Sun Java™ System

Application Server 8 Developer's Guide

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Contents

About This Guide

This guide describes how to create and run Java™ 2 Platform, Enterprise Edition (J2EE™ platform) applications that follow the new open Java standards model for Java™ Servlet, JavaServer Pages™ (JSP™), Enterprise JavaBeans™ (EJB™), and other J2EE components in the Sun Java™ System Application Server Platform Edition 8 environment. In addition to describing programming concepts and tasks, this guide offers sample code, implementation tips, reference material, and a glossary. Topics include application design, developer tools, security, assembly, deployment, debugging, and creating lifecycle modules.

This preface contains information about the following topics:

- Who Should Use This Guide
- Using the Documentation
- How This Guide Is Organized
- Related Information
- Documentation Conventions
- Contacting Sun

Who Should Use This Guide

The intended audience for this guide is the person who develops, assembles, and deploys J2EE applications in a corporate enterprise.

This guide assumes you are familiar with the following topics:

- J2EE specification
- HTML

- Java programming
- Java APIs as defined in the Java™ Servlet, JavaServer Pages™ (JSP™), Enterprise JavaBeans™ (EJB™), and Java™ Database Connectivity (JDBC™) specifications
- Structured database query languages such as SQL
- Relational database concepts
- Software development processes, including debugging and source code control

Using the Documentation

The Sun Java System Application Server Platform Edition manuals are available as online files in Portable Document Format (PDF) and Hypertext Markup Language (HTML).

The following table lists tasks and concepts described in the Sun Java System Application Server manuals.

Table 1 Sun Java System Application Server Documentation Roadmap

For information about	See the following
Late-breaking information about the software and the documentation. Includes a comprehensive, table-based summary of supported hardware, operating system, JDK, and JDBC/RDBMS.	*Release Notes*
Installing the Sun Java System Application Server software and its components, such as sample applications, the Administration Console, and the high-availability components. Instructions for implementing a basic high-availability configuration are included.	*Installation Guide*
Creating and implementing Java™ 2 Platform, Enterprise Edition (J2EE™ platform) applications intended to run on the Sun Java System Application Server that follow the open Java standards model for J2EE components and APIs. Includes general information about application design, developer tools, security, assembly, deployment, debugging, and creating lifecycle modules. A comprehensive Sun Java System Application Server glossary is included.	*Developer's Guide*
Using J2EE 1.4 platform technologies and APIs to develop J2EE applications and deploying the applications on the Sun Java System Application Server.	*J2EE 1.4 Tutorial*
Information and instructions on the configuration, management, and deployment of the Sun Java System Application Server subsystems and components, from both the Administration Console and the command-line interface. Topics include cluster management, the high-availability database, load balancing, and session persistence. A comprehensive Sun Java System Application Server glossary is included.	*Administration Guide*
Editing the Sun Java System Application Server configuration file, `domain.xml`.	*Reference*

Table 1 Sun Java System Application Server Documentation Roadmap *(Continued)*

For information about	See the following
Migrating your applications to the new Sun Java System Application Server programming model, specifically from iPlanet Application Server 6.x and from Netscape Application Server 4.0. Includes a sample migration.	*Migrating and Redeploying Server Applications Guide*
Information on solving Sun Java System Application Server problems.	*Troubleshooting Guide*
Utility commands available with the Sun Java System Application Server; written in manpage style.	*Utility Reference Manual*
Using the Sun™ Java System Message Queue 3.5 software.	The Sun Java System Message Queue documentation at: `http://docs.sun.com/db?p=prod/s1.s1msgqu`

How This Guide Is Organized

This guide provides a Sun Java System Application Server environment overview for developing applications, and includes the following topics:

- Part I, "Developing Applications"
  - Chapter 1, "Setting Up a Development Environment"
  - Chapter 2, "Securing J2EE Applications"
  - Chapter 3, "Assembling and Deploying J2EE Applications"
  - Chapter 4, "Debugging J2EE Applications"
  - Chapter 5, "Deployment Descriptor Files"
- Part II, "Developing Application Components"
  - Chapter 6, "Developing Web Applications"
  - Chapter 7, "Using Enterprise JavaBeans Technology"
  - Chapter 8, "Using Container-Managed Persistence for Entity Beans"
  - Chapter 9, "Developing Java Clients"
  - Chapter 10, "Developing Lifecycle Listeners"
- Part III, "Using Services and APIs"
  - Chapter 11, "Using the JDBC API for Database Access"

- Chapter 12, “Using the Transaction Service”
- Chapter 13, “Using the Java Naming and Directory Interface”
- Chapter 14, “Using the Java Message Service”
- Chapter 15, “Using the JavaMail API”

Finally, an *Index* is provided.

Related Information

You can find a directory of URLs for the official specifications at *install_dir*/`docs/index.htm`. Additionally, the following resources may be useful:

General J2EE Information:

The J2EE 1.4 Tutorial:

`http://java.sun.com/j2ee/1.4/docs/tutorial/doc/index.html`

Core J2EE Patterns: Best Practices and Design Strategies by Deepak Alur, John Crupi, & Dan Malks, Prentice Hall Publishing

Java Security, by Scott Oaks, O’Reilly Publishing

Programming with Servlets and JSPs:

Java Servlet Programming, by Jason Hunter, O’Reilly Publishing

Java Threads, 2nd Edition, by Scott Oaks & Henry Wong, O’Reilly Publishing

Programming with EJB components:

Enterprise JavaBeans, by Richard Monson-Haefel, O’Reilly Publishing

Programming with JDBC:

Database Programming with JDBC and Java, by George Reese, O’Reilly Publishing

JDBC Database Access With Java: A Tutorial and Annotated Reference (Java Series), by Graham Hamilton, Rick Cattell, & Maydene Fisher

Documentation Conventions

This section describes the types of conventions used throughout this guide:

- General Conventions
- Conventions Referring to Directories

General Conventions

The following general conventions are used in this guide:

- **File and directory paths** are given in UNIX® format (with forward slashes separating directory names). For Windows versions, the directory paths are the same, except that backslashes are used to separate directories.
- **URLs** are given in the format:

  http://*server*.*domain*/*path*/*file*.html

  In these URLs, *server* is the server name where applications are run; *domain* is your Internet domain name; *path* is the server's directory structure; and *file* is an individual filename. Italic items in URLs are placeholders.
- **Font conventions** include:
  - The `monospace` font is used for sample code and code listings, API and language elements (such as function names and class names), file names, pathnames, directory names, and HTML tags.
  - *Italic* type is used for code variables.
  - *Italic* type is also used for book titles, emphasis, variables and placeholders, and words used in the literal sense.
  - **Bold** type is used as either a paragraph lead-in or to indicate words used in the literal sense.
- **Installation root directories** for most platforms are indicated by *install_dir* in this document. Exceptions are noted in "Conventions Referring to Directories" on page 24.

  By default, the location of *install_dir* on **most** platforms is:
  - Solaris and Linux file-based installations, non-root user:

    user's home directory`/SUNWappserver`

  - Solaris and Linux file-based installations, root user:

    `/opt/SUNWappserver`

  - Windows, all installations:

    system drive`:\Sun\AppServer`

  For the platforms listed above, *default_config_dir* is identical to *install_dir*. See "Conventions Referring to Directories" on page 24 for exceptions and additional information.

- **Domain root directories** are indicated by *domain_dir* in this document, which by default is an abbreviation for the following:

  install_dir`/domains/`*domain_dir*

  However, for package-based installations, the directory containing all the domains can be changed from *install_dir*`/domains/` to another directory during installation. In configuration files, you may see *domain_dir* represented as follows:

  `${com.sun.aas.instanceRoot}`

- **UNIX-specific descriptions** throughout this manual apply to the Linux operating system as well, except where Linux is specifically mentioned.

Conventions Referring to Directories

By default, when using the Solaris package-based or Linux RPM-based installation, the application server files are spread across several root directories. This guide uses the following document conventions to correspond to the various default installation directories provided:

- *install_dir* refers to `/opt/SUNWappserver`, which is the default location for the static portion of the installation image. All utilities, executables, and libraries that make up the application server reside in this location.

- *default_config_dir* refers to `/var/opt/SUNWappserver/domains`, which is the default location for any domains that are created.

Contacting Sun

You might want to contact Sun Microsystems in order to:

- Give Us Feedback
- Obtain Training
- Contact Product Support

Give Us Feedback

If you have general feedback on the product or documentation, please send this to `appserver-feedback@sun.com`.

Obtain Training

Application Server training courses are available at:

`http://training.sun.com/US/catalog/enterprise/web_application.html/`

Visit this site often for new course availability on the Sun Java System Application Server.

Contact Product Support

If you have problems with your system, contact customer support using one of the following mechanisms:

- The online support web site at:

  `http://www.sun.com/supportraining/`

- The telephone dispatch number associated with your maintenance contract

Please have the following information available prior to contacting support. This helps to ensure that our support staff can best assist you in resolving problems:

- Description of the problem, including the situation where the problem occurs and its impact on your operation
- Machine type, operating system version, and product version, including any patches and other software that might be affecting the problem. Here are some of the commonly used commands:
  - **Solaris:** `pkginfo`, `showrev`

    - **Linux:** `rpm`
    - **All:** `asadmin version --verbose`
- Detailed steps on the methods you have used to reproduce the problem
- Any error logs or core dumps
- Configuration files such as:
    - *domain_dir*`/config/domain.xml`
    - a web application's `web.xml` file,
      when a web application is involved in the problem
- For an application, whether the problem appears when it is running in a cluster or standalone

Part I

Developing Applications

Chapter 1

Setting Up a Development Environment

This chapter gives guidelines for setting up an application development environment in the Sun Java™ System Application Server. Setting up an environment for creating, assembling, deploying, and debugging your code involves installing the mainstream version of Sun Java System Application Server and making use of development tools. In addition, sample applications are available. These topics are covered in the following sections:

- Installing and Preparing the Server for Development
- Development Tools
- Sample Applications

Installing and Preparing the Server for Development

The following components are included in the full installation. For more information, see the *Sun Java System Application Server Installation Guide*.

- Sun Java System Application Server core, including:
  - Sun Java™ System Message Queue
  - PointBase
  - deploytool
  - Administration Console
- JDK
- Sample Applications

After you have installed Sun Java System Application Server, you can further optimize the server for development in these ways:

- Locate utility classes and libraries so they can be accessed by the proper classloaders. For more information, see "Using the System Classloader" on page 89 or "Using the Common Classloader" on page 90.
- Set up debugging. For more information, see Chapter 4, "Debugging J2EE Applications."
- Configure the Java™ Virtual Machine (JVM™) software. For more information, see the *Sun Java System Application Server Administration Guide*.

Development Tools

The following general tools are provided with Sun Java System Application Server:

- The asadmin Command
- The Administration Console

The following development tools are provided with Sun Java System Application Server or downloadable from Sun:

- Apache Ant
- deploytool
- Migration Tools

The following third-party tools may also be useful:

- Debugging Tools
- Profiling Tools

The asadmin Command

The `asadmin` command allows you to configure a local or remote server and perform both administrative and development tasks at the command line. For general information about `asadmin`, see the *Sun Java System Application Server Administration Guide*.

The Administration Console

The Administration Console lets you configure the server and perform both administrative and development tasks using a web browser. For general information about the Administration Console, see the *Sun Java System Application Server Administration Guide*.

Apache Ant

You can use the automated assembly features available through Ant, a Java-based build tool available through the Apache Software Foundation:

`http://ant.apache.org/`

Ant is a java-based build tool that is extended using Java classes. Instead of using shell commands, the configuration files are XML-based, calling out a target tree where tasks get executed. Each task is run by an object that implements a particular task interface.

Apache Ant 1.5.4 is provided with Sun Java System Application Server, and can be launched from the `bin` directory using the command `asant`. Sun Java System Application Server also provides server-specific Ant tasks for deployment and administration with the sample applications. For more information about using Ant with Sun Java System Application Server, see "Apache Ant Assembly and Deployment Tool" on page 115.

deploytool

You can use the deploytool, provided with Sun Java System Application Server, to assemble J2EE applications and modules, configure deployment parameters, perform simple static checks, and deploy the final result. For more information about using the deploytool, see the *J2EE 1.4 Tutorial*:

`http://java.sun.com/j2ee/1.4/docs/tutorial/doc/index.html`

Migration Tools

The following automated migration tools are downloadable from Sun:

- The Migration Tool for Application Servers reassembles J2EE applications and modules developed on these servers:
    - IBM Websphere Application Server 4.0
    - BEA WebLogic Server 5.1, 6.0, and 6.1

- JBoss 3.0
- J2EE 1.3.1 Reference Implementation
- Tomcat Web Server 4.1
- Sun ONE Application Server 6.5 and 7
- Sun ONE Web Server 6.0

You can download the Migration Tool from here:

`http://java.sun.com/j2ee/tools/asmt_14dr.html`

- The Migration Toolbox helps you migrate applications developed on NetDynamics and Netscape Application Servers.

For more information, see *Sun Java System Application Server Migrating and Redeploying Server Applications*.

Debugging Tools

You can use several debuggers with the Sun Java System Application Server. For more information, see Chapter 4, “Debugging J2EE Applications.”

Profiling Tools

You can use several profilers with the Sun Java System Application Server. For more information, see “Profiling” on page 139.

Sample Applications

Sample applications that you can examine and deploy are included with the full installation of the Sun Java System Application Server. You can also download these samples separately if you installed the Sun Java System Application Server without them initially.

If installed with the Sun Java System Application Server, the samples are in the *install_dir*/`samples` directory. The samples are organized in categories such as `ejb`, `jdbc`, `connectors`, `i18n`, and so on. Each sample category is further divided into subcategories. For example, under the `ejb` category are `stateless`, `stateful`, `security`, `mdb`, `bmp`, and `cmp` subcategories.

Most Sun Java System Application Server samples have the following directory structure:

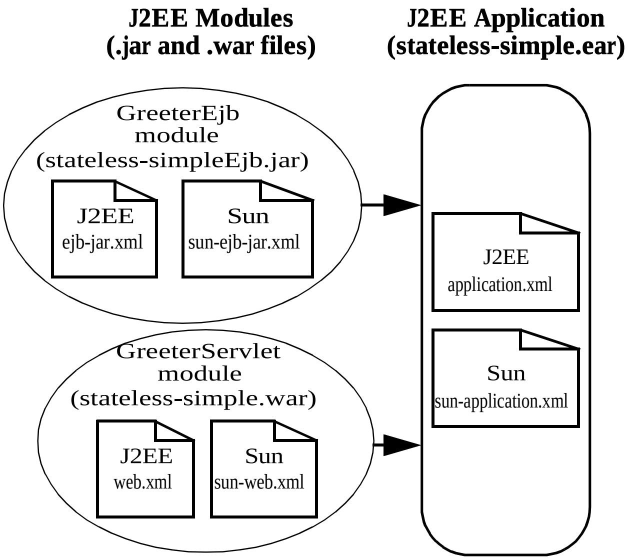
- The `docs` directory contains instructions for how to use the sample.
- The `src` directory contains:
    - Source code
    - The `build.xml` file, which defines `asant` targets for the sample (see "Apache Ant" on page 31)
    - Deployment descriptors
- The `build`, `assemble`, and `javadocs` directories are generated as a result of targets specified in the `build.xml` file.

The *install_dir*/`samples/common.xml` file defines properties common to all sample applications and implements targets needed to compile, assemble, deploy and undeploy sample applications. In most sample applications, the `build.xml` file includes `common.xml`.

NOTE Before using the samples under *install_dir*/`samples/webservices`, make sure to copy the Java XML Pack JAR files into the `jre/lib/endorsed` directory to override the files bundled with the JDK.

The following figure shows the structure of the `helloworld` sample:

Figure 1-1 The `helloworld` sample



After you deploy the sample in Sun Java System Application Server, you can invoke it using the following URL:

`http://`*server*`:`*port*`/helloworld`

For a detailed description of the sample and how to deploy and run it, see the associated documentation at:

install_dir`/samples/ejb/stateless/simple/docs/index.html`

Chapter 2

Securing J2EE Applications

This chapter describes how to write secure J2EE applications, which contain components that perform user authentication and access authorization for servlets and EJB business logic. For information about administrative security for the server, see the *Sun Java System Application Server Administration Guide*.

This chapter contains the following sections:

- Sun Java System Application Server Security Goals
- Sun Java System Application Server Specific Security Features
- Sun Java System Application Server Security Model
- Security Responsibilities Overview
- Common Security Terminology
- Container Security
- Guide to Security Information
- Realm Configuration
- JACC Support
- Pluggable Audit Module Support
- The server.policy File
- Programmatic Login
- User Authentication for Single Sign-on
- Defining Roles
- Authenticating an Application Client Using the JAAS Module

Sun Java System Application Server Security Goals

In an enterprise computing environment, there are many security risks. The Sun Java System Application Server's goal is to provide highly secure, interoperable, and distributed component computing based on the J2EE security model. Security goals include:

- Full compliance with the J2EE security model (for more information, see the J2EE specification, v1.4 Chapter 3 Security)
- Full compliance with the EJB v2.1 security model (for more information, see the Enterprise JavaBean specification v2.1 Chapter 15 Security Management). This includes EJB role-based authorization.
- Full compliance with the Java Servlet v2.3 security model (for more information, see the Java Servlet specification, v2.3 Chapter 11 Security). This includes servlet role-based authorization.
- Support for single sign-on across all Sun Java System Application Server applications within a single security domain.
- Security support for ACC Clients.
- Support for several underlying authentication realms, such as simple file and LDAP. Certificate authentication is also supported for SSL client authentication. For Solaris, OS platform authentication is supported in addition to these.
- Support for declarative security via Sun Java System Application Server specific XML-based role mapping.
- Support for JACC (Java Authorization Contract for Containers) pluggable authorization as included in the J2EE 1.4 specification and defined by JSR-115.

Sun Java System Application Server Specific Security Features

The Sun Java System Application Server supports the J2EE v1.4 security model, as well as the following features which are specific to the Sun Java System Application Server:

- Single sign-on across all Sun Java System Application Server applications within a single security domain
- Programmatic login
- A GUI-based deploytool for building XML files containing the security information.

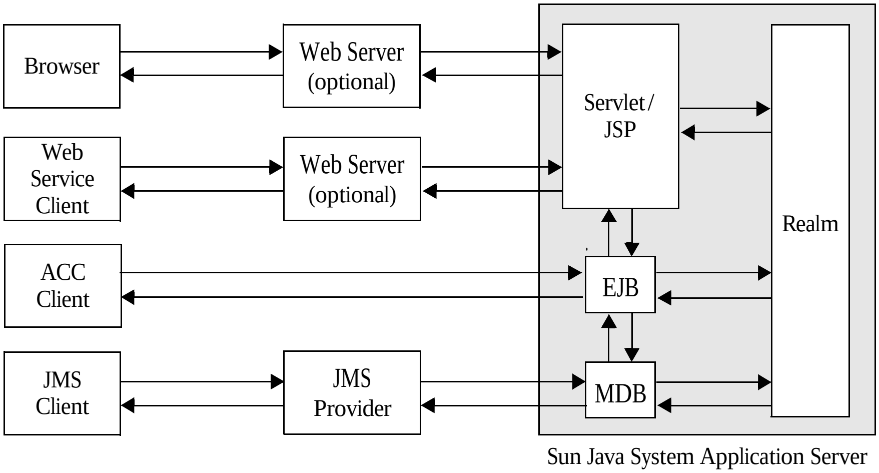
Sun Java System Application Server Security Model

Secure applications require a client to be authenticated as a valid application user and have authorization to access servlets, JSPs, and EJB business logic. Sun Java System Application Server supports security for web, ACC, web service, and JMS clients.

Applications with secure web and EJB containers may enforce the following security processes for clients:

- Authenticate the caller
- Authorize the caller for access to the EJB business methods

The following diagram shows the Sun Java System Application Server security model.



Web Application and URL Authorizations

Secure web applications may have authentication and authorization properties. The web container supports three types of authentication: basic, certificate, and form-based. When a browser requests the main application URL, the web container collects the user authentication information (for example, username and password) and passes it to the security service for authentication.

Sun Java System Application Server consults the security policies (derived from the deployment descriptors) associated with the web resource to determine the security roles used to permit resource access. The web container tests the user credentials against each role to determine if it can map the user to the role.

Invocation of Enterprise Bean Methods

Once the browser client has been authenticated and authorized by the web container and the servlet or JSP performs a method call to the EJB component, the user's credentials (gathered during the authentication process) are propagated to the EJB container. A secure EJB container has a deployment descriptor with authorization properties, which are used to enforce access control on the bean method. The EJB container uses role information received from the EJB JAR deployment descriptors to decide whether it can map the caller to the role and allow access to the bean method.

ACC Client Invocation of Enterprise Bean Methods

For ACC clients, a secure EJB container consults its security policies (obtained from the deployment descriptors) to determine if the caller has the authority to access the bean method. This process is the same for both web and ACC clients.

Security Responsibilities Overview

A J2EE platform's primary goal is to isolate the developer from the security mechanism details and facilitate a secure application deployment in diverse environments. This goal is addressed by providing mechanisms for the application security specification requirements declaratively and outside the application.

Application Developer

The application developer is responsible for the following:

- Specifying application roles.
- Defining role-based access restrictions for the application components (Servlets/JSPs and EJB components).

- If programmatic security is used, verifying the user roles and authorizing access to features based on these roles. (Programmatic security management is discouraged since it hard codes the security login in the application instead of allowing the containers to manage it.)

Application Assembler

The application assembler or application component provider must identify all security dependencies embedded in a component including:

- All role names used by the components that call `isCallerInRole` or `isUserInRole`.
- References to all external resources accessed by the components.
- References to all intercomponent calls made by the component.

Application Deployer

The Sun Java System Application Server deploytool is used to map the views provided by the assembler to the policies and mechanisms specific to the operational environment. The security mechanisms configured by the application deployer are implemented by the containers on behalf of the components hosted in the containers.

The application deployer takes all component security views provided by the assembler and uses them to secure a particular enterprise environment in the application, including:

- Assigning users or groups (or both) to security roles.
- Refines the privileges required to access component methods to suit the requirements of the specific deployment scenario.

Common Security Terminology

The most common security processes are authentication, authorization, realm assignment, and role mapping. The following sections define this terminology.

Authentication

Authentication verifies the user. For example, the user may enter a username and password in a web browser, and if those credentials match the permanent profile stored in the active realm, the user is authenticated. The user is associated with a security identity for the remainder of the session.

Authorization

Authorization permits a user to perform the desired operations, after being authenticated. For example, a human resources application may authorize managers to view personal employee information for all employees, but allow employees to only view their own personal information.

Realms

A *realm*, also called a *security policy domain* or *security domain* in the J2EE specification, is a scope over which a common security policy is defined and enforced by the security administrator of the security service. Supported realms in Sun Java System Application Server are `file`, `ldap`, `certificate`, and `solaris`. For information about how to configure a realm, see "Realm Configuration" on page 44.

Role Mapping

A client may be defined in terms of a security role. For example, a company might use its employee database to generate both a company wide phone book application and to generate payroll information. Obviously, while all employees might have access to phone numbers and email addresses, only some employees would have access to the salary information. Employees with the right to view or change salaries might be defined as having a special security role.

A role is different from a user group in that a role defines a function in an application, while a group is a set of users who are related in some way. For example, members of the groups *astronauts*, *scientists*, and (occasionally) *politicians* all fit into the role of *SpaceShuttlePassenger*.

The EJB security model describes roles (as distinguished from user groups) as being described by an application developer and independent of any particular domain. Groups are specific to a deployment domain. It is up to the deployer to map roles into one or more groups for each application or module.

In the Sun Java System Application Server, roles correspond to users or groups (or both) configured in the active realm.

