Oracle9*i*

CORBA Developer's Guide and Reference

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Oracle9*i* CORBA Developer's Guide and Reference, Release 1 (9.0.1)

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Contents

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Preface

This guide gets you started building CORBA applications for Oracle9*i*. It includes many code examples to help you develop your application.

Who Should Read This Guide?

Anyone developing server-side CORBA applications for Oracle9*i* will benefit from reading this guide. Written especially for programmers, it will also be of value to architects, systems analysts, project managers, and others interested in network-centric database applications. To use this guide effectively, you must have a working knowledge of Java and Oracle9*i*. This guide assumes that you have some familiarity with CORBA See "Suggested Reading" on page xv for more information on CORBA concepts.

How This Guide Is Organized

This guide consists of the following chapters and appendices:

Chapter 1, "Overview", presents a brief overview of the CORBA development model from an Oracle9*i* perspective.

Chapter 2, "Getting Started", describes techniques for developing CORBA server objects that run in the Oracle9*i* data server.

Chapter 3, "Configuring IIOP Applications", discusses how to configure for your CORBA applications.

Chapter 4, "JNDI Connections and Session IIOP Service", discusses how to use JNDI and sessions within your CORBA applications.

Chapter 5, "Advanced CORBA Programming", details how to program your CORBA application beyond the simple example presented in Chapter 2.

Chapter 6, "IIOP Security", covers how to implement security within your CORBA application.

Chapter 7, "Transaction Handling", documents the transaction interfaces that you can use when developing your CORBA applications.

Appendix A, "Example Code: CORBA", includes examples of CORBA applications. Each example contains both the Java and IDL source code.

Appendix B, "Comparing the Oracle9i and VisiBroker VBJ ORBs", discusses some of the fundamental differences between developing CORBA applications for VisiBroker and the Oracle9*i* JVM.

Appendix C, "Abbreviations and Acronyms", supplies a list of acronyms.

Documentation Accessibility

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JAWS, a Windows screen reader, may not always correctly read the Java code examples in this document. The conventions for writing Java code require that closing braces should appear on an otherwise empty line; however, JAWS may not always read a line of text that consists solely of a bracket or brace.‘

For additional information, visit the Oracle Accessibility Program web site at `http://www.oracle.com/accessibility/`.

Notational Conventions

This guide follows these conventions:

Italic	Italic font denotes terms being defined for the first time, words being emphasized, error messages, and book titles.
`Courier`	Courier font denotes Java program names, file names, path names, and Internet addresses.

Java code examples follow these conventions:

`{ }`	Braces enclose a block of statements.
`//`	A double slash begins a single-line comment, which extends to the end of a line.
`/*   */`	A slash-asterisk and an asterisk-slash delimit a multi-line comment, which can span multiple lines.
`...`	An ellipsis shows that statements or clauses irrelevant to the discussion were left out.
`lower case`	Lower case is used for keywords and for one-word names of variables, methods, and packages.
`UPPER CASE`	Upper case is used for names of constants (static final variables) and for names of supplied classes that map to built-in SQL datatypes.
`Mixed Case`	Mixed case is used for names of classes and interfaces and for multi-word names of variables, methods, and packages. The names of classes and interfaces begin with an upper-case letter. In all multi-word names, the second and succeeding words also begin with an upper-case letter.

Suggested Reading

The *Oracle9i Java Developer's Guide* gives you the technical background information necessary to understand Java in the database server. As well as a comprehensive discussion of the advantages of the Oracle9*i* implementation for enterprise application development, it explains the fundamentals of the Oracle9*i* Java virtual machine (JVM) and gives a technical overview of the tools that Oracle9*i* JVM provides.

Programming with VisiBroker, by D. Pedrick et al. (John Wiley and Sons, 1998) provides a good introduction to CORBA development from the VisiBroker point of view.

Core Java by Cornell & Horstmann, second edition, Volume II (Prentice-Hall, 1997) has good presentations of several Java concepts relevant to EJB. For example, this book documents the Remote Method Invocation (RMI) interface.

Online Sources

There are many useful online sources of information about Java. For example, you can view or download guides and tutorials from the Sun Microsystems home page on the Web:

`http://www.sun.com`

Another popular Java Web site is:

`http://www.gamelan.com`

For Java API documentation, see:

`http://www.javasoft.com`

Related Publications

Occasionally, this guide refers you to the following Oracle publications for more information:

Oracle9i Application Developer's Guide - Fundamentals

Oracle9i Java Developer's Guide

Oracle9i Java Tools Reference

Oracle9i JDBC Developer's Guide and Reference

Oracle9i SQL Reference

Oracle9i SQLJ Developer's Guide and Reference

1 Overview

This chapter gives you a general picture of distributed object development in the Oracle9*i* JVM. As with the more specific chapters that follow, this overview focuses on the aspects of CORBA development that are particular to Oracle9*i*, giving a brief general description of the standard CORBA development model.

This chapter covers the following topics:

Prerequisite Reading

Before consulting this Guide, you should read the *Oracle9i Java Developer's Guide*, which gives you the technical background information necessary to understand Java in the database server. As well as a comprehensive discussion of the advantages of the Oracle9*i* implementation for enterprise application development, it explains the fundamentals of the Oracle9*i* JVM and gives a technical overview of the Oracle9*i* tools.

In addition, the *Oracle9i Java Developer's Guide* describes the strategic advantages of the distributed component development model that is implemented by CORBA.

Terminology

This section defines some of the basic terms used in this chapter. See also Appendix C, "Abbreviations and Acronyms", for a list of common acronyms used in Java and distributed object computing.

client

A *client* is an object, an application, or an applet that makes a request of a server object. Remember that a client need not be a Java application running on a workstation or a network computer, nor an applet downloaded by a Web browser. A server object can be a client of another server object. Client refers to a role in a requestor/server relationship, not to a physical location or a type of computer system.

marshalling

In distributed object computing, *marshalling* refers to the process by which the ORB passes requests and data between clients and server objects.

object adapter

Each CORBA ORB implements an object adapter (OA), which is the interface between the ORB and the message-passing objects. CORBA 2.0 specifies that a basic object adapter (BOA) must exist, but most of the details of its interface are left up to individual CORBA vendors. Future CORBA standards will require a vendor-neutral portable object adapter (POA).

request

A *request* is a method invocation. Other names sometimes used in its stead are method call and message.

server object

A CORBA *server object* is a Java object activated by the server, typically on a first request from a client.

session

A *session* always means a database session. Although it is conceptually the same type of session as that established when a tool such as SQL*Plus connects to Oracle, there are differences in the CORBA case, as follows:

- You establish the database session using the IIOP protocol; you establish a SQL*Plus session using the Oracle Net Services TTC protocol.
- A JVM that runs in the database server controls an IIOP session.

Note: To use CORBA with Oracle9*i*, you must configure the database so that the listener can recognize incoming IIOP requests, in addition to TTC requests. DBAs and system administrators should see Chapter 3, "Configuring IIOP Applications" for information on setting up the database and the listener to accept incoming IIOP requests.

See "Session IIOP Service" on page 4-13 for more information about sessions.

About CORBA

CORBA stands for *Common Object Request Broker Architecture*. What is common about CORBA is that it integrates ideas from several of the original proposers. CORBA is deliberately vendor neutral. The CORBA architecture specifies a software component, a broker, that mediates and directs requests to objects that are distributed across one or more networks, which might have been written in a different language from that of the requestor, and which might be running on different hardware from that of the requestor.

CORBA enables your application to tie together components from various sources. Also, and unlike a typical client/server application, a CORBA application is not inherently synchronous. It is not necessarily typical that a CORBA requestor (a client) invokes a method on a server component and waits for a result. Using asynchronous method invocations, event interfaces and callbacks from server object to the client ORB, you can construct elaborate applications that link together many interacting objects and that access one or many data sources and other resources under transactional control.

CORBA offers a well-supported international standard for cross-platform, cross-language development. CORBA supports cross-language development by specifying a neutral language, Interface Definition Language (IDL), in which you develop specifications for the interfaces that the application objects expose.

CORBA supports cross-platform development by specifying a transport mechanism, IIOP, that allows different operating systems running on very different hardware to interoperate. IIOP supplies a common software bus that, together with an ORB running on each system, makes data and request transfer transparent to the application developer.

Although the CORBA standard was developed before the advent of Java and is a standard focused on component development in a heterogeneous application development environment, incorporating systems and languages of varying age and sophistication, it is possible to develop CORBA applications solely in Java.

For CORBA developers, Oracle9*i* offers the following services and tools:

- a Java Transaction API (JTA) interface, which implements the Sun Microsystems specification
- a Java Transaction Service (JTS) interface to the OMG Object Transaction Service (OTS)
- a CosNaming implementation used for publishing objects to an Oracle9*i* database, retrieving the object references, and activating objects
- a version of the IIOP protocol that supports the Oracle9*i* session-based ORB, which is compatible with standard IIOP
- a wide range of tools, which assist in developing CORBA applications, that do the following:
  - load Java classes and resource files into the database
  - drop loaded classes
  - publish objects to the CosNaming service
  - manage the session name space

CORBA Features

CORBA achieves its flexibility in several ways:

- It specifies an interface description language (IDL) that allows you to specify the interfaces to objects. IDL object interfaces describe, among other things:
    - The data that the object makes public.
    - The operations to which the object can respond, including the complete signature of the operation. CORBA operations map to Java methods, and the IDL operation parameter types map to Java datatypes.
    - Exceptions that the object can throw. IDL exceptions also map to Java exceptions, and the mapping is very direct.

      CORBA provides bindings for many languages, including both non-object languages such as COBOL and C, and object-oriented languages such as Smalltalk and Java.
- All CORBA implementations provide an object request broker (ORB) that handles the routing of object requests in a way that is largely transparent to the application developer. For example, requests—or method invocations—on remote objects that appear in the client code look like local method invocations. The remote call functionality, including marshalling of parameter and return data, is performed for the programmer by the ORB.
- CORBA specifies a network protocol, the Internet Inter-ORB Protocol (IIOP), that provides for transmission of ORB requests and data over a widely available transport protocol: TCP/IP, the Internet standard.
- A set of fully-specified services eases the burden of application development by making it unnecessary for the developer to constantly reinvent the wheel. Among these services are:
    - Naming—One or more services that enable you to resolve names that are bound to CORBA server objects.
    - Transactions—Services that enable you to manage transaction control of data resources in a flexible and portable way.
    - Events.

  CORBA specifies more than 12 services; however, most of these are not currently implemented by CORBA ORB vendors.

The remainder of this section introduces some of the essential building blocks of an Oracle9*i* CORBA application. These include:

- ORB—how to talk to remote objects
- IDL—how to write a portable interface
- naming service (and JNDI)—how to locate a persistent object
- object adapters—how to register a transient object

About the ORB

The object request broker (ORB) is the fundamental part of a CORBA implementation. The ORB makes it possible for a client to send messages to a server, and the server to return values to the client. The ORB handles all communication between a client and a server object.

The Oracle9*i* ORB is based on code from Inprise's VisiBroker 3.4 for Java. The ORB that executes on the server side has been slightly modified from the VisiBroker code, to accommodate the Oracle9*i* object location and activation model. The client-side ORB has been changed very little.

Note: The VisiBroker ORB functionality supplied with Oracle9*i* is only licensed for accessing Oracle9*i* servers.

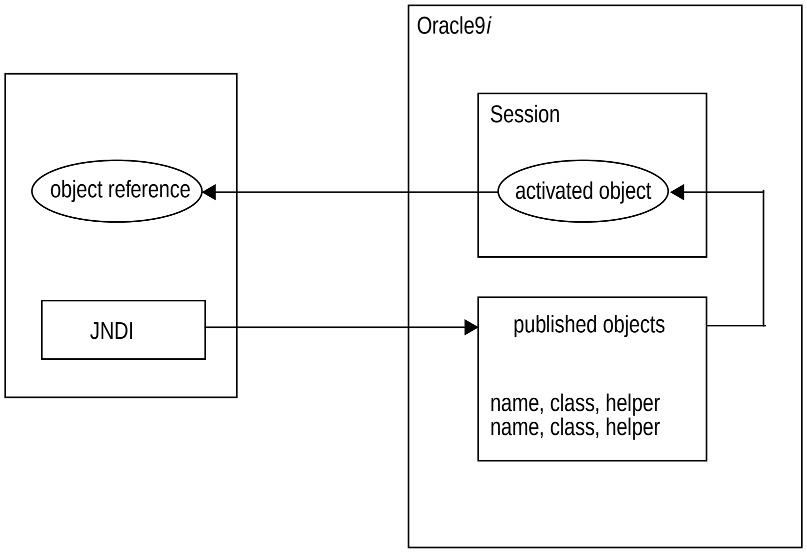
In some CORBA implementations, the application programmer and the server object developer must be aware of the details of how the ORB is activated on the client and the server, and they must include code in their objects to start up the ORB and activate objects. The Oracle9*i* ORB, on the other hand, makes these details largely transparent to the application developer. Only in certain circumstances does the developer need to control the ORB directly. These occur, for example, when coding callback mechanisms or when there is a need to register transient objects with the basic object adapter.

Using JNDI and IIOP

You publish CORBA objects in the Oracle database using the OMG CosNaming service. In addition, you can access these objects using Oracle's JNDI interface to CosNaming.

Figure 1–1 shows how applications access remote objects published in the database, using JNDI.

Figure 1–1 Remote Object Access



IIOP

Oracle9*i* offers a Java interpreter for the IIOP protocol. Oracle embeds a pure Java ORB of a major CORBA vendor—VisiBroker for Java version 3.4 by Inprise. Oracle9*i* repackaged the Visigenic Java IIOP interpreter to run in the database.

Because Oracle9*i* is a highly scalable server, only the essential components of the interpreter are necessary—namely, a set of Java classes that do the following:

- decode the IIOP protocol
- find or activate the relevant Java object
- invoke the method that the IIOP message specifies
- write the IIOP reply back to the client

Oracle9*i* does not use the ORB scheduling facilities. The Oracle multi-threaded server performs the dispatching and enables the server to process IIOP messages efficiently and in a highly scalable manner.

On top of this infrastructure, Oracle9*i* implements both the EJB and CORBA programming models.

For More Information

This section lists some resources that you can access to get more information about CORBA and application development using Java.

Books

The ORB and some of the CORBA services that Oracle9*i* JVM supplies are based on VisiBroker for Java code licensed from Inprise. *Programming with VisiBroker*, by D. Pedrick et al. (John Wiley and Sons, 1998), provides both an introduction to CORBA development from the VisiBroker point of view and an in-depth look at the VisiBroker CORBA environment.

Client/Server Programming with Java and CORBA, by R. Orfali and D. Harkey (John Wiley and Sons, 1998), covers CORBA development in Java. This book also uses the VisiBroker implementation for its examples.

You should be aware that the examples published in both of these books require some modification to run in the Oracle9*i* ORB. It is better to start off using the demos provided with Oracle9*i*, which are more extensive than the examples in the books cited, and demonstrate all the features of Oracle9*i* CORBA. See also Appendix B, "Comparing the Oracle9i and VisiBroker VBJ ORBs" for a discussion of the major differences between VisiBroker for Java and the Oracle9*i* implementation.

URLs

You can download specifications for CORBA 2.0 and for CORBA services from links available at the following web site:

`http://www.omg.org/library/downinst.html`

Documentation on Inprise's VisiBroker for Java product is available at:

`http://www.inprise.com/techpubs/visibroker/visibroker33/`

2 Getting Started

This chapter introduces the basic procedures for creating CORBA applications for Oracle9*i*. The emphasis in this chapter is to present the basics for developing an Oracle9*i* CORBA application. For advanced programming techniques and miscellaneous tips for CORBA applications, see Chapter 5, "Advanced CORBA Programming".

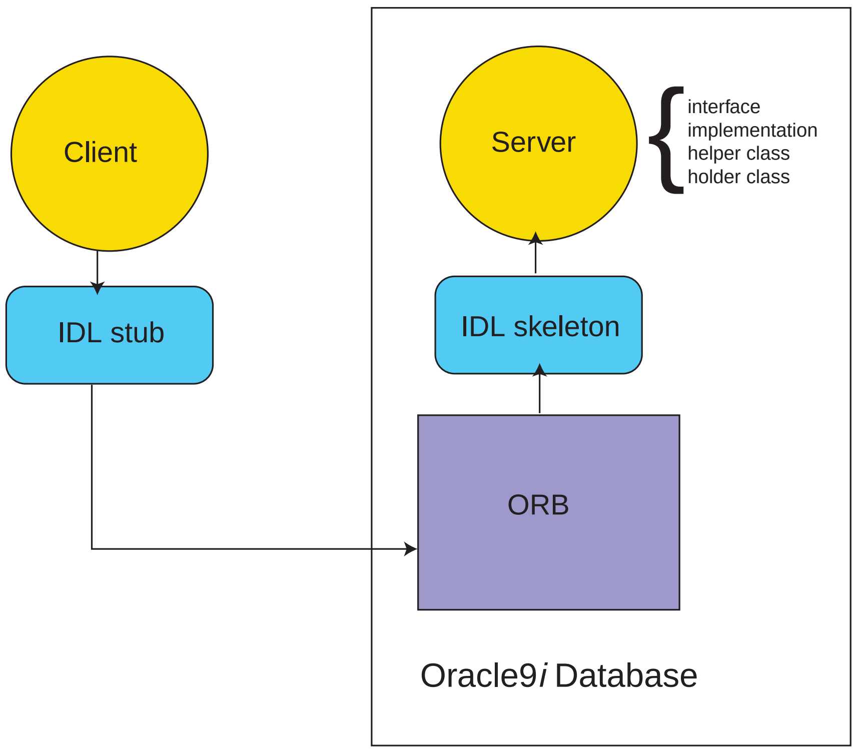
This chapter covers the following topics:

- A First CORBA Application
- The Interface Definition Language (IDL)
- Activating ORBs and Server Objects
- Debugging Techniques

A First CORBA Application

This section introduces the Oracle9*i* CORBA application development process. It tells you how to write a simple but useful program that runs on a client system, connects to Oracle using IIOP, and invokes a method on a CORBA server object that is activated and runs inside the Oracle9*i* JVM.

Figure 2–1 CORBA Application Components



As Figure 2–1 illustrates, a CORBA application requires that you provide the client implementation, the server interface and implementation, and IDL stubs and skeletons. To create this, perform the following steps:

1. Design and write the object interfaces in IDL.
2. Generate stubs, skeletons, and helper and holder support classes.
3. Write the server object implementations.

4. Write the client implementation. This code runs outside of the Oracle9*i* data server on a workstation or PC.
5. Compile the Java server implementation with the client-side Java compiler. In addition, compile all the Java classes generated by the IDL compiler. Generate a JAR file to contain these classes and any other resource files that are needed.
6. Compile the client code using the JDK Java compiler.
7. Load the compiled classes into the Oracle9*i* database using the `loadjava` tool and specifying the JAR file as its argument. Make sure to include all generated classes, such as stubs and skeletons. Client stubs are required in the server only when the server object acts as a client to another CORBA object.
8. Publish a name for the objects that are directly accessible, using the CosNaming service, so that you can access them from the client program.

This chapter uses an employee sample to demonstrate the above steps. The example asks the user for an employee number in the EMP table and returns the employee's last name and current salary. It throws an exception if there is no employee in the database with the given ID number.

Writing Interfaces in IDL

When writing a server application, you must create an Interface Definition Language (IDL) file to define the server's interfaces. An interface is a template that defines a CORBA object. As with any object in an object oriented language, it contains methods and data elements that can be read or set. However, the interface is only a definition and so defines what the interface to an object would be if it existed. In your IDL file, each interface describes an object and the operations clients can perform on that object.

Note: For a full description of IDL, see "The Interface Definition Language (IDL)" on page 2-15.

The IDL for the employee example is called `employee.idl`, and it contains only a single server-side method: `getEmployee`. The `getEmployee` method takes an ID number and queries the database for the employee's name and salary.

This interface defines three things:

- a `getEmployee` method that queries the database and returns the information
- an `EmployeeInfo` data structure to hold the returned information

- a `SQLError` exception to be thrown if the employee is not found

The contents of the `employee.idl` file is as follows:

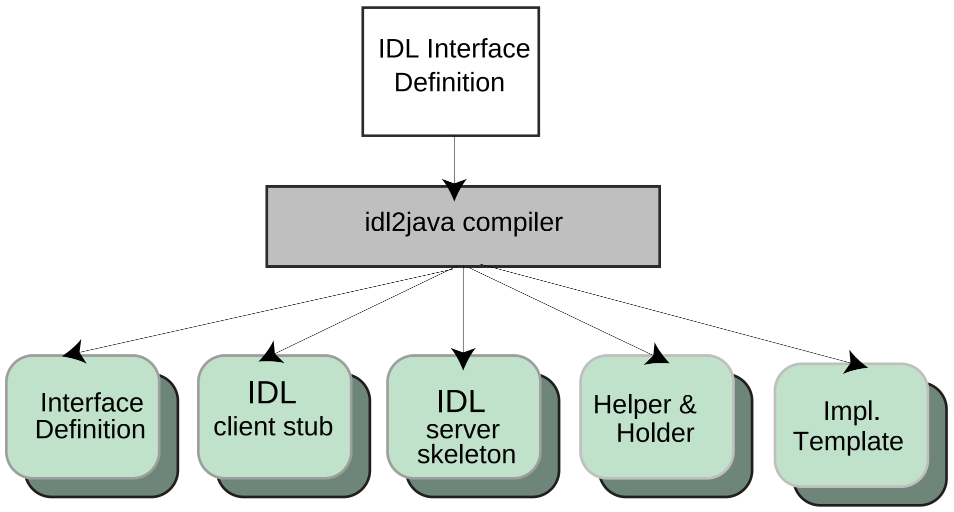
```
module employee {

  struct EmployeeInfo {
    wstring name;
    long number;
    double salary;
  };

  exception SQLError {
    wstring message;
  };

  interface Employee {
    EmployeeInfo getEmployee (in long ID) raises (SQLError);
  };
};
```

Generating Stubs and Skeletons

Use the `idl2java` compiler to compile the interface description. As shown in Figure 2–2, the compiler generates the interface, implementation template, helper, and holder classes for the three objects in the IDL file, as well as a stub and skeleton class for the `Employee` interface. See "Using IDL" on page 2-15 for more information about these classes and the *Oracle9i Java Tools Reference* for more information on the `idl2java` compiler.

Note: Because this example does not use the Tie mechanism, you can invoke the compiler with the `-no_tie` option. Two fewer classes will be generated.

Figure 2–2 IDL Compilation Generates Support Files



Compile the IDL as follows:

```
% idl2java -no_tie -no_comments employee.idl
```

Note: Because developing a CORBA application includes many compilation, loading, and publishing steps, Oracle recommends that if you are working in a command-line oriented environment, always use a makefile or a batch file to control the process. Or, you can use IDE products such as Oracle's JDeveloper to control the process.

When you compile the `employee.idl` file, the `idl2java` tool generates the following files:

File name	**File type**
`_example_Employee.java`	Implementation template for server object.
`Employee.java`	`Employee` interface definition.

File name	**File type**
`EmployeeInfo.java`	`EmployeeInfo` interface definition.
`SQLError.java`	`SQLError` interface definition.
`_st_Employee.java`	IDL client stub.
`_EmployeeImplBase.java`	IDL server skeleton.
`EmployeeHelper.java`	Helper class for `Employee`. The most important methods this class provides are the narrow method for typecasting a returned object to be a `Employee` object, and the id method that returns the interface's identifier.
`EmployeeHolder.java`	Holder class for `Employee`. The Holder class enables a Java object to pass values back to clients.
`EmployeeInfoHelper.java`	Helper class for `EmployeeInfo`.
`EmployeeInfoHolder.java`	Holder class for the `EmployeeInfo` structure.
`SQLErrorHelper.java`	Helper class for `SQLError`.
`SQLErrorHolder.java`	Holder class for the `SQLError` exception.

Modify the `_example_Employee.java` file to include your application implementation. First, rename the `_example_Employee.java` file to a more appropriate name, such as `EmployeeImpl.java`. Once renamed, modify the file to add your server's implementation. The `EmployeeImpl.java` file extends the IDL server skeleton, `_EmployeeImplBase.java`. Add and implement the `getEmployee` method that is defined in the `Employee.java` interface definition. Secondly, create the client application that invokes these methods appropriately. "Writing the Server Object Implementation" on page 2-6 demonstrates how to create the server implementation of `Employee` in `EmployeeImpl.java`.

Writing the Server Object Implementation

An implementation is an instantiation of an interface. That is, the implementation is code that implements all the functions and data elements that were defined in the

IDL interface. The following steps describe how to implement the Employee interface:

1. Modify the EmployeeImpl.java file, which used to be the _example_Employee.java file, to add your server implementation. Notice that the **EmployeeImpl** extends the IDL-generated skeleton, **_EmployeeImplBase**.

   As Figure 2–1 illustrates, the _EmployeeImplBase IDL skeleton exists between the ORB and the server application, so any invocation of the server application is performed through it. The skeleton prepares the parameters, calls the server method, and saves any return values or any out or inout parameters.

2. Implement the **getEmployee** method to query the database for the employee and return the appropriate name and salary in EmployeeInfo.

```
package employeeServer;

import employee.*;
import java.sql.*;

public class EmployeeImpl extends _EmployeeImplBase {

  /*constructor*/
  public EmployeeImpl() {
  }

  /*getEmployee method queries database for employee info*/
  public EmployeeInfo getEmployee (int ID) throws SQLError {
    try {
      /*create a JDBC connection*/
      Connection conn =
          new oracle.jdbc.OracleDriver().defaultConnection ();

      /*Create a SQL statement for the database query*/
      PreparedStatement ps =
          conn.prepareStatement ("select ename, sal from emp where empno = ?");
      /*set the employee identifier and execute query. return the
        result in an EmployeeInfo structure */
      try {
        ps.setInt (1, ID);
        ResultSet rset = ps.executeQuery ();
        if (!rset.next ())
          throw new SQLError ("no employee with ID " + ID);
        return new EmployeeInfo (rset.getString (1), ID, rset.getFloat (2));
      } finally {
        ps.close ();
      }
    /*If a problem occurs, throw the SQLError exception*/
    } catch (SQLException e) {
      throw new SQLError (e.getMessage ());
    }
  }
}
```

This code uses the JDBC API to perform the database query. The implementation uses a prepared statement to accommodate the variable in the WHERE clause of the query. See the *Oracle9i JDBC Developer's Guide and Reference* for more about Oracle9*i* JDBC. You can use SQLJ, instead of JDBC, if your statement is static.

Comparing Oracle9*i* Server Applications to Other ORB Applications

Most ORB applications must provide a server application that instantiates the server implementation and registers this instance with the CORBA object adapter. However, Oracle9*i* instantiates the implementation and registers the resulting instance on demand for you. Thus, you do not need to provide code that initializes the ORB, instantiates the implementation, and registers the instance. The only server code that you provide is the actual server implementation. However, your client will not be able to find an active server implementation instance through the ORB, because it is not instantiated until called.

To facilitate this, Oracle9*i* requires you to publish the implementation object in the Name Service after loading the application into the database. The client retrieves the object from the Name Service through a JNDI `lookup`. Once retrieved, the client invokes the `activate` method, which initializes an instance of the object. At this point, the client can invoke methods on the object.

Writing the Client Code

After writing the server object, you must create the client implementation. In order for the server object to be accessed by the client, you must publish the server object in the Oracle9*i* database. The client code looks up the published name and activates the server object as a by-product of the look up. You can look up any server object either through JNDI or CosNaming. The example below demonstrates the JNDI method for retrieving the server object reference. See "JNDI Connection Basics" on page 4-2 for more information on JNDI and CosNaming.

When you perform the JNDI lookup, the ORB on the server side is started and the client is authenticated using the environment properties supplied when the initial context object is created. See "IIOP Security" on page 6-1.

To retrieve the object from the Name Service, you must provide the following:

- Object name
- IIOP Service Name
- Client Authentication Information

Object name

The object name specifies the complete path name of the published object that you want to look up. For example: `/test/myServer`.

See "Retrieving the JNDI InitialContext" on page 4-9 for further information about the `lookup()` method.

IIOP Service Name

The service name specifies a service that an IIOP presentation manages, and it represents a database instance. "Accessing CORBA Objects Without JNDI" on page 4-29 explains the format of the service URL. Briefly, the service name specifies the following components:

- URL prefix for the service
- the name of the host that manages the service presentation
- the port number of the listener for the target database instance on that host
- the system identifier (SID) for the database instance on the host

A typical example of a service name is `sess_iiop://localhost:2481:ORCL`, where `sess_iiop` is the URL prefix for the service, `localhost` defaults to the host of the local database, 2481 is the default listener port for IIOP connections, and `ORCL` is the SID.

Client Authentication Information

You must authenticate yourself to the database each time you connect. The type of authentication information depends on how you want to authenticate—through a username / password combination, or SSL certificates. See "IIOP Security" on page 6-1 for more information.

Client Example

The client invokes the `getEmployee` method through the following steps:

1. Instantiates and populates a JNDI `InitialContext` object with the required connect properties, including authentication information. See "JNDI Connection Basics" on page 4-2.
2. Invokes the `lookup()` method on the initial context, with a URL as a parameter that specifies the service name and the name of the object to be found. The `lookup()` method returns an object reference to the `Employee` CORBA server object. See "Using JNDI to Access Bound Objects" on page 4-7 for more information.
3. Using the object reference returned by the `lookup()` method invokes the `getEmployee()` method on the object in the server. This method returns an `EmployeeInfo` class, which is derived from the IDL `EmployeeInfo` struct. For simplicity, an employee ID number is hard-coded as a parameter of this method invocation.
4. Prints the values returned by `getEmployee()` in the `EmployeeInfo` class.

```
import employee.*;
import oracle.aurora.jndi.sess_iiop.ServiceCtx;
import javax.naming.Context;
import javax.naming.InitialContext;
import java.util.Hashtable;

public class Client {
  public static void main (String[] args) throws Exception {
    String serviceURL = "sess_iiop://localhost:2481:ORCL";
    String objectName = "/test/myEmployee";

// Step 1: Populate the JNDI properties with connect and authentication
// information
    Hashtable env = new Hashtable ();
    env.put (Context.URL_PKG_PREFIXES, "oracle.aurora.jndi");
    env.put (Context.SECURITY_PRINCIPAL, "SCOTT");
    env.put (Context.SECURITY_CREDENTIALS, "TIGER");
    env.put (Context.SECURITY_AUTHENTICATION, ServiceCtx.NON_SSL_LOGIN);
    Context ic = new InitialContext (env);

// Step 2: Lookup the object providing the service URL and object name
    Employee employee = (Employee)ic.lookup (serviceURL + objectName);

// Step 3 (using SCOTT’s employee ID number): Invoke getEmployee
```

```
    EmployeeInfo info = employee.getEmployee (7788);

// Step 4: Print out the returned values.
    System.out.println (info.name + " " + info.number + " " + info.salary);
  }
}
```

When you execute the client code, it prints the following on the client console:

```
SCOTT 7788 3000.0
```

Compiling the Java Source

Run the client-side Java byte code compiler, `javac`, to compile all the Java source that you have created. The Java source includes the client and server object implementations, as well as the Java classes generated by the IDL compiler.

For the `Employee` example, you compile the following files:

- `employee/Employee.java`
- `employee/EmployeeHelper.java`
- `employee/EmployeeHolder.java`
- `employee/EmployeeInfo.java`
- `employee/EmployeeInfoHelper.java`
- `employee/EmployeeInfoHolder.java`
- `employee/SQLError.java`
- `employee/SQLErrorHelper.java`
- `employee/SQLErrorHolder.java`
- `employee/_EmployeeImplBase.java`
- `employee/_st_Employee.java`
- `EmployeeImpl.java`
- `Client.java`

Compile other generated Java files following the dependencies that the Java compiler uses.

Oracle9*i* JVM supports the Java JDK compiler, releases 1.1.6 or 1.2. Alternatively, you might be able to use other Java compilers, such as a compiler incorporated in an IDE.

Loading the Classes into the Database

CORBA server objects, such as the `EmployeeImpl` object created for this example, execute inside the Oracle9*i* database server. Load all your classes into the server—through the `loadjava` command-line tool—so that they can be activated by the ORB upon demand. In addition, load all dependent classes, such as IDL-generated Holder and Helper classes, and classes the server object uses, such as the `EmployeeInfo` class of this example.

Use the `loadjava` tool to load each of the server classes into the Oracle9*i* database. For the `Employee` example, issue the `loadjava` command in the following way:

```
% loadjava -resolve -user scott/tiger
   employee/Employee.class employee/EmployeeHolder.class
   employee/EmployeeHelper.class employee/EmployeeInfo.class
   employee/EmployeeInfoHolder.class employee/EmployeeInfoHelper.class
   employee/SQLError.class employee/SQLErrorHolder.class
   employee/SQLErrorHelper.class employee/_st_Employee.class
   employee/_EmployeeImplBase.class employeeServer/EmployeeImpl.class
```

Note: Do not load any client implementation classes or any other classes not used on the server side.

It is sometimes convenient to combine the server classes into a JAR file and use that file as the argument to the `loadjava` command. In this example, you could issue the command:

```
% jar -cf0 myJar.jar employee/Employee.class employee/EmployeeHolder.class \
   employee/EmployeeHelper.class employee/EmployeeInfo.class \
   employee/EmployeeInfoHolder.class employee/EmployeeInfoHelper.class \
   employee/SQLError.class employee/SQLErrorHolder.class \
   employee/SQLErrorHelper.class employee/_st_Employee.class \
   employee/_EmployeeImplBase.class employeeServer/EmployeeImpl.class
```

Then, execute the `loadjava` command as follows:

```
% loadjava -resolve -user scott/tiger myJar.jar
```

Publishing the Object Name

The final step in preparing the application is to publish the name of the CORBA server object implementation in the Oracle9*i* database. See "The Name Space" on page 4-3 and the `publish` section in the *Oracle9i Java Tools Reference* for information about publishing objects.

For the example in this section, publish the server object, using the `publish` command, as follows:

```
% publish -republish -user scott -password tiger -schema scott
    -service sess_iiop://localhost:2481:ORCL
    /test/myEmployee employeeServer.EmployeeImpl employee.EmployeeHelper
```

This command specifies the following:

- `publish`—run the publish command
- `-republish`—overwrite any published object of the same name
- `-user scott`—scott is the username for the schema doing the publishing
- `-password tiger`—Scott's password
- `-schema scott`—the name of the schema in which to resolve classes
- `-service sess_iiop://localhost:2481:ORCL`—establishes the service name (see also "Service Context Class" on page 4-16)
- `/test/myEmployee`—the name of the published object
- `employeeServer.EmployeeImpl`—the name of the class, loaded in the database, that implements the server object
- `employee.EmployeeHelper`—the name of the helper class

Running the Example

To run this example, execute the client class using the client-side JVM. For this example, you must set the CLASSPATH for the `java` command to include:

- the standard Java library archive (`classes.zip`)
- any class files the client ORB uses, such as those in VisiBroker for Java `vbjapp.jar` and `vbjorb.jar`
- the Oracle9*i* JAR files: `mts.jar` and `aurora_client.jar`

If you are using JDBC, include one of the following JAR files:

- `classes111.zip` for JDBC 1.1 support
- `classes12.zip` for JDBC 1.2 support

If you are using SSL, include one of the following JAR files:

- `javax-ssl-1_1.jar` and `jssl-1_1.jar` for SSL 1.1 support
- `javax-ssl-1_2.jar` and `jssl-1_2.jar` for SSL 1.2 support

You can locate these libraries in the `lib` and `jlib` directories, under the Oracle home location in your installation.

The following invocation of the JDK `java` command runs this example.

Note: The UNIX shell variable $ORACLE_HOME might be represented as %ORACLE_HOME% on Windows NT. The JDK_HOME is the installation location of the Java Development Kit (JDK).

```
% java -classpath .:$(ORACLE_HOME)/lib/aurora_client.jar                   |
  :$(ORACLE_HOME)/lib/mts.jar                                              |
  :$(ORACLE_HOME)/jdbc/lib/classes111.zip:                                 |
  $(ORACLE_HOME)/sqlj/lib/translator.zip:$(ORACLE_HOME)/lib/vbjorb.jar:    |
  $(ORACLE_HOME)/lib/vbjapp.jar:$(JDK_HOME)/lib/classes.zip                |
    Client                                                                 |
    sess_iiop://localhost:2481:ORCL                                        |
    /test/myEmployee                                                       |
    scott tiger
```

This example assumes that you invoke the client with the following arguments on the command line:

- CLASSPATH libraries
- client object
- service name
- name of the published object to activate
- username
- password

Note: From the `java` command, you can see why it is almost always better to use a makefile or a batch file to build CORBA applications.

The Interface Definition Language (IDL)

CORBA provides language independence: CORBA objects written in one language can send requests to objects implemented in a different language. Objects implemented in an object-oriented language such as Java or Smalltalk can talk to objects written in C or COBOL, and the converse.

CORBA achieves language independence through the use of a specification meta-language that defines the interfaces that an object—or a piece of legacy code wrappered to look like an object—presents to the outside world. As in any object-oriented system, a CORBA object can have its own private data and its own private methods. The specification of the public data and methods is the interface that the object presents to the outside world.

IDL is the language that CORBA uses to specify its objects. You do not write procedural code in IDL—its only use is to specify data, methods, and exceptions.

Each CORBA vendor supplies a compiler that translates IDL specifications into a specific language. Oracle9*i* uses the `idl2java` compiler from Inprise. The `idl2java` compiler translates your IDL interface specifications into Java classes. See the *Oracle9i Java Tools Reference* for more information on this tool.

Note: The `idl2java` compiler accepts only ASCII characters. Do not use ISO Latin-1 or other non-ASCII globalization characters in IDL files.

Using IDL

The following example demonstrates the IDL for the `HelloWorld` example. See "Basic Example" on page A-2 for the complete example.

```
module hello {
  interface Hello {
    wstring helloWorld();
  };
};
```

IDL consists of a *module*, which contains a group of related object interfaces. The IDL compiler uses the module name to name a directory where the Java classes are placed after generation. In addition, the module name is used to name the Java package for the resulting classes.

This module defines a single interface: `Hello`. The `Hello` interface defines a single operation: `helloWorld`, which takes no parameters and returns a `wstring` (a wide string, which is mapped to a Java `String`).

Note: This guide does not specify IDL data and exception types, such the `wstring` shown in the preceding example. Some of the IDL to Java bindings are listed in this guide (for example, see "IDL Types" on page 2-19); however, CORBA developers should refer to the OMG specification for complete information about IDL and IDL types.

The module and interface names must be valid Java identifiers and valid file names for your operating system. When naming interfaces and modules, remember that both Java and CORBA objects are portable, and that some operating systems are case sensitive and some are not, so be sure to keep names distinct in your project.

Nested Modules

You can nest modules. For example, an IDL file that specifies the following modules maps to the Java package hierarchy `package org.omg.CORBA`.

```
module org {
  module omg {
     module CORBA {
       ...
     };
    ...
  };
   ...
};
```

Running the IDL Compiler

Assume that the HelloWorld IDL is saved in a file called `hello.idl`. When you run `idl2java` to compile the `hello` module, eight Java class files are generated and are placed in a subdirectory named `hello`, in the same directory as the IDL file:

```
% idl2java hello.idl
Traversing hello.idl
Creating: hello/Hello.java
Creating: hello/HelloHolder.java
Creating: hello/HelloHelper.java
Creating: hello/_st_Hello.java
Creating: hello/_HelloImplBase.java
Creating: hello/HelloOperations.java
Creating: hello/_tie_Hello.java
Creating: hello/_example_Hello.java
```

The ORB uses these Java classes to invoke a remote object, pass and return parameters, and perform other functions. You can control the files that are generated, where they are put, and other aspects of IDL compiling—such as whether the IDL compiler generates comments in the Java files. See the complete description of the `idl2java` compiler in the *Oracle9i Java Tools Reference.*

The following describes each of the files generated:

`Hello` This specifies, in Java, what the interface to a Hello object looks like. In this case, the interface is:

```
package hello;
public interface Hello extends org.omg.CORBA.Object {
  public java.lang.String helloWorld();
}
```

Because the file is put in a `hello` directory, it takes the package spec from that name. All CORBA basic interface classes subclass, directly or indirectly, the following: `org.omg.CORBA.Object`.

You must implement the methods in the interface. It is recommended that you name the implementation class for the `hello.java` interface `helloImpl`, but this naming convention is not a requirement.

`HelloHolder` The application uses the holder class when parameters in the interface operation are of the types `out` or `inout`. Because the ORB passes Java parameters by value, special holder classes are necessary to provide for parameter return values.

HelloHelper

The helper classes contain methods that read and write the object to a stream, and cast the object to and from the type of the base class. For example, the helper class has a narrow() method that is used to cast an object to the appropriate type, as in the following code:

```
LoginServer lserver = LoginServerHelper.narrow
      (orb.string_to_object (loginIOR));
```

Note that when you get an object reference using the JNDI InitialContext lookup() method, you do not have to call the helper narrow() method—the ORB calls it automatically for you.

_st_Hello

The generated files that have _st_ prefixed to the interface name are the stub files or client proxy objects. (_st_ is a VisiBroker-specific prefix.)

These classes are installed on the client that calls the remote object. In effect, when a client calls a method on the remote object, it is really calling into the stub, which then performs the operations necessary to perform a remote method invocation. For example, it must marshall parameter data for transport to the remote host.

_HelloImplBase

Generated source files of the form _<interfaceName>ImplBase are the skeleton files. A skeleton file is installed on the server and communicates with the stub file on the client, in that it receives the message on the ORB from the client and upcalls to the server. The skeleton file also returns parameters and return values to the client.

HelloOperations
_tie_Hello

The server uses these two classes for Tie implementations of server objects. See "Using the CORBA Tie Mechanism" on page 5-11 for information about Tie classes.

_example_Hello

The _example_<interfaceName> class provides you with a template for your server object implementation. You can copy the example code to the directory where you will implement the Hello server object, rename it, and implement the methods. HelloImpl.java is used in the examples in this guide.

IDL Interface Body

An IDL interface body contains the following kinds of declarations:

constants	constant values exported by the interface
types	type definitions
exceptions	exception structures exported by the interface
attributes	any associated attributes exported by the interface
operations	methods supported by the interface

IDL Types

This section gives a brief description of IDL datatypes and their mapping to Java datatypes. For more information about IDL types that are not covered here, see the CORBA specifications and the books cited in "For More Information" on page 1-8.

Basic Types

The mapping between IDL basic types and Java primitive types is straightforward. Table 2–1 shows the mappings, as well as possible CORBA exceptions that can be raised on conversion.

Table 2–1 IDL to Java Datatype Mappings

CORBA IDL Datatype	Java Datatype	Exception
`boolean`	`boolean`	
`char`	`char`	`CORBA::DATA_CONVERSION`
`wchar`	`char`	
`octet`	`byte`	
`string`	`java.lang.String`	`CORBA::MARSHAL`
		`CORBA::DATA_CONVERSION`
`wstring`	`java.lang.String`	`CORBA::MARSHAL`
`short`	`short`	
`unsigned short`	`short`	
`long`	`int`	
`unsigned long`	`int`	

Table 2–1 IDL to Java Datatype Mappings (Cont.)

CORBA IDL Datatype	Java Datatype	Exception
`long long`	`long`	
`unsigned long long`	`long`	
`float`	`float`	
`double`	`double`	

The IDL character type `char` is an 8-bit type, representing an ISO Latin-1 character that maps to the Java `char` type, which is a 16-bit unsigned element representing a Unicode character. On parameter marshalling, if a Java `char` cannot be mapped to an IDL `char`, a CORBA DATA_CONVERSION exception is thrown.

The IDL `string` type contains IDL chars. On conversion between Java `String`, and IDL `string`, a CORBA DATA_CONVERSION can be thrown. Conversions between Java strings and bounded IDL `string` and `wstring` can throw a CORBA MARSHALS exception if the Java `String` is too large to fit in the IDL string.

Constructed Types

Perhaps the most useful IDL constructed (aggregate) type for the Java developer is the struct. The IDL compiler converts IDL structs to Java classes. For example, the IDL specification:

```
module employee {
  struct EmployeeInfo {
    long empno;
    wstring ename;
    double sal;
  };
  ...
```

causes the IDL compiler to generate a separate Java source file for an `EmployeeInfo` class. It looks like this:

```
package employee;
final public class EmployeeInfo {
  public int empno;
  public java.lang.String ename;
  public double sal;
  public EmployeeInfo() {
  }
  public EmployeeInfo(
    int empno,
    java.lang.String ename,
    double sal
  ) {
    this.empno = empno;
    this.ename = ename;
    this.sal = sal;
  }
 ...
```

The class contains a public constructor with parameters for each of the fields in the struct. The field values are saved in instance variables when the object is constructed. Typically, these are passed by value to CORBA objects.

Collections

The two types of ordered collections in CORBA are sequences and arrays. An IDL sequence maps to a Java array with the same name. An IDL array is a multidimensional aggregate, whose size in each dimension must be established at compile time.

The ORB throws a CORBA MARSHAL exception at runtime if sequence or array bounds are exceeded when Java data is converted to sequences or arrays.

IDL also generates a holder class for a sequence. The holder class name is the sequence's mapped Java class name with `Holder` appended to it.

The following IDL code shows how you can use a sequence of structs to represent information about employees within a department:

```
module employee {
  struct EmployeeInfo {
    long empno;
    wstring ename;
    double sal;
  };

  typedef sequence <EmployeeInfo> employeeInfos;

  struct DepartmentInfo {
    long deptno;
    wstring dname;
    wstring loc;
    EmployeeInfos employees;
  };
```

The following code is the Java class code that the IDL compiler generates for the `DepartmentInfo` class:

```
package employee;
final public class DepartmentInfo {
  public int deptno;
  public java.lang.String dname;
  public java.lang.String loc;
  public employee.EmployeeInfo[] employees;
  public DepartmentInfo() {
  }
  public DepartmentInfo(
    int deptno,
    java.lang.String dname,
    java.lang.String loc,
    employee.EmployeeInfo[] employees
  ) {
    this.deptno = deptno;
    this.dname = dname;
    this.loc = loc;
    this.employees = employees;
  }
```

Notice that the sequence `employeeInfos` is generated as a Java array `EmployeeInfo[]`.

