# Oracle® WebLogic Server

Programming WebLogic JTA

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CHAPTER 1

# Introduction and Roadmap

This section describes the contents and organization of this guide—*Programming WebLogic JTA*.



## Document Scope and Audience

This document is written for application developers who are interested in building transactional Java applications that run in the WebLogic Server environment. It is assumed that readers are familiar with the WebLogic Server platform, Java Platform, Enterprise Edition (Java EE) programming, and transaction processing concepts.

## Guide to this Document

- This chapter, Chapter 1, "Introduction and Roadmap," introduces the organization of this guide.

- Chapter 2, “Introducing Transactions,” introduces transactions in EJB and RMI applications running in the WebLogic Server environment. This chapter also describes distributed transactions and the two-phase commit protocol for enterprise applications.
- Chapter 3, “Configuring Transactions,” describes how to administer transactions in the WebLogic Server environment.
- Chapter 4, “Managing Transactions,” provides information on administration tasks used to manage transactions.
- Chapter 5, “Transaction Service,” describes the WebLogic Server Transaction Service.
- Chapter 6, “Java Transaction API and Oracle WebLogic Extensions,” provides a brief overview of the Java Transaction API (JTA).
- Chapter 8, “Transactions in EJB Applications,” describes how to implement transactions in EJB applications.
- Chapter 9, “Transactions in RMI Applications,” describes how to implement transactions in RMI applications.
- Chapter 10, “Using Third-Party JDBC XA Drivers with WebLogic Server,” describes how to configure and use third-party XA drivers in transactions.
- Chapter 11, “Coordinating XAResources with the WebLogic Server Transaction Manager,” describes how to configure third-party systems to participate in transactions coordinated by the WebLogic Server transaction manager.
- Chapter 12, “Participating in Transactions Managed by a Third-Party Transaction Manager,” describes the process for configuring and participating in foreign-managed transactions.
- Chapter 13, “Troubleshooting Transactions,” describes how to perform troubleshooting tasks for applications using JTA.

# Related Documentation

This document contains JTA-specific design and development information. For comprehensive guidelines for developing, deploying, and monitoring WebLogic Server applications, see the following documents:

- *Developing Applications with WebLogic Server* is a guide to developing WebLogic Server applications.

- *Deploying Applications to WebLogic Server* is the primary source of information about deploying WebLogic Server applications.

# Samples and Tutorials

In addition to this document, Oracle provides a variety of code samples and tutorials for developing transactional applications. The examples and tutorials illustrate WebLogic Server in action, and provide practical instructions on how to perform key application development tasks. You can start the Examples server from the Start menu on Windows machines. For Linux and other platforms, you can start the Examples server from the `WL_HOME\samples\domains\wl_server` directory, where `WL_HOME` is the top-level installation directory for WebLogic Platform.

## Avitek Medical Records Application (MedRec) and Tutorials

MedRec is an end-to-end sample Java EE application shipped with WebLogic Server that simulates an independent, centralized medical record management system. The MedRec application provides a framework for patients, doctors, and administrators to manage patient data using a variety of different clients.

MedRec demonstrates WebLogic Server and Java EE features, and highlights Oracle-recommended best practices. MedRec is included in the WebLogic Server distribution, and can be accessed from the Start menu on Windows machines. For Linux and other platforms, you can start MedRec from the `WL_HOME\samples\domains\medrec` directory, where `WL_HOME` is the top-level installation directory for WebLogic Platform.

# New and Changed Features in This Release

For a comprehensive listing of the new WebLogic Server features introduced in this release, see "What's New in WebLogic Server" in *Release Notes*.

CHAPTER 2

# Introducing Transactions

This section discusses the following topics:

- Overview of Transactions in WebLogic Server Applications
- When to Use Transactions
- What Happens During a Transaction
- Transactions Sample Code

## Overview of Transactions in WebLogic Server Applications

This section includes the following sections:

- ACID Properties of Transactions
- Supported Programming Model
- Supported API Models
- Distributed Transactions and the Two-Phase Commit Protocol
- Support for Business Transactions

## ACID Properties of Transactions

One of the most fundamental features of WebLogic Server is transaction management. Transactions are a means to guarantee that database changes are completed accurately and that they take on all the **ACID properties** of a high-performance transaction, including:

- Atomicity—all changes that a transaction makes to a database are made as one unit; otherwise, all changes are rolled back.
- Consistency—a successful transaction transforms a database from a previous valid state to a new valid state.
- Isolation—changes that a transaction makes to a database are not visible to other operations until the transaction completes its work.
- Durability—changes that a transaction makes to a database survive future system or media failures.

WebLogic Server protects the integrity of your transactions by providing a complete infrastructure for ensuring that database updates are done accurately, even across a variety of resource managers. If any one of the operations fails, the entire set of operations is rolled back.

## Supported Programming Model

WebLogic Server supports transactions in the Sun Microsystems, Inc., Java Platform, Enterprise Edition (Java EE) programming model. WebLogic Server provides full support for transactions in Java applications that use Enterprise JavaBeans, in compliance with the Enterprise JavaBeans Specification 3.0, published by Sun Microsystems, Inc. WebLogic Server also supports the Java Transaction API (JTA) Specification 1.1, also published by Sun Microsystems, Inc.

## Supported API Models

WebLogic Server supports the Sun Microsystems, Inc. Java Transaction API (JTA), which is used by:

- Enterprise JavaBean (EJB) applications within the WebLogic Server EJB container.
- Remote Method Invocation (RMI) applications within the WebLogic Server infrastructure.

For information about JTA, see the following sources:

- The `javax.transaction` and `javax.transaction.xa` package APIs.
- The Java Transaction API specification, published by Sun Microsystems, Inc.

# Distributed Transactions and the Two-Phase Commit Protocol

WebLogic Server supports distributed transactions and the two-phase commit protocol for enterprise applications. A **distributed transaction** is a transaction that updates multiple resource managers (such as databases) in a coordinated manner. In contrast, a **local transaction** begins and commits the transaction to a single resource manager that internally coordinates API calls; there is no transaction manager. The **two-phase commit protocol** is a method of coordinating a single transaction across two or more resource managers. It guarantees data integrity by ensuring that transactional updates are committed in all of the participating databases, or are fully rolled back out of all the databases, reverting to the state prior to the start of the transaction. In other words, either all the participating databases are updated, or none of them are updated.

Distributed transactions involve the following participants:

- Transaction originator—initiates the transaction. The transaction originator can be a user application, an Enterprise JavaBean, or a JMS client.
- Transaction manager—manages transactions on behalf of application programs. A transaction manager coordinates commands from application programs to start and complete transactions by communicating with all resource managers that are participating in those transactions. When resource managers fail during transactions, transaction managers help resource managers decide whether to commit or roll back pending transactions.
- Recoverable resource—provides persistent storage for data. The resource is most often a database.
- Resource manager—provides access to a collection of information and processes. Transaction-aware JDBC drivers are common resource managers. Resource managers provide transaction capabilities and permanence of actions; they are entities accessed and controlled within a distributed transaction. The communication between a resource manager and a specific resource is called a **transaction branch**.

The first phase of the two-phase commit protocol is called the *prepare* phase. The required updates are recorded in a transaction log file, and the resource must indicate, through a resource manager, that it is ready to make the changes. Resources can either vote to commit the updates or to roll back to the previous state. What happens in the second phase depends on how the resources vote. If all resources vote to commit, all the resources participating in the transaction are updated. If one or more of the resources vote to roll back, then all the resources participating in the transaction are rolled back to their previous state.

## Support for Business Transactions

WebLogic JTA provides the following support for your business transactions:

- Creates a unique transaction identifier when a client application initiates a transaction.
- Supports an optional transaction name describing the business process that the transaction represents. The transaction name makes statistics and error messages more meaningful.
- Works with the WebLogic Server infrastructure to track objects that are involved in a transaction and, therefore, need to be coordinated when the transaction is ready to commit.
- Notifies the resource managers—which are, most often, databases—when they are accessed on behalf of a transaction. Resource managers then lock the accessed records until the end of the transaction.
- Orchestrates the two-phase commit when the transaction completes, which ensures that all the participants in the transaction commit their updates simultaneously. It coordinates the commit with any databases that are being updated using Open Group's XA protocol. Many popular relational databases support this standard.
- Executes the rollback procedure when the transaction must be stopped.
- Executes a recovery procedure when failures occur. It determines which transactions were active in the machine at the time of the crash, and then determines whether the transaction should be rolled back or committed.
- Manages transaction timeouts. If a business operation takes too much time or is only partially completed due to failures, the system takes action to automatically issue a timeout for the transaction and free resources, such as database locks.

# When to Use Transactions

Transactions are appropriate in the situations described in the following list. Each situation describes a transaction model supported by the WebLogic Server system. Keep in mind that distributed transactions should not span more than a single user input screen; more complex, higher level transactions are best implemented with a series of distributed transactions.

- Within the scope of a single client invocation on an object, the object performs multiple edits to data in a database. If one of the edits fails, the object needs a mechanism to roll back all the edits. (In this situation, the individual database edits are not necessarily EJB or RMI invocations. A client, such as an applet, can obtain a reference to the `Transaction` and `TransactionManager` objects, using JNDI, and start a transaction.)

For example, consider a banking application. The client invokes the transfer operation on a teller object. The transfer operation requires the teller object to make the following invocations on the bank database:

  – Invoking the debit method on one account.

  – Invoking the credit method on another account.

  If the credit invocation on the bank database fails, the banking application needs a way to roll back the previous debit invocation.

- The client application needs a conversation with an object managed by the server application, and the client application needs to make multiple invocations on a specific object instance. The conversation may be characterized by one or more of the following:

  – Data is cached in memory or written to a database during or after each successive invocation.

  – Data is written to a database at the end of the conversation.

  – The client application needs the object to maintain an in-memory context between each invocation; that is, each successive invocation uses the data that is being maintained in memory across the conversation.

  – At the end of the conversation, the client application needs the ability to cancel all database write operations that may have occurred during or at the end of the conversation.

# What Happens During a Transaction

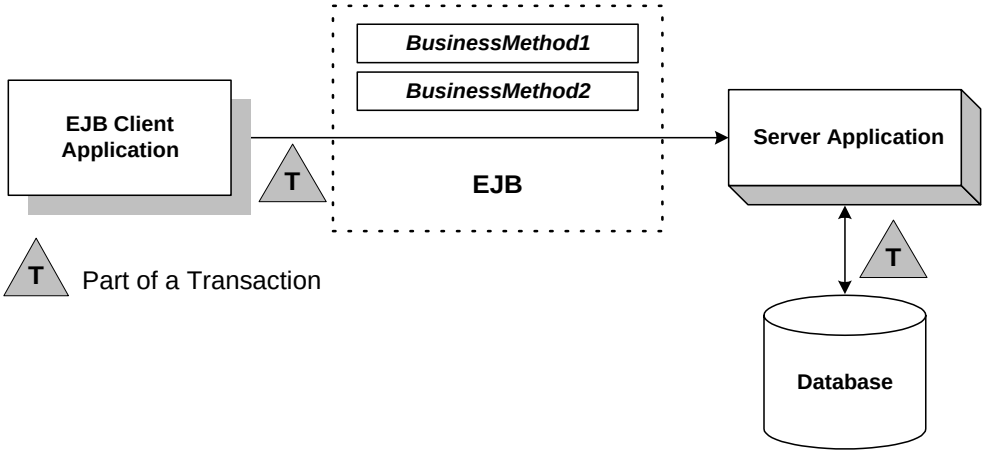
This topic includes the following sections:

- Transactions in WebLogic Server EJB Applications
- Transactions in WebLogic Server RMI Applications

## Transactions in WebLogic Server EJB Applications

Figure 2-1 illustrates how transactions work in a WebLogic Server EJB application.

**Figure 2-1 How Transactions Work in a WebLogic Server EJB Application**




WebLogic Server supports two types of transactions in WebLogic Server EJB applications:

- In **container-managed transactions**, the WebLogic Server EJB container manages the transaction demarcation. Transaction attributes in the EJB deployment descriptor determine how the WebLogic Server EJB container handles transactions with each method invocation. For more information about the deployment descriptor, see "Implementing Enterprise Java Beans" in *Programming WebLogic Enterprise JavaBeans*.
- In **bean-managed transactions**, the EJB manages the transaction demarcation. The EJB makes explicit method invocations on the `UserTransaction` object to begin, commit, and roll back transactions. For more information about the `UserTransaction` object, see the WebLogic Server Javadoc.

The sequence of transaction events differs between container-managed and bean-managed transactions.

## Container-managed Transactions

For EJB applications with container-managed transactions, a basic transaction works in the following way:

1. In the EJB's deployment descriptor, the Bean Provider or Application Assembler specifies the transaction type (`transaction-type` element) for container-managed demarcation (`Container`).

2. In the EJB's deployment descriptor, the Bean Provider or Application Assembler specifies the default transaction attribute (`trans-attribute` element) for the EJB, which is one of the following settings: `NotSupported`, `Required`, `Supports`, `RequiresNew`, `Mandatory`, or `Never`. For a detailed description of these settings, see Section 17.6.2 in the Enterprise JavaBeans Specification 2.0, published by Sun Microsystems, Inc.
3. Optionally, in the EJB's deployment descriptor, the Bean Provider or Application Assembler specifies the `trans-attribute` for one or more methods.
4. When a client application invokes a method in the EJB, the EJB container checks the `trans-attribute` setting in the deployment descriptor for that method. If no setting is specified for the method, the EJB uses the default `trans-attribute` setting for that EJB.
5. The EJB container takes the appropriate action depending on the applicable `trans-attribute` setting.
   - For example, if the `trans-attribute` setting is `Required`, the EJB container invokes the method within the existing transaction context or, if the client called without a transaction context, the EJB container begins a new transaction before executing the method.
   - In another example, if the `trans-attribute` setting is `Mandatory`, the EJB container invokes the method within the existing transaction context. If the client called without a transaction context, the EJB container throws the `javax.transaction.TransactionRequiredException` exception.
6. During invocation of the business method, if it is determined that a rollback is required, the business method calls the `EJBContext.setRollbackOnly` method, which notifies the EJB container that the transaction is to be rolled back at the end of the method invocation.

   **Note:** Calling the `EJBContext.setRollbackOnly` method is allowed only for methods that have a meaningful transaction context.
7. At the end of the method execution and before the result is sent to the client, the EJB container completes the transaction, either by committing the transaction or rolling it back (if the `EJBContext.setRollbackOnly` method was called).

## Bean-managed Transactions

For EJB applications with bean-managed transaction demarcations, a basic transaction works in the following way:

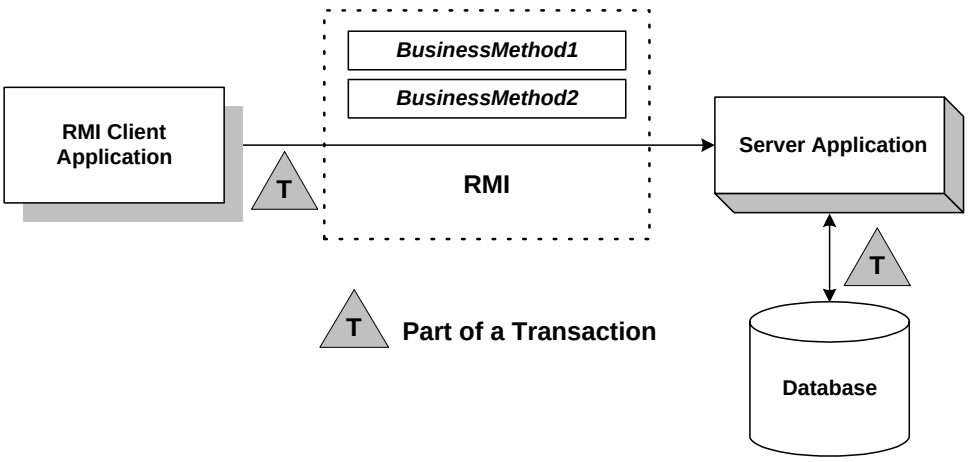
1. In the EJB's deployment descriptor, the Bean Provider or Application Assembler specifies the transaction type (`transaction-type` element) for container-managed demarcation (`Bean`).

2. The client application uses JNDI to obtain an object reference to the `UserTransaction` object for the WebLogic Server domain.
3. The client application begins a transaction using the `UserTransaction.begin` method, and issues a request to the EJB through the EJB container. All operations on the EJB execute within the scope of a transaction.
   - If a call to any of these operations raises an exception (either explicitly or as a result of a communication failure), the exception can be caught and the transaction can be rolled back using the `UserTransaction.rollback` method.
   - If no exceptions occur, the client application commits the current transaction using the `UserTransaction.commit` method. This method ends the transaction and starts the processing of the operation. The transaction is committed only if all of the participants in the transaction agree to commit.
4. The `UserTransaction.commit` method causes the EJB container to call the transaction manager to complete the transaction.
5. The transaction manager is responsible for coordinating with the resource managers to update any databases.

# Transactions in WebLogic Server RMI Applications

Figure 2-2 illustrates how transactions work in a WebLogic Server RMI application.

**Figure 2-2 How Transactions Work in a WebLogic Server RMI Application**




For RMI client and server applications, a basic transaction works in the following way:

1. The application uses JNDI to return an object reference to the `UserTransaction` object for the WebLogic Server domain.

   Obtaining the object reference begins a conversational state between the application and that object. The conversational state continues until the transaction is completed (committed or rolled back). Once instantiated, RMI objects remain active in memory until they are released (typically during server shutdown). For the duration of the transaction, the WebLogic Server infrastructure does not perform any deactivation or activation.

2. The client application begins a transaction using the `UserTransaction.begin` method, and issues a request to the server application. All operations on the server application execute within the scope of a transaction.

   – If a call to any of these operations raises an exception (either explicitly or as a result of a communication failure), the exception can be caught and the transaction can be rolled back using the `UserTransaction.rollback` method.

   – If no exceptions occur, the client application commits the current transaction using the `UserTransaction.commit` method. This method ends the transaction and starts the processing of the operation. The transaction is committed only if all of the participants in the transaction agree to commit.

3. The `UserTransaction.commit` method causes WebLogic Server to call the transaction manager to complete the transaction.

4. The transaction manager is responsible for coordinating with the resource managers to update any databases.

For more information, see Chapter 9, “Transactions in RMI Applications.”

# Transactions Sample Code

This section includes the following sections:



## Transactions Sample EJB Code

This section provides a walkthrough of sample code fragments from a class in an EJB application. This topic includes the following sections:

- Using JNDI to Return an Object Reference
- Starting a Transaction
- Completing a Transaction

The code fragments demonstrate using the `UserTransaction` object for *bean-managed* transaction demarcation. The deployment descriptor for this bean specifies the transaction type (`transaction-type` element) for transaction demarcation (`Bean`).

**Notes:** In a global transaction, use a database connection from a local JDBC data source—on the WebLogic Server instance on which the EJB is running. Do not use a connection from a JDBC data source on a remote WebLogic Server instance.

These code fragments do not derive from any of the sample applications that ship with WebLogic Server. They merely illustrate the use of the `UserTransaction` object within an EJB application.

## Importing Packages

Listing 2-1 shows importing the necessary packages for transactions, including:

- `javax.transaction.UserTransaction`. For a list of methods associated with this object, see the online Javadoc.
- System exceptions. For a list of exceptions, see the online Javadoc.

**Listing 2-1 Importing Packages**

```
import javax.naming.*;
import javax.transaction.UserTransaction;
import javax.transaction.SystemException;
import javax.transaction.HeuristicMixedException
import javax.transaction.HeuristicRollbackException
import javax.transaction.NotSupportedException
import javax.transaction.RollbackException
import javax.transaction.IllegalStateException
import javax.transaction.SecurityException
import java.sql.*;
import java.util.*;
```

## Using JNDI to Return an Object Reference

Listing 2-2 shows how look up an object on the JNDI tree.

