HotCache Using the Coherence-JVisualVM Plug-In

The HotCache tab in the Coherence-JVisualVM Plug-In provides a graphical view of HotCache performance statistics. If you are new to the Coherence-Java VisualVM plug-in, see Using the Coherence-JVisualVM Plug-In.

The HotCache statistical data is collected from the CoherenceAdapMBean MBean and presented over time in both tabular and graph form. The tab displays statistics for each GoldenGate HotCache member including detail about specific caches refreshed by that HotCache member. To view data for a specific member, select the member on the member table. To view data for a specific cache, select the cache on the cache table.

Use the HotCache tab to get a detailed view of performance statistics and to identify potential performance issues with cache update operations. The HotCache tab includes:

- The minimum, maximum, and average time it takes to update a cache for each operation.
- The minimum, maximum, and average time it takes to update a cache for all the operations in a transaction.
- The total number of entry processor invocations that are performed for each operation.
- The minimum, maximum, and average time for the last operation.
- The minimum, maximum, and average operation replication lag time for the last operation since this MBean attribute value was last sampled. Replication lag is the amount of time between the commit of the database transaction and the processing of the operation by the HotCache adapter.
• The minimum, maximum, and average operation replication lag time since the statistics were last reset.
• The minimum, maximum, and average number of operations for each transaction.
• The minimum, maximum, and average time for each operation type for each cache. Operations include: EVICT, INSERT, PK_CHANGE, READ_FROM_DB, REDUNDANT_INSERT, REFRESH, UPDATE, and UPSERT.
Integrating Hibernate and Coherence

Oracle Coherence can be integrated with Hibernate, an object-relational mapping tool for Java environments. The functionality in Oracle Coherence and Hibernate can be combined such that Hibernate can act as the Coherence cache store or Coherence can act as the Hibernate L2 cache.

If you are interested in using Coherence with Hibernate, see the Coherence Hibernate Integration project that is part of the Coherence Community. Coherence Community projects provide example implementations for commonly used design patterns based on Oracle Coherence.
Integrating Coherence Applications with Coherence*Web

You can configure applications running under Coherence*Web so that they can share Coherence cache and session information.

If you are new to Coherence*Web, see Understanding Coherence*Web in Administering HTTP Session Management with Oracle Coherence*Web.

This chapter includes the following section:

- Merging Coherence Cache and Session Information

4.1 Merging Coherence Cache and Session Information

In Coherence, the cache configuration deployment descriptor provides detailed information about the various caches that can be used by applications within a cluster. Coherence provides a sample cache configuration deployment descriptor, named coherence-cache-config.xml, in the root of the coherence.jar library. In Coherence*Web, the session cache configuration deployment descriptor provides detailed information about the caches, services, and attributes used by HTTP session management. Coherence*Web provides a sample session cache configuration deployment descriptor, named default-session-cache-config.xml, in the coherence-web.jar library. You can use this file as the basis for any custom session cache configuration file you may need to write.

At run time, Coherence uses the first coherence-cache-config.xml file that is found in the classpath, and it must precede the coherence.jar library; otherwise, the sample coherence-cache-config.xml file in the coherence.jar file is used.

In the case of Coherence*Web, it first looks for a custom session cache configuration XML file in the classloader that was used to start Coherence*Web. If no custom session cache configuration XML resource is found, then it will use the default-session-cache-config.xml file packaged in coherence-web.jar.

If your Coherence applications are using Coherence*Web for HTTP session management, the start-up script for the application server and the Coherence cache servers must reference the session cache configuration file—not the cache configuration file. In this case, you must complete these steps:

1. Extract the session cache configuration file from the coherence-web.jar library.

2. Merge the cache information from the Coherence cache configuration file into the session cache configuration file.

   Note that in the cache scheme mappings in this file, you cannot use wildcards to specify cache names. You must provide, at least, a common prefix for application cache names.