Specify an array in IDL, as follows:

```
const long ArrayBound = 12;
typedef long larray[ArrayBound];
```

The IDL compiler generates this as:

```
public int[] larray;
```

When you use IDL constructed and aggregate types in your application, you must make sure to compile the generated `.java` files and load them into the Oracle9*i* database when the class is a server object. You should scan the generated `.java` files and make sure that all required files are compiled and loaded. Study the `Makefile` (UNIX) or the `makeit.bat` batch file (Windows NT) of CORBA examples that define these types to see how the set of IDL-generated classes is compiled and loaded into the data server.

Exceptions

You can create new user exception classes in IDL with the exception key word. For example:

```
  exception SQLError {
    wstring message;
  };
```

The IDL can declare that operations raise user-defined exceptions. For example:

```
interface employee {
  attribute name;
  exception invalidID {
    wstring reason;
  };
  ...
  wstring getEmp(long ID)
    raises(invalidID);
  };
};
```

CORBA System Exceptions

Mapping between OMG CORBA system exceptions and their Java form is straightforward. Table 2–2 contains these mappings:

Table 2–2 CORBA and Java Exceptions

OMG CORBA Exception	Java Exception
CORBA::PERSIST_STORE	org.omg.CORBA.PERSIST_STORE
CORBA::BAD_INV_ORDER	org.omg.CORBA.BAD_INV_ORDER
CORBA::TRANSIENT	org.omg.CORBA.TRANSIENT
CORBA::FREE_MEM	org.omg.CORBA.FREE_MEM
CORBA::INV_IDENT	org.omg.CORBA.INV_IDENT
CORBA::INV_FLAG	org.omg.CORBA.INV_FLAG
CORBA::INTF_REPOS	org.omg.CORBA.INTF_REPOS
CORBA::BAD_CONTEXT	org.omg.CORBA.BAD_CONTEXT
CORBA::OBJ_ADAPTER	org.omg.CORBA.OBJ_ADAPTER
CORBA::DATA_CONVERSION	org.omg.CORBA.DATA_CONVERSION

Table 2–2 CORBA and Java Exceptions

OMG CORBA Exception	Java Exception
`CORBA::OBJECT_NOT_EXIST`	`org.omg.CORBA.OBJECT_NOT_EXIST`
`CORBA::TRANSACTIONREQUIRED`	`org.omg.CORBA.TRANSACTIONREQUIRED`
`CORBA::TRANSACTIONROLLEDBACK`	`org.omg.CORBA.TRANSACTIONROLLEDBACK`
`CORBA::INVALIDTRANSACTION`	`org.omg.CORBA.INVALIDTRANSACTION`

Getting by Without IDL

The Oracle9*i* JVM development environment offers the Inprise Caffeine tools, which enable development of pure Java distributed applications that follow the CORBA model. You can write your interface specifications in Java and use the `java2iiop` tool to generate CORBA-compatible Java stubs and skeletons.

Developers can also use the `java2idl` tool to code in pure Java, and generate the IDL required for customers who are using a CORBA server that does not support Java. This tool generates IDL from Java interface specifications.

See the *Oracle9i Java Tools Reference* for more information about `java2iiop` and `java2idl`.

Activating ORBs and Server Objects

A CORBA application requires that an ORB be active on both the client system and the system running the server. This section presents more information about how the ORB is activated.

Client Side

The client-side ORB is normally initialized in one of two ways:

- The ORB is implicitly instantiated when the client instantiates the server object through the JNDI `lookup()` method on the JNDI `InitialContext` object.
- The ORB is explicitly instantiated when a pure CORBA client invokes the CORBA ORB `init` method. See "Oracle9i ORB Interface" on page 5-13 for a full explanation of the `init` method.

Note: The only other time that you explicitly initialize the ORB on the client through the `ORB.init` method is when you are in a callback scenario. See "Implementing CORBA Callbacks" on page 5-3 for a full discussion of callbacks. This discussion includes an example that shows how the ORB is initialized within the object to which the server calls back.

Server Side

The presentation that manages IIOP requests starts the ORB on the server when the session is created. If you want to retrieve the ORB instance, use the CORBA `oracle.aurora.jndi.orb_dep.Orb.init` method. See "Oracle9i ORB Interface" on page 5-13 for a full explanation of this method.

About Object Activation

Objects are activated on demand. When a client looks up an object, the ORB loads the object into memory and caches it. To activate the object, the ORB looks up the class by the fully-qualified class name under which the object was published. The class name is resolved in the schema defined at publication time, rather than the caller's schema. See the description of the command-line tool `publish` in the *Oracle9i Java Tools Reference* for more information.

When the class is located, the ORB creates a new instance of the class, using `newInstance()`. For this reason, the no-argument constructor of a persistent object class must be **public**. If the class implements the `oracle.aurora.AuroraServices.ActivatableObject` interface (as determined by the Java reflection API), then the `_initializeAuroraObject()`message is sent to the instance. See "Using the CORBA Tie Mechanism" on page 5-11 for an example that requires `_initializeAuroraObject()`.

There is no need for the server implementation to register its published objects with the object adapter using a `boa.obj_is_ready()` call—the Oracle9*i* ORB performs this automatically.

You register transient objects generated by other objects, such as persistent published objects, with the BOA using `obj_is_ready()`. For an example, see the `factory` demo in the `$ORACLE_HOME/javavm/demo/corba/basic/factory` directory of the product CD.

CORBA Interceptors

Visibroker enables you to implement interceptors. You can find instructions on how to create them in the Visibroker documentation.

Debugging Techniques

Until Java IDEs and JVMs support remote debugging, you can adopt several techniques for debugging your CORBA client and server code.

1. Use JDeveloper for debugging any Java applications. JDeveloper has provided a user interface that utilizes the Oracle9*i* debugging facilities. You can successfully debug an object loaded into the database by using JDeveloper's debugger. See the JDeveloper documentation for instructions.
2. Use a prepublished `DebugAgent` object for debugging objects executing on a server. See "Using a Debug Agent for Debugging Server Applications" on page 2-27 for more information.
3. Perform standalone ORB debugging, using one machine and ORB tracing.

   Debug by placing both the client and server in a single address space in a single process. Use of an IDE for client or server debugging is optional, though highly desirable.
4. Use Oracle9*i* trace files.

   In the client, the output of `System.out.println()` goes to the screen. However, in the Oracle9*i* ORB, all messages are directed to the server trace files. The directory for trace files is a parameter specified in the database initialization file. Assuming a default install of the product into a directory symbolically named $ORACLE_HOME, the trace file appears, as follows:

   ```
   ${ORACLE_HOME}/admin/<SID>/bdump/ORCL_s000x_xxx.trc
   ```

   where ORCL is the SID, and x_xxx represents a process ID number. Do not delete trace files after the Oracle instance has been started—if you do, no output will be written to a trace file. If you do delete trace files, stop and then restart the server.
5. Use a single Oracle MTS server.

   For debugging only, set the MTS_SERVERS parameter in your INIT*SID*.ORA file to MTS_SERVERS = 1, and set the MTS_MAX_SERVERS to 1. Having multiple MTS servers active means that a trace file is opened for each server process, and, thus, the messages get spread out over several trace files, as objects get activated in more than one session.

6. Use the printback example to redirect `System.out`. This example is available in the `$ORACLE_HOME/javavm/demo/examples/corba/basic/printback` directory.

Using a Debug Agent for Debugging Server Applications

The procedure for setting up your debugging environment is discussed fully in the *Oracle9i Java Developer's Guide*. However, it discusses starting the debug agent using a DBMS_JAVA procedures. Within a CORBA application, you can start, stop, and restart the debug agent using the `oracle.aurora.debug.DebugAgent` class methods. These methods perform exactly as their DBMS_JAVA counterparts perform.

```
public void start( java.lang.String host, int port, long timeout_seconds)
                throws DebugAgentError
public void stop() throws DebugAgentError
public void restart(long timeout) throws DebugAgentError
```

Example 2–1 Starting a DebugAgent on the Server

The following example shows how to debug an object that exists on the server. First, you need to start a debug proxy through the `debugproxy` command-line tool. This example informs the `debugproxy` to start up the `jdb` debugger when contacted by the debug agent.

Once you execute this command, start your client, which will lookup the intended object to be debugged, lookup the `DebugAgent` that is prepublished as "`/etc/debugagent`", and start up the `DebugAgent`.

Once the DebugAgent starts, the debugproxy starts up the jdb debugger and allows you to set your breakpoints. Since you have a specified amount of time before the DebugAgent times out, the first thing you should do is suspend all threads. Then, set all of your breakpoints before resuming. This suspends the timeout until you are ready to execute.

proxy window on tstHost

```
% debugproxy -port 2286 start jdb -password
. (wait until a debug agent starts up and
.  contact this proxy... when it does, jdb
.  starts up automatically and you can set
.  breakpoints and debug the object, as follows:)
> suspend
> load SCOTT:Bank
> stop in Bank:updateAccount
> resume
> ...
```

client code

```
main( ... )
{
 //retrieve the object that you want to debug
 Bank b = (Bank)ic.lookup(sessURL + "/test/Bank");
 //lookup debugagent from JNDI
 DebugAgent dbagt = (DebugAgent)ic.lookup(svcURL + "/etc/debugagent");
 //start the debug agent and give the proxy host, port, and a timeout
 dbagt.start("tstHost",2286,30);
 ...
 //execute methods within Bank)
 ...
 //stop the agent when you want to
 dbagt.stop();
 //restart the agent when you want to
 dbagt.restart(30);
```

3 Configuring IIOP Applications

Configuring IIOP-based applications, whether EJB or CORBA applications, involves configuring the appropriate listener and dispatcher for session-based IIOP communications. The process for configuring IIOP-based applications can include both database and network configuration. These elements are discussed in the sections below:

- Overview
- Oracle9i Database Templates For Default Configuration
- Advanced Configuration

Overview

Clients access EJB and CORBA applications in the database over an Internet Inter-Orb Protocol (IIOP) connection. IIOP is an implementation of General Inter-Orb Protocol (GIOP) over TCP/IP. All CORBA or EJB connections with the database must have IIOP configured on the dispatcher and the Oracle Net Services listener. The database dispatcher and Oracle Net Services listener are automatically configured, during installation, to accept IIOP requests. See Oracle9i Database Templates For Default Configuration on page 3-2 for more information.

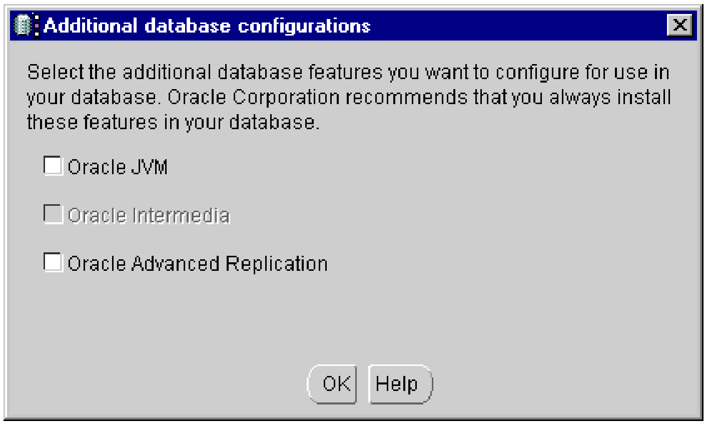
Note: For security concerns, you must decide if your IIOP connection will be Security Socket Layer (SSL) enabled.

- See "Using the Secure Socket Layer" on page 6-3 for information on SSL.
- See "SSL Configuration for EJB and CORBA" on page 3-12 for information on how to configure SSL.

Oracle9*i* Database Templates For Default Configuration

During the database template setup, you can choose the Oracle JVM option (as Figure 3–1 shows). This ensures that the Oracle JVM is installed and configured for you. You automatically receive a configuration for a shared server database with session-based IIOP connections through a Oracle Net Services listener, using non-SSL TCP/IP.

Figure 3–1 Choosing the Oracle JVM Option


Additional database configurations

Select the additional database features you want to configure for use in your database. Oracle Corporation recommends that you always install these features in your database.

- [ ] Oracle JVM
- [ ] Oracle Intermedia
- [ ] Oracle Advanced Replication

After the Oracle9*i* installation is complete, the following line is added to your database initialization file:

```
dispatchers="(protocol=tcp)(presentation=oracle.aurora.server.SGiopServer)"
```

This configures a dispatcher that is GIOP-enabled. If, instead, you install the Advanced Security Option and you want the SSL-based TCP/IP connection, then edit your database initialization file to replace the previous line by removing the hash mark (#) from the following line:

```
dispatchers="(protocol=tcps)(presentation=oracle.aurora.server.SGiopServer)"
```

Note: The (`protocol=tcps`) attribute identifies the connection as SSL-enabled.

In addition, an Oracle Net Services listener is configured with both a TTC and IIOP listening endpoints. TTC listening endpoints are required for Oracle Net Services requests; IIOP listening endpoints are required for IIOP requests. If you require an SSL-enabled IIOP listening endpoint, you must add this endpoint to your existing listener. See SSL Configuration for EJB and CORBA on page 3-12 for more information.

After installation, you must unlock the following three users:

- AURORA$JIS$UTILITY$
- OSE$HTTP$ADMIN

- AURORA$ORB$UNAUTHENTICATED

By default, all database users are locked. These three users must be unlocked by a system administrator in order for Servlets, EJB, or CORBA applications to work correctly.

Once the installation is completed, both the dispatcher and listener are ready for IIOP requests. Your client application must know the host and port number for the listener that it is directing its request towards. You can discover what port the listener is listening on through the Oracle Net Services `lsnrctl` tool.

The client directs its request to a URL that includes the host and port, which identifies the listener, and either the SID or database service name, which identifies the database. The following shows the syntax for this request:

```
sess_iiop://<hostname>/:<portnumber>/:<SID | service_name>
```

Advanced Configuration

Both the listener and dispatcher are configured automatically for IIOP requests. However, you may have an environment that requires changing the default configuration. This section educates you on how listeners and dispatchers work together and how you can modify that behavior.

- Overview of Listeners and Dispatchers
- Handling Incoming Requests
- Configuring The Dispatcher Through Editing Initialization Files
- Configuring the Listener
- SSL Configuration for EJB and CORBA

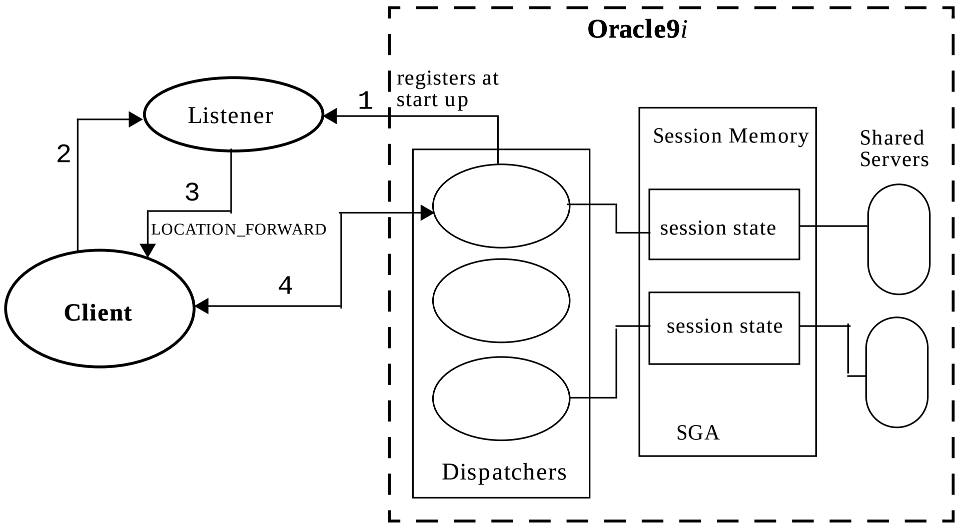
Overview of Listeners and Dispatchers

During installation, the listeners and dispatchers were configured for you in a manner where all IIOP requests are redirected from the listener to the dispatcher. Each dispatcher listens on a random port number assigned to it when it is initiated. Each port number is guaranteed to be unique per database instance. The listener is configured with two listening endpoints: one for TTC requests, and one for IIOP requests.

Note: However, if you want any endpoint to use the secure socket layer (SSL), you will also need a separate endpoint for an SSL-enabled IIOP endpoint. See "Using the Secure Socket Layer" on page 6-3 for more information about connecting using IIOP and SSL.

Once configured, the listeners redirect all IIOP requests to the dispatchers as shown in Figure 3–2.

Figure 3–2 Listener and Dispatcher Interaction



1. Upon database startup, the dispatcher registers itself with the listener.
2. The client invokes a method, giving the listener's URL address as the destination.
3. The listener sends back a LOCATION_FORWARD response to the client's ORB layer, informing it of the dispatcher's address. This redirects the request to the appropriate dispatcher.

Note: The client is unaware of the redirection logic, which is performed by the ORB runtime layer that supports the client.

4. The underlying ORB runtime layer resends the initial request to the dispatcher. All future method invocations are directed to the dispatcher. The listener is no longer a part of the communication.

Handling Incoming Requests

When the database starts up, all dispatchers register with all listeners configured within the same database initialization file. This is how the listeners know where each dispatcher is and the port that the dispatcher listens on. When an IIOP client invokes a request, the listener will either redirect the request to a GIOP-specific dispatcher, or hand off to a generic dispatcher.

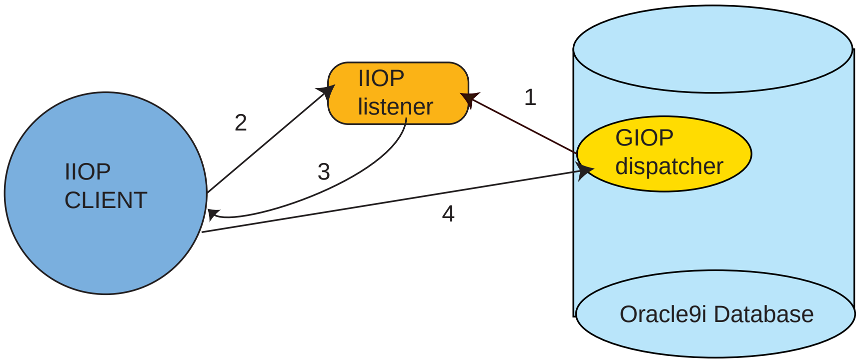
Both methods are discussed in the following sections:

- Redirect to GIOP Dispatcher
- Hand Off to Generic Dispatcher

Redirect to GIOP Dispatcher

A client sends a request to the listener (by designating the host and port for the listener in the `sess_iiop` URL). The listener recognizes the IIOP protocol and redirects the request to a registered GIOP dispatcher. This is the default behavior that is configured during installation.

Figure 3–3 IIOP Listener Redirect to GIOP Dispatcher



1. The GIOP dispatcher registers itself with the listener.
2. The IIOP client—an EJB or CORBA client—invokes a method, giving the address (host, port, and SID) of the listener. You can determine the port number of the listener through the `lsnrctl` tool.
3. The listener sends back a response to the client informing it of the GIOP dispatcher's address.
4. The underlying ORB runtime layer on the client resends its initial request to the GIOP dispatcher. All future method invocations are directed to the dispatcher. The listener is no longer a part of the communication.

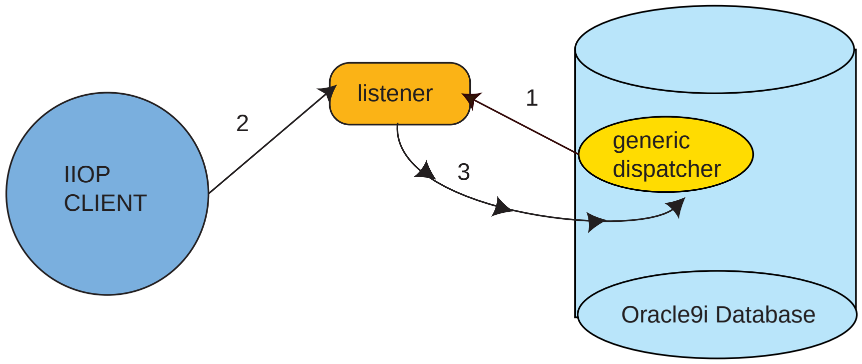
Hand Off to Generic Dispatcher

Handoff is when a listener forfeits the socket to the dispatcher when an incoming request arrives. This can only occur when the following is true:

- Both the listener and the dispatcher exist on the same node.
- No GIOP dispatcher is configured. That is, the `dispatchers` configuration line in the database initialization file has been removed. Thus, a generic dispatcher is used.
- A listener has been configured to receive IIOP requests. That is, it contains an IIOP listening endpoint. The Oracle JVM installation creates an IIOP listening endpoint on a listener. Although, you can also dynamically configure an IIOP listening endpoint on an existing listener through the dynamic registration tool, `regep`. See "Dynamic Listener Endpoint Registration" on page 3-10 for more information.

Figure 3–4 shows the dispatcher and listener combination in a hand-off environment.

Figure 3–4 Hand Off to Dispatcher



1. When the database starts, the generic dispatcher registers itself with the dynamically configured listener.
2. The client sends a request to the listener.
3. The listener hands off the request to the generic dispatcher. The listener negotiates with the generic dispatcher on a separate channel. On this channel, the socket is handed off to the dispatcher through the operating system mechanisms.

   The client communicates directly with the dispatcher from this point on. The client is never made aware that the socket was handed off.

Configuring The Dispatcher Through Editing Initialization Files

The database supports incoming requests through a presentation. Note that the presentation discussed in this chapter is not the same as the presentation layer in the OSI model. Both the listener and the dispatcher accept incoming network requests based upon the presentation that is configured. For IIOP, you configure a GIOP presentation.

You configure the IIOP connection in the database initialization file by modifying the PRESENTATION attribute of the DISPATCHERS parameter. To configure an IIOP connection within the database, manually edit the database initialization file.

The following is the syntax for the DISPATCHERS parameter:

```
dispatchers="(protocol=tcp | tcps)
          (presentation=oracle.aurora.server.SGiopServer)"
```

The attributes for the DISPATCHER are described below:

Attribute	Description
PROTOCOL (PRO or PROT)	Specifies the TCP/IP or TCP/IP with SSL protocol, for which the dispatcher will generate a listening endpoint. Valid values: TCP (for TCP/IP) or TCPS (for TCP/IP with SSL)
PRESENTATION (PRE or PRES)	Enables support for GIOP. Supply the following value for a GIOP presentation: ■ `oracle.aurora.server.SGiopServer` for session-based GIOP connections. This presentation is valid for TCP/IP and TCP/IP with SSL.

Note: If you configure several DISPATCHERS within your database initialization file, then each dispatcher definition must follow the other. Do not define any other configuration parameters between the DISPATCHER definitions.

For example, to configure a shared server for session-based IIOP connections through the listener, using non-SSL TCP/IP, add the following within your database initialization file:

```
dispatchers="(protocol=tcp)(presentation=oracle.aurora.server.SGiopServer)"
```

Direct Dispatcher Connection

If you want your client to go to a dispatcher directly, bypassing the listener, you direct your client to the dispatcher's port number. Do one of the following to discover the dispatcher's port number:

- Configure a port number for the dispatcher by adding the ADDRESS parameter that includes a port number.
- Discover the port assigned to the dispatcher by invoking `lsnrctl service`.

If you choose to configure the port number, the following shows the syntax:

```
dispatchers="(address=(protocol=tcp | tcps)
                (host=<server_host>)(port=<port>))
                (presentation=oracle.aurora.server.SGiopServer)"
```

The attributes are described below:

Attribute	Description
ADDRESS (ADD or ADDR)	Specifies the network address on which the dispatchers will listen. The network address may include either the TCP/IP (TCP) or the TCP/IP with SSL (TCPS) protocol, the host name of the server, and a GIOP listening port, which may be any port you choose that is not already in use.
PRESENTATION (PRE or PRES)	Enables support for GIOP. Supply the following value for a GIOP presentation: ■ `oracle.aurora.server.SGiopServer` for session-based GIOP connections. This presentation is valid for TCP/IP and TCP/IP with SSL.

The client supplies the port number on its URL, as follows:

```
session_iiop://<hostname>/:<portnumber>
```

Notice that the URL excludes a SID or service name. The dispatcher does not need the SID instance or service name, because it is a directed request.

Configuring the Listener

You can configure listeners either dynamically through a tool or statically by modifying the configuration files. Both methods are explained below:

- Dynamic Listener Endpoint Registration
- Static Configuration of the Oracle Net Services Listener
- Displaying Current Listening Endpoints

Dynamic Listener Endpoint Registration

In order for a listener to receive an IIOP incoming request, the listener must have an IIOP endpoint registered. You can register any type of listening endpoint through the dynamic registration tool, `regep`.

The advantage of dynamically registering a listener endpoint is that you do not need to restart your database for the listener to be IIOP enabled. The listening endpoint is active immediately. For full details on the `regep` tool, see the *Oracle9i Java Tools Reference*.

Note: If you statically configure a listener with IIOP endpoints, you must restart your database. See "Static Configuration of the Oracle Net Services Listener" on page 3-11 for more information.

Example 3–1 Dynamically Registering a Listener at Port 2241

The following line dynamically registers a listener on the SUNDB host on endpoint port number 2241. This tool logs on to the SUNDB host.

```
regep -pres oracle.aurora.server.SGiopServer -host sundb -port 2241
```

Static Configuration of the Oracle Net Services Listener

If you statically configure a listener, you need to configure separate ports as listening endpoints for both TTC and IIOP connections. The default listener that is configured by the Oracle JVM install is configured for both TTC and IIOP listening endpoints.

You can configure each listener to listen on a well-known port number, and the client communicates with the listener using this port number. To configure the listener manually, you must modify the listener's DESCRIPTION parameter within the `listener.ora` file with a GIOP listening address. The following example configures a GIOP presentation for non-SSL TCP/IP with port number 2481. You use port 2481 for non-SSL and port 2482 for SSL.

For GIOP, the PROTOCOL_STACK parameter is added to the DESCRIPTION when configuring an IIOP connection to `sales-server`:

```
listener=
  (description_list=
   (description=
     (address=(protocol=tcp)(host=sales-server)(port=2481))
     (protocol_stack=
        (presentation=giop)
        (session=raw))))
```

The following table gives the definition for each of the GIOP parameters:

Attribute	Description
PROTOCOL_STACK	Identifies the presentation and session layer information for a connection.

Attribute	Description
(PRESENTATION=GIOP)	Identifies a presentation of GIOP for IIOP clients. GIOP supports `oracle.aurora.server.SGiopServer`, using TCP/IP.
(SESSION=RAW)	Identifies the session layer. There is no specific session layer for IIOP clients.
(ADDRESS=...)	Specifies a listening address that uses TCP/IP on either port 2481 for non-SSL, or port 2482 for SSL. If non-SSL, define the protocol as TCP; for SSL, define the protocol as TCPS.

After configuration, the client directs its request to a URL that includes the host and port, which identifies the listener, and either the SID or database service name, which identifies the database. The following shows the syntax for this request:

```
sess_iiop://<hostname>/:<portnumber>/:<SID | service_name>
```

Taking the configuration shown in the listener.ora file above, your URL would contain the following values:

```
sess_iiop://sales-server/:2481/:orcl
```

Displaying Current Listening Endpoints

Whether the listening endpoints are registered dynamically or statically, you can display the current endpoints through the `lsnrctl` command, as follows:

```
% lsnrctl
> set display to normal
> status
```

SSL Configuration for EJB and CORBA

Oracle9*i* also supports the use of authentication data such as certificates and private keys, required for use by SSL in combination with GIOP. To configure your transport to be SSL-enabled with GIOP, do the following:

Note: The SSL listening endpoint is automatically registered with a listener. To verify that an SSL endpoint is registered with your listener, follow the directions given in "Displaying Current Listening Endpoints" on page 3-12.

---

1. Enable the DISPATCHERS to be SSL-enabled.
2. Specify the SSL wallet to be used when configuring both the listener and database.

The following sections explain how to accomplish these steps.

Enable the DISPATCHERS for SSL

You must edit the database initialization file to add an SSL-enabled dispatcher. Uncomment the DISPATCHERS parameter in the database initialization file that defines the TCPS port. During installation, the Database Configuration Assistant always includes a commented-out line for SSL TCP/IP. This line is as follows:

```
dispatchers="(protocol=tcps)(presentation=oracle.aurora.server.SGiopServer)"
```

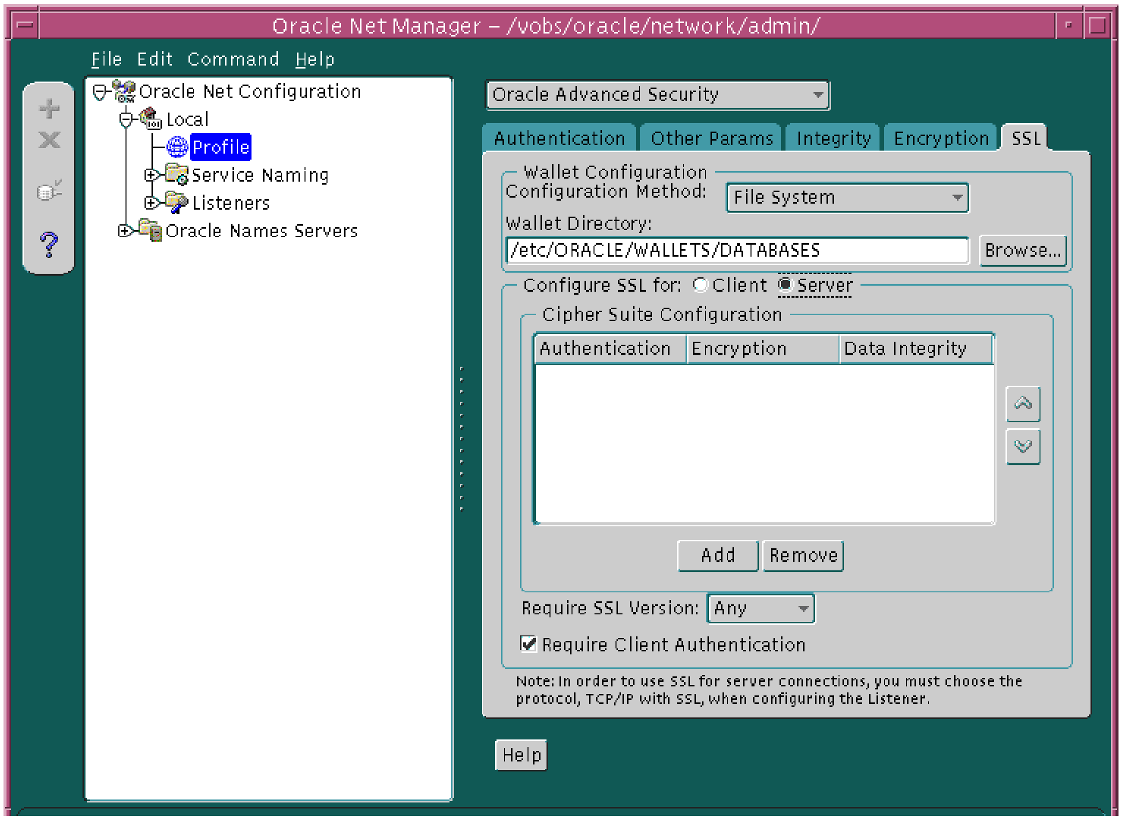
Configure the Wallet Location through Oracle Net Manager

Modify the listener to accept SSL requests on port 2482.

1. Start Oracle Net Manager.
   - On UNIX, run `netmgr` at `$ORACLE_HOME/bin`.
   - On Windows NT, choose Start > Programs > Oracle - *HOME_NAME* > Network Administration > Oracle Net Manager.
2. In the navigator pane, expand Local > Profile.
3. From the pull-down list, select Oracle Advanced Security > SSL.

   This brings you to the listening port panel, as shown in Figure 3–5.

Figure 3–5 IIOP listening port configuration



Oracle Advanced Security

Wallet Configuration
Configuration Method: File System
Wallet Directory: /etc/ORACLE/WALLETS/DATABASES

Configure SSL for: ( ) Client (●) Server

Cipher Suite Configuration

Authentication	Encryption	Data Integrity

Require SSL Version: Any

☑ Require Client Authentication

Note: In order to use SSL for server connections, you must choose the protocol, TCP/IP with SSL, when configuring the Listener.

4. On the "Configure SSL for:" line, select the "Server" radio button.
5. Under "Wallet Directory", enter the location for the wallet.
6. If you desire a certain SSL version, choose the appropriate version on the SSL version pulldown list.
7. If you want the client to authenticate itself by providing certificates, select the "Require Client Authentication" checkbox.
8. Choose File > Save Network Configuration.

These steps will add wallet and SSL configuration information into both the listener and database configuration files. You must specify the SSL wallet location in both the listener and database configuration files: both entities must locate the wallet for certificate handshake capabilities.

The `listener.ora` file:

```
ssl_client_authentication=false
ssl_version=undetermined
```

Both of these parameters apply to the database and to the listener.

The `ssl_client_authentication` parameter is defaulted to FALSE. The value for this parameter is defined, as follows:

- FALSE—The server-side always authenticates itself to the client using a certificate. The client only authenticates itself to the server with username and password.
- TRUE—Both the client and server authenticate to each other using certificates.

The `sqlnet.ora` database file:

```
ssl_client_authentication=true
ssl_version=0
sqlnet.crypto_seed=<seed_info>
```

You can specify a specific SSL version number, such as 3.0, in the `ssl_version` parameter. The `ssl_version` value of 0 means that the version is undetermined and will be agreed upon during handshake. SSL version 2.0 is not supported.

Within both the listener's `listener.ora` and database's `sqlnet.ora` files, the wallet location is specified:

```
oss.source.my_wallet=
       (source=
          (method=file)
          (method_data=
            (directory=wallet_location)))
```

The *Oracle Advanced Security Administrator's Guide* describes how to set up the SSL wallet with the appropriate certificates.

4
JNDI Connections and Session IIOP Service

This chapter describes in detail how clients connect to an Oracle9*i* server session and how they authenticate themselves to the server. The term client, as used in this chapter, includes client applications and applets running on a network PC or a workstation, as well as distributed objects such as EJBs and CORBA server objects that are calling other distributed server objects and, thus, acting as clients to these objects.

To execute CORBA objects, you must first publish these objects in an Oracle9*i* database instance, using a CORBA CosNaming service. Then, you can retrieve the object reference either through a URL-based Java Naming and Directory Interface (JNDI) to CosNaming or straight to the CosNaming service. JNDI is recommended because it is easy for clients written in Java to locate and activate published objects.

In addition to authentication, this chapter discusses security of access control to objects in the database. A published object in the data server has a set of permissions that determine who can access and modify the object. In addition, classes that are loaded into the data server are loaded into a particular schema, and the person who deploys the classes can control who uses them.

This chapter covers the following topics:

JNDI Connection Basics

The client example in Chapter 2 shows how to connect to Oracle, start a database server session, and activate an object using a single URL specification. This is performed through the following steps:

```
1. Hashtable env = new Hashtable();
2. env.put(javax.naming.Context.URL_PKG_PREFIXES, "oracle.aurora.jndi");
3. env.put(javax.naming.Context.SECURITY_PRINCIPAL, username);
4. env.put(javax.naming.Context.SECURITY_CREDENTIALS, password);
5. env.put(javax.naming.Context.SECURITY_AUTHENTICATION,
                       ServiceCtx.NON_SSL_LOGIN);
6. Context ic = new InitialContext(env);
7. myHello hello =
    (myHello) ic.lookup("sess_iiop://localhost:2481:ORCL/test/myHello");
8. System.out.println(hello.helloWorld());
```

In this example, there are four basic operations:

- Lines 1-5 set up an environment for the JNDI initial context.
- Line 6 creates the JNDI initial context.
- Line 7 looks up a published object. (See "URL Syntax" on page 4-5 for a discussion of the URL syntax.)
- Line 8 invokes a method on the object.

When a client looks up an object through the JNDI `lookup` method, the client and server automatically perform the following logic:

- A session IIOP connection is created to the ORCL instance of the local host database.
- The server establishes a database session.
- The client is authenticated, using the NON_SSL_LOGIN protocol, with the username and password specified in the environment context.
- The published object, `/test/myHello`, is located in the session namespace, and a reference to it is returned to the client.

When the client invokes a method—such as `helloWorld()`—on the returned reference, the server activates the object in the server.

The Name Space

The name space in the database looks just like a typical file system. You can examine and manipulate objects in the publishing name space using the session shell tool. See the `sess_sh` tool in the *Oracle9i Java Tools Reference* for information about the session shell.

There is a root directory, indicated by a forward slash ('/'). The root directory is built to contain three other directories: `bin`, `etc`, and `test`. The `/test` directory is where most objects are published for the example programs. You can create new directories under root to hold objects for separate projects; however, you must have access as database user SYS to create new directories under the root.

There is no effective limit to the depth that you can nest directories.

Note: The initial values in the publishing name space are set up when the Oracle9*i* JVM is installed.

The `/etc` directory contains objects that the ORB uses. The objects contained in `/etc` are:

```
deployejb    execute    loadjava    login    transactionFactory
```

Do not delete objects in the `/etc` directory.

The entries in the name space are represented by objects that are instances of the following classes:

- `oracle.aurora.AuroraServices.PublishingContext`—represents a class that can contain other objects (a directory)
- `oracle.aurora.AuroraServices.PublishedObject`—used for the leafs of the tree—that is, the object names themselves.

The javadoc on the product CD documents these classes.

Published names for objects are stored in a database table. Each published object also has a set of associated permissions. Each class or resource file can have a combination (union) of the following permissions:

read The holder of read rights can list the class or the attributes of the class, such as its name, its helper class, and its owner.

write The holder of write for a context can bind new object names into a context. For an object (a leaf node of the tree), write allows the holder to republish the object under a different name.

execute You must have execute rights to resolve and activate an object represented by a context or published object name.

You use the `chmod` command of the session shell tool to view and change object rights.

Execution Rights to Database Objects

In addition to authentication and privacy, Oracle9*i* supports controlled access to the classes that make up CORBA and EJB objects. Only users or roles that have been granted execute rights to the Java class of an object stored in the database can activate the object and invoke methods on it.

You can control execute rights on Java classes with the following tools:

- At load time with the `-grant` argument to `loadjava`. See the *Oracle9i Java Developer's Guide* for more information about `loadjava` and execution rights on Java classes in the database.
- Using SQL commands—Use the SQL DDL GRANT EXECUTE command to grant execute permission on a Java class that is loaded into the database. For example, if SCOTT has loaded the `Hello` class, then SCOTT (or SYS) can grant execute privileges on that class to another user, say OTTO, by issuing the SQL command:

  ```
  SQL> GRANT EXECUTE ON "Hello" TO OTTO;
  ```

  Use the SQL command REVOKE EXECUTE to remove execute rights for a user from a loaded Java class.
- At publish time—Published objects are not restricted to a specific schema; they are potentially available to all users in the instance. Published objects have permissions that can differ from underlying classes. For example, if user SCOTT has execute permission on a published object name, but does not have execute permission on the class that the published object represents, then SCOTT will not be able to activate the object.

  You can control permissions on a published object through the following:

1. Using the `-grant` option with the `publish` tool.
2. Using the `chmod` and `chown` commands within the Session Shell. You must be connected to the Session Shell as the user SYS to use the `chown` command.

   Use the `ls -l` command in the session shell to view the permissions (EXECUTE, READ, and WRITE) and the owner of a published object.

A client can access the following three built-in server objects without being authenticated:

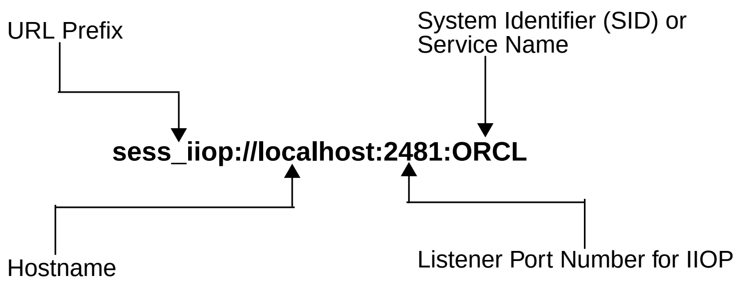
- the Name Service
- the `InitialReferences` object (the boot service)
- the `Login` object

You can activate these objects using `serviceCtx.lookup()` without authentication. See the "Logging In and Out of the Oracle9i Session" on page 6-11 for an example that access the `Login` object explicitly.

URL Syntax

Oracle9*i* provides universal resource locator (URL) syntax to access services and sessions. The URL lets you use JNDI requests to start up services and sessions, and also to access components published in the database instance. An example service URL is shown in Figure 4–1.

Figure 4–1 Service URL


URL Prefix
System Identifier (SID) or Service Name
sess_iiop://localhost:2481:ORCL
Hostname
Listener Port Number for IIOP

Four components make up the service URL:

1. The URL prefix followed by a colon and two slashes: *sess_iiop://* for a session IIOP request.

2. The system name (the hostname). For example: `myPC-1`. You can also use `localhost` or the numeric form of the IP address for the host.
3. The listener port number for IIOP services. The default is 2481.
4. The system identifier (SID)—for example, `ORCL`—or the service name—for example, `mySID.myDomain`.
   - SID—The system identifier is defined in your database initialization file as the db_name. This identifies the database instance to which you are connecting. If you choose to add the SID to your service URL, the listener will load-balance incoming requests across multiple dispatchers for the database instance.
   - Service name—The service name is equivalent to either the `service_name` or the `db_name.db_domain` parameters defined in your database initialization file. If you use the service name within your service URL, the listener will load balance incoming requests across multiple database instances: that is, all database instances registered with the listener. This option is good when you are using parallel servers.

Note: If you do use the service name, you must specify the `-useServiceName` flag on any tool that takes in the URL. If you do not specify this flag, the tool assumes that the last string is a SID.

Always use colons to separate the hostname, port, and SID or service name.

Note: If you specify a dispatcher port instead of a listener port, and you specify a SID, an `ObjectNotFound` exception is thrown by the server. Because applications that connect directly to dispatcher ports do not scale well, Oracle does not recommend direct connection to dispatchers.

URL Components and Classes

When you make a connection to Oracle and look up a published object using JNDI, you use a URL that specifies the service (service name, host, port, and SID), as well as the name of a published object to look up and activate. For example, a complete URL could look like:

```
sess_iiop://localhost:2481:ORCL/:default/projectAurora/Plans816/getPlans
```

where `sess_iiop://localhost:2481:ORCL` specifies the service name, `:default` indicates the default session (when a session has already been established), `/projectAurora/Plans816` specifies a directory path in the namespace, and `getPlans` is the name of a published object to look up.

Note: Do not specify the session name when no session has been established for that connection. That is, on the first look up there is no session active; therefore, `:default` as a session name has no meaning. In addition, `:default` is implied, so you can use a URL without a session name.

Each component of the URL represents a Java class. For example, the service name is represented by a `ServiceCtx` class instance, and the session by a `SessionCtx` instance. See "Using JNDI to Access Bound Objects" and "Session IIOP Service" starting on page 4-7 for more information on the service and session names within the URL.

CosNaming Restriction for JNDI Name

The JNDI bound name for the published object must use JNDI syntax rules. The underlying naming service that Oracle9*i* JNDI uses is CosNaming. Thus, if your name includes a dot (".") in one of the names, the behavior diverges from normal CosNaming rules, as follows:

- The substring before the dot is treated as a CosNaming `NameComponent` id.
- The substring after the dot is treated as a CosNaming `NameComponent` kind.
- Both id and kind are concatenated into a full JNDI name.

Normally, in retrieving a CosNaming object, you supply the id and kind as separate entities. The Oracle9*i* implementation concatenates both id and kind. Thus, to retrieve the object, your application refers to the full name with the dot included as part of the JNDI name, rather than as a separator.

Using JNDI to Access Bound Objects

Clients use JNDI to look up published objects in the Oracle9*i* namespace. JNDI is an interface supplied by Sun Microsystems that gives the Java application developer a methodology to access name and directory services. This section discusses only those parts of the JNDI API that are needed to look up and activate published objects. To obtain a complete set of documentation for JNDI, see the Web site URL: `http://java.sun.com/products/jndi/index.html`.

> **Note:** It is also possible to access the session namespace without using JNDI. Instead, you can use CosNaming methods.

As described in "URL Syntax" on page 4-5, the JNDI URL required to access any bound name in the Oracle9*i* namespace requires a compound name consisting of the following two components:

- Service name—Oracle9*i* uses the service name to retrieve a handle to the correct namespace.

  Several namespaces will exist within your network. The service specifies from which namespace to retrieve the JNDI bound object. Service names can be one of the following:

Service Name	Description
`sess_iiop://<hostname>:<port>:<SID>`	Specifies the host, port, and SID where the desired namespace is located. Specifying this service name only, without a session name, returns a `ServiceCtx` object. The session IIOP service is the main service used by IIOP applications. It retrieves objects and object references bound in JNDI namespaces on different database hosts. See "Session IIOP Service" on page 4-13 for a full description.
`jdbc_access:`	Specifies that the desired object exists in a well-known namespace. Used primarily to retrieve JTA `UserTransaction` and `DataSource` objects from the namespace.
`java:`	Used to specify that the bound name is actually an EJB environment variable that was specified within its deployment descriptor.

- Session name—the actual JNDI bound name of the object within the designated namespace. The syntax mimics a UNIX file system syntax. The session name can be represented by a `SessionCtx` object.

You can utilize the service and session contexts to perform some advanced techniques, such as opening different sessions within a database or enabling several clients to access an object in a single session. These are discussed further in the

"Session IIOP Service" on page 4-13. However, for simple JNDI lookup invocations, you should use the URL syntax specified in "URL Syntax" on page 4-5.