**Listing 2-2 Performing a JNDI Lookup**

```
Context ctx = null;
Hashtable env = new Hashtable();

env.put(Context.INITIAL_CONTEXT_FACTORY,
         "weblogic.jndi.WLInitialContextFactory");

// Parameters for the WebLogic Server.
// Substitute the correct hostname, port number
// user name, and password for your environment:
env.put(Context.PROVIDER_URL, "t3://localhost:7001");
env.put(Context.SECURITY_PRINCIPAL, "Fred");
env.put(Context.SECURITY_CREDENTIALS, "secret");

ctx = new InitialContext(env);

UserTransaction tx = (UserTransaction)
  ctx.lookup("javax.transaction.UserTransaction");
```

## Starting a Transaction

Listing 2-3 shows starting a transaction by getting a `UserTransaction` object and calling the `javax.transaction.UserTransaction.begin()` method. Database operations that occur after this method invocation and prior to completing the transaction exist within the scope of this transaction.

**Listing 2-3 Starting a Transaction**

```
UserTransaction tx = (UserTransaction)
  ctx.lookup("javax.transaction.UserTransaction");
tx.begin();
```

## Completing a Transaction

Listing 2-4 shows completing the transaction depending on whether an exception was thrown during any of the database operations that were attempted within the scope of this transaction:

- If an exception was thrown during any of the database operations, the application calls the `javax.transaction.UserTransaction.rollback()` method.
- If no exception was thrown, the application calls the `javax.transaction.UserTransaction.commit()` method to attempt to commit the transaction after all database operations completed successfully. Calling this method ends the transaction and starts the processing of the operation, causing the WebLogic Server EJB container to call the transaction manager to complete the transaction. The transaction is committed only if all of the participants in the transaction agree to commit.

**Listing 2-4 Completing a Transaction**

```
tx.commit();

// or:

tx.rollback();
```

# Transactions Sample RMI Code

This topic provides a walkthrough of sample code fragments from a class in an RMI application. This topic includes the following sections:

- Importing Packages
- Using JNDI to Return an Object Reference to the UserTransaction Object
- Starting a Transaction
- Completing a Transaction

The code fragments demonstrate using the `UserTransaction` object for RMI transactions. For guidelines on using transactions in RMI applications, see Chapter 9, "Transactions in RMI Applications."

**Note:** These code fragments do not derive from any of the sample applications that ship with WebLogic Server. They merely illustrate the use of the `UserTransaction` object within an RMI application.

## Importing Packages

Listing 2-5 shows importing the necessary packages, including the following packages used to handle transactions:

- `javax.transaction.UserTransaction`. For a list of methods associated with this object, see the online Javadoc.
- System exceptions. For a list of exceptions, see the online Javadoc.

**Listing 2-5 Importing Packages**

```
import javax.naming.*;
import java.rmi.*;
import javax.transaction.UserTransaction;
import javax.transaction.SystemException;
import javax.transaction.HeuristicMixedException
import javax.transaction.HeuristicRollbackException
import javax.transaction.NotSupportedException
import javax.transaction.RollbackException
import javax.transaction.IllegalStateException
import javax.transaction.SecurityException
import java.sql.*;
import java.util.*;
```

After importing these classes, initialize an instance of the `UserTransaction` object to null.

## Using JNDI to Return an Object Reference to the UserTransaction Object

Listing 2-6 shows searching the JNDI tree to return an object reference to the `UserTransaction` object for the appropriate WebLogic Server domain.

**Note:** Obtaining the object reference begins a conversational state between the application and that object. The conversational state continues until the transaction is completed (committed or rolled back). Once instantiated, RMI objects remain active in memory until they are released (typically during server shutdown). For the duration of the transaction, the WebLogic Server infrastructure does not perform any deactivation or activation.

**Listing 2-6 Performing a JNDI Lookup**

```
Context ctx = null;
Hashtable env = new Hashtable();

env.put(Context.INITIAL_CONTEXT_FACTORY,
         "weblogic.jndi.WLInitialContextFactory");

// Parameters for the WebLogic Server.
// Substitute the correct hostname, port number
// user name, and password for your environment:
env.put(Context.PROVIDER_URL, "t3://localhost:7001");
env.put(Context.SECURITY_PRINCIPAL, "Fred");
env.put(Context.SECURITY_CREDENTIALS, "secret");

ctx = new InitialContext(env);

UserTransaction tx = (UserTransaction)
  ctx.lookup("javax.transaction.UserTransaction");
```

## Starting a Transaction

Listing 2-7 shows starting a transaction by calling the `javax.transaction.UserTransaction.begin()` method. Database operations that occur

after this method invocation and prior to completing the transaction exist within the scope of this transaction.

**Listing 2-7 Starting a Transaction**

```
UserTransaction tx = (UserTransaction)
  ctx.lookup("javax.transaction.UserTransaction");
tx.begin();
```

## Completing a Transaction

Listing 2-8 shows completing the transaction depending on whether an exception was thrown during any of the database operations that were attempted within the scope of this transaction:

- If an exception was thrown, the application calls the `javax.transaction.UserTransaction.rollback()` method if an exception was thrown during any of the database operations.
- If no exception was thrown, the application calls the `javax.transaction.UserTransaction.commit()` method to attempt to commit the transaction after all database operations completed successfully. Calling this method ends the transaction and starts the processing of the operation, causing WebLogic Server to call the transaction manager to complete the transaction. The transaction is committed only if all of the participants in the transaction agree to commit.

**Listing 2-8 Completing a Transaction**

```
tx.commit();

// or:

tx.rollback();
```

CHAPTER 3

# Configuring Transactions

The following sections provide configuration tasks related to transactions:



## Overview of Transaction Configuration

The Administration Console provides the interface used to configure features of WebLogic Server, including WebLogic JTA. The configuration process involves specifying values for attributes. These attributes define the transaction environment, including the following:

- Transaction timeouts and limits
- Transaction manager behavior

You should also be familiar with the administration of Java EE components that can participate in transactions, such as EJBs, JDBC data sources, and JMS.

**Note:** You can also use the WebLogic Scripting Tool (WLST; see *WebLogic Scripting Tool*) or JMX (see *Developing Custom Management Utilities with JMX*) to configure transaction-related settings.

# Configuring JTA

Once you configure WebLogic JTA and any transaction participants, the system can manage transactions using the JTA API and the WebLogic JTA extensions. Note the following:

- Configuration settings for JTA (transactions) are applicable at the domain level. This means that configuration attribute settings apply to all servers within a domain. See "Configure JTA" in the *Administration Console Online Help*.
- Monitoring tasks for JTA are performed at the server level. See "Monitor JTA" in the *Administration Console Online Help*.
- Configuration settings for participating resources (such as JDBC data sources) are per configured object. The settings apply to all instances of a particular object. See "Transaction Options" in *Configuring and Managing WebLogic JDBC* and "Configure global transaction options for a JDBC data source" in the *Administration Console Online Help*.

## Unregister Resource Grace Period

If you have resources that you may occasionally undeploy and redeploy such as a JDBC data source module packaged with an application, you can minimize the risk of abandoned transactions because of an unregistered resource by setting the Unregistered Resource Grace Period for the domain. The grace period is the number of seconds that the transaction manager waits for transactions to complete before unregistering a resource.

During the specified grace period, the unregisterResource call will block until the call can return, and no new transactions are started for the associated resource. If the number of outstanding transactions for the resource goes to 0, the unregisterResource call returns immediately.

At the end of the grace period, if there are still outstanding transactions associated with the resource, the unregisterResource call returns and a log message is written on the server on which the resource was previously registered.

## Additional Attributes for Managing Transactions

By default, if an XA resource that is participating in a global transaction fails to respond to an XA call from the WebLogic Server transaction manager, WebLogic Server flags the resource as unhealthy and unavailable, and blocks any further calls to the resource in an effort to preserve resource threads. The failure can be caused by either an unhealthy transaction or an unhealthy

resource—there is no distinction between the two causes. In both cases, the resource is marked as unhealthy.

To mitigate this limitation, WebLogic Server provides the configuration attributes listed in Table 3-1:

**Table 3-1 XA Resource Health Monitoring Configuration Attributes**

| Attribute | MBean | Definition |
|---|---|---|
| `ResourceHealthMonitoring` | `weblogic.managment.configuration.JDBCXAParamsBean` | ResourcehealthMonitoring attribute in JDBCXAParamsBean MBean<br>Enables or disables resource health monitoring for the JDBC data source. This attribute only applies to data sources that use an XA JDBC driver for database connections. It is ignored if a non-XA JDBC driver is used.<br>If set to `true`, resource health monitoring is enabled. If an XA resource fails to respond to an XA call within the period specified in the `MaxXACallMillis` attribute, WebLogic Server marks the data source as unhealthy and blocks any further calls to the resource.<br>If set to `false`, the feature is disabled.<br>Default: `true`<br>You can set the Resource Health Monitoring attribute for a JDBC data source on the JDBC Data Source: Configuration: Connection Pool tab in the Administration Console. |
| `MaxXACallMillis` | `weblogic.management.configuration.JTAMBean` | Sets the maximum allowed duration (in milliseconds) of XA calls to XA resources. This setting applies to the entire domain.<br>Default: `120000` |
| `MaxResourceUnavailableMillis` | `weblogic.management.configuration.JTAMBean` | The maximum duration (in milliseconds) that an XA resource is marked as unhealthy. After this duration, the XA resource is declared available again, even if the resource is not explicitly re-registered with the transaction manager. This setting applies to the entire domain.<br>Default: `1800000` |

**Table 3-1 XA Resource Health Monitoring Configuration Attributes**

| Attribute | MBean | Definition |
|---|---|---|
| MaxResourceRequestOnServer | weblogic.management.configuration.JTAMBean | Maximum number of concurrent requests to resources allowed for each server in the domain.<br>Default: 50<br>Minimum: 10<br>Maximum: java.lang.Integer.MAX_VALUE |

Except for Resource Health Monitoring for a JDBC data source, you set these attributes directly in the config.xml file when the domain is inactive. These attributes are not available in the Administration Console. The following example shows an excerpt of a configuration file with these attributes:

```
...
   <JTA
    MaxUniqueNameStatistics="5"
    TimeoutSeconds="300"
    RecoveryThresholdMillis="150000"
    MaxResourceUnavailableMillis="900000"
    MaxResourceRequestOnServer="60"
    MaxXACallMillis="180000"
   />
```

# Configuring Domains for Inter-Domain Transactions

For a transaction manager to manage distributed transactions, the transaction manager must be able to communicate with all participating resources to prepare and then commit or rollback the transactions. This applies to cases when your WebLogic domain acts as the transaction manager or a transaction participant (resource) in a distributed transaction. The following sections describe how to configure your domain to enable inter-domain transactions.

The following sections provide information on how to configure domains for inter-domain transactions:

- "Limitations for Inter-Domain Transactions" on page 3-5

- "Configuring Communication Channels" on page 3-5

# Limitations for Inter-Domain Transactions

Please note the following limitations for inter-domain transactions:

- The domains and all participating resources must have unique names. That is, you cannot have a JDBC data source, a server, or a domain with the same name as an object in another domain or the domain itself.
- Only one data source with *both* of the following attribute conditions can participate in a global transaction, regardless of the domain in which the data source is configured:
  - Logging Last Resource or Emulate Two-Phase Commit is selected.
  - The data source uses a non-XA driver to create database connections.

**Note:** Oracle recommends that you use an XA driver instead of a non-XA driver (with Emulate Two-Phase Commit) in global transactions. There are risks involved with using a non-XA driver in a global transaction. See Limitations and Risks When Emulating Two-Phase Commit Using a Non-XA Driver in *Configuring and Managing WebLogic JDBC*.

# Configuring Communication Channels

You must correctly configure compatible communication channels using either Cross Domain Security or Security Interoperability Mode for all participating domains in global transactions.

Keep all the domains used by your process symmetric with respect to Cross Domain Security configuration and Security Interoperability Mode. Because both settings are set at the domain level, it is possible for a domain to be in a mixed mode, meaning the domain has both Cross Domain Security and Security Interoperability Mode set.

The following sections provide more information on configuring communication channels for global transactions:

- "Configuring Cross Domain Security" on page 3-11
- "Configuring Security Interoperability Mode" on page 3-14

Use the following table to determine the type of communication channel configuration required for inter-domain transactions.

**Table 3-2 Communication Channel Configurations for Inter-Domain Transactions**

| Domain | 10.x and 9.2 MP2 and higher MPs | 9.0, 9.1, 9.2 MP1 and lower | 8.1 SP5 and higher | 8.1 SP4 and lower | 7.0 and higher SPs |
|---|---|---|---|---|---|
| **10.x and 9.2 MP2 and higher MPs** | Configure both domains for Cross Domain Security<br>or<br>use Security Interoperability mode and set both domains to either `default` or `performance` | Configure the 10.x or 9.2 MP2 and higher MP domain for Cross Domain Security and include the 9.0, 9.1, or 9.2 MP1 and lower domain in the exception list<br>or<br>use Security Interoperability mode and set both domains to either `default` or `performance` | Configure the 10.x or 9.2 MP2 and higher MP domain for Cross Domain Security and include the 8.1 domain in the exception list<br>or<br>use Security Interoperability mode and set both domains to `performance` | Configure the 10.x or 9.2 MP2 and higher MP for Cross Domain Security and include the 8.1 domain in the exception list<br>or<br>use Security Interoperability mode and set the 10.x or 9.2 MP2 and higher MP to `compatibility` | Configure the 10.x or 9.2 MP2 and higher MP for Cross Domain Security and include the 8.1 domain in the exception list<br>or<br>use Security Interoperability mode and set the 10.x or 9.2 MP2 and higher MP to `compatibility` |

**Table 3-2 Communication Channel Configurations for Inter-Domain Transactions**

| Domain | 10.x and 9.2 MP2 and higher MPs | 9.0, 9.1, 9.2 MP1 and lower | 8.1 SP5 and higher | 8.1 SP4 and lower | 7.0 and higher SPs |
|---|---|---|---|---|---|
| **9.0, 9.1, 9.2 MP1 and lower** | Configure the 10.x or 9.2 MP2 and higher MP domain for Cross Domain Security and include the 9.0, 9.1, or 9.2 MP1 and lower domain in the exception list<br>or<br>use Security Interoperability mode and set both domains to either `default` or `performance` | Set both domains to either `default` or `performance` | Set both domains to `performance` | Set the 9.x domain to `compatibility` | Set the 9.x domain to `compatibility` |

**Table 3-2 Communication Channel Configurations for Inter-Domain Transactions**

| Domain | 10.x and 9.2 MP2 and higher MPs | 9.0, 9.1, 9.2 MP1 and lower | 8.1 SP5 and higher | 8.1 SP4 and lower | 7.0 and higher SPs |
|---|---|---|---|---|---|
| **8.1 SP5 and higher** | Configure the 10.x or 9.2 MP2 and higher MP domain for Cross Domain Security and include the 8.1 domain in the exception list<br>or<br>use Security Interoperability mode and set both domains to `performance` | Set both domains to `performance` | Set both domains to `performance` | Set the 8.1 SP5 and higher domain to `compatibility` | Set the 8.1 SP5 and higher domain to `compatibility` |

**Table 3-2 Communication Channel Configurations for Inter-Domain Transactions**

| Domain | 10.x and 9.2 MP2 and higher MPs | 9.0, 9.1, 9.2 MP1 and lower | 8.1 SP5 and higher | 8.1 SP4 and lower | 7.0 and higher SPs |
|---|---|---|---|---|---|
| **8.1 SP4 and lower** | Configure the 10.x or 9.2 MP2 and higher MP for Cross Domain Security and include the 8.1 domain in the exception list<br>or<br>use Security Interoperability mode and set the 10.x or 9.2 MP2 and higher MP to `compatibility` | Set the 9.x domain to `compatibility` | Set the 8.1 SP5 and higher domain to `compatibility` | N/A | N/A |
| **7.0 and higher SPs** | Configure the 10.x or 9.2 MP2 and higher MP for Cross Domain Security and include the 8.1 domain in the exception list<br>or<br>use Security Interoperability mode and set the 10.x or 9.2 MP2 and higher MP to `compatibility` | Set the 9.x domain to `compatibility` | Set the 8.1 SP5 and higher domain to `compatibility` | N/A | N/A |

**Note:** When `Security Interoperability Mode` is set to `performance`, you are not required to set domain trust between the domains.

## JMX Incompatibility

There is a known issue which may occur when performing inter-domain transactions due incompatibilities between JMX 1.0 and JMX 1.2. To correct this incompatibility, use the JVM flag `-Djmx.serial.form=1.0` as described in JMX 1.2 Implementation in *Upgrading WebLogic Application Environments*.

## Configuring Cross Domain Security

Cross Domain Security uses a credential mapper to enable you to configure compatible communication channels between servers in global transactions. For every domain pair that participates in a transaction, a credential mapper is configured. Every domain pair can have a different set of credentials which belong to the `CrossDomainConnector` security role.

See "Configuring Cross-Domain Security" and "Configure a Credential Mapping for Cross-Domain Security" in *Securing WebLogic Server*.

### Cross Domain Security is Not Transitive

Servers participating in a transaction set cross-domain credential mapping with each other. Unlike domain-trust, the cross domain security configuration is not transitive; that is, because `A` trusts `B` and `B` trusts `C`, it is not therefore also true that `A` trusts `C`.

Consider the follow scenario:

- DomainA has Server1 (coordinator)
- DomainB has Server2 (sub-coordinator)
- DomainC has Server3 and Server4 (Server3 is a sub-coordinator)
- DomainD has Server5 (does not participate in the transaction)

To set the cross-domain credential mapping in this scenario, you need to do the following:

1. Set cross-domain security in DomainA for DomainB
2. Set cross-domain security in DomainB for DomainA
3. Set cross-domain security in DomainA for DomainC
4. Set cross-domain security in DomainC for DomainA

5. Set cross-domain security in DomainB for DomainC
6. Set cross-domain security in DomainC for DomainB

Because DomainD does not participate in the transaction there is no need to set cross-domain credential mapping. However, see "Adding Domains to the Exclude List Based on Transaction Participation" on page 3-13 for further clarification.

To present this information in another way, consider Table 3-3. The checkmark (✓) indicates that you must configure cross domain security for this domain combination.

**Table 3-3 Setting Cross Domain Security with Three Participating Domains**

| | DomainA | DomainB | DomainC | DomainD |
|---|---|---|---|---|
| DomainA | | ✓ | ✓ | |
| DomainB | ✓ | | ✓ | |
| DomainC | ✓ | ✓ | | |
| DomainD | | | | |

If you were then to add both DomainD and an additional DomainE to the cross-domain security configuration, the cross-domain credential map would be as shown in Table 3-4. The checkmark (✓) indicates that you must configure cross domain security for this domain combination.

**Table 3-4 Setting Cross Domain Security with Five Participating Domains**

| | DomainA | DomainB | DomainC | DomainD | DomainE |
|---|---|---|---|---|---|
| DomainA | | ✓ | ✓ | ✓ | ✓ |
| DomainB | ✓ | | ✓ | ✓ | ✓ |
| DomainC | ✓ | ✓ | | ✓ | ✓ |
| DomainD | ✓ | ✓ | ✓ | | ✓ |
| DomainE | ✓ | ✓ | ✓ | ✓ | |

## Adding Domains to the Exclude List Based on Transaction Participation

If any server in a domain in which cross domain security is not configured participates in a transaction with any server in a domain in which cross domain security is configured, you need to add that domain to the exclude list of the domain that has cross domain security configured.

You do not need to add the domain to the exclude list of all domains that have cross domain security configured; the domain must explicitly participate in a transaction with the domain in question for this requirement to take effect.

Consider the following scenario:

- Transaction #1:
  - DomainA has Server1 (coordinator)
  - DomainB has Server2 (sub-coordinator)
  - DomainC has Server3 and Server4 (Server3 is a sub-coordinator)
  - DomainD has Server5 (does not participate in the transaction, cross-domain security not configured)
- Transaction #2:
  - DomainB has Server6 (coordinator)
  - DomainD has Server5 (sub-coordinator, cross-domain security not configured)

In this case DomainD has to be in the exclusion list of DomainB because of Transaction #2.

You do not need to include it in the exclusion list of DomainA or DomainC because DomainD does not participate in any transactions with servers in these two domains.

## Important Considerations When Configuring Cross Domain Security

When configuring Cross Domain Security, consider the following guidelines:

- Domain trust is not required for Cross Domain Security.
- For every domain pair that participates in a transaction, a credential mapper must be correctly configured having a set of credentials which belong to the `CrossDomainConnector` security role. If the credential mapping is not correct, transactions across the participating domains will fail. See Configure a Credential Mapping for Cross-Domain Security in *Securing WebLogic Server.*
- Configure one-way SSL to provide additional communication security to protect the transaction from a man-in-the-middle attack.