3. Ensure that modified session cache configuration file is used by the Coherence members in the cluster.
The cache and session configuration must be consistent across WebLogic Servers and Coherence cache servers.
Using Memcached Clients with Oracle Coherence

You can configure a memcached adapter to allow Coherence to be used as a distributed cache for memcached clients. A simple hello world client that is written using the spymemcached API is provided for demonstration purposes; however any existing memcached client can be used to connect to Coherence. This chapter includes the following sections:

- Overview of the Oracle Coherence Memcached Adapter
- Setting Up the Memcached Adapter
  Memcached adapters are configured within a proxy service using a specific memcached acceptor. The acceptor configuration defines the socket address and the distributed cache for use by memcached clients.
- Connecting to the Memcached Adapter
- Securing Memcached Client Communication
- Sharing Data Between Memcached and Coherence Clients

5.1 Overview of the Oracle Coherence Memcached Adapter

The memcached adapter provides access to Coherence caches over the memcached binary protocol and allows Coherence to be used as a drop-in replacement for a memcached server. The adapter supports any memcached client API that supports the memcached binary protocol. This allows memcached clients that are written in many different programming languages to use Coherence. The memcached adapter is located on a Coherence proxy server and is implemented as a Coherence*Extend-styled acceptor. Memcached clients connect to the acceptor, which manages the distributed cache operations on the cluster. The cache operations are performed as entry processor operations. The acceptor must first be enabled within a proxy service in order to interact with Coherence cached data. Additional features for securing memcached client communication and for sharing data with native Coherence clients are provided and can be configured as required.

Figure 5-1 shows a conceptual view of a memcached client connecting to the memcached acceptor located on a Coherence proxy server in order to use a distributed cache.
5.2 Setting Up the Memcached Adapter

Memcached adapters are configured within a proxy service using a specific memcached acceptor. The acceptor configuration defines the socket address and the distributed cache for use by memcached clients.

This section includes the following topics:

- Define the Memcached Adapter Socket Address
- Define Memcached Adapter Proxy Service

5.2.1 Define the Memcached Adapter Socket Address

The memcached adapter uses a socket address (IP, or DNS name, and port) for clients to connect to. The socket address is configured in an operational override configuration file using the `<address-provider>` element. The address is then referenced from a proxy service definition using the configured `id` attribute. See `address-provider` in Developing Applications with Oracle Coherence.

The following example configures a socket address and uses 198.168.1.5 for the IP address, 9099 for the port, and memcached for the ID.

```xml
...<cluster-config>
  <address-providers>
    <address-provider id="memcached">
      <socket-address>
        <address>198.168.1.5</address>
        <port>9099</port>
      </socket-address>
    </address-provider>
  </address-providers>
...```
5.2.2 Define Memcached Adapter Proxy Service

A proxy service allows remote clients to interact with the caching services of a Coherence cluster without becoming cluster members. A proxy service for the memcached adapter includes a specific memcached acceptor that accepts memcached client requests on a defined socket address and then delegates the requests to a distributed cache.

**Note:**
The memcached adapter can only use a distributed cache.

To create a proxy service for memcached clients, edit the cache configuration file and add a `<proxy-scheme>` element and include the `<memcached-acceptor>` element within the `<acceptor-config>` element. The `<memcached-acceptor>` element must include the name of the cache to use and a reference to an address provider definition that defines the socket address to listen to for memcached client communication. See `memcached-acceptor` in *Developing Applications with Oracle Coherence*.

The following example creates a proxy service and defines a memcached acceptor.
The example references the address provider that was defined in Define the Memcached Adapter Socket Address.

```xml
...<caching-schemes>
  <proxy-scheme>
    <service-name>MemcachedProxyService</service-name>
    <acceptor-config>
      <memcached-acceptor>
        <cache-name>hello-example</cache-name>
        <address-provider>memcached</address-provider>
      </memcached-acceptor>
    </acceptor-config>
    <autostart>true</autostart>
  </proxy-scheme>
</caching-schemes>
...
```

The cache name refers to the `hello-example` cache. The cache name must resolve to a distributed cache. The following example shows the definition of the `hello-example` cache and the distributed scheme to which it maps.

```xml
<?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>hello-example</cache-name>
      <scheme-name>distributed</scheme-name>
    </cache-mapping>
  </caching-scheme-mapping>
</cache-config>
```
5.3 Connecting to the Memcached Adapter

Memcached clients must specify the address and port of a proxy service for the memcached adapter. The proxy service address is used in place of the memcached server address. Refer to your memcached client documentation for details on how to specify the address of a memcached server.

The following example shows a simple hello world client that uses the spymemcached client API to connect to the proxy service for the memcached adapter that was defined in Setting Up the Memcached Adapter.