Importing JNDI Support Classes

When you use JNDI in your client or server object implementations, be sure to include the following import statements in each source file:

```
import javax.naming.Context;    // the JNDI Context interface
import javax.naming.InitialContext;
import oracle.aurora.jndi.sess_iiop.ServiceCtx; // JNDI property constants
import java.util.Hashtable;     // hashtable for the initial context environment
```

Retrieving the JNDI InitialContext

`Context` is an interface in the `javax.naming` package that is used to retrieve the `InitialContext`. All Oracle9*i* EJB and CORBA clients use the `InitialContext` for JNDI `lookup()`. Before you perform a JNDI `lookup()`, set the environment variables, such as authentication information into the `Context`. You can use a hash table or a properties list for the environment. Then, this information is made available to the naming service when the `lookup()` is performed. The examples in this guide always use a Java `Hashtable`, as follows:

```
Hashtable environment = new Hashtable();
```

Next, set up properties in the hash table. You must always set the `Context URL_PKG_PREFIXES` property, whether you are on the client or the server. The remaining properties are used for authentication, which are primarily used by clients or by a server authenticating itself as another user.

- `javax.naming.Context.URL_PKG_PREFIXES`
- `javax.naming.Context.SECURITY_PRINCIPAL`
- `javax.naming.Context.SECURITY_CREDENTIALS`
- `javax.naming.Context.SECURITY_ROLE`
- `javax.naming.Context.SECURITY_AUTHENTICATION`
- `USE_SERVICE_NAME`

URL_PKG_PREFIXES

`Context.URL_PKG_PREFIXES` holds the name of the environment property for specifying the list of package prefixes to use when loading in URL context factories.

The value of the property should be a colon-separated list of package prefixes for the class name of the factory class that will create a URL context factory.

In the current implementation, you must always supply this property in the Context environment, and it must be set to the String "`oracle.aurora.jndi`".

SECURITY_PRINCIPAL

`Context.SECURITY_PRINCIPAL` holds the database username.

SECURITY_CREDENTIALS

`Context.SECURITY_CREDENTIAL` holds the clear-text password. This is the Oracle database password for the SECURITY_PRINCIPAL (the database user). In all of the three authentication methods mentioned in SECURITY_AUTHENTICATION below, the password is encrypted when it is transmitted to the server.

SECURITY_ROLE

`Context.SECURITY_ROLE` holds the Oracle9*i* database role with which the user is connecting. For example, "CLERK" or "MANAGER".

SECURITY_AUTHENTICATION

`Context.SECURITY_AUTHENTICATION` holds the name of the environment property that specifies the type of authentication to use. Values for this property provide for the authentication types supported by Oracle9*i*. There are four possible values, which are defined in the `ServiceCtx` class:

- `ServiceCtx.NON_SSL_LOGIN`: The client authenticates itself to the server with a username and password, using the Login protocol over a standard TCP/IP connection (not a secure socket layer connection). The Login protocol encrypts the password as it is transmitted from the client to the server. The server does not authenticate itself to the client. See "Providing Username and Password for Client-Side Authentication" on page 6-9 for more information about this protocol.
- `ServiceCtx.SSL_CREDENTIAL`: The client authenticates itself to the server providing a username and password that are encrypted over a secure socket layer (SSL) connection. The server authenticates itself to the client by providing credentials.
- `SSL_LOGIN`: The client authenticates itself to the server with a username and password within the Login protocol, over an SSL connection. The server does not authenticate itself to the client.

- SSL_CLIENT_AUTH: Both the client and the server authenticate themselves to each other by providing certificates to each other over an SSL connection.

Note: To use an SSL connection, you must be able to access a listener that has an SSL port configured, and the listener must be able to redirect requests to an SSL-enabled database IIOP port. You must also include the following JAR files when you compile and build your application:

- If your client uses JDK 1.1, import jssl-1_1.jar and javax-ssl-1_1.jar.
- If your client uses Java 2, import jssl-1_2.jar and javax-ssl-1_2.jar.

USE_SERVICE_NAME

If you are using a service name instead of an SID in the URL, set this property to true. Otherwise, the last string in the URL must contain the SID. Given a Hashtable within the variable env, the following designates that the service name is used instead of the SID within the URL:

```
Hashtable env = new Hashtable();
env.put(Context.URL_PKG_PREFIXES, "oracle.aurora.jndi");
env.put(Context.SECURITY_PRINCIPAL, "scott");
env.put(Context.SECURITY_CREDENTIALS, "tiger");
env.put(Context.SECURITY_AUTHENTICATION, ServiceCtx.NON_SSL_LOGIN);
env.put("USE_SERVICE_NAME", "true");
Context ic = new InitialContext(env);
```

The default is false.

The URL given within the lookup should contain a service name, instead of an SID. The following URL contains the service name orasun12:

```
myHello hello =
      (myHello) ic.lookup("sess_iiop://localhost:2481:orasun12/test/myHello");
```

The JNDI InitialContext Methods

InitialContext is a class in the javax.naming package that implements the Context interface. All naming operations are relative to a context. The initial context implements the Context interface and provides the starting point for resolution of names.

Constructor

You construct a new initial context using the constructor:

`public InitialContext(Hashtable environment)`

It requires a `Hashtable` for the input parameter that contains the environment information described in "Retrieving the JNDI InitialContext" above. The following code fragment sets up an environment for a typical client and creates a new initial context:

```
Hashtable env = new Hashtable();
env.put(Context.URL_PKG_PREFIXES, "oracle.aurora.jndi");
env.put(Context.SECURITY_PRINCIPAL, "scott");
env.put(Context.SECURITY_CREDENTIALS, "tiger");
env.put(Context.SECURITY_AUTHENTICATION, ServiceCtx.NON_SSL_LOGIN);
Context ic = new InitialContext(env);
```

lookup

This is the most common initial context class method that the CORBA or EJB application developer will use:

`public Object lookup(String URL)`

You use `lookup()` to retrieve an object instance or to create a new service context.

- To retrieve an object instance, specify a URL for the service name and append the JNDI bound name (the session name). The returned result must be cast to the expected object type. For example, to retrieve the Hello interface, you would do the following:

  ```
  myHello hello =
      (myHello) ic.lookup("sess_iiop://localhost:2481:ORCL/test/myHello");
  ```

  The service name is "`sess_iiop://localhost:2481:ORCL`"; the JNDI bound name for Hello's home interface is "`/test/myHello`".

- To retrieve a handle to a specific namespace, specify the desired service context. The return result must be cast to `ServiceCtx` when a new service context is being created. For example, if `initContext` is a JNDI initial context, the following statement creates a new service context:

  ```
  ServiceCtx service =
      (ServiceCtx) initContext.lookup("sess_iiop://localhost:2481:ORCL");
  ```

See "Session Management Scenarios" on page 4-18 for examples of how to use the JNDI `lookup` method within an EJB or CORBA application.

Session IIOP Service

All client/server network communications route requests over an accepted protocol between both entities. Most network communications to the Oracle9*i* database are routed over the two-task common (TTC) layer. This is the service that processes incoming Oracle Net requests for database SQL services. However, with the addition of Java into the database, Oracle9*i* requires that clients communicate with the server over an IIOP transport that recognizes database sessions. This is accomplished through the session IIOP service.

The session IIOP service is used for facilitating requests for IIOP applications, which includes CORBA and EJB applications. The following sections describe how to manage your applications within one or more database sessions:

- Session IIOP Service Overview
- Session Management
- Service Context Class
- Session Context Class
- Session Management Scenarios
- Setting Session Timeout

Session IIOP Service Overview

As discussed in the *Oracle9i Java Developer's Guide*, since the EJB is loaded into the database, your client application must start up the EJB within the context of a database session. Because beans are activated within a session, each client cannot see bean instances active in another session unless given a handle to that session. However, you can activate objects either within the existing session or another session.

The session IIOP service session component tag—TAG_SESSION_IIOP— exists inside the IIOP profile—`SessionIIOP`. The value for this Oracle session IIOP component tag is 0x4f524100 and contains information that uniquely identifies the session in which the object was activated. The client ORB runtime uses this information to send requests to objects in a particular session.

Although the Oracle9*i* session IIOP service provides an enhancement of the standard IIOP protocol—it includes session ID information—it does not differ from standard IIOP in its on-the-wire data transfer protocol.

Client Requirements

Clients must have an ORB implementation that supports session IIOP to be able to access objects in different sessions simultaneously, from within the same program, and to be able to disconnect from and reconnect to the same session. The version of the Visigenic ORB that ships with Oracle9*i* has been extended to support session IIOP.

Session Routing

When a client makes an IIOP connection to the database, Oracle9*i* determines if a new session should be started to handle the request, or if the request should be routed to an existing session. If the client initializes a new request for a connection (using the `InitialContext.lookup()` method) and no session is active for that connection, a new session is automatically started. If a session has already been activated for the client, the session identifier is encoded into the object key of the object. This information enables the session IIOP service to route the request to the correct session. In addition, a client can use this session identifier to access multiple sessions. See "Session Management Scenarios" on page 4-18 for more information.

Oracle9*i* JVM Tools

When using the Oracle9*i* JVM tools, especially when developing EJB and CORBA applications, it is important to distinguish the two network service protocol types: TTC and IIOP.

Figure 4–2 TTC and IIOP Services

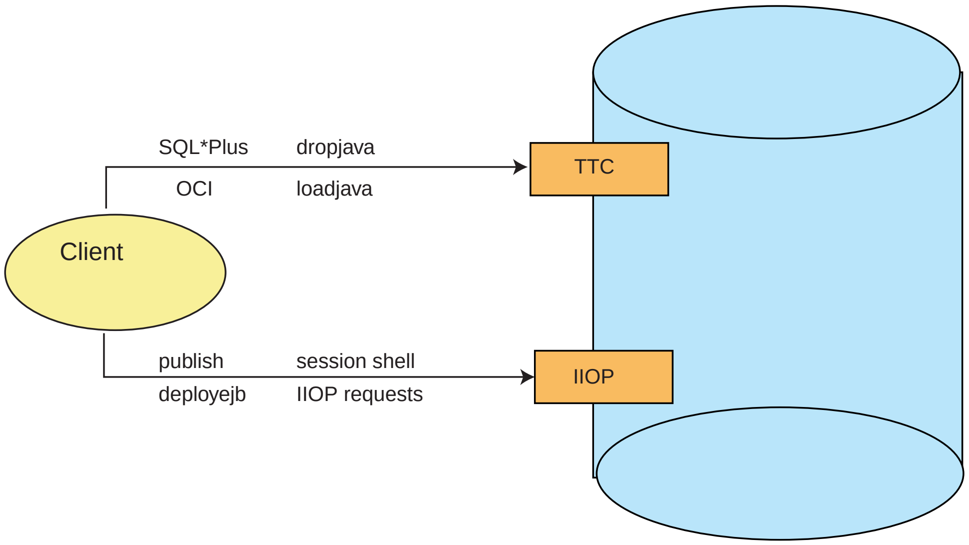


Figure 4–2 shows which tools and requests use TTC and which use IIOP database ports. The default port number for TTC is 1521, and the default for IIOP is 2481.

- Tools such as `publish`, `deployejb`, and the session shell access IIOP objects and so must connect using an IIOP port. In addition, EJB and CORBA clients must use an IIOP port when sending requests to Oracle.
- Tools such as `loadjava` and `dropjava` connect using a TTC port.

Session Management

In simple cases, a client (or a server object acting as a client) starts a new server session implicitly when it performs the lookup for a server object. Oracle9*i* also gives you the ability to control session start-up explicitly. Two Oracle-specific classes give you control over the session IIOP service connection and over the sessions within the database:

- Service Context Class—controls the session IIOP service connection to the database

  Given a URL to that database, you can create a service context. You can open one or more named sessions within the database off of this service context.

- Session Context Class—controls named database sessions that are created off of a service context

  Once the session has been created, you can activate CORBA or EJB objects within the session using the named session context object.

Service Context Class

The service context class controls the session IIOP service connection to the database. Given a URL to that database, you can create a service context. You can open one or more named sessions within the database off of this service context. This Oracle-specific class extends the JNDI `Context` class.

Variables

The `ServiceCtx` class defines a number of final public static variables that you can use to define environment properties and other variables. Table 4–1 shows these.

Table 4–1 ***ServiceCtx Public Variables***

String Name	Value
NON_SSL_CREDENTIAL	"Credential"
NON_SSL_LOGIN	"Login"
SSL_CREDENTIAL	"SecureCredential"
SSL_LOGIN	"SecureLogin"
SSL_CLIENT_AUTH	"SslClientAuth"
SSL_30	"30"
SSL_20	"20"
SSL_30_WITH_20_HELLO	"30_WITH_20_HELLO"
Integer Name	**Integer Constructor**
SESS_IIOP	new Integer(2)
IIOP	new Integer(1)

Methods

The public methods in this class that CORBA and EJB application developers can use are as follows:

`public Context createSubcontext(String name)`

This method takes a Java String as the parameter and returns a JNDI `Context` object representing a session in the database. The method creates a new named session. The parameter is the name of the session to be created, which must start with a colon (:).

The return result should be cast to a `SessionCtx` object.

This method can throw the exception: `javax.naming.NamingException`.

`public Context createSubcontext(Name name)`

Each of the methods that takes a **`String`** parameter has a corresponding method that takes a `Name` parameter. The functionality is the same.

```
public static org.omg.CORBA.ORB init(String username,
                                     String password,
                                     String role,
                                     boolean ssl,
                                     java.util.Properties props)
```

This method retrieves access to the ORB that is created when you perform a look up. Set the `ssl` parameter to **true** for SSL authentication. Clients that do not use JNDI to access server objects should use this method.

See the sharedsession example in Appendix A of the *Oracle9i CORBA Developer's Guide and Reference* for a usage example.

`public Object lookup(String string)`

The `lookup` method looks up a published object in the database instance associated with the service context, and either returns an activated instance of the object, or throws `javax.naming.NamingException.`

Session Context Class

The session context class controls named database sessions that are created off of a service context. Once the session has been created, you can activate CORBA or EJB objects within the session, using the named session context object. Session contexts represent sessions and contain methods that enable you to perform session operations, such as authenticating the client to the session or activating objects. This class extends the JNDI `Context` class.

Note: Creating a subcontext within the session context affects the object type returned on the final JNDI lookup. See "Lookup of Objects Off of JNDI Context" on page 4-25 for more information.

Methods

The session context methods that a client uses are the following:

`public synchronized boolean login()`

The `login` method authenticates the client, using the initial context environment properties passed in the `InitialContext` constructor: username, password, and role.

```
public synchronized boolean login(String username,
                                String password,
                               String role)
```

The `login` method authenticates the client, using the username, password, and optional database role supplied as parameters.

`public Object activate(String name)`

The `activate` method looks up and activates a published object with the given name.

Session Management Scenarios

The following sections describe the five different scenarios for managing database sessions:

- Client Accessing a Single Session—A client activates and accesses an object in the :`default` session.
- Ending a Session—Discusses methods that explicitly terminate a session.
- Client Starting a Named Session—A client activates and accesses one or more objects in a session other than the default session. This session is identified by a name within a `SessionCtx`.
- Two Clients Accessing the Same Session—Two or more clients can access an activated object within a session, by providing x and y to both clients.

- In-Session Activation—A server object, acting as a client, activates another object within the same session.
- Lookup of Objects Off of JNDI Context—Lookup of a partial JNDI name requires that you activate the bound object.

Client Accessing a Single Session In general, when you look up a published object from a client with a URL, hostname, and port, the object is activated in a new session. For example, a client would perform the following:

```
Hashtable env = new Hashtable();
env.put(Context.URL_PKG_PREFIXES, "oracle.aurora.jndi");
env.put(Context.SECURITY_PRINCIPAL, "scott");
env.put(Context.SECURITY_CREDENTIALS, "tiger");
env.put(Context.SECURITY_AUTHENTICATION, ServiceCtx.NON_SSL_LOGIN);
Context ic = new InitialContext(env);
SomeObject myObj =
   (SomeObject) ic.lookup("sess_iiop://localhost:5521:ORCL/test/myObj");
```

Activating an object in a new session from a server object is identical to starting a session from an application client. If you invoke the `lookup` method within the server object, the second object instance is activated in a separate session from the originating session.

Ending a Session Normally, a session terminates when the client terminates. However, if you want to explicitly terminate a session, you can do one of the following:

Terminate A Session From The Server-Side Using The Endsession Method
The server can control session termination by executing the following method:

```
oracle.aurora.mts.session.Session.THIS_SESSION().endSession();
```

Terminate A Session From The Client-side Using The Logout Object
If the client wishes to exit the session, it can execute the `logout` method of the `LogoutServer` object, which is pre-published as "`/etc/logout`". Only the session owner is allowed to logout. Any other owner receives a NO_PERMISSION exception.

The `LogoutServer` object is analogous to the `LoginServer` object, which is pre-published as "`/etc/login`". You can use the `LoginServer` object to retrieve the `Login` object, which is used to authenticate to the server. This is an alternative method to using the `Login` object within the JNDI lookup.

The following example shows how a client can authenticate using the `LoginServer` object and can exit the session through the `LogoutServer` object.

```
import oracle.aurora.AuroraServices.LoginServer;
import oracle.aurora.AuroraServices.LogoutServer;
...
// To log in using the LoginServer object
LoginServer loginServer = (LoginServer)ic.lookup(serviceURL + "/etc/login");
Login login = new Login(loginServer);
System.out.println("Logging in ..");
login.authenticate(user, password, null);
...
//To logout using the LogoutServer
LogoutServer logout = (LogoutServer)ic.lookup(serviceURL + "/etc/logout");
logout.logout();
```

Client Starting a Named Session You can explicitly create multiple sessions on the database instance through the JNDI methods provided in the `ServiceCtx` and `SessionCtx` classes.

The following `lookup` method contains a URL that defines the IIOP service URL of "`sess_iiop://localhost:5521:ORCL`" and a default session context.

```
SomeObject myObj =
   (SomeObject) ic.lookup("sess_iiop://localhost:5521:ORCL/test/myHello");
```

In this simple case, the JNDI initial context `lookup` method implicitly starts a session and authenticates the client. This session becomes the default session, which is identified by the name "`:default`". All sessions are named. However, in the default case, the client does not need to know the name of the session, because all requests go to this single session. Unless specified, all additional objects will be activated in the default session. Even if you create a new JNDI initial context and look up the same or a new object, the object is instantiated in the same session as the first object.

The only way to activate objects within another session is to create a named session. You can create other sessions in place of or in addition to the default session by creating session contexts off of the service context. Because each session is a named session, you can activate objects in different sessions within the database.

1. Instantiate a new hashtable for the environment properties to be passed to the server.

   ```
   Hashtable env = new Hashtable();
   env.put(Context.URL_PKG_PREFIXES, "oracle.aurora.jndi");
   ```

Note: Only the `URL_PKG_PREFIXES Context` variable is filled in—the other information will be provided in the `login.authenticate()` method parameters.

---

2. Create a new JNDI Context.

   ```
   Context ic = new InitialContext(env);
   ```

3. Use the JNDI `lookup` method on the initial context, passing in the service URL, to establish a service context. This example uses a service URL with the service prefix of hostname, listener port, and SID.

   Note: Provide only the service URL of hostname, listener port, and database SID. If you provide the JNDI name of the desired object, a default session will be created for you.

   ```
   ServiceCtx service =
          (ServiceCtx) ic.lookup("sess_iiop://localhost:2481:ORCL");
   ```

4. Create a session by invoking the `createSubcontext` method on the service context object. Provide the name for the session as a parameter to the `createSubcontext` method. A new session is created within the database.

   ```
   SessionCtx session = (SessionCtx) service.createSubcontext(":session1");
   ```

   Note: You must name a new session when you create it. The session name must start with a colon (:) and cannot contain a slash (/), but is not otherwise restricted.

   ---

5. Authenticate the client program to the database by invoking the `login` method on the session context object.

   ```
   session.login("scott", "tiger", null);    // role is null
   ```

6. Activate the object, identified by its bound JNDI name, in the named session.

   ```
   Hello hello = (Hello)session.activate (objectName);

   System.out.println (hello.helloWorld ());
   ```

Example 4–1   Activating Objects in Named Sessions

The following example creates two named sessions of the name `:session1` and `:session2`. Each one retrieves the `Hello` object separately. The client invokes both `Hello` objects in each named session.

```
Hashtable env = new Hashtable ();
env.put (Context.URL_PKG_PREFIXES, "oracle.aurora.jndi");
Context ic = new InitialContext (env);

// Get a SessionCtx that represents a database instance
ServiceCtx service = (ServiceCtx) ic.lookup ("sess_iiop://localhost:2481:ORCL");

// Create and authenticate a first session in the instance.
SessionCtx session1 = (SessionCtx) service.createSubcontext (":session1");

// Authenticate
session1.login("scott", "tiger", null);

// Create and authenticate a second session in the instance.
SessionCtx session2 = (SessionCtx) service.createSubcontext (":session2");

// Authenticate using a login object (not required, just shown for example).
LoginServer login_server2 = (LoginServer)session2.activate ("/etc/login");
Login login2 = new Login (login_server2);
login2.authenticate ("scott", "tiger", null);

// Activate one Hello object in each session
Hello hello1 = (Hello)session1.activate (objectName);
Hello hello2 = (Hello)session2.activate (objectName);

// Verify that the objects are indeed different
System.out.println (hello1.helloWorld ());
System.out.println (hello2.helloWorld ());
```

Two Clients Accessing the Same Session When the client invokes the JNDI lookup method, Oracle9*i* creates a session. If you want a second client to access the instantiated object in this session, you must do the following:

1. The first client saves both the object instance handle and a `Login` object reference.
2. The second client retrieves the handle and `Login` object reference and uses them to access the object instance.

Example 4–2 Two Clients Accessing a Single Instance

1. The first client authenticates itself to the database by providing a username and password through the `authenticate` method on a `Login` object.
2. The session is created and the object is instantiated through the `lookup` method that is given the URL.
3. Both the `LoginServer` object and the server object instance handle are saved to a file for the second client to retrieve.

```
// Login to the 9i server
LoginServer lserver = (LoginServer)ic.lookup (serviceURL + "/etc/login");
new Login (lserver).authenticate (username, password, null);

// Activate a Hello in the 9i server
// This creates a first session in the server
Hello hello = (Hello)ic.lookup (serviceURL + objectName);
hello.setMessage ("As created by Client1");
System.out.println ("Client1: " + hello.helloWorld ());

// save Login object into a file, loginFile, for Client2 to read
com.visigenic.vbroker.orb.ORB orb = oracle.aurora.jndi.orb_dep.Orb.init();
String log = orb.object_to_string (lserver);
OutputStream os = new FileOutputStream (loginFile);
os.write (log.getBytes ());
os.close ();

// save object instance handle into a file, helloFile,
// for Client2 to read
String obj_hndl = orb.object_to_string (hello);
OutputStream os = new FileOutputStream (helloFile);
os.write (obj_hndl.getBytes ());
os.close ();
```

The second client accesses the `Hello` object instance in the active session by doing the following:

1. Retrieves the object handle and the `Login` object. This example uses implementation-defined methods of `readHandle` and `readLogin` to retrieve these objects from storage.
2. Authenticates to the database session with the same `Login` object as the first client through the `authenticate` method. You can recreate the `Login` object from the `LoginServer` object through the `Login` constructor.

```
FileInputStream finstream = new FileInputStream (hellofile);
```

```
ObjectInputStream istream = new ObjectInputStream (finstream);
Hello hello = (Hello) orb.string_to_object(istream.readObject());
finstream.close ();

// Authenticate with the login Object
LoginServer lserver = (LoginServer) readLogin(loginFile);

//Set the VisiBroker bind options to specify that the
//login is to not try recursively, which means that if it
//fails on the first try, return with the error immediately.
//See VisiBroker manuals for more information.
lserver._bind_options (new BindOptions (false, false));

Login login = new Login (lserver);
login.authenticate (username, password, null);
```

In-Session Activation If the server object wants to look up and activate a new published object in the same session in which it is running, the server object can execute the following:

```
Context ic = new InitialContext( );
SomeObject myObj = (SomeObject) ic.lookup("/test/Hello");
```

Notice that there are no environment settings for authentication information in the environment or a session URL in the lookup. The authentication already succeeded in order to log into the session. Plus, the object exists on the local machine. So, any other object activation within the session can proceed without specifying authentication information or a target `sess_iiop` URL address.

All object parameters designated within in-session object methods use pass-by-reference semantics, instead of pass-by-value semantics. The following example contains a single input object parameter of `myParmObj` into the `foo` method for the previously retrieved in-session object, `myObj`.

```
myObj.foo(myParmObj);
```

With pass-by-reference, the reference to the input object parameter is directly passed to the destination server object. Any changes to the contents of the `myParmObj` on the client or the server are reflected to the other party—as both parties reference the same object. Alternatively, if it were pass-by-value, a copy of the `myParmObj` object would be passed. In this case, any changes to the party's copy of `myParmObj` would be visible only with the party that made the changes.

Note: In-session activation as demonstrated in this section is valid for both IIOP and non-IIOP clients.

In-Session Activation in Prior Releases In releases previous to Release 8.1.7, in-session activation was performed with the `thisServer/:thisSession` notation in place of the `hostname:port:SID` in the URL. This notation is still valid, but only for IIOP clients.

For example, to look up and activate an object in the same session, do the following:

```
Hashtable env = new Hashtable();
env.put(Context.URL_PKG_PREFIXES, "oracle.aurora.jndi");
Context ic = new InitialContext(env);
SomeObject myObj =
   (SomeObject) ic.lookup("sess_iiop://thisServer/:thisSession/test/Hello");
```

In this case, `myObj` is activated in the same session in which the invoking object is running. Note that there is no need to supply login authentication information, because the client (a server object, in this case) is already authenticated to Oracle9*i*.

Realize that objects are not authenticated—instead, clients must be authenticated to a session. However, when a separate session is to be started, then some form of authentication must be done—either login or SSL credential authentication.

Note: You can use the `thisServer` notation only on the server side—that is, from server objects. You cannot use it in a client program.

Lookup of Objects Off of JNDI Context In the Sun Microsystems JNDI, if you bind a name of "`/test/myObject`", you can retrieve an object from a `Context` when executing the following:

```
Context ctx = ic.lookup("/test");
MyObject myobj = ctx.lookup("myObject");
```

The returned object is activated and ready for you to perform method invocations off of it.

In Oracle9*i*, trying to retrieve an object from a `Context` results in an inactive object being returned. Instead, you must do the following:

1. Retrieve a `SessionCtx`, instead of a `Context`. You can retrieve the `SessionCtx` from a `ServiceCtx`, in one of the two following ways:

   - Retrieve the `ServiceCtx` first and the `SessionCtx` from the `ServiceCtx`, as follows:

     ```
     ServiceCtx service =
             (ServiceCtx) ic.lookup("sess_iiop://localhost:2481:ORCL");
     //Retrieve the ServiceCtx subcontext
     SessionCtx sess = (SessionCtx) service.lookup("/test");
     ```

   - Retrieve the `ServiceCtx` and `SessionCtx` in the same lookup, as follows:

     ```
     SessionCtx sess =
             (SessionCtx) ic.lookup("sess_iiop://localhost:2481:ORCL/test");
     ```

2. Execute the Oracle-specific `SessionCtx.activate` method for each object in the session that you want to retrieve. This method activates the object in the session and returns the object reference. You cannot just perform a `lookup` of the object, as it will return an inactive object. Instead, execute the `activate` method, as follows:

   ```
   MyObject myObj = (MyObject) sessCtx.activate("myObject");
   // Verify that the objects are indeed different
   System.out.println (myObj.printMe ());
   ```

The Oracle9*i* JNDI implementation provides two implementations of the `Context` object:

- `ServiceCtx`—identifies the database instance through a `sess_iiop` URL
- `SessionCtx`—represents database session within the database

In performing a lookup, you must lookup both the `ServiceCtx` for identifying the database and the `SessionCtx` for retrieving the actual JNDI bound object. Normally, you supply the URLs for both objects within the JNDI URL given to the `lookup` method. However, you can also retrieve each individually as demonstrated above.

Setting Session Timeout

A session—with its state—normally exits when the last connection terminates. However, there are situations where you may want a session and its state to idle for a specified amount of time after the last connection terminates, such as the following:

- A middle-tier layer does not want to keep connections open to the session because connections are expensive; but, the middle-tier may want to keep the session open in case of another incoming client request.
- If you experience a network problem that abnormally terminates the connection, the session will stay around for the specified amount of time to allow the connection to be re-established.
- If your application passes a handle to an existing object within the session to another client before its connection terminates, the second client has time to access the session.

The timeout clock starts when the last connection to the session terminates. If another connection to the session starts within the timed window, the timeout clock is reset. If not, the session exits.

You can set the session idle timeout either from the client or from within a server object:

- Set the Session Timeout from the Client
- Set the Session Timeout from a Server Object

Set the Session Timeout from the Client

You can set the idle timeout on the client through the pre-published utility object—`oracle.aurora.AuroraServices.Timeout`. This object is pre-published under "`/etc/timeout`". Use the `setTimeout` method from this object.

1. Retrieve the `Timeout` object through a JNDI lookup of "`/etc/timeout`"
2. Set the timeout with the `setTimeout` method giving the number of seconds for session idle.

```
Timeout timeout = (Timeout)ic.lookup(serviceURL + "/etc/timeout");
System.out.println("Setting a timeout of 20 seconds ");
timeout.setTimeout(20);
```

Set the Session Timeout from a Server Object

A server object can control the session timeout by using the `oracle.aurora.net.Presentation` object, which contains the `sessionTimeout()` method. This method takes one parameter: the session timeout value in seconds. For example:

```
int timeoutValue = 30;
```

```
...
// set the timeout to 30 seconds
oracle.aurora.net.Presentation.sessionTimeout(timeoutValue);
...
// set the timeout to a very long time
oracle.aurora.net.Presentation.sessionTimout(Integer.MAX_INT);
```

Note: When you use the `sessionTimeout()` method, you must add `$(ORACLE_HOME)/javavm/lib/aurora.zip to` your CLASSPATH.

Retrieving the Oracle9*i* Version Number

You can retrieve the version of Oracle9*i* that is installed in the database through the pre-published `oracle.aurora.AuroraServices.Version` object, which is published as "`/etc/version`" in the JNDI namespace. The `Version` object contains the `getVersion` method, which returns a string that contains the version, such as "8.1.7". You can retrieve the `Version` object by providing "`/etc/version`" within the JNDI lookup. The following example retrieves the version number:

```
Version version = (Version)ic.lookup(serviceURL + "/etc/version");
System.out.println("The server version is : " + version.getVersion());
```

Activating In-Session CORBA Objects From Non-IIOP Presentations

Non-IIOP server requests, such as HTTP or DCOM, can activate a CORBA object within the same session.

- HTTP — An HTTP client interacts with the Oracle9*i* webserver and executes a JSP or servlet, which can activate the CORBA object within the same session that it is running in.
- DCOM — A DCOM client uses a DCOM bridge to access Oracle9*i*. While within the Oracle9*i* session, the DCOM bridge session can activate the CORBA object within the same session that it is running in.

If the non-IIOP server object wants to look up and activate a new published object in the *same session* in which it is running, the server object can execute the following:

```
Context ic = new InitialContext( );
SomeObject myObj = (SomeObject) ic.lookup("/test/Hello");
```

Note: Once you retrieve the IIOP object reference through this method, you cannot pass this object to a remote client or server.

Notice that there are no environment settings for authentication information in the environment or a URL specified in the lookup. The authentication already succeeded in order to log into the session. Plus, the object exists on the local machine. So, any other object activation within the session can proceed without specifying authentication information or a target URL address.

Accessing CORBA Objects Without JNDI

It is possible for clients to access server objects without using the JNDI classes shown in the other sections of this chapter. These clients can connect to an Oracle server by using CosNaming methods.

Retrieving the NameService Initial Reference

In order to use the CORBA ORB methods, you must first retrieve the naming service object. Oracle9*i* prepublishes a `NameService` object that you can retrieve through the ORB `resolve_initial_references` method.

In CORBA, there are two methods to retrieve the `NameService` initial reference: using `ORBInitRef` or `ORBDefaultInitRef`. At this time, we have provided only the `ORBDefaultInitRef` methodology.

You must provide a service URL to the `ORBDefaultInitRef` of the form of host, port, and SID. Or you can provide the service URL with host, port, service name. In addition, you can specify some optional properties, such as:

- The connection should use SSL, set the `ORBUseSSL` property to true:

  ```
  System.setProperty("ORBUseSSL", "true");
  ```

- The transport type, which can be `sess_iiop` or `iiop`. Set the `TRANSPORT_TYPE` property, as follows:

  ```
  System.setProperty("TRANSPORT_TYPE", "sess_iiop");
  ```

- If retrieving the `NameService` without first accessing the `BootService`, set the backward compatible property (`ORBNameServiceBackCompat`) to false, as follows:

  ```
  System.setProperty("ORBNameServiceBackCompat", "false");
  ```

- Use the service name instead of the SID in the service URL. Set the `USE_SERVICE_NAME` property to true, as follows:

  ```
  System.setProperty("USE_SERVICE_NAME", "true");
  ```

> **Note:** You initialize the server URL either through the `ORBDefaultInitRef` or through the individual properties: `ORBBootHost`, `ORBBootPort`, and `ORACLE_SID`.

Example 4–3 Retrieving a Server Object Using CosNaming

The following example demonstrates how to retrieve the `NameService` object. From this object, the login is executed and the server object is retrieved.

```
import java.lang.Exception;

import org.omg.CORBA.Object;
import org.omg.CORBA.SystemException;
import org.omg.CosNaming.NameComponent;

import oracle.aurora.client.Login;
import oracle.aurora.AuroraServices.LoginServer;
import oracle.aurora.AuroraServices.LoginServerHelper;
import oracle.aurora.AuroraServices.PublishedObject;
import oracle.aurora.AuroraServices.PublishingContext;
import oracle.aurora.AuroraServices.PublishedObjectHelper;
import oracle.aurora.AuroraServices.PublishingContextHelper;

import Bank.Account;
import Bank.AccountManager;
import Bank.AccountManagerHelper;

public class Client {
  public static void main(String args[]) throws Exception {
    // Parse the args
    if (args.length < 4 || args.length > 5 ) {
      System.out.println ("usage: Client host port username password <sid>");
      System.exit(1);
    }
    String host = args[0];
    String port = args[1];
    String username = args[2];
    String password = args[3];
```

```
String sid = null;
if(args.length == 5)
  sid  = args[4];

// Declarations for an account and manager
Account account = null;
AccountManager manager = null;
PublishingContext rootCtx = null;

// access the Oracle9i Names Service
try {
  // Initialize the ORB
  // The service URL for the server is provided in a string
  // that is prefixed with 'iioploc://' and includes either
  // host, port, sid or, if the USE_SERVICE_NAME is set to true,
  // host, port, service_name. This example uses host, port, sid
  // and sets it in the ORBDefaultInitRef.
  String initref;
  initref = (sid == null) ? "iioploc://" + host + ":" + port :
          "iioploc://" + host + ":" + port + ":" + sid;
  System.setProperty("ORBDefaultInitRef", initref);

  /*
   * Alternatively, you can set the host, port, sid or service in the
   * following individual properties. If set, these properties
   * take precedence over the URL set within the ORBDefaultInitRef property
  System.setProperty("ORBBootHost", host);
  System.setProperty("ORBBootPort", port);
  if (sid != null)
     //set the SID. alternatively, if the USE_SERVICE_NAME property is
  //true, this should contain the service name instead of the sid.
          System.setProperty("ORACLE_SID", sid);
   */

  /*
   * Some of the other properties that you can set
   * include the backwards compatibility flag, the service name
   * indicator, the SSL protocol definition, and the transport type.
   System.setProperty("ORBNameServiceBackCompat", "false");
   System.setProperty("USE_SERVICE_NAME", "true");
   System.setProperty("ORBUseSSL", "true");
   //transport type can be either sess_iiop or iiop
   System.setProperty("TRANSPORT_TYPE", "sess_iiop");
   */
```

```
 //initialize the ORB
 com.visigenic.vbroker.orb.ORB orb =
          oracle.aurora.jndi.orb_dep.Orb.init();

// Get the Name service Object reference with the
//  resolve_initial_references method
rootCtx = PublishingContextHelper.narrow(orb.resolve_initial_references(
      "NameService"));

//After retrieving the NameService initial reference, you must perform
// the login, as follows:
// Get the pre-published login object reference
PublishedObject loginPubObj = null;
LoginServer serv = null;
NameComponent[] nameComponent = new NameComponent[2];
nameComponent[0] = new NameComponent ("etc", "");
nameComponent[1] = new NameComponent ("login", "");

// Lookup this object in the Name service
Object loginCorbaObj = rootCtx.resolve (nameComponent);

// Make sure it is a published object
loginPubObj = PublishedObjectHelper.narrow (loginCorbaObj);

// create and activate this object (non-standard call)
loginCorbaObj = loginPubObj.activate_no_helper ();
serv = LoginServerHelper.narrow (loginCorbaObj);

// Create a client login proxy object and authenticate to the DB
Login login = new Login (serv);
login.authenticate (username, password, null);

// Now create and get the bank object reference
PublishedObject bankPubObj = null;
nameComponent[0] = new NameComponent ("test", "");
nameComponent[1] = new NameComponent ("bank", "");

// Lookup this object in the name service
Object bankCorbaObj = rootCtx.resolve (nameComponent);

// Make sure it is a published object
bankPubObj = PublishedObjectHelper.narrow (bankCorbaObj);

// create and activate this object (non-standard call)
bankCorbaObj = bankPubObj.activate_no_helper ();
```

```
          manager = AccountManagerHelper.narrow (bankCorbaObj);

          account = manager.open ("Jack.B.Quick");

          float balance = account.balance ();
          System.out.println ("The balance in Jack.B.Quick's account is $"
                                    + balance);
        } catch (SystemException e) {
          System.out.println ("Caught System Exception: " + e);
          e.printStackTrace ();
        } catch (Exception e) {
          System.out.println ("Caught Unknown Exception: " + e);
          e.printStackTrace ();
        }
      }
    }
```

See "Ending a Session" on page 4-19 for more information on the `LoginServer`, `Login`, and `LogoutServer` objects.

Retrieving Initial References from ORBDefaultInitRef

CORBA 2.3 Interoperable Name Service supports both the `ORBInitRef` and `ORBDefaultInitRef` methodologies for creating and retrieving initial references. At this time, Oracle9*i* only supports an IIOP URL scheme within the `ORBDefaultInitRef`, as shown in "Retrieving the NameService Initial Reference" on page 4-29. You can only provide either a host, port, SID or host, port, service name combination—prefixed by "`iioploc://`"—to the `ORBDefaultInitRef` for locating the initial reference. Within this location, the service must have been activated. Any service activated within the specified location can be retrieved using the `resolve_initial_references` method with its object key, which is defined at the time of activation.

For example, if you set the ORBDefaultInitRef to the following server URL:

```
System.setProperty("ORBDefaultInitRef","iioploc://myHost:myPort:mySID);
```

Then, initialize the ORB and retrieve your service, as follows:

```
//initialize the ORB
com.visigenic.vbroker.orb.ORB orb = oracle.aurora.jndi.orb_dep.Orb.init();

// Get the myService service Object reference with resolve_initial_references
rootCtx = PublishingContextHelper.narrow(orb.resolve_initial_references(
            "myService"));
```

The object key that is used to retrieve the service is "`myService`". The object with this key is returned with the `resolve_initial_references` method.

The following are the Oracle9*i* services that are activated during startup: `NameService`, `BootService`, `AuroraSSLCurrent`, and `AuroraSSLCertificateManager`.

If you want Oracle9*i* to initiate any services for you during startup, supply a string with a comma-separated list of services to be installed when the ORB is initialized in the `UserORBServices` property. Each service must be a fully-qualified package name and name of the class that extends the `ORBServiceInit` class. You must extend this class in order for your service to be installed by Oracle9*i*.

5 Advanced CORBA Programming

This chapter discusses advanced CORBA programming techniques, such as calling back to the client from the server. Advanced programming for security and transactions are covered in their own chapters. This chapter covers the following topics:

Using SQLJ

You can often simplify the implementation of a CORBA server object by using Oracle9*i* SQLJ to perform static SQL operations. Using SQLJ statements results in less code than the equivalent JDBC calls and makes the implementation easier to understand and debug. This section describes a version of the example first shown in "A First CORBA Application" on page 2-2, but uses SQLJ rather than JDBC for the database access. Refer to the *Oracle9i SQLJ Developer's Guide and Reference* for complete information about SQLJ.

The only code that changes for this SQLJ implementation is in the `EmployeeImpl.java` file, which implements the `Employee` object. The SQLJ implementation, which can be called `EmployeeImpl.sqlj`, is listed below. You can contrast that with the JDBC implementation of the same object in "Writing the Server Object Implementation" on page 2-6.

```
package employeeServer;

import employee.*;
import java.sql.*;

public class EmployeeImpl extends _EmployeeImplBase {
  public EmployeeInfo getEmployee (int ID) throws SQLError {
    try {
      String name = null;
      double salary = 0.0;
      #sql { select ename, sal into :name, :salary from emp
             where empno = :ID };
      return new EmployeeInfo (name, empno, (float)salary);
    } catch (SQLException e) {
      throw new SQLError (e.getMessage ());
    }
  }
}
```

The SQLJ version of this implementation is considerably shorter than the JDBC version. In general, Oracle recommends that you use SQLJ where you have static SQL commands to process, and use JDBC, or a combination of JDBC and SQLJ, in applications where dynamic SQL statements are required.

Running the SQLJ Translator

To compile the `EmployeeImpl.sqlj` file, issue the following SQLJ command:

```
% sqlj -J-classpath
```

```
.:$(ORACLE_HOME)/lib/aurora_client.jar:$(ORACLE_HOME)/jdbc/lib/classes111.zip:
$(ORACLE_HOME)/sqlj/lib/translator.zip:$(ORACLE_HOME)/lib/vbjorb.jar:
$(ORACLE_HOME)/lib/vbjapp.jar:$(JDK_HOME)/lib/classes.zip -ser2class
  employeeServer/EmployeeImpl.sqlj
```

This command does the following:

- translates the SQLJ code into a pure Java file
- compiles the resulting `.java` source to get a `.class` file
- the `-ser2class` option translates SER files to `.class` files

The SQLJ translation generates two additional class files:

```
employeeServer/EmployeeImpl_SJProfile0
employeeServer/EmployeeImpl_SJProfileKeys
```

which you must also load into the database when you execute the `loadjava` command.

A Complete SQLJ Example

This example is available in complete form in the examples`/corba/basic` example directory, complete with a Makefile or Windows NT batch file so that you can see how the example is compiled and loaded.

Implementing CORBA Callbacks

This section describes how a CORBA server object can call back to a client. The basic technique that is shown in this example is the following:

- Write a client object that runs on the client side and contains the methods that the called-back-to object performs.
- Implement a server object that has a method that takes a reference to the client callback object as a parameter.
- In the client code:
  - Instantiate the client callback object.
  - Register it with the BOA.
  - Pass its reference to the server object that calls it.
- In the server object implementation, perform the callback to the client.

Note: See "Callbacks using Security" on page 6-21 for examples of using callbacks within an SSL environment.

IDL

The IDL for this example is shown below. There are two separate IDL files: `client.idl` and `server.idl`:

```
/* client.idl */
module client {
  interface Client {
    wstring helloBack ();
  };
};

/* server.idl */
#include <client.idl>

module server {
  interface Server {
    wstring hello (in client::Client object);
  };
};
```

Note that the server interface includes the interface defined in `client.idl`.

Client Code

The client code for this example must instantiate the client-side callback object and register it with the BOA so that it can be accessed by the server. The code performs the following steps to do this:

- Invokes the `init()` method, with no parameters, on the ORB pseudo-object. This returns a reference to the existing client-side ORB.
- Uses the ORB reference to initialize the BOA.
- Instantiates a new client object.
- Registers the client object with the client-side BOA.

The code to perform these steps is as follows:

```
com.visigenic.vbroker.orb.ORB orb = oracle.aurora.jndi.orb_dep.Orb.init();
org.omg.CORBA.BOA boa = orb.BOA_init ();
```

```
ClientImpl client = new ClientImpl ();
boa.obj_is_ready (client);
```

Finally, the client code calls the server object, passes it a reference to the registered client-side callback object, and prints its return value, as follows:

```
System.out.println (server.hello (client));
```

Callback Server Implementation

The implementation of the server-side object is simple. It receives the client-side callback object and invokes a method from this object. In this example, the server invokes the client-side `helloBack` method.

```
package serverServer;

import server.*;
import client.*;
import oracle.aurora.AuroraServices.ActivatableObject;

public class ServerImpl extends _ServerImplBase implements ActivatableObject
{
  public String hello (Client client) {
    return "I Called back and got: " + client.helloBack ();
  }

  public org.omg.CORBA.Object _initializeAuroraObject () {
    return this;
  }
}
```

The server simply returns a string that includes the string return value from the callback.

Callback Client-Server Implementation

The client-side callback server implements the desired callback method. The following example implements the `helloBack` method:

```
package clientServer;

import client.*;
import oracle.aurora.AuroraServices.ActivatableObject;

public class ClientImpl extends _ClientImplBase implements ActivatableObject
```

```
{
  public String helloBack () {
    return "Hello Client World!";
  }

  public org.omg.CORBA.Object _initializeAuroraObject () {
    return this;
  }
}
```

The client-side object is just like any other server object. But in this callback example it is running in the client ORB, which can be running on a client system, not necessarily running inside an Oracle9*i* database server.

Retrieving Interfaces With The IFR

The Interface Repository (IFR) specified by OMG defines how to store and retrieve interface definitions. The information contained within the interface can be used internally by the ORB to retrieve information about an object reference, for type-checking the request signatures, or used externally by DII/DSI applications for instantiating objects dynamically through DII/DSI.

You store the IDL interface definition within the IFR through the Oracle9*i* `publish` command. The `publish` command stores the interface within the IFR Repository, which has been implemented using database tables.

Once stored, you can retrieve the interface definition either implicitly through the `_get_interface_def` method or explicitly looking up the IFR `Repository` object and invoking the standard methods to traverse through the repository.