- To interoperate with WebLogic domains that either do not support Cross Domain Security or have Cross Domain Security disable, you must add these domains to the `Excluded Domain Names` list of every participating WebLogic Server domain that has Cross Domain Security enabled. If the configuration of the `Excluded Domain Names` list and the `CrossDomainSecurityEnabled` flag is not consistent in all participating domains, branches of the transaction will fail.
- If `Cross Domain Security Enabled` flag is disabled or the domain is in the `Excluded Domain Names` list, then Security Interoperability Mode is used to establish communication channels for participating domains.
- When enabling or disabling the `Cross Domain Security Enabled` flag, there may be a period of time where transactions or other remote calls can fail. For transactions, if the commit request fails, the commit will be retried after the configuration change is complete. If a transaction RMI call fails during any other request, then the transaction times out and the transaction is rolledback. The rollback is retried until `AbandonTimeoutSeconds`.

## Configuring Security Interoperability Mode

`Security Interoperability Mode` enables you to configure compatible communication channels between servers in global transactions. Use the following steps to configure Security Interoperability Mode:

1. "Establish Domain Trust" on page 3-14
2. "Configuring Security Interoperability Mode" on page 3-15 using the values from Table 3-2.

**Note:** When `Security Interoperability Mode` is set to `performance`, you are not required to set domain trust between the domains.

### Establish Domain Trust

Establish domain trust by setting a security credential for all domains to the same value in all participating domains.

- For 8.x domains, see Enabling Trust Between WebLogic Domains in *Managing WebLogic Security.*
- For 9.x domains, see Enable trust between domains in *Administration Console Online Help.*
- For 10.x domains, see Enable trust between domains in *Administration Console Online Help.*

## Configuring Security Interoperability Mode

Every participating server must set the `Security Interoperability Mode` parameter to the same value:

Valid values are:

- **default**—The transaction coordinator makes calls using the kernel identity over an admin channel if it is enabled, and `anonymous` otherwise. Man-in-the-middle attacks are possible if the admin channel is not enabled.
- **performance**—The transaction coordinator makes calls using `anonymous` at all times. This implies a security risk since a malicious third party could then try to affect the outcome of transactions using a man-in-the-middle attack.
- **compatibility**—The transaction coordinator makes calls as the kernel identity over an unsecure channel. This is a high security risk because a successful man-in-the-middle attack would allow the attacker to gain administrative control over both domains. This setting should only be used when strong network security is in place.

To configure `Security Interoperability Mode` for participating servers, see:

- For servers in WebLogic Server 10.x domains, see Configure securityity interoperabilty mode in the *Administration Console Online Help*.
- For servers in WebLogic Server 9.x domains, see Configure the security mode for XA transactions in *Administration Console Online Help*.
- For servers in WebLogic Server 8.1 domains, see Using Security Interoperability Mode in *Administration Console Online Help*.

## Configuring Domains for JNDI Lookups Requiring an Admin User

The following section provides information on how to configure SecurityInteropMode when transactions use JNDI lookups that require an admin user.

- If the WebLogic Server domain is 9.0, 9.1, 9.2 and higher MP, 10.x or higher MP then do one of the following:
  - Set `SecurityInteropMode=default,` configure admin channels, and enable domain trust.
  - Set `SecurityInteropMode=compatibility` and enable domain trust.
- If the WebLogic Server domain is 7.0sp7 and higher and 8.1sp5 higher then set `SecurityInteropMode=compatibility` and enable domain trust.

When SecurityInteropMode is set to compatibility Man-in-the-middle attacks are possible.

# Configuring Domains for Intra-Domain Transactions

You must correctly configure compatible communication channels between servers participating in transactions within the same domain using Security Interoperability Mode. See "Configuring Security Interoperability Mode" on page 3-14.

Use the following information to determine the type of communication channel configuration required for intra-domain transactions.

- For servers in a WebLogic Server 10.x domain, set participating servers to either `default` or `performance`.
- For servers in a WebLogic Server 9.x domain, set participating servers to either `default` or `performance`.
- For servers in a WebLogic Server 8.1 SP5 and higher domain, set participating servers to `performance`.
- For servers in a WebLogic Server 8.1 SP4 and lower domain, Security Interoperability Mode is not available.

# Transaction Log Files

Each server has a transaction log which stores information about committed transactions coordinated by the server that may not have been completed. WebLogic Server uses the transaction log when recovering from system crashes or network failures. You cannot directly view the transaction log—the records are in a binary format and are stored in the default persistent store for the server.

To take advantage of the migration capability of the Transaction Recovery Service for servers in a cluster, you must store the transaction log in a location that is available to a server and its backup servers, preferably on a dual-ported SCSI disk or on a Storage Area Network (SAN). See "Setting the Path for the Default Persistent Store" on page 3-17 for more information.

If the file system on which the default store saves transaction log records runs out of space or is inaccessible, `commit()` throws `SystemException`, and the transaction manager places a message in the system error log. No transactions are committed until more space is available.

## Setting the Path for the Default Persistent Store

Each server instance, including the administration server, has a default persistent store, which is a file-based store that is available to subsystems that do not require explicit selection of a particular store and function best by using the system's default storage mechanism. The transaction manager uses the default persistent store to store transaction log records. In many cases, the default persistent store requires no configuration. However, to enable migration of the Transaction Recovery Service, you must configure the default persistent store so that it stores its data files on a persistent storage solution that is available to other servers in the cluster if the original server fails.

See "Configure the default persistent store for Transaction Recovery Service migration" in the *Administration Console Online Help* for instructions.

## Setting the Default Persistent Store Synchronous Write Policy

WebLogic Server uses the default persistent store to store transaction log records. You can select a write policy for the default store to change the way WebLogic Server writes records to disk. You can select one of the following options:

- Cache-Flush – Flushes operating system and on-disk caches after each entry to the store. Transactions cannot commit until the commit record is written to stable storage.
- Disabled – Transactions are complete as soon as their writes are cached in memory, instead of waiting for the writes to successfully reach the disk. This policy is the fastest, but is not transactionally safe. Power outages or operating system failures can cause lost or duplicate entries.

  **WARNING:** The Disabled synchronous write policy is not transactionally safe. Do not select this option if your applications use global transactions.

- Direct-Write – Forces the operating system to write directly to disk with each write. This option is available on Windows, Solaris and HP-UX platforms.

On Windows, the Direct-Write transaction log file write policy may leave transaction data in the on-disk cache without immediately writing it to disk. This is not transactionally safe because a power failure can cause loss of on-disk cache data. To prevent cache data loss when using the Direct-Write transaction log file write policy on Windows, disable all write caching for the disk (which is enabled by default) or use a battery backup for the system.

See "Configure the default persistent store for Transaction Recovery Service migration" in the *Administration Console Online Help* for instructions.

CHAPTER 4

# Managing Transactions

The following sections provide information on administration tasks used to manage transactions:



You can monitor transactions on a server using statistics and monitoring facilities. Use the Administration Console to configure these features and to display the resulting output.

## Monitoring Transactions

In the Administration Console, you can monitor transactions for each server in the domain. Transaction statistics are displayed for a specific server, not the entire domain.

For instructions, see the following pages in the *Administration Console Online Help*:

- View transaction statistics (and Servers: Monitoring: JTA: Summary)
- View statistics for named transactions (and Servers: Monitoring: JTA: Transactions By Name)
- View transaction statistics for XA resources (and Servers: Monitoring: JTA XA Resources)

- View transaction statistics for non-XA resources (and Servers: Monitoring: JTA: Non-XA Resources)
- View current transactions (and Servers: Monitoring: JTA: Transactions)
- View transaction recovery statistics (and Servers: Monitoring: JTA: Recovery Services)

# Handling Heuristic Completions

A **heuristic completion** (or heuristic decision) occurs when a resource makes a unilateral decision during the completion stage of a distributed transaction to commit or rollback updates. This can leave distributed data in an indeterminate state. Network failures or resource timeouts are possible causes for heuristic completion. In the event of an heuristic completion, one of the following heuristic outcome exceptions may be thrown:

- `HeuristicRollback`—one resource participating in a transaction decided to autonomously rollback its work, even though it agreed to prepare itself and wait for a commit decision. If the Transaction Manager decided to commit the transaction, the resource's heuristic rollback decision was incorrect, and might lead to an inconsistent outcome since other branches of the transaction were committed.
- `HeuristicCommit`—one resource participating in a transaction decided to autonomously commit its work, even though it agreed to prepare itself and wait for a commit decision. If the Transaction Manager decided to rollback the transaction, the resource's heuristic commit decision was incorrect, and might lead to an inconsistent outcome since other branches of the transaction were rolled back.
- `HeuristicMixed`—the Transaction Manager is aware that a transaction resulted in a mixed outcome, where some participating resources committed and some rolled back. The underlying cause was most likely heuristic rollback or heuristic commit decisions made by one or more of the participating resources.
- `HeuristicHazard`—the Transaction Manager is aware that a transaction might have resulted in a mixed outcome, where some participating resources committed and some rolled back. But system or resource failures make it impossible to know for sure whether a Heuristic Mixed outcome definitely occurred. The underlying cause was most likely heuristic rollback or heuristic commit decisions made by one or more of the participating resources.

When an heuristic completion occurs, a message is written to the server log. Refer to your database vendor documentation for instructions on resolving heuristic completions.

Some resource managers save context information for heuristic completions. This information can be helpful in resolving resource manager data inconsistencies. If the `ForgetHeuristics` attribute is selected (set to true) on the JTA panel of the WebLogic Console, this information is removed after an heuristic completion. When using a resource manager that saves context information, you may want to set the `ForgetHeuristics` attribute to false.

# Moving a Server

A server instance is identified by its URL (IP address or DNS name plus the listening port number). Changing the URL by moving the server to a new machine or changing the Listening Port of a server on the same machine effectively moves the server so the server identity may no longer match the information stored in the transaction logs.

- If the new server has the same URL as the old server, the Transaction Recovery Service searches all transaction log files for incomplete transactions and completes them as described in "Transaction Recovery Service Actions After a Crash" on page 4-5.
- If the new server does not have the same URL, any pending transactions stored in the transaction log files are unrecoverable. If you wish, you can delete the transaction log files. This step prevents the Transaction Recovery Service from attempting to resolve these transactions until the value of the `AbandonTimeoutSeconds` parameter is exceeded. See "Abandoning Transactions" on page 4-3 for more information.
- If a server acting as a remote transaction sub-coordinator fails and its URL changes, any ongoing transactions will not complete (commit or rolled back) because the coordinator is unable to communicate with the remote sub-coordinator. The coordinator will attempt the commit or rollback request until `AbandonTimeoutSeconds` is exceeded. See "Abandoning Transactions" on page 4-3 for more information.

Oracle recommends configuring server instances using DNS names rather than IP addresses to promote portability.

If you need to move a server to a new machine, follow the instructions for "Recovering Transactions For a Failed Non-Clustered Server" on page 4-6.

# Abandoning Transactions

You can choose to abandon incomplete transactions after a specified amount of time. In the two-phase commit process for distributed transactions, the transaction manager coordinates all resource managers involved in a transaction. After all resource managers vote to commit or rollback, the transaction manager notifies the resource managers to act—to either commit or

rollback changes. During this second phase of the two-phase commit process, the transaction manager will continue to try to complete the transaction until all resource managers indicate that the transaction is completed. Using the `AbandonTimeoutSeconds` attribute, you can set the maximum time, in seconds, that a transaction manager will persist in attempting to complete a transaction during the second phase of the commit protocol. The default value is 86400 seconds, or 24 hours. After the abandon transaction timer expires, no further attempt is made to resolve the transaction with any resources that are unavailable or unable to acknowledge the transaction outcome. If the transaction is in a prepared state before being abandoned, the transaction manager will roll back the transaction to release any locks held on behalf of the abandoned transaction and will write an heuristic error to the server log.

You may want to review the following related information:

- For instructions on how to set the `AbandonTimeoutSeconds` attribute, see Configure JTA in the *Administration Console Online Help*.
- For more information about the two-phase commit process, see "Distributed Transactions and the Two-Phase Commit Protocol" on page 2-3.

# Transaction Recovery After a Server Fails

The WebLogic Server transaction manager is designed to recover from system crashes with minimal user intervention. The transaction manager makes every effort to resolve transaction branches that are prepared by resource managers with a commit or roll back, even after multiple crashes or crashes during recovery.

To facilitate recovery after a crash, WebLogic Server provides the Transaction Recovery Service, which automatically attempts to recover transactions on system startup. On startup, the Transaction Recovery Service parses all transaction log records for incomplete transactions and completes them as described in "Transaction Recovery Service Actions After a Crash" on page 4-5.

Because the Transaction Recovery Service is designed to gracefully handle transaction recovery after a crash, Oracle recommends that you attempt to restart a crashed server and allow the Transaction Recovery Service to handle incomplete transactions.

If a server crashes and you do not expect to be able to restart it within a reasonable period of time, you may need to take action. Procedures for recovering transactions after a server failure differ based on your WebLogic Server environment. For a non-clustered server, you can manually move the server (with the default persistent store DAT file) to another system (machine) to recover transactions. See "Recovering Transactions For a Failed Non-Clustered Server" on

page 4-6 for more information. For a server in a cluster, you can manually migrate the whole server or the *Transaction Recovery Service* to another server in the same cluster. Migrating the Transaction Recovery Service involves selecting a server with access to the transaction logs to recover transactions, and then migrating the service using the Administration Console or the WebLogic command line interface.

**Note:** For non-clustered servers, you can only move the entire server to a new system. For clustered servers, you can migrate the entire server or temporarily migrate the Transaction Recovery Service.

For more information about migrating the Transaction Recovery Service, see "Recovering Transactions For a Failed Clustered Server" on page 4-7. For more information about clusters, see *Using WebLogic Server Clusters*.

The following sections provide information on how to recover transactions after a failure:

- "Transaction Recovery Service Actions After a Crash" on page 4-5
- "Recovering Transactions For a Failed Non-Clustered Server" on page 4-6
- "Recovering Transactions For a Failed Clustered Server" on page 4-7

# Transaction Recovery Service Actions After a Crash

When you restart a server after a crash or when you migrate the Transaction Recovery Service to another (backup) server, the Transaction Recovery Service does the following:

- Complete transactions ready for second phase of two-phase commit

  For transactions for which a commit decision has been made but the second phase of the two-phase commit process has not completed (transactions recorded in the transaction log), the Transaction Recovery Service completes the commit process.

- Resolve prepared transactions

  For transactions that the transaction manager has prepared with a resource manager (transactions in phase one of the two-phase commit process), the Transaction Recovery Service must call `XAResource.recover()` during crash recovery for each resource manager and eventually resolve (by calling the `commit()`, `rollback()`, or `forget()` method) all transaction IDs returned by `recover()`.

- Report heuristic completions

  If a resource manager reports a heuristic exception, the Transaction Recovery Service records the heuristic exception in the server log and calls `forget()` if the `Forget`

`Heuristics` configuration attribute is enabled. If the `Forget Heuristics` configuration attribute is not enabled, refer to your database vendor's documentation for information about resolving heuristic completions. See "Handling Heuristic Completions" on page 4-2 for more information.

The Transaction Recovery Service provides the following benefits:

- Maintains consistency across resources

  The Transaction Recovery Service handles transaction recovery in a consistent, predictable manner: For a transaction for which a commit decision has been made but is not yet committed before a crash, and `XAResource.recover()` returns the transaction ID, the Transaction Recovery Service consistently calls `XAResource.commit()`; for a transaction for which a commit decision has not been made before a crash, and `XAResource.recover()` returns its transaction ID, the Transaction Recovery Service consistently calls `XAResource.rollback()`. With consistent, predictable transaction recovery, a transaction manager crash by itself cannot cause a mixed heuristic completion where some branches are committed and some are rolled back.

- Persists in achieving transaction resolution

  If a resource manager crashes, the Transaction Recovery Service must eventually call `commit()` or `rollback()` for each prepared transaction until it gets a successful return from `commit()` or `rollback()`. The attempts to resolve the transaction can be limited by setting the `AbandonTimeoutSeconds` configuration attribute. See "Abandoning Transactions" on page 4-3 for more information.

# Recovering Transactions For a Failed Non-Clustered Server

To recover transactions for a failed server, follow these steps:

1. Move (or make available) the persistent store DAT file (which contains all transaction log records) from the failed server to a new server.
2. Set the path for the default persistent store with the path to the data file. See "Setting the Path for the Default Persistent Store" on page 3-17.
3. Start the new server. The Transaction Recovery Service searches all transaction log files for incomplete transactions and completes them as described in "Transaction Recovery Service Actions After a Crash" on page 4-5.

When moving transaction log records after a server failure, make all transaction log records available on the new machine before starting the server there. Otherwise, transactions in the process of being committed at the time of a crash might not be resolved correctly, resulting in

application data inconsistencies.You can accomplish this by storing persistent store data files on a dual-ported disk available to both machines. As in the case of a planned migration, update the default file store `directory` attribute with the new path before starting the server if the pathname is different on the new machine.

**Note:** The Transaction Recovery Service is designed to gracefully handle transaction recovery after a crash. Oracle recommends that you attempt to restart a crashed server and allow the Transaction Recovery Service to handle incomplete transactions, rather than move the server to a new machine.

# Recovering Transactions For a Failed Clustered Server

When a clustered server fails, you have the following options for recovering transactions:


- "Server Migration" on page 4-7
- "Manual Transaction Recovery Service Migration" on page 4-7


## Server Migration

For clustered servers, WebLogic Server enables you to migrate a failing server to a new machine, including the Transaction Recovery Service. When the server migrates to another machine, it must be able to locate the transaction log records to complete or recover transactions. Transaction log records are stored in the default persistent store for the server. If you plan to migrate clustered servers in the event of a failure, you must set up the default persistent store so that it stores records in a shared storage system that is accessible to any potential machine to which a failed migratable server might be migrated. For highest reliability, use a shared storage solution that is itself highly available—for example, a storage area network (SAN).

For information about server migration, see Server-level Migration in *Using WebLogic Server Clusters*.

For more information about setting default persistent store options, see:


- "Setting the Path for the Default Persistent Store" on page 3-17
- "Setting the Default Persistent Store Synchronous Write Policy" on page 3-17


## Manual Transaction Recovery Service Migration

When a clustered server crashes, you can manually migrate the Transaction Recovery Service from the crashed server to another server in the same cluster using the Administration Console or the command-line interface. For instructions to manually migrate the Transaction Recovery

Service using the Administration Console, see Manually Migrate the Transaction Recovery Service in the *Administration Console Online Help*.

You can also configure WebLogic Server to automatically migrate the Transaction Recovery Service to a healthy candidate server based with the help of WebLogic Server health monitoring of singleton services. See "Automatic Transaction Recovery Service Migration" on page 4-9.

## What Occurs During Transaction Recovery Service Migration

When manual or automatic service migration takes place, the following events occur:

1. The Transaction Recovery Service on the backup server takes ownership of the transaction log from the crashed server.
2. The Transaction Recovery Service searches all transaction log records from the failed server for incomplete transactions and completes them as described in "Transaction Recovery Service Actions After a Crash" on page 4-5.
3. If the Transaction Recovery Service on the backup server successfully completes all incomplete transactions from the failed server, the server releases ownership of the Transaction Recovery Service for the failed server so the failed server can reclaim it upon restart.

A server can perform transaction recovery for more than one failed server. While recovering transactions for other servers, the backup server continues to process and recover its own transactions. If the backup server fails during recovery, you can migrate the Transaction Recovery Service to yet another server, which will continue the transaction recovery. You can also manually migrate the Transaction Recovery Service back to the original failed server using the Administration Console or the command line interface. See "Manually Migrating the Transaction Recovery Service Back to the Original Server" on page 4-12 for more information.

When a backup server completes transaction recovery for a server, it releases ownership of the Transaction Recovery Service for the failed server. When you restart a failed server, it attempts to reclaim ownership of its Transaction Recovery Service. If a backup server is in the process of recovering transactions when you restart the failed server, the backup server stops recovering transactions, performs some internal cleanup, and releases ownership of the Transaction Recovery service so the failed server can reclaim it and start properly. The failed server will then complete its own transaction recovery.