Container Security

The component containers are responsible for providing J2EE application security. There are two security forms provided by the container:

- Programmatic Security
- Declarative Security

Programmatic Security

Programmatic security is when an EJB component or servlet uses method calls to the security API, as specified by the J2EE security model, to make business logic decisions based on the caller or remote user's security role. Programmatic security should only be used when declarative security alone is insufficient to meet the application's security model.

The J2EE specification, v1.4 defines programmatic security as consisting of two methods of the EJB `EJBContext` interface and two methods of the servlet `HttpServletRequest` interface. The Sun Java System Application Server supports these interfaces as specified in the specification.

For more information on programmatic security, see the following:

- Section 3.3.6, Programmatic Security, in the J2EE Specification,v1.4
- "Programmatic Login" on page 62

Declarative Security

Declarative security means that the security mechanism for an application is declared and handled externally to the application. Deployment descriptors describe the J2EE application's security structure, including security roles, access control, and authentication requirements.

The Sun Java System Application Server supports the DTDs specified by J2EE v1.4 and has additional security elements included in its own deployment descriptors. Declarative security is the application deployer's responsibility.

There are two levels of declarative security, as follows:

- Application Level Security
- Component Level Security

Application Level Security

The application XML deployment descriptor (`application.xml`) contains authorization descriptors for all user roles for accessing the application's servlets and EJB components. On the application level, all roles used by any application container must be listed in a `role-name` element in this file. The role names are scoped to the EJB XML deployment descriptors (`ejb-jar.xml` and `sun-ejb-jar.xml` files) and to the servlet XML deployment descriptors (`web.xml` and `sun-web.xml` files). The `sun-application.xml` file must also contain matching `security-role-mapping` elements for each `role-name` used by the application.

Component Level Security

Component level security encompasses web components and EJB components.

A secure web container authenticates users and authorizes access to a servlet or JSP by using the security policy laid out in the servlet XML deployment descriptors (`web.xml` and `sun-web.xml` files). Once the user has been authenticated and authorized, the servlet passes on user credentials to an EJB component to establish a secure association with the bean.

The EJB container is responsible for authorizing access to a bean method by using the security policy laid out in the EJB XML deployment descriptors (`ejb-jar.xml` and `sun-ejb-jar.xml` files).

Guide to Security Information

Each information type below is shown with a short description, the location where the information resides, how to create the information, how to access the information, and where to look for further information.

- User Information
- Security Roles

User Information

User name, password, and so on.

Location:

The location of the user information depends on the realm being used:

- For the `file` realm, the users and groups are listed in the key file, which is located in *domain_dir*`/config`.
- For the `ldap` realm, the users and groups are stored in an external LDAP directory.
- For the `certificate` realm, the user identities are obtained from cryptographically verified client certificates in the `cacerts.jks` and `keystore.jks` files. These files are located in *domain_dir*`/config` by default.
- For the `solaris` realm, the users and groups are stored in the underlying Solaris user database, as determined by the system's PAM configuration.

For more information about these realms, see "Realm Configuration" on page 44.

How to Create:

How to create users and define groups is specific to the realm being used. The Sun Java System Application Server does not provide administration capabilities for external realms such as Solaris/PAM or LDAP. Consult your Solaris or LDAP server documentation for details.

Security Roles

Role that defines an application function, made up of a number of users, groups, or both. The relationship between users and groups is determined by the specific realm implementation being used.

Location:

Roles are defined in the J2EE application deployment descriptors.

How to Create:

Use the Sun Java System Application Server Administration Console, the deploytool, or the `asadmin deploy` command for application assembly and deployment.

How To Access:

Use `isCallerInRole()` to test for a user's role membership. For example, in the following code, if `securedMethod()` can be accessed by the `Manager` role, the call to `sctx.isCallerInRole("Manager")` returns `true`.

```
public class SecTestEJB implements SessionBean
{
    private SessionContext sctx = null;

    public void setSessionContext(SessionContext sc)
    {
        sctx = sc;
    }

    public void securedMethod( )
    {
        System.out.println(  sctx.isCallerInRole( "Manager" ) );
    }
}
```

Realm Configuration

This section covers the following topics:

- How to Configure a Realm and Set the Default Realm
- How to Set a Realm for an Application or Module
- Supported Realms

How to Configure a Realm and Set the Default Realm

You can configure a realm in one of these ways:

- Using the Administration Console
- Using the asadmin Command
- Editing the domain.xml File

If you use the Administration Console or edit the `domain.xml` file, you can set the default realm.

Using the Administration Console

To configure a realm using the Administration Console:

1. Login to the Administration Console by going to the following URL in your web browser:

   ```
   http://host:port/asadmin
   ```

   For example:

   ```
   http://localhost:4848/asadmin
   ```

2. Open the Security component.
3. Open the Realms component under the Security component.
4. Go to the Realms page.
5. Click on the check boxes of the realms you wish to activate.
6. Use the New and Delete buttons to add and remove realms. To edit a realm, click on its name.
7. If you are adding or editing a realm, enter the realm's name and classname.
8. To add a property, click the Add Property button and enter the property name and value. To delete properties, check the properties you want to delete, then click the Delete Properties button.
9. For the `file` realm, you can click on the Manage Users button to add, delete, or edit users. See "file" on page 48.
10. Select the Save button to finish adding or editing the realm.
11. Go to the Security page.
12. Select a default realm, then select the Save button.
13. Restart the server.

Using the asadmin Command

You can use the `asadmin` command to configure realms on local servers.

asadmin create-auth-realm

The `asadmin create-auth-realm` command configures a realm. The syntax is as follows, with defaults shown for optional parameters that have them:

```
asadmin create-auth-realm --user user --classname realm_class
[--isdefault=true] [--property (name=value)[:name=value]*] realm_name
```

For more information about the optional general asadmin parameters (--password, --passwordfile, --host, --port, --secure, --terse, --echo, and --interactive), see the *Sun Java System Application Server Administration Guide*.

For example, the following command configures the certificate realm:

```
asadmin create-auth-realm --user joeuser --classname
com.sun.enterprise.security.auth.realm.certificate.CertificateRealm certificate
```

asadmin delete-auth-realm

The asadmin delete-auth-realm command deactivates a realm. The syntax is as follows, with defaults shown for optional parameters that have them:

```
asadmin delete-auth-realm --user user realm_name
```

For example, the following command deactivates the certificate realm:

```
asadmin delete-auth-realm --user joeuser certificate
```

asadmin list-auth-realms

The asadmin list-auth-realms command lists all realms. The syntax is as follows, with defaults shown for optional parameters that have them:

```
asadmin list-auth-realms --user user [config_name]
```

For example, the following command lists all realms:

```
asadmin list-auth-realms --user joeuser
```

Editing the domain.xml File

Behind the scenes, the default realm is set in the security-service element in the domain.xml file. The security-service configuration looks like this:

```
<security-service default-realm="file">
    <auth-realm name="file"
            classname="com.sun.enterprise.security.auth.realm.file.FileRealm">
        <property name="file" value="domain_dir/config/keyfile"/>
        <property name="jaas-context" value="fileRealm"/>
    </auth-realm>
    ...
</security-service>
```

The default-realm attribute points to the realm the server is using. It must point to one of the configured auth-realm names. The default is the file realm.

The audit flag determines whether auditing information is logged. If set to true, the server logs audit messages for all authentication and authorization events.

If you change the realm configuration, you must restart the server for the change to take effect.

For more information about the domain.xml file, see the *Sun Java System Application Server Reference*.

How to Set a Realm for an Application or Module

The following deployment descriptor elements have optional realm or realm-name data subelements that override the domain's default realm:

- sun-application element in sun-application.xml
- web-app element in web.xml
- sun-ejb-jar element in sun-ejb-jar.xml

If modules within an application specify conflicting realms, these are ignored. If present, the realm defined in sun-application.xml is used, otherwise the domain's default realm is used.

For example, a realm is specified in sun-application.xml as follows:

```
<sun-application>
    ...
    <realm>ldap</realm>
</sun-application>
```

For more information about the deployment descriptor files and elements, see Chapter 5, "Deployment Descriptor Files."

Supported Realms

The following realms are supported in Sun Java System Application Server:

- file
- ldap
- certificate
- solaris
- Creating a Custom Realm

file

The `file` realm is the default realm when you first install the Sun Java System Application Server. It has the following configuration characteristics:

- Name - `file`
- Classname - `com.sun.enterprise.security.auth.realm.file.FileRealm`

Required properties are as follows:

- `file` - The name of the file that stores user information. By default this file is named `keyfile` and is in the domain root directory, typically *install_dir*`/domains/`*domain_dir*`/config`.
- `jaas-context` - The value must be `fileRealm`.

The user information file is initially empty, so you must add users before you can use the `file` realm. You can configure users in one of these ways:

- Using the Administration Console
- Using the asadmin Command

Using the Administration Console

To configure a user in the `file` realm using the Administration Console:

1. Login to the Administration Console by going to the following URL in your web browser:

   `http://`*host*`:`*port*`/asadmin`

   For example:

   `http://localhost:4848/asadmin`

2. Open the Security component.
3. Open the Realms component under the Security component.
4. Go to the file page.
5. Click on the Manage Users button.
6. To activate a user, check the box by the user's name.
7. To add a new user, click on the New button. To modify information for a user, click on the user's name in the list. In either case, enter the following information:
   - User ID (required if new) - The name of the user.
   - Password (required) - The user's password.

- Retype Password (required) - The user's password again, for verification.
- Group List (optional) - A comma-separated list of the groups the user belongs to.

8. Click on the Save button.

9. You do not need to restart the server.

Using the asadmin Command

The `asadmin create-file-user` command creates one user in the `file` realm. Its syntax is as follows, with defaults shown for optional parameters that have them:

```
asadmin create-file-user --user user [--userpassword user_password]
[--authrealmname auth_realm_name] [--groups user_group[:user_group]*] user_name
```

For more information about the optional general `asadmin` parameters (`--password`, `--passwordfile`, `--host`, `--port`, `--secure`, `--terse`, `--echo`, and `--interactive`), see the *Sun Java System Application Server Administration Guide*.

For example, the following command adds user `dsanchez` to the `file` realm and assigns `secret` as this user's password. The `--user` parameter specifies the administrative user.

```
asadmin create-file-user --user joeuser --userpassword secret dsanchez
```

The `asadmin delete-file-user` command removes one user from the `file` realm. Its syntax is as follows, with defaults shown for optional parameters that have them:

```
asadmin delete-file-user --user user user_name
```

For example, the following command removes user `dsanchez` from the `file` realm. The `--user` parameter specifies the administrative user.

```
asadmin delete-file-user --user joeuser dsanchez
```

The `asadmin update-file-user` command changes information for one user in the `file` realm. Its syntax is as follows, with defaults shown for optional parameters that have them:

```
asadmin update-file-user --user user [--userpassword user_password] [--groups
user_group[:user_group]*] user_name
```

For example, the following command changes the password for user `dsanchez` to `private`. The `--user` parameter specifies the administrative user.

```
asadmin update-file-user --user joeuser --userpassword private dsanchez
```

The `asadmin list-file-users` command lists users in the `file` realm. Its syntax is as follows, with defaults shown for optional parameters that have them:

```
asadmin list-file-users --user user [config_name]
```

For example, the following command lists `file` realm users. The `--user` parameter specifies the administrative user.

```
asadmin list-file-users --user joeuser
```

The `asadmin list-file-groups` command lists groups in the `file` realm. Its syntax is as follows, with defaults shown for optional parameters that have them:

```
asadmin list-file-groups --user user [--name user_name] [config_name]
```

For example, the following command lists `file` realm groups for user `dsanchez`. The `--user` parameter specifies the administrative user.

```
asadmin list-file-groups --user joeuser --name dsanchez
```

ldap

The `ldap` realm allows you to use an LDAP database for user security information. It has the following configuration characteristics:

- Name - `ldap`
- Classname - `com.sun.enterprise.security.auth.realm.ldap.LDAPRealm`

Required properties are as follows:

- `directory` - The LDAP URL to your server.
- `base-dn` - The base DN for the location of user data. This base DN can be at any level above the user data, since a tree scope search is performed. The smaller the search tree, the better the performance.
- `jaas-context` - The value must be `ldapRealm`.

You can add the following optional properties to tailor the LDAP realm behavior.

- `search-filter` - The search filter to use to find the user. The default is `uid=%s` (`%s` expands to the subject name).
- `group-base-dn` - The base DN for the location of groups data. By default it is same as the `base-dn`, but it can be tuned if necessary.
- `group-search-filter` - The search filter to find group memberships for the user. The default is `uniquemember=%d` (`%d` expands to the user element DN).
- `group-target` - The LDAP attribute name that contains group name entries. The default is `CN`.
- `search-bind-dn` - An optional DN used to authenticate to the directory for performing the `search-filter` lookup. Only required for directories that do not allow anonymous search.

- search-bind-password - The LDAP password for the DN given in search-bind-dn.

You must create the user(s) in your LDAP directory. You can do this from the Sun Java™ System Directory Proxy Server 5 2004Q2 console in the Users & Groups main tab, or through any other administration tool which supports LDAP and your directory's schema.

The principal-name used in the deployment descriptors must correspond to your LDAP user information.

For example, suppose an LDAP user, joe java, is defined in your LDAP directory as follows:

```
uid=jjava,ou=People,dc=acme,dc=com
uid=jjava
givenName=joe
objectClass=top
objectClass=person
objectClass=organizationalPerson
objectClass=inetorgperson
sn=java
cn=joe java
```

The required properties in the ldap realm configuration would be as follows:

- The directory would be the LDAP URL to your server, for example:

  ```
  ldap://ldap.acme.com:389
  ```

- The base-dn could be ou=People,dc=acme,dc=com. Note that it could also be rooted at a higher point, for example dc=acme,dc=com, but searches would traverse a larger part of the tree, impacting performance.

- The jaas-context must be ldapRealm.

certificate

The certificate realm supports SSL authentication. This realm sets up the user identity in the Sun Java System Application Server's security context, and populates it with user data obtained from cryptographically verified client certificates in the cacerts.jks and keystore.jks files, which are located in *domain_dir*/config by default. The J2EE containers then handle authorization processing based on each user's DN from his or her certificate. This realm has the following configuration characteristics:

- Name - certificate
- Classname -

```
com.sun.enterprise.security.auth.realm.certificate.CertificateRealm
```

You can add the following optional property to tailor the certificate realm behavior.

- `assign-groups` - If this property is set, its value is taken to be a comma-separated list of group names. All clients who present valid certificates are assigned membership to these groups for the purposes of authorization decisions in the web and EJB containers.

When you deploy an application, you must specify `CLIENT-CERT` as the authentication mechanism in the `web.xml` file as follows:

```
<login-config>
    <auth-method>CLIENT-CERT</auth-method>
</login-config>
```

You must obtain a client certificate and install it in your browser to complete the setup for client certificate authentication. For details on how to set up the server and client certificates, see the *Sun Java System Application Server Administration Guide*.

You can configure SSL authentication in these ways:

- Configure an `ssl` subelement of an `http-listener` or `iiop=listener` element in `domain.xml`, then restart the server. For more information about the `domain.xml` file, see the *Sun Java System Application Server Reference*.
- Use the Administration Console, as follows:

  a. Login to the Administration Console by going to the following URL in your web browser:

  `http://`*host*`:`*port*`/asadmin`

  For example:

  `http://localhost:4848/asadmin`

  b. Open the HTTP Service or ORB component.

  c. Open the HTTP Listeners or IIOP Listeners component.

  d. Select the listener for which you want to configure SSL.

  e. Edit the SSL3/TLS Settings for the listener.

  f. Select the Save button.

  g. Restart the server.

You can change the location of the `cacerts.jks` and `keystore.jks` files as follows:

1. Set the $TRUSTSTORE and $KEYSTORE system variables to the locations of the `cacerts.jks` and `keystore.jks` files.

2. Login to the Administration Console by going to the following URL in your web browser:

   http://*host*:*port*/asadmin

   For example:

   ```
   http://localhost:4848/asadmin
   ```

3. Go to the Application Server page.

4. Select the JVM Settings tab and the General option (JVM™ is an abbreviation of Java™ Virtual Machine).

5. Add the following to the Debug Options field:

   ```
   -Djavax.net.ssl.trustStore=$TRUSTSTORE
   -Djavax.net.ssl.keyStore=$KEYSTORE
   ```

6. Click Save.

7. Restart the server.

solaris

The `solaris` realm allows authentication using Solaris `username+password` data. This realm is only supported on Solaris 9. It has the following configuration characteristics:

- Name - `solaris`
- Classname - `com.sun.enterprise.security.auth.realm.solaris.SolarisRealm`

Required properties are as follows:

- `jaas-context` - The value must be `solarisRealm`.

NOTE The Solaris realm invokes the underlying PAM infrastructure for authenticating. If the configured PAM modules require root privileges, the domain must run as root to use this realm. For details, see the “Using Authentication Services (Tasks)” chapter in the *Solaris 9 Systems Administrators Guide: Security Services*.

Solaris supports an enhanced method for controlling access to resources called Role Based Access Control (RBAC). Sun Java System Application Server includes RBAC facilities for its administrative commands. For details, see the “Role-Based Access Control (Overview)” chapter in the *Solaris 9 Systems Administrators Guide: Security Services*.

Creating a Custom Realm

You can create a custom realm by providing a Java Authentication and Authorization Service (JAAS) login module and a realm implementation. Note that client-side JAAS login modules are not suitable for use with Sun Java System Application Server. For more information about JAAS, refer to the JAAS specification for Java 2 SDK, v 1.4, available here:

`http://java.sun.com/products/jaas/`

A sample application that uses a custom realm is available with the Sun Java System Application Server here:

install_dir`/samples/security/realms`

Custom realms must extend the `com.sun.enterprise.security.auth.login.PasswordLoginModule` class. This class extends `javax.security.auth.spi.LoginModule`. Custom realms must not extend `LoginModule` directly.

Custom login modules must provide an implementation for one abstract method defined in `PasswordLoginModule`:

`abstract protected void authenticate() throws LoginException`

This method performs the actual authentication. The custom login module must not implement any of the other methods, such as `login()`, `logout()`, `abort()`, `commit()`, or `initialize()`. Default implementations are provided in `PasswordLoginModule` which hook into Sun Java System Application Server infrastructure.

The custom login module can access the following protected object fields, which it inherits from `PasswordLoginModule`. These contain the user name and password of the user to be authenticated:

`protected String _username;`

`protected String _password;`

The `authenticate()` method must end with the following sequence:

```
String[] grpList;
// populate grpList with the set of groups to which
// _username belongs in this realm, if any
return commitAuthentication(_username, _password, _currentRealm, grpList);
```

Custom realms must also implement a `Realm` class which extends the `com.sun.enterprise.security.auth.realm.IASRealm` class.

Custom realms must implement the following methods:

```
public void init(Properties props) throws BadRealmException,
NoSuchRealmException
```

This method is invoked during server startup when the realm is initially loaded. The `props` argument contains the properties defined for this realm in `domain.xml`. The realm can do any initialization it needs in this method. If the method returns without throwing an exception, Sun Java System Application Server assumes the realm is ready to service authentication requests. If an exception is thrown, the realm is disabled.

```
public String getAuthType()
```

This method returns a descriptive string representing the type of authentication done by this realm.

```
public abstract Enumeration getGroupNames(String username) throws
InvalidOperationException, NoSuchUserException
```

This method returns an `Enumeration` (of `String` objects) enumerating the groups (if any) to which the given `username` belongs in this realm.

JACC Support

JACC (Java Authorization Contract for Containers) is part of the J2EE 1.4 specification and defined by JSR-115. JACC defines an interface for pluggable authorization providers. This provides third parties with a mechanism to develop and plug in modules that are responsible for answering authorization decisions during J2EE application execution. The interfaces and rules used for developing JACC providers are defined in the JACC 1.0 specification.

The Sun Java System Application Server provides a simple file-based JACC-compliant authorization engine as a default JACC provider. As part of specifying an alternate provider, you can configure the provider in the Sun Java System Application Server in one of these ways:

- Using the Administration Console
- Editing the domain.xml File

Using the Administration Console

To specify an alternate JACC provider using the Administration Console:

1. Login to the Administration Console by going to the following URL in your web browser:

   `http://`*host*`:`*port*`/asadmin`

For example:

`http://localhost:4848/asadmin`

2. Open the Security component.
3. Open the JACC Providers component under the Security component.
4. Go to the JACC Providers page.
5. Click on the check boxes of the JACC providers you wish to activate.
6. Use the New and Delete buttons to add and remove JACC providers. To edit a JACC provider, click on its name.
7. If you are adding or editing a JACC provider, enter the following information:
   - Name - The application name as displayed in the deployed application list
   - Policy Configuration - The name of the class that implements the policy configuration factory
   - Policy Provider - The name of the class that implements the policy factory
8. Select the Save button.
9. Restart the server.

Editing the domain.xml File

Behind the scenes, the JACC provider is set in the `security-service` element in the `domain.xml` file. The `security-service` configuration looks like this:

```
<security-service jacc="default">
    ...
    <jacc-provider
        name="default"
        policy-provider="com.sun.enterprise.security.provider.PolicyWrapper"
        policy-configuration-factory-provider="com.sun.enterprise.security.
            provider.PolicyConfigurationFactoryImpl">
        <property name="repository"
            value="domain_dir/generated/policy"/>
    </jacc-provider>
    ...
</security-service>
```

For more information about the `domain.xml` file, see the *Sun Java System Application Server Reference*.

Pluggable Audit Module Support

You can create a custom audit module. This section covers the following topics:

- Configuring an Audit Module
- The AuditModule Class

Configuring an Audit Module

To configure an audit module, you can perform one of the following tasks:

- Using the Administration Console
- Using the asadmin Command
- Editing the domain.xml File

Using the Administration Console

To specify an audit module using the Administration Console:

1. Login to the Administration Console by going to the following URL in your web browser:

   `http://`*host*`:`*port*`/asadmin`

   For example:

   `http://localhost:4848/asadmin`

2. Open the Security component.
3. Open the Audit Modules component under the Security component.
4. Go to the Audit Modules page.
5. Click on the check boxes of the audit modules you wish to activate.
6. Use the New and Delete buttons to add and remove audit modules. To edit an audit module, click on its name.
7. If you are adding or editing an audit module, enter the following information:
   - Name - The application name as displayed in the deployed application list
   - Classname - The fully qualified name of the class that implements this module
8. Select the Save button.

9. Restart the server.

Using the asadmin Command

You can use the `asadmin` command to configure realms on local servers.

asadmin create-audit-module

The `asadmin create-audit-module` command configures an audit module. The syntax is as follows, with defaults shown for optional parameters that have them:

```
asadmin create-audit-module --user user --classname audit_module_class
[--property (name=value)[:name=value]*] audit_module_name
```

For more information about the optional general `asadmin` parameters (`--password`, `--passwordfile`, `--host`, `--port`, `--secure`, `--terse`, `--echo`, and `--interactive`), see the *Sun Java System Application Server Administration Guide*.

For example:

```
asadmin create-audit-module --user joeuser --classname
com.sun.enterprise.security.Audit audit1
```

asadmin delete-audit-module

The `asadmin delete-audit-module` command deactivates an audit module. The syntax is as follows, with defaults shown for optional parameters that have them:

```
asadmin delete-audit-module --user user audit_module_name
```

For example:

```
asadmin delete-audit-module --user joeuser audit1
```

asadmin list-audit-modules

The `asadmin list-audit-modules` command lists all audit modules. The syntax is as follows, with defaults shown for optional parameters that have them:

```
asadmin list-audit-modules --user user [config_name]
```

For example, the following command lists audit modules.

```
asadmin list-audit-modules --user joeuser
```

Editing the domain.xml File

Behind the scenes, an audit module can be set in the security-service element in the domain.xml file. The security-service configuration looks like this:

```
<security-service>
    ...
    <audit-module
        name="default"
        classname="com.sun.enterprise.security.Audit">
        <property name="auditOn" value="false"/>
    </audit-module>
    ...
</security-service>
```

The classname must extend com.sun.appserv.security.AuditModule.