The following sections explain how to publish and retrieve IDL interface information:

- Publishing the IDL Interface
- Circular References Between Interfaces
- Managing Security Within the IFR
- Retrieving Interfaces Implicitly
- Retrieving Interfaces Explicitly

Publishing the IDL Interface

You store the IDL interface definition within the IFR through the Oracle9*i* JVM `publish` command. This command contains the following two options for storing the IDL interface definition within the IFR:

`-idl`	Load the IDL interface definition into the IFR. In order for the IDL interface to be loaded into the server, the full directory path and IDL file name must be accessible from the server. That is, no relative path names are allowed and the path directory given is one that exists on the server, not on the client.
`-replaceIDL`	If an IDL interface definition currently exists within the IFR, replace it with this version. You must have the appropriate security permissions for this to succeed. If not specified, the `publish` command will not replace the existing interface within the IFR.

The following publish command loads the `Bank.idl` interfaces into the IFR. This is executed under the `SCOTT` schema security permissions. If it already exists, the `-replaceIDL` option specifies that the interfaces should be replaced with this version of `Bank.idl`, which is located in `/private/idl_int` on the server node.

```
publish -republish -user SCOTT -password TIGER -schema SCOTT \
        -service sess_iiop://dlsun164:2481:orcl \
       /test/myBank bankServer.AccountManagerImpl \
       Bank.AccountManagerHelper -idl /private/idl_int/Bank.idl -replaceIDL
```

The interfaces within the IDL are loaded within the schema that executes the `publish` command. Thus, if another user loads an IDL of the same name, it will not overwrite this one because they exist within separate schemas.

The interfaces are removed from the IFR when you remove the associated PublishedObject. To remove the published object and the interfaces added with the above `myBank` example, do the following:

```
sess_sh -command "remove /test/myBank -user SCOTT -password TIGER \
           -service sess_iiop://dlsun164:2481:orcl" -idl
```

Circular References Between Interfaces

The current implementation of the IFR does not allow circular references between interfaces within a module. That is, you cannot have two interfaces which reference each other. The following example shows an invalid module definition, where `x` references `y` and `y` references `x`:

```
module circular {
  interface x;
  interface y { x func1(); };
  interface x { y func2(); };
};
```

Managing Security Within the IFR

The IFR is implemented using SQL tables. Thus, you must have the correct permissions to change or remove an existing IDL from the IFR. The user who created the IDL automatically has permission. Otherwise, this user must grant permission for any other user to modify or remove the IDL from within the IFR. Any grant executed on a PublishedObject also extends to the interface that was stored in the IFR with the `-idl` option on the `publish` command.

See the security chapter in the *Oracle9i Java Developer's Guide* for information on granting permissions.

Retrieving Interfaces Implicitly

You can retrieve the interface definition implicitly through the `org.omg.CORBA.Object._get_interface_def` method. The object returned should be cast to `InterfaceDef`. The following code retrieves the `InterfaceDef` object for the `Bank.Account`:

```
AccountManager manager =
      (AccountManager)ic.lookup (serviceURL + objectName);

Bank.Account account = manager.open(name);

org.omg.CORBA.InterfaceDef intf = (org.omg.CORBA.InterfaceDef)
                             account._get_interface_def();
```

Once retrieved, you can execute any of the `InterfaceDef` methods for retrieving information about the interface.

Retrieving Interfaces Explicitly

All defined interfaces stored in the IFR are stored in a hierarchy. The top level of the hierarchy is a `Repository` object, which is also a `Container` object. All objects under the `Repository` object are `Contained` objects. You can parse down through the `Container` objects, reviewing the `Contained` objects, until you find the particular interface definition you want.

Note: The user can only see the objects to which the user has read privileges.

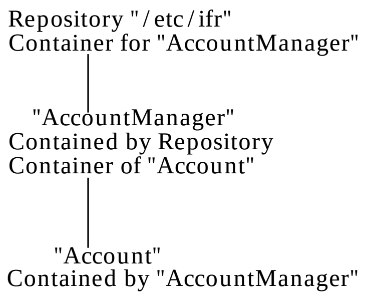
The `Repository` object is pre-published under the name "`/etc/ifr`". To retrieve a prepublished IFR `Repository` object, look up the "`/etc/ifr`" object as shown below:

```
Repository rep = (Repository)ic.lookup(serviceURL + "/etc/ifr");
```

Once the `Repository` object is retrieved, you can traverse through the hierarchy until you reach the object you are interested in. The methods for each object type, `InterfaceDef`, and others are documented fully in the OMG CORBA specification.

As shown in Figure 5–1, the `Account` interface is contained within `AccountManager`, which is contained within the `Repository` object.

Figure 5–1 IFR Hierarchy for Account Interface



Example 5–1 Traversing IFR Repository Within the print Method

Once you retrieve the IFR object, you can traverse through all stored definitions within the IFR. The `print` method in Example 5–1 prints out all stored definitions located within the IFR.

```
public void print( ) throws org.omg.CORBA.UserException {

    //retrieve the repository as a container... as the top level container
    org.omg.CORBA.Container container =
          (Container)ic.lookup(serviceURL + "/etc/ifr");

    //All objects in the IFR are Contained, except for the Repository.
    //Retrieve the contents of the Repository, which would be all objects that
    //it contains.
    org.omg.CORBA.Contained[] contained =
      container.contents(org.omg.CORBA.DefinitionKind.dk_all, true);

    //The length is equal to the number of objects contained within the IFR
    for(int i = 0; i < contained.length; i++) {
    {
     //Each Contained object has a description.
     org.omg.CORBA.ContainedPackage.Description description =
            contained[i].describe();

  //Each object is of a certain type, which is retrieved by the value method.
  switch(contained[i].def_kind().value()) {
    case org.omg.CORBA.DefinitionKind._dk_Attribute:
      printAttribute(org.omg.CORBA.AttributeDefHelper.narrow(contained[i]));
     break;
    case org.omg.CORBA.DefinitionKind._dk_Constant:
      printConstant(org.omg.CORBA.ConstantDefHelper.narrow(contained[i]));
     break;
    case org.omg.CORBA.DefinitionKind._dk_Exception:
      printException(org.omg.CORBA.ExceptionDefHelper.narrow(contained[i]));
     break;
    case org.omg.CORBA.DefinitionKind._dk_Interface:
      printInterface(org.omg.CORBA.InterfaceDefHelper.narrow(contained[i]));
     break;
    case org.omg.CORBA.DefinitionKind._dk_Module:
      printModule(org.omg.CORBA.ModuleDefHelper.narrow(contained[i]));
     break;
    case org.omg.CORBA.DefinitionKind._dk_Operation:
      printOperation(org.omg.CORBA.OperationDefHelper.narrow(contained[i]));
     break;
    case org.omg.CORBA.DefinitionKind._dk_Alias:
      printAlias(org.omg.CORBA.AliasDefHelper.narrow(contained[i]));
     break;
    case org.omg.CORBA.DefinitionKind._dk_Struct:
      printStruct(org.omg.CORBA.StructDefHelper.narrow(contained[i]));
     break;
    case org.omg.CORBA.DefinitionKind._dk_Union:
      printUnion(org.omg.CORBA.UnionDefHelper.narrow(contained[i]));
     break;
    case org.omg.CORBA.DefinitionKind._dk_Enum:
      printEnum(org.omg.CORBA.EnumDefHelper.narrow(contained[i]));
     break;
    case org.omg.CORBA.DefinitionKind._dk_none:
    case org.omg.CORBA.DefinitionKind._dk_all:
    case org.omg.CORBA.DefinitionKind._dk_Typedef:
    case org.omg.CORBA.DefinitionKind._dk_Primitive:
    case org.omg.CORBA.DefinitionKind._dk_String:
    case org.omg.CORBA.DefinitionKind._dk_Sequence:
    case org.omg.CORBA.DefinitionKind._dk_Array:
    default:
     break;
      }
    }
  }
```

Using the CORBA Tie Mechanism

There is only one special consideration when you use the CORBA Tie, or delegation, mechanism rather than the inheritance mechanism for server object implementations. In the Tie case, you must implement the `oracle.aurora.AuroraServices.ActivatableObject` interface. This interface has a single method: `_initializeAuroraObject().`

Note that earlier releases of the Oracle9*i* ORB required you to implement this method for all server objects. For the current release, its implementation is required only for Tie objects.

The implementation of `_initializeAuroraObject()` for a tie class is typically:

```
import oracle.aurora.AuroraServices.ActivatableObject;
...
public org.omg.CORBA.Object _initializeAuroraObject () {
  return new _tie_Hello (this);
...
```

where `_tie_<interface_name>` is the tie class generated by the IDL compiler.

Additionally, you must always include a public, parameterless constructor for the implementation object.

See the "TIE Example" on page A-21 for a complete example that shows how to use the Tie mechanism.

Migrating from JDK 1.1 to Java 2

Oracle9*i* updated its ORB implementation to Visibroker 3.4, which is compatible with both JDK 1.1 and Java 2.

Note: All release 8.1.5 CORBA applications must regenerate their stubs and skeletons to work with Oracle9*i* release 8.1.6 and following. You must use the current release tools when regenerating code from an IDL file.

JDK 1.1 did not contain an OMG CORBA implementation. Thus, when you imported the Inprise libraries and invoked the CORBA methods, it always invoked the Visibroker implementation. The Sun Microsystems Java 2 contains an OMG CORBA implementation. Thus, if you invoke the CORBA methods without any modifications—as discussed below—you will invoke the Sun Microsystems CORBA implementation, which can cause unexpected results. To avoid this, you should bypass the Sun Microsystems CORBA implementation.

Here are the three methods for initializing the ORB on the client-side and recommendations for bypassing the Sun Microsystems CORBA implementation:

- JNDI Lookup—The setup for the lookup method is the same for both JDK 1.1 and Java 2. However, you must regenerate the stubs and skeletons.
- Oracle9i ORB Interface—The Oracle9*i* ORB provides an interface for initializing the ORB. If you do not use JNDI, your client initializes an ORB on its node to communicate with the ORB in the database. You can use an Oracle9*i* ORB on your client through this class.
- CORBA ORB Interface—If you want to use OMG's CORBA ORB interface, you must set a few properties to ensure that you are accessing the correct implementation. If you do not wish to use the Oracle9*i* ORB on your client, you can use the pure CORBA interfaces. However, you must set up your environment to direct your calls to the correct implementation.

JNDI Lookup

If you are using JNDI on the client to access CORBA objects that reside in the server, no code changes are necessary. However, you must regenerate your CORBA stubs and skeletons.

Oracle9*i* ORB Interface

If your client environment uses JDK 1.1, you do not need to change your existing code. However, you must regenerate your stubs and skeletons.

If your client environment has been upgraded to Java 2, you can initialize the ORB through the `oracle.aurora.jndi.orb_dep.Orb.init` method. This method guarantees that when you initialize the ORB, it will initialize only a single ORB instance. That is, if you use the Java 2 ORB interface, it returns a new ORB instance each time you invoke the `init` method. The Oracle9*i* `init` method initializes a singleton ORB instance. Each successive call to `init` returns an object reference to the existing ORB instance.

In addition, the Oracle9*i* ORB interface manages the session-based IIOP connection.

oracle.aurora.jndi.orb_dep.Orb Class There are several `init` methods, each with a different parameter list. The following describes the syntax and parameters for each `init` method.

Note: The returned class for each `init` method is different. You can safely cast the `org.omg.CORBA.ORB` class to `com.visigenic.vbroker.orb.ORB`.

No Parameters

If you execute the `ORB.init` method that takes no parameters, it does the following:

- If no ORB instance exists, it creates an ORB instance and returns its reference to you.
- If an ORB instance exists, it returns the ORB reference to you.

Syntax

```
public com.visigenic.vbroker.orb.ORB init();
```

Providing ORB Properties

If you execute the `ORB.init` method that takes the ORB properties as the only parameter, it does the following:

- If no ORB instance exists, it creates an ORB instance, taking into account the properties argument, and returns its reference to you.

- If an ORB instance exists, it returns the ORB reference to you.

Syntax

```
public org.omg.CORBA.ORB init(Properties props);
```

Providing Input Arguments and ORB Properties

If you execute the `ORB.init` method that takes the ORB properties and ORB command-line arguments, it always creates an ORB instance and returns the reference to you.

Syntax

```
public org.omg.CORBA.ORB init(String[] args, Properties props);
```

Parameter	Description
Properties props	ORB system properties
String[] args	Arguments that are passed to the ORB instance

Example 5–2 Using the Oracle9i ORB init Method

The following example shows a client instantiating an ORB using the Oracle9*i* `Orb` class.

```
// Create the client object and publish it to the orb in the client
// Substitute Oracle9i's Orb.init for OMG ORB.init call
// old way: org.omg.CORBA.ORB orb = org.omg.CORBA.ORB.init ();
com.visigenic.vbroker.orb.ORB orb = oracle.aurora.jndi.orb_dep.Orb.init();
```

Providing ORB Properties with Username, Password, and Role

If you execute the `ORB.init` method that provides the ORB properties, username, password, and role as parameters, it does the following:

- If no ORB instance exists, it creates an ORB instance and returns its reference to you.
- If an ORB instance exists, it returns the ORB reference to you.

Use this method when your client chooses not to use JNDI for ORB initialization and it receives a reference to an existing object from another client. To access an active object within a session, the new client must authenticate itself to the database in one of two ways:

- If SSL_CREDENTIALS is requested, provide the username, password, and role in the `init` method parameters. Then, when you invoke a method on the supplied object reference, the username, password, and role are passed implicitly on the first message to authenticate the client to the database.
- If the login protocol is requested, through either SSL_LOGIN or NON_SSL_LOGIN, the first client must pass object references to both the login object and the destination object. The second client authenticates itself by providing the username, password, and role on the `authenticate` method of the login object. Then, it executes any method on the object.

This method is how a second client invokes an active object in an established session.

Syntax

```
public org.omg.CORBA.ORB init(String un, String pw, String role,
                              boolean ssl, java.util.Properties props);
```

Parameter	Description
String un	The username for client-side authentication.
String pw	The password for client-side authentication.
String role	The role to use after logging on.
Boolean ssl	If true, SSL is enabled for the connection. If false, a NON-SSL connection is used.
Properties props	Properties that are used by the ORB.

CORBA ORB Interface

If you have implemented a pure CORBA client—that is, you do not use JNDI—you must set the following properties before the ORB initialization call. These properties direct the call to the Oracle9*i* implementation rather than the Java 2 implementation. This ensures the behavior that you expect. The behavior expected from Visibroker is as follows:

- Even if you invoke `ORB.init` more than once, Oracle9*i* creates only a single ORB instance. If you do not set these properties, be aware that each invocation of `ORB.init` will create a new ORB instance.
- The session IIOP connection is managed correctly.
- Callbacks from the server are managed correctly.

Property	Assign Value
org.omg.corba.ORBClass	com.visigenic.vbroker.orb
org.omg.corba.ORBSingletonClass	com.visigenic.vbroker.orb

Example 5–3 Assigning Visibroker Values to OMG Properties

The following example shows how to set up the OMG properties for directing the OMG CORBA `init` method to the Visibroker implementation.

```
System.getProperties().put("org.omg.CORBA.ORBClass",
                            "com.visigenic.vbroker.orb.ORB");
System.getProperties().put("org.omg.CORBA.ORBSingletonClass",
                           "com.visigenic.vbroker.orb.ORB");
```

Or you can set the properties on the command line, as follows:

```
java -Dorg.omg.CORBA.ORBClass=com.visigenic.vbroker.orb.ORB
     -Dorg.omg.CORBA.ORBSingletonClass=com.visigenic.vbroker.orb.ORB
```

Backward Compatibility with Oracle9*i* Release 8.1.5

The tools provided with Oracle9*i*, such as `publish`, have been modified to work with either a JDK 1.1 or Java 2 environment. However, any code that has been generated or loaded with the 8.1.5 version of any tool will not succeed. Make sure that you always use the current version of all tools. This rule applies to your CORBA stubs and skeletons. In migrating any release 8.1.5 applications, you must regenerate all stubs and skeletons with the current version of the IDL compiler.

Invoking CORBA Objects From Applets

You invoke a server object from an applet in the same manner as from a client. The only differences are the following:

- You must conform to the applet standards.
- You must conform to the Java plug-in standards. The Java plug-ins that are supported are JDK 1.1, Java 2, and Oracle's JInitiator.
- You set the following properties within the initial context environment before the object lookup: `ORBdisableLocator`, `ORBClass`, and `ORBSingletonClass.`

Using Signed JAR Files to Conform to Sandbox Security

The security sandbox constricts your applet from accessing anything on the local disk or from connecting to a remote host other than the host that the applet was downloaded from. If you create a signed JAR file as a trusted party, you can bypass the sandbox security. See `http://java.sun.com` for more information on applet sandbox security and signed JAR files.

Performing Object Lookup in Applets

You perform the JNDI lookup within the applet the same as within any Oracle Java client, except that you set the following property within the initial context:

```
env.put(ServiceCtx.APPLET_CLASS, this);
```

By default, you do not need to install any JAR files on the client to run the applet. However, if you want to place the Oracle JAR files on the client machine, set the `ClassLoader` property in the `InitialContext` environment, as follows:

```
env.put('ClassLoader', this.getClass().getClassLoader());
```

The following shows the `init` method within an applet that invokes the Bank example. The applet sets up the initial context—including setting the `APPLET_CLASS` property—and performs the JNDI lookup giving the URL.

```
public void init() {
    // This GUI uses a 2 by 2 grid of widgets.
    setLayout(new GridLayout(2, 2, 5, 5));
    // Add the four widgets.
    add(new Label("Account Name"));
    add(_nameField = new TextField());
    add(_checkBalance = new Button("Check Balance"));
    add(_balanceField = new TextField());
    // make the balance text field non-editable.
    _balanceField.setEditable(false);
    try {
      // Initialize the ORB (using the Applet).
      Hashtable env = new Hashtable();
      env.put(Context.URL_PKG_PREFIXES, "oracle.aurora.jndi");
      env.put(Context.SECURITY_PRINCIPAL, "scott");
      env.put(Context.SECURITY_CREDENTIALS, "tiger");
      env.put(Context.SECURITY_AUTHENTICATION, ServiceCtx.NON_SSL_LOGIN);
      env.put(ServiceCtx.APPLET_CLASS, this);

      Context ic = new InitialContext(env);
      _manager = (AccountManager)ic.lookup
                          ("sess_iiop://hostfunk:2222/test/myBank");
    } catch (Exception e) {
      System.out.println(e.getMessage());
      e.printStackTrace();
      throw new RuntimeException();
    }
  }
```

Within the `action` method, the applet invokes methods off of the retrieved object. In this example, the `open` method of the retrieved `AccountManager` object is invoked.

```
  public boolean action(Event ev, Object arg) {
    if(ev.target == _checkBalance) {
      // Request the account manager to open a named account.
      // Get the account name from the name text widget.
      Bank.Account account = _manager.open(_nameField.getText());
      // Set the balance text widget to the account's balance.
      _balanceField.setText(Float.toString(account.balance()));
      return true;
    }
    return false;
  }
```

Modifying HTML for Applets that Access CORBA Objects

Oracle9*i* supports only the following Java plug-ins for the HTML page that loads in the applet: JDK 1.1, Java 2, and Oracle JInitiator. Each plug-in contains different syntax for the applet information. However, each HTML page may contain definitions for the following two properties:

- `ORBdisableLocator` set to TRUE—Required for all applets.
- `ORBClass` and `ORBSingletonClass` definitions—Required for the applets that use the Java 2 or JInitiator plug-in.

Note: Because of the sandbox security rules, you cannot set or read any system properties. Therefore, any values that you want to pass on to the ORB runtime, you may set within the applet parameters. This is the method used to set the `ORBdisableLocator`, `ORBClass` and `ORBSingletonClass` properties.

The examples in the following sections show how to create the correct HTML definition for each plug-in type. Each HTML definition defines the applet bank example.

- Example 5–4, "HTML Definition for JDK 1.1 Plug-in"
- Example 5–5, "HTML Definition for Java 2 Plug-in"
- Example 5–6, "HTML Definition for JInitiator Plug-in"

Example 5–4 HTML Definition for JDK 1.1 Plug-in

```
<pre>
<html>
<title>Applet talking to 8i</title>
<h1>applet talking to 8i using java plug in 1.1  </h1>
<hr>
The bank example
Specify the plugin in codebase, the class within the CODE parameter, the JAR
files in the ARCHIVE parameter, the plugin version in the type parameter, and
set ORBdisableLocator to true.
<OBJECT classid="clsid:8AD9C840-044E-11D1-B3E9-00805F499D93"
          WIDTH = 500 HEIGHT = 50
          codebase="http://java.sun.com/products/plugin/1.1/
                jinstall-11-win32.cab#Version=1,1,0,0">
          <PARAM NAME = CODE VALUE = OracleClientApplet.class >
          <PARAM NAME = ARCHIVE VALUE = "oracleClient.jar,
                aurora_client.jar,vbjorb.jar,vbjapp.jar" >
          <PARAM NAME="type" VALUE="application/x-java-applet;version=1.1">
          <PARAM NAME="ORBdisableLocator" VALUE="true">
<COMMENT>
Set the plugin version in the type, set ORBdisableLocator to true, the applet
class within the java_CODE tag, the JAR files in the java_ARCHIVE tag, and the
plug-in source site within the pluginspage tag.
<EMBED type="application/x-java-applet;version=1.1"
             ORBdisableLocator="true"
             java_CODE = OracleClientApplet.class
             java_ARCHIVE = "oracleClient.jar,
             aurora_client.jar,vbjorb.jar,vbjapp.jar"
             WIDTH = 500 HEIGHT = 50
pluginspage="http://java.sun.com/products/plugin/1.1/plugin-install.html">
<NOEMBED></COMMENT>
</NOEMBED></EMBED>
</OBJECT>

</center>
<hr>
</pre>
```

Example 5–5   HTML Definition for Java 2 Plug-in

```
<pre>
<html>
<title>applet talking to 8i</title>
<h1>applet talking to 8i using Java plug in 1.2 </h1>
<hr>
The bank example
Specify the plugin in codebase, the class within the CODE parameter, the JAR
files in the ARCHIVE parameter, the plugin version in the type parameter, and
set ORBdisableLocator to true.
<OBJECT classid="clsid:8AD9C840-044E-11D1-B3E9-00805F499D93"
   WIDTH = 500 HEIGHT = 50
   codebase="http://java.sun.com/products/plugin/1.2/jinstall-11-win32.cab#
           Version=1,1,0,0">
   <PARAM NAME = CODE VALUE = OracleClientApplet.class >
   <PARAM NAME = ARCHIVE VALUE = "oracleClient.jar,
   aurora_client.jar,vbjorb.jar,vbjapp.jar" >
   <PARAM NAME="type" VALUE="application/x-java-applet;version=1.1.2">
   <PARAM NAME="ORBdisableLocator" VALUE="true">
   <PARAM NAME="org.omg.CORBA.ORBClass" VALUE="com.visigenic.vbroker.orb.ORB">
   <PARAM NAME="org.omg.CORBA.ORBSingletonClass"
           VALUE="com.visigenic.vbroker.orb.ORB">
<COMMENT>
Set the plugin version in the type, set ORBdisableLocator to true, the ORBClass
and ORBSingletonClass to the correct ORB class, the applet
class within the java_CODE tag, the JAR files in the java_ARCHIVE tag, and the
plug-in source site within the pluginspage tag.
<EMBED type="application/x-java-applet;version=1.1.2"
          ORBdisableLocator="true"
          org.omg.CORBA.ORBClass="com.visigenic.vbroker.orb.ORB"
          org.omg.CORBA.ORBSingletonClass="com.visigenic.vbroker.orb.ORB"
          java_CODE = OracleClientApplet.class
          java_ARCHIVE = "oracleClient.jar,
             aurora_client.jar,vbjorb.jar,vbjapp.jar"
          WIDTH = 500 HEIGHT = 50
pluginspage="http://java.sun.com/products/plugin/1.2/plugin-install.html">
<NOEMBED></COMMENT>
</NOEMBED></EMBED>
</OBJECT>

</center>
<hr>
</pre>
```

Example 5–6   HTML Definition for JInitiator Plug-in

```
<h1> applet talking to 8i using JInitiator 1.1.7.18</h1>
   <COMMENT>
   Set the plugin version in the type, set ORBdisableLocator to true, the
   ORBClass and ORBSingletonClass to the correct ORB class, the applet
   class within the java_CODE tag, the source of the applet in the java_CODEBASE
   and the JAR files in the java_ARCHIVE tag.
   <EMBED   type="application/x-jinit-applet;version=1.1.7.18"
      java_CODE="OracleClientApplet"
      java_CODEBASE="http://hostfunk:8080/applets/bank"
      java_ARCHIVE="oracleClient.jar,aurora_client.jar,vbjorb.jar,vbjapp.jar"
      WIDTH=400
      HEIGHT=100
      ORBdisableLocator="true"
      org.omg.CORBA.ORBClass="com.visigenic.vbroker.orb.ORB"
      org.omg.CORBA.ORBSingletonClass="com.visigenic.vbroker.orb.ORB"
      serverHost="orasundb"
      serverPort=8080
      <NOEMBED>
      </COMMENT>
      </NOEMBED>
    </EMBED>
```

Interoperability with Non-Oracle ORBs

You can interoperate with Oracle9*i* from a client that uses another vendor's ORB. To do so, the vendor must provide the functionality that Oracle9*i* uses by being part of the database: functions such as session-based connections, extended CosNaming, and the login protocol. To provide this functionality, your ORB vendor must work with Oracle's Product Management to provide libraries for you.

All client-side functionality has been packaged into `aurora_client.jar`. This JAR file has been broken into two JAR files for interoperating with your ORB vendor:

- `aurora_orbindep.jar`—includes ORB-independent features, such as JNDI
- `aurora_orbdep.jar`—includes Oracle ORB dependent functionality, such as session-based communication, the login protocol, and security context

Your ORB vendor needs to provide you with the `aurora_orbdep.jar` file. Thus, you include the vendor's `aurora_orbdep.jar` file and the Oracle-provided `aurora_orbindep.jar` file to replace `aurora_client.jar`.

Note: If you do not remove the `aurora_client.jar` file from your CLASSPATH, you will be using Oracle's classes instead of your ORB vendor's classes.

The `aurora_orbdep.jar` includes the following functionality:

Function	Description
login	The login protocol performs the challenge/response protocol for authenticating the client to the database. See "IIOP Security" on page 6-1 for more information.
bootstrap	The boot service obtains key services, such as CosNaming.
extended CosNaming	The Oracle9*i* ORB extended CosNaming to automatically instantiate an object upon first lookup.
Session IIOP	Session IIOP is implemented to allow one client to connect to more than a single IIOP session at the same time. See Chapter 3, "Configuring IIOP Applications", for more information.
Credentials	This is the security context interceptor for the credential type of authentication.

Java Client Using Oracle ORB

Perform the following if you choose to use the Oracle-provided ORB on your client:

1. Put `aurora_client.jar` in a directory that exists in the CLASSPATH.
2. Compile and run your CORBA application.

Java Client Using Non-Oracle ORB

Perform the following if you choose to use another vendor's ORB on your client:

1. Put `aurora_orbindep.jar` in a directory that exists in the CLASSPATH.
2. Contact your ORB vendor to receive their `aurora_orbdep.jar`.
3. Put their `aurora_orbdep.jar` in a directory that exists in the CLASSPATH.
4. Compile and run your CORBA application.

Note: If you do not remove the `aurora_client.jar` file from your CLASSPATH, you will be using Oracle's classes instead of your ORB vendor's classes.

C++ Client Interoperability

With C++ clients, the ORB vendor must provide the `aurora_client.jar` file functionality in shared libraries. The vendor will make use of the Oracle-provided C++ login protocol for authentication. All clients are required to authenticate themselves to the database. One of the methods for authenticating is through the login protocol.

The login protocol is an Oracle-specific design, used for logging in to a database by providing a username and password to authenticate the client. The following example shows how to write a sample C++ CORBA client to Oracle9*i*. This example uses the Visigenics C++ ORB for its client-side ORB.

Example 5–7 C++ Client Using Login Protocol to Authenticate

The following C++ client uses the Visigenics C++ ORB for the client-side ORB. Your implementation can be different, depending on the type of ORB you use.

```
#include <Login.h>
#include <oracle_orbdep.h>

// set up host, port, and SID
char *sid = NULL;
char *host = argv[1];
int port = atol(argv[2]);
if(argc == 4) sid = argv[3];

// set up username, password, and role
wchar_t *username = new wchar_t[6];
```

```
username[0] = 's';
username[1] = 'c';
username[2] = 'o';
username[3] = 't';
username[4] = 't';
username[5] = '\0';

wchar_t *password = new wchar_t[6];
password[0] = 't';
password[1] = 'i';
password[2] = 'g';
password[3] = 'e';
password[4] = 'r';
password[5] = '\0';

wchar_t *role = new wchar_t[1];
role[0] = '\0';

// Get the Name service Object reference
AuroraServices::PublishingContext_ptr rootCtx = NULL;

// Contact Visibroker’s boot service for initializing
rootCtx = VisiCppBootstrap::getNameService (host, port, sid);

// Get the pre-published login object reference
AuroraServices::PublishedObject_ptr loginPubObj = NULL;
AuroraServices::LoginServer_ptr serv = NULL;
CosNaming::NameComponent *nameComponent = new CosNaming::NameComponent[2];

nameComponent[0].id = (const char *)"etc";
nameComponent[0].kind = (const char *)"";
nameComponent[1].id = (const char *)"login";
nameComponent[1].kind = (const char *)"";

CosNaming::Name *name1 = new CosNaming::Name(2, 2, nameComponent, 0);

// Lookup this object in the Name service
CORBA::Object_ptr loginCorbaObj = rootCtx->resolve (*name1);

// Make sure it is a published object
loginPubObj = AuroraServices::PublishedObject::_narrow (loginCorbaObj);

// create and activate this object (non-standard call)
loginCorbaObj = loginPubObj->activate_no_helper ();
serv = AuroraServices::LoginServer::_narrow (loginCorbaObj);
```

```
// Create a client login proxy object and authenticate to the DB
oracle_orbdep *_visi = new oracle_orbdep(serv);
Login login(_visi);
boolean res = login.authenticate(username, password, role);
```

IIOP Transport Protocol

If, when using another vendor's ORB, the ORB vendor does not support session-based IIOP, you can use a regular IIOP port. Any client that uses a regular IIOP transport cannot access multiple sessions.

To configure a non-session-based IIOP listener, you must do the following:

1. Configure the MTS_DISPATCHERS parameter to `oracle.aurora.server.GiopServer` instead of `oracle.aurora.server.SGiopServer`.

   ```
   mts_dispatchers="(protocol=tcp | tcps)
          (presentation=oracle.aurora.server.GiopServer)"
   ```

2. Set the TRANSPORT_TYPE property to `ServiceCtx.IIOP`, as shown below:

   ```
   Hashtable env = new Hashtable();
   env.put(Context.URL_PKG_PREFIXES, "oracle.aurora.jndi");
   env.put(Context.SECURITY_PRINCIPAL, user);
   env.put(Context.SECURITY_CREDENTIALS, password);
   env.put(Context.SECURITY_AUTHENTICATION, ServiceCtx.NON_SSL_LOGIN);
   env.put("TRANSPORT_TYPE", ServiceCtx.IIOP);
   Context ic = new InitialContext(env);
   ```

Note: Instead of setting the TRANSPORT_TYPE property, you can use the `-iiop` option on any of the command-line tools. If your client is directing the request to a dispatcher, you must also provide the regular IIOP port within the service name on the command-line.

6 IIOP Security

Security involves data integrity, authentication, and authorization.

- For data integrity, Oracle9*i* enables your application to use IIOP over a secure socket layer (SSL).
- For authentication, your application can choose between providing a username/password combination or a certificate.
- For authorization, you can choose the level of trust points that any incoming clients will be required to give.

The following sections explain these subjects in detail:

Overview

As discussed in the *Oracle9i Java Developer's Guide*, there are several security issues you must think about for your application. The *Oracle9i Java Developer's Guide* divides security into network connection, database contents, and JVM security issues. All these factors pertain to IIOP. However, IIOP has specific implementation issues for both the networking and the JVM security, as listed below:

- JVM security includes both utilizing Java2 permissions and granting execution rights. For IIOP, you can grant execution privileges in one of two ways:
  - CORBA—The owner grants execution rights to CORBA objects with an option on the `loadjava` tool. See the `loadjava` discussion in the *Oracle9i Java Developer's Guide* for information on granting execution rights when loading the CORBA classes.
  - EJB—The owner grants execution rights to EJB objects and, potentially, methods within the deployment descriptor. See the section on "Access Control" in the *Oracle9i Enterprise JavaBeans Developer's Guide and Reference* for more information on defining execution rights within your deployment descriptor.
- Network connection security includes the following issues:
  - Data Integrity—To prevent a sniffer from reading the transmission directly off the wire, all transmissions are encoded. Oracle supports Secure Socket Layer (SSL) for encryption.
  - Authentication—To prevent an invalid user from impersonating a valid user, the client or server provides authentication information. This information can take the form of a username / password combination or certificates.
  - Authorization—To prove that the user is allowed access to the object, two types of authorization are performed:

    - Session authorization—The session is authorized to the user. In this case, the client is authorized to access the server through validating either the username or certificate provided.

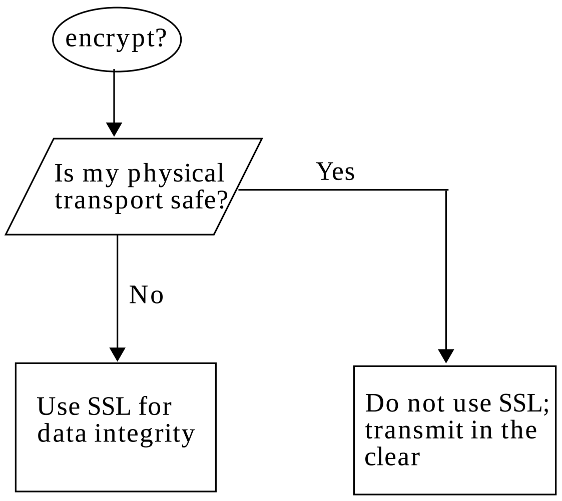
    - User authorization—The client or server can perform authorization on a provided certificate. This type of authorization can be performed only when the client or server authenticates itself by providing a certificate.

This section describes fully the network connection security issues that IIOP applications must consider.

Data Integrity

Do you want your transport line to be encrypted? Do you want data integrity and confidentiality? If you believe that the physical connection can be tampered with, you can consider encrypting all transmissions by using the secure socket layer (SSL) encryption technology. However, because adding encryption to your transmission affects your connection performance, if you do not have any transport security issues, you should transmit unencrypted.

Figure 6–1 Data Integrity Decision Tree


encrypt?
Is my physical transport safe?
Yes
No
Use SSL for data integrity
Do not use SSL; transmit in the clear

Using the Secure Socket Layer

The Oracle9*i* CORBA and EJB implementations rely on the Secure Socket Layer (SSL) for data integrity and authentication. SSL is a secure networking protocol, originally defined by Netscape Communications, Inc. Oracle9*i* supports SSL over the IIOP protocol used for the ORB.

When a connection is requested between a client and the server, the SSL layer within both parties negotiate during the connection handshake to verify if the connection is allowed. The connection is verified at several levels:

1. The SSL version on both the client and the server must agree for the transport to be guaranteed for data integrity.

2. If server-side authentication with certificates is requested, the certificates provided by the server are verified by the client at the SSL layer. This means that the server is guaranteed to be itself. That is, it is not a third party pretending to be the server.
3. If client-side authentication with certificates is requested, the certificates provided by the client are verified at the SSL layer. The server receives the client's certificates for authentication or authorization of the client.

Note: Normally, client-side authentication means only that the server verifies that the client is not an impersonator and is trusted. However, when you specify SSL_CLIENT_AUTH, you are requesting both server-side and client-side authentication.

The SSL layer performs authentication between the peers. After the handshake, you can be assured that the peers are authenticated to be who they say they are. You can perform additional tests on their certificate chain to authorize that this user can access your application. See "Authorization" on page 6-26 for how to go beyond authentication.

Note: If you decide to use SSL, your client must import the following JAR files:

- If your client uses JDK 1.1, import `jssl-1_1.jar` and `javax-ssl-1_1.jar.`
- If your client uses Java 2, import `jssl-1_2.jar` and `javax-ssl-1_2.jar`.

SSL Version Negotiation

SSL makes sure that both the client and server side agree on an SSL protocol version number. The values that you can specify are as follows:

- Undetermined: `SSL_UNDETERMINED`. This is the default setting.
- 3.0 with 2.0 Hello: This setting is not supported.
- 3.0: `SSL_30`.
- 2.0: This setting is not supported.

In the database, the default is "Undetermined". The database does not support 2.0 or 3.0 with 2.0 Hello. Thus, you can use only the Undetermined or 3.0 setting for the client.

- The server's version is set within the database SQLNET.ORA file, using the SSL_VERSION parameter. For example, SSL_VERSION = 3.0.
- For the client, set the SSL client version number in the client's JNDI environment, as follows:

  ```
  environment.put("CLIENT_SSL_VERSION", ServiceCtx.SSL_30);
  ```

Table 6–1 shows which handshakes resolve to depending on SSL version settings on both the client and the server. The star sign "✷" indicates cases where the handshake fails.

Table 6–1 SSL Version Numbers

	Server Setting			
Client Setting	**Undetermined**	**3.0 W/2.0 Hello (Not Supported)**	**3.0**	**2.0 (Not Supported)**
Undetermined	3.0	✷	✷	✷
3.0 W/2.0 Hello (not supported)	✷	✷	✷	✷
3.0	3.0	✷	3.0	✷
2.0 (not supported)	✷	✷	✷	✷

Authentication

Authentication is the process by which one party supplies to a requesting party information that identifies itself. This information guarantees that the originator is not an imposter. In the client/server distributed environment, authentication can be required from the client or the server:

- Server-side authentication—The server sends identifying information to authenticate itself. The client uses this information to verify that the server is itself, and not an imposter. If you request SSL, the server will always send certificate-based authentication information.
- Client-side authentication—For the same reasons, the client sends identifying information to the server, which includes either a username/password

combination or certificates. Since the client is logging on to a database, the client must always authenticate itself to the database.

- Callout authentication—The server initiates a call to another object. This causes the server to act as a client; as such, the server cannot use the database authentication information, but must provide information and authenticate itself as an independent party.
- Callback authentication—The server is given either a CORBA IOR or an EJB handle for calling back to an object that exists on the client. In this scenario, the server is acting as a client; as such, the server cannot use the database authentication information, but must provide information and authenticate itself as an independent party.

Client-Side Authentication

The Oracle data server is a secure server: a client application cannot access data stored in the database without first being authenticated by the database server. Oracle9*i* CORBA server objects and Enterprise JavaBeans execute in the database server. For a client to activate such an object and invoke methods on it, the client must authenticate itself to the server. The client authenticates itself when a CORBA or EJB object starts a new session. The following are examples of how each IIOP client must authenticate itself to the database:

- When a client initially starts a new session, it must authenticate itself to the database.
- When a client passes an object reference (a CORBA IOR or an EJB bean handle) to a second client, the second client connects to the session specified in the object reference. The second client authenticates itself to the server.

The client authenticates itself by providing one of the following types:

Authentication type	Definition
Certificates	You can provide the user certificate, the Certificate Authority certificate (or a chain that contains both, including other identifying certificates), and a private key.
Username and password combination	You can provide the username and password through either credentials or the login protocol. In addition, you can pass a database role to the server, along with the username and password.

The type of client-side authentication can be determined by the server's configuration. If, within the SQLNET.ORA file, the `SSL_CLIENT_AUTHENTICATION` parameter is `TRUE`, then the client must provide certificate-based authentication. If the `SSL_CLIENT_AUTHENTICATION` parameter is `FALSE`, the client authenticates itself with a username / password combination. If the `SSL_CLIENT_AUTHENTICATION` parameter is `TRUE` and the client provides a username / password, the connection handshake will fail.

The following table gives a brief overview of the options that the client has for authentication.

- The columns represent the options available if you have chosen to use SSL for data integrity.
- The rows demonstrate the three authentication vehicles: login protocol, credentials, and certificates.
- The table entries detail the different methods you must employ when implementing the client-side authentication type.

Authentication vehicle	NON-SSL transport	SSL transport
Providing username and password using the login protocol	■ Implicit method: Set JNDI property to NON_SSL_LOGIN; provide username and password in JNDI properties. ■ Explicit method: Create a Login object with username and password.	■ Implicit method: Set JNDI property to SSL_LOGIN; provide username and password in JNDI properties. ■ Explicit method: Create a Login object with username and password.
Providing username and password using credentials	Not supported because the password would transmit in the clear.	Set JNDI property to SSL_CREDENTIAL; username and password are implicitly sent to the server in the handshake.
Providing certificates	Not supported because certificates require an SSL transport.	Set JNDI property to SSL_CLIENT_AUTH; provide client certificate, CA certificate, and private key in JNDI properties. Pure CORBA objects use `AuroraCertificateManager` class to specify certificates, CA certificate, and private key.

As the table demonstrates, most of the authentication options include setting an appropriate value in JNDI properties.

Using JNDI for Authentication

To set up client-side authentication using JNDI, set the `javax.naming.Context.SECURITY_AUTHENTICATION` attribute to one of the following values:

- `ServiceCtx.NON_SSL_LOGIN`—A plain IIOP connection is used. Because SSL is not used, all data flowing over the line is not encrypted. Thus, to protect the password, the client uses the login protocol to authenticate itself. In addition, the server does not provide SSL certificates to the client to identify itself.
- `ServiceCtx.SSL_LOGIN`—An SSL-enabled IIOP connection is used. All data flowing over the transport is encrypted. If you do not want to provide a certificate for the client authentication, use the login protocol to provide the username and password.

  Because this is an SSL connection, the server sends its certificate identity to the client. The client is responsible for verifying the server's certificate, if interested, for server authentication. Optionally, the client can set up trust points for the server's certificate to be verified against.
- `ServiceCtx.SSL_CREDENTIAL`—An SSL-enabled IIOP connection is used. All data flowing over the transport is encrypted. The client provides the username and password without using the login protocol for client authentication to the server. The username and password are automatically passed to the server in a security context, on the first message.

  > **Note:** The client's password is not encrypted, as it is with SSL. It might be slightly more efficient than SSL_LOGIN, where encrypting a password over an SSL connection is redundant.

  The server provides its certificate identity to the client. The client is responsible for verifying the server's certificate, if interested, for server authentication.
- `ServiceCtx.SSL_CLIENT_AUTH`—An SSL-enabled IIOP connection is used. All data flowing over the transport is encrypted. The client provides appropriate certificates for client-side authentication to the server. In addition, the server provides its certificate identity to the client. If interested, the client is responsible for authorizing the server's certificate.

- Nothing is specified. The client must activate the login protocol explicitly before activating and invoking methods on a server-side object. Use this method when a client must connect to an existing session and invoke methods on an existing object. See the `$ORACLE_HOME/javavm/demo/examples/corba/session/sharedsession` example for more information. The username and password in the initial context environment are automatically passed as parameters to the login object's `authenticate()` method.

Within each of these options, you choose to do one or more of the following:

Client authentication	■ authenticate itself to the server using login protocol ■ authenticate itself to the server using straight username and password ■ authenticate itself to the server using SSL certificates
Server authentication	■ authenticate itself to the client using SSL certificates

For information on how to implement each of these methods for client or server authentication, see the following sections:

- Providing Username and Password for Client-Side Authentication
- Using Certificates for Client Authentication
- Server-Side Authentication

Providing Username and Password for Client-Side Authentication

The client authenticates itself to the database server either through a username/password or by supplying appropriate certificates. The username/password can be supplied either through Oracle's login protocol, or credentials over the SSL transport connection.

- Provide a username and password by setting JNDI properties, which implicitly sets these values in a login protocol. Set `SECURITY_AUTHENTICATION` to `ServiceCtx.SSL_LOGIN` or `ServiceCtx.NON_SSL_LOGIN`.
- Provide a username and password through credentials. The username and password are provided implicitly and are shipped to the server over the encrypted SSL transport. Set `SECURITY_AUTHENTICATION` to `serviceCtx.SSL_CREDENTIAL`.
- Provide a username and password in an explicitly activated login protocol.

Note: The `Login` class serves as an implementation of the client side of the login handshaking protocol and as a proxy object for calling the server login object. This component is packaged in the `aurora_client.jar` file. All Oracle9*i* ORB applications must import this library.

Username Sent by Setting JNDI Properties for the Login Protocol

A client can use the login protocol to authenticate itself to the Oracle9*i* data server. You can use the login protocol either with or without SSL encryption, because a secure handshaking encryption protocol is built in to the login protocol.

If your application requires an SSL connection for client-server data security, specify the **SSL_LOGIN** service context value for the SECURITY_AUTHENTICATION property that is passed when the JNDI initial context is obtained. The following example defines the connection to be SSL-enabled for the login protocol. Notice that the username and password are set.

```
Hashtable env = new Hashtable();
env.put(javax.naming.Context.URL_PKG_PREFIXES, "oracle.aurora.jndi");
env.put(javax.naming.Context.SECURITY_PRINCIPAL, username);
env.put(javax.naming.Context.SECURITY_CREDENTIALS, password);
env.put(javax.naming.Context.SECURITY_AUTHENTICATION, ServiceCtx.SSL_LOGIN);
Context ic = new InitialContext(env);
...
```

If your application does not use an SSL connection, specify **NON_SSL_LOGIN** within the SECURITY_AUTHENTICATION parameter as shown below:

Note: The login handshaking is secured by encryption, but the remainder of the client-server interaction is not secure.

```
env.put(javax.naming.Context.SECURITY_AUTHENTICATION, ServiceCtx.NON_SSL_LOGIN);
```

When you specify values for all four JNDI Context variables—URL_PKG_PREFIXES, SECURITY_PRINCIPAL, SECURITY_CREDENTIALS, and SECURITY_AUTHENTICATION—the first invocation of the `Context.lookup()` method performs a login automatically.

If the client setting up the connection is not using JNDI `lookup()` because it already has an IOR, the user that gave it the IOR for the object should have also passed in a Login object that exists in the same session as the active object. You must provide the username and password in the `authenticate` method of the Login object before invoking the methods on the active object.