If a backup server still owns the Transaction Recovery Service for a failed server and the backup server is inactive when you attempt to restart the failed server, the failed server will not start because the backup server cannot release ownership of the Transaction Recovery Service. This is also true if the fail back mechanism fails or if the backup server cannot communicate with the

Administration Server. You can manually migrate the Transaction Recovery using the Administration Console or the command-line interface.

## Automatic Transaction Recovery Service Migration

You can specify to have the Transaction Recovery Service automatically migrated from an unhealthy server instance to a healthy server instance, with the help of the server health monitoring services. This way the backup server can complete transaction work for the failed server. See Roadmap for Configuring Automatic Migration of the JTA Transaction Recovery Service in *Using WebLogic Server Clusters*.

## Managed Server Independence

Prior to WebLogic Server 10.0, when a cluster's primary Managed Server was booted, but was unable to contact the Administration Server (mostly because that Administration Server had not started yet), then the primary Managed Server would automatically go into MSI (managed server independence) mode and continue to boot up using its local configuration information. During a manual migration of the Transaction Recovery Service, this situation posed a potential risk that a backup server was still recovering TLOG data on behalf of the primary Managed Server, which could then lead to concurrent access to TLOG and potential corruption of the TLOG.

To avoid risking potential TLOG corruption, there is a `strictOwnershipCheck` property on the `JTAMigratableTargetMBean`. This way, when a primary Managed Server attempts to boot up and it finds that it cannot connect to the Administration Server (for the manual JTA migration policy) or the Singleton Master (for the automatic JTA migration policy), then it will verify its independence by checking the value of the `strictOwnershipCheck`, as follows:

- `True` – This is the recommended setting. The primary Managed Server will throw an exception and fail to boot.
- `False` – The primary Managed Server will skip Transaction Recovery Service failback, then it can boot successfully. This poses the same TLOG corruption risk as in WebLogic Server 9.2 or earlier.

## Limitations of Migrating the Transaction Recovery Service

When manually or automatically migrating the Transaction Recovery Service, the following limitations apply:

- You cannot migrate the Transaction Recovery Service to a backup server from a server that is running. You must stop the server before migrating the Transactions Recovery Service.

- The backup server does not accept new transaction work for the failed server. It only processes incomplete transactions.
- The backup server does not process heuristic log files.
- The backup server only processes log records written by WebLogic Server. It does not process log records written by gateway implementations, including WebLogic Tuxedo Connector.

In addition to the limitations described above, the following rules also apply when WebLogic Server 10.0 is configured to automatically migrate the Transaction Recovery Service:

- If the cluster also contains servers from earlier releases of WebLogic Server, the primary server and backup servers must be WebLogic Server 10.0 or later. To enforce this when automatic migration is enabled, on the Administration Console, only WebLogic Server 10.0 or later servers will appear in the Candidate Servers **Available** list.
- Manual service migration is supported between release 9.2 or earlier servers and release 10.0 or later servers if no migration scripts are used.

## Preparing to Migrate the Transaction Recovery Service

To migrate the Transaction Recovery Service from a failed server in a cluster to another server (backup server) in the same cluster, the backup server must have access to the transaction log records from the failed server. Therefore, you must store default persistent store data files on persistent storage available to all potential backup servers in the cluster. Oracle recommends that you store transaction log records on a Storage Area Network (SAN) device or a dual-ported disk. Do not use an NFS file system to store transaction log records. Because of the caching scheme in NFS, files on disk may not always be current. Using transaction log records stored on an NFS device for recovery may cause data corruption.

The following persistent store rules apply when manually or automatically migrating the Transaction Recovery Service:

- The default persistent store cannot be shared by JTA and other migratable services. Other migratable services, such as JMS services, must use another custom store if they are targeted to a migratable target.
- If post-deactivation and pre-activation scripts are specified to perform any unmounting and mounting of the default store, then the Node Manager must be configure and running on all candidate machines.

The Administration Server must be available when the primary server starts up, fails over, or fails back. This is required to guarantee that the Transaction Recovery Service gets exclusive

ownership to its TLOG correctly and without conflict. When the primary server starts up, the Transaction Recovery Service connects to Administration Server to get the latest information about JTA. And should failover/failback occur, the Transaction Recovery Service saves the latest information to Administration Server.

When migrating the Transaction Recovery Service from a server, you must stop the failing or failed server before actually migrating the Transaction Recovery Service. If the original server is still running, you cannot migrate the Transaction Recovery Service from it.

All servers that participate in the migration must have a listen address specified in their configuration. See Configure listen addresses in the *Administration Console Help*.

## Constraining the Servers to Which the Transaction Recovery Service Can Migrate

You may want to limit the choices of the servers to use as a Transaction Recovery Service backup for a server in a cluster. For example, all servers in your cluster may not have access to the transaction log records for a server. You can limit the list of destination servers available on the Servers: Configuration: Migration page in the Administration Console. See Configure candidate servers for Transaction Recovery Service migration for instructions.

**Note:** You must include the original server in the list of chosen servers so that you can manually migrate the Transaction Recovery Service back to the original server, if need be. The Administration Console enforces this rule.

## Viewing Current Owner of the Transaction Recovery Service

When you migrate the Transaction Recovery Service to another server in the cluster, the backup server takes ownership of the Transaction Recovery Service until it completes all incomplete transactions. After which, it releases ownership of the Transaction Recovery Service and the original server can reclaim it. You can see the current owner on the Servers: Control: Migration page in the Administration Console. Follow these instructions:

1. In the Domain Structure tree in the Administration console, expand Environment and click Servers.
2. Select the original server from which the Transaction Recovery Service was migrated, then select the Control > Migration tab.
3. Click Advanced. Under JTA Migration Options, Hosting Server indicates the current owner of the Transaction Recovery Service.

## Manually Migrating the Transaction Recovery Service Back to the Original Server

After completing transaction recovery for a failed server, a backup server releases ownership of the Transaction Recovery Service so that the original server can reclaim it when the server is restarted. If the backup server stops (crashes) for any reason before it completes transaction recovery, the original server cannot reclaim ownership of the Transaction Recovery Service and will not start.

You can manually migrate the Transaction Recovery Service back to the original server by selecting the original server as the destination server. The backup server must not be running when you migrate the service back to the original server. Follow the instructions below.

**Note:** Please note the following:

- If a backup server fails before completing the transaction recovery actions, the primary server cannot reclaim ownership of the Transaction Recovery Service and recovery will not be re-attempted after the rebooting server. Therefore, you must attempt to manually re-migrate the Transaction Recovery Service to another backup server.
- If you restart the original server while the backup server is recovering transactions, the backup server will gracefully release ownership of the Transaction Recovery Service. You do not need to stop the backup server. See "Recovering Transactions For a Failed Clustered Server" on page 4-7.

For instructions on manually migrating the Transaction Recovery Service using the Administration Console, see "Migrate the Transaction Recovery Service" in the *Administration Console Help*.

CHAPTER 5

# Transaction Service

This section provides information that programmers need to write transactional applications for the WebLogic Server system.

This section discusses the following topics:



## About the Transaction Service

WebLogic Server provides a Transaction Service that supports transactions in EJB and RMI applications. In the WebLogic Server EJB container, the Transaction Service provides an implementation of the transaction services described in the Enterprise JavaBeans Specification 3.0, published by Sun Microsystems, Inc.

For EJB and RMI applications, WebLogic Server also provides the `javax.transaction` and `javax.transaction.xa` packages, from Sun Microsystems, Inc., which implements the Java Transaction API (JTA) for Java applications. For more information about JTA, see the Java Transaction API (JTA) Specification 1.1, published by Sun Microsystems, Inc. For more

information about the `UserTransaction` object that applications use to demarcate transaction boundaries, see the WebLogic Server Javadoc.

# Capabilities and Limitations

This section includes the following sections:

- Lightweight Clients with Delegated Commit
- Client-initiated Transactions
- Transaction Integrity
- Transaction Termination
- Flat Transactions
- Relationship of the Transaction Service to Transaction Processing
- Multithreaded Transaction Client Support
- General Constraints

These sections describe the capabilities and limitations of the Transaction Service that supports EJB and RMI applications:

## Lightweight Clients with Delegated Commit

A lightweight client runs on a single-user, unmanaged desktop system that has irregular availability. Owners may turn their desktop systems off when they are not in use. These single-user, unmanaged desktop systems should not be required to perform network functions such as transaction coordination. In particular, unmanaged systems should not be responsible for ensuring atomicity, consistency, isolation, and durability (ACID) properties across failures for transactions involving server resources. WebLogic Server remote clients are lightweight clients.

The Transaction Service allows lightweight clients to do a delegated commit, which means that the Transaction Service allows lightweight clients to begin and terminate transactions while the responsibility for transaction coordination is delegated to a transaction manager running on a server machine. Client applications do not require a local transaction server. The remote implementation of `UserTransaction` that EJB or RMI clients use delegates the actual responsibility of transaction coordination to the transaction manager on the server.

## Client-initiated Transactions

A client, such as an applet, can obtain a reference to the `UserTransaction` and `TransactionManager` objects using JNDI. A client can begin a transaction using either object reference. To get the `Transaction` object for the current thread, the client program must invoke the `((TransactionManager)tm).getTransaction()` method.

## Transaction Integrity

Checked transaction behavior provides transaction integrity by guaranteeing that a `commit` will not succeed unless all transactional objects involved in the transaction have completed the processing of their transactional requests. The Transaction Service *provides* checked transaction behavior that is equivalent to that provided by the request/response interprocess communication models defined by The Open Group.

## Transaction Termination

WebLogic Server allows transactions to be terminated *only* by the client that created the transaction.

**Note:** The client may be a server object that requests the services of another object.

## Flat Transactions

WebLogic Server implements the flat transaction model. Nested transactions are *not* supported.

## Relationship of the Transaction Service to Transaction Processing

The Transaction Service relates to various transaction processing servers, interfaces, protocols, and standards in the following ways:

- **Support for The Open Group XA interface.**The Open Group Resource Managers are resource managers that can be involved in a distributed transaction by allowing their two-phase commit protocol to be controlled via The Open Group XA interface. WebLogic Server supports interaction with The Open Group Resource Managers.
- **Support for the OSI TP protocol.** Open Systems Interconnect Transaction Processing (OSI TP) is the transactional protocol defined by the International Organization for Standardization (ISO). WebLogic Server *does not* support interactions with OSI TP transactions.

- **Support for the LU 6.2 protocol.** Systems Network Architecture (SNA) LU 6.2 is a transactional protocol defined by IBM. WebLogic Server *does not* support interactions with LU 6.2 transactions.
- **Support for the ODMG standard.** ODMG-93 is a standard defined by the Object Database Management Group (ODMG) that describes a portable interface to access Object Database Management Systems. WebLogic Server *does not* support interactions with ODMG transactions.

# Multithreaded Transaction Client Support

WebLogic Server supports multithreaded transactional clients. Clients can make transaction requests concurrently in multiple threads.

# Transaction Id

The Transaction Service assigns a transaction identifier (`XID`) to each transaction. This ID can be used to isolate information about a specific transaction in a log file. You can retrieve the transaction identifier using the `getXID` method in the `weblogic.transaction.Transaction` interface. For detailed information on methods for getting the transaction identifier, see the `weblogic.transaction.Transaction` Javadoc.

# Transaction Name and Properties

WebLogic JTA provides extensions to `javax.transaction.Transaction` that support transaction naming and user-defined properties. These extensions are included in the `weblogic.transaction.Transaction` interface.

The transaction name indicates a type of transaction (for example, funds transfer or ticket purchase) and should not be confused with the transaction ID, which identifies a unique transaction on a server. The transaction name makes it easier to identify a transaction type in the context of an exception or a log file.

User-defined properties are key/value pairs, where the key is a string identifying the property and the value is the current value assigned to the property. Transaction property values must be objects that implement the `Serializable` interface. You manage properties in your application using the set and get methods defined in the `weblogic.transaction.Transaction` interface. Once set, properties stay with a transaction during its entire lifetime and are passed between machines as the transaction travels through the system. Properties are saved in the transaction log, and are restored during crash recovery processing. If a transaction property is set more than once, the latest value is retained.

For detailed information on methods for setting and getting the transaction name and transaction properties, see the `weblogic.transaction.Transaction` Javadoc.

## Transaction Status

The Java Transaction API provides transaction status codes using the `javax.transaction.Status` class. Use the `getStatusAsString` method in `weblogic.transaction.Transaction` to return the status of the transaction as a string. The string contains the major state as specified in `javax.transaction.Status` with an additional minor state (such as `logging` or `pre-preparing`).

## Transaction Statistics

Transaction statistics are provided for all transactions handled by the transaction manager on a server. These statistics include the number of total transactions, transactions with a specific outcome (such as committed, rolled back, or heuristic completion), rolled back transactions by reason, and the total time that transactions were active. For detailed information on transaction statistics, see "Monitoring Transactions" on page 4-1.

## General Constraints

The following constraints apply to the Transaction Service:

- In WebLogic Server, a client or a server object *cannot* invoke methods on an object that is infected with (or participating in) another transaction. The method invocation issued by the client or the server will return an exception.
- In WebLogic Server, clients using third-party implementations of the Java Transaction API (for Java applications) *are not* supported.
- The transaction log buffer is limited to 250 KB. If your application includes very large transactions that require transaction log writes that exceed this value, WebLogic Server will throw an exception. In that case, you must reconfigure your application to work around the buffer size.

# Transaction Scope

The scope of a transaction refers to the environment in which the transaction is performed. WebLogic Server supports transactions on standalone servers, between non-clustered servers,

between clustered servers within a domain, and between domains. To enable inter-domain transaction support, see "Configuring Domains for Inter-Domain Transactions" on page 3-4.

# Transaction Service in EJB Applications

The WebLogic Server EJB container provides a Transaction Service that supports the two types of transactions in WebLogic Server EJB applications:

- **Container-managed transactions**. In container-managed transactions, the WebLogic Server EJB container manages the transaction demarcation. Transaction attributes in the EJB deployment descriptor determine how the WebLogic Server EJB container handles transactions with each method invocation.
- **Bean-managed transactions**. In bean-managed transactions, the EJB manages the transaction demarcation. The EJB makes explicit method invocations on the `UserTransaction` object to begin, commit, and roll back transactions. For more information about `UserTransaction` methods, see the online Javadoc.

For an introduction to transaction management in EJB applications, see "Transactions in WebLogic Server EJB Applications," and "Transactions Sample EJB Code" in the "Introducing Transactions" section.

# Transaction Service in RMI Applications

WebLogic Server provides a Transaction Service that supports transactions in WebLogic Server RMI applications. In RMI applications, the client or server application makes explicit method invocations on the `UserTransaction` object to begin, commit, and roll back transactions.

For more information about `UserTransaction` methods, see the online javadoc. For an introduction to transaction management in RMI applications, see "Transactions in WebLogic Server RMI Applications," and "Transactions Sample RMI Code" in the "Introducing Transactions" section.

# Transaction Service Interoperating with OTS

WebLogic Server provides a Transaction Service that supports interoperation with the Object Transaction Service (OTS). See the Java Transaction Service (JTS) Specification at `http://java.sun.com/products/jts/index.html`. For this release, WebLogic Server interoperates with OTS in the following scenarios:

- "Server-Server 2PC" on page 5-7

- "Client Demarcated Transactions" on page 5-7

## Server-Server 2PC

In this situation, a server-to-server 2PC transaction is completed using interposition. The originating server creates an Xid and propagates the transaction to the target server. The target server registers itself as a resource with the originating server. The originating server drives the completion of the transaction. Logging Last Resource Transaction Optimization is not supported.

## Client Demarcated Transactions

The client starts a transaction on the server via the OTS client APIs. The client then retrieves the Xid from this transaction and then propagates this per-request until the transaction is committed. Although the client initiates the transaction, all the commit processing is done on the server.

CHAPTER 6

# Java Transaction API and Oracle WebLogic Extensions

This section provides a brief overview of the Java Transaction API (JTA) and extensions to the API provided by Oracle.

This section discusses the following topics:

- JTA API Overview
- Oracle WebLogic Extensions to JTA

## JTA API Overview

WebLogic Server supports the `javax.transaction` package and the `javax.transaction.xa` package, from Sun Microsystems, Inc., which implement the Java Transaction API (JTA) for Java applications. For more information about JTA, see the Java Transaction API (JTA) Specification published by Sun Microsystems, Inc. For a detailed description of the `javax.transaction` and `javax.transaction.xa` interfaces, see the JTA Javadoc.

JTA includes the following components:

- An interface for demarcating and controlling transactions from an application, `javax.transaction.UserTransaction`. You use this interface as part of a Java client program or within an EJB as part of a bean-managed transaction.
- An interface for allowing a transaction manager to demarcate and control transactions for an application, `javax.transaction.TransactionManager`. This interface is used by an EJB container as part of a container-managed transaction and uses the

`javax.transaction.Transaction` interface to perform operations on a specific transaction.

- Interfaces that allow the transaction manager to provide status and synchronization information to an applications server, `javax.transaction.Status` and `javax.transaction.Synchronization`. These interfaces are accessed only by the transaction manager and cannot be used as part of an applications program.
- Interfaces for allowing a transaction manager to work with resource managers for XA-compliant resources (`javax.transaction.xa.XAResource`) and to retrieve transaction identifiers (`javax.transaction.xa.Xid`). These interfaces are accessed only by the transaction manager and cannot be used as part of an applications program.

# Oracle WebLogic Extensions to JTA

Extensions to the Java Transactions API are provided where the JTA specification does not cover implementation details and where additional capabilities are required.

Oracle WebLogic provides the following capabilities based on interpretations of the JTA specification:

- Client-initiated transactions—the JTA transaction manager interface (`javax.transaction.TransactionManager`) is made available to clients and bean providers through JNDI. This allows clients and EJBs using bean-managed transactions to suspend and resume transactions.

  **Note:** A suspended transaction must be resumed in the same server process in which it was suspended.

- Scope of transactions—transactions can operate within and between clusters and domains.
- Enhanced `javax.transaction.TransactionSynchronizationRegistry` support—WebLogic Server provides the ability to lookup the `TransactionSynchronizationRegistry` object in JNDI using the standard name of `java:comp/TransactionSynchronizationRegistry`. Oracle extends support by providing two additional global JNDI names: `javax/transaction/TransactionSynchronizationRegistry` and `weblogic/transaction/TransactionSynchronizationRegistry`. For more information, see `javax.transaction.TransactionSynchronizationRegistry`.

Oracle WebLogic Server provides the following classes and interfaces as extensions to JTA:

- `weblogic.transaction.RollbackException` (extends `javax.transaction.RollbackException`)

This class preserves the original reason for a rollback for use in more comprehensive exception information.

- `weblogic.transaction.TransactionManager` (extends `javax.transaction.TransactionManager`)

  The WebLogic JTA transaction manager object supports this interface, which allows XA resources to register and unregister themselves with the transaction manager on startup. It also allows a transaction to be resumed after suspension.

  This interface includes the following methods:

  - `registerStaticResource`, `registerDynamicResource`, and `unregisterResource`
  - `registerResource`— (new in WebLogic Server 8.1) This method includes support for properties that determine how the resource is controlled by the transaction manager.
  - `getTransaction`
  - `forceResume` and `forceSuspend`
  - begin

- `weblogic.transaction.Transaction` (extends `javax.transaction.Transaction`)

  The WebLogic JTA transaction object supports this interface, which allows users to get and set transaction properties.

  This interface includes the following methods:

  - `setName` and `getName`
  - `addProperties`, `setProperty`, `getProperty`, and `getProperties`
  - `setRollbackReason` and `getRollbackReason`
  - `getHeuristicErrorMessage`
  - `getXID` and `getXid`
  - `getStatusAsString`
  - `getMillisSinceBegin`
  - `getTimeToLiveMillis`
  - `isTimedOut`

- `weblogic.transaction.TransactionHelper`

  This class allows you to obtain the current transaction manager and transaction. It replaces `TxHelper`.

This interface includes the following static methods:

  - `getTransaction`
  - `getUserTransaction`
  - `getTransactionManager`

- `weblogic.transaction.TxHelper` (Deprecated, use `TransactionHelper` instead)

  This class allows you to obtain the current transaction manager and transaction.