For more information about the domain.xml file, see the *Sun Java System Application Server Reference*.

The AuditModule Class

You can create a custom audit module by implementing a class that extends com.sun.appserv.security.AuditModule. The AuditModule class provides default “no-op” implementations for each of the following methods, which your custom class can override.

```
public void init(Properties props)
```

This method is invoked during server startup when the audit module is initially loaded. The props argument contains the properties defined for this module in domain.xml. The module can do any initialization it needs in this method. If the method returns without throwing an exception, Sun Java System Application Server assumes the module realm is ready to service audit requests. If an exception is thrown the module is disabled.

```
public void authentication(String user, String realm, boolean success)
```

This method is invoked when an authentication request has been processed by a realm for the given user. The success flag indicates whether the authorization was granted or denied.

```
public void webInvocation(String user, HttpServletRequest req, String type,
boolean success)
```

This method is invoked when a web container call has been processed by authorization. The success flag indicates whether the authorization was granted or denied. The req object is the standard HttpServletRequest object for this request. The type string is one of hasUserDataPermission or hasResourcePermission (see JSR-115).

`public void ejbInvocation(String user, String ejb, String method, boolean success)`

This method is invoked when an EJB container call has been processed by authorization. The `success` flag indicates whether the authorization was granted or denied. The `ejb` and `method` strings describe the EJB component and its method that is being invoked.

`public void shutdown()`

This method is invoked once, during normal server shutdown. It provides the audit module an opportunity to record server shutdown events and to perform any necessary internal cleanup.

The server.policy File

Each Sun Java System Application Server domain has its own standard J2SE policy file, located in the domain root directory, typically *install_dir*`/domains/`*domain_dir*`/config`. The file is named `server.policy`.

Sun Java System Application Server is a J2EE 1.4-compliant application server. As such, it follows the requirements of the J2EE specification, including the presence of the security manager (the Java component that enforces the policy) and a limited permission set for J2EE application code.

This section covers the following topics:

- Default Permissions
- Changing Permissions for an Application

Default Permissions

Internal server code is granted all permissions. These are covered by the `AllPermission` grant blocks to various parts of the server infrastructure code. Do not modify these entries.

Application permissions are granted in the default grant block. These permissions apply to all code not part of the internal server code listed previously. Sun Java System Application Server does not distinguish between EJB and web module permissions. All code is granted the minimal set of Web component permissions (which is a superset of the EJB minimal set).

A few permissions above the minimal set are also granted in the default `server.policy` file. These are necessary due to various internal dependencies of the server implementation. J2EE application developers must not rely on these additional permissions.

One additional permission is granted specifically for using connectors. If connectors are not used in a particular domain, you should remove this permission, because it is not otherwise necessary.

Changing Permissions for an Application

The default policy for each domain limits the permissions of J2EE deployed applications to the minimal set of permissions required for these applications to operate correctly. If you develop applications that require more than this default set of permissions, you can edit the `server.policy` file to add the custom permissions that your applications need.

You should add the extra permissions only to the applications that require them, not to all applications deployed to a domain. Do not add extra permissions to the default set (the grant block with no codebase, which applies to all code). Instead, add a new grant block with a codebase specific to the application requiring the extra permissions, and only add the minimally necessary permissions in that block.

NOTE Do not add `java.security.AllPermission` to the `server.policy` file for application code. Doing so completely defeats the purpose of the security manager, yet you still get the performance overhead associated with it.

As noted in the J2EE specification, an application should provide documentation of the additional permissions it needs. If an application requires extra permissions but does not document the set it needs, contact the application author for details.

As a last resort, you can iteratively determine the permission set an application needs by observing `AccessControlException` occurrences in the server log. If this is not sufficient, you can add the `-Djava.security.debug=all` JVM option to the domain. For details, see the *Sun Java System Application Server Administration Guide* or the *Sun Java System Application Server Reference*.

You can use the J2SE standard `policytool` or any text editor to edit the `server.policy` file. For more information, see:

http://java.sun.com/docs/books/tutorial/security1.2/tour2/index.html

For detailed information about the permissions you can set in the `server.policy` file, see:

http://java.sun.com/j2se/1.4/docs/guide/security/permissions.html

The Javadoc for the `Permission` class is here:

http://java.sun.com/j2se/1.4/docs/api/java/security/Permission.html

Programmatic Login

Programmatic login allows a deployed J2EE application to invoke a login method. If the login is successful, a `SecurityContext` is established as if the client had authenticated using any of the conventional J2EE mechanisms.

Programmatic login is useful for an application that has special needs which cannot be accommodated by any of the J2EE standard authentication mechanisms.

NOTE Programmatic login is specific to Sun Java System Application Server and not portable to other application servers.

This section contains the following topics:

- Precautions
- Granting Programmatic Login Permission
- The ProgrammaticLogin Class

Precautions

The Sun Java System Application Server is not involved in how the login information (`user`, `password`) is obtained by the deployed application. Programmatic login places the burden on the application developer with respect to assuring that the resulting system meets their security requirements. If the application code reads the authentication information across the network, it is up to the application to determine whether to trust the user.

Programmatic login allows the application developer to bypass the application server-supported authentication mechanisms and feed authentication data directly to the security service. While flexible, this capability should not be used without some understanding of security issues.

Since this mechanism bypasses the container-managed authentication process and sequence, the application developer must be very careful in making sure that authentication is established before accessing any restricted resources or methods. It is also the application developer’s responsibility to verify the status of the login attempt and to alter the behavior of the application accordingly.

The programmatic login state does not necessarily persist in sessions or participate in single sign-on.

Lazy authentication is not supported for programmatic login. If an access check is reached and the deployed application has not properly authenticated via the programmatic login method, access is denied immediately and the application may fail if not properly coded to account for this occurrence.

Granting Programmatic Login Permission

The `ProgrammaticLoginPermission` permission is required to invoke the programmatic login mechanism for an application. This permission is not granted by default to deployed applications because this is not a standard J2EE mechanism.

To grant the required permission to the application, add the following to the *domain_dir*`/config/server.policy` file:

```
grant codeBase "file:jar_file_path" {
   permission com.sun.appserv.security.ProgrammaticLoginPermission
   "login";
};
```

The *jar_file_path* is the path to the application's JAR file.

For more information about the `server.policy` file, see "The server.policy File" on page 60.

The ProgrammaticLogin Class

The `com.sun.appserv.security.ProgrammaticLogin` class enables a user to perform login programmatically. This class has four `login` methods, two for servlets or JSPs and two for EJB components.

The login methods for servlets or JSPs have the following signatures:

```
public Boolean login(String user, String password,
javax.servlet.http.HttpServletRequest request,
javax.servlet.http.HttpServletResponse response)
```

```
public Boolean login(String user, String password, String realm,
javax.servlet.http.HttpServletRequest request,
javax.servlet.http.HttpServletResponse response, boolean errors) throws
Exception
```

The login methods for EJB components have the following signatures:

```
public Boolean login(String user, String password)
public Boolean login(String user, String password, String realm, boolean
errors) throws Exception
```

All of these `login` methods:

- Perform the authentication
- Return `true` if login succeeded, `false` if login failed

The methods with `errors` flags propagate to the caller any exceptions encountered during the authentication and return `true` upon a successful authentication. The login occurs on the `realm` specified unless it is null, in which case the domain’s default realm is used. The methods with no `realm` parameter use the domain’s default realm.

The logout method for servlets or JSPs has the following signature:

```
public Boolean login(String user, String password, String realm,
HttpServletRequest request, HttpServletResponse response, boolean errors)
throws Exception
```

The logout method for EJB components has the following signature:

```
public Boolean login(String user, String password, String realm, boolean
errors) throws Exception
```

The `errors` flags are used to propagate to the caller any exceptions encountered during the logout. These methods return `true` upon a successful logout. The logout occurs on the `realm` specified unless it is null, in which case the domain’s default realm is used.

User Authentication for Single Sign-on

The single sign-on across applications on the Sun Java System Application Server is supported by the Sun Java System Application Server servlets and JSPs. This feature allows multiple applications that require the same user sign-on information to share this information between them, rather than having the user sign-on separately for each application. These applications are created to authenticate the user one time, and when needed this authentication information is propagated to all other involved applications.

An example application using the single sign-on scenario could be a consolidated airline booking service that searches all airlines and provides links to different airline web sites. Once the user signs on to the consolidated booking service, the user information can be used by each individual airline site without requiring another sign-on.

Single sign-on operates according to the following rules:

- Single sign-on applies to web applications configured for the same realm and virtual server. The realm is defined by the `realm-name` element in the `web.xml` file. For information about virtual servers, see the *Sun Java System Application Server Administration Guide* or the *Sun Java System Application Server Reference*.
- As long as users access only unprotected resources in any of the web applications on a virtual server, they are not challenged to authenticate themselves.
- As soon as a user accesses a protected resource in any web application associated with a virtual server, the user is challenged to authenticate himself or herself, using the login method defined for the web application currently being accessed.
- Once authenticated, the roles associated with this user are used for access control decisions across all associated web applications, without challenging the user to authenticate to each application individually.
- When the user logs out of one web application (for example, by invalidating or timing out the corresponding session if form based login is used), the user's sessions in all web applications are invalidated. Any subsequent attempt to access a protected resource in any application requires the user to authenticate himself or herself again.

The single sign-on feature utilizes HTTP cookies to transmit a token that associates each request with the saved user identity, so it can only be used in client environments that support cookies.

To configure single sign-on, set the following properties in the `virtual-server` element of the `domain.xml` file:

- `sso-enabled` - If `false`, single sign-on is disabled for this virtual server, and users must authenticate separately to every application on the virtual server. The default is `true`.
- `sso-max-inactive-seconds` - Specifies the time after which a user's single sign-on record becomes eligible for purging if no client activity is received. Since single sign-on applies across several applications on the same virtual server, access to any of the applications keeps the single sign-on record active. The default value is 5 minutes (`300` seconds). Higher values provide longer single sign-on persistence for the users at the expense of more memory use on the server.
- `sso-reap-interval-seconds` - Specifies the interval between purges of expired single sign-on records. The default value is `60`.

Here is an example configuration with all default values:

```
<virtual-server id="server1" ... >
    ...
    <property name="sso-enabled" value="true"/>
    <property name="sso-max-inactive-seconds" value="300"/>
    <property name="sso-reap-interval-seconds" value="60"/>
</virtual-server>
```

Defining Roles

You define roles in the J2EE deployment descriptor file, `web.xml`, and the corresponding role mappings in the Sun Java System Application Server deployment descriptor file, `sun-application.xml` (or `sun-web.xml` for individually deployed web modules).

For more information regarding `web.xml` elements, see Chapter 13, “Deployment Descriptor,” of the Java Servlet Specification, v2.3. For more information regarding `sun-web.xml` and `sun-application.xml` elements, see Chapter 5, “Deployment Descriptor Files.”

Each `security-role-mapping` element in the `sun-application.xml` or `sun-web.xml` file maps a role name permitted by the web application to principals and groups. For example, a `sun-web.xml` file for an individually deployed web module might contain the following:

```
<sun-web-app>
    <security-role-mapping>
        <role-name>manager</role-name>
        <principal-name>jgarcia</principal-name>
        <principal-name>mwebster</principal-name>
        <group-name>team-leads</group-name>
    </security-role-mapping>
    <security-role-mapping>
        <role-name>administrator</role-name>
        <principal-name>dsmith</principal-name>
    </security-role-mapping>
</sun-web-app>
```

Note that the `role-name` in this example must match the `role-name` in the `security-role` element of the corresponding `web.xml` file.

Note that for J2EE applications (EAR files), all security role mappings for the application modules must be specified in the sun-application.xml file. For individually deployed web modules, the roles are always specified in the sun-web.xml file. A role can be mapped to either specific principals or to groups (or both). The principal or group names used must be valid principals or groups in the current default realm.

Authenticating an Application Client Using the JAAS Module

Using the JAAS module, you can provide security in your application client code by creating a LoginModule that describes the interface implemented by authentication technology providers. For general information about application clients, see Chapter 9, “Developing Java Clients.”

The following steps are involved in creating a LoginModule:

1. Write the LoginModule interface.

```
public class ClientPasswordLoginModule implements LoginModule{
    private static Logger _logger=null;
        static{
        _logger=LogDomains.getLogger(LogDomains.SECURITY_LOGGER);
        }
    }
    private Subject subject;
    private CallbackHandler callbackHandler;
    private Map sharedState;
    private Map options;
    ...
}
```

   The standard JAAS package required by this class is javax.security. The code line below illustrates how you can import the package in your client application:

```
import javax.security.*;
```

2. Initialize the LoginModule interface that you just created.

```
public void initialize(Subject subject, CallbackHandler
callbackHandler, Map sharedState, Map options) {
    this.subject = subject;
    this.callbackHandler = callbackHandler;
    this.sharedState = sharedState;
    this.options = options;
}
```

- The parameter `subject`, is the subject to be authenticated.
- `callbackHandler`, for communicating with the end user which prompts for the username and password.
- `sharedState`, is the shared `LoginModule` state.
- `options`, the options specified in the configuration file of the `LoginModule`.

3. Use `login()` method to fetch the login information from the client application and authenticate the user.

```
public boolean login() throws LoginException {
    if (uname != null) {
        username = new String (uname);
        pswd = System.getProperty (LOGIN_PASSWORD);
    ...
}
```

The login information is fetched using the `CallBackHandler`.

```
Callback[] callbacks = new Callback[2];
```

```
callbacks[0] = new
NameCallback(localStrings.getLocalString("login.username",
"ClientPasswordModule username: "));
```

```
callbacks[1] = new
PasswordCallback(localStrings.getLocalString("login.password",
"ClientPasswordModule password: "), false);
```

```
username = ((NameCallback)callbacks[0]).getName();
```

```
char[] tmpPassword = ((PasswordCallback)callbacks[1]).getPassword();
```

The `login()` method tries to connect to the server using the login information that is fetched. If the connection is established, the method returns the value true.

4. Use `commit()` method to set the subject in the session to the user name that is verified by the login method. If the commit method returns a value true, then this method associates `PrincipalImpl` with the `subject` located in the `LoginModule`. If this LoginModule's own authentication attempt is failed, then this method removes any state that was originally saved.

```
public boolean commit() throws LoginException {
    if (succeeded == false) {
        return false;
        } else {
        // add a Principal (authenticated identity)to the Subject
        // assume the user we authenticated is the PrincipalImpl
        userPrincipal = new PrincipalImpl(username);
    ...
}
```

5. Use `logout()` method to remove the privilege settings associated with the roles of the subject.

```
public boolean logout() throws LoginException {
    subject.getPrincipals().remove(userPrincipal);
    succeeded = false;
    succeeded = commitSucceeded;
    username = null;
    if (password != null) {
        for (int i = 0; i < password.length; i++)
            password[i] = ' ';
            password = null;
    }
    userPrincipal = null;
    return true;
}
```

6. Edit the `sun-acc.xml` deployment descriptor to configure JAAS authentication for the client.

7. Integrate the `LoginModule` with the application server. Edit the deployment descriptor to make the following changes:

   - Configure the server with a realm that uses a specific `LoginModule` for security authentication.

   - Map the application realm and roles to the realm and roles defined by the `LoginModule`.

8. Assemble the application client.

Sample Code

The sample code of `ClinetLoginPasswordModule` is given below:

```
package com.sun.enterprise.security.auth.login;

import java.util.*;
import java.io.IOException;
import javax.security.auth.*;
import javax.security.auth.callback.*;
import javax.security.auth.login.*;
import javax.security.auth.spi.*;
import com.sun.enterprise.security.auth.login.PasswordCredential;
import com.sun.enterprise.security.PrincipalImpl;
import com.sun.enterprise.security.auth.LoginContextDriver;
import com.sun.enterprise.util.LocalStringManagerImpl;
import java.util.logging.*;
import com.sun.logging.*;

public class ClientPasswordLoginModule implements LoginModule {

    private static Logger _logger=null;
        static{
            _logger=LogDomains.getLogger(LogDomains.SECURITY_LOGGER);
        }

    private static final String DEFAULT_REALMNAME = "default";
    private static LocalStringManagerImpl localStrings =
        new LocalStringManagerImpl(ClientPasswordLoginModule.class);

// initial state

    private Subject subject;
    private CallbackHandler callbackHandler;
    private Map sharedState;
    private Map options;

    private boolean debug =
        com.sun.enterprise.util.logging.Debug.enabled;

// the authentication status

    private boolean succeeded = false;
    private boolean commitSucceeded = false;

// username and password

    private String username;
    private char[] password;

    private final  PasswordCredential passwordCredential=null;

// testUser’s PrincipalImpl

    private PrincipalImpl userPrincipal;
    public static String LOGIN_NAME = "j2eelogin.name";
    public static String LOGIN_PASSWORD = "j2eelogin.password";

    public void initialize(Subject subject, CallbackHandler
        callbackHandler, Map sharedState, Map options) {

        this.subject = subject;
        this.callbackHandler = callbackHandler;
        this.sharedState = sharedState;
        this.options = options;
```

```
// initialize any configured options

        debug =
        "true".equalsIgnoreCase((String)options.get("debug"));

    }

/* Authenticate the user by prompting for a username and password. @return
true in all cases since this <code>LoginModule</code> should not be
ignored.*/

/* @exception FailedLoginException if the authentication fails. @exception
LoginException if this <code>LoginModule</code> is unable to perform the
authentication.*/

    public boolean login() throws LoginException {

    // prompt for a username and password

        if (callbackHandler == null){

            String failure =
                localStrings.getLocalString("login.nocallback","Error:
                no CallbackHandler available to garner authentication
                information from the user");

            throw new LoginException(failure);
        }

        String uname = System.getProperty (LOGIN_NAME);
        String pswd;

        if (uname != null) {

            username = new String (uname);
            pswd = System.getProperty (LOGIN_PASSWORD);
            char[] dest;
            if (pswd == null){
                dest = new char[0];
                password = new char[0];
            } else {
                int length = pswd.length();
                dest = new char[length];
                pswd.getChars(0, length, dest, 0 );
                password = new char[length];
            }
            System.arraycopy (dest, 0, password, 0, dest.length);
        } else {
            Callback[] callbacks = new Callback[2];
            callbacks[0] = new
        NameCallback(localStrings.getLocalString("login.username",
            "ClientPasswordModule username: "));
                callbacks[1] = new
        PasswordCallback(localStrings.getLocalString("login.password",
        "ClientPasswordModule password: "), false);
            }

            try {
                callbackHandler.handle(callbacks);
                username = ((NameCallback)callbacks[0]).getName();
                if(username == null){
                    String fail =
                        localStrings.getLocalString("login.nousername",
                        "No user specified");
                    throw new LoginException(fail);
                }

                char[] tmpPassword =
                    ((PasswordCallback)callbacks[1]).getPassword();

                if (tmpPassword == null) {
                // treat a NULL password as an empty password
                    tmpPassword = new char[0];
                }
                password = new char[tmpPassword.length];
                System.arraycopy(tmpPassword, 0,
                    password, 0, tmpPassword.length);
                    ((PasswordCallback)callbacks[1]).clearPassword();
            } catch (java.io.IOException ioe) {
                throw new LoginException(ioe.toString());
            } catch (UnsupportedCallbackException uce) {
                String nocallback =
                    localStrings.getLocalString("login.callback","Error:
                    Callback not available to garner authentication
                    information from user(CallbackName):" );

                throw new LoginException(nocallback +
                    uce.getCallback().toString());

            }
    // print debugging information
            if (debug) {

                for (int i = 0; i < password.length; i++){
                    //System.out.print(password[i]);
                }
                //System.out.println();
            }
```

```
// by default -  the client side login module will always say
// that the login successful. The actual login will take place
// on the server side.
        if (debug) {
            _logger.log(Level.FINE,"[ClientPasswordLoginModule] "
                +"authentication succeeded");
            succeeded = true;
            return true;
        }

    }

    public boolean commit() throws LoginException {
        if (succeeded == false) {
            return false;
        } else {
        // add a Principal (authenticated identity)to the Subject
        // assume the user we authenticated is the PrincipalImpl
            userPrincipal = new PrincipalImpl(username);
            if (!subject.getPrincipals().contains(userPrincipal))
                subject.getPrincipals().add(userPrincipal);
            if (debug) {
                _logger.log(Level.FINE,"[ClientPasswordLoginModule] "
                + "added PrincipalImpl to Subject");
            }

            PasswordCredential pc = new PasswordCredential(username,
                new String(password), realm);
if(!subject.getPrivateCredentials().contains(pc))subject.getPrivateCredent
ials().add(pc);

            username = null;
            for (int i = 0; i < password.length; i++){
                password[i] = ’ ’;
                password = null;
                commitSucceeded = true;
                return true;
            }
        }
    }

    public boolean abort() throws LoginException {
        if (succeeded == false) {
            return false;
        } else if (succeeded == true && commitSucceeded == false) {
    // login succeeded but overall authentication failed
            succeeded = false;
            username = null;
            if (password != null) {
                for (int i = 0; i < password.length; i++)
                    password[i] = ’ ’;
                    password = en das ull;
            }

        userPrincipal = null;
        } else {

        // overall authentication succeeded and commit succeeded,
        // but someone else’s commit failed
        logout();
        }
        return true;
    }

    public boolean logout() throws LoginException {
        subject.getPrincipals().remove(userPrincipal);
        succeeded = false;
        succeeded = commitSucceeded;
        username = null;
        if (password != null) {
            for (int i = 0; i < password.length; i++)
                password[i] = ’ ’;
                password = null;
        }
        userPrincipal = null;
        return true;
    }

}
```

Chapter 3

Assembling and Deploying J2EE Applications

This chapter describes Sun Java System Application Server modules and how these modules are assembled separately or together in an application.

Sun Java System Application Server modules and applications include J2EE standard elements and Sun Java System Application Server specific elements. Only Sun Java System Application Server specific elements are described in detail in this chapter.

The following topics are presented in this chapter:

- Overview of Assembly and Deployment
- Assembling Modules and Applications
- Deploying Modules and Applications
- Apache Ant Assembly and Deployment Tool

Overview of Assembly and Deployment

Application assembly (also known as packaging) is the process of combining discrete components of an application into a single unit that can be deployed to a J2EE-compliant application server. A package can be classified either as a module or as a full-fledged application. This section covers the following topics:

- Modules
- Applications
- J2EE Standard Descriptors
- Sun Java System Application Server Descriptors

- Naming Standards
- Directory Structure
- Runtime Environments
- Classloaders

Modules

A J2EE module is a collection of one or more J2EE components of the same container type (for example, web or EJB) with deployment descriptors of that type. One descriptor is J2EE standard, the other is Sun Java System Application Server specific. Types of J2EE modules are as follows:

- **Web Application Archive (WAR):** A web application is a collection of servlets, HTML pages, classes, and other resources that can be bundled and deployed to several J2EE application servers. A WAR file can consist of the following items: servlets, JSPs, JSP tag libraries, utility classes, static pages, client-side applets, beans, bean classes, and deployment descriptors (`web.xml` and optionally `sun-web.xml`).
- **EJB JAR File:** The EJB JAR file is the standard format for assembling enterprise beans. This file contains the bean classes (home, remote, local, and implementation), all of the utility classes, and the deployment descriptors (`ejb-jar.xml` and `sun-ejb-jar.xml`). If the EJB component is an entity bean with container managed persistence, a `.dbschema` file and a CMP mapping descriptor, `sun-cmp-mapping.xml`, must be included as well.
- **Application Client Container JAR File:** An ACC client is a Sun Java System Application Server specific type of J2EE client. An ACC client supports the standard J2EE Application Client specifications, and in addition, supports direct access to the Sun Java System Application Server. Its deployment descriptors are `application-client.xml` and `sun-application-client.xml`.
- **Resource RAR File:** RAR files apply to J2EE CA connectors. A connector module is like a device driver. It is a portable way of allowing EJB components to access a foreign enterprise system. Each Sun Java System Application Server connector has a J2EE XML file, `ra.xml`.