Logging In and Out of the Oracle9*i* Session If the session owner wishes to exit the session, the owner can use the `logout` method of the `LogoutServer` object, which is pre-published as "`/etc/logout`". You use the `LogoutServer` object to exit the session. Only the session owner is allowed to logout. Any other owner receives a NO_PERMISSION exception.

The `LogoutServer` object is analogous to the `LoginServer` object, which is pre-published as "`/etc/login`". You can use the `LoginServer` object to retrieve the `Login` object, which is used to authenticate to the server. This is an alternative method to using the `Login` object within the JNDI lookup.

The following example shows how a client can authenticate using the `LoginServer` object and can exit the session through the `LogoutServer` object.

```
import oracle.aurora.AuroraServices.LoginServer;
import oracle.aurora.AuroraServices.LogoutServer;
...
// To log in using the LoginServer object
LoginServer loginServer = (LoginServer)ic.lookup(serviceURL + "/etc/login");
Login login = new Login(loginServer);
System.out.println("Logging in ..");
login.authenticate(user, password, null);
...
//To logout using the LogoutServer
LogoutServer logout = (LogoutServer)ic.lookup(serviceURL + "/etc/logout");
logout.logout();
```

Username Sent Implicitly by Using Credentials

Using the `ServiceCtx.SSL_CREDENTIAL` authentication type means that the username, password, and, potentially, a role are passed to the server on the first request. Because this information is passed over an SSL connection, the password is encrypted by the transfer protocol, and there is no need for the handshaking that the Login protocol uses. This is slightly more efficient and is recommended for SSL connections.

Username Sent by Explicitly Activating a Login Object

You can explicitly create and populate a Login object for the database login. Typically, you would do this if you wanted to create and use more than a single session from a client. The following example shows a client creating and logging on to two different sessions. To do this, you must perform the following steps:

1. Create the initial context.
2. Perform a look up on a URL for the destination database.
3. On this database service context, create two subcontexts—one for each session.
4. Login to each session using a Login object, providing a username and password.

Note: The username and password for both sessions are identical, because the destination database is the same database. If the client connects to two different databases, the username and password may need to be different for logging on.

```
// Prepare a simplified Initial Context as we are going to do
// everything by hand
Hashtable env = new Hashtable ();
env.put (Context.URL_PKG_PREFIXES, "oracle.aurora.jndi");
Context ic = new InitialContext (env);

// Get a SessionCtx that represents a database instance
ServiceCtx service = (ServiceCtx)ic.lookup (serviceURL);

// Create and authenticate a first session in the instance.
SessionCtx session1 = (SessionCtx)service.createSubcontext (":session1");
LoginServer login_server1 = (LoginServer)session1.activate ("etc/login");
Login login1 = new Login (login_server1);
login1.authenticate (user, password, null);

// Create and authenticate a second session in the instance.
SessionCtx session2 = (SessionCtx)service.createSubcontext (":session2");
LoginServer login_server2 = (LoginServer)session2.activate ("etc/login");
Login login2 = new Login (login_server2);
login2.authenticate (user, password, null);

// Activate one Hello object in each session
Hello hello1 = (Hello)session1.activate (objectName);
Hello hello2 = (Hello)session2.activate (objectName);
```

Using Certificates for Client Authentication

Client authentication through certificates requires the client sending a certificate or certificate chain to the server; the server verifies that the client is truly who the client said it was and that it is trusted.

Note: All certificates, trustpoints, and the private key should be in base-64 encoded format.

You set up the client for certificate authentication through one of the following methods:

- Specifying Certificates in a File
- Specifying Certificates in Individual JNDI Properties
- Specifying Certificates Using AuroraCertificateManager

Specifying Certificates in a File

You can set up a file that contains the user certificate, the issuer certificate, the entire certificate chain, an encrypted private key, and the trustpoints. Once created, you can specify that the client use the file during connection handshake for client authentication.

1. Create the client certificate file—Create this file through an export feature in the Wallet Manager. The Oracle Wallet Manager has an option that creates this file. You must populate a wallet using the Wallet Manager before requesting that the file is created.

   After you create a valid wallet, bring up the Wallet Manager and perform the following:

   - From the menu bar pull down, click on Operations > Export Wallet.
   - Within the filename field, enter the name that you want the certificate file to be known as.

   This creates a base-64 encoded file that contains all certificates, keys, and trustpoints that you added within your wallet. For information on how to create the wallet, see the *Oracle Advanced Security Administrator's Guide.*

2. Specify the client certificates file for the connection—Within the client code, set the `SECURITY_AUTHENTICATION` property to `ServiceCtx.SSL_CLIENT_AUTH`. Provide the appropriate certificates and

trustpoints for the server to authenticate against. Specify the filename and decrypting key in the JNDI properties, as follows:

Values	Set in JNDI Property
Name of the certificate file	SECURITY_PRINCIPAL
Key for decrypting the private key	SECURITY_CREDENTIAL

The following code is an example of how to set up the JNDI properties to define the client certificate file:

```
Hashtable env = new Hashtable();
env.put(javax.naming.Context.URL_PKG_PREFIXES, "oracle.aurora.jndi");
env.put(javax.naming.Context.SECURITY_PRINCIPAL, <filename>);
env.put(javax.naming.Context.SECURITY_CREDENTIAL, <decrypting_key>);
env.put(javax.naming.Context.SECURITY_AUTHENTICATION,
                                        ServiceCtx.SSL_CLIENT_AUTH);
Context ic = new InitialContext(env);
...
```

For example, if your decrypting key is `welcome12` and the certificate file is `credsFile`, the following two lines would specify these values within the JNDI context:

```
env.put(Context.SECURITY_CREDENTIALS, "welcome12");
env.put(Context.SECURITY_PRINCIPAL, "credsFile");
```

Specifying Certificates in Individual JNDI Properties

You can provide each certificate, private key, and trust point programmatically, by setting each item individually within JNDI properties. Once you populate the JNDI properties with the user certificate, issuer (Certificate Authority) certificate, encrypted private key, and trust points, they are used during connection handshake for authentication. To identify client-side authentication, set the `SECURITY_AUTHENTICATION` property to `serviceCtx.SSL_CLIENT_AUTH`.

Note: Only a single issuer certificate can be set through JNDI properties.

You can choose any method for setting up your certificates within the JNDI properties. All authorization information values must be set up before initializing the context.

The following example declares the certificates as a static variable. However, this is just one of many options. Your certificate must be base-64 encoded. For example, in the following code, the **testCert_base64** is a base-64 encoded client certificate declared as a static variable. The other variables for CA certificate, private key, and so on, are not shown, but they are defined similarly.

Note: When you are setting individual certificates as static variables, note that certificates for Oracle9*i* parties do not have any separators. However, if you are setting a certificate for a Visigenic ORB (as the client callback object does in a callback scenario), the certificate must be delineated by "BEGIN CERTIFICATE" and "END CERTIFICATE" identifying lines. See the Visigenic documentation for the format of these strings.

```
final private static String testCert_base64 =
  "MIICejCCAeOgAwIBAgICAmowDQYJKoZIhvcNAQEEBQAwazELMAkGA1UEBhMCVVMx" +
  "DzANBgNVBAoTBk9yYWNsZTEoMCYGA1UECxMfRW50ZXJwcmlzZSBBcHBsaWNhdGlv" +
  "biBTZXJ2aWNlczEhMB8GA1UEAxMYRUFTUUEgQ2VydGlmaWNhdGUgU2VydmVyMB4X" +
  "DTk5MDgxNzE2MjIxMloXDTAwMDIxMzE2MjIxMlowgYUxCzAJBgNVBAYTAlVTMRsw" +
  "GQYDVQQKExJPcmFjbGUgQ29ycG9yYXRpb24xPDA6BgNVBAsUMyoqIFNlY3VyaXR5" +
  "IFRFU1RJTkcgQU5EIEVWQUxVQVRJT04gT05MWSB2ZXJzaW9uMiAqKjEbMBkGA1UE" +
  "AxQSdGVzdEB1cy5vcmFjbGUuY29tMHwwDQYJKoZIhvcNAQEBBQADawAwaAJhANG1" +
  "Kk2K7uOOtI/UBYrmTe89LVRrG83Eb0/wY3xWGelkBeEUTwW57a26u2M9LZAfmT91" +
  "e8Afksqc4qQW23Sjxyo4ObQK3Kth6y1NJgovBgfMu1YGtDHaSn2VEg8p58g+nwID" +
  "AQABozYwNDARBglghkgBhvhCAQEEBAMCAMAwHwYDVR0jBBgwFoAUDCHwEuJfIFXD" +
  "a7tuYNO8bOw1EYwwDQYJKoZIhvcNAQEEBQADgYEARC5rWKge5trqgZ18onldinCg" +
  "Fof6D/qFT9b6Cex5JK3a2dEekg/P/KqDINyifIZL0DV7z/XCK6PQDLwYcVqSSK/m" +
  "487qjdH+zM5X+1DaJ+ROhqOOX54UpiAhAleRMdLT5KuXV6AtAx6Q2mc8k9bzFzwq" +
  "eR3uI+i5Tn0dKgxhCZU=\n";

Hashtable env = new Hashtable();
env.put(Context.URL_PKG_PREFIXES, "oracle.aurora.jndi");
env.put(Context.SECURITY_AUTHENTICATION, ServiceCtx.SSL_CLIENT_AUTH);
//decrypting key
env.put(Context.SECURITY_CREDENTIALS, "welcome12");

// you may also set the certificates individually, as shown bellow.
//User certificate
env.put(ServiceCtx.SECURITY_USER_CERT, testCert_base64);
//Certificate Authority’s certificate
env.put(ServiceCtx.SECURITY_CA_CERT, caCert_base64);
//Private key
```

```
env.put(ServiceCtx.SECURITY_ENCRYPTED_PKEY, encryptedPrivateKey_base64);
// setup the trust point
env.put(ServiceCtx.SECURITY_TRUSTED_CERT, trustedCert);

Context ic = new InitialContext(env);
```

Specifying Certificates Using AuroraCertificateManager

CORBA clients that do not use JNDI can use `AuroraCertificateManager` for setting the user and issuer certificates, the encrypted private key, and the trust points.

`AuroraCertificateManager` maintains certificates for your application. For the certificates to be passed on the SSL handshake for the connection, you must set the certificates before an SSL connection is made. Setting up a certificate in this manner is required only if the following is true:

- The client sets its certificates through `AuroraCertificateManager` if client-side authentication is required, and the client does not want to use JNDI properties for setting certificates.
- The server sets its certificates through `AuroraCertficateManager` if it is executing a callout or a callback. The typical server-side authentication for a simple client/server exchange is taken care of by the database wallet. However, if this server intends to act as a client by executing a callout or callback, it needs to set certificates identifying itself; it cannot use the database certificate that is contained in the wallet.

AuroraCertificateManager Class

The methods offered by this object allow you to:

- Set the SSL protocol version. The default is Undetermined.
- Set the private key and certificate chain.
- Require that client applications authenticate themselves by presenting their certificate chain. This method is used only by servers.

Invoking the `ORB.resolve_initial_references` method with the parameter `SSLCertificateManager` will return an object that can be narrowed to a `AuroraCertificateManager`. Example 6–1 shows a code example of the following methods.

addTrustedCertificate

This method adds the specified certificate as a trusted certificate. The certificate must be in DER encoded format. The client adds trustpoints through this method for server-side authentication.

When your client wants to authenticate a server, the server sends its certificate chain to the client. You might not want to check every certificate in the chain. For example, you have a chain composed of the following certificates: Certificate Authority, enterprise, business unit, a company site, and a user. If you trust the company site, you would check the user's certificate, but you might stop checking the chain when you get to the company site's certificate, because you accept the certificates above the company sites in the hierarchical chain.

Syntax

```
void addTrustedCertificate(byte[] derCert);
```

Parameter	Description
derCert	The DER encoded byte array containing the certificate.

requestClientCertificate

This method is invoked by servers that wish to require certificates from client applications. This method is not intended for use by client applications.

Note: The `requestClientCertificate` method is not currently required, because the SQLNET.ORA and LISTENER.ORA configuration parameter SSL_CLIENT_AUTHENTICATION performs its function.

Syntax

```
void requestClientCertificate(boolean need);
```

Parameter	Description
need	If true, the client must send a certificate for authentication. If false, no certificate is requested from the client.

setCertificateChain

This method sets the certificate chain for your client application or server object and can be invoked by clients or by servers. The certificate chain always starts with the Certificate Authority certificate. Each subsequent certificate is for the issuer of the preceding certificate. The last certificate in the chain is the certificate for the user or process.

Syntax

```
void setCertificateChain(byte[][] derCertChain)
```

Parameter	Description
derCertChain	A byte array containing an array of certificates.

setEncryptedPrivateKey

This method sets the private key for your client application or server object. You must specify the key in PKCS5 or PKCS8 format.

Syntax

```
void setEncryptedPrivateKey(byte[] key, String password);
```

Parameter	Description
key	The byte array that contains the encrypted private key.
password	A string containing a password for decrypting the private key.

setProtocolVersion

This method sets the SSL protocol version that can be used for the connection. A 2.0 Client trying to establish an SSL connection with a 3.0 Server will fail and the converse. We recommend using Version_Undetermined, because it lets the peers establish an SSL connection whether they are using the same protocol version or not. `SSL_Version_Undetermined` is the default value.

Syntax

```
void setProtocolVersion(int protocolVersion);
```

Parameter	Description
protocolVersion	The protocol version being specified. The value you supply is defined in `oracle.security.SSL.OracleSSLProtocolVersion`. This class defines the following values: ■ `SSL_Version_Undetermined`: Version is undetermined. This is used to connect to SSL 2.0 and SSL 3.0 peers. This is the default version. ■ `SSL_Version_3_0_With_2_0_Hello`: Not supported. ■ `SSL_Version_3_0`: Used to connect to 3.0 peers only. ■ `SSL_Version_2_0`: Not supported.

Example 6–1 Setting SSL Security Information Using AuroraCertificateManager

This example does the following:

1. Retrieves the **`AuroraCertificateManager.`**
2. Initializes this client's SSL information:
   a. Sets the certificate chain through **`setCertificateChain`**.
   b. Sets the trustpoint through **addTrustedCertificate**.
   c. Sets the private key through **`setEncryptedPrivateKey`**.

```
// Get the certificate manager
AuroraCertificateManager cm = AuroraCertificateManagerHelper.narrow(
               orb.resolve_initial_references("AuroraSSLCertificateManager"));

BASE64Decoder decoder = new BASE64Decoder();
byte[] userCert = decoder.decodeBuffer(testCert_base64);
byte[] caCert = decoder.decodeBuffer(caCert_base64);

// Set my certificate chain, ordered from CA to user.
byte[][] certificates = {
        caCert, userCert
};
cm.setCertificateChain(certificates);
cm.addTrustedCertificate(caCert);

// Set my private key.
byte[] encryptedPrivateKey =
decoder.decodeBuffer(encryptedPrivateKey_base64);

cm.setEncryptedPrivateKey(encryptedPrivateKey, "welcome12");
```

Server-Side Authentication

The server can require a different type of authentication, depending on its role. If you are utilizing the database as a server in a typical client/server environment, you use certificates that are set within a wallet for the database for server-side authentication. However, if you are using the server to callout to another object or callback to an object on the client, the server is now acting as a client and so requires its own identifying certificates. That is, in a callout or callback scenario, the server cannot use the wallet generated for database server-side authentication.

Server activity	Authentication method
Typical client/server	Use database wallet generated by Oracle Wallet Manager.
Callout to another object	Set identifying certificates, using either JNDI properties or `AuroraCurrentManager` class.
Callback to client object	Set identifying certificates, using `AuroraCurrentManager` class.

The following sections describe this in more detail:

- Typical Client/Server
- Callouts using Security
- Callbacks using Security

Typical Client/Server

Server-side authentication takes place when the server provides certificates for authentication to the client. When requested, the server will authenticate itself to the client, also known as server-side authentication, by providing certificates to the client. The SSL layer authenticates both peers during the connection handshake. The client requests server-side authentication by setting any of the SSL_* values in the JNDI property. See "Using JNDI for Authentication" on page 6-8 for more information on these JNDI values.

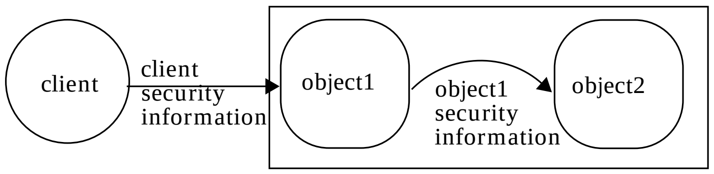
For server-side authentication, you must set up a database wallet with the appropriate certificates, using the Wallet Manager. See the *Oracle Advanced Security Administrator's Guide* for information on how to create a wallet.

Note: If the client wants to verify the server against trustpoints or authorize the server, it is up to the client to set up its trustpoints and parse the server's certificates for authorization. See "Authorization" on page 6-26 for more information.

Callouts using Security

A callout is when a Java object loaded within the database invokes a method within another Java object. If the original call from the client required a certain level of security—certificate-based or username / password security—the server object is also required to provide the same level of security information for itself before invoking the method on the second server object.

Figure 6–2 Server callout requires security

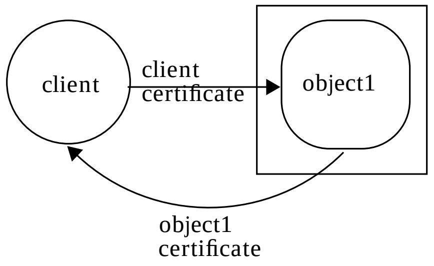


- Username / password: If the client sent a username / password combination for authenticating to the database, the server object is also required to send its own username / password combination to the second object. The server object cannot forward along the client's username / password combination, but must supply its own. You can set the username / password combination in the same manner as the client. See "Providing Username and Password for Client-Side Authentication" on page 6-9 for more information.
- Certificate-based: Similarly, if the client sent certificates for authentication, the server object must do the same. Additionally, the server must create and send its own certificates; it cannot forward on the client's certificates for authentication. You set up your server object certificates using either the appropriate JNDI properties or the `AuroraCertificateManager`, as discussed in "Using Certificates for Client Authentication" on page 6-13.

Callbacks using Security

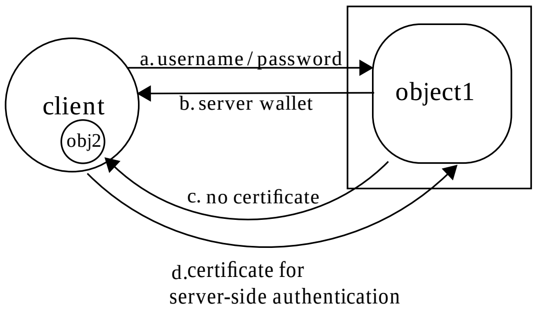
A callback is when the client passes the server object an object reference to an object that exists on the client. As shown in Figure 6–3, the server object receives the object reference and invokes methods. This effectively calls out of the server and back to an object located in the client. See "Debugging Techniques" on page 2-26 for more information on callbacks.

Figure 6–3 Server Callout Requires Security



The type of security you can use for callbacks is certificate-based security over SSL. When you add SSL security to callbacks, you can have one of two situations:

1. Server-side authentication only.



a. The client is not required to authenticate itself with a certificate. However, it must still authenticate itself to the database using a username / password combination.

b. The server, because server-side authentication is always required with SSL, authenticates itself to the client by providing certificates contained in the database wallet.

c. When the server calls back to the client, it acts as a client; thus, it is not required to provide certificates for authentication.

d. The called object, although contained in the client, is the server object in the callback scenario. Thus, because server-side authentication rules hold, the callback object must provide certificates to authenticate itself.

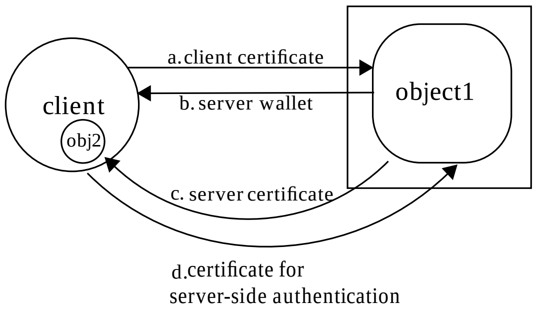
Example 6–2 Callback Code With Server-side Authentication Only

The following code shows the client code that performs (a) and (d) steps above. The first half of the client code sets up a username and password for authenticating itself to the database. It retrieves the server object. However, before it invokes the server's method, the last half of the code sets up the client callback object by setting certificates, initializing the BOA, and instantiating the callback object. Finally, the server method is invoked.

```
public static void main (String[] args) throws Exception {
String serviceURL = args [0];
String objectName = args [1];
String user = args [2];
String password = args [3];

//set up username/password for authentication to database. Set up
//security to be SSL_LOGIN - login authentication for client and server-side
//authentication.
Hashtable env = new Hashtable ();
env.put (Context.URL_PKG_PREFIXES, "oracle.aurora.jndi");
env.put (Context.SECURITY_PRINCIPAL, user);
env.put (Context.SECURITY_CREDENTIALS, password);
env.put (Context.SECURITY_AUTHENTICATION, ServiceCtx.SSL_LOGIN);
Context ic = new InitialContext (env);

// Get the server object before preparing the client object.
// You have to do it in this order to get the ORB initialized correctly
Server server = (Server)ic.lookup (serviceURL + objectName);

// Create the client object and export it to the ORB in the client
// First, set up the ORB properties for the callback object
java.util.Properties props = new java.util.Properties();
props.put("ORBservices", "oracle.aurora.ssl");

BASE64Decoder decoder = new BASE64Decoder();

// Initialize the ORB.
com.visigenic.vbroker.orb.ORB orb = (com.visigenic.vbroker.orb.ORB)
       oracle.aurora.jndi.orb_dep.Orb.init(args, props);

// Get the certificate manager
```

```
AuroraCertificateManager certificateManager =
        AuroraCertificateManagerHelper.narrow(
           orb.resolve_initial_references("AuroraSSLCertificateManager"));

// Set up client callback certificate chain, ordered from user to CA.
byte[] userCert = decoder.decodeBuffer(testCert_base64);
byte[] caCert = decoder.decodeBuffer(caCert_base64);

// Set my certificate chain, ordered from CA to user.
byte[][] certificates = { caCert, userCert };
cm.setCertificateChain(certificates);
cm.addTrustedCertificate(caCert);

// Set client callback object's private key.
byte[] encryptedPrivateKey=decoder.decodeBuffer(encryptedPrivateKey_base64);

cm.setEncryptedPrivateKey(encryptedPrivateKey, "welcome12");

// Initialize the BOA with SSL
org.omg.CORBA.BOA boa = orb.BOA_init("AuroraSSLTSession", null);

//Instantiate the client callback object
ClientImpl client = new ClientImpl ();

//register callback object with BOA
boa.obj_is_ready (client);

// Invoke the server method, passing the client to call us back
System.out.println (server.hello (client));
```

2. Client-side and server-side authentication.



   a. The client is required to authenticate itself with a certificate.
   b. The server, because server-side authentication is always required with SSL, authenticates itself to the client by providing certificates contained in the database wallet.
   c. When the server calls back to the client, it acts as a client; thus, it is required to provide its own certificates for authentication.
   d. The called object, although contained in the client, is the server object in the callback scenario. Thus, because server-side authentication rules hold, the callback object must provide certificates to authenticate itself.

The code for the client shown in Example 6–2 is the same for this scenario, except that instead of providing a username and password, the client provides certificates.

Because client-side authentication is required and because the server is acting as a client, the server code sets up identifying certificates for itself before invoking the callback object. The server must create and send its own certificates; it cannot forward on the client’s certificates for authentication. You set up your server object certificates using either the appropriate JNDI properties or the `AuroraCertificateManager` as discussed in "Using Certificates for Client Authentication" on page 6-13.

Example 6–3 Server Code in Callback with Client-side Authentication

The following server code does the following:

1. Retrieves the Oracle9*i* ORB reference by invoking the init method.
2. Retrieves the `AuroraCertificateManager`

3. Sets certificates and key through `AuroraCertificateManager` methods.
4. Invokes the client callback method, `hello`.

```
public String hello (Client client) {
BASE64Decoder decoder = new BASE64Decoder();
com.visigenic.vbroker.orb.ORB orb = (com.visigenic.vbroker.orb.ORB)
                         oracle.aurora.jndi.orb_dep.Orb.init();

try  {
// Get the certificate manager
     AuroraCertificateManager cm = AuroraCertificateManagerHelper.narrow(
           orb.resolve_initial_references("AuroraSSLCertificateManager"));

      byte[] userCert = decoder.decodeBuffer(testCert_base64);
      byte[] caCert = decoder.decodeBuffer(caCert_base64);

    // Set my certificate chain, ordered from CA to user.
      byte[][] certificates = { caCert, userCert };
      cm.setCertificateChain(certificates);

      // Set my private key.
      byte[] encryptedPrivateKey =
                 decoder.decodeBuffer(encryptedPrivateKey_base64);

      cm.setEncryptedPrivateKey(encryptedPrivateKey, "welcome12");

    } catch (Exception e) {
      e.printStackTrace();
      throw new org.omg.CORBA.INITIALIZE( "Couldn’t initialize SSL context");
    }

    return "I Called back and got: " + client.helloBack ();
}
```

Authorization

The SSL layer authenticates the peers during the connect handshake. After the handshake, you can be assured that the peers are authenticated to be who they said they are. In addition, because the server has specified, within an Oracle wallet, its trustpoints, the SSL adapter on the server will authorize the client. However, the client has the option of how much authorization is done against the server.

- The client can direct the SSL layer to authorize the server by setting up trustpoints.

- The client can authorize the server itself by extracting the server's certificate chain and parsing through the chain.

Setting Up Trust Points

The server automatically has trustpoints established through the installed Oracle Wallet. The trustpoints in the wallet are used to verify the client's certificates. However, if the client wants to verify the server's certificates against certain trustpoints, it can set up these trustpoints, as follows:

- If server-side authentication is requested, the client does not have any certificates set. Thus, to verify the server's certificates, the client can set a single trustpoint through JNDI, or if it is a pure CORBA application—that does not use JNDI—can add trustpoints through the `AuroraCertificateManager.addTrustedCertificate` method. See Example 6–4 on how to set a single trustpoint through JNDI.
- If client-side authentication is requested, the client has set up certificates. Thus, the client can add trustpoints to the file that contains its certificates, can add a single trustpoint through JNDI, or if it is a pure CORBA application—that does not use JNDI—can add trustpoints through the `AuroraCertificateManager.addTrustedCertificate` method.

If the client does not set up trust points, it does not hinder the authorization. That is, Oracle9*i* assumes that the client trusts the server.

Example 6–4 Verifying Trustpoints

The following example shows how the client sets up its trustpoints through JNDI. The JNDI `SECURITY_TRUSTED_CERT` property can take only a single certificate.

```
// setup the trust point
env.put(ServiceCtx.SECURITY_TRUSTED_CERT, trustedCert);
```

Parsing Through the Server's Certificate Chain

The client retrieves the certificates to perform any authorization checks. In the past, you could retrieve the single issuer certificate. Now, you receive the entire issuer certificate chain. You must parse the certificate chain for the information that you need. You can parse the chain through the `AuroraCurrent` object.

Note: You must configure the database and listener to be SSL-enabled, as described in Chapter 3, "Configuring IIOP Applications".

Note: JDK 1.1 certificate classes were contained within `javax.security.cert`. In JDK 1.2, these classes have been moved to `java.security.cert`.

`AuroraCurrent` contains three methods for retrieving and managing the certificate chain. For creating and parsing the certificate chain, you can use the `X509Cert` class methods. For information on this class, see the Sun Microsystems JDK documentation. Note that the `X509Cert` class manipulates the certificate chain differently in JDK 1.1 than in Java 2.

The `AuroraCurrent` class methods are as follows:

- `getPeerDERCertChain`—Obtain the peer's certificate chain, which enables you to verify that the peer is authorized to access your application methods.
- `getNegotiatedProtocolVersion`—Obtain the SSL protocol version being used by the connection, to verify the versioning.
- `getNegotiatedCipherSuite`—Obtain the cipher suite used to encrypt messages passed over the connection, to verify that the encryption is strong enough for your purposes.

When the handshake occurs, the protocol version and the type of encryption used is negotiated. The type of encryption can be full or limited encryption, which complies with the United States legal restrictions. After the handshake completes, the AuroraCurrent can retrieve what was resolved in the negotiation.

AuroraCurrent Class

The following describes the methods contained within `AuroraCurrent`. See Example 6–5 for a code example of these methods.

getNegotiatedCipherSuite

This method obtains the type of encryption negotiated in the handshake with the peer.

Syntax

```
String getNegotiatedCipherSuite(org.omg.CORBA.Object peer);
```

Parameter	Description
peer	the peer from which you obtain the negotiated cipher

Returns

This method returns a string with one of the following values:

Export ciphers:

- SSL_RSA_EXPORT_WITH_RC4_40_MD5
- SSL_RSA_EXPORT_WITH_DES40_CBC_SHA
- SSL_DH_anon_EXPORT_WITH_RC4_40_MD5
- SSL_DH_anon_EXPORT_WITH_DES40_CBC_SHA
- SSL_RSA_WITH_NULL_SHA
- SSL_RSA_WITH_NULL_MD5

Domestic ciphers:

- SSL_RSA_WITH_3DES_EDE_CBC_SHA
- SSL_RSA_WITH_RC4_128_SHA
- SSL_RSA_WITH_RC4_128_MD5
- SSL_RSA_WITH_DES_CBC_SHA
- SSL_DH_anon_WITH_3DES_EDE_CBC_SHA
- SSL_DH_anon_WITH_RC4_128_MD5
- SSL_DH_anon_WITH_DES_CBC_SH

getPeerDERCertificateChain

This method obtains the peer’s certificate chain. After retrieving the chain, you can parse through the certificates within the chain, to authorize the peer to your application.

Syntax

```
byte [] [] getPeerDERCertificateChain(org.omg.CORBA.Object peer);
```

Parameter	Description
peer	the peer from which you obtain its certificate chain

Returns

This method returns a byte array that contains an array of certificates.

getNegotiatedProtocolVersion

This method obtains the negotiated SSL protocol version of a peer.

Syntax

```
String getNegoriatedProtocolVersion(org.omg.CORBA.Object peer);
```

Parameter	Description
peer	the peer from which you obtain the negotiated protocol version

Returns

This method returns a string with one of the following values:

- SSL_Version_Undetermined
- SSL_Version_3_0

Example 6–5 Retrieving a Peer's SSL Information for Authorization

This example shows how to authorize a peer by retrieving the certificate information, using the `AuroraCurrent` object.

1. To retrieve an **`AuroraCurrent`** object, invoke the `ORB.resolve_initial_references` method with **`AuroraSSLCurrent`** as the argument.
2. Retrieve the SSL information from the peer through **`AuroraCurrent`** methods: **`getNegotiatedCipherSuite`**, **`getNegotiatedProtocolVersion`**, and **`getPeerDERCertChain`**.
3. Authorize the peer. You can authorize the peer based on its certificate chain.

Note: This example uses the `x509Certificate` class methods for parsing the certificate chain and is specific to Java 2. If you are using Java 1.1, you must use the `x509Certificate` class methods specific to Java 1.1.

```
static boolean verifyPeerCert(org.omg.CORBA.Object obj) throws Exception
 {
   org.omg.CORBA.ORB orb = oracle.aurora.jndi.orb_dep.Orb.init();

   // Get the SSL current
   AuroraCurrent current = AuroraCurrentHelper.narrow
       (orb.resolve_initial_references("AuroraSSLCurrent"));

   // Check the cipher
   System.out.println("Negotiated Cipher:  " +
                      current.getNegotiatedCipherSuite(obj));
   // Check the protocol version
   System.out.println("Protocol Version:   " +
                      current.getNegotiatedProtocolVersion(obj));
   // Check the peer’s certificate
   System.out.println("Peer’s certificate chain : ");
   byte [] [] certChain = current.getPeerDERCertChain(obj);

   //Parse through the certificate chain using the X509Certificate methods
   System.out.println("length : " + certChain.length);
   System.out.println("Certificates: ");
   CertificateFactory cf = CertificateFactory.getInstance("X.509");

   //For each certificate in the chain
   for(int i = 0; i < certChain.length; i++) {
     ByteArrayInputStream bais = new ByteArrayInputStream(certChain[i]);
     Certificate  xcert = cf.generateCertificate(bais);
     System.out.println(xcert);
     if(xcert instanceof X509Certificate)
     {
       X509Certificate x509Cert = (X509Certificate)xcert;
       String globalUser = x509Cert.getSubjectDN().getName();
       System.out.println("DN out of the cert : " + globalUser);
     }
   }

   return true;
 }
```

Note: The x509Certificate class is a Java 2 class. See the Sun Microsystems documentation for more information. In addition, you can find information in the javadoc for javax.net.ssl.

7 Transaction Handling

This chapter covers transaction management for CORBA applications. The CORBA developer can choose to use one of the following transactional APIs provided:

- Java Transaction API (JTA) by Sun Microsystems is a method for creating global transactions in a pure Java environment. JTA can be used in either a single or two-phase commit transaction. In addition, it can be demarcated either from the client or the server object.
- Java Transaction Service (JTS) is a mapping of a subset of the OMG Object Transaction Service (OTS) API that is supplied with Oracle9*i*. The CORBA developer invokes a transaction service to enable transactional properties for distributed objects in either a Java or non-Java environment. JTS can only be used in a single-phase commit transaction. In addition, it only supports client-side demarcation.

In Oracle9*i*, Java Transaction API (JTA) 1.0.1 for managing transactions. This chapter assumes that you have a working knowledge of JTA. The discussion focuses mostly on examples and explaining the differences between the Sun Microsystems JTA specification and the Oracle JTA implementation. See `http://www.javasoft.com` for the Sun Microsystems JTA specification.

- Creating DataSource Objects Dynamically
- Setting the Transaction Timeout
- JTA Limitations
- Java Transaction Service
- Transaction Service Interfaces
- JDBC Restrictions

Transaction Overview

Transactions manage changes to multiple databases within a single application as a unit of work. That is, if you have an application that manages data within one or more databases, you can ensure that all changes in all databases are committed at the same time if they are managed within a transaction.

Transactions are described in terms of ACID properties, which are as follows:

- *Atomic*: all changes to the database made in a transaction are rolled back if any change fails.
- *Consistent*: the effects of a transaction take the database from one consistent state to another consistent state.
- *Isolated*: the intermediate steps in a transaction are not visible to other users of the database.
- *Durable*: when a transaction is completed (committed or rolled back), its effects persist in the database.

The JTA implementation, specified by Sun Microsystems, relies heavily on the JDBC 2.0 specification and XA architecture. The result is a complex requirement on applications in order to ensure that the transaction is managed completely across all databases. Sun Microsystems's specifies Java Transaction API (JTA) 1.0.1 and JDBC 2.0 on `http://www.javasoft.com`.

You should be aware of the following when using JTA within the Oracle9*i* environment:

- Global and Local Transactions
- Demarcating Transactions
- Transaction Context Propagation
- Enlisting Resources

- Two-Phase Commit

Global and Local Transactions

Whenever your application connected to a database using JDBC or a SQL server, you were creating a transaction. However, the transaction involved only the single database and all updates made to the database were committed at the end of these changes. This is referred to as a local transaction.

A global transaction involves a complicated set of management objects—objects that track all of the objects and databases involved in the transaction. These global transaction objects—`TransactionManager` and `Transaction`—track all objects and resources involved in the global transaction. At the end of the transaction, the `TransactionManager` and `Transaction` objects ensure that all database changes are atomically committed at the same time.

Within a global transaction, you cannot execute a local transaction. If you try, the following error will be thrown:

```
ORA-2089 "COMMIT is not allowed in a subordinate session."
```

Some SQL commands implicitly execute a local transaction. All SQL DDL statements, such as "CREATE TABLE", implicitly starts and commits a local transaction under the covers. If you are involved in a global transaction that has enlisted the database that the DDL statement is executing against, the global transaction will fail.

Demarcating Transactions

A transaction is said to be demarcated, which means that each transaction has a definite start and stop point. For example, in a client-side demarcated transaction, the client starts the transaction with a `begin` method and completes the transaction with either executing the `commit` or `rollback` method.

The originating client or object that starts the transaction must also end the transaction with a commit or rollback. If the client begins the transaction, calls out to a server object, the client must end the transaction after the invoked method returns. The invoked server object cannot end the transaction.

In a distributed object application, transactions are demarcated differently if the originator is the client or the server. Where the transaction originates defines the transaction as *client-side demarcated* or *server-side demarcated*.

UserTransaction Interface

The following are the methods that you can use for transaction demarcation. These methods are defined within the `javax.transaction.UserTransaction` interface:

public abstract void begin() throws NotSupported, SystemException;

Creates a new transaction and associates the transaction with the thread.

Exceptions:

- `NotSupportedException`: Thrown if the thread is already involved with a transaction. Nested transactions are not supported.
- `SystemException`: Thrown if an unexpected error condition occurs.

public abstract void commit() throws RollbackException, HeuristicMixedException, HeuristicRollbackException, SecurityException, IllegalStateException, SystemException;

Completes the existing transaction by saving all changes to resources involved in the transaction. The thread is disassociated from this transaction when this method finishes.

Exceptions:

- `RollbackException`: Thrown if any resource within the transaction could not commit successfully. All resource changes are rolled back.
- `HeuristicMixedException`: Thrown to indicate that some of the resources were committed; some were rolled back.
- `HeuristicRollbackException`: Thrown to indicate that some updates to resources involved in the transaction were rolled back.
- `SecurityException`: Thrown when the thread is not allowed to commit the transaction based on a security violation.
- `IllegalStateException`: Thrown if the current thread has not been associated with a transaction. This occurs if you try to commit a transaction that was never started.
- `SystemException`: Thrown if an unexpected error condition occurs.

public abstract void rollback() throws IllegalStateException, SecurityException, SystemException;

Roll back the transaction associated with the current thread.

Exceptions:

- `SecurityException`: Thrown when the thread is not allowed to roll back the transaction based on a security violation.
- `IllegalStateException`: Thrown if the current thread has not been associated with a transaction. This occurs if you try to roll back a transaction that was never started.
- `SystemException`: Thrown if an unexpected error condition occurs.

public abstract int getStatus() throws SystemException;

Retrieve the transaction status associated with the current thread.

Exceptions:

- `SystemException`: Thrown if an unexpected error condition occurs.

public abstract void setRollbackOnly() throws IllegalStateException, SystemException;

Modify the transaction associated with the current thread so that the outcome results in a rollback.

Exceptions:

- `IllegalStateException`: Thrown if the current thread has not been associated with a transaction. This occurs if you try to set for a roll back a transaction that was never started.
- `SystemException`: Thrown if an unexpected error condition occurs.

public abstract setTransactionTimeout(int seconds) throws SystemException;

Set the timeout value in seconds for the transaction associated with this current thread. See "Setting the Transaction Timeout" on page 7-30 for more information on this method.

Exceptions:

- `SystemException`: Thrown if an unexpected error condition occurs.

Transaction Context Propagation

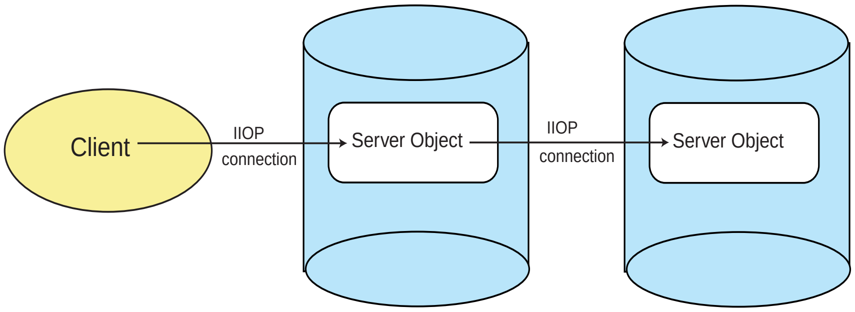
When you begin a transaction within either a client or a server instance, JTA denotes the originator in the transaction manager. As the transaction involves more objects and resources, the transaction manager tracks all of these objects and resources in the transaction and manages the transaction for these entities.

When an object calls another object, in order for the invoked object to be included in the transaction, JTA propagates the transaction context to the invoked object.

Propagation of the transaction context is necessary for including the invoked object into the global transaction.

As shown in Figure 7–1, if the client begins a global transaction, calls a server object in the database, the transaction context is propagated to the server object. If this server object invokes another server object, within the same or a remote database, the transaction context is propagated to this object as well. This ensures that all objects that are supposed to be involved in the global transaction are tracked by the transaction manager.

Figure 7–1 Connection to an Object over IIOP



Enlisting Resources

While there are several methods for retrieving a JDBC connection to a database, only one of these methods causes the database to be included in a JTA transaction. The following table lists the normal methods for retrieving JDBC connections:

Table 7–1 JDBC Methods

Retrieval Method	Description
`OracleDriver().defaultConnection()`	Pre-JDBC 2.0 method for retrieving the local connection. Use only within local transactions.
`DriverManager.getConnection("jdbc:oracle:kprb:")`	Pre-JDBC 2.0 method for retrieving the local connection. Use only within local transactions.
`DataSource.getConnection("jdbc:oracle:kprb:")`	JDBC 2.0 method for retrieving connections to the local databases. Can be used for JTA transactions.

Of these methods, only the `DataSource` object can be used to include a database resource in the global transaction. In order to ensure that the statements are included within a global transaction, you must do the following:

1. Bind a JTA `DataSource` object (`OracleJTADataSource`) in the JNDI namespace. There are several types of `DataSource` objects that you can bind. You must bind the JTA type in order for this database to be included in the global transaction.
2. The object method must retrieve the `DataSource` object from the JNDI namespace after the global transaction has started.
3. Retrieve the connection object from this `DataSource` object using the `getConnection` method.

An example is shown in "Enlisting Resources on the Server-side" on page 7-19.

If your transaction involves more than one database, you must specify an Oracle9*i* database as the two-phase commit engine. See "Configuring Two-Phase Commit Engine" on page 7-25 for more information.

Two-Phase Commit

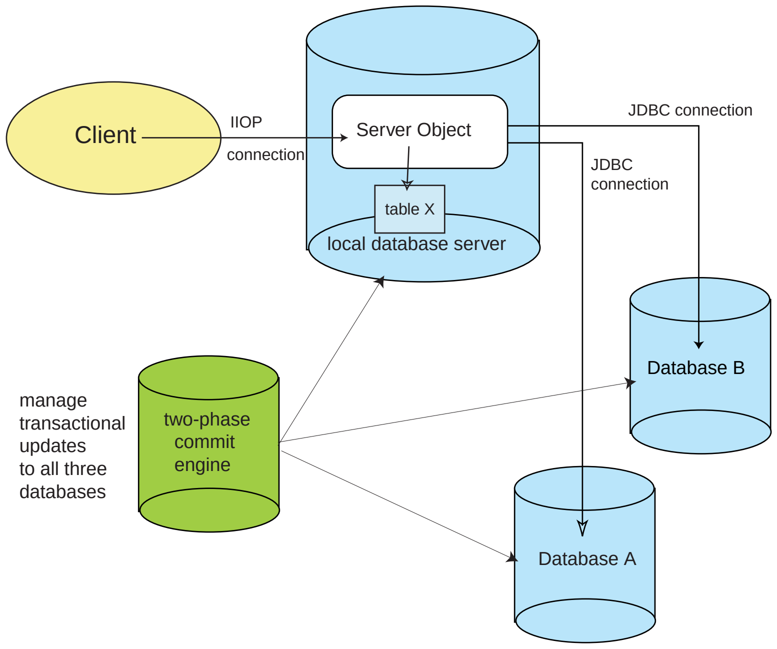
One of the primary advantages for a global transaction is the number of objects and database resources managed as a single unit within the transaction. If your global transaction involves more than one database resource, you must specify a two-phase commit engine, which is an Oracle9*i* database designated to manage the changes to all databases within the transaction. The two-phase commit engine is responsible for ensuring that when the transaction ends, all changes to all databases are either totally committed or fully rolled back.

On the other hand, if your global transaction has multiple server objects, but only a single database resource, you do not need to specify a two-phase commit engine. The two-phase commit engine is required only to synchronize the changes for multiple databases. If you have only a single database, single-phase commit can be performed by the transaction manager.

Note: Your two-phase commit engine can be any Oracle9*i* database. It can be the database where your server object exists, or even a database that is not involved in the transaction at all. See "Configuring Two-Phase Commit Engine" on page 7-25 for a full explanation of the two-phase commit engine setup.

Figure 7–2 shows three databases enlisted in a global transaction and another database that is designated as the two-phase commit engine. When the global transaction ends, the two-phase commit engine ensures that all changes made to the databases A, B, and the local are committed or rolled back simultaneously.

Figure 7–2 Two-Phase Commit for Global Transactions



JTA Summary

The following sections summarize the details for demarcating the transaction and enlisting the database in the transaction. These details are explained and demonstrated in the rest of the chapter. However, these tables provide a reference point for you.

Environment Initialization

Before you can retrieve the `UserTransaction` or `DataSource` bound objects from the JNDI namespace, you must provide the following before the JNDI lookup:

- authentication information, such as username and password
- namespace URL

Table 7–2 Environment Setup For Transactional Object Retrieval

Source	Qualifiers	Environment Setup
		Setup includes authentication information, and namespace URL
Client	Retrieves a remote object or a remote database connection.	Must always provide the environment setup before retrieving the `UserTransaction` from a remote JNDI provider. All JNDI providers are remote from a true client.
Server	■ Can use in-session activation to retrieve a local object or local database connection.	If the JNDI provider is within the same database as the object, it can use in-session lookup. Since the server uses its own session for the lookup, no setup is required.
	■ Retrieves a remote object or a remote database connection.	The JNDI provider is remote, so the server object must always provide the environment setup.