  This interface includes the following static methods:

  - `getTransaction`, `getUserTransaction`, `getTransactionManager`
  - `status2String`

- `weblogic.transaction.XAResource` (extends `javax.transaction.xa.XAResource`)

  This class provides delistment capabilities for XA resources.

  This interface includes the following method:

  - `getDelistFlag`

- `weblogic.transaction.nonxa.NonXAResource`

  This interface enables resources that do not support the `javax.transaction.xa.XAResource` interface to easily integrate with the WebLogic Server transaction manager. The transaction manager supports a variation of the Last Agent two-phase commit optimization that allows a non-XA resource to participate in a distributed transaction. The protocol issues a one-phase commit to the non-XA resource and uses the result of the operation to base the commit decision for the transaction.

For a detailed description of the WebLogic extensions to the `javax.transaction` and `javax.transaction.xa` interfaces, see the weblogic.transaction package description.

CHAPTER 7

# Logging Last Resource Transaction Optimization

WebLogic Server includes support for the Logging Last Resource (LLR) transaction optimization through JDBC data sources. LLR is a performance enhancement option that enables one non-XA resource to participate in a global transaction with the same ACID guarantee as XA. LLR is a refinement of the "Last Agent Optimization." It differs from Last Agent Optimization in that it is transactionally safe. The LLR resource uses a local transaction for its transaction work. The WebLogic Server transaction manager prepares all other resources in the transaction and then determines the commit decision for the global transaction based on the outcome of the LLR resource's local transaction.

In a global two-phase commit (2PC) transaction with an LLR participant, the WebLogic Server transaction manager follows these basic steps:

- Calls prepare on all other (XA-compliant) transaction participants.
- Inserts a commit record to a table on the LLR participant (rather than to the file-based transaction log).
- Commits the LLR participant's local transaction (which includes both the transaction commit record insert and the application's SQL work).
- Calls commit on all other transaction participants.
- After the transaction completes successfully, lazily deletes the database transaction log entry as part of a future transaction.

The following sections provide more information about LLR transaction processing in WebLogic Server:

For more information about the advantages of LLR, see "Understanding the Logging Last Resource Transaction Option" in *Configuring and Managing WebLogic JDBC*.

# About the LLR Optimization Transaction Optimization

In many cases a global transaction becomes a two-phase commit (2PC) transaction because it involves a database operation (using JDBC) and another non-database operation, such as a message queueing operation (using JMS). In cases such as this where there is one database participant in a 2PC transaction, the Logging Last Resource (LLR) Optimization transaction option can significantly improve transaction performance by eliminating some of the XA overhead for database processing and by avoiding the use of JDBC XA drivers, which typically are less efficient than non-XA drivers. The LLR transaction option does not incur the same data risks as borne by the Emulate Two-Phase Commit JDBC data source option and the NonXAResource resource adapter (Connector) option.

# Logging Last Resource Processing Details

At server boot or data source deployment, LLR data sources load or create a table on the database from which the data source pools database connections. The table is created in the schema determined by the user specified to create database connections. If the database table cannot be created or loaded, then server boot will fail.

Within a global transaction, the first connection obtained from an LLR data source reserves an internal JDBC connection that is dedicated to the transaction. The internal JDBC connection is reserved on the specific server that is also the transactions' coordinator. All subsequent transaction operations on any connections obtained from a same-named data source on any server are routed to this same single internal JDBC connection.

When an LLR transaction is committed, the WebLogic Server transaction manager handles the processing transparently. From an application perspective, the transaction semantics remain the same, but from an internal perspective, the transaction is handled differently than standard XA transactions. When the application commits the global transaction, the WebLogic Server

transaction manager atomically commits the local transaction on the LLR connection before committing transaction work on any other transaction participants. For a two-phase commit transaction, the transaction manager also writes a 2PC record on the database as part of the same local transaction. After the local transaction completes successfully, the transaction manager calls commit on all other global transaction participants. After all other transaction participants complete the commit phase, the related LLR 2PC transaction record is freed for deletion. The transaction manager will lazily delete the transaction record after a short interval or with another local transaction.

If the application rolls back the global transaction or the transaction times out, the transaction manager rolls back the work in the local transaction and does not store a 2PC record in the database.

To enable the LLR transaction optimization, you create a JDBC data source with the Logging Last Resource transaction protocol, then use database connections from the data source in your applications. WebLogic Server automatically creates the required table on the database.

See "Create LLR-enabled JDBC data sources" in the *Administration Console Online Help*. Also see "Understanding the Logging Last Resource Transaction Option" in *Configuring and Managing WebLogic JDBC*.

For a list of data source configuration and usage requirements and limitations, see:

- "Programming Considerations and Limitations for LLR Data Sources" in *Configuring and Managing WebLogic JDBC*
- "Administrative Considerations and Limitations for LLR Data Sources" in *Configuring and Managing WebLogic JDBC*

# LLR Database Table Details

Each WebLogic server instance maintains a database "LLR" table on the database to which a JDBC LLR data source pools database connections. These tables are used for storing transaction log records, and are automatically created. If multiple LLR data sources are deployed on the same WebLogic server instance and connect to the same database instance and database schema, they will also share the same LLR table.

LLR table names are automatically generated unless administrators choose to configure them. The default table name is `WL_LLR_SERVERNAME`. For some DBMSs, the maximum length for a table name is 18 characters. You should consider maximum table name length when configuring your environment.

Note the following restrictions with regard to LLR database tables:

- The server **will not boot** if an LLR table is unreachable during boot. LLR transaction records must be available to correctly resolve in-doubt transactions during recovery, which runs automatically at server startup.
- Multiple servers must not share the same LLR table. On server startup, WebLogic Server checks to make sure that the domain and server name of the JDBC data source match the domain and server name stored in the table when the table is created. If WebLogic Server detects that more than one server is sharing the same LLR table, WebLogic Server will shut down one or more of the servers.

To change the table name used to store transaction log records for the resource, follow these steps:

1. In the Change Center in the upper-left corner of the Administration Console window, click Lock & Edit to start a configuration editing session.
2. On the Server: Configuration: General page, click to Advanced to show the advanced configuration options. See
3. In JDBC LLR Table Name, enter the name of the table to use to store transaction records for the resource, then click Save. See Server: Configuration: General.
4. Repeat steps 2 and 3 for each server on which the LLR-enabled data source is deployed.
5. Click Activate Changes in the Change Center.

**Note:** You must restart all servers for the change to take effect.

# LLR Table Transaction Log Records

For each committed 2PC LLR transaction, the transaction manager automatically inserts a transaction record into an LLR database table. Once LLR transactions complete, the transaction manager lazily deletes their transaction records. If an LLR table transaction log record delete fails, the server will log a warning message and retry the delete again later.

If you need to move a database that contains LLR transaction records, make sure you move the LLR table contents to the new database so that transactions can be completed properly.

**Caution:** Do not manually delete the LLR transaction records or the LLR table in a production system. Doing so can lead to silent heuristic transaction failures which will be not logged.

# Failure and Recovery Processing for LLR

In general, the WebLogic transaction manager processes transaction failures in the following way:

- For two-phase commit errors that occur before the local transaction commit is attempted, the transaction manager immediately throws a transaction rolled back exception.
- For two-phase commit errors that occur during the local transaction commit, the behavior depends on whether the transaction record is written to the database:
  - If the record is written, the transaction manager commits the transaction.
  - If the record is not written, the transaction manager rolls back the transaction.
  - If it is unknown whether the record is written, the transaction manager throws an ambiguous commit failure exception and attempts to complete the transaction every 5 seconds until the transaction abandon timeout. If the transaction is still incomplete, the transaction manager logs an abandoned transaction message.

## Coordinating Server Crash

If a transaction's coordinating server crashes before an LLR resource stores its transaction log record or before an LLR resource commits, the transaction rolls back. If the server crashes after the LLR resource is committed, the transaction will eventually fully commit. During server boot, the transaction coordinator will use the LLR resource to read the transaction log record from the database and then use the recovered information to commit any unfinished work on any participating non-LLR XA resources.

## JDBC Connection Failure

If the JDBC connection in an LLR resource fails during a 2PC transaction record insert, the transaction manager rolls back the transaction.

If the JDBC connection in an LLR resource fails during the commit of the local transaction, the result depends on whether the transaction is a one-phase commit (1PC, where the LLR resource is the only participant) or 2PC:

- For a 1PC transaction, the transaction will be fully committed, fully rolled back, or block waiting for the resolution of the local transaction. The outcome of the transaction is fully ACID because it will eventually be fully committed or fully rolled back.

- For a 2PC transaction, the outcome is as described in “Failure and Recovery Processing for LLR” on page 7-5.

## LLR Transaction Recover During Server Startup

During server startup, the transaction manager for each WebLogic server must recover incomplete transactions coordinated by the server, including LLR transactions. To do so, each server will attempt to read the transaction records from the LLR database tables for each LLR data source. If the server cannot access the LLR database tables or if the recovery fails, the server will not start and the transaction manager will mark the server with a bad health state: HealthState.HEALTH_FAILED.

If a timeout occurs during recovery, it may be due to unresolved local transactions that have locked rows within the LLR log tables. Such local transactions must be resolved so that the transaction manager can determine the state of the global transaction whose record is stored in the locked row. Local database transactions can only be diagnosed and resolved using each database's specific tools (the commands differ from database to database).

## Failover Considerations for LLR

Consider the following notes and limitations with regard to failover with LLR:

- The file-based transaction log (TLog) is still required for LLR transactions:
  - TLog still stores transaction manager “checkpoint” records
  - TLog must still be reachable or copied on failover
- LLR supports server migration and transaction recovery service migration. To use the transaction recovery service migration, ensure that each LLR resource be targeted to either the cluster or the set of candidate servers in the cluster. See “Recovering Transactions For a Failed Clustered Server” on page 4-7.

# Optimizing Performance with LLR

This section includes the following information:

## Optimizing Transaction Coordinator Location

Within a global transaction with an LLR participant, WebLogic Server automatically routes all connection operations to the transaction's coordinating server. This routing can be expensive. You may see better performance if you optimize your applications to run directly on the coordinating server if possible, and optimize your applications to use connection instances that are directly hosted on the coordinator.

For client applications that begin a transaction, the coordinator of transaction is the first WebLogic server the client calls under the transaction (any RMI, EJB, JDBC, or JMS call). In the JMS case, this is the server that hosts the client's JMS connection, which is not necessarily the same as the server that hosts the JMS destination.

For server side applications, the coordinator of the transaction is the local server if a local resource is invoked first (including JMS destinations and JDBC connections) unless a remote server is called first (any remotely hosted JDBC connection, EJB, RMI call, or JMS connection). This includes remote servers in other clusters or domains.

## Varied Performance for Read-Only Operations through an LLR Data Source

The LLR optimization provides a significant increase in performance for insert, update, and delete operations. However, for read operations with LLR, performance is somewhat slower than read operations with XA. For best performance, you may want to configure a non-LLR JDBC data source for read-only operations.

CHAPTER 8

# Transactions in EJB Applications

This section includes the following topics:



This section describes how to integrate transactions in Enterprise JavaBeans (EJBs) applications that run under Oracle WebLogic Server.

## Before You Begin

Before you begin, you should read Chapter 2, "Introducing Transactions," particularly the following topics:

- Transactions in WebLogic Server EJB Applications

- Transactions Sample EJB Code

This document describes the Oracle WebLogic Server implementation of transactions in Enterprise JavaBeans. The information in this document supplements the Enterprise JavaBeans Specification 2.1, published by Sun Microsystems, Inc.

**Note:** Before proceeding with the rest of this chapter, you should be familiar with the contents of the EJB Specification 2.1 document, particularly the concepts and material presented in Chapter 16, "Support for Transactions."

For information about implementing Enterprise JavaBeans in WebLogic Server applications, see Programming WebLogic Enterprise JavaBeans.

# General Guidelines

The following general guidelines apply when implementing transactions in EJB applications for WebLogic Server:

- The EJB specification allows for flat transactions only. Transactions cannot be nested.
- The EJB specification allows for distributed transactions that span multiple resources (such as databases) and supports the two-phase commit protocol for both EJB CMP 2.1 and EJB CMP 1.1.
- Use standard programming techniques to optimize transaction processing. For example, properly demarcate transaction boundaries and complete transactions quickly.
- Use a database connection from a local TxDataSource—on the WebLogic Server instance on which the EJB is running. Do not use a connection from a TxDataSource on a remote WebLogic Server instance.
- Be sure to tune the EJB cache to ensure maximum performance in transactional EJB applications. For more information, see *Programming WebLogic Server Enterprise Java Beans*.

For general guidelines about the WebLogic Server Transaction Service, see "Capabilities and Limitations."

# Transaction Attributes

This section includes the following sections:

- About Transaction Attributes for EJBs

# About Transaction Attributes for EJBs

Transaction attributes determine how transactions are managed in EJB applications. For each EJB, the transaction attribute specifies whether transactions are demarcated by the WebLogic Server EJB container (container-managed transactions) or by the EJB itself (bean-managed transactions). The setting of the `transaction-type` element in the deployment descriptor determines whether an EJB is container-managed or bean-managed. See Chapter 16, "Support for Transactions," and Chapter 21, "Deployment Descriptor," in the EJB Specification 2.1, for more information about the `transaction-type` element.

In general, the use of container-managed transactions is preferred over bean-managed transactions because application coding is simpler. For example, in container-managed transactions, transactions do not need to be started explicitly.

WebLogic Server fully supports method-level transaction attributes as defined in Section 16.4 in the EJB Specification 2.1.

# Transaction Attributes for Container-Managed Transactions

For container-managed transactions, the transaction attribute is specified in the `container-transaction` element in the deployment descriptor. Container-managed transactions include all entity beans and any stateful or stateless session beans with a `transaction-type` set to `Container`. For more information about these elements, see *Programming WebLogic Enterprise JavaBeans*.

The Application Assembler can specify the following transaction attributes for EJBs and their business methods:

- `NotSupported`
- `Supports`
- `Required`
- `RequiresNew`
- `Mandatory`
- `Never`

For a detailed explanation about how the WebLogic Server EJB container responds to the `trans-attribute` setting, see section 17.6.2 in the EJB Specification 2.1.

The WebLogic Server EJB container automatically sets the transaction timeout if a timeout value is not defined in the deployment descriptor. The container uses the value of the `Timeout Seconds` configuration parameter. The default timeout value is 30 seconds.

For EJBs with container-managed transactions, the EJBs have no access to the `javax.transaction.UserTransaction` interface, and the entering and exiting transaction contexts must match. In addition, EJBs with container-managed transactions have limited support for the `setRollbackOnly` and `getRollbackOnly` methods of the `javax.ejb.EJBContext` interface, where invocations are restricted by rules specified in Sections 16.4.4.2 and 16.4.4.3 of the EJB Specification 2.1.

## Transaction Attributes for Bean-Managed Transactions

For bean-managed transactions, the bean specifies transaction demarcations using methods in the `javax.transaction.UserTransaction` interface. Bean-managed transactions include any stateful or stateless session beans with a `transaction-type` set to `Bean`. Entity beans cannot use bean-managed transactions.

For stateless session beans, the entering and exiting transaction contexts must match. For stateful session beans, the entering and exiting transaction contexts may or may not match. If they do not match, the WebLogic Server EJB container maintains associations between the bean and the nonterminated transaction.

Session beans with bean-managed transactions cannot use the `setRollbackOnly` and `getRollbackOnly` methods of the `javax.ejb.EJBContext` interface.

# Participating in a Transaction

When the EJB Specification 2.1 uses the phrase “participating in a transaction,” Oracle interprets this to mean that the bean meets either of the following conditions:

- The bean is invoked in a transactional context (container-managed transaction).
- The bean begins a transaction using the UserTransaction API in a bean method invoked by the client (bean-managed transaction), and it does *not* suspend or terminate that transaction upon completion of the corresponding bean method invoked by the client.

# Transaction Semantics

This topic contains the following sections:

- Transaction Semantics for Container-Managed Transactions
- Transaction Semantics for Bean-Managed Transactions

The EJB Specification 2.1 describes semantics that govern transaction processing behavior based on the EJB type (entity bean, stateless session bean, or stateful session bean) and the transaction type (container-managed or bean-managed). These semantics describe the transaction context at the time a method is invoked and define whether the EJB can access methods in the `javax.transaction.UserTransaction` interface. EJB applications must be designed with these semantics in mind.

## Transaction Semantics for Container-Managed Transactions

For container-managed transactions, transaction semantics vary for each bean type.

### Transaction Semantics for Stateful Session Beans

Table 8-1 describes the transaction semantics for stateful session beans in container-managed transactions.

**Table 8-1 Transaction Semantics for Stateful Session Beans in Container-Managed Transactions**

| Method | Transaction Context at the Time the Method Was Invoked | Can Access UserTransaction Methods? |
|---|---|---|
| Constructor | Unspecified | No |
| `setSessionContext()` | Unspecified | No |
| `ejbCreate()` | Unspecified | No |
| `ejbRemove()` | Unspecified | No |
| `ejbActivate()` | Unspecified | No |
| `ejbPassivate()` | Unspecified | No |

**Table 8-1 Transaction Semantics for Stateful Session Beans in Container-Managed Transactions**

| Method | Transaction Context at the Time the Method Was Invoked | Can Access UserTransaction Methods? |
|---|---|---|
| Business method | Yes or No based on transaction attribute | No |
| `afterBegin()` | Yes | No |
| `beforeCompletion()` | Yes | No |
| `afterCompletion()` | No | No |

## Transaction Semantics for Stateless Session Beans

Table 8-2 describes the transaction semantics for stateless session beans in container-managed transactions.

**Table 8-2 Transaction Semantics for Stateless Session Beans in Container-Managed Transactions**

| Method | Transaction Context at the Time the Method Was Invoked | Can Access UserTransaction Methods? |
|---|---|---|
| Constructor | Unspecified | No |
| `setSessionContext()` | Unspecified | No |
| `ejbCreate()` | Unspecified | No |
| `ejbRemove()` | Unspecified | No |
| Business method | Yes or No based on transaction attribute | No |

## Transaction Semantics for Entity Beans

Table 8-3 describes the transaction semantics for entity beans in container-managed transactions.

**Table 8-3 Transaction Semantics for Entity Beans in Container-Managed Transactions**

| Method | Transaction Context at the Time the Method Was Invoked | Can Access UserTransaction Methods? |
|---|---|---|
| Constructor | Unspecified | No |
| `setEntityContext()` | Unspecified | No |
| `unsetEntityContext()` | Unspecified | No |
| `ejbCreate()` | Determined by transaction attribute of matching create | No |
| `ejbPostCreate()` | Determined by transaction attribute of matching create | No |
| `ejbRemove()` | Determined by transaction attribute of matching remove | No |
| `ejbFind()` | Determined by transaction attribute of matching find | No |
| `ejbActivate()` | Unspecified | No |
| `ejbPassivate()` | Unspecified | No |
| `ejbLoad()` | Determined by transaction attribute of business method that invoked `ejbLoad()` | No |
| `ejbStore()` | Determined by transaction attribute of business method that invoked `ejbStore()` | No |
| Business method | Yes or No based on transaction attribute | No |

# Transaction Semantics for Bean-Managed Transactions

For bean-managed transactions, the transaction semantics differ between stateful and stateless session beans. For entity beans, transactions are never bean-managed.

## Transaction Semantics for Stateful Session Beans

Table 8-4 describes the transaction semantics for stateful session beans in bean-managed transactions.

**Table 8-4 Transaction Semantics for Stateful Session Beans in Bean-Managed Transactions**

| Method | Transaction Context at the Time the Method Was Invoked | Can Access UserTransaction Methods? |
|---|---|---|
| Constructor | Unspecified | No |
| `setSessionContext()` | Unspecified | No |
| `ejbCreate()` | Unspecified | Yes |
| `ejbRemove()` | Unspecified | Yes |
| `ejbActivate()` | Unspecified | Yes |
| `ejbPassivate()` | Unspecified | Yes |
| Business method | Typically, no *unless* a previous method execution on the bean had completed while in a transaction context | Yes |
| `afterBegin()` | Not applicable | Not applicable |
| `beforeCompletion()` | Not applicable | Not applicable |
| `afterCompletion()` | Not applicable | Not applicable |

### Transaction Semantics for Stateless Session Beans

Table 8-5 describes the transaction semantics for stateless session beans in bean-managed transactions.