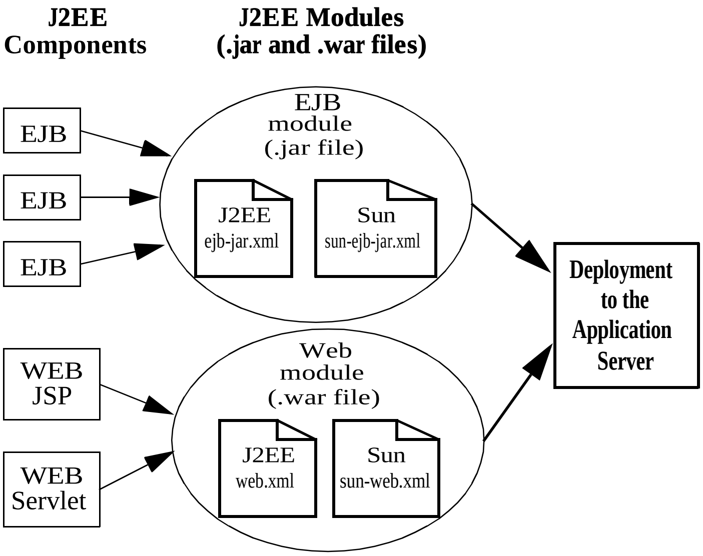
Package definitions must be used in the source code of all modules so the classloader can properly locate the classes after the modules have been deployed.

Because the information in a deployment descriptor is declarative, it can be changed without requiring modifications to source code. At run time, the J2EE server reads this information and acts accordingly.

Sun Java System Application Server also supports lifecycle modules. See Chapter 10, "Developing Lifecycle Listeners," for more information.

EJB JAR and Web modules can also be assembled as separate JAR or WAR files and deployed separately, outside of any application, as in the following figure.

Figure 3-1 Module Assembly and Deployment

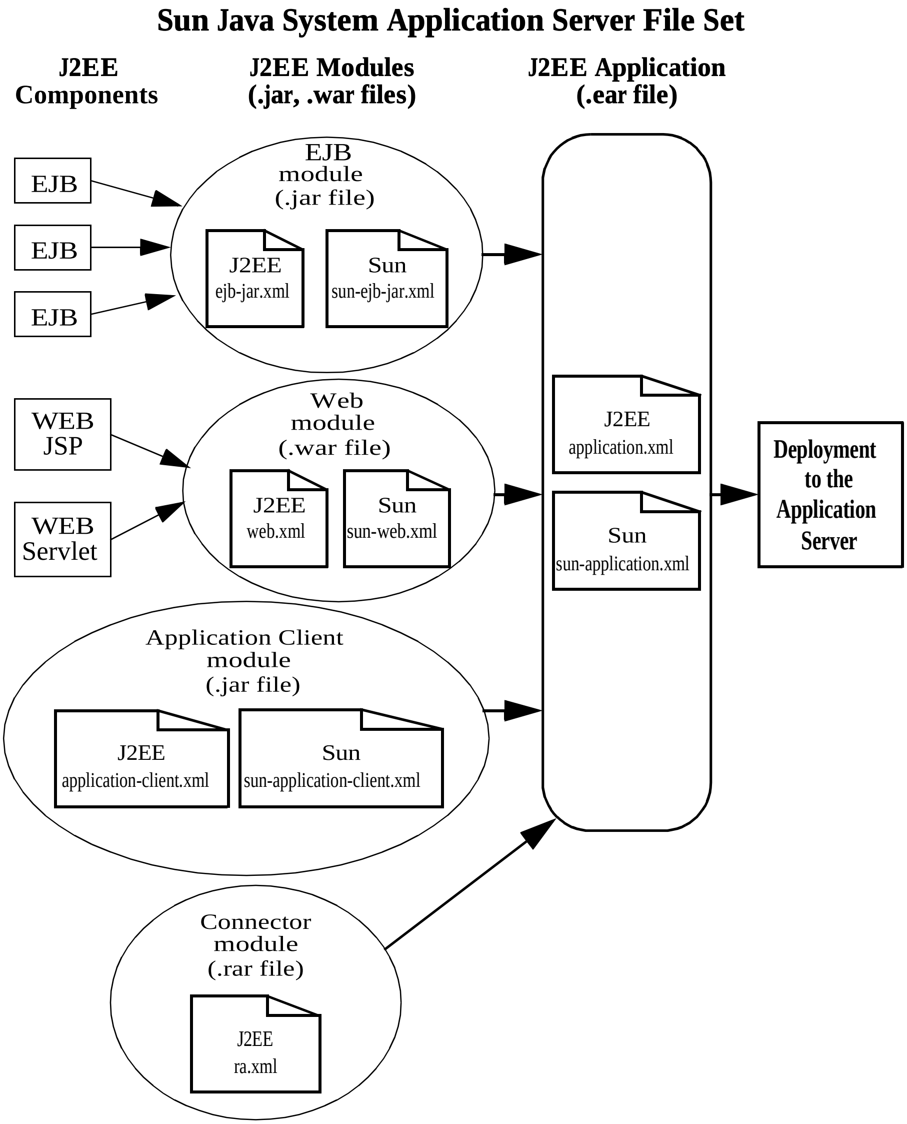


Applications

A J2EE application is a logical collection of one or more J2EE modules tied together by application deployment descriptors. Components can be assembled at either the module or the application level. Components can also be deployed at either the module or the application level.

The following diagram illustrates how components are assembled into modules and then assembled into a Sun Java System Application Server application EAR file ready for deployment.

Figure 3-2 Application Assembly and Deployment


Sun Java System Application Server File Set
J2EE Components
J2EE Modules (.jar, .war files)
J2EE Application (.ear file)
EJB
EJB
EJB
EJB module (.jar file)
J2EE ejb-jar.xml
Sun sun-ejb-jar.xml
WEB JSP
WEB Servlet
Web module (.war file)
J2EE web.xml
Sun sun-web.xml
Application Client module (.jar file)
J2EE application-client.xml
Sun sun-application-client.xml
Connector module (.rar file)
J2EE ra.xml
J2EE application.xml
Sun sun-application.xml
Deployment to the Application Server

Each module has a Sun Java System Application Server deployment descriptor and a J2EE deployment descriptor. The Sun Java System Application Server Administration Console uses the deployment descriptors to deploy the application components and to register the resources with the Sun Java System Application Server.

An application consists of one or more modules, an optional Sun Java System Application Server deployment descriptor, and a required J2EE application deployment descriptor. All items are assembled, using the Java ARchive (.jar) file format, into one file with an extension of .ear.

J2EE Standard Descriptors

The J2EE platform provides assembly and deployment facilities. These facilities use WAR, JAR, and EAR files as standard packages for components and applications, and XML-based deployment descriptors for customizing parameters.

J2EE standard deployment descriptors are described in the J2EE specification, v1.4. You can find the specification here:

http://java.sun.com/products/

To check the correctness of these deployment descriptors prior to deployment, see "The Deployment Descriptor Verifier" on page 92.

The following table shows where to find more information about J2EE standard deployment descriptors.

Table 3-1 J2EE Standard Descriptors

Deployment Descriptor	Where to Find More Information
application.xml	Java 2 Platform Enterprise Edition Specification, v1.4, Chapter 8, "Application Assembly and Deployment - J2EE:application XML DTD"
web.xml	Java Servlet Specification, v2.3 Chapter 13, "Deployment Descriptor," and JavaServer Pages Specification, v1.2, Chapter 7, "JSP Pages as XML Documents," and Chapter 5, "Tag Extensions"
ejb-jar.xml	Enterprise JavaBeans Specification, v2.1, Chapter 16, "Deployment Descriptor"
application-client.xml	Java 2 Platform Enterprise Edition Specification, v1.4, Chapter 9, "Application Clients - J2EE:application-client XML DTD"
ra.xml	Java 2 Enterprise Edition, J2EE Connector Architecture Specification, v1.0, Chapter 10, "Packaging and Deployment."

Sun Java System Application Server Descriptors

Sun Java System Application Server uses additional deployment descriptors for configuring features specific to the Sun Java System Application Server. The `sun-application.xml` and `sun-web.xml` files are optional; all the others are required.

The DTD schema files for all the Sun Java System Application Server deployment descriptors are located in the *install_dir*`/lib/dtds` directory. Do not edit these files.

To check the correctness of these deployment descriptors prior to deployment, see "The Deployment Descriptor Verifier" on page 92.

The following table lists the Sun Java System Application Server deployment descriptors and their schema files. For complete descriptions of these files, see Chapter 5, "Deployment Descriptor Files."

Table 3-2 Sun Java System Application Server Descriptors

Deployment Descriptor	Schema File	Description
`sun-application.xml`	`sun-application_1_4-0.dtd`	Configures an entire J2EE application (EAR file).
`sun-web.xml`	`sun-web-app_2_4-0.dtd`	Configures a web application (WAR file).
`sun-ejb-jar.xml`	`sun-ejb-jar_2_1-0.dtd`	Configures an enterprise bean (EJB JAR file).
`sun-cmp-mappings.xml`	`sun-cmp-mapping_1_1.dtd`	Configures container-managed persistence for an enterprise bean.
`sun-application-client.xml`	`sun-application-client_1_4-0.dtd`	Configures an Application Client Container (ACC) client (JAR file).
`sun-acc.xml`	`sun-application-client-container_1_0.dtd`	Configures the Application Client Container.

NOTE The Sun Java System Application Server deployment descriptors must be readable and writable by the file owners.

Naming Standards

Names of applications and individually deployed EJB JAR, WAR, and connector RAR modules (as specified by the `name` attributes in the `domain.xml` file) must be unique within a Sun Java System Application Server domain. Modules of the same type within an application must have unique names. In addition, for entity beans that use CMP, `.dbschema` file names must be unique within an application.

If you do not explicitly specify a name, the default name is the first portion of the file name (without the `.war` or `.jar` extension). Modules of different types can have the same name within an application, because the directories holding the individual modules are named with `_jar`, `_war` and `_rar` suffixes. This is the case when you use the Administration Console, the `asadmin` command, or the deploytool to deploy an application or module. See "Tools for Deployment" on page 106.

Make sure your package and file names do not contain spaces or characters that are illegal for your operating system.

If you are writing your own JSR 88 client to deploy applications to the Sun Java System Application Server using the following API, the name of the application is taken from the `display-name` entry in the J2EE standard deployment descriptor, because there is no file name in this case.

```
javax.enterprise.deploy.spi.DeploymentManager.distribute(Target[],
InputStream, InputStream)
```

Neither the Administration Console, the `asadmin` command, nor the deploytool uses this API.

For details about `domain.xml`, see the *Sun Java System Application Server Reference*. For more information about JSR 88, see the JSR 88 page:

`http://jcp.org/en/jsr/detail?id=88`

Directory Structure

When you deploy an application, the application is expanded to an open directory structure, and the directories holding the individual modules are named with `_jar`, `_war` and `_rar` suffixes. If you use the `asadmin deploydir` command to deploy a directory instead of an EAR file, your directory structure must follow this same convention.

Module and application directory structures follow the structure outlined in the J2EE specification. Here is an example directory structure of a simple application containing a web module, an EJB module, and a client module.

```
+ converter_1/
|--- converterClient.jar
|--+ META-INF/
|  |--- MANIFEST.MF
|  |--- application.xml
|  '--- sun-application.xml
|--+ war-ic_war/
|  |--- index.jsp
|  |--+ META-INF/
|  |  |--- MANIFEST.MF
|  '--+ WEB-INF/
|     |--- web.xml
|     '--- sun-web.xml
|--+ ejb-jar-ic_jar/
|  |--- Converter.class
|  |--- ConverterBean.class
|  |--- ConverterHome.class
|  '--+ META-INF/
|     |--- MANIFEST.MF
|     |--- ejb-jar.xml
|     '--- sun-ejb-jar.xml
'--+ app-client-ic_jar/
   |--- ConverterClient.class
   '--+ META-INF/
      |--- MANIFEST.MF
      |--- application-client.xml
      '--- sun-application-client.xml
```

Here is an example directory structure of an individually deployed connector module.

```
+ MyConnector/
|--- readme.html
|--- ra.jar
|--- client.jar
|--- win.dll
|--- solaris.so
'--+ META-INF/
   |--- MANIFEST.MF
   '--- ra.xml
```

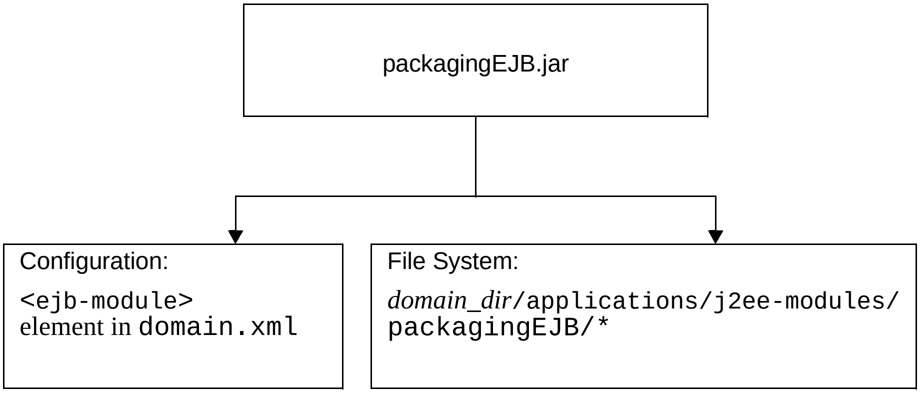
Runtime Environments

Whether you deploy an individual module or an application, deployment affects both the file system and the server configuration. See the following "Module runtime environment" and "Application runtime environment" figures.

Module Runtime Environment

The following figure illustrates the environment for individually deployed module-based deployment.

Figure 3-3 Module runtime environment



For file system entries, modules are extracted as follows:

domain_dir`/applications/j2ee-modules/`*module_name*
domain_dir`/generated/ejb/j2ee-modules/`*module_name*
domain_dir`/generated/jsp/j2ee-modules/`*module_name*

The `applications` directory contains the directory structures described in "Directory Structure" on page 81. The `generated/ejb` directory contains the stubs and ties that an ACC client needs to access the module; the `generated/jsp` directory contains compiled JSPs.

Lifecycle modules (see Chapter 10, "Developing Lifecycle Listeners") are extracted as follows:

domain_dir`/applications/lifecycle-modules/`*module_name*

Configuration entries are added in the `domain.xml` file as follows:

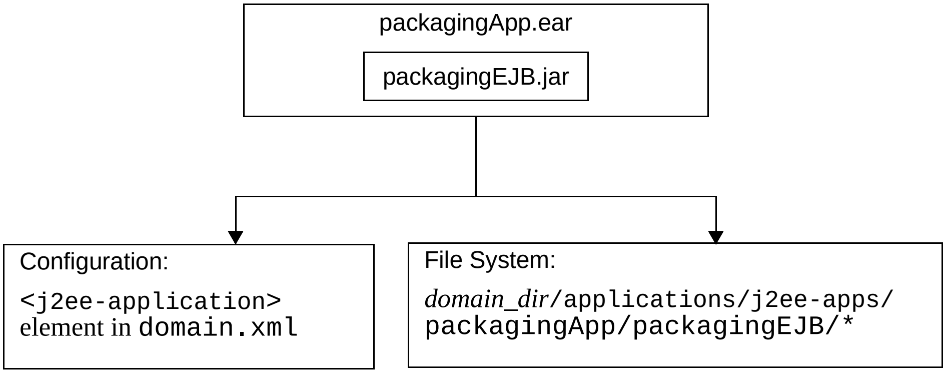
```
<server>
    <applications>
        <type-module>
            ...module configuration...
        </type-module>
    </applications>
</server>
```

The *type* of the module in `domain.xml` can be `lifecycle`, `ejb`, `web`, or `connector`. For details about `domain.xml`, see the *Sun Java System Application Server Reference*.

Application Runtime Environment

The following figure illustrates the environment for application-based deployment.

Figure 3-4 Application runtime environment


packagingApp.ear
packagingEJB.jar
Configuration:
<j2ee-application> element in domain.xml
File System:
domain_dir/applications/j2ee-apps/packagingApp/packagingEJB/*

For file system entries, applications are extracted as follows:

domain_dir`/applications/j2ee-apps/`*app_name*
domain_dir`/generated/ejb/j2ee-apps/`*app_name*
domain_dir`/generated/jsp/j2ee-apps/`*app_name*

The `applications` directory contains the directory structures described in "Directory Structure" on page 81. The `generated/ejb` directory contains the stubs and ties that an ACC client needs to access the module; the `generated/jsp` directory contains compiled JSPs.

Configuration entries are added in the `domain.xml` file as follows:

```
<server>
    <applications>
        <j2ee-application>
            ...application configuration...
        </j2ee-application>
    </applications>
</server>
```

For details about `domain.xml`, see the *Sun Java System Application Server Reference*.

Classloaders

Understanding Sun Java System Application Server classloaders can help you determine where and how you can position supporting JAR and resource files for your modules and applications.

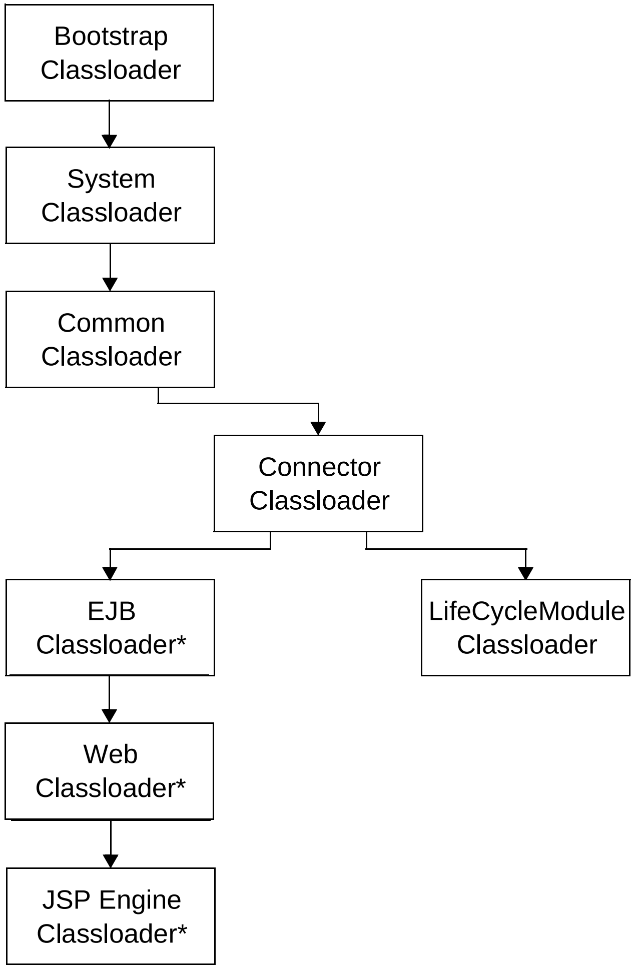
In a Java Virtual Machine (JVM), the classloaders dynamically load a specific java class file needed for resolving a dependency. For example, when an instance of `java.util.Enumeration` needs to be created, one of the classloaders loads the relevant class into the environment. This section includes the following topics:

- The Classloader Hierarchy
- Classloader Universes
- Circumventing Classloader Isolation

The Classloader Hierarchy

Classloaders in the Sun Java System Application Server runtime follow a hierarchy that is illustrated in the following figure.

Figure 3-5 Classloader runtime hierarchy



*There are separate classloader instances for each application (one of these classloaders is in each application classloader universe).

Note that this is not a Java inheritance hierarchy, but a delegation hierarchy. In the delegation design, a classloader delegates classloading to its parent before attempting to load a class itself. A classloader parent can be either the System Classloader or another custom classloader. If the parent classloader can't load a class, the `findClass()` method is called on the classloader subclass. In effect, a classloader is responsible for loading only the classes not available to the parent.

The Servlet specification recommends that the Web Classloader look in the local classloader before delegating to its parent. You can make the Web Classloader follow the delegation model in the Servlet specification by setting `delegate="false"` in the `class-loader` element of the `sun-web.xml` file. It's safe to do this only for a web module that does not interact with any other modules.

The default value is `delegate="true"`, which causes the Web Classloader to delegate in the same manner as the other classloaders. You must use `delegate="true"` for a web application that accesses EJB components or that acts as a web service client or endpoint. For details about `sun-web.xml`, see "The sun-web.xml File" on page 151.

The following table describes Sun Java System Application Server classloaders.

Table 3-3 Sun Java System Application Server Classloaders

Classloader	**Description**
Bootstrap	The Bootstrap Classloader loads all the JDK classes.
System	The System Classloader loads most of the core Sun Java System Application Server classes. It is created based on the `classpath-prefix`, `server-classpath`, and `classpath-suffix` attributes of the `java-config` element in the `domain.xml` file. The environment classpath is included if `env-classpath-ignored="false"` is set in the `java-config` element.
Common	The Common Classloader loads classes in the *domain_dir*`/lib/classes` directory, followed by JAR and ZIP files in the *domain_dir*`/lib` directory. No special classpath settings are required. The existence of these directories is optional; if they don't exist, the Common Classloader is not created.
Connector	The Connector Classloader is a single classloader instance that loads individually deployed connector modules, which are shared across all applications.
LifeCycleModule	The LifeCycleModule Classloader is the parent classloader for lifecycle modules. Each lifecycle module's classpath is used to construct its own classloader.
EJB	The EJB Classloader loads the enabled EJB classes in a specific enabled EJB module or J2EE application. One instance of this classloader is present in each classloader universe. The EJB Classloader is created with a list of URLs that point to the locations of the classes it needs to load.

Table 3-3 Sun Java System Application Server Classloaders *(Continued)*

Classloader	Description
Web	The Web Classloader loads the servlets and other classes in a specific enabled web module or J2EE application. One instance of this classloader is present in each classloader universe. The Web Classloader is created with a list of URLs that point to the locations of the classes it needs to load.
JSP Engine	The JSP Engine Classloader loads compiled JSP classes of enabled JSPs. One instance of this classloader is present in each classloader universe. The JSP Engine Classloader is created with a list of URLs that point to the locations of the classes it needs to load.

Classloader Universes

Access to components within applications and modules installed on the server occurs within the context of isolated classloader universes, each of which has its own EJB, Web, and JSP Engine classloaders.

- **Application Universe:** Each J2EE application has its own classloader universe, which loads the classes in all the modules in the application.
- **Individually Deployed Module Universe:** Each individually deployed EJB JAR, web WAR, or lifecycle module has its own classloader universe, which loads the classes in the module.

NOTE A resource such as a file that is accessed by a servlet, JSP, or EJB component must be in a directory pointed to by the classloader's classpath. For example, the web classloader's classpath includes these directories:

module_name`/WEB-INF/classes`
module_name`/WEB-INF/lib`

If a servlet accesses a resource, it must be in one of these directories or it will not be loaded.

NOTE In iPlanet Application Server 6.*x*, individually deployed modules shared the same classloader. In Sun Java System Application Server 8, each individually deployed module has its own classloader universe.

Circumventing Classloader Isolation

Since each application or individually deployed module classloader universe is isolated, an application or module cannot load classes from another application or module. This prevents two similarly named classes in different applications from interfering with each other.

To circumvent this limitation for libraries, utility classes, or individually deployed modules accessed by more than one application, you can include the relevant path to the required classes in one of these ways:

- Using the System Classloader
- Using the Common Classloader
- Using the Java Optional Package Mechanism
- Packaging the Client JAR for One Application in Another Application

Using the System Classloader

To use the System Classloader, do one of the following, then restart the server:

- Use the Administration Console:

  a. Login to the Administration Console by going to the following URL in your web browser:

  `http://`*host*`:`*port*`/asadmin`

  For example:

  `http://localhost:4848/asadmin`

  b. Go to the Application Server page.

  c. Select the JVM Settings tab and the Path Settings option.

  d. Edit the Classpath Suffix field.

  e. Select Save.