Methods for Enlisting Database Resources

The `DataSource` object is used to explicitly enlist the database in the JTA transaction. In order for the database to be correctly enlisted, the `DataSource` must be bound correctly, and the retrieval mechanism can be one of three methods. These are discussed below:

Table 7–3 JDBC 2.0 DataSource Overview

	JDBC 2.0 DataSource
Binding	You must bind a JTA `DataSource` into the namespace with the `bindds` command. The `bindds` command must contain the `-dstype jta` option.
Retrieving `DataSource` object from remote JNDI provider	**1.** Provide the environment `Hashtable`, which contains authentication information and namespace URL. **2.** Retrieve the `DataSource` object through a JNDI lookup that contains the "`jdbc_access://`" prefix.
Retrieving `DataSource` object from local JNDI provider	Retrieve the `DataSource` object using in-session activation. Environment setup and "`jdbc_access://`" prefix is not required.

Summary of Single-Phase and Two-Phase Commit

Table 7–4 summarizes the single-phase commit scenario. It covers the JNDI binding requirements and the application implementation runtime requirements.

Table 7–4 Single-Phase Commit

Aspect	Description
Binding	■ No binding required for `UserTransaction`. The `UserTransaction` object is created for you. ■ If using a `DataSource` object in the transaction, bind it using the `bindds` command.
Runtime	■ Retrieve the `UserTransaction` through a JNDI `lookup` with the "`java:comp/UserTransaction`" string, or a normal JNDI lookup. ■ Your runtime is responsible for starting and terminating the transaction. ■ If using the `DataSource` object to manage SQL DML statements within the transaction, retrieve the `DataSource`.

Table 7–5 summarizes the two-phase commit scenario.

Table 7–5 Two-Phase Commit Requirements

Aspect	Requirements
Binding `UserTransaction` One of two scenarios:	Scenario one is where you bind the `UserTransaction` WITH a username and password that is to be used to complete all global transactions started from this `UserTransaction`. ■ You bind a `UserTransaction` object with the fully-qualified database address of the two-phase commit engine and its username and password. ■ You bind `DataSource` objects for each database involved in the transaction with a fully-qualified public database link from the two-phase commit engine to itself.
	Scenario two is where you bind the `UserTransaction` WITHOUT a username and password. Thus, the username that is used when retrieving the `UserTransaction` is the user that completes the transaction. ■ You bind a `UserTransaction` object with the fully-qualified database address of the two-phase commit engine. ■ You bind `DataSource` objects for each database involved in the transaction with a fully-qualified public database link from the two-phase commit engine to itself.

Table 7–5 Two-Phase Commit Requirements (Cont.)

Aspect	**Requirements**
Binding `DataSource`	You must bind a JTA `DataSource` for each database involved in the transaction. You must create public database links, as discussed in the System Administration section.
System Administration	■ The user that completes the transaction (as described in the binding section) must have the privilege to commit the transaction on all included databases. There are one of two methods for ensuring that the user can complete the transaction. - If the username is not bound with the `UserTransaction` object, the user that retrieves the `UserTransaction` both starts and stops the transaction. Thus, this user must be created on all involved database in order to be able to open a session to all databases. - If the username is bound with the `UserTransaction` object is different than the user that retrieves the `UserTransaction` object, the username bound with the `UserTransaction` object must be given explicit privilege to complete a transaction it did not start. Thus, make sure that this user exists on each database in order to open sessions to all databases and grant it the "`CONNECT`, `REMOVE`, `CREATE SESSION`, and `FORCE ANY TRANSACTION`" privileges on each database. ■ Create public database links from the two-phase commit engine to each database involved.
Runtime	Runtime requirements are the same as indicated in the single-phase commit table.

JTA Server-Side Demarcation

To retrieve any objects or database resources, you can perform in-session activation or remote lookup.

- In-session activation: Server objects can be local or remote, the `UserTransaction` is always local, and `DataSource` objects can be local or remote. For local retrieval of any of these objects, you can activate these objects within this session. The namespace is always local, so you do not have to provide authentication information, namespace URL, or the "`jdbc_access://`" prefix. In this scenario, the `lookup` would require only the JNDI name, In addition, the initial context can be created without any set environment.
- Remote retrieval: The server object and / or the `DataSource` object is remote, so you must still provide all of the same information that was provided in the client scenario: authentication information, namespace URL, and the "`jdbc_access://`" prefix. For remote retrieval, perform exactly as demonstrated in the "JTA Client-Side Demarcation" on page 7-14.

Example 7–1   Server-Side Demarcation for Single-Phase Commit

The following example demonstrates a server object performing an in-session lookup of the `UserTransaction` and `DataSource` objects. This example uses a single phase commit transaction. Notice that because this is an in-session activation, none of the following are needed: authentication information, location of the namespace, and the "`jdbc_access://`" prefix.

Note: To modify this for two-phase commit, supply a username and password within the environment passed into the initial context constructor.

```
ic = new InitialContext ( );

// lookup the usertransaction
UserTransaction ut = (UserTransaction)ic.lookup ("/test/myUT");
...
ut.begin ();

// Retrieve the DataSource
DataSource ds = (DataSource)ic.lookup ("/test/empDB");

// Get connection to the database through DataSource.getConnection
```

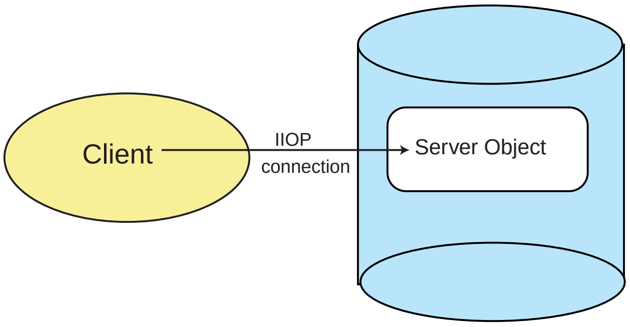
```
Connection conn = ds.getConnection ();
```

JTA Client-Side Demarcation

For JTA, client-side demarcated transactions are programmatically demarcated through the `UserTransaction` interface (see "UserTransaction Interface" on page 7-4). A `UserTransaction` object must be bound with the `bindut` command into the namespace (see "Bind UserTransaction Object in the Namespace" on page 7-22). With client-side transaction demarcation, the client controls the transaction. The client starts a global transaction by invoking the `UserTransaction` `begin` method; it ends the transaction by invoking either the `commit` or `rollback` methods. In addition, the client must always set up an environment including a `Hashtable` with authentication information and namespace location URL.

Figure 7–3 shows a client invoking a server object. The client starts a global transaction, then invokes the object. The transactional context is propagated to include the server object.

Figure 7–3 Client Demarcated Global Transaction



The following must occur for the client to demarcate the transaction:

1. Initialize a `Hashtable` environment with the namespace address and authentication information.
2. Retrieve the `UserTransaction` object from the namespace within the client logic. When you retrieve the `UserTransaction` object from any client, the URL must consist of "`jdbc_access://`" prefix before the JNDI name.
3. Start the global transaction within the client using `UserTransaction.begin()`.

4. Retrieve the server object.
5. Invoke any object methods to be included in the transaction.
6. End the transaction through `UserTransaction.commit()` or `UserTransaction.rollback()`.

Example 7–2 shows a client that invokes a server object within the transaction.

Example 7–2 Bind UserTransaction Object in Namespace

Before starting the client, you must first bind the `UserTransaction` object in the namespace. To bind a `UserTransaction` object to the name "`/test/myUT`" in the namespace located on `nsHost`, execute the following:

```
sess_sh -service jdbc:oracle:thin:@nsHost:5521:ORCL -user SCOTT -password TIGER
& bindut /test/myUT
```

See "Bind UserTransaction Object in the Namespace" on page 7-22 for more information.

Developing the Client Application

After binding the `UserTransaction` object, your client code can retrieve the `UserTransaction` object and start a global transaction. Since the client is retrieving the `UserTransaction` object from a remote site, the lookup requires authentication information, location of the namespace, and the "`jdbc_access://`" prefix.

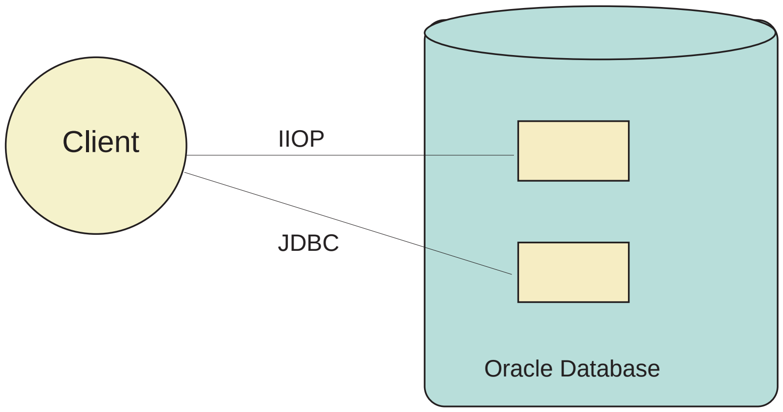
```
EmployeeInfo info;
String sessiiopURL = args [0];
String objectName = args [1];

//Set up the service URL to where the UserTransaction object
//is bound. Since from the client, the connection to the database
//where the namespace is located can be communicated with over either
//a Thin or OCI JDBC driver. This example uses a Thin JDBC driver.
String namespaceURL = "jdbc:oracle:thin:@nsHost:1521:ORCL";

// lookup usertransaction object in the namespace
//1.(a) Authenticate to the database.
// create InitialContext and initialize for authenticating client
Hashtable env = new Hashtable ();
env.put (Context.URL_PKG_PREFIXES, "oracle.aurora.jndi");
env.put (Context.SECURITY_PRINCIPAL, "SCOTT");
env.put (Context.SECURITY_CREDENTIALS, "TIGER");
env.put (Context.SECURITY_AUTHENTICATION, ServiceCtx.NON_SSL_LOGIN);
//1.(b) Specify the location of the namespace where the transaction objects
//   are bound.
env.put(jdbc_accessURLContextFactory.CONNECTION_URL_PROP, namespaceURL);
Context ic = new InitialContext (env);

//2. Retrieve the UserTransaction object from JNDI namespace
UserTransaction  ut = (UserTransaction)ic.lookup ("jdbc_access://test/myUT");

//3. Start the transaction
ut.begin();

//4. Retrieve the server object reference
// lookup employee object in the namespace
Employee employee = (Employee)ic.lookup
              ("sess_iiop://myhost:1521:orcl/test/employee");

//5. Perform business logic.
...

//6. End the transaction
//Commit the updated value
ut.commit ();
```

JTA Client-Side Demarcation Including Databases

The previous example showed how a transaction context was propagated to server objects from a client within the JTA global transaction. When you execute the server object, the transaction is propagated over the IIOP transport layer. In addition to invoking IIOP server objects, you may wish to update databases over JDBC connections. This section shows how you enlist databases using a JDBC connection in tandem with the IIOP server object propagation.

Figure 7–4 demonstrates how the client can open both an IIOP and a JDBC connection to the database. To open the JDBC connection within the context of a global transaction, you must use a JTA `DataSource` object.

Figure 7–4 Client Creating Both JDBC and IIOP Connections



To include a remote database within the transaction from a client, you must use a `DataSource` object, which has been bound in the namespace as a JTA `DataSource`. Then, invoke the `getConnection` method of the `DataSource` object after the transaction has started, and the database is included in the global transaction. See "Enlisting Resources" on page 7-6 for more information.

The following must occur in the client runtime to demarcate the transaction:

1. Initialize a `Hashtable` environment with the namespace address and authentication information.
2. Retrieve the `UserTransaction` object from the namespace within the client logic. When you retrieve the `UserTransaction` object from the client, the URL must consist of "`jdbc_access://`" prefix before the JNDI name.
3. Start the global transaction within the client using `UserTransaction.begin()`.
4. Enlist any database resources to be included in the transaction by opening a connection to the specified database, as follows:
   a. Retrieve the `DataSource` object from the namespace within the client logic. When you retrieve the `DataSource` object from any client, the URL must consist of "`jdbc_access://`" prefix before the JNDI name.
   b. Open a connection to the database through `DataSource.getConnection` method.
5. Retrieve the object reference.

6. Invoke any object methods to be included in the transaction.
7. Invoke SQL DML statements against any enlisted databases. SQL DDL creates a local transaction that will abort the global transaction. Thus, SQL DDL cannot be executed within a JTA transaction.
8. End the transaction through `UserTransaction.commit()` or `UserTransaction.rollback()`.

Example 7–3 shows a client that invokes a server object and enlists a single database within the transaction.

Example 7–3 Employee Client Code for Client Demarcated Transaction

Before starting the client, you must first bind the `UserTransaction` and `DataSource` objects in the JNDI namespace. See "Bind UserTransaction Object in the Namespace" on page 7-22 and "Bind DataSource Object in the Namespace" on page 7-24 for directions on the binding these objects.

```
sess_sh -service jdbc:oracle:thin:@nsHost:5521:ORCL -user SCOTT -password TIGER
> bindut /test/myUT
> bindds /test/DataSource/empDB -url jdbc:oracle:thin:@empHost:5521:ORCL
                               -dstype jta
```

Developing the Client Application

The following example follows the steps listed in "JTA Client-Side Demarcation Including Databases" on page 7-16.

```
//Set up the service URL to where the UserTransaction object
//is bound. Since from the client, the connection to the database
//where the namespace is located can be communicated with over either
//a Thin or OCI JDBC driver. This example uses a Thin JDBC driver.
String namespaceURL = "jdbc:oracle:thin:@nsHost:1521:ORCL";

// lookup usertransaction object in the namespace
//1.(a) Authenticate to the database.
// create InitialContext and initialize for authenticating client
Hashtable env = new Hashtable ();
env.put (Context.URL_PKG_PREFIXES, "oracle.aurora.jndi");
env.put (Context.SECURITY_PRINCIPAL, "SCOTT");
env.put (Context.SECURITY_CREDENTIALS, "TIGER");
env.put (Context.SECURITY_AUTHENTICATION, ServiceCtx.NON_SSL_LOGIN);
//1.(b) Specify the location of the namespace where the transaction objects
//   are bound.
env.put(jdbc_accessURLContextFactory.CONNECTION_URL_PROP, namespaceURL);
```

```
Context ic = new InitialContext (env);

//2. Retrieve the UserTransaction object from JNDI namespace
ut = (UserTransaction)ic.lookup ("jdbc_access://test/myUT");

//3. Start the transaction
ut.begin();

//4.(a) Retrieve the DataSource (that was previously bound with bindds in
// the namespace. After retrieving the DataSource...
// get a connection to a database. You need to provide authentication info
// for a remote database lookup, similar to what you would do from a client.
// In addition, if this was a two-phase commit transaction, you must provide
// the username and password.
DataSource ds = (DataSource)ic.lookup ("jdbc_access://test/empDB");

//4.(b). Get connection to the database through DataSource.getConnection
// in this case, the database requires the same username and password as
// set in the environment.
Connection conn = ds.getConnection ("SCOTT", "TIGER");

//5. Retrieve the server object reference
// lookup employee object in the namespace
Employee employee = (Employee)ic.lookup (sessiiopURL + objectName);

//6. Perform business logic.
...

//7. Close the database connection.
conn.close ();

//8. End the transaction
//Commit the updated value
ut.commit ();
}
```

Enlisting Resources on the Server-side

The databases that the object accesses must be enlisted to be included within the global transaction. This is discussed more in "Enlisting Resources" on page 7-6 and "Bind DataSource Object in the Namespace" on page 7-24.

If you access an Oracle9*i* database from the server that should be included in the transaction, you must open the connection to the database after the global transaction starts.

Note: At this time, the Oracle JTA implementation does not support including non-Oracle databases in a global transaction.

Example 7–4 Enlist Database in Single Phase Transaction

The following example enlists a database in the global transaction.

```
//retrieve the initial context.
InitialContext ic = new InitialContext ();

// lookup the usertransaction
UserTransaction ut = (UserTransaction)ic.lookup ("/test/myUT");

//start the transaction
ut.begin ();

// get a connection to the local database. If this was a two-phase commit
// transaction, you would provide the username and password for the 2pc engine
DataSource ds = (DataSource)ic.lookup (dsName);

// get connection to the local database through DataSource.getConnection
Connection conn = ds.getConnection ("SCOTT", "TIGER");

//perform your SQL against the database.
//prepare and execute a sql statement. retrieve the employee’s selected benefits
PreparedStatement ps =
    conn.prepareStatement ("update emp set ename = :(employee.name),
          sal = :(employee.salary) where empno = :(employee.number)");
    .... //do work
 ps.close();
}

//close the connection
conn.close();

// commit the transaction
ut.commit ();

//return the employee information.
return new EmployeeInfo (name, empno, (float)salary);
```

Example 7–5 Using SQLJ with Explicit Enlistment

As in Example 7–4, you would retrieve the JTA `DataSource` from the JNDI provider, retrieve the connection, retrieve a context from that connection, and then provide the context on the SQLJ command-line.

```
//retrieve the initial context.
InitialContext ic = new InitialContext ();

// lookup the usertransaction
UserTransaction ut = (UserTransaction)ic.lookup ("/test/myUT");

//start the transaction
ut.begin ();

// get a connection to the local database. If this was a two-phase commit
// transaction, you would provide the username and password for the 2pc engine
DataSource ds = (DataSource)ic.lookup (dsName);

// get connection to the local database through DataSource.getConnection
Connection conn = ds.getConnection ("SCOTT", "TIGER");

//setup the context for issuing SQLJ against the database
DefaultContext defCtx = new DefaultContext (conn);

//issue SQL DML statements against the database
#sql [defCtx] { update emp set ename = :(remoteEmployee.name),
             sal = :(remoteEmployee.salary)
               where empno = :(remoteEmployee.number) };

//close the connection
conn.close();

// commit the transaction
ut.commit ();

//return the employee information.
return new EmployeeInfo (name, empno, (float)salary);
```

Binding Transactional Objects in the Namespace

For most global transactions, you will need to bind at least one of the following objects in the namespace:

- `UserTransaction` object

- DataSource object—Necessary for specifying databases that will be included in the transaction.

Bind UserTransaction Object in the Namespace

The bindut command binds a UserTransaction object in the namespace. This object is used for demarcation of global transactions by either a client or by an object.

You must bind a UserTransaction object for both single and two-phase commit transactions through the bindut command of the sess_sh tool.

The options used to bind a UserTransaction object depend on whether the transaction uses a single or two-phase commit, as described below:

Single-Phase Commit Binding for UserTransaction Single-phase commit requires the JNDI bound name for the UserTransaction object. You do not need to provide the address to a two-phase commit engine. For example, the following binds a UserTransaction with the name of "/test/myUT" that exists for a single-phase commit transaction:

```
bindut /test/myUT
```

To bind a UserTransaction object to the name "/test/myUT" in the namespace located on nsHost through the sess_sh command, execute the following:

```
sess_sh -service jdbc:oracle:thin:@nsHost:5521:ORCL -user SCOTT -password TIGER
& bindut /test/myUT
```

Two-Phase Commit Binding for UserTransaction Two-phase commit binding requires the JNDI bound name for the UserTransaction object and the address to a two-phase commit engine. You provide a URL for the two-phase commit engine in the bindut command, which can be either a JDBC URL or a sess_iiop URL.

Note: The client needs the same information to retrieve the UserTransaction as you give within the bindut command.

In addition, you can bind a username and password with the UserTransaction object.

- If you do not bind a username and password with the UserTransaction, the user that retrieved the UserTransaction will be the same user that is used to perform the commit or rollback for the two-phase commit on all involved databases.

- If you bind a username and password with the `UserTransaction`, then this is the username that the two-phase commit will be committed or rolled back with on all involved databases. The transaction will be started by the user that retrieves the `UserTransaction` object; it will be completed by the user bound with the `UserTransaction` object.

The username that is used to commit or rollback the two-phase commit transaction must be created on the two-phase commit engine and on each database involved in the transaction. It needs to be created so that it can open a session from the two-phase commit engine to each of the involved databases using database links. Secondly, it must be granted the `CONNECT`, `RESOURCE`, `CREATE SESSION` privileges to be able to connect to each of these databases. For example, if the user that is needed for completing the transaction is SCOTT, you would do the following on the two-phase commit engine and each database involved in the transaction:

```
CONNECT SYSTEM/MANAGER;
CREATE USER SCOTT IDENTIFIED BY SCOTT;
GRANT CONNECT, RESOURCE, CREATE SESSION TO SCOTT;
```

Lastly, if you bound a username and password with the `UserTransaction` object, it will be using a different username to finalize the transaction than the username used to start the transaction. For this to be allowed, you must grant the `FORCE ANY TRANSACTION` privileges on each database involved in the transaction in order for two separate users to start and stop the transaction. If `SCOTT` is the username bound with the `UserTransaction` object, you would need to do the following in addition to the previous grant:

```
GRANT FORCE ANY TRANSACTION TO SCOTT;
```

The following binds a `UserTransaction` with the name of "`/test/myUT`" and a two-phase commit engine at "`2pcHost`" using a JDBC URL:

```
bindut /test/myUT -url jdbc:oracle:thin:@2pcHost:5521:ORCL
```

To bind the `UserTransaction` in the namespace designating the two-phase commit engine at `dbsun.mycompany.com` with a `sess_iiop` URL:

```
bindut /test/myUT -url sess_iiop://dbsun.mycompany.com:2481:ORCL
```

When the transaction commits, the `UserTransaction` communicates with the two-phase engine designated in the `-url` option to commit all changes to all included databases. In this example, the username and password were not bound with the `UserTransaction` object, so the user that retrieves the `UserTransaction` object from the JNDI namespace is used to start and stop the transaction. Thus, this user must exist on all involved databases and the two-phase commit engine. The `UserTransaction` tracks all databases involved in the transaction; the two-phase commit engine uses the database links for these databases to complete the transaction.

Note: If you change the two-phase commit engine, you must update all database links on all `DataSource` objects involved in the transaction, and rebind the `UserTransaction`.

Bind DataSource Object in the Namespace

The `bindds` command binds a `DataSource` object in the JNDI namespace. In order to enlist any database in a global transaction—including the local database—you must bind a JTA `DataSource` object to identify each database included in the transaction. There are multiple types of `DataSource` objects for use with certain scenarios. However, for use with JTA transactions, you must bind a JTA `DataSource` object, also known as an `OracleJTADataSource` object, to identify each database included in the transaction. See the `bindds` command of the `sess_sh` tool in the *Oracle9i Java Tools Reference* for a description of other `DataSource` object types.

Single-Phase Commit Scenario In a single-phase commit scenario, the transaction only includes a single database in the transaction. Since no coordination for updates to multiple databases is needed, you do not need to specify a coordinator. Instead, you simply provide the JNDI bound name and the URL address information for this database within the `OracleJTADataSource` object. You do not need to provide a database link for a transaction coordinator.

Use the `bindds` command of the `sess_sh` tool to bind an `DataSource` object in the namespace. The full command is detailed in the *Oracle9i Java Tools Reference*. For example, the following binds an `OracleJTADataSource` with the name of "`/test/empDS`" that exists within a single-phase commit transaction with the `bindds` command:

```
bindds /test/empDS -url jdbc:oracle:thin:@empHost:5521:ORCL -dstype jta
```

After binding the `DataSource` object in the namespace, the server can enlist the database within a global transaction.

Two-Phase Commit Scenario If multiple databases are to be included in the global transaction, you will need a two-phase commit engine, which is an Oracle9*i* database that is configured to be the transaction coordinator. Basically, the two-phase commit engine must have database links to each of the databases involved in the transaction. When the transaction ends, the transaction manager notifies the two-phase commit engine to either coordinate the commit of all changes to all involved databases or coordinate a roll back of these same changes.

In order to facilitate this coordination, you must configure the following:

1. Your system administrator must create fully-qualified public database links from the two-phase commit engine (Oracle9*i* database) to each database involved in the transaction. These database link names must be included when binding the `OracleJTADataSource` object.
2. Bind a JTA `DataSource` (`OracleJTADataSource`) object for each database in the transaction. You must include the following in the bindds command:
   a. The JNDI bound name for the object
   b. The URL for creating a connection to the database
   c. The fully-qualified public database link from the two-phase commit engine to this database

Note: In a two-phase commit scenario, the `DataSource` object is bound, with respect to the two-phase commit engine. If you change the two-phase commit engine, you must update all database links, and rebind all concerned `DataSource` and `UserTransaction` objects.

The following example binds the `empDS` JTA `DataSource` into the namespace with `2pcToEmp` as the database link name created on the two-phase commit engine:

```
% bindds /test/empDS -url jdbc:oracle:thin:@dbsun:5521:ORCL
                    -dstype jta -dblink 2pcToEmp.oracle.com
```

Configuring Two-Phase Commit Engine

When multiple databases are included in a global transaction, the changes to these resources must all be committed or rolled back at the same time. That is, when the transaction ends, the transaction manager contacts a coordinator—also known as a two-phase commit engine—to either commit or roll back all changes to all included databases. The two-phase commit engine is an Oracle9*i* database that is configured with the following:

- Fully-qualified database links from the itself to each of the databases involved in the transaction. When the transaction ends, the two-phase commit engine communicates with the included databases over their fully-qualified database links.
- A user that is designated to create sessions to each database involved and is given the responsibility of performing the commit or rollback. The user that does the communication must be created on all involved databases and be given the appropriate privileges.

In order to facilitate this coordination, you must configure the following:

1. Designate an Oracle9*i* database as the two-phase commit engine.
2. Configure fully-qualified public database links (using the `CREATE DATABASE LINK` command) from the two-phase commit engine to each database that may be involved in the global transaction. This is necessary for the two-phase commit engine to communicate with each database at the end of the transaction. These database link names must be included when binding the JTA `DataSource` (`OracleJTADataSource)` object.
3. Bind a JTA `DataSource` (`OracleJTADataSource`) object for each database in the transaction. You must include the following in the `bindds` command:
   a. The JNDI bound name for the object
   b. The URL for creating a connection to the database
   c. The fully-qualified database link from the two-phase commit engine to this database

      Provide the fully-qualified database link name in the `-dblink` option of `bindds` for each individual database when binding that database's `DataSource` into the namespace.

      ```
      bindds /test/empDS -url jdbc:oracle:thin:@empHost:5521:ORCL
           -dstype jta -dblink 2pcToEmp.oracle.com
      ```

Note: In a two-phase commit scenario, the `DataSource` object is bound, with respect to the two-phase commit engine. If you change the two-phase commit engine, you must update all database links, and rebind all concerned `DataSource` and `UserTransaction` objects.

---

4. Create the user on the two-phase commit engine that facilitates the two-phase commit. This user will open sessions to each resource involved in the transaction and complete the transaction. To do this, the user must be created on each database and granted `CONNECT`, `RESOURCE`, and `CREATE SESSION` privileges. If the user that completes the transaction is different from the user that starts the transaction, you also need to grant the `FORCE ANY TRANSACTION` privilege. These privileges must be granted on all databases included in the transaction.

   The decision on whether the `FORCE ANY TRANSACTION` privilege is needed is determined by whether you bound a username and password with the `UserTransaction` object.

   - If you do not bind a username and password with the `UserTransaction`, the user that retrieved the `UserTransaction` will be the same user that is used to perform the commit or rollback for the two-phase commit on all involved databases.
   - If you bind a username and password with the `UserTransaction`, then this is the username that the two-phase commit will be committed or rolled back with on all involved databases. The transaction will be started by the user that retrieves the `UserTransaction` object.

   Both types of users must be created, so that it can open a session from the two-phase commit engine to each of the involved databases. Secondly, it must be granted the `CONNECT`, `RESOURCE`, `CREATE SESSION` privileges to be able to connect to each of these databases. For example, if the user that is needed for completing the transaction is SCOTT, you would do the following on the two-phase commit engine and each database involved in the transaction:

   ```
   CONNECT SYSTEM/MANAGER;
   CREATE USER SCOTT IDENTIFIED BY SCOTT;
   GRANT CONNECT, RESOURCE, CREATE SESSION TO SCOTT;
   ```

   Lastly, if you bound a username and password with the `UserTransaction` object, it will be using a different username to finalize the transaction than the username used to start the transaction. For this to be allowed, you must grant the `FORCE ANY TRANSACTION` privileges on each database involved in the transaction in order for two separate users to start and stop the transaction.

The advantage of binding a username with the `UserTransaction` is that it is treated as a global user is always committing all transactions started with this `UserTransaction` object. Thus, if you have more than one JTA transactions, you will only have to create one user and grant privileges to that user on all involved databases.

For example, if `SCOTT` is the username bound with the `UserTransaction` object, you would need to do the following in addition to the previous grant:

```
GRANT FORCE ANY TRANSACTION TO SCOTT;
```

5. Bind a `UserTransaction` into the namespace. You must provide the two-phase commit engine's fully-qualified database address. At this point, you should decide (based on the discussion in step 3) on whether to bind it with a username and password. The following assumes a global username is bound with the `UserTransaction`.

```
bindut /test/myUT -url sess_iiop://dbsun.mycompany.com:2481:ORCL
                     -user SCOTT -password TIGER
```

Example 7–6 Two-Phase Commit Example

The following example shows a server object that performs an in-session activation to retrieve both the `UserTransaction` and `DataSource` objects that have been bound locally. The `UserTransaction` was bound with the two-phase commit engine's URL, username, and password. The `DataSource` objects were all bound with the proper database links.

```
//with the environment set, create the initial context.
InitialContext ic = new InitialContext ();
UserTransaction ut = (UserTransaction)ic.lookup ("/test/myUT");

//With the same username and password for the 2pc engine,
// lookup the local datasource and a remote database.
DataSource localDS = (DataSource)ic.lookup ("/test/localDS");

//remote lookup requires environment setup
Hashtable env = new Hashtable ();
env.put (Context.URL_PKG_PREFIXES, "oracle.aurora.jndi");
env.put (Context.SECURITY_PRINCIPAL, user);
env.put (Context.SECURITY_CREDENTIALS, password);
env.put (Context.SECURITY_AUTHENTICATION, ServiceCtx.NON_SSL_LOGIN);
env.put(jdbc_accessURLContextFactory.CONNECTION_URL_PROP, namespaceURL);
Context ic = new InitialContext (env);

//retrieve the DataSource for the remote database
DataSource remoteDS = (DataSource)ic.lookup ("jdbc_access://test/NewYorkDS");

//retrieve connections to both local and remote databases
Connection localConn = localDS.getConnection ();
Connection remoteConn = remoteDS.getConnection ();
...
//close the connections
localConn.close();
remoteConn.close();

//end the transaction
 ut.commit();
```

Creating DataSource Objects Dynamically

If you want to bind only a single DataSource object in the namespace to be used for multiple database resources, you must do the following:

1. Bind the DataSource without specifying the URL, host, port, SID, or driver type. Thus, you execute the bindds tool with only the -dstype jta option, as follows:

   ```
   sess_sh -service jdbc:oracle:thin:@nsHost:5521:ORCL -user SCOTT -password
   TIGER
   & bindds /test/empDS -dstype jta
   ```

2. Retrieve the DataSource in your code. When you perform the lookup, you must cast the returned object to OracleJTADataSource instead of DataSource. The Oracle-specific version of the DataSource class contains methods to set the DataSource properties.
3. Set the following properties:
   - Set the URL with the OracleJTADataSource.setURL method
   - Fully-qualified database link if using two-phase commit engine with the OracleJTADataSource.setDBLink method

4. Retrieve the connection through the `OracleJTADataSource.getConnection` method as indicated in the other examples.

Example 7–7 Retrieving Generic DataSource

The following example retrieves a generically bound `DataSource` from the namespace using in-session lookup and initializes all relevant fields.

```
//retrieve an in-session generic DataSource object
OracleJTADataSource ds =
      (OracleJTADataSource)ic.lookup ("java:comp/env/test/empDS");

//set all relevant properties for my database
//URL is for a local database so use the KPRB URL
ds.setURL ("jdbc:oracle:kprb:");
//Used in two-phase commit, so provide the fully qualified database link that
//was created from the two-phase commit engine to this database
ds.setDBLink("localDB.oracle.com");

//Finally, retrieve a connection to the local database using the DataSource
Connection conn = ds.getConnection ();
```

Setting the Transaction Timeout

A global transaction automatically has an idle timeout of 60 seconds. If the session attached to the transaction is idle for over the timeout limit, the transaction is rolled back. If any activity occurs within this timeframe, the timeout is reset to zero.

To initialize a different timeout, set the timeout value—in seconds—through the `setTransactionTimeout` method before the transaction is begun. If you change the timeout value after the transaction begins, it will not affect the current transaction. The following example sets the timeout to 2 minutes (120 seconds) before the transaction begins.

```
//create the initial context
InitialContext ic = new InitialContext ( );

//retrieve the UserTransaction object
ut = (UserTransaction)ic.lookup ("/test/myUT");

//set the timeout value to 2 minutes
ut.setTransactionTimeout (120);

//begin the transaction
```

```
ut.begin

//Update employee table with new employees
updateEmployees(emp, newEmp);

//end the transaction.
ut.commit ();
```

JTA Limitations

The following are the portions of the JTA specification that Oracle9*i* does not support.

Nested Transactions

Nested transactions are not supported in this release. If you attempt to begin a new transaction before committing or rolling back any existing transaction, the transaction service throws a `NotSupportedException` exception.

Interoperability

The transaction services supplied with this release do not interoperate with other JTA implementations.

Timeouts

The global transaction timeout does not work. In addition, the `UserTransaction` idle timeout (`setTransactionTimeout` method) starts only when a database connection is closed and idle. Oracle recommends that you do not use timeouts.

Java Transaction Service

With JTS, you demarcate the transaction off of a transaction context, which you can retrieve from the `TransactionService` object. The transaction context contains the begin, commit, rollback, suspend, and resume methods. One of the disadvantages to JTS is that you cannot use a two-phase commit engine to coordinate changes to multiple databases. The advantage to JTS is that you can suspend and resume the transaction. Also, because it is specific to CORBA, you can use either Java or non-Java languages in your application.

This implementation of JTS does not manage distributed transactions. Transaction control distributed among multiple database servers, with support for the required two-phase commit protocol, is only available within the JTA implementation.

The JTS transaction API supplied with Oracle9*i* manages only one resource: an Oracle9*i* database session. A transaction exists within only a single server, which means that it cannot span multiple servers or multiple database sessions in a single service. Transaction contexts are never propagated outside a server. If a server object calls out to another server, the transaction context is not carried along. However, a transaction can involve one or many objects. The transaction can encompass one or many methods within these objects.

Whether you demarcate the transaction on the client or the server, the following must occur:

1. Initialize the `TransactionService` object.

   Oracle9*i* automatically initializes this object for any server objects; thus, only the client must explicitly initialize this object. The initialization is accomplished through the `AuroraTransactionService.initialize` method.
2. Retrieve the `TransactionService` object through the static `TS.getTS` method.
3. Retrieve the current transaction context through the `TransactionService.getCurrent` method.
4. Manage the transaction through the following transaction context (`Current` class) methods: `begin`, `commit`, `rollback`, `rollback_only`, `suspend`, `resume`.

JTS Client-Side Demarcation

The only difference between client and server-side demarcation is that the client must initialize the `TransactionService` object before retrieving it. The client initializes a `TransactionService` object on the intended server. Since JTS can only manage a transaction within a single server, the client should invoke server objects that exist only on that single server. In addition, any SQL statements executed against the database should also be solely applied to the same server.

The following example demonstrates the steps required for a client-side demarcation:

1. Initialize the `TransactionService` object. The initialization is accomplished through the `AuroraTransactionService.initialize` method.
2. Retrieve the `TransactionService` object through the static `TS.getTS` method.

3. Retrieve the current transaction context through the `TransactionService.getCurrent` method.
4. Manage the transaction through the following transaction context (`Current` class) methods: `begin`, `commit`, `rollback`, `rollback_only`, `suspend`, `resume`.

Example 7–8 Client-Side Demarcation for JTS Example

```
import employee.*;
import oracle.aurora.jndi.sess_iiop.ServiceCtx;
import oracle.aurora.jts.client.AuroraTransactionService;
import oracle.aurora.jts.util.*;
import javax.naming.Context;
import javax.naming.InitialContext;
import java.util.Hashtable;

public class Client
{
  public static void main (String[] args) throws Exception {
    if (args.length != 4) {
      System.out.println ("usage: Client serviceURL objectName user password");
      System.exit (1);
    }
    String serviceURL = args [0];
    String objectName = args [1];
    String user = args [2];
    String password = args [3];

    //The environment must be setup with the correct authentication
    //and prefix information before you create the initial context
    Hashtable env = new Hashtable ();
    env.put (Context.URL_PKG_PREFIXES, "oracle.aurora.jndi");
    env.put (Context.SECURITY_PRINCIPAL, user);
    env.put (Context.SECURITY_CREDENTIALS, password);
    env.put (Context.SECURITY_AUTHENTICATION, ServiceCtx.NON_SSL_LOGIN);
    Context ic = new InitialContext (env);

    //provide the intial context and the service URL of the server
    AuroraTransactionService.initialize (ic, serviceURL);

    //Since JTS can only manage transactions on a single server, the
    //destination server object exists on the same server as the transaction
    //service. Thus, you use the same service URL to retrieve the object.
    Employee employee = (Employee)ic.lookup (serviceURL + objectName);
    EmployeeInfo info;

    //Use the static method getTS to retrieve the TransactionService and the
    //static method getCurrent to retrieve the current transaction context.
    //Off of the Current object, you can start the transaction with the begin
    //method. All three methods have been combined as follows:
    TS.getTS ().getCurrent ().begin ();

    //invoke a method on the retrieved server object. Since the object exists
    //on the transaction server, it is included in the transaction.
    info = employee.getEmployee ("SCOTT");
    System.out.println (info.name + " "  + " " + info.salary);
    System.out.println ("Increase by 10%");
    info.salary += (info.salary * 10) / 100;
    employee.updateEmployee (info);
    info = employee.getEmployee ("SCOTT");
    System.out.println (info.name + " "  + " " + info.salary);

    //Finally, commit the transaction with the Current.commit method.
    TS.getTS ().getCurrent ().commit (true);
  }
}
```

JTS Server-Side Demarcation

Oracle9*i* initializes the `TransactionService` for any server object. In the same manner as the client, the server must invoke only other server objects on the same server. SQL statements should also only be applied to the same database.

The following example demonstrates the steps required for a client-side demarcation:

1. Retrieve the `TransactionService` object through the static `TS.getTS` method.
2. Retrieve the current transaction context through the `TransactionService.getCurrent` method.
3. Manage the transaction through the following transaction context (`Current` class) methods: `begin`, `commit`, `rollback`, `rollback_only`, `suspend`, `resume`.

Example 7–9 Server-Side Demarcation for JTS Example

```
package employeeServer;
```

```
import employee.*;
import java.sql.*;
import oracle.aurora.jts.util.*;
import org.omg.CosTransactions.*;

public class EmployeeImpl extends _EmployeeImplBase
{
  Control txn;

  public EmployeeInfo getEmployee (String name) throws SQLError {
    //When the client invokes the getEmployee method, the transaction is started
    //Retreive the Transaction service through the static getTS method.
    //Retrieve the current transaction context through the getCurrent method.
    //And start the transaction with the Current.begin method. These have
    //been combined into one statement....
    TS.getTS ().getCurrent ().begin ();

    //Retrieve the employee information given the employee name.
    int empno = 0;
    double salary = 0.0;
    #sql { select empno, sal into :empno, :salary from emp
                    where ename = :name };

    //At this point, we suspend the transaction to return the employee
    //information to the client.
    txn = TS.getTS().getCurrent().suspend();
    return new EmployeeInfo (name, empno, (float)salary);
  }

  public void updateEmployee (EmployeeInfo employee) throws SQLError {
    //After the client retrieves the employee info, it invokes the updateEmp
    //method to change any values.
    //The transaction is resumed in this method through the Current.resume,
    //which requires the Control object returned on the suspend method.
    TS.getTS().getCurrent().resume(txn);

    //update the employee's information.
    #sql { update emp set ename = :(employee.name), sal = :(employee.salary)
                    where empno = :(employee.number) };

    //Once finished, complete the transaction with the Current.commit method.
    TS.getTS ().getCurrent ().commit (true);
 }
```

JTS Limitations

The implementations of JTS that is supplied for this Oracle9*i* release is intended to support client-side transaction demarcation. It has limitations that you should be aware of when designing your application.

No Distributed Transactions

This implementation of JTS does not manage distributed transactions. Transaction control distributed among multiple database servers, with support for the required two-phase commit protocol, is only available within the JTA implementation.

Resources

The JTS transaction API supplied with Oracle9*i* manages only one resource: an Oracle9*i* database session. A transaction cannot span multiple servers or multiple database sessions in a single service.

Transaction contexts are never propagated outside a server. If a server object calls out to another server, the transaction context is not carried along.

However, a transaction can involve one or many objects. The transaction can encompass one or many methods of these objects. The scope of a transaction is defined by a *transaction context* that is shared by the participating objects. For example, your client can invoke one or more objects on the same server within a single session or several objects on the same server within multiple sessions.

Nested Transactions

Nested transactions are not supported in this release. If you attempt to begin a new transaction before committing or rolling back any existing transaction, the transaction service throws a `SubtransactionsUnavailable` exception.

Timeouts

Methods of the JTS that support transaction timeout, such as `setTimeout()`, do not work in this release. You can invoke them from your code, and no exception is thrown, but they have no effect.

Interoperability

The transaction services supplied with this release do not interoperate with other OTS implementations.

Transaction Service Interfaces

Oracle9*i* supports a version of the JTS. The JTS is a Java mapping of the OMG Object Transaction Service (OTS). There are two classes that the application developer can use:

- `TransactionService`
- `UserTransaction`, implemented by `oracle.aurora.jts.client.AuroraTransactionService`

TransactionService

Use the `TransactionService` to initialize a transaction context on the client. Include the `AuroraTransactionService` package in your Java client source with the following **import** statements:

```
import oracle.aurora.jts.client.AuroraTransactionService;
import javax.jts.*;
import oracle.aurora.jts.util.*;
```

These classes are included in the library file `aurora_client.jar`, which must be in the CLASSPATH when compiling and executing all source files that use the JTS.

There is only one method in this package that you can call:

```
public synchronized static void initialize(Context initialContext,
                                           String serviceName)
```

This method initializes the transaction context on a client. The parameters are:

`initialContext`	The `context` object returned by a JNDI `Context` constructor.
`serviceName`	The complete service name. For example `sess_iiop://localhost:2481:ORCL`

An example of using `initialize()` is:

```
Hashtable env = new Hashtable();
env.put(Context.URL_PKG_PREFIXES, "oracle.aurora.jndi");
env.put(Context.SECURITY_PRINCIPAL, "scott");
env.put(Context.SECURITY_CREDENTIALS, "tiger");
env.put(Context.SECURITY_AUTHENTICATION, ServiceCtx.NON_SSL_LOGIN);
Context initialContext = new InitialContext(env);
AuroraTransactionService.initialize
          (initialContext, "sess_iiop://localhost:2481:ORCL");
```

Using The Java Transaction Service

JTS contains methods that a client-side or server-side object uses to begin transactions, commit or roll back a transaction, and perform utility functions such as setting the transaction timeout. JTS methods should be used in CORBA clients server objects.

The following sections describe the JTS APIs:

- Required Import Statements
- Java Transaction Service Methods
- Current Transaction Methods

Required Import Statements

To use the JTS methods, include the following import statements in your source:

```
import oracle.aurora.jts.util.TS;
import javax.jts.util.*;
import org.omg.CosTransactions.*;
```

The `oracle.aurora.jts.util` package is included in the library file `aurora_client.jar`, which must be in the CLASSPATH for all Java sources that use the JTS.

You use the static methods in the `TS` class to retrieve the transaction service.

Java Transaction Service Methods

The JTS includes the following methods:

`public static synchronized TransactionService getTS()`

1. The `getTS` method returns a transaction service object.
2. Once a transaction service has been obtained, you can invoke the static method `getCurrent()` on it to return a `Current` pseudo-object, the transaction context.
3. Finally, you can invoke methods to begin, suspend, resume, commit, or roll back the current transaction on the `Current` pseudo-object.

Here is an example that begins a new transaction on a client, starting with getting the JNDI initial context:

```
import oracle.aurora.jndi.sess_iiop.ServiceCtx;
import oracle.aurora.jts.client.AuroraTransactionService;
import javax.naming.Context;
import javax.naming.InitialContext;
import java.util.Hashtable;
...
Context ic = new InitialContext(env);
...
AuroraTransactionService.initialize(ic, serviceURL);
...
Employee employee = (Employee)ic.lookup (serviceURL + objectName);
EmployeeInfo info;
oracle.aurora.jts.util.TS.getTS().getCurrent().begin();
```

If there is no transaction service available, then `getTS()` throws a `NoTransactionService` exception.

Current Transaction Methods

The methods that you can call to control transactions on the current transaction context are the following:

`public void begin()`

Begins a new transaction.

Can throw these exceptions:

- `NoTransactionService`—if you have not initialized a transaction context.
- `SubtransactionsUnavailable`—if you invoke a `begin()` before the current transaction has been committed or rolled back.

See the section "TransactionService" on page 7-37 for information about initialization.

`public Control suspend()`

Suspends the current transaction in the session. Returns a `Control` transaction context pseudo-object. You must save this object reference for use in any subsequent `resume()` invocations. Invoke `suspend()` in this way:

```
org.omg.CosTransactions.Control c =
          oracle.aurora.jts.util.TS.getTS().getCurrent().suspend();
```

`suspend()` can throw these exceptions:

- `NoTransactionService`—if you have not initialized a transaction context.

- `TransactionDoesNotExist`—if not in an active transaction context. This can occur if a `suspend()` follows a previous `suspend()`, with no intervening `resume()`.

If `suspend()` is invoked outside of a transaction context, then a `NoTransactionService` exception is thrown. If `suspend()` is invoked before `begin()` has been invoked, or after a `suspend()`, the a exception is thrown.

public void resume(Control which)

Resumes a suspended transaction. Invoke this method after a `suspend()`, in order to resume the specified transaction context. The `which` parameter must be the transaction `Control` object that was returned by the previous matching `suspend()` invocation in the same session. For example:

```
org.omg.CosTransactions.Control c =
           oracle.aurora.jts.util.TS.getTS().getCurrent().suspend();
...   // do some non-transactional work
oracle.aurora.jts.util.TS.getTS().getCurrent().resume(c);
```

`resume()` can throw:

- `InvalidControl`—if the `which` parameter is not valid, or is null.

public void commit(boolean report_heuristics)

Commits the current transaction. Set the `report_heuristics` parameter to **`false`**.