**Table 8-5 Transaction Semantics for Stateless Session Beans in Bean-Managed Transactions**

| Method | Transaction Context at the Time the Method Was Invoked | Can Access UserTransaction Methods? |
|---|---|---|
| Constructor | Unspecified | No |
| `setSessionContext()` | Unspecified | No |
| `ejbCreate()` | Unspecified | Yes |
| `ejbRemove()` | Unspecified | Yes |
| Business method | No | Yes |

## Session Synchronization

A stateful session bean using container-managed transactions can implement the `javax.ejb.SessionSynchronization` interface to provide transaction synchronization notifications. In addition, all methods on the stateful session bean must support one of the following transaction attributes: `REQUIRES_NEW`, `MANDATORY` or `REQUIRED`. For more information about the `javax.ejb.SessionSynchronization` interface, see Section 6.5.3 in the EJB Specification 2.1.

## Synchronization During Transactions

If a bean implements `SessionSynchronization`, the WebLogic Server EJB container will typically make the following callbacks to the bean during transaction commit time:

- `afterBegin()`
- `beforeCompletion()`
- `afterCompletion()`

The EJB container can call other beans or involve additional XA resources in the `beforeCompletion` method. The number of calls is limited by the `beforeCompletionIterationLimit` attribute. This attribute specifies how many cycles of

callbacks are processed before the transaction is rolled back. A synchronization cycle can occur when a registered object receives a `beforeCompletion` callback and then enlists additional resources or causes a previously synchronized object to be reregistered. The iteration limit ensures that synchronization cycles do not run indefinitely.

# Setting Transaction Timeouts

Bean providers can specify the timeout period for transactions in EJB applications. If the duration of a transaction exceeds the specified timeout setting, then the Transaction Service rolls back the transaction automatically.

**Note:** You must set the timeout before you `begin()` the transaction. Setting a timeout does not affect transaction transactions that have already begun.

Timeouts are specified according to the transaction type:

- **Container-managed transactions**. The Bean Provider configures the `trans-timeout-seconds` attribute in the `weblogic-ejb-jar.xml` deployment descriptor. For more information, see the *Administration Guide*.

  The Bean Provider should configure the trans-timeout-seconds attribute in the weblogic-ejb-jar.xml deployment descriptor.

- **Bean-managed transactions**. An application calls the `UserTransaction.setTransactionTimeout` method.

# Handling Exceptions in EJB Transactions

WebLogic Server EJB applications need to catch and handle specific exceptions thrown during transactions. For detailed information about handling exceptions, see Chapter 17, “Exception Handling,” in the EJB Specification 2.1 published by Sun Microsystems, Inc.

For more information about how exceptions are thrown by business methods in EJB transactions, see the following tables in Section 17.3: Table 12 (for container-managed transactions) and Table 13 (for bean-managed transactions).

For a client’s view of exceptions, see Section 17.4, particularly Section 12.4.1 (application exceptions), Section 17.4.2 (`java.rmi.RemoteException`), Section 17.4.2.1 (`javax.transaction.TransactionRolledBackException`), and Section 17.4.2.2 (`javax.transaction.TransactionRequiredException`).

CHAPTER 9

# Transactions in RMI Applications

The following sections provide guidelines and additional references for using transactions in RMI applications that run under Oracle WebLogic Server:

- Before You Begin
- General Guidelines

## Before You Begin

Before you begin, read Chapter 2, "Introducing Transactions," particularly the following topics:

- "Transactions in WebLogic Server RMI Applications" on page 2-8
- "Transactions Sample RMI Code" on page 2-12

For more information about RMI applications, see *Programming Stand-alone Clients*.

## General Guidelines

The following general guidelines apply when implementing transactions in RMI applications for WebLogic Server:

- WebLogic Server allows for flat transactions only. Transactions cannot be nested.
- Use standard programming techniques to optimize transaction processing. For example, properly demarcate transaction boundaries and complete transactions quickly.

- For RMI applications, callback objects are not recommended for use in transactions because they are not subject to WebLogic Server administration.

  By default, all method invocations on the remote objects are transactional. If a callback object is required, you must compile these classes using the WebLogic RMI compiler (`weblogic.rmic`) using the `-nontransactional` flag.

- In RMI applications, an RMI client can initiate a transaction, but all transaction processing must occur on server objects or remote objects hosted by WebLogic Server. Remote objects hosted on a client JVM cannot participate in the transaction processing.

  As a work-around, you can suspend the transaction before making a call to a remote object on a client JVM, and then resume the transaction after the remote operation returns.

For general guidelines about the WebLogic Server Transaction Service, see "Capabilities and Limitations."

CHAPTER 10

# Using Third-Party JDBC XA Drivers with WebLogic Server

This section discusses the following topics:



## Overview of Third-Party XA Drivers

This section provides an overview of using third-party JDBC drivers with WebLogic Server in distributed transactions. These drivers provide connectivity between WebLogic Server connection pools and the DBMS. Drivers used in distributed transactions are designated by the driver name followed by /XA; for example, Oracle Thin/XA Driver.

### Table of Third-Party XA Drivers

The following table summarizes known functionality of these third-party JDBC/XA drivers when used with WebLogic Server:

**Table 10-1 Two-Tier JDBC/XA Drivers**

| Driver/Database Version | Comments |
|---|---|
| Oracle Thin Driver XA | See "Using Oracle Thin/XA Driver" on page 10-2. |
| Sybase jConnect/XA<br>• Version 6.0<br>• Version 5.5<br>• Adaptive Server Enterprise 12.0 | See "Using Sybase jConnect 5.5 and 6.0/XA Drivers" on page 10-4. |

# Using Oracle Thin/XA Driver

WebLogic Server ships with the Oracle Thin Driver version 10g preconfigured and ready to use. If you want to update the driver or use a different version, see "Using Orace Extensions with the Oracle Thin Driver" in *Programming WebLogic JDBC*.

The following sections provide information for using the Oracle Thin/XA Driver with WebLogic Server.

## Software Requirements for the Oracle Thin/XA Driver

The Oracle Thin/XA Driver requires the following:

- Java 2 SDK 1.4.x or later.

  **Note:** The Oracle 10g and 9.2 Thin driver (`ojdbc14.jar`) are the only versions of the driver supported for use with a Java 2 SDK 1.4.*X*.

- Oracle server configured for XA functionality (limitation does not apply for non-XA usage).

## Set the Environment for the Oracle Thin/XA Driver

### Configure WebLogic Server

See "Using Oracle Extensions with the Oracle Thin Driver" in *Configuring and Managing WebLogic JDBC*.

### Enable XA on the Database Server

To prepare the database for XA, perform these steps:

1. Log on to sqlplus as system user, e.g. `sqlplus sys/CHANGE_ON_INSTALL@<DATABASE ALIAS NAME>`
2. Execute the following command: `@xaview.sql`

   The `xaview.sql` script resides in the *`$ORACLE_HOME`*`/rdbms/admin` directory
3. Grant the following permissions:
   - `grant select on v$xatrans$ to public (or <user>);`
   - `grant select on pending_trans$ to public;`
   - `grant select on dba_2pc_pending to public;`
   - `grant select on dba_pending_transactions to public;`
   - (when using the Oracle Thin driver 10.1.0.3 or later)
     `grant execute on dbms_system to <user>;`

If the above steps are not performed on the database server, normal XA database queries and updates may work fine. However, when the Weblogic Server Transaction Manager performs recovery on a re-boot after a crash, recover for the Oracle resource will fail with `XAER_RMERR`. Crash recovery is a standard operation for an XA resource.

## Oracle Thin/XA Driver Configuration Properties

The following table contains sample code for configuring a JDBC data source:

**Oracle Thin/XA Driver: Connection Pool Configuration**

| Property Name | Property Value |
|---|---|
| Name | `oracleXAPool` |
| URL | `jdbc:oracle:thin:@`*`serverName`*`:`*`port(typically 1521 on Windows)`*`:`*`sid`* |
| DriverClassname | `oracle.jdbc.xa.client.OracleXADataSource` |
| Database Username | `Scott` |

**Oracle Thin/XA Driver: Connection Pool Configuration**

| Property Name | Property Value |
|---|---|
| Properties | `user=scott` |
| Test Table Name | `DUAL` |

# Using Sybase jConnect 5.5 and 6.0/XA Drivers

The following sections provide important configuration information and performance issues when using the Sybase jConnect Driver 5.5 and 6.0/XA Drivers:


- "Configuring a Sybase Server for XA Support" on page 10-4
- "XA and Sybase Adaptive Server" on page 10-5
- "Configuration Properties for Java Clients" on page 10-6
- "Known Sybase jConnect 5.5 and 6.0/XA Issues" on page 10-7


## Configuring a Sybase Server for XA Support

Follow these instructions to set up the environment on your database server:

- Run `sp_configure "enable DTM",1` to enable transactions.
- Run `sp_configure "enable xact coordination",1.`
- Run grant role `dtm_tm_role` to `<USER_NAME>.`
- Copy the sample `xa_config` file from the `SYBASE_INSTALL\OCS-12_0\sample\xa-dtm` subdirectory up three levels to `SYBASE_INSTALL`, where `SYBASE_INSTALL` is the directory of your Sybase server installation. For example:

  ```
  $ SYBASE_INSTALL\xa_config
  ```

- Edit the `xa_config file`. In the first [`xa`] section, modify the sample server name to reflect the correct server name.

To prevent deadlocks when running transactions, enable row level lock by default:

- Run `sp_configure "lock scheme",0,` datarows

**Note:** Both the `jConnect.jar, jconn2,` and `jconn3.jar` files are included in the *`WL_HOME`*`\server\lib` folder and are referenced in the `weblogic.jar` manifest file. When you start WebLogic Server, the drivers are loaded automatically and are ready to use with WebLogic Server. To use these drivers with the WebLogic utilities or with other applications, you must include the path to these files in your `CLASSPATH`.

# XA and Sybase Adaptive Server

Correct support for XA connections is available in the Sybase Adaptive Server Enterprise 12.0 and later versions only. XA connections with WebLogic Server are not supported on Sybase Adaptive Server 11.5 and 11.9.

## Execution Threads and Transactions in Sybase Adaptive Server

Prior to Adaptive Server version 12.0, all resources of a transaction were privately owned by a single task on the server. The server could not share a transaction with any task other than the one that initiated the transaction. Adaptive Server version 12.x includes support for the suspend and join semantics used by XA-compliant transaction managers (such as WebLogic Server). Transactions can be shared among different execution threads, or may not be associated with an execution thread (detached).

## Setting the Timeout for Detached Transactions

On the Sybase server, you can set the `dtm detach timeout period`, which sets the amount of time (in minutes) that a distributed transaction branch can remain in the detached state (without an associated execution thread). After this period, the DBMS automatically rolls back the transaction. The `dtm detach timeout period` applies to all transactions on the database server. It cannot be set for each transaction.

For example, to automatically rollback transactions after being detached for 10 minutes, use the following command:

```
sp_configure 'dtm detach timeout period', 10
```

You should set the `dtm detach timeout period` higher than the transaction timeout to prevent the database server from rolling back the transaction before the transaction times out in WebLogic Server.

For more information about the `dtm detach timeout period`, see the Sybase documentation.

### Transaction Behavior on Sybase Adaptive Server

If a global transaction is started on the Sybase server, but is not completed, the outcome of the transaction varies depending on the transaction state before the transaction is abandoned:

- If the client is terminated before the `xa.end` call, the transaction is rolled back.
- If the client is terminated after the `xa.end` call, the transaction remains on the database server (and holds all relevant locks).
- If an application calls `xa.start` but has not called `xa.end` and the application terminates unexpectedly, the database server immediately rolls back the transaction and frees locks held by the transaction.
- If an application calls `xa.start` and `xa.end` and the application terminates unexpectedly, the database server rolls back the transaction and frees locks held by the transaction *after the* `dtm detach timeout period` *has elapsed*. See "Setting the Timeout for Detached Transactions" on page 10-5.
- If an application calls `xa.start` and `xa.end`, and then the transaction is prepared, if the application terminates unexpectedly, the transaction will persist so that it can be properly recovered. The Transaction Manager must call rollback or commit to complete the transaction.

## Configuration Properties for Java Clients

Set the following configuration properties when running a Java client.

**Table 10-2 Sybase jConnect 5.5/XA Driver: Java Client Connection Properties**

| Property Name | Property Value |
|---|---|
| `ds.setPassword` | *<password>* |
| `ds.setUser` | *<username>* |
| `ds.setNetworkProtocol` | `Tds` |
| `ds.setDatabaseName` | *<database-name>* |
| `ds.setResourceManagerName` | *<Lrm name in xa_config file>* |
| `ds.setResourceManagerType` | `2` |

**Table 10-2 Sybase jConnect 5.5/XA Driver: Java Client Connection Properties**

| Property Name | Property Value |
|---|---|
| `ds.setServerName` | *<machine host name>* |
| `ds.setPortNumber` | *port* (Typically 4100) |

# Known Sybase jConnect 5.5 and 6.0/XA Issues

These are the known issues and Oracle workarounds:

**Table 10-3 Sybase jConnect 5.5 and 6.0 Known Issues and Workarounds**

| Description | Sybase Bug | Comments/Workarounds for WebLogic Server |
|---|---|---|
| When calling setAutoCommit(true) the following exception is thrown:<br>`java.sql.SQLException: JZ0S3: The inherited method setAutoCommit(true) cannot be used in this subclass.` | 10726192 | No workaround. Vendor fixed in jConnect 6.0. |
| When driver used in distributed transactions, calling `XAResource.end(TMSUSPEND)` followed by `XAResource.end(TMSUCCESS)` results in `XAER_RMERR`. | 10727617 | WebLogic Server has provided an internal workaround for this bug:<br>Set the data source connection pool property `XAEndOnlyOnce="true"`.<br>Vendor fix has been requested. |

# Using Other Third-Party XA Drivers

To use other third-party XA-compliant JDBC drivers, you must include the path to the driver class libraries in your `CLASSPATH` and follow the configuration instructions provided by the vendor.

CHAPTER 11

# Coordinating XAResources with the WebLogic Server Transaction Manager

External, third-party systems can participate in distributed transactions coordinated by the WebLogic Server transaction manager by registering a `javax.transaction.xa.XAResource` implementation with the WebLogic Server transaction manager. The WebLogic Server transaction manager then drives the XAResource as part of its Two-Phase Commit (2PC) protocol. This is referred to as "exporting transactions."

By exporting transactions, you can integrate third-party transaction managers with the WebLogic Server transaction manager if the third-party transaction manager implements the `XAResource` interface. With an exported transaction, the third-party transaction manager would act as a subordinate transaction manager to the WebLogic Server transaction manager.

WebLogic Server can also participate in distributed transactions coordinated by third-party systems (sometimes referred to as foreign transaction managers). The WebLogic Server processing is done as part of the work of the external transaction. The third-party transaction manager then drives the WebLogic Server transaction manager as part of its commit processing. This is referred to as "importing transactions."

Details about coordinating third-party systems within a transaction (exporting transactions) are described in this section. Details about participating in transactions coordinated by third-party systems (importing transactions) are described in Chapter 12, "Participating in Transactions Managed by a Third-Party Transaction Manager." Note that WebLogic Server IIOP, WebLogic Tuxedo Connector (WTC) gateway, and Oracle Java Adapter for Mainframe (JAM) gateway internally use the same mechanism described in these chapters to import and export transactions in WebLogic Server.

The following sections describe how to configure third-party systems to participate in transactions coordinated by the WebLogic Server transaction manager:



# Overview of Coordinating Distributed Transactions with Foreign XAResources

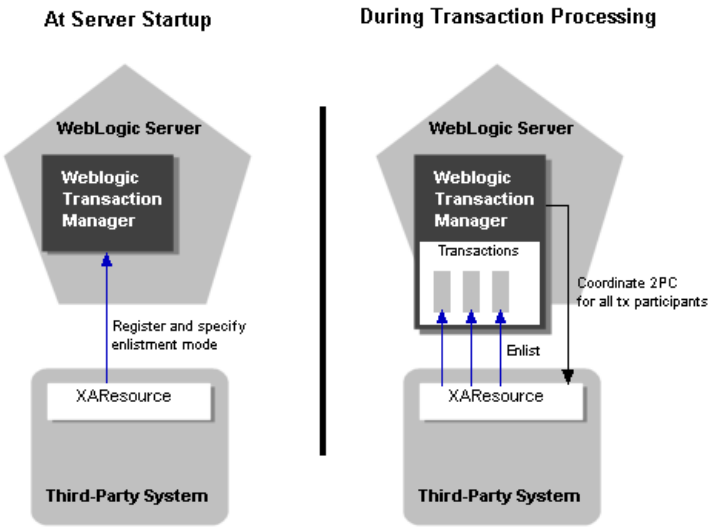
In order to participate in distributed transactions coordinated by the WebLogic Server transaction manager, third-party systems must implement the `javax.transaction.xa.XAResource` interface and then register its `XAResource` object with the WebLogic Server transaction manager. For details about implementing the `javax.transaction.xa.XAResource` interface, refer to the Java EE Javadocs at:

`http://java.sun.com/javaee/5/docs/api/javax/transaction/xa/XAResource.html`

During transaction processing, you must enlist the `XAResource` object of the third-party system with each applicable transaction object.

Figure 11-1 shows the process for third-party systems to participate in transactions coordinated by the WebLogic Server transaction manager.

**Figure 11-1 Distributed Transactions with Third-Party Participants**




Depending on the enlistment mode that you use when you enlist an XAResource object with a transaction, WebLogic Server may automatically delist the XAResource object at the appropriate time. For more information about enlistment and delistment, see "Enlisting and Delisting an XAResource in a Transaction" on page 11-6. For more information about registering XAResource objects with the WebLogic Server transaction manager, see "Registering an XAResource to Participate in Transactions" on page 11-3.

# Registering an XAResource to Participate in Transactions

In order to participate in distributed transactions coordinated by the WebLogic Server transaction manager, third-party systems must implement the `javax.transaction.xa.XAResource` interface and then register its `XAResource` object with the WebLogic Server transaction manager. Registration is required to:

- Specify the transaction branch qualifier for the `XAResource`. The branch qualifier identifies the transaction branch of the resource manager instance and is used for all distributed transactions that the resource manager (RM) instance participates in. Each

transaction branch represents a unit of work in the distributed transaction and is isolated from other branches. Each transaction branch receives exactly one set of prepare-commit calls during Two-Phase Commit (2PC) processing. The WebLogic Server transaction manager uses the resource name as the transaction branch qualifier.

A resource manager instance is defined by the `XAResource.isSameRM` method. XAResource instances that belong to the same resource manager instance should return true for `isSameRM`. Note that you should avoid registering the same resource manager instance under different resource names (i.e., different resource branches) to avoid confusion of transaction branches.

- Specify the enlistment mode. For a resource manager instance to participate in a specific distributed transaction, it needs to enlist an XAResource instance with the JTA `javax.transaction.Transaction` object. The WebLogic Server transaction manager provides three enlistment modes: static, dynamic, and object-oriented. Enlistment modes are discussed in greater detail in "Enlisting and Delisting an XAResource in a Transaction" on page 11-6.

- Bootstrap the `XAResource` in the event that the WebLogic Server transaction manager must perform crash recovery. (The JTA Specification does not define a standard API to do so; see Java Transaction API).

  The Java Transaction API suggests that the transaction manager is responsible for assigning the branch qualifiers. However, for recovery to work properly, the same transaction branch qualifier needs to be supplied both at normal processing and upon crash recovery. As the transaction branch qualifier is specified during registration, registration with the WebLogic Server transaction manager is required to support crash recovery and normal transaction processing.

  During recovery, the WebLogic Server transaction manager performs the following tasks:

  – It reads its transaction log records and for those XA resources that participated in the distributed transactions that were logged, it continues the second phase of the 2PC protocol to commit the XA resources with the specified branch qualifier.

  – It resolves any other in-doubt transactions of the XA resources by calling `XAResource.recover`. It then commits or rolls back the returned transactions (Xids) that belonged to it. (Note that the returned Xids would already have the specified branch qualifier.)