- Edit the `classpath-suffix` attribute of the `java-config` element in the `domain.xml` file. For details about `domain.xml`, see the *Sun Java System Application Server Reference*.

Using the System Classloader makes an application or module accessible to any other application or module across the domain.

Using the Common Classloader

To use the Common Classloader, copy the JAR and ZIP files into the *domain_dir*`/lib` directory or copy the `.class` files into the *domain_dir*`/lib/classes` directory, then restart the server.

Using the Common Classloader makes an application or module accessible to any other application or module across the domain.

Using the Java Optional Package Mechanism

To use the Java optional package mechanism, copy the JAR and ZIP files into the *domain_dir*`/lib/ext` directory, then restart the server.

Using the Java optional package mechanism makes an application or module accessible to any other application or module across the domain. For example, this is the recommended way of adding JDBC drivers to the Sun Java System Application Server.

Packaging the Client JAR for One Application in Another Application

By packaging the client JAR for one application in a second application, you allow an EJB or web component in the second application to call an EJB component in the first (dependent) application, without making either of them accessible to any other application or module.

As an alternative for a production environment, you can have the Common Classloader load client JAR of the dependent application as described in "Using the Common Classloader" on page 90. Server performance is better, but you must restart the server to make the dependent application accessible, and it is accessible across the domain.

To package the client JAR for one application in another application:

1. Deploy the dependent application.

2. Add the dependent application's client JAR file to the calling application.

   ❍ For a calling EJB component, add the client JAR file at the same level as the EJB component. Then add a `Class-Path` entry to the `MANIFEST.MF` file of the calling EJB component. The `Class-Path` entry has this syntax:

   ```
   Class-Path: filepath1.jar filepath2.jar ...
   ```

   Each *filepath* is relative to the directory or JAR file containing the `MANIFEST.MF` file. For details, see the J2EE specification, section 8.1.1.2, "Dependencies."

   ❍ For a calling web component, add the client JAR file under the `WEB-INF/lib` directory.

3. For most applications, packaging the client JAR file with the calling EJB component should suffice. You do not need to package the client JAR file with both the EJB and web components unless the web component is directly calling the EJB component in the dependent application. If you need to package the client JAR with both the EJB and web components, set `delegate="true"` in the `class-loader` element of the `sun-web.xml` file. This changes the Web Classloader so it follows the standard classloader delegation model and delegates to its parent before attempting to load a class itself.

4. Deploy the calling application.

NOTE The calling EJB or web component must specify in its `sun-ejb-jar.xml` or `sun-web.xml` file the JNDI name of the EJB component in the dependent application. Using an `ejb-link` mapping does not work when the EJB component being called resides in another application.

Assembling Modules and Applications

Assembling (or packaging) modules and applications in Sun Java System Application Server conforms to all of the customary J2EE-defined specifications. The only difference is that when you assemble in Sun Java System Application Server, you include Sun Java System Application Server-specific deployment descriptors (such as `sun-web.xml` and `sun-ejb-jar.xml`) that enhance the functionality of the application server.

This section covers the following topics:

- Tools for Assembly
- Assembling a WAR Module
- Assembling an EJB JAR Module
- Assembling a Lifecycle Module
- Assembling an Application
- Assembling an ACC Client
- Assembling a J2EE CA Resource Adapter

Tools for Assembly

The Sun Java System Application Server provides these methods for assembling a module or an application:

- deploytool
- Apache Ant
- The Deployment Descriptor Verifier

deploytool

You can use the deploytool, provided with Sun Java System Application Server, to assemble J2EE applications and modules, configure deployment parameters, perform simple static checks, and deploy the final result. For more information about using the deploytool, see the *J2EE 1.4 Tutorial*:

`http://java.sun.com/j2ee/1.4/docs/tutorial/doc/index.html`

Apache Ant

Ant can help you assemble and deploy modules and applications. For details, see "Apache Ant Assembly and Deployment Tool" on page 115.

The Deployment Descriptor Verifier

The verifier tool validates both J2EE and Sun Java System Application Server specific deployment descriptors against their corresponding DTD files and gives errors and warnings if a module or application is not J2EE and Sun Java System Application Server compliant. You can verify deployment descriptors in EAR, WAR, RAR, and JAR files.

The verifier tool is not simply an XML syntax verifier. Rules and interdependencies between various elements in the deployment descriptors are verified. Where needed, user application classes are introspected to apply validation rules.

The verifier is integrated into Sun Java System Application Server deployment, the deploytool, and the `sun-appserv-deploy` Ant task. You can also run it as a stand-alone utility from the command line.

When you run the verifier during Sun Java System Application Server deployment, the output of the verifier is written to the *tempdir*`/verifier-results/` directory, where *tempdir* is the temporary directory defined in the operating system. Deployment fails if any failures are reported during the verification process. The verifier also logs information about verification progress to the standard output.

TIP Using the verifier tool can help you avoid runtime errors that are difficult to debug.

This section covers the following topics:

- Command Line Syntax
- Ant Integration
- Sample Results Files

Command Line Syntax

The verifier tool's syntax is as follows:

`verifier [`*options*`]` *file*

The *file* can be an EAR, WAR, RAR, or JAR file.

The following table shows the *options* for the `verifier` tool.

Table 3-4 Verifier Options

Short Form	Long Form	Description
`-v`	`--verbose`	Turns on verbose mode.
`-d` *output_dir*	`--destdir`	Writes test results to the *output_dir*, which must already exist. By default, the results files are created in the current directory.
`-r` *level*	`--reportlevel` *level*	Sets the output report *level* to one of the following values: • `a` or `all` - Reports all results. This is the default in both verbose and non verbose modes. • `w` or `warnings` - Reports only warning and failure results. • `f` or `failures` - Reports only failure results.
`-n`	`--notimestamp`	Does not append the timestamp to the output file name.
`-h` or `-?`	`--help`	Displays help for the verifier command. If you use this option, you do not need to specify an EAR, WAR, RAR, or JAR file.
`-V`	`--version`	Displays the verifier tool version. If you use this option, you do not need to specify an EAR, WAR, RAR, or JAR file.
`-u`	`--gui`	Opens a graphical interface for performing verification. If you use this option, you do not need to specify an EAR, WAR, RAR, or JAR file. For more information, see the verifier online help.

For example, the following command runs the verifier in verbose mode and writes all the results of static verification of the `ejb.jar` file to the output directory `ResultsDir`:

```
verifier -v -r a -d ResultsDir ejb.jar
```

The results files are `ejb.jar_verifier.`*timestamp*`.txt` and `ejb.jar_verifier.`*timestamp*`.xml`. The format of the *timestamp* is yyyyMMddhhmmss.

If the verifier runs successfully, a result code of `0` is returned. This does not mean that no verification errors occurred. A non-zero error code is returned if the verifier fails to run.

Ant Integration

You can integrate the verifier into an Ant build file as a target and use the Ant call feature to call the target each time an application or module is assembled. This is because the `main` method in `com.sun.enterprise.tools.verifier.Verifier` is callable from user Ant scripts. The `main` method accepts the arguments described in the "Verifier Options" table.

Example code for an Ant verify target is as follows:

```
<target name="verify">
    <echo message="Verification Process for ${testfile}"/>
    <java classname="com.sun.enterprise.tools.verifier.Verifier"
            fork="yes">
        <sysproperty key="com.sun.enterprise.home"
            value="${appserv.home}"/>
        <sysproperty key="verifier.xsl"
            value="${appserv.home}/verifier/config" />
        <!-- uncomment the following for verbose output -->
        <!--<arg value="-v"/>-->
        <arg value="${assemble}/${ejbjar}" />
        <classpath path="${appserv.cpath}:${java.class.path}"/>
    </java>
</target>
```

Sample Results Files

Here is a sample results XML file:

```
<static-verification>
    <ejb>
        <failed>
            <test>
                <test-name>
tests.ejb.session.TransactionTypeNullForContainerTX
                </test-name>
                <test-assertion>
Session bean with bean managed transaction demarcation test
```

```
               </test-assertion>
               <test-description>
For [ TheGreeter ] Error: Session Beans [ TheGreeter ] with [ Bean ] managed
transaction demarcation should not have container transactions defined.
               </test-description>
           </test>
       </failed>
   </ejb>
...
</static-verification>
```

Here is a sample results TXT file:

```
---------------------------
STATIC VERIFICATION RESULTS
---------------------------
----------------------------------
NUMBER OF FAILURES/WARNINGS/ERRORS
----------------------------------

# of Failures : 3
# of Warnings : 6
# of Errors : 0

-----------------------------
RESULTS FOR EJB-RELATED TESTS
-----------------------------
--------------
FAILED TESTS :
--------------

Test Name : tests.ejb.session.TransactionTypeNullForContainerTX
Test Assertion : Session bean with bean managed transaction demarcation
test
Test Description : For [ TheGreeter ]
Error: Session Beans [ TheGreeter ] with [ Bean ] managed transaction
demarcation should not have container transactions defined.

...

---------------
PASSED TESTS :
---------------

Test Name : tests.ejb.session.ejbcreatemethod.EjbCreateMethodStatic
Test Assertion : Each session Bean must have at least one non-static
```

```
ejbCreate method test
Test Description : For [ TheGreeter ] For EJB Class [
samples.helloworld.ejb.GreeterEJB ] method [ ejbCreate ] [
samples.helloworld.ejb.GreeterEJB ] properly declares non-static
ejbCreate(...) method.

...

-----------
WARNINGS :
-----------

Test Name : tests.ejb.businessmethod.BusinessMethodException
Test Assertion : Enterprise bean business method throws RemoteException
test
Test Description :

Test Name : tests.ejb.ias.beanpool.IASEjbBeanPool
Test Assertion :
Test Description : WARNING [IAS-EJB ejb] : bean-pool should be defined for
Stateless Session and Message Driven Beans

...

---------------------
NOTAPPLICABLE TESTS :
---------------------

Test Name : tests.ejb.entity.pkmultiplefield.PrimaryKeyClassFieldsCmp
Test Assertion : Ejb primary key class properly declares all class fields
within subset of the names of the container-managed fields test.
Test Description : For [ TheGreeter ] class
com.sun.enterprise.tools.verifier.tests.ejb.entity.pkmultiplefield.Primary
KeyClassFieldsCmp expected Entity bean, but called with Session.

Test Name : tests.ejb.entity.ejbcreatemethod.EjbCreateMethodReturn
Test Assertion : Each entity Bean may have zero or more ejbCreate methods
which return primary key type test
Test Description : For [ TheGreeter ] class
com.sun.enterprise.tools.verifier.tests.ejb.entity.ejbcreatemethod.EjbCrea
teMethodReturn expected Entity bean, but called with Session bean.

...

-----------------------------------
```

```
RESULTS FOR OTHER XML-RELATED TESTS
-----------------------------------
---------------
PASSED TESTS :
---------------

Test Name : tests.dd.ParseDD
Test Assertion : Test parses the deployment descriptor using a SAX parser to
avoid the dependency on the DOL
Test Description : PASSED [EJB] : [ remote ] and [ home ] tags present.
PASSED [EJB]: session-type is Stateless.
PASSED [EJB]: trans-attribute is NotSupported.
PASSED [EJB]: transaction-type is Bean.

...
```

Assembling a WAR Module

To assemble a WAR module, follow these steps:

1. Create a working directory, and copy the contents of your web module into it.
2. Create two deployment descriptor files with these names: `web.xml` (required) and `sun-web.xml` (optional). For more information about `sun-web.xml`, see Chapter 5, "Deployment Descriptor Files."

TIP The first time, you can assemble the WAR module and create the deployment descriptors using the deploytool. The resulting WAR file can be extracted to yield the deployment descriptors.

3. Execute this command to create the WAR file:

   ```
   jar -cvf module_name.war *
   ```

TIP The assembly process can be automated using the Ant tool. To learn more, see "Apache Ant Assembly and Deployment Tool" on page 115.

Assembling an EJB JAR Module

To assemble an EJB JAR module, follow these steps:

1. Create a working directory, and copy the contents of your module into it.
2. Create two deployment descriptor files with these names: `ejb-jar.xml` and `sun-ejb-jar.xml` (both required). If the EJB component is an entity bean with container-managed persistence, you must also create a `.dbschema` file and a `sun-cmp-mapping.xml` file. For more information about `sun-ejb-jar.xml` and `sun-cmp-mapping.xml`, see Chapter 5, "Deployment Descriptor Files."

TIP The first time, you can assemble the EJB JAR module and create the deployment descriptors using the deploytool. The resulting EJB JAR file can be extracted to yield the deployment descriptors.

3. Execute this command to create the JAR file:

```
jar -cvf module_name.jar *
```

TIP The assembly process can be automated using the Ant tool. To learn more, see "Apache Ant Assembly and Deployment Tool" on page 115.

NOTE According to the J2EE specification, section 8.1.1.2, "Dependencies," you cannot package utility classes within an individually deployed EJB module. Instead, package the EJB module and utility JAR within an application using the JAR Extension Mechanism Architecture. For other alternatives, see "Circumventing Classloader Isolation" on page 89.

Assembling a Lifecycle Module

To assemble a lifecycle module, follow these steps:

1. Create a working directory, and copy the contents of your module into it.
2. Execute this command to create the JAR file:

```
jar -cvf module_name.jar *
```

TIP The assembly process can be automated using the Ant tool. To learn more, see "Apache Ant Assembly and Deployment Tool" on page 115.

For general information about lifecycle modules, see Chapter 10, "Developing Lifecycle Listeners."

Assembling an Application

To assemble an application, follow these steps:

1. Create a working directory, and copy the contents of your application into it, including all modules.
2. Create two deployment descriptor files with these names: `application.xml` (required) and `sun-application.xml` (optional). For more information about `sun-application.xml`, see Chapter 5, "Deployment Descriptor Files."

TIP The first time, you can assemble the application and create the deployment descriptors using the deploytool. The resulting EAR file can be extracted to yield the deployment descriptors.

3. Execute this command to create the J2EE application EAR file:

```
jar -cvf app_name.ear *
```

TIP The assembly process can be automated using the Ant tool. To learn more, see "Apache Ant Assembly and Deployment Tool" on page 115.

Assembling an ACC Client

This section provides some brief pointers for assembling ACC clients. For more detailed information, see Chapter 9, "Developing Java Clients." To assemble an ACC client JAR module, follow these steps:

1. Create a working directory, and copy the contents of your module into it.
2. Create deployment descriptor files with these names: `application-client.xml` and `sun-application-client.xml` (both required). For more information about `sun-application-client.xml`, see "The sun-application-client.xml file" on page 237

TIP The first time, you can assemble the client JAR module and create the deployment descriptors using the deploytool. The resulting client JAR file can be extracted to yield the deployment descriptors.

3. Execute this command to create the client JAR file:

```
jar -cvfm module_name.jar META-INF/MANIFEST.MF *
```

TIP The assembly process can be automated using the Ant tool. To learn more, see "Apache Ant Assembly and Deployment Tool" on page 115.

For a brief description of how to deploy an ACC client and prepare the client machine, see "Deploying an Application Client" on page 113.

Assembling a J2EE CA Resource Adapter

This section provides some brief pointers for assembling J2EE CA resource adapters. To assemble a connector RAR module, follow these steps:

1. Create a working directory, and copy the contents of your module into it.
2. Create the deployment descriptor file with this name: `ra.xml`. The `ra.xml` file is required for deploying a connector to the application server. This file is based on the J2EE CA specification and is packaged with the connector.

TIP The first time, you can assemble the RAR module and create the deployment descriptors using the deploytool. The resulting RAR file can be extracted to yield the deployment descriptors.

3. Execute this command to create the RAR file:

   ```
   jar -cvf module_name.rar *
   ```

TIP The assembly process can be automated using the Ant tool. To learn more, see "Apache Ant Assembly and Deployment Tool" on page 115.

Deploying Modules and Applications

This section describes the different ways to deploy J2EE applications and modules to the Sun Java System Application Server. It covers the following topics:

- Deployment Errors
- The Deployment Life Cycle
- Tools for Deployment
- Deployment by Module or Application
- Deploying a WAR Module
- Deploying an EJB JAR Module
- Deploying a Lifecycle Module
- Deploying an Application Client
- Deploying a J2EE CA Resource Adapter
- Access to Shared Frameworks

Deployment Errors

If an error occurs during deployment, the application or module is not deployed. If a module within an application contains an error, the entire application is not deployed. This prevents a partial deployment that could leave the server in an inconsistent state.

The Deployment Life Cycle

After an application is initially deployed, it may be modified and reloaded, redeployed, disabled, re-enabled, and finally undeployed (removed from the server). This section covers the following topics related to the deployment life cycle:

- Dynamic Deployment
- Disabling a Deployed Application or Module
- Dynamic Reloading
- Automatic Deployment

Dynamic Deployment

You can deploy, redeploy, and undeploy an application or module without restarting the server. This is called dynamic deployment.

Although primarily for developers, dynamic deployment can be used in operational environments to bring new applications and modules online without requiring a server restart. Whenever a redeployment is done, the sessions at that transit time become invalid. The client must restart the session.

NOTE You can overwrite a previously deployed application by using the `--force` option of `asadmin deploy` or by checking the appropriate box in the Administration Console during deployment. However, you must remove a preconfigured resource before you can update it.

Disabling a Deployed Application or Module

You can disable a deployed application or module without removing it from the server. Disabling an application makes it inaccessible to clients.

To disable an application or module, you can do one of the following:

- Set `enabled="false"` for the application or module in the `domain.xml` file. For details about `domain.xml`, see the *Sun Java System Application Server Reference*.
- Use the Administration Console:

  a. Login to the Administration Console by going to the following URL in your web browser:

  `http://`*host*`:`*port*`/asadmin`

For example:

`http://localhost:4848/asadmin`

b. Open the Applications component.

c. Go to the page for the type of application or module. For example, for a web application, go to the Web Applications page.

d. Click on the name of the application or module you wish to disable.

e. Uncheck the Status Enabled box.

f. Click Save.

Dynamic Reloading

If dynamic reloading is enabled (it is by default), you do not have to redeploy an application or module when you change its code or deployment descriptors. All you have to do is copy the changed JSP or class files into the deployment directory for the application or module. The server checks for changes periodically and redeploys the application, automatically and dynamically, with the changes.

This is useful in a development environment, because it allows code changes to be tested quickly. In a production environment, however, dynamic reloading may degrade performance. In addition, whenever a reload is done, the sessions at that transit time become invalid. The client must restart the session.

To enable dynamic reloading, you can do one of the following:

- Use the Administration Console:

a. Login to the Administration Console by going to the following URL in your web browser:

`http://`*host*`:`*port*`/asadmin`

For example:

`http://localhost:4848/asadmin`

b. Open the Applications component.

c. Go to the Applications page.

d. Check the Reload Enabled box to enable dynamic reloading.

e. Enter a number of seconds in the Reload Poll Interval field to set the interval at which applications and modules are checked for code changes and dynamically reloaded. The default is 2.

   f. Click on the Save button.

   For details, see the *Sun Java System Application Server Administration Guide*.

- Edit the following attributes of the `domain.xml` file’s `applications` element:
  - ❍ `dynamic-reload-enabled="true"` enables dynamic reloading.
  - ❍ `dynamic-reload-poll-interval-in-seconds` sets the interval at which applications and modules are checked for code changes and dynamically reloaded.

  For details about `domain.xml`, see the *Sun Java System Application Server Reference*.

In addition, to load new servlet files, reload EJB related changes, or reload deployment descriptor changes, you must do the following:

1. Create an empty file named `.reload` at the root of the deployed application:

   domain_dir`/applications/j2ee-apps/`*app_name*`/.reload`

   or individually deployed module:

   domain_dir`/applications/j2ee-modules/`*module_name*`/.reload`

2. Explicitly update the `.reload` file’s timestamp (`touch .reload` in UNIX) each time you make the above changes.

Automatic Deployment

Automatic deployment, also called *autodeployment*, involves copying an application or module file (JAR, WAR, RAR, or EAR) into a special directory, where it is automatically deployed by the Sun Java System Application Server. To undeploy an automatically deployed application or module, simply remove its file from the special autodeployment directory. This is useful in a development environment, because it allows new code to be tested quickly.

Autodeployment is enabled by default. To enable and configure or to disable autodeployment, you can do one of the following:

- Use the Administration Console:

  a. Login to the Administration Console by going to the following URL in your web browser:

     `http://`*host*`:`*port*`/asadmin`

     For example:

     `http://localhost:4848/asadmin`

  b. Open the Applications component.

c. Go to the Applications page.

d. Check the Auto Deploy Enabled box to enable autodeployment, or uncheck this box to disable autodeployment.

e. Enter a number of seconds in the Auto Deploy Poll Interval field to set the interval at which applications and modules are checked for code changes and dynamically reloaded. The default is `2`.

f. You can change the Auto Deploy Directory if you like. The default is *domain_dir*`/autodeploy`. You can enter an absolute or relative path. A relative path is relative to *domain_dir*.

g. You can check the Verifier Enabled box to verify your deployment descriptor files. This is optional. For details about the verifier, see "The Deployment Descriptor Verifier" on page 92.

h. Check the Precompile Enabled box if you would like any JSPs to be precompiled.

i. Click on the Save button.

For details, see the *Sun Java System Application Server Administration Guide*.

- Edit the following attributes of the `domain.xml` file's `applications` element:

  ❍ `autodeploy-enabled="true"` enables autodeployment; `false` disables it.

  ❍ `autodeploy-polling-interval-in-seconds` sets the interval at which the autodeployment directory is checked for changes.

  ❍ `autodeploy-dir` sets the location of the autodeployment directory. You can enter an absloute or relative path. A relative path is relative to *domain_dir*.

  ❍ `autodeploy-verifier-enabled` verifies your deployment descriptor files. This is optional. For details about the verifier, see "The Deployment Descriptor Verifier" on page 92.

  ❍ `autodeploy-jsp-precompilation-enabled` precompiles any JSPs.

For details about `domain.xml`, see the *Sun Java System Application Server Reference*.

Tools for Deployment

This section discusses the various tools that can be used to deploy modules and applications. The deployment tools include:

- Apache Ant
- The deploytool
- JSR 88
- The FastJavac Compiler
- The asadmin Command
- The Administration Console

Apache Ant

Ant can help you assemble and deploy modules and applications. For details, see "Apache Ant Assembly and Deployment Tool" on page 115.

The deploytool

You can use the deploytool, provided with Sun Java System Application Server, to assemble J2EE applications and modules, configure deployment parameters, perform simple static checks, and deploy the final result. For more information about using the deploytool, see the *J2EE 1.4 Tutorial*:

`http://java.sun.com/j2ee/1.4/docs/tutorial/doc/index.html`

JSR 88

You can write your own JSR 88 client to deploy applications to the Sun Java System Application Server. For more information, see the JSR 88 page:

`http://jcp.org/en/jsr/detail?id=88`

See "Naming Standards" on page 81 for application and module naming considerations.

The FastJavac Compiler

By default, Sun Java System Application Server uses the built-in JDK compiler to compile applications during deployment. You can also use Sun ONE Studio's FastJavac compiler, which has a faster compilation rate, during deployment.

To use the FastJavac compiler, you must configure the administration server's `domain.xml` file with the path to the compiler. Edit the `java-config` element as follows:

```
<java-config java-home="/install_dir/jdk" server-classpath="classpath" ... >
    ...
    <jvm-options>
        -Dcom.sun.aas.deployment.java.compiler=/install_dir/studio5/bin/fastjavac/fastjavac.sun
    </jvm-options>
    ...
    <property name="com.sun.aas.deployment.java.compiler.options"
        value="-jdk /install_dir/jdk" />
    ...
</java-config>
```

The asadmin Command

You can use the `asadmin` command to deploy or undeploy applications and individually deployed modules on local servers. This section describes the `asadmin` command only briefly. For full details, see the *Sun Java System Application Server Administration Guide*.