```java
import net.spy.memcached.AddrUtil;
import net.spy.memcached.BinaryConnectionFactory;
import net.spy.memcached.MemcachedClient;

public class MemcachedExample {
    public static void main(String[] args) throws Exception {
        String key = "k1";
        String value = "Hello World!";

        MemcachedClient c = new MemcachedClient(
            new BinaryConnectionFactory(),
            AddrUtil.getAddresses("198.168.1.5:9099"));

        c.add(key, 0, value);
        System.out.println(((String)c.get(key)));
    }
}
```

5.4 Securing Memcached Client Communication

The memcached adapter can use both authentication and authorization to restrict access to cluster resources. Authentication support is provided for the SASL (Simple Authentication and Security Layer) plain authentication. Authorization is implemented
using Oracle Coherence*Extend-styled authorization, which relies on interceptor classes that provide fine-grained access for cache service operations. The memcached adapter authentication and authorization features reuses much of the existing security capabilities of Oracle Coherence: references are provided to existing content where applicable.

This section includes the following topics:

- Performing Memcached Client Authentication
- Performing Memcached Client Authorization

5.4.1 Performing Memcached Client Authentication

Memcached clients can use SASL plain authentication to provide a username and password when connecting to the memcached adapter. To use SASL plain authentication, you must create an IdentityAsserter implementation on the proxy. The memcached adapter calls the IdentityAsserter implementation and passes the com.tangosol.net.security.UsernameAndPassword object as a token. See Using Identity Tokens to Restrict Client Connections in Securing Oracle Coherence. Refer to your memcached client documentation for details on establishing a SASL plain connection.

In addition to an IdentityAsserter implementation, authentication must be enabled on a memcached adapter to use SASL plain authentication. To enable authentication, edit the proxy service definition in the cache configuration file and add a `<memcached-auth-method>` element, within the `<memcached-acceptor>` element, and set it to `plain`.

```xml
...<caching-schemes>
  <proxy-scheme>
    <service-name>MemcachedProxyService</service-name>
    <acceptor-config>
      <memcached-acceptor>
        <cache-name>hello-example</cache-name>
        <memcached-auth-method>plain</memcached-auth-method>
        <address-provider>memcached</address-provider>
      </memcached-acceptor>
    </acceptor-config>
  </proxy-scheme>
...<caching-schemes>
```

5.4.2 Performing Memcached Client Authorization

The memcached adapter relies on the Oracle Coherence*Extend authorization framework to restrict which operations a memcached client performs on a cluster. See Implementing Extend Client Authorization in Securing Oracle Coherence.

5.5 Sharing Data Between Memcached and Coherence Clients

The memcached adapter stores entries in a cache using a binary format. If you intend to share the data with Coherence clients, then memcached clients must use a serialization format that Coherence clients also support. Coherence clients typically
use Portable Object Format (POF), which is highlighted in this section. See Using Portable Object Format in *Developing Applications with Oracle Coherence*. This section includes the following topics:

- Configuring POF for Memcached Clients
- Create a Memcached Client that Uses POF

### 5.5.1 Configuring POF for Memcached Clients

To configure POF for Memcached clients:

1. Edit the proxy service definition in the cache configuration file and add an `<interop-enabled>` element, within the `<memcached-acceptor>` element, and set it to `true`.

   ...<proxy-scheme>
   <service-name>MemcachedProxyService</service-name>
   <acceptor-config>
     <memcached-acceptor>
       <cache-name>hello-example</cache-name>
       <interop-enabled>true</interop-enabled>
       <address-provider>memcached</address-provider>
     </memcached-acceptor>
     <acceptor-config>
     <autostart>true</autostart>
   </acceptor-config>
   </proxy-scheme>
   ...

2. Enable POF on the distributed cache that is used by the memcached acceptor.

   ...<distributed-scheme>
   <scheme-name>distributed</scheme-name>
   <service-name>MemcachedTest</service-name>
   <serializer>
     <instance>
       <class-name>com.tangosol.io.pof.ConfigurablePofContext</class-name>
       <init-params>
         <init-param>
           <param-type>String</param-type>
           <param-value>memcached-pof-config.xml</param-value>
         </init-param>
       </init-params>
     </instance>
   </serializer>
   <backing-map-scheme>
     <local-scheme/>
   </backing-map-scheme>
   <autostart>true</autostart>
 </distributed-scheme>

3. Register POF types in the defined POF configuration file. For the above example, the POF configuration file is named `memcached-pof-config.xml`. The file must be found on the classpath before the `coherence.jar` file. The following example defines a POF user type for the `PofUser` object:

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

   <pof-config xmlns='http://www.w3.org/2001/XMLSchema-instance'
     xmlns:xml='http://www.w3.org/2001/XMLSchema-instance'
     xmlns:xsi='http://www.w3.org/2001/XMLSchema-instance'
     xmlns='http://xmlns.oracle.com/coherence/coherence-pof-config'>
     ...
   </pof-config>
   ```
5.5.2 Create a Memcached Client that Uses POF