**Note:** Registration is a per-process action (compared with enlistment and delistment which is per-transaction).

Failure to register the XAResource implementation with the WebLogic Server transaction manager may result in unexpected transaction branching behavior. If registration is not

performed before the XA resource is enlisted with a WebLogic Server distributed transaction, the WebLogic Server transaction manager will use the class name of the XAResource instance as the resource name (and thus the branch qualifier), which may cause undesirable resource name and transaction branch conflicts.

Each resource manager instance should register itself only once with the WebLogic Server transaction manager. Each resource manager instance, as identified by the resource name during registration, adds significant overhead to the system during recovery and commit processing and health monitoring, increases memory used by associated internal data structures, reduces efficiency in searching through internal maps, and so forth. Therefore, for scalability and performance reasons, you should not indiscriminately register XAResource instances under different transaction branches.

Note that the JTA XAResource adopts an explicit transaction model, where the Xid is always explicitly passed in the XAResource methods and a single resource manager instance handles all of the transactions. This is in contrast to the CORBA OTS Resource, which adopts an implicit transaction model, where there is a different OTS Resource instance for each transaction that it participates in. You should use the JTA model when designing an XAResource.

Each foreign resource manager instance should register an XAResource instance with the WebLogic Server transaction manager upon server startup. In WebLogic Server, you can use startup classes to register foreign transaction managers.Follow these steps to register the resource manager with the WebLogic Server transaction manager:

1. Obtain the WebLogic Server transaction manager using JNDI or the `TxHelper` interface:

```
import javax.transaction.xa.XAResource;
import weblogic.transaction.TransactionManager;
import weblogic.transaction.TxHelper;

InitialContext initCtx = ... ; // initialized to the initial context

TransactionManager tm = TxHelper.getTransactionManager();
```

   or

```
TransactionManager tm =
(TransactionManager)initCtx.lookup("weblogic.transaction.TransactionMan
ager");
```

   or

```
TransactionManager tm =
(TransactionManager)initCtx.lookup("javax.transaction.TransactionManage
r");
```

2. Register the XA resource instance with the WebLogic Server transaction manager:

```
String name = ... ; // name of the RM instance

XAResource res = ... ; // an XAResource instance of the RM instance

tm.registerResource(name, res); // register a resource with the standard
enlistment mode
```

or

```
tm.registerDynamicResource(name, res); // register a resource with the
dynamic enlistment mode
```

or

```
tm.registerStaticResource(name, res); // register a resource with the
static enlistment mode
```

Refer to "Enlisting and Delisting an XAResource in a Transaction" on page 11-6 for a detailed discussion of the different enlistment modes. Note that when you register the XAResource, you specify the enlistment mode that will be used subsequently, but you are not actually enlisting the resource during the registration process. Actual enlistment should be done with the transaction (not at server startup) using a different API, which is also discussed in detail in "Enlisting and Delisting an XAResource in a Transaction."

Each XAResource instance that you register is used for recovery and commit processing of multiple transactions in parallel. Make sure that the XAResource instance supports resource sharing as defined in JTA Specification Version 1.0.1B Section 3.4.6.

**Note:** Duplicate registration of the same XAResource is ignored.

You should unregister the XAResource from the WebLogic Server transaction manager when the resource no longer accept new requests. Use the following method to unregister the XAResource:

```
tm.unregisterResource(name, res);
```

# Enlisting and Delisting an XAResource in a Transaction

For an XAResource to participate in a distributed transaction, the XAResource instance must be enlisted with the Transaction object. Depending on the enlistment mode, you may need to perform different actions. The WebLogic Server transaction manager supports the following enlistment modes:

- Standard Enlistment
- Dynamic Enlistment
- Static Enlistment

Even though you enlist the XAResource with the Transaction object, the enlistment *mode* is determined when you register the XAResource with the WebLogic Server transaction manger, not when you enlist the resource in the Transaction. See "Registering an XAResource to Participate in Transactions" on page 11-3.

`XAResource.start` and `end` calls can be expensive. The WebLogic Server transaction manager provides the following optimizations to minimize the number of these calls:

- Delayed delistment:

  Whether or not your XAResource implementation performs any explicit delistment or not, the WebLogic Server transaction manager always delays delisting of any XAResource instances that are enlisted in the current transaction until immediately before the following events, at which time the XAResource is delisted:

  – Returning the call to the caller, whether it is returned normally or with an exception

  – Making a call to another server

- Ignored duplicate enlistment:

  The WebLogic Server transaction manager ignores any explicit enlistment of an XAResource that is already enlisted. This may happen if the XAResource is explicitly delisted (which is delayed or ignored by the WebLogic Server transaction manager as mentioned above) and is subsequently re-enlisted within the duration of the same call.

By default, the WebLogic Server transaction manager delists the XAResource by calling `XAResource.end` with the `TMSUSPEND` flag. Some database management systems may keep cursors open if `XAResource.end` is called with `TMSUSPEND`, so you may prefer to delist an XAResource by calling `XAResource.end` with `TMSUCCESS` wherever possible. To do so, you can implement the `weblogic.transaction.XAResource` interface (instead of the `javax.transaction.xa.XAResource`), which includes the `getDelistFlag` method. See the *WebLogic Server Javadocs* for more details.

# Standard Enlistment

With standard enlistment mode, you need to enlist the XAResource instance only once with the Transaction object. Also, it is possible to enlist more than one XAResource instance of the same branch with the same transaction. The WebLogic Server transaction manager ensures that `XAResource.end` is called on all XAResource instances when appropriate (as discussed below). The WebLogic Server transaction manager ensures that each branch receives only one set of prepare-commit calls during transaction commit time. However, attempting to enlist a particular XAResource instance when it is already enlisted will be ignored.

Standard enlistment simplifies enlistment, but it may also cause unnecessary enlistment and delistment of an XAResource if the resource is not accessed at all within the duration of a particular method call.

To enlist an XAResource with the Transaction object, follow these steps:

1. Obtain the current Transaction object using the `TransactionHelper` interface:

```
import weblogic.transaction.Transaction; // extends
javax.transaction.Transaction
import weblogic.transaction.TransactionHelper;

Transaction tx = TransactionHelper.getTransaction();
```

2. Enlist the XAResource instance with the Transaction object:

```
tx.enlistResource(res);
```

After the XAResource is enlisted with the Transaction, the WebLogic Server transaction manager manages any subsequent delistment (as described in "Enlisting and Delisting an XAResource in a Transaction") and re-enlistment. For standard enlistment mode, the WebLogic Server transaction manager re-enlists the XAResource in the same Transaction upon the following occasions:

- Before a request is executed
- After a reply is received from another server. (The WebLogic Server transaction manager delists the XAResource before sending the request to another server.)

# Dynamic Enlistment

With the dynamic enlistment mode, you must enlist the XAResource instance with the Transaction object before every access of the resource. With this enlistment mode, only one XAResource instance from each transaction branch is allowed to be enlisted for each transaction at a time. The WebLogic Server transaction manager ignores attempts to enlist additional XAResource instances (of the same transaction branch) after the first instance is enlisted, but before it is delisted.

With dynamic enlistment, enlistments and delistments of XAResource instances are minimized.

The steps for enlisting the XAResource is the same as described in "Standard Enlistment."

## Static Enlistment

With static enlistment mode, you do not need to enlist the XAResource instance with any Transaction object. The WebLogic Server transaction manager implicitly enlists the XAResource for *all* transactions with the following events:

- Before a request is executed
- After a reply is received from another server

**Note:** Consider the following before using the static enlistment mode:

- Static enlistment mode eliminates the need to enlist XAResources. However, unnecessary enlistment and delistment may result, if the resource is not used in a particular transaction.
- A faulty XAResource may adversely affect all transactions even if the resource is not used in the transaction.
- A single XAResource instance is used to associate different transactions with different threads at the same time. That is, `XAResource.start` and `XAResource.end` can be called on the same XAResource instance in an interleaved manner for different Xids in different threads. You must ensure that the XAResource supports such an association pattern, which is not required by the JTA specification.

Due to the performance overhead, poor fault isolation, and demanding transaction association requirement, static enlistment should only be used with discretion and after careful consideration.

# Commit processing

During commit processing, the WebLogic Server transaction manager will either use the XAResource instances currently enlisted with the transaction, or the XAResource instances that are registered with the transaction manager to perform the two-phase commit. The WebLogic Server transaction manager ensures that each transaction branch will receive only one set of prepare-commit calls. You must ensure that any XAResource instance can be used for commit processing for multiple transactions simultaneously from different threads, as defined in JTA Specification Version 1.0.1B Section 3.4.6.

# Recovery

When a WebLogic Server server is restarted, the WebLogic Server transaction manager reads its own transaction logs (with log records of transactions that are successfully prepared, but may not have completed the second commit phase of 2PC processing). The WebLogic Server transaction manager then continues to retry commit of the XAResources for these transactions. As discussed in "Registering an XAResource to Participate in Transactions," one purpose of the WebLogic Server transaction manager resource registration API is for bootstrapping XAResource instances for recovery. You must make sure that an XAResource instance is registered with the WebLogic Server transaction manager upon server restart. The WebLogic Server transaction manager retries the commit call every minute, until a valid XAResource instance is registered with the WebLogic Server transaction manager.

When a transaction manager that is acting as a transaction coordinator crashes, it is possible that the coordinator may not have logged some in-doubt transactions in the coordinator's transaction log. Thus, upon server restart, the coordinator needs to call `XAResource.recover` on the resource managers, and roll back the in-doubt transactions that were not logged. As with commit retries, the WebLogic Server transaction manager retries `XAResource.recover` every 5 minutes, until a valid XAResource instance is registered with the WebLogic Server transaction manager.

The WebLogic Server transaction manager checkpoints a new XAResource in its transaction log records when the XAResource is first enlisted with the WebLogic Server transaction manager. Upon server restart, the WebLogic Server transaction manager then calls `XAResource.recover` on all the resources previously checkpointed (removed from the transaction log records after the transaction completed). A resource is only removed from a checkpoint record if it has not been accessed for the last `PurgeResourceFromCheckpointIntervalSeconds` interval (default is 24 hours). Therefore, to reduce the resource recovery overhead, you should make sure that only a small number of resource manager instances are registered with the WebLogic Server transaction manager.

When implementing `XAResource.recover`, you should use the flags as described in the X/Open XA specification as follows:

- When the WebLogic Server transaction manager calls `XAResource.recover` with `TMSTARTRSCAN`, the resource returns the first batch of in-doubt Xids.

  The WebLogic Server transaction manager then calls `XAResource.recover` with `TMNOFLAGS` repeatedly, until the resource returns either null or a zero-length array to signal that there are no more Xids to recover. If the resource has already returned all the Xids in the previous `XAResource.recover(TMSTARTRSCAN)` call, then it can either return null or

a zero-length array here, or it may also throw `XAER_PROTO`, to indicate that it has already finished and forgotten the previous recovery scan. A common `XAResource.recover` implementation problem is ignoring the flags or always returning the same set of Xids on `XAResource.recover(TMNOFLAGS)`. This will cause the WebLogic Server transaction manager recovery to loop infinitely, and subsequently fail.

- The WebLogic Server transaction manager `XAResource.recover` with `TMENDRSCAN` flag to end the recovery scan. The resource may return additional Xids.

# Resource Health Monitoring

To prevent losing server threads to faulty XAResources, WebLogic Server JTA has an internal resource health monitoring mechanism. A resource is considered active if either there are no pending requests or the result from any of the XAResource pending requests is not `XAER_RMFAIL`. If an XAResource is not active within two minutes, the WebLogic Server transaction manager will declare it dead. Any further requests to the XAResource are shunned, and an `XAER_RMFAIL XAException` is thrown.

The two minute interval can be configured via the `maxXACallMillis` JTAMBean attribute. It is not exposed through the Administration Console. You can configure `maxXACallMillis` in the `config.xml` file. For example:

```
<Domain>

....

<JTA
   MaxXACallMillis="240000"
/>

....

</Domain>
```

To receive notification from the WebLogic Server transaction manager and to inform the WebLogic Server transaction manager whether it is indeed dead when the resource is about to be declared dead, you can implement `weblogic.transaction.XAResource` (which extends `javax.transaction.xa.XAResource`) and register it with the transaction manager. The transaction manager will call the `detectUnavailable` method of the XAResource when it is about to declare it unavailable. If the XAResource returns `true`, then it will not be declared unavailable. If the XAResource is indeed unavailable, it can use this opportunity to perform cleanup and re-registration with the transaction manager. See the *WebLogic Server Javadocs* for `weblogic.transaction.XAResource` for more information.

# Java EE Connector Architecture Resource Adapter

Besides registering with the WebLogic Server transaction manager directly, you can also implement the Java EE Connector Architecture resource adapter interfaces. When you deploy the resource adapter, the WebLogic Server Java EE container will register the resource manager's XAResource with the WebLogic Server transaction manager automatically.

For more information, see *Programming WebLogic Resource Adapters*.

# Implementation Tips

The following sections provide tips for exporting and importing transactions with the WebLogic Server transaction manager:


- "Sharing the WebLogic Server Transaction Log" on page 11-12
- "Transaction global properties" on page 11-13
- "TxHelper.createXid" on page 11-13


## Sharing the WebLogic Server Transaction Log

The WebLogic Server transaction manager exposes the transaction log to be shared with system applications such as gateways. This provides a way for system applications to take advantage of the box-carring (batching) transaction log optimization of the WebLogic Server transaction manager for fast logging. Note that it is important to release the transaction log records in a timely fashion. (The WebLogic Server transaction manager will only remove a transaction log file if all the records in it are released). Failure to do so may result in a large number of transaction log files, and could lead to re-commit of a large number of already committed transactions, or in an extreme case, circular collision and overwriting of transaction log files.

The WebLogic Server transaction manager exposes a transaction logger interface: `weblogic.transaction.TransactionLogger`. It is only available on the server, and it can be obtained with the following steps:

1. Get the server transaction manager:

```
import weblogic.transaction.ServerTransactionManager;
import weblogic.transaction.TxHelper;

ServerTransactionManager stm =
(ServerTransactionManager)TxHelper.getTransactionManager();
```

2. Get the `TransactionLogger`:

```
TransactionLogger tlog = stm.getTransactionLogger();
```

The XAResource's log records must implement the `weblogic.transaction.TransactionLoggable` interface in order to be written to the transaction log. See the *WebLogic Server Javadocs* for the `weblogic.transaction.TransactionLogger` interface for more details and the usage of the `TransactionLogger` interface.

# Transaction global properties

A WebLogic Server JTA transaction object is associated with both local and global properties. Global properties are propagated with the transaction propagation context among servers, and are also saved as part of the log record in the transaction log. You can access the transaction global properties as follows:

1. Obtain the transaction object:

```
import weblogic.transaction.Transaction;
import weblogic.transaction.TransactionHelper;

Transaction tx = TransactionHelper.getTransaction();  // Get the
transaction associated with the thread
```

or

```
Transaction tx = TxHelper.getTransaction(xid); // Get the transaction
with the given Xid
```

2. Get or set the properties on the transaction object:

```
tx.setProperty("foo", "fooValue");

tx.getProperty("bar");
```

See the *WebLogic Server Javadocs* for the `weblogic.transaction.TxHelper` class for more information.

# TxHelper.createXid

You can use the `TxHelper.createXid(int formatId, byte[] gtrid, byte[] bqual)` method to create Xids, for example, to return to the WebLogic Server transaction manager on recovery.

See the *WebLogic Server Javadocs* for the `weblogic.transaction.TxHelper` class for more information.

# FAQs

- XAResource's Xid has a branch qualifier, but not the transaction manager's transaction.

WebLogic Server JTA transaction objects do not have branch qualifiers (i.e., `TxHelper.getTransaction().getXid().getBranchQualifier()` would be null). Since the branch qualifiers are specific to individual resource managers, the WebLogic Server transaction manager only sets the branch qualifiers in the Xids that are passed into XAResource methods.

- What is the `TxHelper.getTransaction()` method used for?

The WebLogic Server JTA provides the `TxHelper.getTransaction()` API to return the transaction associated with the current thread. However, note that WebLogic Server JTA suspends the transaction context before calling the XAResource methods, so you should only rely on the Xid input parameter to identify the transaction, but not the transaction associated with the current thread.

# Additional Documentation about JTA

Refer to the JTA specification 1.0.1B Section 4.1 for a connection-based Resource Usage scenario, which illustrates the JTA interaction between the transaction manager and resource manager. The JTA specification is available at `http://java.sun.com/products/jta/`.

CHAPTER 12

# Participating in Transactions Managed by a Third-Party Transaction Manager

WebLogic Server can participate in distributed transactions coordinated by third-party systems (referred to as foreign transaction managers). The WebLogic Server processing is done as part of the work of the external transaction. The foreign transaction manager then drives the WebLogic Server transaction manager as part of its commit processing. This is referred to as "importing" transactions into WebLogic Server.

The following sections describe the process for configuring and participating in foreign-managed transactions:



## Overview of Participating in Foreign-Managed Transactions

The WebLogic Server transaction manager exposes a `javax.transaction.xa.XAResource` implementation via the `weblogic.transaction.InterposedTransactionManager` interface. A foreign transaction manager can access the `InterposedTransactionManager`

interface to coordinate the WebLogic Server transaction manager XAResource during its commit processing.

When importing a transaction from a foreign transaction manager into the WebLogic Server transaction manager, you must register the WebLogic Server interposed transaction manager as a subordinate with the foreign transaction manager. The WebLogic Server transaction manager then acts as the coordinator for the imported transaction within WebLogic Server.

WebLogic Server supports two configuration schemes for importing transactions:

- Using a client-side gateway (implemented externally to WebLogic Server) that uses the *client* interposed transaction manager
- Using a server-side gateway implemented on a WebLogic Server instance that uses the *server* interposed transaction manager

Although there are some differences in limitations and in implementation details, the basic behavior is the same for importing transactions in both configurations:

1. Lookup the WebLogic Server transaction manager and register it as an XAResource as necessary in the third-party system.
2. Enlist and delist applicable transaction participants during transaction processing.
3. Send the prepare message to the WebLogic Server transaction manager, which then acts as a subordinate transaction manager and coordinates the prepare phase for transaction participants within WebLogic Server.
4. Send the commit or roll back message to the WebLogic Server transaction manager, which then acts as a subordinate transaction manager and coordinates the second phase of the two-phase commit process for transaction participants within WebLogic Server.
5. Unregister, as necessary.

# Importing Transactions with the Client Interposed Transaction Manager

You can use the client interposed transaction manager in WebLogic Server to drive the two-phase commit process for transactions that are coordinated by a third-party transaction manager and include transaction participants within WebLogic Server, such as JMS resources and JDBC resources. The client interposed transaction manager is an implementation of the `javax.transaction.xa.XAResource` interface. You access the client interposed transaction manager directly from the third-party application, typically from a gateway in the third-party

application. The transaction manager in the third-party system then sends the prepare and commit messages to the gateway, which propagates the message to the WebLogic Server transaction manger. The WebLogic Server transaction manager then acts as a subordinate transaction manager and coordinates the transaction participants within WebLogic Server. Figure 12-1 shows the interaction between the two transaction managers and the client-side gateway.