To deploy a lifecycle module, see “Deploying a Lifecycle Module” on page 111.

asadmin deploy

The `asadmin deploy` command deploys a WAR, JAR, RAR, or EAR file. The syntax is as follows, with defaults shown for optional parameters that have them:

```
asadmin deploy --user user [--virtualservers virtual_servers] [--contextroot
contextroot] [--force=true] [--precompilejsp=false] [--verify=false] [--name
component_name] [--upload=true] [--retrieve local_dirpath] [--dbvendorname
dbvendorname] [--createtables=false] --dropandcreatetables=false]
[--uniquetablenames=false] [--enable=true] [--deploymentplan deployment_plan]
filepath
```

For more information about the `--dbvendorname`, `--createtables`, `--dropandcreatetables`, and `--uniquetablenames` parameters, see “Automatic Mapping Options” on page 308.

For more information about the optional general `asadmin` parameters (`--password`, `--passwordfile`, `--host`, `--port`, `--secure`, `--terse`, `--echo`, and `--interactive`), see the *Sun Java System Application Server Administration Guide*.

For example, the following command deploys an individual EJB module:

```
asadmin deploy --user joeuser packagingEJB.jar
```

If `upload` is set to `false`, the *filepath* must be an absolute path on the server machine.

asadmin deploydir

The `asadmin deploydir` command deploys an application or module in an open directory structure. The structure must be as specified in "Directory Structure" on page 81. The location of the *dirpath* under *domain_dir*`/applications/j2ee-apps` or *domain_dir*`/applications/j2ee-modules` determines whether it is an application or individually deployed module.

The syntax is as follows, with defaults shown for optional parameters that have them:

```
asadmin deploydir --user user [--virtualservers virtual_servers] [--contextroot
contextroot] [--force=true] [--precompilejsp=false] [--verify=false] [--name
component_name] [--dbvendorname dbvendorname] [--createtables=false]
--dropandcreatetables=false] [--uniquetablenames=false] dirpath
```

For more information about the `--dbvendorname`, `--createtables`, `--dropandcreatetables`, and `--uniquetablenames` parameters, see "Automatic Mapping Options" on page 308.

For example, the following command deploys an individual EJB module:

```
asadmin deploydir --user joeuser packagingEJB
```

If `upload` is set to `false`, the *filepath* must be an absolute path on the server machine.

NOTE On Windows, if you are deploying a directory on a mapped drive, you must be running Sun Java System Application Server as the same user to which the mapped drive is assigned, or Sun Java System Application Server won't see the directory.

asadmin undeploy

The `asadmin undeploy` command undeploys an application or module. The syntax is as follows, with defaults shown for optional parameters that have them:

```
asadmin undeploy --user user [--droptables=false] [--cascade=false]
component_name
```

For more information about the `--droptables` parameter, see "Automatic Mapping Options" on page 308.

For example, the following command undeploys an individual EJB module:

```
asadmin undeploy --user joeuser packagingEJB
```

The Administration Console

You can use the Administration Console to deploy modules and applications to both local and remote Sun Java System Application Server sites. To use this tool, follow these steps:

1. Login to the Administration Console by going to the following URL in your web browser:

   `http://`*host*`:`*port*`/asadmin`

   For example:

   ```
   http://localhost:4848/asadmin
   ```

2. Open the Applications component.
3. Go to the page for the type of application or module. For example, for a web application, go to the Web Applications page.
4. Click on the Deploy button. (You can also undeploy, enable, or disable an application or module from this page.)
5. If your application or module is in an archive file rather than an open directory structure, click Yes next to Upload File.
6. Enter the full path to the module or application directory or archive file (or click on Browse to find it), then click on the Next button.
7. Enter the module or application name.
8. For an application or web module, enter the context root.
9. Assign the application or web module to one or more virtual servers by entering the virtual server names.
10. You can also redeploy the module or application if it already exists (called *forced* deployment) by checking the If Exists Redeploy box. This is optional.
11. You can check the Verifier Enabled box to verify your deployment descriptor files. This is optional. For details about the verifier, see "The Deployment Descriptor Verifier" on page 92.
12. Other fields are displayed depending on the type of module. Check appropriate boxes and enter appropriate values. Required fields are marked with asterisks (*).
13. Click on the Finish button.

To deploy a lifecycle module, see "Deploying a Lifecycle Module" on page 111.

Deployment by Module or Application

You can deploy applications or individual modules that are independent of applications. The runtime and file system implications of application-based or individual module-based deployment are described in "Runtime Environments" on page 83.

Individual module-based deployment is preferable when components need to be accessed by:

- Other modules
- J2EE Applications
- ACC clients (Module-based deployment allows shared access to a bean from an ACC client, a servlet, or an EJB component.)

Modules can be combined into an EAR file and then deployed as a single module. This is similar to deploying the modules of the EAR independently.

Deploying a WAR Module

You deploy a WAR module as described in "Tools for Deployment" on page 106.

You can precompile JSPs during deployment by checking the appropriate box in the Administration Console or by using the `--precompilejsp` option of the `asadmin deploy` or `asadmin deploydir` command. The `sun-appserv-deploy` and `sun-appserv-jspc` Ant tasks also allow you to precompile JSPs.

You can keep the generated source for JSPs by adding the `-keepgenerated` flag to the `jsp-config` element in `sun-web.xml`. If you include this property when you deploy the WAR module, the generated source is kept in *domain_dir*`/generated/jsp/j2ee-apps/`*app_name*`/`*module_name* if it is in an application or *domain_dir*`/generated/jsp/j2ee-modules/`*module_name* if it is in an individually deployed web module.

For more information about JSP precompilation, see "Compiling JSPs: The Command-Line Compiler" on page 280. For more information about the `-keepgenerated` property, see "JSP Elements" on page 178.

Deploying an EJB JAR Module

You deploy an EJB JAR module as described in "Tools for Deployment" on page 106.

You can keep the generated source for stubs and ties by adding the `-keepgenerated` flag to the `rmic-options` attribute of the `java-config` element in `domain.xml`. If you include this flag when you deploy the EJB JAR module, the generated source is kept in *domain_dir*`/generated/ejb/j2ee-apps/`*app_name*`/`*module_name* if it is in an application or *domain_dir*`/generated/ejb/j2ee-modules/`*module_name* if it is in an individually deployed EJB JAR module. For more information about the `-keepgenerated` flag, see the *Sun Java System Application Server Reference*.

Generation of stubs and ties is performed asynchronously, so unless you request their generation during deployment (for example, using the `--retrieve` option of the `asadmin deploy` command), stubs and ties are not guaranteed to be available immediately after deployment. You can use the `asadmin get-client-stubs` command to retrieve the stubs and ties whether or not you requested their generation during deployment. The syntax is as follows:

```
asadmin get-client-stubs --user user --appname app_name local_dirpath
```

Deploying a Lifecycle Module

For general information about lifecycle modules, see Chapter 10, "Developing Lifecycle Listeners."

You can deploy a lifecycle module using the following tools:

- The asadmin Command
- The Administration Console

The asadmin Command

To deploy a lifecycle module, use the `asadmin create-lifecycle-module` command. The syntax is as follows, with defaults shown for optional parameters that have them:

```
asadmin create-lifecycle-module --user user --classname classname [--classpath
classpath] [--loadorder load_order_number] [--failurefatal=false]
[--enabled=true] [--description text_description] [--property
(name=value)[:name=value]*] modulename
```

For more information about the optional general `asadmin` parameters (`--password`, `--passwordfile`, `--host`, `--port`, `--secure`, `--terse`, `--echo`, and `--interactive`), see the *Sun Java System Application Server Administration Guide*.

For example:

```
asadmin create-lifecycle-module --user joeuser --classname RMIServer
MyRMIServer
```

To undeploy a lifecycle module, use the `asadmin delete-lifecycle-module` command. The syntax is as follows, with defaults shown for optional parameters that have them:

```
asadmin delete-lifecycle-module --user user module_name
```

For example:

```
asadmin delete-lifecycle-module --user joeuser MyRMIServer
```

To list the lifecycle modules that are deployed, use the `asadmin list-lifecycle-modules` command. The syntax is as follows, with defaults shown for optional parameters that have them:

```
asadmin list-lifecycle-modules --user user
```

For example:

```
asadmin list-lifecycle-module --user joeuser
```

The Administration Console

You can also use the Administration Console to deploy a lifecycle module. Follow these steps:

1. Login to the Administration Console by going to the following URL in your web browser:

   `http://`*host*`:`*port*`/asadmin`

   For example:

   `http://localhost:4848/asadmin`

2. Open the Applications component.
3. Go to the Lifecycle Modules page.
4. Click on the New button.
5. Enter the following information:
   - Name (required) - The name of the lifecycle module.
   - Class Name (required) - The fully qualified name of the lifecycle module’s class file.
   - Classpath (optional) - The classpath for the lifecycle module. Specifies where the module is located. The default location is under the application root directory.

- Load Order (optional) - Determines the order in which lifecycle modules are loaded at startup. Modules with smaller integer values are loaded sooner. Values can range from `101` to the operating system's `MAXINT`. Values from `1` to `100` are reserved.
- On Load Failure Prevent Server Startup (optional) - Determines whether the server is shut down if the lifecycle module fails. The default is `false`.
- Status Enabled (optional) - Determines whether the lifecycle module is enabled. The default is `true`.
- Description (optional) - A text description of the lifecycle module.

6. Click on the OK button.

Deploying an Application Client

Deployment is only necessary for application clients that communicate with EJB components. To deploy an application client:

1. Assemble the necessary client files (as described in "Assembling an ACC Client" on page 100).
2. Assemble the EJB components to be accessed by the client.
3. Package the client and EJB components together in an application.
4. Deploy the application as described in "Tools for Deployment" on page 106. You can use the `--retrieve` option to get the client JAR file.

   You can also use the `asadmin get-client-stubs` command to retrieve the stubs and ties whether or not you requested their generation during deployment. The syntax is as follows:

   `asadmin get-client-stubs --user` *user* `--appname` *app_name local_dirpath*
5. The client JAR contains the ties and necessary classes for the ACC client. Copy this file to the client machine, and set the APPCPATH environment variable on the client to point to this JAR.

If you wish to execute the client on the Sun Java System Application Server machine to test it, you can use the `appclient` script in the *install_dir*`/bin` directory. The only required option is `-client`. For example:

```
appclient -client converterClient.jar
```

The `-xml` parameter specifies the location of the `sun-acc.xml` file.

Before you can execute an ACC client on a different machine, you must prepare the client machine:

1. You can use the `package-appclient` script in the *install_dir*`/bin` directory to create the ACC package JAR file. This is optional. This JAR file is created in the *install_dir*`/lib/appclient` directory.
2. Copy the ACC package JAR file to the client machine and unjar it.
3. Configure the `sun-acc.xml` file, located in the `appclient/appserv/lib/appclient` directory by default if you used the `package-appclient` script.
4. Configure the `asenv.conf` (`asenv.bat` on Windows) file, located in `appclient/appserv/bin` by default if you used the `package-appclient` script.
5. Copy the client JAR file to the client machine. You are now ready to execute the client.

For more detailed information about the `appclient` and `package-appclient` scripts, see Chapter 9, "Developing Java Clients."

Deploying a J2EE CA Resource Adapter

You deploy a connector module as described in "Tools for Deployment" on page 106. After deploying the module, you must configure it as described in the following document:

`http://developers.sun.com/prodtech/appserver/reference/techart/as8_connectors`

Access to Shared Frameworks

When J2EE applications and modules use shared framework classes (such as utility classes and libraries) the classes can be put in the path for the System Classloader or the Common Classloader rather than in an application or module. If you assemble a large, shared library into every module that uses it, the result is a huge file that takes too long to register with the server. In addition, several versions of the same class could exist in different classloaders, which is a waste of resources. For more information, see "Circumventing Classloader Isolation" on page 89.

Apache Ant Assembly and Deployment Tool

You can use the automated assembly features available through Ant, a Java-based build tool available through the Apache Software Foundation:

http://ant.apache.org/

Ant is a Java-based build tool that is extended using Java classes. Instead of using shell commands, you declare the assembly steps using an XML document. Each task is run by an object that implements a particular task interface.

Apache Ant 1.5.4 is provided with Sun Java System Application Server. The sample applications provided with Sun Java System Application Server have Ant `build.xml` files; see "Sample Applications" on page 33.

Make sure you have done these things before using Ant:

- Include *install_dir*/`bin` in the PATH environment variable. The Ant script provided with Sun Java System Application Server, `asant`, is located in this directory. For details on how to use `asant`, see the sample applications documentation in the *install_dir*/`samples/docs/ant.html` file.
    - ❍ If you are executing platform-specific applications, such as the `exec` or `cvs` task, the ANT_HOME environment variable must be set to the Ant installation directory.The ANT_HOME environment variable for all platforms is *install_dir*/`lib`.

This section covers the following Ant-related topics:

- Ant Tasks for Sun Java System Application Server 8
- Reusable Subelements

For information about standard Ant tasks, see the Ant documentation:

http://computing.ee.ethz.ch/sepp/ant-1.5.4-ke/manual/index.html

Ant Tasks for Sun Java System Application Server 8

Use the Ant tasks provided by Sun Java System Application Server for assembling, deploying, and undeploying modules and applications, and for configuring the server. The tasks are as follows:

- sun-appserv-deploy
- sun-appserv-undeploy

- sun-appserv-component
- sun-appserv-admin
- sun-appserv-jspc
- sun-appserv-update

sun-appserv-deploy

Deploys any of the following.

- Enterprise application (EAR file)
- Web application (WAR file)
- Enterprise Java Bean (EJB-JAR file)
- Enterprise connector (RAR file)
- Application client

Subelements

The following table describes subelements for the `sun-appserv-deploy` task. These are objects upon which this task acts.

Table 3-5 `sun-appserv-deploy` Subelements

Element	Description
`component`	A component to be deployed.
`fileset`	A set of component files that match specified parameters.

Attributes

The following table describes attributes for the `sun-appserv-deploy` task.

Table 3-6 `sun-appserv-deploy` Attributes

Attribute	Default	Description
`file`	none	(optional if a `component` or `fileset` subelement is present, otherwise required) The component to deploy. If this attribute refers to a file, it must be a valid archive. If this attribute refers to a directory, it must contain a valid archive in which all components have been exploded. If `upload` is set to `false`, this must be an absolute path on the server machine.

Table 3-6 sun-appserv-deploy Attributes *(Continued)*

Attribute	Default	Description
name	file name without extension	(optional) The display name for the component being deployed.
type	determined from the file or directory name extension	(optional) The type of component being deployed. Valid types are application, ejb, web, and connector. If not specified, the file (or directory) extension is used to determine the component type: .ear for applicaton, .jar for ejb, .war for web, and .rar for connector. If it's not possible to determine the component type using the file extension, the default is application.
force	true	(optional) If true, the component is overwritten if it already exists on the server. If false, sun-appserv-deploy fails if the component exists.
retrievestubs	client stubs not saved	(optional) The directory where client stubs are saved. This attribute is inherited by nested component elements.
precompilejsp	false	(optional) If true, all JSPs found in an enterprise application (.ear) or web application (.war) are precompiled. This attribute is ignored for other component types. This attribute is inherited by nested component elements.
verify	false	(optional) If true, syntax and semantics for all deployment descriptors are automatically verified for correctness. This attribute is inherited by nested component elements.
contextroot	file name without extension	(optional) The context root for a web module (WAR file). This attribute is ignored if the component is not a WAR file.
upload	true	(optional) If true, the component is transferred to the server for deployment. If the component is being deployed on the local machine, set upload to false to reduce deployment time. If a directory is specified for deployment, upload must be false.
virtualservers	default virtual server only	(optional) A comma-separated list of virtual servers to be deployment targets. This attribute applies only to application (.ear) or web (.war) components and is ignored for other component types.
user	admin	(optional) The user name used when logging into the application server.
password	none	The password used when logging into the application server.

Table 3-6 sun-appserv-deploy Attributes *(Continued)*

Attribute	Default	Description
host	localhost	(optional) Target server. When deploying to a remote server, use the fully qualified host name.
port	4848	(optional) The administration port on the target server.
sunonehome	see description	(optional) The installation directory for the local Sun Java System Application Server 8 installation, which is used to find the administrative classes. If not specified, the command checks to see if the sunone.home parameter has been set. Otherwise, administrative classes must be in the system classpath.

Examples

Here is a simple application deployment script with many implied attributes:

```
<sun-appserv-deploy
    file="${assemble}/simpleapp.ear"
    password="${password}" />
```

Here is an equivalent script showing all the implied attributes:

```
<sun-appserv-deploy
    file="${assemble}/simpleapp.ear"
    name="simpleapp"
    type="application"
    force="true"
    precompilejsp="false"
    verify="false"
    upload="true"
    user="admin"
    password="${password}"
    host="localhost"
    port="4848"
    sunonehome="${sunone.home}" />
```

This example deploys multiple components to the same Sun Java System Application Server running on a remote server:

```
<sun-appserv-deploy password="${password}" host="greg.sun.com"
           sunonehome="/opt/sun" >
   <component file="${assemble}/simpleapp.ear"/>
   <component file="${assemble}/simpleservlet.war"
      contextroot="test"/>
   <component file="${assemble}/simplebean.jar"/>
</sun-appserv-deploy>
```

This example deploys the same components as the previous example because the three components match the `fileset` criteria, but note that it's not possible to set some component-specific attributes. All component-specific attributes (`name`, `type`, and `contextroot`) use their default values.

```
<sun-appserv-deploy password="${password}" host="greg.sun.com"
           sunonehome="/opt/sun" >
   <fileset dir="${assemble}" includes="**/*.?ar" />
</sun-appserv-deploy>
```

sun-appserv-undeploy

Undeploys any of the following.

- Enterprise application (EAR file)
- Web application (WAR file)
- Enterprise Java Bean (EJB-JAR file)
- Enterprise connector (RAR file)
- Application client

Subelements

The following table describes subelements for the `sun-appserv-undeploy` task. These are objects upon which this task acts.

Table 3-7 `sun-appserv-undeploy` Subelements

Element	Description
`component`	A component to be deployed.
`fileset`	A set of component files that match specified parameters.

Attributes

The following table describes attributes for the `sun-appserv-undeploy` task.

Table 3-8 `sun-appserv-undeploy` Attributes

Attribute	Default	Description
`name`	file name without extension	(optional if a `component` or `fileset` subelement is present or the `file` attribute is specified, otherwise required) The display name for the component being undeployed.
`file`	none	(optional) The component to undeploy. If this attribute refers to a file, it must be a valid archive. If this attribute refers to a directory, it must contain a valid archive in which all components have been exploded.
`type`	determined from the file or directory name extension	(optional) The type of component being undeployed. Valid types are `application`, `ejb`, `web`, and `connector`. If not specified, the file (or directory) extension is used to determine the component type: `.ear` for `applicaton`, `.jar` for `ejb`, `.war` for `web`, and `.rar` for `connector`. If it's not possible to determine the component type using the file extension, the default is `application`.
`user`	`admin`	(optional) The user name used when logging into the application server.
`password`	none	The password used when logging into the application server.
`host`	`localhost`	(optional) Target server. When deploying to a remote server, use the fully qualified host name.
`port`	4848	(optional) The administration port on the target server.
`sunonehome`	see description	(optional) The installation directory for the local Sun Java System Application Server 8 installation, which is used to find the administrative classes. If not specified, the command checks to see if the `sunone.home` parameter has been set. Otherwise, the administrative classes must be in the system classpath.

Examples

Here is a simple application undeployment script with many implied attributes:

```
<sun-appserv-undeploy name="simpleapp" password="${password}" />
```

Here is an equivalent script showing all the implied attributes:

```
<sun-appserv-undeploy
   name="simpleapp"
   type="application"
   user="admin"
```

```
    password="${password}"
    host="localhost"
    port="4848"
    sunonehome="${sunone.home}" />
```

This example demonstrates using the archive files (EAR and WAR, in this case) for the undeployment, using the component name and type (for undeploying the EJB component in this example), and undeploying multiple components.

```
<sun-appserv-undeploy password="${password}">
    <component file="${assemble}/simpleapp.ear"/>
    <component file="${assemble}/simpleservlet.war"/>
    <component name="simplebean" type="ejb"/>
</sun-appserv-undeploy>
```

sun-appserv-component

Enables or disables the following J2EE component types that have been deployed to Sun Java System Application Server 8.

- Enterprise application (EAR file)
- Web application (WAR file)
- Enterprise Java Bean (EJB-JAR file)
- Enterprise connector (RAR file)
- Application client

You don’t need to specify the archive to enable or disable a component: only the component name is required. You can use the component archive, however, because it implies the component name.

Subelements

The following table describes subelements for the `sun-appserv-component` task. These are objects upon which this task acts.

Table 3-9 `sun-appserv-component` Subelements

Element	Description
`component`	A component to be deployed.
`fileset`	A set of component files that match specified parameters.

Attributes

The following table describes attributes for the `sun-appserv-component` task.

Table 3-10 `sun-appserv-component` Attributes

Attribute	Default	Description
`action`	none	The control command for the target application server. Valid values are `enable` and `disable`.
`name`	file name without extension	(optional if a `component` or `fileset` subelement is present or the `file` attribute is specified, otherwise required) The display name for the component being enabled or disabled.
`file`	none	(optional) The component to enable or disable. If this attribute refers to a file, it must be a valid archive. If this attribute refers to a directory, it must contain a valid archive in which all components have been exploded.
`type`	determined from the file or directory name extension	(optional) The type of component being enabled or disabled. Valid types are `application`, `ejb`, web, and `connector`. If not specified, the file (or directory) extension is used to determine the component type: `.ear` for `applicaton`, `.jar` for `ejb`, `.war` for web, and `.rar` for `connector`. If it's not possible to determine the component type using the file extension, the default is `application`.
`user`	`admin`	(optional) The user name used when logging into the application server.
`password`	none	The password used when logging into the application server.
`host`	`localhost`	(optional) Target server. When enabling or disabling a remote server, use the fully qualified host name.
`port`	`4848`	(optional) The administration port on the target server.
`sunonehome`	see description	(optional) The installation directory for the local Sun Java System Application Server 8 installation, which is used to find the administrative classes. If not specified, the command checks to see if the `sunone.home` parameter has been set. Otherwise, the administrative classes must be in the system classpath.

Examples

Here is a simple example of disabling a component:

```
<sun-appserv-component
    action="disable"
    name="simpleapp"
    password="${password}" />
```

Here is a simple example of enabling a component:

```
<sun-appserv-component
    action="enable"
    name="simpleapp"
    password="${password}" />
```

Here is an equivalent script showing all the implied attributes:

```
<sun-appserv-component
    action="enable"
    name="simpleapp"
    type="application"
    user="admin"
    password="${password}"
    host="localhost"
    port="4848"
    sunonehome="${sunone.home}" />
```

This example demonstrates disabling multiple components using the archive files (EAR and WAR, in this case) and using the component name and type (for an EJB component in this example).

```
<sun-appserv-component action="disable" password="${password}">
    <component file="${assemble}/simpleapp.ear"/>
    <component file="${assemble}/simpleservlet.war"/>
    <component name="simplebean" type="ejb"/>
</sun-appserv-component>
```

sun-appserv-admin

Enables arbitrary administrative commands and scripts to be executed on the Sun Java System Application Server 8. This is useful for cases where a specific Ant task hasn’t been developed or a set of related commands are in a single script.

Subelements

none

Attributes

The following table describes attributes for the `sun-appserv-admin` task.