The `report_heuristics` parameter is set to **`true`** for extra information on two-phase commits. Because this release of Oracle9*i* does not support the two-phase commit protocol for distributed objects for JTS, use of the `report_heuristics` parameter is not meaningful. It is included for compatibility with future releases.

`commit()` can throw:

- `HeuristicMixed`—if `report_heuristics` was set true, and a two-phase commit is in progress.
- `HeuristicHazard`—if `report_heuristics` was set true, and a two-phase commit is in progress.

The `HeuristicMixed` and `HeuristicHazard` exceptions are documented in the OTS specification.

If there is no active transaction, `commit()` throws a `NoTransaction` exception.

`public void rollback()`

Rolls back the effects of the current transaction.

Invoking `rollback()` has the effect of ending the transaction, so invoking any JTS method except `begin()` after a `rollback()` throws a `NoTransaction` exception.

If not in a transaction context, `rollback()` throws the `NoTransaction` exception.

`public void rollback_only() throws NoTransaction {`

`rollback_only()` modifies the transaction associated with the current thread so that the only possible outcome is to roll back the transaction. If not in a transaction context, `rollback_only()` throws the `NoTransaction` exception.

`public void set_timeout(int seconds)`

This method is not supported, and has no effect if invoked. The default timeout value is 60 seconds in all cases.

`public Status get_status()`

You can call `get_status()` at any time to discover the status of the current transaction. Possible return values are:

- `javax.transaction.Status.StatusActive`
- `javax.transaction.Status.StatusMarkedRollback`
- `javax.transaction.Status.StatusNoTransaction`

The complete set of status **int**s is defined in `javax.transaction.Status`.

`public String get_transaction_name() {`

Invoke `get_transaction_name()` to see the name of the transaction, returned as a String. If this method is invoked before a `begin()`, after a `rollback()`, or outside of a transaction context, it returns a null string.

For More Information on JTS

Information on the Java Transaction Service is available at:

`http://java.sun.com:/products/jts/index.html`

The Sun JTS specification is available at:

`http://java.sun.com/products/jta/index.html`

The OTS specification is part of the CORBA services specification. Chapter 10 (individually downloadable) contains the OTS specification. Get it at:

`http://www.omg.org/library/csindx.html`

JDBC Restrictions

If you are using JDBC calls in your CORBA server object to update a database, and you have an active transaction context, you should *not* also use JDBC to perform transaction services, by calling methods on the JDBC connection. Do *not* code JDBC transaction management methods. For example:

```
Connection conn = ...
...
conn.commit();  // DO NOT DO THIS!!
```

Doing so will cause a `SQLException` to be thrown. Instead, you must commit using the `UserTransaction` object retrieved to handle the global transaction. When you commit using the JDBC connection, you are instructing a local transaction to commit, not the global transaction. When the connection is involved in a global transaction, trying to commit a local transaction within the global transaction causes an error to occur.

In the same manner, you must also avoid doing direct SQL commits or rollbacks through JDBC. Code the object to either handle transactions directly using the `UserTransaction` interface.

Within a global transaction, you cannot execute a local transaction. If you try, the following error will be thrown:

```
ORA-2089 "COMMIT is not allowed in a subordinate session."
```

Some SQL commands implicitly execute a local transaction. All SQL DDL statements, such as "CREATE TABLE", implicitly starts and commits a local transaction under the covers. If you are involved in a global transaction that has enlisted the database that the DDL statement is executing against, the global transaction will fail.

A

Example Code: CORBA

Oracle9*i* installs several samples under the `$ORACLE_HOME/javavm/demo` directory. Some of these samples are included in this appendix for your perusal.

The examples in the `$ORACLE_HOME/javavm/demo` directory include a UNIX makefile and Windows NT batch file to compile and run each example. You need a Java-enabled Oracle9*i* database with the standard EMP and DEPT demo tables to run the examples.

The emphasis in these short examples is on demonstrating features of the ORB and CORBA, not on elaborate Java coding techniques. Each of the examples includes a README file that tell you what files the example contains, what the example does, and how to compile and run the example.

- Basic Example
- IFR Example
- Callback Example
- TIE Example
- Pure CORBA Client
- JTA Examples
- JTS Transaction Example
- SSL Examples
- Session Example
- Applet Example

Basic Example

The following is a Bank example that demonstrates a simple CORBA application. Included is the README, the IDL, the server code, and the client code. Refer to the `$ORACLE_HOME/javavm/demo/corba/basic` directory for the Makefile.

README

```
This is an Oracle9i-compatible version of the VisiBroker Bank
example. The major differences from the Vb example are:

(1) There is no server main loop. For Oracle9i the
"wait-for-activation" loop is part of the IIOP presentation (MTS
server).

(2) _boa.connect(object) is used instead of the less portable
 _boa_obj_is_ready(object) in the server object implementation to
register the new Account objects.

(3) The client program contains the code necessary to lookup the
AccountManager object (published under /test/BankCorb) and activate it,
and to authenticate the client to the server. (Note that object
activation and authentication, via NON_SSL_LOGIN, happen "under the
covers" so to speak on the lookup() method invocation.)

(4) There is also a tie implementation of this example, with the
server being AccountManagerImplTie.java.
```

Bank.IDL

```
// Bank.idl

module common {
  interface Account {
    float balance();
  };
  interface AccountManager {
    Account open(in string name);
  };
};
```

Server

The server code is implemented in the following:

AccountManagerImpl.java

```
// AccountManagerImpl.java

package server;

import common.*;
import java.util.*;

public class AccountManagerImpl extends _AccountManagerImplBase
{
  private Dictionary _accounts = new Hashtable();
  private Random _random = new Random();

  public synchronized Account open(String accountName)
  {
    // Lookup the account in the account dictionary.
    Account account = (Account) _accounts.get(accountName);

    // If there was no account in the dictionary, create one.
    if(account == null) {

      // Make up the account’s balance, between 0 and 1000 dollars.
      float balance = Math.abs(_random.nextInt()) % 100000 / 100f;

      // Intialize orb and boa
      //org.omg.CORBA.ORB orb = org.omg.CORBA.ORB.init();
      //org.omg.CORBA.BOA boa = orb.BOA_init();

      // Create the account implementation, given the balance.
      account = new AccountImpl(balance);

      // register object with boa
      //boa.obj_is_ready(account);
      //orb.connect(account);
      _orb().connect(account);


      // Print out the new account.
      // This just goes to the system trace file for Oracle 9i.
      System.out.println("Created " + accountName + "’s account: " + account);

      // Save the account in the account dictionary.
      _accounts.put(accountName, account);
    }
    // Return the account.
    return account;
  }
}
```

AccountImpl.java

```
package server;
import common.*;

public class AccountImpl extends _AccountImplBase
{
  private float _balance;

  public AccountImpl(float balance)
  {
    _balance = balance;
  }

  public float balance()
  {
    return _balance;
  }
}
```

AccountManagerImplTie.java

```
package server;

import common.*;
import java.util.*;
import oracle.aurora.AuroraServices.ActivatableObject;


public class AccountManagerImplTie implements AccountManagerOperations,
                                              ActivatableObject
{
  private Dictionary _accounts = new Hashtable();
  private Random _random = new Random();

  public synchronized Account open(String name)
  {
    // Lookup the account in the account dictionary.
    Account account = (Account) _accounts.get(name);
    // If there was no account in the dictionary, create one.
    if(account == null) {

      // Make up the account’s balance, between 0 and 1000 dollars.
      float balance = Math.abs(_random.nextInt()) % 100000 / 100f;

      // Intialize orb and boa
      org.omg.CORBA.ORB orb = org.omg.CORBA.ORB.init();
      //org.omg.CORBA.BOA boa = orb.BOA_init();

      // Create the account implementation, given the balance.
      account = new AccountImpl(balance);

      // register object with boa
      //boa.obj_is_ready(account);
      orb.connect(account);

      // Print out the new account.
      // This just goes to the system trace file for Oracle 9i.
      System.out.println("Created " + name + "’s account: " + account);

      // Save the account in the account dictionary.
      _accounts.put(name, account);
    }
    // Return the account.
    return account;
  }

  public org.omg.CORBA.Object _initializeAuroraObject()
  {
    return new _tie_AccountManager(this);
  }
}
```

Client.java

```
package client;

import common.*;
import java.util.Hashtable;
import javax.naming.Context;
import javax.naming.InitialContext;
import oracle.aurora.jndi.sess_iiop.ServiceCtx;

public class Client
```

```
{
  public static void main (String[] args)
  {
    if (args.length != 5) {
      System.out.println("usage: Client user password GIOP_SERVICE CorbaPubname 
accountName");
      System.exit(1);
    }
    String user = args[0];
    String password = args[1];
    String GIOP_SERVICE = args[2];
    String corbaPubname = args[3];
    String accountName = args[4];

    Hashtable env = new Hashtable();
    env.put(Context.URL_PKG_PREFIXES, "oracle.aurora.jndi");
    env.put(Context.SECURITY_PRINCIPAL, user);
    env.put(Context.SECURITY_CREDENTIALS, password);
    env.put(Context.SECURITY_AUTHENTICATION, ServiceCtx.NON_SSL_LOGIN);

    try {
      Context ic = new InitialContext(env);

      AccountManager manager = 
        (AccountManager)ic.lookup(GIOP_SERVICE + corbaPubname);

      // Request the account manager to open a named account.
      Account account = manager.open(accountName);

      // Get the balance of the account.
      float balance = account.balance();

      // Print out the balance.
      System.out.println("The balance in " + accountName + 
                     "'s account is $" + balance);
    } catch (Exception e) {
      System.out.println("Client.main(): " + e.getMessage());
    }
  }
}
```

StoredClient.java

```
package client;
```

```
import common.*;
import java.util.Hashtable;
import javax.naming.Context;
import javax.naming.InitialContext;
import oracle.aurora.jndi.sess_iiop.ServiceCtx;

public class StoredClient
{
  public static String callBankCorb(String corbaPubname, String accountName)
  {
    Hashtable env = new Hashtable();

    String ret = null;
    try {
      Context ic = new InitialContext(env);

      AccountManager manager =
        (AccountManager)ic.lookup(corbaPubname);

      // Request the account manager to open a named account.
      Account account = manager.open(accountName);

      // Get the balance of the account.
      float balance = account.balance();

      // Print out the balance.
      ret = "The balance in " + accountName + "'s account is $" + balance;
    } catch (Exception e) {
      ret = "StoredClient.callBankCorb(): " + e.getMessage();
    }
    return ret;
  }
}
```

IFR Example

The following example shows how to use the IFR. Soft copy is located at `$ORACLE_HOME/javavm/demo/corba/basic/bankWithIFR`.

Bank.IDL

```
module common {
  interface Account {
    float balance();
  };
  interface AccountManager {
    Account open(in string name);
  };
};
```

Server

The server code is implemented in the `AccountManager`, `Account`, and TIE classes.

AccountManagerImpl.java

```
package server;

import common.*;
import java.util.*;

public class AccountManagerImpl extends _AccountManagerImplBase
{
  private Dictionary _accounts = new Hashtable();
  private Random _random = new Random();

  public synchronized Account open(String accountName)
  {
    // Lookup the account in the account dictionary.
    Account account = (Account) _accounts.get(accountName);

    // If there was no account in the dictionary, create one.
    if(account == null) {

      // Make up the account’s balance, between 0 and 1000 dollars.
      float balance = Math.abs(_random.nextInt()) % 100000 / 100f;

      // Intialize orb and boa
      //org.omg.CORBA.ORB orb = org.omg.CORBA.ORB.init();
      //org.omg.CORBA.BOA boa = orb.BOA_init();

      // Create the account implementation, given the balance.
      account = new AccountImpl(balance);

      // register object with boa
      //boa.obj_is_ready(account);
      //orb.connect(account);
      _orb().connect(account);
      // Print out the new account.
      // This just goes to the system trace file for Oracle 9i.
      System.out.println("Created " + accountName + "'s account: " + account);

      // Save the account in the account dictionary.
      _accounts.put(accountName, account);
    }
    // Return the account.
    return account;
  }
}
```

AccountImpl.java

```
package server;

import common.*;

public class AccountImpl extends _AccountImplBase
{
  private float _balance;

  public AccountImpl(float balance)
  {
    _balance = balance;
  }

  public float balance()
  {
    return _balance;
  }
}
```

AccountManagerImplTie.java

```
package server;

import common.*;
import java.util.*;
import oracle.aurora.AuroraServices.ActivatableObject;


public class AccountManagerImplTie implements AccountManagerOperations,
                                             ActivatableObject
{
  private Dictionary _accounts = new Hashtable();
  private Random _random = new Random();

  public synchronized Account open(String name)
  {
    // Lookup the account in the account dictionary.
    Account account = (Account) _accounts.get(name);

    // If there was no account in the dictionary, create one.
    if(account == null) {

      // Make up the account’s balance, between 0 and 1000 dollars.
      float balance = Math.abs(_random.nextInt()) % 100000 / 100f;

      // Intialize orb and boa
      org.omg.CORBA.ORB orb = org.omg.CORBA.ORB.init();
      //org.omg.CORBA.BOA boa = orb.BOA_init();

      // Create the account implementation, given the balance.
      account = new AccountImpl(balance);

      // register object with boa
      //boa.obj_is_ready(account);
      orb.connect(account);

      // Print out the new account.
      // This just goes to the system trace file for Oracle 9i.
      System.out.println("Created " + name + "’s account: " + account);

      // Save the account in the account dictionary.
      _accounts.put(name, account);
    }
    // Return the account.
    return account;
  }

  public org.omg.CORBA.Object _initializeAuroraObject()
  {
    return new _tie_AccountManager(this);
  }
}
```

Client

The client code is facilitated in the following:

- Client.java
- PrintIDL.java

Client.java

```
package client;

import common.*;
import java.util.Hashtable;
import javax.naming.Context;
import javax.naming.InitialContext;
import org.omg.CORBA.Repository;
import oracle.aurora.jndi.sess_iiop.ServiceCtx;

public class Client
{
  public static void main (String[] args)
  {
    if (args.length != 5) {
      System.out.println("usage: Client user password GIOP_SERVICE CorbaPubname
accountName");
      System.exit(1);
    }
    String user = args[0];
    String password = args[1];
    String GIOP_SERVICE = args[2];
    String corbaPubname = args[3];
    String accountName = args[4];

    Hashtable env = new Hashtable();
    env.put(Context.URL_PKG_PREFIXES, "oracle.aurora.jndi");
    env.put(Context.SECURITY_PRINCIPAL, user);
    env.put(Context.SECURITY_CREDENTIALS, password);
    env.put(Context.SECURITY_AUTHENTICATION, ServiceCtx.NON_SSL_LOGIN);

    try {
      Context ic = new InitialContext(env);

      AccountManager manager =
        (AccountManager)ic.lookup(GIOP_SERVICE + corbaPubname);
```

```
            // Request the account manager to open a named account.
            Account account = manager.open(accountName);

            // Get the balance of the account.
            float balance = account.balance();

            // Print out the balance.
            System.out.println
              ("The balance in " + accountName + "'s account is $" + balance);

            System.out.println("Calling the implicit method get_interface()");
            org.omg.CORBA.InterfaceDef intf =
              (org.omg.CORBA.InterfaceDef)account._get_interface_def();
            System.out.println("intf = " + intf.name());

            System.out.println("Now explicitly looking up for IFR and printing the");
            System.out.println("whole repository");
            System.out.println("");

            Repository rep = (Repository)ic.lookup(GIOP_SERVICE + "/etc/ifr");

            new PrintIDL(org.omg.CORBA.ORB.init()).print(rep);

          } catch (Exception e) {
            System.out.println("Client.main(): " + e.getMessage());
            e.printStackTrace();
          }
        }
      }
```

PrintIDL.java

```
package client;

import common.*;
import java.io.PrintStream;
import java.util.Vector;
import java.io.DataInputStream;
import org.omg.CORBA.Repository;

public class PrintIDL
{
  private static org.omg.CORBA.ORB _orb;
  private static PrintStream _out = System.out;
  private static int _indent;
```

```
public PrintIDL (org.omg.CORBA.ORB orb) {
  _orb = orb;
}
private void println(Object o) {
  for(int i = 0; i < _indent; i++) {
    _out.print("  ");
  }
  _out.println(o);
}

private String toIdl(org.omg.CORBA.IDLType idlType) {
  org.omg.CORBA.Contained contained =
         org.omg.CORBA.ContainedHelper.narrow(idl Type);
  return contained == null ?
    idlType.type().toString() :
    contained.absolute_name();
}

public void print(org.omg.CORBA.Container container)
                          throws org.omg.CORBA.UserException {
  org.omg.CORBA.Contained[] contained =
    container.contents(org.omg.CORBA.DefinitionKind.dk_all, true);
  for(int i = 0; i < contained.length; i++) {
    {
      org.omg.CORBA.ContainedPackage.Description description =
                    contained[i].describe();
      org.omg.CORBA.portable.OutputStream output =
             _orb.create_output_stream();
      org.omg.CORBA.ContainedPackage.DescriptionHelper.write(output,
              description);
      org.omg.CORBA.portable.InputStream input = output.create_input_stream();
      org.omg.CORBA.ContainedPackage.Description description2 =
        org.omg.CORBA.ContainedPackage.DescriptionHelper.read(input);
      org.omg.CORBA.Any any1 = _orb.create_any();
      org.omg.CORBA.ContainedPackage.DescriptionHelper.insert(any1,
              description);
      org.omg.CORBA.Any any2 = _orb.create_any();
      org.omg.CORBA.ContainedPackage.DescriptionHelper.insert(any2,
               description2);
      if(!any1.equals(any1) ||
         !any1.equals(any2) ||
         !any2.equals(any2) ||
         !any2.equals(any1)) {
```

```
      System.out.println("\n*** The desriptions were not equal (1) *** \n");
    }
    org.omg.CORBA.ContainedPackage.Description description3 =
      org.omg.CORBA.ContainedPackage.DescriptionHelper.extract(any2);
    if(description.kind != description2.kind ||
       !description.value.equals(description3.value)) {
      System.out.println("\n*** The desriptions were not equal (2) *** \n");
    }
  }
  switch(contained[i].def_kind().value()) {
  case org.omg.CORBA.DefinitionKind._dk_Attribute:
    printAttribute(org.omg.CORBA.AttributeDefHelper.narrow(contained[i]));
    break;
  case org.omg.CORBA.DefinitionKind._dk_Constant:
    printConstant(org.omg.CORBA.ConstantDefHelper.narrow(contained[i]));
    break;
  case org.omg.CORBA.DefinitionKind._dk_Exception:
    printException(org.omg.CORBA.ExceptionDefHelper.narrow(contained[i]));
    break;
  case org.omg.CORBA.DefinitionKind._dk_Interface:
    printInterface(org.omg.CORBA.InterfaceDefHelper.narrow(contained[i]));
    break;
  case org.omg.CORBA.DefinitionKind._dk_Module:
    printModule(org.omg.CORBA.ModuleDefHelper.narrow(contained[i]));
    break;
  case org.omg.CORBA.DefinitionKind._dk_Operation:
    printOperation(org.omg.CORBA.OperationDefHelper.narrow(contained[i]));
    break;
  case org.omg.CORBA.DefinitionKind._dk_Alias:
    printAlias(org.omg.CORBA.AliasDefHelper.narrow(contained[i]));
    break;
  case org.omg.CORBA.DefinitionKind._dk_Struct:
    printStruct(org.omg.CORBA.StructDefHelper.narrow(contained[i]));
    break;
  case org.omg.CORBA.DefinitionKind._dk_Union:
    printUnion(org.omg.CORBA.UnionDefHelper.narrow(contained[i]));
    break;
  case org.omg.CORBA.DefinitionKind._dk_Enum:
    printEnum(org.omg.CORBA.EnumDefHelper.narrow(contained[i]));
    break;
  case org.omg.CORBA.DefinitionKind._dk_none:
  case org.omg.CORBA.DefinitionKind._dk_all:
  case org.omg.CORBA.DefinitionKind._dk_Typedef:
  case org.omg.CORBA.DefinitionKind._dk_Primitive:
  case org.omg.CORBA.DefinitionKind._dk_String:
      case org.omg.CORBA.DefinitionKind._dk_Sequence:
      case org.omg.CORBA.DefinitionKind._dk_Array:
      default:
        break;
      }
    }
  }

  private void printConstant(org.omg.CORBA.ConstantDef def)
            throws org.omg.CORBA.UserException {
    println("const " + toIdl(def.type_def()) + " " + def.name() + " = " +
           def.value() + ";");
  }

  private void printStruct(org.omg.CORBA.StructDef def)
          throws org.omg.CORBA.UserException {
    println("struct " + def.name() + " {");
    _indent++;
    org.omg.CORBA.StructMember[] members = def.members();
    for(int j = 0; j < members.length; j++) {
      println(toIdl(members[j].type_def) + " " + members[j].name + ";");
    }
    _indent--;
    println("};");
  }

  private void printUnion(org.omg.CORBA.UnionDef def)
           throws org.omg.CORBA.UserException {
    println("union " + def.name() + "
         switch(" + toIdl(def.discriminator_type_def()) + ") {");
    org.omg.CORBA.UnionMember[] members = def.members();
    int default_index = def.type().default_index();
    _indent++;
    for(int j = 0; j < members.length; j++) {
      if(j == default_index) {
        println("default:");
      }
      else {
        println("case " + members[j].label + ":");
      }
      _indent++;
      println(toIdl(members[j].type_def) + " " + members[j].name + ";");
      _indent--;
    }
    _indent--;
    println("};");
  }
  private void printException(org.omg.CORBA.ExceptionDef def)
            throws org.omg.CORBA.UserException {
    println("exception " + def.name() + " {");
    _indent++;
    org.omg.CORBA.StructMember[] members = def.members();
    for(int j = 0; j < members.length; j++) {
      println(toIdl(members[j].type_def) + " " + members[j].name + ";");
    }
    _indent--;
    println("};");
  }

  private void printEnum(org.omg.CORBA.EnumDef def)
        throws org.omg.CORBA.UserException {
    org.omg.CORBA.TypeCode type = def.type();
    println("enum " + type.name() + " {");
    _indent++;
    int count = type.member_count();
    for(int j = 0; j < count; j++) {
      println(type.member_name(j) + ((j == count - 1) ? "" : ","));
    }
    _indent--;
    println("};");
  }

  private void printAlias(org.omg.CORBA.AliasDef def)
           throws org.omg.CORBA.UserException {
    org.omg.CORBA.IDLType idlType = def.original_type_def();
    String arrayBounds = "";
    while(true) {
      // This is a little strange, since the syntax of typedef'ed
      // arrays is stupid.
      org.omg.CORBA.ArrayDef arrayDef =
              org.omg.CORBA.ArrayDefHelper.narrow(idlType);
      if(arrayDef == null) {
        break;
      }
      arrayBounds += "[" + arrayDef.length() + "]";
      idlType = arrayDef.element_type_def();
    }
    println("typedef " + toIdl(idlType) + " " + def.name() + arrayBounds + ";");
  }
```

```
 private void printAttribute(org.omg.CORBA.AttributeDef def)
        throws org.omg.CORBA.UserException {
   String readonly = def.mode() == org.omg.CORBA.AttributeMode.ATTR_READONLY ?
     "readonly " : "";
   println(readonly + "attribute " + toIdl(def.type_def()) + " " + def.name() +
";");
 }

 private void printOperation(org.omg.CORBA.OperationDef def)
           throws org.omg.CORBA.UserException {
   String oneway = def.mode() == org.omg.CORBA.OperationMode.OP_ONEWAY ?
     "oneway " : "";
   println(oneway + toIdl(def.result_def()) + " " + def.name() + "(");
   _indent++;
   org.omg.CORBA.ParameterDescription[] parameters = def.params();
   for(int k = 0; k < parameters.length; k++) {
     String[] mode = { "in", "out", "inout" };
     String comma = k == parameters.length - 1 ? "" : ",";
     println(mode[parameters[k].mode.value()] + " " +
          toIdl(parameters[k].type_def) + " " +
             parameters[k].name + comma);
   }
   _indent--;
   org.omg.CORBA.ExceptionDef[] exceptions = def.exceptions();
   if(exceptions.length > 0) {
     println(") raises (");
     _indent++;
     for(int k = 0; k < exceptions.length; k++) {
       String comma = k == exceptions.length - 1 ? "" : ",";
       println(exceptions[k].absolute_name() + comma);
     }
     _indent--;
   }
   println(");");
 }

 private void printInterface(org.omg.CORBA.InterfaceDef idef)
        throws org.omg.CORBA.UserException {
   String superList = "";
   {
     org.omg.CORBA.InterfaceDef[] base_interfaces = idef.base_interfaces();
     if(base_interfaces.length > 0) {
       superList += " :";
       for(int j = 0; j < base_interfaces.length; j++) {
         String comma = j == base_interfaces.length - 1 ? "" : ",";
```

```
          superList += " " + base_interfaces[j].absolute_name() + comma;
        }
      }
    }
    println("interface " + idef.name() + superList + " {");
    _indent++;
    print(idef);
    _indent--;
    println("};");
  }

  private void printModule(org.omg.CORBA.ModuleDef def)
            throws org.omg.CORBA.UserException {
    println("module " + def.name() + " {");
    _indent++;
    print(def);
    _indent--;
    println("};");
  }
}
```

Callback Example

The callback example is available online at `$ORACLE_HOME/javavm/demo/examples/corba/basic/callback`.

IDL Files

Client.IDL

```
module common {
  interface Client {
    wstring helloBack ();
  };
};
```

Server.IDL

```
#include <Client.idl>

module common {
  interface Server {
    wstring hello (in Client object);
  };
};
```

Server

ServerImpl.java

```
package server;

import common.*;
import oracle.aurora.AuroraServices.ActivatableObject;

public class ServerImpl extends _ServerImplBase implements ActivatableObject
{
  public String hello (Client client) {
    return "I Called back and got: " + client.helloBack ();
  }

  public org.omg.CORBA.Object _initializeAuroraObject () {
    return this;
  }
}
```

Client

The client invokes the server object, which calls back to another object on the client-side. The originating client is implemented in Client.java. The client-side callback object is implemented in ClientImpl.java.

Client.java

```
// Client.java

package client;

import common.*;
import java.util.Hashtable;
import javax.naming.Context;
import javax.naming.InitialContext;
import oracle.aurora.jndi.sess_iiop.ServiceCtx;

public class Client
{
  public static void main (String[] args) throws Exception
  {
    if (args.length != 4) {
      System.out.println ("usage: Client user password GIOP_SERVICE corbaPubname
");
      System.exit (1);
    }
    String user = args[0];
    String password = args[1];
    String GIOP_SERVICE = args[2];
    String corbaPubname = args[3];

    Hashtable env = new Hashtable ();
    env.put (Context.URL_PKG_PREFIXES, "oracle.aurora.jndi");
    env.put (Context.SECURITY_PRINCIPAL, user);
    env.put (Context.SECURITY_CREDENTIALS, password);
    env.put (Context.SECURITY_AUTHENTICATION, ServiceCtx.NON_SSL_LOGIN);
    Context ic = new InitialContext (env);

    // Get the server object before preparing the client object
    // You have to do it in that order to get the ORB initialized correctly
    Server server = (Server)ic.lookup (GIOP_SERVICE + corbaPubname);

    // Create the client object and publish it to the orb in the client
    //org.omg.CORBA.ORB orb = org.omg.CORBA.ORB.init ();
    com.visigenic.vbroker.orb.ORB orb = oracle.aurora.jndi.orb_dep.Orb.init();
    org.omg.CORBA.BOA boa = orb.BOA_init ();
    ClientImpl client = new ClientImpl ();
    boa.obj_is_ready (client);

    // Pass the client to the server that will call us back
    System.out.println (server.hello (client));
  }
}
```

ClientImpl.java

```
package client;

import common.*;
import oracle.aurora.AuroraServices.ActivatableObject;

public class ClientImpl extends _ClientImplBase implements ActivatableObject
{
  public String helloBack ()
  {
    return "Hello Client World!";
  }

  public org.omg.CORBA.Object _initializeAuroraObject ()
  {
    return this;
  }
}
```

TIE Example

This example demonstrates how to use the TIE mechanism.

Hello.IDL

```
module common {
  interface Hello {
    wstring helloWorld ();
  };
};
```

Server Code - HelloImpl.java

```
package server;

import common.*;
import oracle.aurora.AuroraServices.ActivatableObject;

public class HelloImpl implements HelloOperations, ActivatableObject
{
  public String helloWorld()
  {
    return "Hello World!";
  }

  public org.omg.CORBA.Object _initializeAuroraObject()
  {
    return new _tie_Hello (this);
  }
}
```

Client.java

```
package client;
```

```
import common.*;
import javax.naming.Context;
import javax.naming.InitialContext;
import java.util.Hashtable;
import oracle.aurora.jndi.sess_iiop.ServiceCtx;

public class Client
{
  public static void main (String[] args) throws Exception
  {
    if (args.length != 4) {
      System.out.println("usage: Client user password GIOP_SERVICE corbaPubname"
);
      System.exit(1);
    }
    String user = args[0];
    String password = args[1];
    String GIOP_SERVICE = args[2];
    String corbaPubname = args[3];

    Hashtable env = new Hashtable();
    env.put(Context.URL_PKG_PREFIXES, "oracle.aurora.jndi");
    env.put(Context.SECURITY_PRINCIPAL, user);
    env.put(Context.SECURITY_CREDENTIALS, password);
    env.put(Context.SECURITY_AUTHENTICATION, ServiceCtx.NON_SSL_LOGIN);
    Context ic = new InitialContext(env);

    Hello hello = (Hello) ic.lookup(GIOP_SERVICE + corbaPubname);
    System.out.println(hello.helloWorld());
  }
}
```

Pure CORBA Client

This example uses CORBA Naming Service to retrieve any objects instead of JNDI.

Bank.IDL

```
module common {
  interface Account { float balance(); };
  interface AccountManager { Account open(in string name); };
};
```

Server Code

AccountManagerImpl.java

```
package server;

import common.*;
import java.util.*;
import org.omg.CORBA.Object;
import oracle.aurora.AuroraServices.ActivatableObject;

public class AccountManagerImpl extends _AccountManagerImplBase
  implements ActivatableObject
{
  private Dictionary _accounts = new Hashtable ();
  private Random _random = new Random();

  // Constructors
  public AccountManagerImpl() { super(); }
  public AccountManagerImpl(String name) { super(name); }

  public Object  _initializeAuroraObject()
  {
    return new AccountManagerImpl("BankManager");
  }

  public synchronized Account open(String name)
  {
    // Lookup the account in the account dictionary.
    Account account = (Account) _accounts.get (name);

    // If there was no account in the dictionary, create one.
    if (account == null) {
      // Make up the account’s balance, between 0 and 1000 dollars.
      float balance = Math.abs (_random.nextInt ()) % 100000 / 100f;

      // Create the account implementation, given the balance.
      account = new AccountImpl(balance);

      // Make the object available to the ORB.
      _orb().connect(account);

      // Print out the new account.
      System.out.println("Created " + name + "’s account: " + account);
      // Save the account in the account dictionary.
      _accounts.put(name, account);
    }

    // Return the account.
    return account;
  }
}
```

AccountImpl.java

```
package server;

import common.*;

public class AccountImpl extends _AccountImplBase
{
  private float _balance;

  public AccountImpl () { _balance = (float) 100000.00; }
  public AccountImpl (float balance) { _balance = balance; }
  public float balance () { return _balance; }
}
```

Client.java

```
package client;

import common.*;
import org.omg.CORBA.Object;
import org.omg.CORBA.SystemException;
import org.omg.CosNaming.NameComponent;
import oracle.aurora.client.Login;
import oracle.aurora.AuroraServices.LoginServer;
import oracle.aurora.AuroraServices.LoginServerHelper;
import oracle.aurora.AuroraServices.PublishedObject;
import oracle.aurora.AuroraServices.PublishingContext;
import oracle.aurora.AuroraServices.PublishedObjectHelper;
import oracle.aurora.AuroraServices.PublishingContextHelper;

public class Client
{
  public static void main(String args[]) throws Exception
  {
    // Parse the args
```

```
if (args.length < 4 || args.length > 5 ) {
  System.out.println ("usage: Client user password HOST PORT SID");
  System.exit(1);
}
String username = args[0];
String password = args[1];
String host = args[2];
String port = args[3];
String sid = null;
if(args.length == 5)
  sid  = args[4];

// Declarations for an account and manager
Account account = null;
AccountManager manager = null;
com.visigenic.vbroker.orb.ORB orb;
PublishingContext rootCtx = null;

// access the Aurora Names Service
try {
  // Initialize the ORB
  String initref;
  initref = (sid == null) ? "iioploc://" + host + ":" + port :
    "iioploc://" + host + ":" + port + ":" + sid;
  System.getProperties().put("ORBDefaultInitRef", initref);

  /*
   * Alternatively the following individual properties can be set
   * which take precedence over the URL above
  System.getProperties().put("ORBBootHost", host);
  System.getProperties().put("ORBBootPort", port);
  if(sid != null)
    System.getProperties().put("ORACLE_SID", sid);
   */

  /*
   * Some of the other properties that you can set
   System.getProperties().put("ORBNameServiceBackCompat", "false");
   System.getProperties().put("USE_SERVICE_NAME", "true");
   System.getProperties().put("ORBUseSSL", "true");
   System.getProperties().put("TRANSPORT_TYPE", "sess_iiop");
   */

  orb = oracle.aurora.jndi.orb_dep.Orb.init();
  // Get the Name service Object reference
  rootCtx = PublishingContextHelper.narrow(orb.resolve_initial_references(
                                                    "NameService"));
  // Get the pre-published login object reference
  PublishedObject loginPubObj = null;
  LoginServer serv = null;
  NameComponent[] nameComponent = new NameComponent[2];
  nameComponent[0] = new NameComponent ("etc", "");
  nameComponent[1] = new NameComponent ("login", "");

  // Lookup this object in the Name service
  Object loginCorbaObj = rootCtx.resolve (nameComponent);

  // Make sure it is a published object
  loginPubObj = PublishedObjectHelper.narrow (loginCorbaObj);

  // create and activate this object (non-standard call)
  loginCorbaObj = loginPubObj.activate_no_helper ();
  serv = LoginServerHelper.narrow (loginCorbaObj);

  // Create a client login proxy object and authenticate to the DB
  Login login = new Login (serv);
  login.authenticate (username, password, null);

  // Now create and get the bank object reference
  PublishedObject bankPubObj = null;
  nameComponent[0] = new NameComponent ("test", "");
  nameComponent[1] = new NameComponent ("bank", "");

  // Lookup this object in the name service
  Object bankCorbaObj = rootCtx.resolve (nameComponent);

  // Make sure it is a published object
  bankPubObj = PublishedObjectHelper.narrow (bankCorbaObj);

  // create and activate this object (non-standard call)
  bankCorbaObj = bankPubObj.activate_no_helper ();
  manager = AccountManagerHelper.narrow (bankCorbaObj);

  account = manager.open ("Jack.B.Quick");

  float balance = account.balance ();
  System.out.println ("The balance in Jack.B.Quick’s account is $"
                      + balance);
} catch (SystemException e) {
  System.out.println ("Caught System Exception: " + e);
```

```
        e.printStackTrace ();
      } catch (Exception e) {
        System.out.println ("Caught Unknown Exception: " + e);
        e.printStackTrace ();
      }
    }
  }
```

JTA Examples

Single-Phase Commit JTA Transaction Example

Employee.IDL

```
module employee {
  struct EmployeeInfo {
    wstring name;
    long number;
    double salary;
  };

  exception SQLError {
    wstring message;
  };

  interface Employee {
    void setUpDSConnection (in wstring dsName) raises (SQLError);
    EmployeeInfo getEmployee (in wstring name) raises (SQLError);
    void updateEmployee (in EmployeeInfo name) raises (SQLError);
  };
};
```

Client.java

```
import employee.*;

import java.sql.DriverManager;
import java.util.Hashtable;
import javax.naming.Context;
import javax.naming.InitialContext;
import javax.transaction.UserTransaction;
import java.sql.SQLException;
import javax.naming.NamingException;

import oracle.aurora.jndi.jdbc_access.jdbc_accessURLContextFactory;
import oracle.aurora.jndi.sess_iiop.ServiceCtx;

public class Client
{
  public static void main (String[] args) throws Exception
  {
    if (args.length != 7)
    {
      System.out.println ("usage: Client sessiiopURL jdbcURL objectName " +
                          "user password userTxnName dataSrcName");
      System.exit (1);
    }
    String sessiiopURL = args [0];
    String jdbcURL = args [1];
    String objectName = args [2];
    String user = args [3];
    String password = args [4];
    String utName = args [5];
    String dsName = args [6];

    // lookup usertransaction object in the namespace
    UserTransaction ut = lookupUserTransaction (user, password,
                                                jdbcURL, utName);

    // lookup employee object in the namespace
    Employee employee = lookupObject (user, password, sessiiopURL, objectName);
    EmployeeInfo info;

    // for (int ii = 0; ii < 10; ii++)
    // {
    // start a transaction
    ut.begin ();

    // set up the DS on the server
    employee.setUpDSConnection (dsName);

    // retrieve the info
    info = employee.getEmployee ("SCOTT");
    System.out.println ("Before Update: " + info.name +"  " + info.salary);

    // change the salary and update it
    System.out.println ("Increase by 10%");
    info.salary += (info.salary * 10) / 100;
    employee.updateEmployee (info);

    // commit the changes
    ut.commit ();

    // NOTE: you can do this before the commit of the previous transaction
    // (without starting a txn) then it becomes part of the first
    // global transaction.
    // start another transaction to retrieve the updated info
    ut.begin ();

    // Since, you started a new transaction, the DS needs to be
    // enlisted with the 'new' transaction. Hence, setup the DS on the server
    employee.setUpDSConnection (dsName);

    // try to retrieve the updated info
    info = employee.getEmployee ("SCOTT");
    System.out.println ("After Update: " + info.name +"  " + info.salary);

    // commit the seond transaction
    ut.commit ();

    /*
     * ut.rollback ();
     * ut.begin ();
     * info = employee.getEmployee ("SCOTT", dsName);
     * System.out.println (info.name + " "  + " " + info.salary);
     *
     * System.out.println ("Increase by 10%");
     * info.salary += (info.salary * 10) / 100;
     * employee.updateEmployee (info);
     *
     * info = employee.getEmployee ("SCOTT", dsName);
     * System.out.println (info.name + " "  + " " + info.salary);
     * //ut.commit ();
     * ut.rollback ();
     * }
     */
  }

  private static UserTransaction lookupUserTransaction (String user,
                                                        String password,
                                                        String jdbcURL,
                                                        String utName)
  {
    UserTransaction ut = null;
    try {
      Hashtable env = new Hashtable ();
      env.put (Context.URL_PKG_PREFIXES, "oracle.aurora.jndi");
      env.put (Context.SECURITY_PRINCIPAL, user);
      env.put (Context.SECURITY_CREDENTIALS, password);
      env.put(jdbc_accessURLContextFactory.CONNECTION_URL_PROP, jdbcURL);
      Context ic = new InitialContext (env);

      DriverManager.registerDriver (new oracle.jdbc.driver.OracleDriver ());

      ut = (UserTransaction)ic.lookup ("jdbc_access:/" + utName);
    } catch (NamingException e) {
      e.printStackTrace ();
    } catch (SQLException e) {
      e.printStackTrace ();
    }
    return ut;
  }

  private static Employee lookupObject (String user, String password,
                                         String sessiiopURL, String objectName)
  {
    Employee emp = null;
    try {
      Hashtable env = new Hashtable ();
      env.put (Context.URL_PKG_PREFIXES, "oracle.aurora.jndi");
      env.put (Context.SECURITY_PRINCIPAL, user);
      env.put (Context.SECURITY_CREDENTIALS, password);
      env.put (Context.SECURITY_AUTHENTICATION, ServiceCtx.NON_SSL_LOGIN);
      Context ic = new InitialContext (env);

      System.out.println ("Trying to lookup: " + sessiiopURL + objectName);
      emp = (Employee)ic.lookup (sessiiopURL + objectName);
    } catch (NamingException e) {
      e.printStackTrace ();
    }
    return emp;
  }
}
```

EmployeeServer.sqlj

```
package employeeServer;

import employee.*;

import java.sql.Connection;
import java.sql.SQLException;
import java.util.Hashtable;
import javax.sql.DataSource;
import javax.naming.Context;
import javax.naming.InitialContext;
import javax.naming.NamingException;

//import oracle.aurora.transaction.xa.OracleJTADataSource;

public class EmployeeImpl
       extends _EmployeeImplBase
{
  Context ic = null;
  DataSource ds = null;
  Connection conn = null;

  public void setUpDSConnection (String dsName)
       throws SQLError
  {
    try {
      if (ic == null)
        ic = new InitialContext ();

      // get a connection to the local DB
      ds = (DataSource)ic.lookup (dsName);

      // get a connection to the local DB
      // ((OracleJTADataSource)ds).setURL ("jdbc:oracle:kprb:");
      conn = ds.getConnection ();
    } catch (NamingException e) {
      e.printStackTrace ();
      throw new SQLError ("setUpDSConnection failed:" + e.toString ());
    } catch (SQLException e) {
      e.printStackTrace ();
      throw new SQLError ("setUpDSConnection failed:" + e.toString ());
    }
  }
  public EmployeeInfo getEmployee (String name)
       throws SQLError
  {
    try {
      if (conn == null)
        throw new SQLError ("getEmployee: conn is null");

      int empno = 0;
      double salary = 0.0;
      #sql { select empno, sal into :empno, :salary from emp
                    where ename = :name };
      return new EmployeeInfo (name, empno, (float)salary);
    } catch (SQLException e) {
      throw new SQLError (e.getMessage ());
    }
  }

  public void updateEmployee (EmployeeInfo employee)
       throws SQLError
  {
    if (conn == null)
      throw new SQLError ("updateEmployee: conn is null");

    try {
      #sql { update emp set ename = :(employee.name), sal = :(employee.salary)
                    where empno = :(employee.number) };
    } catch (SQLException e) {
      throw new SQLError (e.getMessage ());
    }
  }
}
```

Two-Phase Commit JTA Transaction Example

Employee.IDL

```
module employee {
  struct EmployeeInfo {
    wstring name;
    long number;
    double salary;
  };
  exception SQLError {
    wstring message;
  };

  interface Employee {
    void initialize (in wstring user, in wstring password,
                     in wstring serviceURL, in wstring utName,
                     in wstring dsName) raises (SQLError);
    void setRemoteObject (in wstring objName) raises (SQLError);

    EmployeeInfo getEmployee (in wstring empName) raises (SQLError);
    EmployeeInfo getRemoteEmployee (in wstring name) raises (SQLError);
    void updateEmployee (in EmployeeInfo empInfo) raises (SQLError);
    void updateRemoteEmployee (in EmployeeInfo empInfo) raises (SQLError);
  };
};
```

Client.java

```
import employee.*;

import java.util.Hashtable;
import javax.naming.Context;
import javax.naming.InitialContext;

import oracle.aurora.jndi.sess_iiop.ServiceCtx;

public class Client
{
  public static void main (String[] args) throws Exception
  {
    if (args.length != 6)
    {
      System.out.println ("usage: Client serviceURL objectName " +
                          "user password userTxnName dataSrcName");
      System.exit (1);
    }
    String serviceURL = args [0];
    String objectName = args [1];
    String user = args [2];
    String password = args [3];
    String utName = args [4];
    String dsName = args [5];

    Hashtable env = new Hashtable ();
```

```
env.put (Context.URL_PKG_PREFIXES, "oracle.aurora.jndi");
env.put (Context.SECURITY_PRINCIPAL, user);
env.put (Context.SECURITY_CREDENTIALS, password);
env.put (Context.SECURITY_AUTHENTICATION, ServiceCtx.NON_SSL_LOGIN);
Context ic = new InitialContext (env);

EmployeeInfo localInfo;
EmployeeInfo remoteInfo;

try {
  // lookup an employee object
  Employee employee = (Employee)ic.lookup (serviceURL + objectName);

  // initialize the employee object
  employee.initialize (user, password, serviceURL, utName, dsName);

  // setup the remote Object
  employee.setRemoteObject (objectName);

  // get info for "SCOTT"
  localInfo = employee.getEmployee ("SCOTT");
  System.out.println ("Before Update: " + localInfo.name + "  " +
                      localInfo.salary);
  // get info for "SMITH"
  remoteInfo = employee.getRemoteEmployee ("SMITH");
  System.out.println ("               " + remoteInfo.name + "  " +
                      remoteInfo.salary);

  // try to update locally
  localInfo.salary += 100;
  remoteInfo.salary += 200;

  // update Scott's salary
  employee.updateEmployee (localInfo);

  // update Smith's salary
  employee.updateRemoteEmployee (remoteInfo);

  // get updated info for "SCOTT"
  localInfo = employee.getEmployee ("SCOTT");
  System.out.println ("After Update: " + localInfo.name +"  " +
                      localInfo.salary);

  // get updated info for "SMITH"
  remoteInfo = employee.getRemoteEmployee ("SMITH");
```

```
      System.out.println ("              " + remoteInfo.name +"  " +
                          remoteInfo.salary);
    } catch (SQLError e) {
      System.out.println ("  Got SQLError: " + e.toString ());
    }
  }
}
```