**Figure 12-1 Importing Transactions into WebLogic Server Using a Client-Side Gateway**

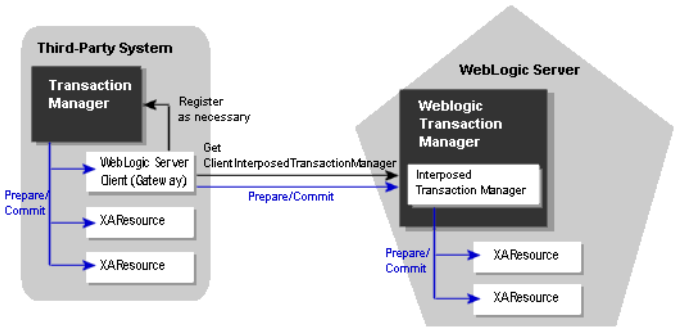
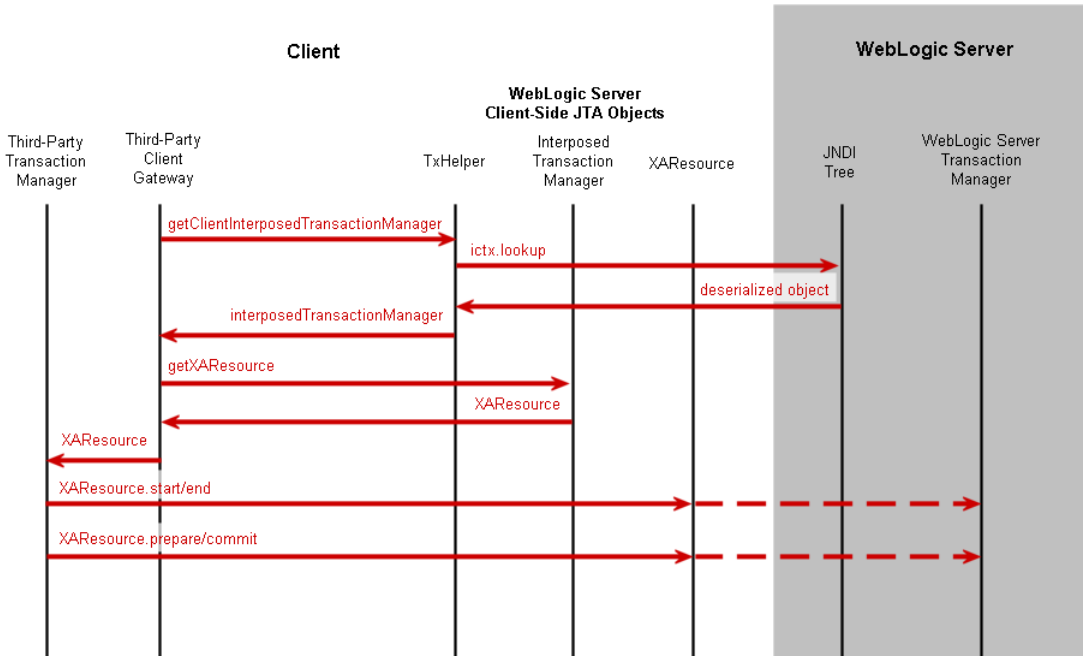



Figure 12-2 shows the flow of interactions between a foreign transaction manager, WebLogic Server client-side JTA objects, and the WebLogic Server transaction manager.

**Figure 12-2 State Diagram Illustrating Steps to Import a Transaction Using the Client Interposed Transaction Manager**




To access the interposed transaction manager in WebLogic Server using a client-side gateway, you must perform the following steps:

- Get the Client Interposed Transaction Manager
- Get the XAResource from the Interposed Transaction Manager

# Get the Client Interposed Transaction Manager

In a client-side gateway, the you can get the WebLogic server interposed transaction manager's XAResource with the `getClientInterposedTransactionManager` method. For example:

```
import javax.naming.Context;
import weblogic.transaction.InterposedTransactionManager;
import weblogic.transaction.TxHelper;

Context initialCtx;
```

```
String serverName;

InterposedTransactionManager itm =
TxHelper.getClientInterposedTransactionManager(initialCtx, serverName);
```

The server name parameter is the name of the server that acts as the interposed transaction manager for the foreign transaction. When the foreign transaction manager performs crash recovery, it needs to contact the same WebLogic Server server to obtain the list of in-doubt transactions that were previously imported into WebLogic Server.

See the *WebLogic Server Javadocs* for the `weblogic.transaction.TxHelper` class for more information.

## Get the XAResource from the Interposed Transaction Manager

After you get the interposed transaction manager, you must get the XAResource object associated with the interposed transaction manager:

```
import javax.transaction.xa.XAResource;

XAResource xar = itm.getXAResource();
```

## Limitations of the Client Interposed Transaction Manager

Note the following limitations when importing transactions using a client-side gateway:

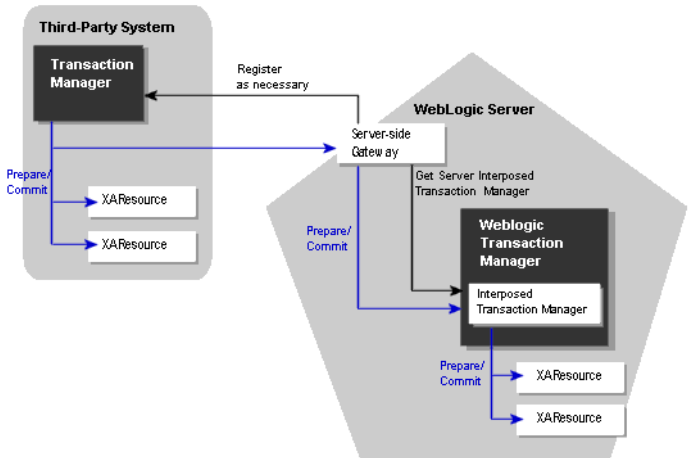
- You cannot use the `TxHelper.getServerInterposedTransactionManager()` method in client-side gateways.
- You can only use *one* WebLogic Server client interposed transaction manager at a time. Do not use more than one client interposed transaction manager (connecting to different WebLogic Server servers) to import transactions at the same time. (See "Transaction Processing for Imported Transactions" on page 12-7 for more information about this limitation and how transactions are processed with the WebLogic Server interposed transaction manager.)

# Importing Transactions with the Server Interposed Transaction Manager

You can use the server interposed transaction manager in WebLogic Server to drive the two-phase commit process for transactions that are coordinated by a third-party transaction

manager and include transaction participants within WebLogic Server, such as JMS resources and JDBC resources. The server interposed transaction manager is an implementation of the `javax.transaction.xa.XAResource` interface. You access the server interposed transaction manager by creating a server-side gateway on WebLogic Server and then accessing the gateway from a third-party system. The transaction manager in the third-party system then sends the prepare and commit messages to the server-side gateway, which propagates the message to the WebLogic Server transaction manger. The WebLogic Server transaction manager then acts as a subordinate transaction manager and coordinates the transaction participants within WebLogic Server. Figure 12-3 shows the interaction between the two transaction managers and the server-side gateway.

**Figure 12-3 Importing Transactions into WebLogic Server Using a Server-Side Gateway**




To access the interposed transaction manager in WebLogic Server using a server-side gateway, you must perform the following steps:

- Get the Server Interposed Transaction Manager
- Get the XAResource from the Interposed Transaction Manager

# Get the Server Interposed Transaction Manager

In a server-side gateway, you can get the interposed transaction manager's XAResource as follows:

```
import javax.naming.Context;
import weblogic.transaction.InterposedTransactionManager;
import weblogic.transaction.TxHelper;

InterposedTransactionManager itm =
TxHelper.getServerInterposedTransactionManager();
```

See the *WebLogic Server Javadocs* for the `weblogic.transaction.TxHelper` class for more information.

After you get the interposed transaction manager, you must get the XAResource. See "Get the XAResource from the Interposed Transaction Manager" on page 12-5.

## Limitations of the Server Interposed Transaction Manager

Note the following limitations when importing transactions using a server-side gateway:

- Do not use the `TxHelper.getClientInterposedTransactionManager()` method in a server-side gateway on a WebLogic Server server. Doing so will cause performance issues.
- You can only use *one* WebLogic Server server interposed transaction manager at a time. Do not use more than one server interposed transaction manager (on the same thread) to import transactions at the same time. (See "Transaction Processing for Imported Transactions" for more information about this limitation and how transactions are processed with the WebLogic Server interposed transaction manager.)

# Transaction Processing for Imported Transactions

To import a foreign transaction into WebLogic Server, the foreign transaction manager or gateway can do the following:

```
xar.start(foreignXid, TMNOFLAGS);
```

This operation associates the current thread with the imported transaction. All subsequent calls made to other servers will propagate the imported WebLogic Server transaction, until the transaction is disassociated from the thread.

**Note:** The flag is ignored by the WebLogic Server transaction manager. If the foreign Xid has already been imported previously on the same WebLogic Server server, WebLogic Server will associate the current thread with the previously imported WebLogic Server transaction.

To disassociate the imported transaction from the current thread, the foreign transaction manager or gateway should do the following:

```
xar.end(foreignXid, TMSUCCESS);
```

Note that the WebLogic Server transaction manager ignores the flag.

## Transaction Processing Limitations for Imported Transactions

Note the following processing limitations and behavior for imported transactions:

- After a WebLogic Server transaction is started, the gateway cannot call start again on the same thread. With a client-side gateway, you can only call `xar.start` on one client interposed transaction manager at a time. Attempting to call `xar.start` on another client interposed transaction manager (before `xar.end` was called on the first one) will throw an `XAException` with `XAER_RMERR`. With a server-side gateway, attempting to call `xar.start` on a client or server interposed transaction manager will also throw a `XAException` with `XAER_RMERR` if there is already an active transaction associated with the current thread.
- The WebLogic Server interposed transaction manager's XAResource exhibits loosely-coupled transaction branching behavior on different WebLogic Server servers. That is, if the same foreign Xid is imported on different WebLogic Server servers, they will be imported to different WebLogic Server transactions.
- The WebLogic Server transaction manager does not flatten the transaction tree, for example, the imported transaction of a previously exported WebLogic Server transaction will be in a separate branch from the original WebLogic Server transaction.
- A foreign transaction manager should make sure that all foreign Xids that are imported into WebLogic Server are unique and are not reused within the sum of the transaction abandon timeout period and the transaction timeout period. Failure to do so may result in log records that are never released in the WebLogic Server transaction manager. This could lead to inefficient crash recovery.

# Commit Processing for Imported Transactions

The foreign transaction manager should drive the interposed transaction manager in the 2PC protocol as it does the other XAResources. Note that the `beforeCompletion` callbacks registered with the WebLogic Server JTA (e.g., the EJB container) are called when the foreign transaction manager prepares the interposed transaction manager's XAResource. The `afterCompletion` callbacks are called during `XAResource.commit` or `XAResource.rollback`.

The WebLogic Server interposed transaction manager honors the XAResource contract as described in the Java Transaction API.

- Once prepared by a foreign transaction manager, the WebLogic Server interposed transaction manager waits persistently for a commit or rollback outcome from the foreign transaction manager until the transaction abandon timeout expires.
- The WebLogic Server interposed transaction manager remembers heuristic outcomes persistently until being told to forget about the transaction by the foreign transaction manager or until transaction abandon timeout.

The WebLogic Server transaction manager logs a `prepare` record for the imported transaction after all the WebLogic Server participants are successfully prepared. If there are more than one WebLogic Server participants for the imported transaction, the transaction manager logs a prepare record even if the `XAResource.commit` is a one-phase commit.

# Recovery for Imported Transactions

During the crash recovery of the foreign transaction manager, the foreign transaction manager must get the XAResource of the WebLogic Server interposed transaction manager again, and call recover on it. The WebLogic Server interposed transaction manager then returns the list of prepared or heuristically completed transactions. The foreign transaction manager should then resolve those in-doubt transactions: either commit or rollback the prepared transactions, and call forget on the heuristically completed transactions.

CHAPTER 13

# Troubleshooting Transactions

This section describes troubleshooting tools and tasks for use in determining why transactions fail and deciding what actions to take to correct the problem.

This section discusses the following topics:

- Overview
- Troubleshooting Tools

## Overview

WebLogic Server includes the ability to monitor currently running transactions and ensure that adequate information is captured in the case of heuristic completion. It also provides the ability to monitor performance of database queries, transactional requests, and bean methods.

## Troubleshooting Tools

WebLogic Server provides the following aids to transaction troubleshooting:

# Exceptions

WebLogic JTA supports all standard JTA exceptions. For more information about standard JTA exceptions, see the Javadoc for the `javax.transaction` and `javax.transaction.xa` package APIs.

In addition to the standard JTA exceptions, WebLogic Server provides the class `weblogic.transaction.RollbackException`. This class extends `javax.transaction.RollbackException` and preserves the original reason for a rollback. Before rolling a transaction back, or before setting it to `rollbackonly`, an application can supply a reason for the rollback. All rollbacks triggered inside the transaction service set the reason (for example, timeouts, XA errors, unchecked exceptions in `beforeCompletion`, or inability to contact the transaction manager). Once set, the reason cannot be overwritten.

# Transaction Identifier

The Transaction Service assigns a transaction identifier (`Xid`) to each transaction. This ID can be used to isolate information about a specific transaction in a log file. You can retrieve the transaction identifier using the `getXID` method in the `weblogic.transaction.Transaction` interface. For detailed information on methods for getting the transaction identifier, see the `weblogic.transaction.Transaction` Javadoc.

# Transaction Name and Properties

WebLogic JTA provides extensions to `javax.transaction.Transaction` that support transaction naming and user-defined properties. These extensions are included in the `weblogic.transaction.Transaction` interface.

The transaction name indicates a type of transaction (for example, funds transfer or ticket purchase) and should not be confused with the transaction ID, which identifies a unique transaction on a server. The transaction name makes it easier to identify a transaction type in the context of an exception or a log file.

User-defined properties are key/value pairs, where the key is a string identifying the property and the value is the current value assigned to the property. Transaction property values must be objects that implement the `Serializable` interface. You manage properties in your application using the set and get methods defined in the `weblogic.transaction.Transaction` interface.

Once set, properties stay with a transaction during its entire lifetime and are passed between machines as the transaction travels through the system. Properties are saved in the transaction log, and are restored during crash recovery processing. If a transaction property is set more than once, the latest value is retained.

For detailed information on methods for setting and getting the transaction name and transaction properties, see the `weblogic.transaction.Transaction` Javadoc.

# Transaction Status

The Java Transaction API provides transaction status codes using the `javax.transaction.Status` class. Use the `getStatusAsString` method in `weblogic.transaction.Transaction` to return the status of the transaction as a string. The string contains the major state as specified in `javax.transaction.Status` with an additional minor state (such as `logging` or `pre-preparing`).

# Transaction Statistics

Transaction statistics are provided for all transactions handled by the transaction manager on a server. These statistics include the number of total transactions, transactions with a specific outcome (such as committed, rolled back, or heuristic completion), rolled back transactions by reason, and the total time that transactions were active. For detailed information on transaction statistics, see the Administration Console Online Help.

# Transaction Monitoring

The Administration Console allows you to monitor transactions. Monitoring tasks are performed at the server level. Transaction statistics are displayed for a specific server.

# Debugging JTA Resources

Once you have narrowed the problem down to a specific application, you can activate WebLogic Server's debugging features to track down the specific problem within the application.

## Enabling Debugging

You can enable debugging by setting the appropriate `ServerDebug` configuration attribute to "`true`." Optionally, you can also set the server `StdoutSeverity` to "`Debug`".

You can modify the configuration attribute in any of the following ways.

## Enable Debugging Using the Command Line

Set the appropriate properties on the command line. For example,

```
-Dweblogic.debug.DebugJDBCJTA=true
-Dweblogic.log.StdoutSeverity="Debug"
```

This method is static and can only be used at server startup.

## Enable Debugging Using the WebLogic Server Administration Console

Use the WebLogic Server Administration Console to set the debugging values:

1. If you have not already done so, in the Change Center of the Administration Console, click Lock & Edit (see Use the Change Center).
2. In the left pane of the console, expand Environment and select Servers.
3. On the Summary of Servers page, click the server on which you want to enable or disable debugging to open the settings page for that server.
4. Click Debug.
5. Expand default.
6. Select the check box for the debug scopes or attributes you want to modify.
7. Select Enable to enable (or Disable to disable) the debug scopes or attributes you have checked.
8. To activate these changes, in the Change Center of the Administration Console, click Activate Changes.
   Not all changes take effect immediately—some require a restart (see Use the Change Center).

   This method is dynamic and can be used to enable debugging while the server is running.

## Enable Debugging Using the WebLogic Scripting Tool

Use the WebLogic Scripting Tool (WLST) to set the debugging values. For example, the following command runs a program for setting debugging values called `debug.py`:

```
java weblogic.WLST debug.py
```

The debug.py program contains the following code:

```
user='user1'
password='password'
```

```
url='t3://localhost:7001'
connect(user, password, url)
edit()
cd('Servers/myserver/ServerDebug/myserver')
startEdit()
set('DebugJDBCJTA','true')
save()
activate()
```

Note that you can also use WLST from Java. The following example shows a Java file used to set debugging values:

```
import weblogic.management.scripting.utils.WLSTInterpreter;
import java.io.*;
import weblogic.jndi.Environment;
import javax.naming.Context;
import javax.naming.InitialContext;
import javax.naming.NamingException;

public class test {
        public static void main(String args[]) {
       try {
              WLSTInterpreter interpreter = null;
              String user="user1";
              String pass="pw12ab";
              String url ="t3://localhost:7001";
              Environment env = new Environment();
              env.setProviderUrl(url);
              env.setSecurityPrincipal(user);
              env.setSecurityCredentials(pass);
              Context ctx = env.getInitialContext();

              interpreter = new WLSTInterpreter();
              interpreter.exec
                     ("connect('"+user+"','"+pass+"','"+url+"')");
              interpreter.exec("edit()");
              interpreter.exec("startEdit()");
              interpreter.exec
                     ("cd('Servers/myserver/ServerDebug/myserver')");
```

```
                interpreter.exec("set('DebugJDBCJTA','true')");
                interpreter.exec("save()");
                interpreter.exec("activate()");

        } catch (Exception e) {
        System.out.println("Exception "+e);
        }
        }
}
```

Using the WLST is a dynamic method and can be used to enable debugging while the server is running.

## Changes to the config.xml File

Changes in debugging characteristics, through console, or WLST, or command line are persisted in the `config.xml` file. See Figure 13-1:

**Listing 13-1 Example Debugging Stanza for JTA**

```
.
.
.
<server>
<name>myserver</name>
<server-debug>
<debug-scope>
<name>weblogic.transaction</name>
<enabled>true</enabled>
</debug-scope>
<debug-jdbcjta>true</debug-jdbcjta>
</server-debug>
</server>
.
.
.
```

This sample `config.xml` fragment shows a transaction debug scope (set of debug attributes) and a single JTA attribute.

## JTA Debugging Scopes

It is possible to see the tree view of the DebugScope definitions using `java weblogic.diagnostics.debug.DebugScopeViewer`.

You can enable the following registered debugging scopes for JTA:

- `DebugJDBCJTA` (scope weblogic.jdbc.transaction) - not currently used.
- `DebugJTAXA` (scope weblogic.transaction.xa) - traces for XA resources.
- `DebugJTANonXA` (scope weblogic.transaction.nonxa) - traces for non-XA resources.
- `DebugJTAXAStackTrace` (scope weblogic.transaction.stacktrace) - detailed tracing that prints stack traces at various critical locations.
- `DebugJTARMI` (scope weblogic.transaction.rmi) - not currently used.
- `DebugJTA2PC` (scope weblogic.transaction.twopc) - traces all 2-phase commit operations.
- `DebugJTA2PCStackTrace` (scope weblogic.transaction.twopcstacktrace) - detailed two-phase commit tracing that prints stack traces.
- `DebugJTATLOG` (scope weblogic.transaction.tlog) - traces transaction logging information.
- `DebugJTAJDBC` (scope weblogic.transaction.jdbc, weblogic.jdbc.transaction) - traces information about reading/writing JTA records.
- `DebugJTARecovery` (scope weblogic.transaction.recovery) - traces recovery information.
- `DebugJTAGateway` (scope weblogic.transaction.gateway) - traces information about imported transactions.
- `DebugJTAGatewayStackTrace` (scope weblogic.transaction.gatewaystacktrace) - stack traces related to imported transactions.
- `DebugJTANaming` (scope weblogic.transaction.naming) - traces transaction naming information.
- `DebugJTANamingStackTrace` (scope weblogic.transaction.namingstacktrace) - traces transaction naming information.

- `DebugJTAResourceHealth` (scope weblogic.transaction.resourcehealth) - traces information about XA transaction resource health.
- `DebugJTAMigration` (scope weblogic.transaction.migration) - traces information about Transaction Log migration.
- `DebugJTALifecycle` (scope weblogic.transaction.lifecycle) - traces information about the transaction server lifecycle (initialization, suspension, resuming, and shutdown).
- `DebugJTALLR` (scope weblogic.transaction.llr) - traces all Logging Last Resource operations.
- `DebugJTAHealth` (scope weblogic.transaction.health) - traces information about transaction subsystem health.
- `DebugJTATransactionName` (scope weblogic.transaction.name) - traces transaction names.
- `DebugJTAResourceName` (scope weblogic.transaction.resourcename) - traces transaction resource names.