Table 3-11 sun-appserv-admin Attributes

Attribute	Default	Description
command	none	(exactly one of these is required: command, commandfile, or explicitcommand) The command to execute. If the user, password, host, or port attributes are also specified, they are automatically inserted into the command before execution. If any of these options are specified in the command string, the corresponding attribute values are ignored.
commandfile	none	(exactly one of these is required: command, commandfile, or explicitcommand) The command script to execute. If commandfile is used, the values of all other attributes are ignored. Be sure to end the script referenced by commandfile with the exit command; if you omit exit, the Ant task may appear to hang after the command script is called.
explicitcommand	none	(exactly one of these is required: command, commandfile, or explicitcommand) The exact command to execute. No command processing is done, and all other attributes are ignored.
user	admin	(optional) The user name used when logging into the application server.
password	none	(optional) The password used when logging into the application server.
host	localhost	(optional) Target server. If it is a remote server, use the fully qualified host name.
port	4848	(optional) The administration port on the target server.
sunonehome	see description	(optional) The installation directory for the local Sun Java System Application Server 8 installation, which is used to find the administrative classes. If not specified, the command checks to see if the sunone.home parameter has been set. Otherwise, the administrative classes must be in the system classpath.

sun-appserv-jspc

Precompiles JSP source code into Sun Java System Application Server compatible Java code for initial invocation by Sun Java System Application Server. Use this task to speed up access to JSP pages or to check the syntax of JSP source code. You can feed the resulting Java code to the `javac` task to generate class files for the JSPs.

Subelements

none

Attributes

The following table describes attributes for the `sun-appserv-jspc` task.

Table 3-12 `sun-appserv-jspc` Attributes

Attribute	Default	Description
`destdir`		The destination directory for the generated Java source files.
`srcdir`		(exactly one of these is required: `srcdir` or `webapp`) The source directory where the JSP files are located.
`webapp`		(exactly one of these is required: `srcdir` or `webapp`) The directory containing the web application. All JSP pages within the directory are recursively parsed. The base directory must have a `WEB-INF` subdirectory beneath it. When `webapp` is used, `sun-appserv-jspc` hands off all dependency checking to the compiler.
`verbose`	`2`	(optional) The verbosity integer to be passed to the compiler.
`classpath`		(optional) The classpath for running the JSP compiler.
`classpathref`		(optional) A reference to the JSP compiler classpath.
`uribase`	`/`	(optional) The URI context of relative URI references in the JSP pages. If this context does not exist, it is derived from the location of the JSP file relative to the declared or derived value of `uriroot`. Only pages translated from an explicitly declared JSP file are affected.
`uriroot`	see description	(optional) The root directory of the web application, against which URI files are resolved. If this directory is not specified, the first JSP page is used to derive it: each parent directory of the first JSP page is searched for a `WEB-INF` directory, and the directory closest to the JSP page that has one is used. If no `WEB-INF` directory is found, the directory `sun-appserv-jspc` was called from is used. Only pages translated from an explicitly declared JSP file (including tag libraries) are affected.

Table 3-12 `sun-appserv-jspc` Attributes *(Continued)*

Attribute	Default	Description
`package`		(optional) The destination package for the generated Java classes.
`failonerror`	`true`	(optional) If `true`, JSP compilation fails if errors are encountered.
`sunonehome`	see description	(optional) The installation directory for the local Sun Java System Application Server 8 installation, which is used to find the administrative classes. If not specified, the command checks to see if the `sunone.home` parameter has been set. Otherwise, the administrative classes must be in the system classpath.

Example

The following example uses the `webapp` attribute to generate Java source files from JSP files. The `sun-appserv-jspc` task is immediately followed by a `javac` task, which compiles the generated Java files into class files. The `classpath` value in the `javac` task must be all on one line with no spaces.

```
<sun-appserv-jspc
   destdir="${assemble.war}/generated"
   webapp="${assemble.war}"
   classpath="${assemble.war}/WEB-INF/classes"
   sunonehome="${sunone.home}" />
<javac
   srcdir="${assemble.war}/WEB-INF/generated"
   destdir="${assemble.war}/WEB-INF/generated"
   debug="on"
   classpath="${assemble.war}/WEB-INF/classes:${sunone.home}/lib/
      appserv-rt.jar:${sunone.home}/lib/appserv-ext.jar">
   <include name="**/*.java"/>
</javac>
```

sun-appserv-update

Enables deployed applications (EAR files) and modules (EJB JAR, RAR, and WAR files) to be updated and reloaded for fast iterative development. This task copies modified class files, XML files, and other contents of the archive files to the appropriate subdirectory of the *domain_dir*/`applications` directory, then touches the `.reload` file to cause dynamic reloading to occur.

This is a local task and must be executed on the same machine as the application server.

Subelements

none

Attributes

The following table describes attributes for the `sun-appserv-update` task.

Table 3-13 `sun-appserv-update` Attributes

Attribute	Default	Description
`file`	none	The component to update, which must be a valid archive.
`domain`	`domain1`	(optional) The domain in which the application has been previously deployed.

Example

The following example updates the J2EE application `foo.ear`, which is deployed to the default domain, `domain1`.

```
<sun-appserv-update file="foo.ear"/>
```

Reusable Subelements

Reusable subelements of the Ant tasks for Sun Java System Application Server 8 are as follows. These are objects upon which the Ant tasks act.

- component
- fileset

component

Specifies a J2EE component. Allows a single task to act on multiple components. The `component` attributes override corresponding attributes in the parent task; therefore, the parent task attributes function as default values.

Subelements

none

Attributes

The following table describes attributes for the `component` element.

Table 3-14 `component` Attributes

Attribute	Default	Description
`file`	none	(optional if the parent task is `sun-appserv-undeploy` or `sun-appserv-component`) The target component. If this attribute refers to a file, it must be a valid archive. If this attribute refers to a directory, it must contain a valid archive in which all components have been exploded. If `upload` is set to `false`, this must be an absolute path on the server machine.
`name`	file name without extension	(optional) The display name for the component.
`type`	determined from the file or directory name extension	(optional) The type of component. Valid types are `application`, `ejb`, `web`, and `connector`. If not specified, the file (or directory) extension is used to determine the component type: `.ear` for `applicaton`, `.jar` for `ejb`, `.war` for `web`, and `.rar` for `connector`. If it's not possible to determine the component type using the file extension, the default is `application`.
`force`	`true`	(applies to `sun-appserv-deploy` only, optional) If `true`, the component is overwritten if it already exists on the server. If `false`, the containing element's operation fails if the component exists.
`precompilejsp`	`false`	(applies to `sun-appserv-deploy` only, optional) If `true`, all JSPs found in an enterprise application (`.ear`) or web application (`.war`) are precompiled. This attribute is ignored for other component types.
`retrievestubs`	client stubs not saved	(applies to `sun-appserv-deploy` only, optional) The directory where client stubs are saved.
`contextroot`	file name without extension	(applies to `sun-appserv-deploy` only, optional) The context root for a web module (WAR file). This attribute is ignored if the component is not a WAR file.
`verify`	`false`	(applies to `sun-appserv-deploy` only, optional) If `true`, syntax and semantics for all deployment descriptors is automatically verified for correctness.

Examples

You can deploy multiple components using a single task. This example deploys each component to the same Sun Java System Application Server running on a remote server.

```
<sun-appserv-deploy password="${password}" host="greg.sun.com"
       sunonehome="/opt/s1as8" >
    <component file="${assemble}/simpleapp.ear"/>
    <component file="${assemble}/simpleservlet.war"
       contextroot="test"/>
    <component file="${assemble}/simplebean.jar"/>
</sun-appserv-deploy>
```

You can also undeploy multiple components using a single task. This example demonstrates using the archive files (EAR and WAR, in this case) and the component name and type (for the EJB component).

```
<sun-appserv-undeploy password="${password}">
    <component file="${assemble}/simpleapp.ear"/
    <component file="${assemble}/simpleservlet.war"/>
    <component name="simplebean" type="ejb"/>
</sun-appserv-undeploy>
```

You can enable or disable multiple components. This example demonstrates disabling multiple components using the archive files (EAR and WAR, in this case) and the component name and type (for the EJB component).

```
<sun-appserv-component action="disable" password="${password}">
    <component file="${assemble}/simpleapp.ear"/>
    <component file="${assemble}/simpleservlet.war"/>
    <component name="simplebean" type="ejb"/>
</sun-appserv-component>
```

fileset

Selects component files that match specified parameters. When `fileset` is included as a subelement, the `name` and `contextroot` attributes of the containing element must use their default values for each file in the `fileset`. For more information, see:

http://computing.ee.ethz.ch/sepp/ant-1.5.4-ke/manual/CoreTypes/fileset.html

Chapter 4

Debugging J2EE Applications

This chapter gives guidelines for debugging applications in Sun Java System Application Server. It includes the following sections:

- Enabling Debugging
- JPDA Options
- Generating a Stack Trace for Debugging
- The Java Debugger
- Using the Sun ONE Studio IDE for Debugging
- Using the NetBeans IDE for Debugging
- Using the JBuilder IDE for Debugging
- Sun Java System Message Queue Debugging
- Enabling Verbose Mode
- Logging
- Profiling

The `domain.xml` file described in this chapter is located at *domain_dir*`/config/domain.xml`. For more information about this file, see the *Sun Java System Application Server Reference*.

Enabling Debugging

When you enable debugging, you enable both local and remote debugging. To start the server in debug mode, use the `--debug` option as follows:

```
asadmin start-domain --debug [domain_name]
```

You can then attach to the server from the debugger at its default JPDA port, which is 1044. For example, for UNIX systems:

```
jdb -attach 1044
```

For Windows:

```
jdb -connect com.sun.jdi.SocketAttach:port=1044
```

You can enable debugging even when the application server is started without the `--debug` option. This is useful if you start the application server from the Windows Start Menu or if you want to make sure that debugging is always turned on. You can set the server to automatically start up in debug mode in one of these ways:

- Using the Administration Console
- Editing the domain.xml File

Sun Java System Application Server debugging is based on the JPDA (Java Platform Debugger Architecture). For more information, see "JPDA Options" on page 133.

Using the Administration Console

To enable debugging for each server restart:

1. Login to the Administration Console by going to the following URL in your web browser:

   `http://`*host*`:`*port*`/asadmin`

   For example:

   ```
   http://localhost:4848/asadmin
   ```

2. Go to the Application Server page.
3. Select the JVM Settings tab and the General option.
4. Check the Debug Enabled box.
5. To specify a different port (from 1044, the default) to use when attaching the JVM to a debugger, specify `address=`*port_number* in the Debug Options field.
6. If you wish to add JPDA options, add any desired JPDA debugging options in Debug Options. See "JPDA Options" on page 133.
7. Select the Save button.

Editing the domain.xml File

To enable debugging for each server restart, set the following attributes of the `java-config` element in the `domain.xml` file:

- Set `debug-enabled="true"` to turn on debugging.
- To specify a different port (from 1044, the default) to use when attaching the JVM to a debugger, specify `address=`*port_number* in the `debug-options` attribute.
- Add any desired JPDA debugging options in the `debug-options` attribute. See "JPDA Options" on page 133.

For details about the `domain.xml` file, see the *Sun Java System Application Server Reference*.

JPDA Options

The default JPDA options in Sun Java System Application Server are as follows:

```
-Xdebug -Xrunjdwp:transport=dt_socket,server=y,suspend=n,address=1044
```

For Windows, you must change `dt_socket` to `dt_shmem`.

If you substitute `suspend=y`, the JVM starts in suspended mode and stays suspended until a debugger attaches to it. This is helpful if you want to start debugging as soon as the JVM starts.

To specify a different port (from 1044, the default) to use when attaching the JVM to a debugger, specify `address=`*port_number*.

You can include additional options. A list of JPDA debugging options is available here:

`http://java.sun.com/products/jpda/doc/conninv.html#Invocation`

Generating a Stack Trace for Debugging

You can generate a Java stack trace for debugging as described here if the Sun Java System Application Server is in verbose mode (see "Enabling Verbose Mode" on page 138):

`http://developer.java.sun.com/developer/technicalArticles/Programming/Stacktrace/`

The stack trace goes to the *domain_dir*`/logs/server.log` file and also appears on the command prompt screen.

If the `-Xrs` flag is set (for reduced signal usage) in the `domain.xml` file (under `<jvm-options>`), comment it out before generating the stack trace. If the `-Xrs` flag is used, the server may simply dump core and restart when you send the signal to generate the trace. For more about the `domain.xml` file, see the *Sun Java System Application Server Reference*.

The Java Debugger

The Java Debugger (`jdb`) helps you find and fix bugs in Java language programs. When using the `jdb` debugger with Sun Java System Application Server, you must attach to the server from the debugger at its default JPDA port, which is 1044. For example, for UNIX systems:

```
jdb -attach 1044
```

For Windows:

```
jdb -connect com.sun.jdi.SocketAttach:port=1044
```

For more information about the `jdb` debugger, see the following links:

`http://java.sun.com/products/jpda/doc/soljdb.html`

`http://java.sun.com/products/jpda/doc/conninv.html#JDB`

`http://java.sun.com/products/jdk/1.2/debugging/JDBTutorial.html`

Using the Sun ONE Studio IDE for Debugging

To use the Sun ONE Studio 5 debugger with Sun Java System Application Server:

1. Start Sun ONE Studio, and mount the directory that contains the application source code you want to debug.
2. Select the Debug menu and the Attach... option.
3. Change the Connector:text field to SocketAttach.
4. Type the host name of the Application Server in the Host text box.
5. Type the port number you specified when you enabled debugging in the Sun Java System Application Server in the Port text box (the default is 1044), then select OK.

You should be able to debug your Java classes now using Sun ONE Studio.

For help on debugging applications with Sun ONE Studio, select Help, select Contents, then select Debugging Java Programs. You can also consult the Sun ONE Studio documentation.

Using the NetBeans IDE for Debugging

To use the NetBeans 3.5.1 IDE with the Sun Java System Application Server:

1. Download the latest version of NetBeans from `www.netbeans.org`.
2. Set up the classpath in NetBeans to compile J2EE applications using the standard J2EE 1.4 API libraries provided with the Sun Java System Application Server. Perform the following steps in the NetBeans IDE:

   a. In the Menu bar, click on the File menu and select Mount Filesystem.

   b. In the wizard dialog box, select Archive Files as the Filesystem type and click Next.

   c. Navigate the file chooser to the Sun Java System Application Server directory *install_dir*`/lib`.

   d. Select `j2ee.jar`. If you plan to use Sun-specific public APIs provided in the Sun Java System Application Server, you should also select the `appserv-ext.jar` archive. Click Finish.

   The `j2ee.jar` file should appear in the list of mounted file systems under the Editing pane inside the Filesystems tab of the NetBeans IDE. You can now import J2EE 1.4 API packages in your source files and compile the source files.

3. Build your application in the NetBeans IDE.
4. Assemble your application into a J2EE archive file (WAR, JAR, RAR or EAR file) and deploy it to the Sun Java System Application Server.
5. Start the Sun Java System Application Server with debugging enabled. See "Enabling Debugging" on page 131.
6. Attach to the Sun Java System Application Server using the Netbeans IDE debugger:

   a. Click on the Debug menu, select Start Session, then select Attach.

   b. In the Attach dialog box, make sure the host (default `localhost`) and port (default `1044`) correspond to the host and JPDA debug port of the Sun Java System Application Server. Click OK.

The Output Window of the Debugger Console should display the message `Connection established`.

7. Set break points in your source file in the NetBeans IDE as usual, and run the application.
8. When finished with debugging, detach from the server by clicking Finish in the Debug menu.

Using the JBuilder IDE for Debugging

To use the JBuilder X Developer or JBuilder X Enterprise debugger with the Sun Java System Application Server:

1. Start JBuilder X.
2. If you are using JBuilder X Developer, create a library that holds the J2EE interfaces. This step is not necessary if you are using JBuilder X Enterprise.
   a. Select the Configure Libraries item from the Tools menu. This opens the Configure Libraries dialog box.
   b. Press the New button. This opens the New Library Wizard.
   c. Enter a library name and location.
   d. Press the Add button. This opens a file/directory chooser dialog box.
   e. Navigate through the chooser to select *install_dir*`/lib/j2ee.jar`.
   f. If you plan to use Sun-specific public APIs provided with the Sun Java System Application Server, you should also include the *install_dir*`/lib/appserv-ext.jar` archive in this library.
   g. Press OK to accept the selection and dismiss the chooser.
   h. Press OK to accept and dismiss the New Library Wizard.
   i. Press OK to accept and dismiss the Configure Libraries dialog box.
3. Create a project for the application source code.
4. Add the library created in Step 2 to the project created in Step 3.
   a. Select the Project Properties item from the Project menu. This opens the Project Properties dialog box.
   b. Select the Paths node in the tree on the left side of the dialog box.

   c. Select the Required libraries tab that appears on right side of the dialog box.

   d. Press the Add button. This opens a tree chooser dialog box. The library that was created in Step 2 should appear in the list of libraries.

   e. Select the library created in Step 2.

   f. Press OK to accept the selection and dismiss this dialog box.

   g. Press OK to accept and dismiss the Project Properties dialog box.

5. Open the project created in Step 3.

6. Select the Configurations item from the Run menu. This opens the Runtime Configurations dialog box.

7. Use the New button to create a runtime configuration to be used for debugging your application code. This opens the New Runtime Configuration dialog box.

8. Give the configuration a unique name.

9. Expand the Debug node in the tree on the left side of the dialog box.

10. Select the Remote node.

11. Set Enable remote debugging to true.

12. Set the action to Attach.

13. In the Transport panel, make sure the address (default `localhost`) and port (default `1044`) correspond to the host and JPDA debug port of the Sun Java System Application Server. Select OK.

14. Assemble your application into a J2EE archive file (WAR, JAR, RAR or EAR file) and deploy it to the Sun Java System Application Server.

15. Start the Sun Java System Application Server with debugging enabled. See "Enabling Debugging" on page 131.

16. To use the remote debugging capabilities of the JBuilder X debugger by attaching to the running server process, press Shift+F9.

Sun Java System Message Queue Debugging

Sun Java System Message Queue has a broker logger, which can be useful for debugging JMS, including message-driven bean, applications. You can adjust the logger's verbosity, and you can send the logger output to the broker's console using the broker's `-tty` option. For more information, see the *Sun Java System Message Queue Administrator's Guide*.

Enabling Verbose Mode

If you want to see the server logs and messages printed to `System.out` or `System.err` on your command prompt screen, you can start the server in verbose mode. This makes it easy to do simple debugging using print statements, without having to view the `server.log` file every time.

When the server is in verbose mode, messages are logged to the client in addition to the log file. In addition, pressing Ctrl-C stops the server and pressing Ctrl-\ prints a thread dump. To start the server in verbose mode, use the `--verbose` option as follows:

```
asadmin start-domain --verbose [domain_name]
```

You can enable verbose mode even when the application server is started without the `--verbose` option. This is useful if you start the application server from the Windows Start Menu or if you want to make sure that verbose mode is always turned on. You can set the server to automatically start up in verbose mode in one of these ways:

- Using the Administration Console
- Editing the domain.xml File

Using the Administration Console

To enable verbose mode for each server restart:

1. Login to the Administration Console by going to the following URL in your web browser:

   ```
   http://host:port/asadmin
   ```

   For example:

   ```
   http://localhost:4848/asadmin
   ```

2. Go to the Application Server page.
3. Select the Logging tab and the General option.
4. Check the Log Messages to Standard Error box.
5. Select the Save button.

Editing the domain.xml File

To enable verbose mode for each server restart, set the attributes of the `log-service` element in the `domain.xml` file.

You can send exceptions to the client in addition to the log file. Set the following parameter in `domain.xml`. If the client is a browser, exceptions are displayed in the browser.

```
<log-service ... log-to-console=true ... />
```

For details about the `domain.xml` file, see the *Sun Java System Application Server Reference*.

Logging

You can use the Sun Java System Application Server's log files to help debug your applications. For general information about logging, see the *Sun Java System Application Server Administration Guide*. For information about configuring logging in the `domain.xml` file, see the *Sun Java System Application Server Reference*.

Profiling

You can use a profiler to perform remote profiling on the Sun Java System Application Server to discover bottlenecks in server-side performance. This section describes how to configure these profilers for use with Sun Java System Application Server:

- The HPROF Profiler
- The Optimizeit Profiler

The HPROF Profiler

HPROF is a simple profiler agent shipped with the Java 2 SDK. It is a dynamically linked library that interacts with the JVMPI and writes out profiling information either to a file or to a socket in ASCII or binary format.

HPROF can present CPU usage, heap allocation statistics, and monitor contention profiles. In addition, it can also report complete heap dumps and states of all the monitors and threads in the Java virtual machine. For more details on the HPROF profiler, see the JDK documentation at:

`http://java.sun.com/products/jpda/doc/soljdb.html`

Once HPROF is enabled using the following instructions, its libraries are loaded into the server process. To use HPROF profiling on UNIX, follow these steps:

1. Configure Sun Java System Application Server in one of these ways:
    - Use the Administration Console:
        I. Login to the Administration Console by going to the following URL in your web browser:

            `http://`*host*`:`*port*`/asadmin`

            For example:

            `http://localhost:4848/asadmin`

        II. Go to the Application Server page.

        III. Select the JVM Settings tab and the Profiler option.

        IV. Edit the following fields:

        - Profiler Name: `hprof`
        - Profiler Enabled: `true`
        - Classpath: (leave blank)
        - Native Library Path: (leave blank)
        - JVM Option: For each of these options, select Add, type the option in the Value field, then check its box:

            `-Xrunhprof:file=log.txt,`*options*

        V. Select the Save button.

- Edit the `domain.xml` file as appropriate:

  ```
  <!-- hprof options -->
  <profiler name="hprof" enabled="true">
      <jvm-options>
          -Xrunhprof:file=log.txt,options
      </jvm-options>
  </profiler>
  ```

NOTE Do not use the `-Xrs` flag.

Here is an example of *options* you can use:

```
-Xrunhprof:file=log.txt,thread=y,depth=3
```

The `file` option determines where the stack dump is written in Step 2.

The syntax of HPROF options is as follows:

```
-Xrunhprof[:help]|[:option=value,option2=value2, ...]
```

Using `help` lists options that can be passed to HPROF. The output is as follows:

```
Hprof usage: -Xrunhprof[:help]|[:<option>=<value>, ...]

Option Name and Value    Description             Default
---------------------    -----------             -------
heap=dump|sites|all      heap profiling          all
cpu=samples|old          CPU usage               off
format=a|b               ascii or binary output  a
file=<file>              write data to file      java.hprof
                                                 (.txt for ascii)
net=<host>:<port>        send data over a socket write to file
depth=<size>             stack trace depth       4
cutoff=<value>           output cutoff point     0.0001
lineno=y|n               line number in traces?  y
thread=y|n               thread in traces?       n
doe=y|n                  dump on exit?           y
```

2. Restart the Application Server. This writes an HPROF stack dump to the file you specified using the `file` HPROF option in Step 1.