Server

```
package employeeServer;

import employee.*;

import java.sql.Connection;
import java.util.Hashtable;
import javax.naming.Context;
import javax.naming.InitialContext;
import javax.sql.DataSource;
import javax.transaction.Status;
import javax.transaction.UserTransaction;

import java.sql.SQLException;
import javax.naming.NamingException;

import oracle.aurora.jndi.sess_iiop.ServiceCtx;
import oracle.aurora.transaction.xa.OracleJTADataSource;

public class EmployeeImpl extends _EmployeeImplBase
{
  Context inSessionLookupctx = null;
  Context remoteLookupCtx = null;
  UserTransaction ut = null;
  DataSource ds = null;
  Connection conn = null;
  String utName = null;
  String dsName = null;
  String user = null;
  String pwd = null;
  String serviceURL = null;
  Employee remoteEmployee = null;

  private void setInSessionLookupContext ()
       throws NamingException
  {
```

```
  // NOTE: here we need to set env as 2-phase coord needs
  //       branches, user/pwd to be set (branches is must)
  Hashtable env = new Hashtable ();
  env.put ("oracle.aurora.jta.branches", "true");
  env.put (Context.SECURITY_PRINCIPAL, user);
  env.put (Context.SECURITY_CREDENTIALS, pwd);
  inSessionLookupctx = new InitialContext (env);
  // ic = new InitialContext ();
}

private void setRemoteLookupInitialContext ()
     throws NamingException
{
  Hashtable env = new Hashtable ();
  env.put (Context.URL_PKG_PREFIXES, "oracle.aurora.jndi");
  env.put (Context.SECURITY_PRINCIPAL, user);
  env.put (Context.SECURITY_CREDENTIALS, pwd);
  env.put (Context.SECURITY_AUTHENTICATION, ServiceCtx.NON_SSL_LOGIN);
  remoteLookupCtx = new InitialContext (env);
}

public void initialize (String user, String password, String serviceURL,
                        String utName, String dsName)
     throws SQLError
{
  try {
    // set the local variables
    this.user = user;
    this.pwd = password;
    this.utName = utName;
    this.dsName = dsName;
    this.serviceURL = serviceURL;

    // set up a ctx to lookup the local/in-session objects
    if (inSessionLookupctx == null)
      setInSessionLookupContext ();

    // setup a ctx to lookup the remote objects
    if (remoteLookupCtx == null)
      setRemoteLookupInitialContext ();

    // lookup the usertransaction
    if (utName != null)
      ut = (UserTransaction)inSessionLookupctx.lookup (utName);
    // get a connection to the local DB
    if (dsName != null)
      ds = (DataSource)inSessionLookupctx.lookup (dsName);
  } catch (NamingException e) {
    e.printStackTrace ();
    throw new SQLError ("setUpDSConnection failed:" + e.toString ());
  }
}

public void setRemoteObject (String objName)
     throws SQLError
{
  if (remoteLookupCtx == null)
    throw new SQLError ("setRemoteObject: context is null");
  if (serviceURL == null)
    throw new SQLError ("setRemoteObject: serviceURL is null");

  try {
    if (remoteEmployee == null)
      remoteEmployee = (Employee)remoteLookupCtx.lookup (serviceURL +
                                                         objName);
    remoteEmployee.initialize (user, pwd, serviceURL, utName, dsName);
  } catch (NamingException e) {
    e.printStackTrace ();
    throw new SQLError ("setRemoteObject: " + e.toString ());
  }
  return;
}

public EmployeeInfo getEmployee (String name)
     throws SQLError
{
  System.out.println ("getEmployee: begin");
  this.startTrans ();

  EmployeeInfo info = this.doSelect (name);
  System.out.println ("getEmployee: end");
  return info;
}

public EmployeeInfo getRemoteEmployee (String name)
     throws SQLError
{
  System.out.println ("getRemoteEmployee: begin");
  if (remoteEmployee == null)
```

```
      throw new SQLError ("updateRemoteEmployee--remoteEmployee is NULL");

    EmployeeInfo info = remoteEmployee.getEmployee (name);
    System.out.println ("getRemoteEmployee: end " + info.name + "  " +
                        info.salary);

    this.commitTrans ();
    return info;
  }

  public void updateEmployee (EmployeeInfo empInfo)
       throws SQLError
  {
    System.out.println ("updateEmployee: begin");
    this.startTrans ();

    try {
      System.out.println ("  Before updating: ");
      this.doSelect (empInfo.name);

      #sql { update emp set ename = :(empInfo.name), sal = :(empInfo.salary)
                    where empno = :(empInfo.number) };
      System.out.println ("  After updating: ");
      this.doSelect (empInfo.name);
    } catch (SQLException e) {
      System.out.println ("updateEmployee: end with SQLException");
      e.printStackTrace ();
      throw new SQLError ("updateEmployee failed: " + e.toString ());
    }
    System.out.println ("updateEmployee: end");
  }

  public void updateRemoteEmployee (EmployeeInfo empInfo)
       throws SQLError
  {
    System.out.println ("updateRemoteEmployee: begin");
    if (remoteEmployee == null)
      throw new SQLError ("updateRemoteEmployee--remoteEmployee is NULL");

    remoteEmployee.updateEmployee (empInfo);
    System.out.println ("updateRemoteEmployee: end");
    this.commitTrans ();
    return;
  }
```

```
private void getLocalDBConenction ()
     throws SQLError
{
  try {
    if (ds == null)
      throw new SQLError ("datasource is not set");
    // get a connection to the local DB
    ((OracleJTADataSource)ds).setURL ("jdbc:oracle:kprb:");
    conn = ds.getConnection ();
  } catch (SQLException e) {
    System.out.println ("getLocalDBConenction: end: with SQLException");
    e.printStackTrace ();
    throw new SQLError (e.toString ());
  }
}

private void startTrans ()
     throws SQLError
{
  try {
    if (ut == null)
      throw new SQLError ("startTrans: userTransaction is null");

    // start a new-transaction iff no-txn is associated with the thread
    if (ut.getStatus () == Status.STATUS_NO_TRANSACTION)
      ut.begin ();

    // get the local-db connection--To enlist with the TM
    this.getLocalDBConenction ();
  } catch (Exception e) {
    throw new SQLError ("startTrans failed:" + e.toString ());
  }
}

private void commitTrans ()
     throws SQLError
{
  try {
    ut.commit ();
  } catch (Exception e) {
    throw new SQLError ("commitTrans failed:" + e.toString ());
  }
}

private EmployeeInfo doSelect (String name)
```

```
       throws SQLError
  {
    try {
      int empNo = 0;
      double empSalary = 0.0;
      #sql { select empno, sal into :empNo, :empSalary from emp
             where ename = :name };
      System.out.println ("  (" + name + ", " + empSalary + ")");
      return new EmployeeInfo (name, empNo, (float)empSalary);
    } catch (SQLException e) {
      System.out.println ("getEmployee: end: with SQLException");
      e.printStackTrace ();
      throw new SQLError (e.toString ());
    }
  }
}
```

JTS Transaction Example

Employee.IDL

```
module employee {
  struct EmployeeInfo {
    wstring name;
    long number;
    double salary;
  };

  exception SQLError {
    wstring message;
  };

  interface Employee {
    EmployeeInfo getEmployee (in wstring name) raises (SQLError);
    EmployeeInfo getEmployeeForUpdate (in wstring name) raises (SQLError);
    void updateEmployee (in EmployeeInfo name) raises (SQLError);
  };
};
```

Client.java

```
import employee.*;
import oracle.aurora.jndi.sess_iiop.ServiceCtx;

import javax.naming.Context;
import javax.naming.InitialContext;
import java.util.Hashtable;

public class Client
{
  public static void main (String[] args) throws Exception {
    if (args.length != 4) {
      System.out.println ("usage: Client serviceURL objectName user password");
      System.exit (1);
    }
    String serviceURL = args [0];
    String objectName = args [1];
    String user = args [2];
    String password = args [3];

    // get the handle to the InitialContext
    Hashtable env = new Hashtable ();
    env.put (Context.URL_PKG_PREFIXES, "oracle.aurora.jndi");
    env.put (Context.SECURITY_PRINCIPAL, user);
    env.put (Context.SECURITY_CREDENTIALS, password);
    env.put (Context.SECURITY_AUTHENTICATION, ServiceCtx.NON_SSL_LOGIN);
    Context ic = new InitialContext (env);

    // This is using Server-side TX services, specifically, JTS/XA TX:

    // get handle to the object and it’s info
    Employee employee = (Employee)ic.lookup (serviceURL + objectName);

    // get the info about a specific employee
    EmployeeInfo info = employee.getEmployee ("SCOTT");
    System.out.println ("Beginning salary = " + info.salary);
    System.out.println ("Decrease by 10%");
    // do work on the object or it’s info
    info.salary -= (info.salary * 10) / 100;

    // call update on the server-side
    employee.updateEmployee (info);

    System.out.println ("Final Salary = " + info.salary);
  }
}
```

Server

```
package employeeServer;

import employee.*;
import java.sql.*;

import oracle.aurora.jts.util.*;
import org.omg.CosTransactions.*;

public class EmployeeImpl extends _EmployeeImplBase
{
  Control c;

  private void startTrans () throws SQLError {
    try {
      TS.getTS ().getCurrent ().begin ();
    } catch (Exception e) {
      throw new SQLError ("begin failed:" + e);
    }
  }

  private void commitTrans () throws SQLError {
    try {
      TS.getTS ().getCurrent ().commit (true);
    } catch (Exception e) {
      throw new SQLError ("commit failed:" + e);
    }
  }

  public EmployeeInfo getEmployee (String name) throws SQLError {
    try {
      startTrans ();

      int empno = 0;
      double salary = 0.0;
      #sql { select empno, sal into :empno, :salary from emp
                    where ename = :name };
      c = TS.getTS().getCurrent().suspend();
      return new EmployeeInfo (name, empno, (float)salary);
    } catch (SQLException e) {
      throw new SQLError (e.getMessage ());
    } catch (Exception e) {
      throw new SQLError (e.getMessage());
    }
  }

  public EmployeeInfo getEmployeeForUpdate (String name) throws SQLError {
    try {
      startTrans ();

      int empno = 0;
      double salary = 0.0;
      #sql { select empno, sal into :empno, :salary from emp
                    where ename = :name for update };
      return new EmployeeInfo (name, empno, (float)salary);
    } catch (SQLException e) {
      throw new SQLError (e.getMessage ());
    }
  }

  public void updateEmployee (EmployeeInfo employee) throws SQLError {
    try {
      TS.getTS().getCurrent().resume(c);

      #sql { update emp set ename = :(employee.name), sal = :(employee.salary)
                    where empno = :(employee.number) };
      commitTrans ();
    } catch (SQLException e) {
      throw new SQLError (e.getMessage ());
    } catch (Exception e) {
      throw new SQLError (e.getMessage ());
    }
  }
}
```

SSL Examples

Client-Side Authentication

Hello.IDL

```
module common {
  interface Hello {
    wstring helloWorld ();
  };
};
```

Client.java

```
package client;

import common.Hello;
import oracle.aurora.jndi.sess_iiop.ServiceCtx;
import javax.naming.Context;
import javax.naming.InitialContext;
import java.util.Hashtable;

public class Client
{

  public static void main (String[] args) throws Exception {
    if (args.length != 3) {
      System.out.println("usage: Client serviceURL objectName credsFile");
      System.exit(1);
    }
    String serviceURL = args [0];
    String objectName = args [1];
    String credsFile = args [2];

    Hashtable env = new Hashtable();
    env.put(Context.URL_PKG_PREFIXES, "oracle.aurora.jndi");
    env.put(Context.SECURITY_AUTHENTICATION, ServiceCtx.SSL_CLIENT_AUTH);
    env.put(Context.SECURITY_CREDENTIALS, "welcome");

    // Simply specify  a file that contains all the credential info. This is
    // the file generated by the wallet manager tool.
    env.put(Context.SECURITY_PRINCIPAL, credsFile);

/*
    // As an alternative, you may also set the credentials individually, as
    // shown bellow.
    env.put(ServiceCtx.SECURITY_USER_CERT, testCert_base64);
    env.put(ServiceCtx.SECURITY_CA_CERT, caCert_base64);
    env.put(ServiceCtx.SECURITY_ENCRYPTED_PKEY, encryptedPrivateKey_base64);
    //System.getProperties().put("AURORA_CLIENT_SSL_DEBUG", "true");
*/

    Context ic = new InitialContext(env);

    Hello hello = (Hello) ic.lookup(serviceURL + objectName);
    System.out.println(hello.helloWorld());
  }
}
```

Server

```
package server;

import common.*;

public class HelloImpl extends _HelloImplBase {
  public String helloWorld() {
    String v = System.getProperty("oracle.server.version");
    return "Hello client, your javavm version is " + v + ".";
  }
}
```

Server-Side Authentication

This example includes setting a trustpoint. If you do not want to involve trustpoints, just remove the section of the code that sets the trustpoint.

Hello.IDL

```
module common {
  interface Hello {
    wstring helloWorld ();
  };
};
```

Client.java

```
package client;

import common.Hello;
import java.util.Hashtable;
import java.io.*;
import java.security.cert.*;  // for JDK 1.2
//import javax.security.cert.*;  // for JDK 1.1
import javax.naming.Context;
import javax.naming.InitialContext;
import oracle.aurora.ssl.*;
import oracle.aurora.jndi.sess_iiop.ServiceCtx;
import oracle.aurora.jndi.sess_iiop.SessionCtx;
import oracle.aurora.AuroraServices.LoginServer;
```

```
public class Client
{
   private static String trustedCert =
"MIIB1jCCAYCgAwIBAgIQQQFhvgccFLBfXGa6Y/iSGzANBgkqhkiG9w0BAQQFADBsMQswCQYDVQQG"+
"EwJVUzEPMA0GA1UEChQGT3JhY2xlMSkwJwYDVQQLFCBFbnRlcnByaQpzZSBBcHBsaWNhdGlvbiBT"+
"ZXJ2aWNlczEhMB8GA1UEAxQYRUFTUUEgQ2VydGlmaWNhdGUgU2VydmVyMB4XDTAwMDcyODIzMDA0"+
"OVoXDTAzMDcwNzIzMDA0OVowbDELMAkGA1UEBhMCVVMxDzANBgNVBAoUBk9yYWNsZTEpMCcGA1UE"+
"CxQgRW50ZXJwcmkKc2UgQXBwbGljYXRpb24gU2VydmljZXMxITAfBgNVBAMUGEVBU1FBIENlcnRp"+
"ZmljYXRlIFNlcnZlcjBcMA0GCSqGSIb3DQEBAQUAA0sAMEgCQQCy+w2AxY8u5kKI3rco9PWNr1Bb"+
"C3bwFZzd4+sdTqyHDy8Y2t2E7qfg9CwBO5ki530vT4ImH5x6lhbPN4QbcfgRAgMBAAEwDQYJKoZI"+
"hvcNAQEEBQADQQAYMohM/rz5ksAeorTw9qDcfH2TV6Qu0aXBvNJqBT5x4RvwLWYGMzcy77uSkiM1"+
"NkF3xY7MfZGqObKE3NQNgEuK";


 static boolean verifyPeerCert(org.omg.CORBA.Object obj) throws Exception
 {
   org.omg.CORBA.ORB orb = oracle.aurora.jndi.orb_dep.Orb.init();

   // Get the SSL current
   AuroraCurrent current = AuroraCurrentHelper.narrow
       (orb.resolve_initial_references("AuroraSSLCurrent"));

   // Check the cipher
   System.out.println("Negotiated Cipher:  " +
                      current.getNegotiatedCipherSuite(obj));
   // Check the protocol version
   System.out.println("Protocol Version:   " +
                      current.getNegotiatedProtocolVersion(obj));
   // Check the peer's certificate
   System.out.println("The account obj's certificate chain : ");
   byte [] [] certChain = current.getPeerDERCertChain(obj);
   System.out.println("length : " + certChain.length);
   System.out.println("Certificates: ");

   // JDB 1.2 way
   CertificateFactory cf = CertificateFactory.getInstance("X.509");
   for(int i = 0; i < certChain.length; i++) {
     ByteArrayInputStream bais = new ByteArrayInputStream(certChain[i]);
     Certificate  xcert = cf.generateCertificate(bais);
     System.out.println(xcert);
     if(xcert instanceof X509Certificate)
     {
       X509Certificate x509Cert = (X509Certificate)xcert;
       String globalUser = x509Cert.getSubjectDN().getName();
       System.out.println("DN out of the cert : " + globalUser);
     }
   }

   // JDK 1.1 way
/*
   java.security.Security.setProperty("cert.provider.x509v1",
                    "oracle.security.cert.X509CertificateImpl");
   for(int i = 0; i < certChain.length; i++) {
   javax.security.cert.X509Certificate cert =
      javax.security.cert.X509Certificate.getInstance(certChain[i]);
   String globalUser = cert.getSubjectDN().getName();
   System.out.println("DN out of the cert : " + globalUser);
   }
*/


   return true;
 }

  public static void main (String[] args) throws Exception {
    if (args.length != 2) {
      System.out.println("usage: Client serviceURL objectName");
      System.exit(1);
    }
    String serviceURL = args [0];
    String objectName = args [1];

    Hashtable env = new Hashtable();
    env.put(Context.URL_PKG_PREFIXES, "oracle.aurora.jndi");
    env.put(Context.SECURITY_AUTHENTICATION, ServiceCtx.SSL_LOGIN);
    env.put(Context.SECURITY_PRINCIPAL, "scott");
    env.put(Context.SECURITY_CREDENTIALS, "tiger");

    // setup the trust point
    env.put(ServiceCtx.SECURITY_TRUSTED_CERT, trustedCert);

    Context ic = new InitialContext(env);

    // Make an SSL connection to the server first. If the connection
    // succeeds, then inspect the  server’s certificate, since we haven’t
    // specified a trust point.
    // Get a SessionCtx that represents a database instance
    ServiceCtx service = (ServiceCtx)ic.lookup (serviceURL);
    SessionCtx session1 = (SessionCtx)service.createSubcontext (":session1");
    // Lookup login object for the purpose of getting hold of some corba
    // object needed for verifyPeerCert(). We should provide an extension
    // to just getting the NS object, for this purpose.
    LoginServer obj = (LoginServer) session1.activate("/etc/login");

    if(!verifyPeerCert(obj))
      throw new org.omg.CORBA.COMM_FAILURE("Verification of Peer cert failed");

    // Now that we trust the server, let's go ahead and do our business.
    session1.login();
    Hello hello = (Hello) session1.activate(objectName);
    System.out.println(hello.helloWorld());
  }
}
```

Server

```
package server;

import common.*;

public class HelloImpl extends _HelloImplBase {
  public String helloWorld() {
    String v = System.getProperty("oracle.server.version");
    return "Hello client, your javavm version is " + v + ".";
  }
}
```

Session Example

You can manage sessions in multiple ways, which are all discussed in "Session Management Scenarios" on page 4-18. The example presented here demonstrates how to access two sessions from a single client.

Hello.IDL

```
module common
{
  interface Hello
  {
    wstring helloWorld();
    void setMessage(in wstring message);
  };
};
```

Client.java

```
package client;

import common.*;
import java.util.Hashtable;
import javax.naming.Context;
import javax.naming.InitialContext;
import oracle.aurora.jndi.sess_iiop.ServiceCtx;
import oracle.aurora.jndi.sess_iiop.SessionCtx;
import oracle.aurora.AuroraServices.LoginServer;
import oracle.aurora.client.Login;

public class Client
{
  public static void main (String[] args) throws Exception
  {
    if (args.length != 4) {
      System.out.println ("usage: Client user password GIOP_SERVICE
            corbaPubname");
      System.exit (1);
    }
    String user = args[0];
    String password = args[1];
    String GIOP_SERVICE = args[2];
    String corbaPubname = args[3];

    // Prepare a simplified Initial Context as we are going to do
    // everything by hand
    Hashtable env = new Hashtable ();
    env.put (Context.URL_PKG_PREFIXES, "oracle.aurora.jndi");
    Context ic = new InitialContext (env);

    // Get a SessionCtx that represents a database instance
    ServiceCtx service = (ServiceCtx) ic.lookup(GIOP_SERVICE);

    // Create and authenticate a first session in the instance.
    SessionCtx session1 = (SessionCtx)service.createSubcontext (":session1");
    LoginServer login_server1 = (LoginServer)session1.activate ("etc/login");
    Login login1 = new Login (login_server1);
    login1.authenticate (user, password, null);

    // Create and authenticate a second session in the instance.
    SessionCtx session2 = (SessionCtx)service.createSubcontext (":session2");
    LoginServer login_server2 = (LoginServer)session2.activate ("etc/login");
    Login login2 = new Login (login_server2);
    login2.authenticate (user, password, null);

    // Activate one Hello object in each session
    Hello hello1 = (Hello)session1.activate (corbaPubname);
    Hello hello2 = (Hello)session2.activate (corbaPubname);

    // Verify that the objects are indeed different
    hello1.setMessage ("Hello from Session1");
    hello2.setMessage ("Hello from Session2");

    System.out.println (hello1.helloWorld ());
    System.out.println (hello2.helloWorld ());
  }
}
```

Server

```
package server;

import common.*;
import oracle.aurora.AuroraServices.ActivatableObject;

public class HelloImpl extends _HelloImplBase implements ActivatableObject
{
  String message;

  public String helloWorld()
  {
    return message;
  }

  public void setMessage(String message)
  {
    this.message = message;
  }

  public org.omg.CORBA.Object _initializeAuroraObject()
  {
    return this;
  }
}
```

Applet Example

JDK and JInitiator Applets

HTML for JDK 1.1

```
<pre>
<html>
<title> CORBA Applet talking to 9i</title>
<h1> CORBA applet talking to 9i using java plug in 1.1  </h1>
<hr>
The good old bank example
<OBJECT classid="clsid:8AD9C840-044E-11D1-B3E9-00805F499D93"
WIDTH = 500 HEIGHT = 50  codebase="http://java.sun.com/products/plugin/1.1/jinst
all-11-win32.cab#Version=1,1,0,0">
<PARAM NAME = CODE VALUE = OracleClientApplet.class >
<PARAM NAME = ARCHIVE VALUE = "oracleClient.jar,aurora_client.jar,vbjorb.jar,vbj
app.jar" >
<PARAM NAME="type" VALUE="application/x-java-applet;version=1.1">
<PARAM NAME="ORBdisableLocator" VALUE="true">
<COMMENT>
<EMBED type="application/x-java-applet;version=1.1"
ORBdisableLocator="true" java_CODE = OracleClientApplet.class java_ARCHIVE = "or
acleClient.jar,aurora_client.jar,vbjorb.jar,vbjapp.jar" WIDTH = 500 HEIGHT = 50
  pluginspage="http://java.sun.com/products/plugin/1.1/plugin-install.html">
<NOEMBED></COMMENT>
</NOEMBED></EMBED>
</OBJECT>

</center>
<hr>
</pre>
```

HTML for JDK 1.2

```
<pre>
<html>
<title> CORBA applet talking to 9i</title>
<h1> CORBA applet talking to 9i using Java plug in 1.2 </h1>
<hr>
The good old bank example
<OBJECT classid="clsid:8AD9C840-044E-11D1-B3E9-00805F499D93"
WIDTH = 500 HEIGHT = 50  codebase="http://java.sun.com/products/plugin/1.2/jinst
```

```
all-11-win32.cab#Version=1,1,0,0">
<PARAM NAME = CODE VALUE = OracleClientApplet.class >
<PARAM NAME = ARCHIVE VALUE = "oracleClient.jar,aurora_client.jar,vbjorb.jar,vbj
app.jar" >
<PARAM NAME="type" VALUE="application/x-java-applet;version=1.1.2">
<PARAM NAME="ORBdisableLocator" VALUE="true">
<PARAM NAME="org.omg.CORBA.ORBClass" VALUE="com.visigenic.vbroker.orb.ORB">
<PARAM NAME="org.omg.CORBA.ORBSingletonClass" VALUE="com.visigenic.vbroker.orb.O
RB">
<COMMENT>
<EMBED type="application/x-java-applet;version=1.1.2"
ORBdisableLocator="true"
org.omg.CORBA.ORBClass="com.visigenic.vbroker.orb.ORB"
org.omg.CORBA.ORBSingletonClass="com.visigenic.vbroker.orb.ORB" java_CODE = Orac
leClientApplet.class java_ARCHIVE = "oracleClient.jar,aurora_client.jar,vbjorb.j
ar,vbjapp.jar" WIDTH = 500 HEIGHT = 50   pluginspage="http://java.sun.com/produc
ts/plugin/1.2/plugin-install.html">
<NOEMBED></COMMENT>
</NOEMBED></EMBED>
</OBJECT>

</center>
<hr>
</pre>
```

HTML for Oracle JInitiator

```
<h1>CORBA applet talking to 9i using JInitiator 1.1.7.18</h1>
   <COMMENT>
   <EMBED   type="application/x-jinit-applet;version=1.1.7.18"
      java_CODE="OracleClientApplet"
      java_CODEBASE="http://mysun:8080/applets/bank"
      java_ARCHIVE="oracleClient.jar,aurora_client.jar,vbjorb.jar,vbjapp.jar"
      WIDTH=400
      HEIGHT=100
      ORBdisableLocator="true"
      org.omg.CORBA.ORBClass="com.visigenic.vbroker.orb.ORB"
      org.omg.CORBA.ORBSingletonClass="com.visigenic.vbroker.orb.ORB"
      serverHost="mysun"
      serverPort=8080
      <NOEMBED>
      </COMMENT>
      </NOEMBED>
    </EMBED>
```

Applet Client

```
// ClientApplet.java

import java.awt.*;

import oracle.aurora.jndi.sess_iiop.ServiceCtx;

import javax.naming.Context;
import javax.naming.InitialContext;
import java.util.Hashtable;
import Bank.*;

public class OracleClientApplet extends java.applet.Applet {

  private TextField _nameField, _balanceField;
  private Button _checkBalance;
  private Bank.AccountManager _manager;

  public void init() {
    // This GUI uses a 2 by 2 grid of widgets.
    setLayout(new GridLayout(2, 2, 5, 5));
    // Add the four widgets.
    add(new Label("Account Name"));
    add(_nameField = new TextField());
    add(_checkBalance = new Button("Check Balance"));
    add(_balanceField = new TextField());
    // make the balance text field non-editable.
    _balanceField.setEditable(false);
    try {
      String serviceURL = "sess_iiop://mysun:2222";
      String objectName = "/test/myBank";

      // Initialize the ORB (using the Applet).
      Hashtable env = new Hashtable();
      env.put(Context.URL_PKG_PREFIXES, "oracle.aurora.jndi");
      env.put(Context.SECURITY_PRINCIPAL, "scott");
      env.put(Context.SECURITY_CREDENTIALS, "tiger");
      env.put(Context.SECURITY_AUTHENTICATION, ServiceCtx.NON_SSL_LOGIN);
      env.put(ServiceCtx.APPLET_CLASS, this);

      Context ic = new InitialContext(env);
    _manager = (AccountManager)ic.lookup (serviceURL + objectName);
    } catch (Exception e) {
      System.out.println(e.getMessage());
      e.printStackTrace();
      throw new RuntimeException();
    }
  }

  public boolean action(Event ev, Object arg) {
    if(ev.target == _checkBalance) {
      // Request the account manager to open a named account.
      // Get the account name from the name text widget.
      Bank.Account account = _manager.open(_nameField.getText());
      // Set the balance text widget to the account's balance.
      _balanceField.setText(Float.toString(account.balance()));
      return true;
    }
    return false;
  }

}
```

Visigenic Applet

README

```
To run VisiClient applet, you need to do the following.

Start osagent and gatekeeper (with port 16000)
(for gate keeper, create a file called gatekeeper.properties and just
put this entry in there : exterior_port=16000)

Then start the Bank server (vbj Server &).

Your browser should have Jinitiator installed (use ojdk-pc.us.oracle.com
for getting JInitiator, jdk 1.1.7.18)
(Browser security doesn’t have to be off, i.e, you may set it to
AppletHost in Jinitiator)

Then simply connect to  mysun:8080/applets/bank/VisiClient.html
```

HTML for Visigenic Client Applet

```
<h1>Visigenic Client applet</h1>
   <COMMENT>
   <EMBED   type="application/x-jinit-applet;version=1.1.7.18"
```

```
    java_CODE="VisiClientApplet"
    java_CODEBASE="http://mysun:8080/applets/bank"
    java_ARCHIVE="visiClient.jar,vbjorb.jar,vbjapp.jar"
    WIDTH=400
    HEIGHT=100
    ORBgatekeeperIOR="http://mysun:16000/gatekeeper.ior"
    USE_ORB_LOCATOR="true"
    ORBbackCompat="true"
    serverHost="mysun"
    serverPort=8080
    <NOEMBED>
    </COMMENT>
    </NOEMBED>
  </EMBED>
```

Visigenic Client Applet

```
// ClientApplet.java

import java.awt.*;

public class VisiClientApplet extends java.applet.Applet {

  private TextField _nameField, _balanceField;
  private Button _checkBalance;
  private Bank.AccountManager _manager;

  public void init() {
    // This GUI uses a 2 by 2 grid of widgets.
    setLayout(new GridLayout(2, 2, 5, 5));
    // Add the four widgets.
    add(new Label("Account Name"));
    add(_nameField = new TextField());
    add(_checkBalance = new Button("Check Balance"));
    add(_balanceField = new TextField());
    // make the balance text field non-editable.
    _balanceField.setEditable(false);
    // Initialize the ORB (using the Applet).
    org.omg.CORBA.ORB orb = org.omg.CORBA.ORB.init(this, null);
    // Locate an account manager.
    _manager = Bank.AccountManagerHelper.bind(orb, "BankManager");
  }

  public boolean action(Event ev, Object arg) {
    if(ev.target == _checkBalance) {
      // Request the account manager to open a named account.
      // Get the account name from the name text widget.
      Bank.Account account = _manager.open(_nameField.getText());
      // Set the balance text widget to the account’s balance.
      _balanceField.setText(Float.toString(account.balance()));
      return true;
    }
    return false;
  }

}
```

B

Comparing the Oracle9*i* and VisiBroker VBJ ORBs

This appendix, which is for developers who are familiar with the VisiBroker VBJ ORB, summarizes the main differences between that ORB and the current version of the Oracle9*i* ORB. Each ORB supports multiple styles of usage, but this appendix compares only the most commonly used styles. In particular, it assumes that VBJ clients use the helper `bind` method to find objects by name, whereas Oracle9*i* clients use the JNDI `lookup` method for the same purpose. It also assumes that Oracle9*i* clients use Oracle's session IIOP to communicate with server objects, although the Oracle9*i* ORB also supports the standard IIOP used by the VBJ ORB.

The differences in the ORBs are summarized in these sections:

- Object References Have Session Lifetimes
- The Database Server Is the Implementation Mainline
- Server Object Implementations Are Deployed by Loading and Publishing
- Implementation by Inheritance Is Nearly Identical
- Implementation by Delegation Is Different
- Clients Look Up Object Names with JNDI
- No Interface or Implementation Repository
- The Bank Example in Oracle9i and VBJ

At the end of the appendix, equivalent client and server implementations of the same IDL for the VBJ and Oracle9*i* ORBs are provided for comparison.

Object References Have Session Lifetimes

The Oracle9*i* ORB creates object instances in database sessions. When a session disappears, references to objects created in that session become invalid: attempts to use them incur the "object does not exist" exception. A session disappears when the last client connection to the session is closed or the session's timeout value is reached. An object in a session can set the session timeout value with `oracle.aurora.net.Presentation.sessionTimeout()` optionally providing a client interface to this method, which a client can call if it wants an object to persist after client connections to the session are closed.

The life of a typical Oracle9*i* CORBA object proceeds as follows:

- A client looks up an object implementation's name with JNDI specifying the database where the implementation has been published.
- The Oracle ORB responds by instantiating an object of the type, and returning a reference to the client.
- The client calls methods on the object, and may pass the reference to other clients who may then call methods on the object.
- The object ceases to exist when its session is destroyed.

The Database Server Is the Implementation Mainline

An Oracle9*i* server object implementation consists of a single class. Developers do not write a mainline server, because the database server is the mainline. If the database is running, all implementations published in that database are available to clients. The database server dynamically assigns MTS threads to implementations. An implementation may multithread its own execution with Java threads.

Server Object Implementations Are Deployed by Loading and Publishing

Loading an object implementation into a database with the `loadjava` tool makes that implementation accessible to the ORB running in that database. Publishing a loaded implementation's name to a database's session name space with the `publish` tool makes the implementation accessible to clients by name. Every CORBA object implementation must be loaded, but only those whose names will be looked up by clients need to be published.

Implementation by Inheritance Is Nearly Identical

To implement the hypothetical interface `Alpha` in *Oracle9i*, write a class called `AlphaImpl`, which extends `AlphaImplBase` and defines the Java methods that implement the IDL operations. You may also provide instance initialization code in an `_initializeAuroraObject` method, which the Oracle ORB will call when it creates a new instance.

Implementation by Delegation Is Different

For an Oracle9*i* implementation by delegation (tie), the class you write extends a class you have defined and implements two Oracle-defined interfaces. The first interface, whose name is the IDL interface name concatenated with `Operations`, defines the methods corresponding to the IDL operations. The second interface, called `ActivatableObject`, defines a single method called `_initializeAuroraObject()`. To implement this method, create and return an instance. Here is a minimal example:

```
// IDL
module hello {
  interface Hello {
    wstring helloWorld ();
  };
};

// Oracle9i tie implementation
package helloServer;

import hello.*;
import oracle.aurora.AuroraServices.ActivatableObject;

public class HelloImpl implements HelloOperations, ActivatableObject
//, extends <YourClass>
{
  public String helloWorld () {
    return "Hello World!";
  }

  public org.omg.CORBA.Object _initializeAuroraObject () {
    // create and initialize an instance and return it, for example ...
    return new _tie_Hello (this);
  }
}
```

Clients Look Up Object Names with JNDI

An Oracle9*i* client can look up a published object by name, with CORBA COSNaming or with the simpler JNDI, which interacts with COSNaming in the client's behalf.

A client creates an initial JNDI context for a particular database with a Java constructor, for example:

```
Context ic = new InitialContext(env);
```

The `env` parameter specifies user name and password under which the client is logging in. Because object implementations run in database servers, CORBA object users (through their clients) must identify and authenticate themselves to the database as they would for any database operation.

To obtain an instance of a published implementation, the client calls the JNDI context's `lookup()` method, passing a URL that names the target database and the published name of the desired object implementation. The `lookup()` call returns a reference to an instance in the target database. A client may pass the reference (perhaps in stringified form) to other clients, and the reference will remain valid as long as the session in which the associated object was created survives. Clients that use copies of the same object reference share the object's database session.

If a client executes `lookup()` twice in succession with the same parameters, the second object reference is identical to the first, that is, it refers to the instance created by the first `lookup()` call. However, if a client creates a second session and does the second `lookup()` in that session, a different instance is created and its reference returned.

No Interface or Implementation Repository

The current version of the Oracle9*i* ORB does not include an interface repository or an implementation repository.

The Bank Example in Oracle9*i* and VBJ

The following sections compare implementations of the bank example, widely used in VBJ documentation. Both client and server are shown as they would be implemented in Oracle9*i* and VBJ. All implementations use inheritance.

The Bank IDL Module

```
// Bank.idl

module Bank {
  interface Account {
    float balance();
  };
  interface AccountManager {
    Account open(in string name);
  };
};
```

Oracle9*i* Client

```
// Client.java

import bankServer.*;
import Bank.*;
import oracle.aurora.jndi.sess_iiop.ServiceCtx;

import javax.naming.Context;
import javax.naming.InitialContext;
import java.util.Hashtable;

public class Client
{
  public static void main (String[] args) throws Exception {

    String serviceURL = "sess_iiop://localhost:2222";
    String objectName = "/test/myBank";
    String username = "scott";
    String password = "tiger";

    Hashtable env = new Hashtable();
    env.put(Context.URL_PKG_PREFIXES, "oracle.aurora.jndi");
    env.put(Context.SECURITY_PRINCIPAL, username);
    env.put(Context.SECURITY_CREDENTIALS, password);
    env.put(Context.SECURITY_AUTHENTICATION, ServiceCtx.NON_SSL_LOGIN);

    Context ic = new InitialContext(env);

    AccountManager manager =
      (AccountManager) ic.lookup(serviceURL + objectName);

    // use args[0] as the account name, or a default.
    String name = args.length == 1 ? args[0] : "Jack B. Quick";

    // Request the account manager to open a named account.
    Bank.Account account = manager.open(name);

    // Get the balance of the account.
    float balance = account.balance();

    // Print out the balance.
    System.out.println
      ("The balance in " + name + "'s account is $" + balance);
  }
}
```

VBJ Client

```
// Client.java
```

```
public class Client {

  public static void main(String[] args) {
    // Initialize the ORB.
    org.omg.CORBA.ORB orb = org.omg.CORBA.ORB.init(args,null);
    // Locate an account manager.
    Bank.AccountManager manager =
      Bank.AccountManagerHelper.bind(orb, "BankManager");
    // use args[0] as the account name, or a default.
    String name = args.length > 0 ? args[0] : "Jack B. Quick";
    // Request the account manager to open a named account.
    Bank.Account account = manager.open(name);
      // Get the balance of the account.
    float balance = account.balance();
    // Print out the balance.
    System.out.println
      ("The balance in " + name + "‘s account is $" + balance);
  }

}
```

Oracle9*i* Account Implementation

```
// AccountImpl.java
package bankServer;

public class AccountImpl extends Bank._AccountImplBase {
  public AccountImpl(float balance) {
    _balance = balance;
  }
  public float balance() {
    return _balance;
  }
  private float _balance;
}
```

VBJ Account Implementation

```
// AccountImpl.java

public class AccountImpl extends Bank._AccountImplBase {
  public AccountImpl(float balance) {
    _balance = balance;
  }
  public float balance() {
    return _balance;
  }
  private float _balance;
}
```

Oracle9*i* Account Manager Implementation

```
// AccountManagerImpl.java
package bankServer;

import java.util.*;

public class AccountManagerImpl extends Bank._AccountManagerImplBase {

  public AccountManagerImpl() {
    super();
  }

  public AccountManagerImpl(String name) {
    super(name);
  }

  public synchronized Bank.Account open(String name) {
    // Lookup the account in the account dictionary.
    Bank.Account account = (Bank.Account) _accounts.get(name);
    // If there was no account in the dictionary, create one.
    if(account == null) {

      // Make up the account's balance, between 0 and 1000 dollars.
      float balance = Math.abs(_random.nextInt()) % 100000 / 100f;

      // Create the account implementation, given the balance.
      account = new AccountImpl(balance);
```

```
        _orb().connect (account);

        // Print out the new account.
        // This just goes to the system trace file for Oracle9i.
        System.out.println("Created " + name + "'s account: " + account);

        // Save the account in the account dictionary.
        _accounts.put(name, account);
      }
      // Return the account.
      return account;
    }

    private Dictionary _accounts = new Hashtable();
    private Random _random = new Random();

  }
```

VBJ Account Manager Implementation

```
// AccountManagerImpl.java

import java.util.*;

public class AccountManagerImpl extends Bank._AccountManagerImplBase {
  public AccountManagerImpl(String name) {
    super(name);
  }
  public synchronized Bank.Account open(String name) {
    // Lookup the account in the account dictionary.
    Bank.Account account = (Bank.Account) _accounts.get(name);
    // If there was no account in the dictionary, create one.
    if(account == null) {
      // Make up the account's balance, between 0 and 1000 dollars.
      float balance = Math.abs(_random.nextInt()) % 100000 / 100f;
      // Create the account implementation, given the balance.
      account = new AccountImpl(balance);
      // Make the object available to the ORB.
      _boa().obj_is_ready(account);
      // Print out the new account.
      System.out.println("Created " + name + "'s account: " + account);
      // Save the account in the account dictionary.
```

```
        _accounts.put(name, account);
      }
      // Return the account.
      return account;
    }
    private Dictionary _accounts = new Hashtable();
    private Random _random = new Random();
  }
```

VBJ Server Mainline

```
// Server.java


public class Server {

  public static void main(String[] args) {
    // Initialize the ORB.
    org.omg.CORBA.ORB orb = org.omg.CORBA.ORB.init(args,null);
    // Initialize the BOA.
    org.omg.CORBA.BOA boa = orb.BOA_init();
    // Create the account manager object.
    Bank.AccountManager manager =
      new AccountManagerImpl("BankManager");
    // Export the newly created object.
    boa.obj_is_ready(manager);
    System.out.println(manager + " is ready.");
    // Wait for incoming requests
    boa.impl_is_ready();
  }

}
```

C

Abbreviations and Acronyms

This appendix lists some of the most common acronyms that you will find in the areas of networks, distributed object development, and Java. In cases where an acronym refers to a product or a concept that is associated with a specific group, company or product, the group, company, or product is indicated in brackets following the acronym expansion. For example: CORBA ... [OMG].

3GL	third generation language
4GL	fourth generation language
ACID	atomicity, consistency, isolation, durability
ACL	access control list
ADT	abstract datatype
AFC	application foundation classes [Microsoft]
ANSI	American National Standards Institute
API	application program interface
AQ	advanced queueing [Oracle9*i*]
ASCII	American standard code for information interchange
ASP	active server pages [Microsoft] application service provider
AWT	abstract windowing toolkit [Java]
BDK	beans developer kit [Java]
BLOB	binary large object
BOA	basic object adapter [CORBA]

BSD	Berkeley system distribution [UNIX]
C/S	client/server
CGI	common gateway interface
CICS	customer information control system [IBM]
CLI	call level interface [SAG]
CLOB	character large object
COM	component object model [Microsoft]
COM+	component object model, extended [Microsoft]
CORBA	common object request broker architecture [OMG]
DB	database
DBA	database administrator, database administration
DBMS	database management system
DCE	distributed computing environment [OSF]
DCOM	distributed common object model [Microsoft]
DDCF	distributed document component facility
DDE	dynamic data exchange [Microsoft]
DDL	data definition language [SQL]
DLL	dynamic link library [Microsoft]
DLM	distributed lock manager [Oracle9*i*]
DML	data manipulation language [SQL]
DOS	disk operating system
DSOM	distributed system object model [IBM]
DSS	decision support system
DTP	distributed transaction processing
EBCDIC	extended binary-coded decimal interchange code [IBM]
EJB	Enterprise JavaBean
ERP	enterprise resource planning
ESIOP	environment-specific inter-orb protocol
FTP	file transfer protocol

GB	gigabyte
GIF	graphics interchange format
GIOP	general inter-orb protocol
GUI	graphical user interface
GUID	globally-unique identifier
HTML	hypertext markup language
HTTP	hypertext transfer protocol
IDE	integrated development environment interactive development environment
IDL	interface definition language
IEEE	Institute of Electrical and Electronics Engineers
IIOP	Internet inter-ORB protocol
IIS	Internet information server [Microsoft]
IP	Internet protocol
IPC	interprocess communication
IS	information services
ISAM	indexed sequential access method
ISAPI	Internet server API [Microsoft]
ISO	international standards organization (translation)
ISP	Internet service provider
ISQL	interactive SQL [Interbase]
ISV	independent software vendor
IT	information technology
J2EE	Java 2 Enterprise Edition [Sun]
JAR	Java archive (on analogy with tar, q.v.)
JCK	Java compatibility kit [Sun]
JDBC	Java database connectivity
JDK	Java developer kit
JFC	Java foundation classes

JIT	just in time
JLS	Java language specification
JMF	Java media framework
JMS	Java messaging service
JNDI	Java naming and directory interface
JNI	Java native interface
JOB	Java Objects for Business [Sun]
JPEG	joint photographic experts group
JRMP	Java remote message protocol
JSP	Java server pages [Sun] (sometimes used for Java Stored Procedure [Oracle])
JTA	Java transaction API
JTS	Java transaction service
JWS	Java Web Server [Sun]
KB	kilobyte
LAN	local area network
LDAP	lightweight directory access protocol
LDIF	LDPA data interchange format
LOB	large object
MB	megabyte
MIME	multipurpose Internet mail extensions
MIS	management information services
MOM	message-oriented middleware
MPEG	motion picture experts group
MTS	multi-threaded server [Oracle]
MTS	Microsoft Transaction Server [Microsoft]
NCLOB	national character large object
NIC	network information center [Internet]
NNTP	net news transfer protocol

NSAPI	Netscape server application programming interface
NSP	network service provider
NT	New Technology [Microsoft]
OCI	Oracle call interface
OCX	OLE common control [Microsoft]
ODBC	open database connectivity [Microsoft]
ODBMS	object database management system
ODL	object definition language [Microsoft]
ODMG	Object Database Management Group
OEM	original equipment manufacturer
OID	object identifier
OLE	object linking and embedding
OLTP	on line transaction processing
OMA	object management architecture [OMG]
OMG	Object Management Group
OO	object-oriented, object orientation
OODBMS	object-oriented database management system
OQL	object query language
ORB	object request broker
ORDBMS	object-relational database management system
OS	operating system
OSF	Open System Foundation
OSI	open systems interconnect
OSQL	object SQL
OTM	object transaction monitor
OTS	object transaction service
OWS	Oracle Web Server
PB	petabyte
PDF	portable document format [Adobe]

PGP	pretty good privacy
PL/SQL	procedural language/SQL [Oracle]
POA	portable object adapter [CORBA]
RAM	random access memory
RAS	remote access service [Microsoft]
RCS	revision control system
RDBMS	relational database management system
RFC	request for comments
RFP	request for proposal
RMI	remote method invocation [Sun]
ROM	read only memory
RPC	remote procedure call
RTF	rich text file
SAF	server application function [Netscape]
SAG	SQL Access Group
SCSI	small computer system interface
SDK	software developer kit
SET	secure electronic transaction
SGML	standard generalized markup language
SID	system identifier [Oracle]
SLAPD	standalone LDAP daemon
SMP	symmetric multiprocessing
SMTP	simple mail transfer protocol
SPI	service provider interface
SQL	structured query language
SQLJ	SQL for Java
SRAM	static (or synchronous) random access memory
SSL	secure socket layer
TB	terabyte

TCPS	TCP for SSL
TCP/IP	transmission control protocol/Internet protocol
TP	transaction processing
TPC	Transaction Processing Council
TPCW	TPC web benchmark
TPF	transaction processing facility
TPM	transaction processing monitor
UCS	universal character set [ISO 10646]
UDP	user datagram protocol
UI	user interface
UML	unified modeling language [Rational]
URI	uniform resource identifier
URL	universal resource locator
URN	universal resource name
VAR	value-added reseller
VB	Visual Basic [Microsoft]
VRML	virtual reality modeling language
WAI	web application interface [Netscape]
WAN	wide area network
WIPS	Web interactions per second [TPCW]
WWW	world wide Web
XA	extended architecture [X/Open]
XML	extended markup language
jdb	Java debugger [Sun]
tar	tape archive, tape archiver [UNIX]
tps	transactions per second

Index