Many memcached client libraries include the ability to plug in custom serializers. Refer to your memcached client documentation for details on how to plug in custom serializers. The following excerpt shows a spymemcached client that adds the `PofUser` object that was registered in step 3 and uses a spymemcached transcoder to plug in the POF serializer.

```java
MemcachedClient client = m_client;
String key = "pofKey";
PofUser user = new PofUser("memcached", 1);
PofTranscoder<PofUser> tc = new PofTranscoder("memcached-pof-config.xml");

if (!client.set(key, 0, user, tc).get())
{
    throw new Exception("failed to set value");
}
```

The POF transcoder plug-in is defined as follows:

```java
import com.tangosol.io.pof.ConfigurablePofContext;
import com.tangosol.util.Binary;
import com.tangosol.util.ExternalizableHelper;
import net.spy.memcached.CachedData;
import net.spy.memcached.compat.SpyObject;
import net.spy.memcached.transcoders.Transcoder;

public class PofTranscoder<T> extends SpyObject implements Transcoder<T>
{
    public PofTranscoder(String sLocator)
    {
        m_ctx = new ConfigurablePofContext(sLocator);
    }

    @Override
    public boolean asyncDecode(CachedData arg0)
    {
        return Boolean.FALSE;
    }

    @Override
    public T decode(CachedData cachedData)
    {
```
```java
int nFlag = cachedData.getFlags();
Binary bin = new Binary(cachedData.getData());
return (T) ExternalizableHelper.fromBinary(bin, m_ctx);
}

@Override
public CachedData encode(Object obj)
{
    byte[] oValue = ExternalizableHelper.toByteArray(obj, m_ctx);
    return new CachedData(FLAG, oValue, CachedData.MAX_SIZE);
}

@Override
public int getMaxSize()
{
    return CachedData.MAX_SIZE;
}

protected ConfigurablePofContext m_ctx;

protected static final int FLAG = 4;
```
Integrating Spring with Coherence

Oracle Coherence can be integrated with Spring, which is a platform for building and running Java-based enterprise applications.

If you are interested in using Coherence with Spring, see the Coherence Spring Integration project that is part of the Coherence Community. Coherence Community projects provide example implementations for commonly used design patterns based on Oracle Coherence.
Enabling ECID in Coherence Logs

Oracle Coherence can use an Execution Context ID (ECID). This globally unique ID can be attached to requests between Oracle components. The ECID allows you to track log messages pertaining to the same request when multiple requests are processed in parallel.

Coherence logs will include ECID only if the client already has an activated ECID prior to calling Coherence operations. The ECID may be passed from another component or obtained in the client code. To activate the context, use the `get` and `activate` methods on the `oracle.dms.context.ExecutionContext` interface in the Coherence client code. The ECID will be attached to the executing thread. Use the `deactivate` method to release the context, for example:

Example 7-1  Using a DMS Context in Coherence Client Code

```java
... // Get the context associated with this thread
ExecutionContext ctx = ExecutionContext.get();
ctx.activate();
... set additional execution context values (optional)
perform some cache operations
... // Release the context
ctx.deactivate();
...
```

ECID logging will occur only on the node where the client is running. If a client request is processed on some other node and an exception is thrown by Coherence, then the remote error will be returned to the originating node and it will be logged on the Coherence client. The log message will contain the ECID of the request. Messages logged on the remote node will not contain the ECID.

To include the ECID in a Coherence log message, see Changing the Log Message Format in Developing Applications with Oracle Coherence.