The Optimizeit Profiler

You can purchase Optimizeit™ 4.2 from Intuitive Systems at:

`http://www.optimizeit.com/index.html`

Once Optimizeit is enabled using the following instructions, its libraries are loaded into the server process. To enable remote profiling with Optimizeit, do one of the following:

1. Configure your operating system:
   - On Solaris, add *Optimizeit_dir*`/lib` to the LD_LIBRARY_PATH environment variable.
   - On Windows, add *Optimizeit_dir*`/lib` to the PATH environment variable.
2. Configure Sun Java System Application Server in one of these ways:
   - Use the Administration Console:
     I. Login to the Administration Console by going to the following URL in your web browser:

        `http://`*host*`:`*port*`/asadmin`

        For example:

        `http://localhost:4848/asadmin`

     II. Go to the Application Server page.

     III. Select the JVM Settings tab and the Profiler option.

     IV. Edit the following fields:

     - Profiler Name: `optimizeit`
     - Profiler Enabled: `true`
     - Classpath: *Optimizeit_dir*`/lib/optit.jar`
     - Native Library Path: *Optimizeit_dir*`/lib`
     - JVM Option: For each of these options, select Add, type the option in the Value field, then check its box:

       ```
       -DOPTITHOME=Optimizeit_dir
       -Xrunpri
       -Xbootclasspath/Optimizeit_dir/lib/oibcp.jar
       ```

     V. Select the Save button.

- Edit the `domain.xml` file as appropriate:

```
<!-- Optimizeit options -->
<profiler name="optimizeit" classpath="Optimizeit_dir/lib/optit.jar"
       native-library-path="Optimizeit_dir/lib" enabled="true">
    <jvm-options>-DOPTIT_HOME=Optimizeit_dir</jvm-options>
    <jvm-options>-Xrunpri</jvm-options>
    <jvm-options>-Xbootclasspath/Optimizeit_dir/lib/oibcp.jar</jvm-options>
</profiler>
```

3. In addition, you may have to set the following in your `server.policy` file. For more information about the `server.policy` file, see “The server.policy File” on page 60.

```
grant codeBase "file:Optimizeit_dir/lib/optit.jar" {
    permission java.security.AllPermission;
};
```

4. Restart the Application Server.

When the server starts up with this configuration, you can attach the profiler. For further details, see the Optimizeit documentation.

NOTE If any of the configuration options are missing or incorrect, the profiler may experience problems that affect the performance of the Sun Java System Application Server.

Chapter 5

Deployment Descriptor Files

This chapter describes deployment descriptor files specific to Sun Java System Application Server in the following sections:

- Sun Java System Application Server Descriptors
- The sun-application.xml File
- The sun-web.xml File
- The sun-ejb-jar.xml File
- The sun-cmp-mappings.xml File
- The sun-application-client.xml file
- The sun-acc.xml File
- Web Service Elements

Sun Java System Application Server Descriptors

Sun Java System Application Server uses deployment descriptors in addition to the J2EE standard descriptors for configuring features specific to the Sun Java System Application Server. The `sun-application.xml` and `sun-web.xml` files are optional; all the others are required.

Each deployment descriptor (or XML) file has a corresponding schema (or DTD) file, which defines the elements, data, and attributes that the deployment descriptor file can contain. For example, the `sun-application_1_4-0.dtd` schema file defines the structure of the `sun-application.xml` file. All of the DTD files are located in the *install_dir*`/lib/dtds` directory.

NOTE Do not edit the DTD files; their contents change only with new versions of Sun Java System Application Server.

For general information about DTD files and XML, see the XML specification at:

http://www.w3.org/TR/REC-xml

The following table lists the Sun Java System Application Server deployment descriptors and their DTD schema files.

Table 5-1 Sun Java System Application Server Descriptors

Deployment Descriptor	DTD Schema File	Description
`sun-application.xml`	`sun-application_1_4-0.dtd`	Configures an entire J2EE application (EAR file).
`sun-web.xml`	`sun-web-app_2_4-0.dtd`	Configures a web application (WAR file).
`sun-ejb-jar.xml`	`sun-ejb-jar_2_1-0.dtd`	Configures an enterprise bean (EJB JAR file).
`sun-cmp-mappings.xml`	`sun-cmp-mapping_1_1.dtd`	Configures container-managed persistence for an enterprise bean.
`sun-application-client.xml`	`sun-application-client_1_4-0.dtd`	Configures an Application Client Container (ACC) client (JAR file).
`sun-acc.xml`	`sun-application-client-container_1_0.dtd`	Configures the Application Client Container.

NOTE The Sun Java System Application Server deployment descriptors must be readable and writable by the file owners.

In each deployment descriptor file, subelements must be defined in the order in which they are listed under each **Subelements** heading unless otherwise noted.

The sun-application.xml File

This section describes the XML elements in the sun-application.xml file and provides an example file in the following sections:

- sun-application
- web
- web-uri
- context-root
- pass-by-reference
- unique-id
- security-role-mapping
- role-name
- principal-name
- group-name
- realm
- Sample sun-application.xml File

sun-application

Defines Sun Java System Application Server specific configuration for an application. This is the root element; there can only be one sun-application element in a sun-application.xml file.

Subelements

The following table describes subelements for the sun-application element.

Table 5-2 sun-application Subelements

Element	Required	Description
web	zero or more	Specifies the application's web tier configuration.
pass-by-reference	zero or one	Determines whether EJB modules use pass-by-value or pass-by-reference semantics.
unique-id	zero or one	Contains the unique ID for the application.

Table 5-2 `sun-application` Subelements *(Continued)*

Element	Required	Description
`security-role-mapping`	zero or more	Maps a role in the corresponding J2EE XML file to a user or group.
`realm`	zero or one	Specifies an authentication realm.

web

Specifies the application's web tier configuration.

Subelements

The following table describes subelements for the `web` element.

Table 5-3 `web` Subelements

Element	Required	Description
`web-uri`	only one	Contains the web URI for the application.
`context-root`	only one	Contains the web context root for the application.

web-uri

Contains the web URI for the application. Must match the corresponding element in the `application.xml` file.

Subelements

none

context-root

Contains the web context root for the application. Overrides the corresponding element in the `application.xml` file.

If you are setting up load balancing, web module context roots must be unique within a cluster. See the *Sun Java System Application Server Administration Guide* for more information about load balancing.

Subelements

none

pass-by-reference

Specifies the passing method used by a servlet or enterprise bean calling a remote interface method in another bean that is co-located within the same process.

- If `false` (the default if this element is not present), this application uses pass-by-value semantics.
- If `true`, this application uses pass-by-reference semantics.

NOTE The `pass-by-reference` element only applies to remote calls. As defined in the EJB 2.1 specification, section 5.4, calls to local interfaces use pass-by-reference semantics.

If the `pass-by-reference` element is set to its default value of `false`, the passing semantics for calls to remote interfaces comply with the EJB 2.1 specification, section 5.4. If set to `true`, remote calls involve pass-by-reference semantics instead of pass-by-value semantics, contrary to this specification.

Portable programs should not assume that a copy of the object is made during such a call, and thus that it's safe to modify the original. Nor should they assume that a copy is not made, and thus that changes to the object are visible to both caller and callee. When this element is set to `true`, parameters and return values should be considered read-only. The behavior of a program that modifies such parameters or return values is undefined.

When a servlet or enterprise bean calls a remote interface method in another bean that is co-located within the same process, by default the Sun Java System Application Server makes copies of all the call parameters in order to preserve the pass-by-value semantics. This increases the call overhead and decreases performance.

However, if the calling method does not mutate the object being passed as a parameter, it is safe to pass the object itself without making a copy of it. To do this, set the pass-by-reference value to `true`.

The setting of this element in the `sun-application.xml` file applies to all EJB modules in the application. For an individually deployed EJB module, you can set the same element in the `sun-ejb-jar.xml` file. If you want to use `pass-by-reference` at both the bean and application level, the bean level takes precedence. For more information about the `sun-ejb-jar.xml` file, see "The sun-ejb-jar.xml File" on page 184.

Subelements

none

unique-id

Contains the unique ID for the application. This value is automatically updated each time the application is deployed or redeployed. Do not edit this value.

Subelements

none

security-role-mapping

Maps roles to users and groups. At least one principal or group name is required, but you do not need to have one of each.

Subelements

The following table describes subelements for the `security-role-mapping` element.

Table 5-4 `security-role-mapping` Subelements

Element	Required	Description
`role-name`	only one	Contains the `role-name` in the `security-role` element of the `application.xml` file.
`principal-name`	one or more if no `group-name`, otherwise zero or more	Contains the principal (user) name.
`group-name`	one or more if no `principal-name`, otherwise zero or more	Contains the group name.

role-name

Contains the `role-name` in the `security-role` element of the `application.xml` file.

Subelements

none

principal-name

Contains the principal (user) name.

Subelements

none

group-name

Contains the group name.

Subelements

none

realm

Contains the name of the realm used to process all authentication requests associated with this application. If this element is not specified or does not match the name of a configured realm, the default realm is used. For more information about realms, see “Realm Configuration” on page 44.

Subelements

none

Sample sun-application.xml File

```
<?xml version="1.0" encoding="UTF-8"?>

<!DOCTYPE sun-application PUBLIC '-//Sun Microsystems, Inc.//DTD
Application Server 8.0 J2EE Application 1.4//EN'
'http://www.sun.com/software/appserver/dtds/sun-application_1_4-0.dtd'>

<sun-application>

    <unique-id>67488732739338240</unique-id>

</sun-application>
```

The sun-web.xml File

This section describes the XML elements in the `sun-web.xml` file and provides an example file in the following sections:

- General Elements
- Security Elements
- Session Elements
- Reference Elements
- Caching Elements

- Classloader Elements
- JSP Elements
- Internationalization Elements
- Web Service Elements
- Sample sun-web.xml File

General Elements

General elements are as follows:

- `sun-web-app`
- `property`
- `description`
- `context-root`

sun-web-app

Defines Sun Java System Application Server specific configuration for a web module. This is the root element; there can only be one `sun-web-app` element in a `sun-web.xml` file.

Subelements

The following table describes subelements for the `sun-web-app` element.

Table 5-5 `sun-web-app` Subelements

Element	Required	Description
`context-root`	zero or one	Contains the web context root for the web application.
`security-role-mapping`	zero or more	Maps roles to users or groups in the currently active realm.
`servlet`	zero or more	Specifies a principal name for a servlet, which is used for the `run-as` role defined in `web.xml`.
`session-config`	zero or one	Specifies session manager, session cookie, and other session-related information.
`ejb-ref`	zero or more	Maps the absolute JNDI name to the `ejb-ref` in the corresponding J2EE XML file.

Table 5-5 sun-web-app Subelements *(Continued)*

Element	Required	Description
resource-ref	zero or more	Maps the absolute JNDI name to the resource-ref in the corresponding J2EE XML file.
resource-env-ref	zero or more	Maps the absolute JNDI name to the resource-env-ref in the corresponding J2EE XML file.
service-ref	zero or more	Specifies runtime settings for a web service reference.
cache	zero or one	Configures caching for web application components.
class-loader	zero or one	Specifies classloader configuration information.
jsp-config	zero or one	Specifies JSP configuration information.
locale-charset-info	zero or one	Specifies internationalization settings.
property	zero or more	Specifies a property, which has a name and a value.
message-destination	zero or more	Specifies the name of a logical message destination.
webservice-description	zero or more	Specifies a name and optional publish location for a web service.

Attributes

none

Properties

The following table describes properties for the sun-web-app element.

Table 5-6 sun-web-app Properties

Property	Default	Description
crossContextAllowed	true	If true, allows this web application to access the contexts of other web applications using the ServletContext.getContext()method.

Table 5-6 sun-web-app Properties *(Continued)*

Property	Default	Description
tempdir	*domain_dir*/generated/j2ee-apps/*app_name* or *domain_dir*/generated/j2ee-modules/*module_name*	Specifies a temporary directory for use by this web module. This value is used to construct the value of the javax.servlet.context.tempdir context attribute. Compiled JSPs are also placed in this directory.
singleThreadedServletPoolSize	5	Specifies the maximum number of servlet instances allocated for each SingleThreadModel servlet in the web application.

property

Specifies a property, which has a name and a value. A property adds configuration information to its parent element that is one or both of the following:

- Optional with respect to Sun Java System Application Server
- Needed by a system or object that Sun Java System Application Server doesn't have knowledge of, such as an LDAP server or a Java class

For example, a manager-properties element can include property subelements:

```
<manager-properties>
   <property name="reapIntervalSeconds" value="20" />
</manager-properties>
```

Which properties a manager-properties element uses depends on the value of the parent session-manager element's persistence-type attribute. For details, see the description of the session-manager element.

Subelements

The following table describes subelements for the property element.

Table 5-7 property Subelements

Element	Required	Description
description	zero or one	Specifies an optional text description of a property.

Attributes

The following table describes attributes for the property element.

Table 5-8 property Attributes

Attribute	Default	Description
name	none	Specifies the name of the property.
value	none	Specifies the value of the property.

description

Contains data that specifies a text description of the containing element.

Subelements

none

Attributes

none

context-root

Contains the web context root for the web application. Overrides the corresponding element in the web.xml file.

If you are setting up load balancing, web module context roots must be unique within a cluster. See the *Sun Java System Application Server Administration Guide* for more information about load balancing.

Subelements

none

Security Elements

Security elements are as follows:

- security-role-mapping
- servlet
- servlet-name
- role-name
- principal-name
- group-name

security-role-mapping

Maps roles to users or groups in the currently active realm. See "Realm Configuration" on page 44 for how to define the currently active realm.

Subelements

The following table describes subelements for the `security-role-mapping` element.

Table 5-9 `security-role-mapping` Subelements

Element	Required	Description
`role-name`	only one	Contains the role name.
`principal-name`	requires at least one `principal-name` or `group-name`	Contains a principal (user) name in the current realm.
`group-name`	requires at least one `principal-name` or `group-name`	Contains a group name in the current realm.

Attributes

none

servlet

Specifies a principal name for a servlet, which is used for the `run-as` role defined in `web-xml`.

Subelements

The following table describes subelements for the `servlet` element.

Table 5-10 `servlet` Subelements

Element	Required	Description
`servlet-name`	only one	Contains the name of a servlet, which is matched to a `servlet-name` in `web.xml`.
`principal-name`	zero or one	Contains a principal (user) name in the current realm.
`webservice-endpoint`	zero or more	Specifies information about a web service endpoint.

Attributes

none

servlet-name

Contains data that specifies the name of a servlet, which is matched to a `servlet-name` in `web.xml`. This name must be present in `web.xml`.

Subelements

none

Attributes

none

role-name

Contains data that specifies the `role-name` in the `security-role` element of the `web.xml` file.

Subelements

none

Attributes

none

principal-name

Contains data that specifies a principal (user) name in the current realm.

Subelements

none

Attributes

none

group-name

Contains data that specifies a group name in the current realm.

Subelements

none

Attributes

none

Session Elements

Session elements are as follows:

- session-config
- session-manager
- manager-properties
- store-properties
- session-properties
- cookie-properties

session-config

Specifies session configuration information. Overrides the web container settings for an individual web application.

Subelements

The following table describes subelements for the session-config element.

Table 5-11 session-config Subelements

Element	Required	Description
session-manager	zero or one	Specifies session manager configuration information.
session-properties	zero or one	Specifies session properties.
cookie-properties	zero or one	Specifies session cookie properties.

Attributes

none

session-manager

Specifies session manager information.

Subelements

The following table describes subelements for the session-manager element.

Table 5-12 session-manager Subelements

Element	Required	Description
manager-properties	zero or one	Specifies session manager properties.
store-properties	zero or one	Specifies session persistence (storage) properties.

Attributes

The following table describes attributes for the session-manager element.

Table 5-13 session-manager Attributes

Attribute	Default	Description
persistence-type	memory	(optional) Specifies the session persistence mechanism. Allowed values are memory and file. The ha and custom values are not implemented and should not be used.

manager-properties

Specifies session manager properties.

Subelements

The following table describes subelements for the manager-properties element.

Table 5-14 manager-properties Subelements

Element	Required	Description
property	zero or more	Specifies a property, which has a name and a value.

Attributes

none

Properties

The following table describes properties for the manager-properties element.

Table 5-15 manager-properties Properties

Property	Default	Description
reapIntervalSeconds	60	Specifies the number of seconds between checks for expired sessions. If the persistence-type attribute of the session-manager element is file, sessions are passivated if maxSessions has been exceeded. You should set this value lower than the frequency at which session data changes to prevent data inconsistency. For example, this value should be as low as possible (1 second) for a hit counter servlet on a frequently accessed website, or you could lose the last few hits each time you restart the server.
maxSessions	-1	Specifies the maximum number of sessions that can be in cache, or -1 for no limit. After this, an attempt to create a new session causes an IllegalStateException to be thrown. If the persistence-type attribute of the session-manager element is file, the session manager passivates sessions to the persistent store when this maximum is reached.
sessionFilename	none; state is not preserved across restarts	Specifies the absolute or relative path to the directory in which the session state is preserved between application restarts, if preserving the state is possible. A relative path is relative to the temporary directory for this web application. Applicable only if the persistence-type attribute of the session-manager element is memory.

store-properties

Specifies session persistence (storage) properties.

Subelements

The following table describes subelements for the store-properties element.

Table 5-16 store-properties Subelements

Element	Required	Description
property	zero or more	Specifies a property, which has a name and a value.

Attributes

none

Properties

The following table describes properties for the `store-properties` element.

Table 5-17 `store-properties` Properties

Property	Default	Description
`directory`	*domain_dir*`/generated/jsp/j2ee-apps/`*appname*`/`*appname*`_war`	Specifies the absolute or relative pathname of the directory into which individual session files are written. A relative path is relative to the temporary work directory for this web application. Applicable only if the `persistence-type` attribute of the `session-manager` element is `file`.

session-properties

Specifies session properties.

Subelements

The following table describes subelements for the `session-properties` element.

Table 5-18 `session-properties` Subelements

Element	Required	Description
`property`	zero or more	Specifies a property, which has a name and a value.

Attributes

none

Properties

The following table describes properties for the `session-properties` element.

Table 5-19 session-properties Properties

Property	Default	Description
timeoutSeconds	600	Specifies the default maximum inactive interval (in seconds) for all sessions created in this web module. If set to 0 or less, sessions in this web module never expire. If a session-timeout element is specified in the web.xml file, the session-timeout value overrides any timeoutSeconds value. If neither session-timeout nor timeoutSeconds is specified, the timeoutSeconds default is used. Note that the session-timeout element in web.xml is specified in minutes, not seconds.
enableCookies	true	Uses cookies for session tracking if set to true.
enableURLRewriting	true	Enables URL rewriting. This provides session tracking via URL rewriting when the browser does not accept cookies. You must also use an encodeURL or encodeRedirectURL call in the servlet or JSP.
idLengthBytes	16	Specifies the number of bytes in this web module's session ID.

cookie-properties

Specifies session cookie properties.

Subelements

The following table describes subelements for the cookie-properties element.

Table 5-20 cookie-properties Subelements

Element	Required	Description
property	zero or more	Specifies a property, which has a name and a value.

Attributes

none

Properties

The following table describes properties for the cookie-properties element.

Table 5-21 cookie-properties Properties

Property	Default	Description
cookiePath	Context path at which the web module is installed.	Specifies the pathname that is set when the cookie is created. The browser sends the cookie if the pathname for the request contains this pathname. If set to / (slash), the browser sends cookies to all URLs served by the Sun Java System Application Server. You can set the path to a narrower mapping to limit the request URLs to which the browser sends cookies.
cookieMaxAgeSeconds	-1	Specifies the expiration time (in seconds) after which the browser expires the cookie.
cookieDomain	(unset)	Specifies the domain for which the cookie is valid.
cookieComment	Sun Java System Application Server Session Tracking Cookie	Specifies the comment that identifies the session tracking cookie in the cookie file. Applications can provide a more specific comment for the cookie.

Reference Elements

Reference elements are as follows:

- resource-env-ref
- resource-env-ref-name
- resource-ref
- res-ref-name
- default-resource-principal
- name
- password
- ejb-ref
- ejb-ref-name
- message-destination
- message-destination-name
- jndi-name

resource-env-ref

Maps the res-ref-name in the corresponding J2EE web.xml file resource-env-ref entry to the absolute jndi-name of a resource.

Subelements

The following table describes subelements for the resource-env-ref element.

Table 5-22 resource-env-ref Subelements

Element	Required	Description
resource-env-ref-name	only one	Specifies the res-ref-name in the corresponding J2EE web.xml file resource-env-ref entry.
jndi-name	only one	Specifies the absolute jndi-name of a resource.

Attributes

none

resource-env-ref-name

Contains data that specifies the res-ref-name in the corresponding J2EE web.xml file resource-env-ref entry.

Subelements

none

Attributes

none

resource-ref

Maps the res-ref-name in the corresponding J2EE web.xml file resource-ref entry to the absolute jndi-name of a resource.

Subelements

The following table describes subelements for the resource-ref element.

Table 5-23 `resource-ref` Subelements

Element	Required	Description
`res-ref-name`	only one	Specifies the `res-ref-name` in the corresponding J2EE `web.xml` file `resource-ref` entry.
`jndi-name`	only one	Specifies the absolute `jndi-name` of a resource.
`default-resource-principal`	zero or one	Specifies the default principal (user) for the resource.

Attributes

none

res-ref-name

Contains data that specifies the `res-ref-name` in the corresponding J2EE `web.xml` file `resource-ref` entry.

Subelements

none

Attributes

none

default-resource-principal

Specifies the default principal (user) for the resource.

If this element is used in conjunction with a JMS Connection Factory resource, the `name` and `password` subelements must be valid entries in the Sun Java™ System Message Queue broker user repository. See the "Security Management" chapter in the *Sun Java System Message Queue Administrator's Guide* for details.

Subelements

The following table describes subelements for the `default-resource-principal` element.

Table 5-24 `default-resource-principal` Subelements

Element	Required	Description
`name`	only one	Contains the name of the principal.

Table 5-24 default-resource-principal Subelements *(Continued)*

Element	Required	Description
password	only one	Contains the password for the principal.

Attributes

none

name

Contains data that specifies the name of the principal.

Subelements

none

Attributes

none

password

Contains data that specifies the password for the principal.

Subelements

none

Attributes

none

ejb-ref

Maps the ejb-ref-name in the corresponding J2EE web.xml file ejb-ref entry to the absolute jndi-name of a resource.

Subelements

The following table describes subelements for the ejb-ref element.

Table 5-25 ejb-ref Subelements

Element	Required	Description
ejb-ref-name	only one	Specifies the ejb-ref-name in the corresponding J2EE web.xml file ejb-ref entry.
jndi-name	only one	Specifies the absolute jndi-name of a resource.

Attributes

none

ejb-ref-name

Contains data that specifies the `ejb-ref-name` in the corresponding J2EE `web.xml` file `ejb-ref` entry.

Subelements

none

Attributes

none

message-destination

Specifies the name of a logical `message-destination` defined within an application. The `message-destination-name` matches the corresponding `message-destination-name` in the `web.xml` file.

Subelements

The following table describes subelements for the `message-destination` element.

Table 5-26 `message-destination` subelements

Element	Required	Description
`message-destination-name`	only one	Specifies the name of a logical message destination defined within the corresponding `web.xml` file.
`jndi-name`	only one	Specifies the `jndi-name` of the associated entity.

Attributes

none

message-destination-name

Contains data that specifies the name of a logical message destination defined within the corresponding `web.xml` file.

Subelements

none

Attributes

none

jndi-name

Contains data that specifies the absolute `jndi-name` of a URL resource or a resource in the `domain.xml` file.

Subelements

none

Attributes

none

Caching Elements

For details about response caching as it pertains to servlets and JSP caching, see "Caching Servlet Results" on page 268 and "JSP Caching" on page 276.

Caching elements are as follows:

- `cache`
- `cache-helper`
- `default-helper`
- `cache-mapping`
- `url-pattern`
- `timeout`
- `http-method`
- `key-field`
- `constraint-field`
- `value`

cache

Configures caching for web application components.

Subelements

The following table describes subelements for the `cache` element.

Table 5-27 cache Subelements

Element	Required	Description
cache-helper	zero or more	Specifies a custom class that implements the CacheHelper interface.
default-helper	zero or one	Allows you to change the properties of the default, built-in cache-helper class.
property	zero or more	Specifies a cache property, which has a name and a value.
cache-mapping	zero or more	Maps a URL pattern or a servlet name to its cacheability constraints.

Attributes

The following table describes attributes for the cache element.

Table 5-28 cache Attributes

Attribute	Default	Description
max-entries	4096	(optional) Specifies the maximum number of entries the cache can contain. Must be a positive integer.
timeout-in-seconds	30	(optional) Specifies the maximum amount of time in seconds that an entry can remain in the cache after it is created or refreshed. Can be overridden by a timeout element.
enabled	false	(optional) Determines whether servlet and JSP caching is enabled.

Properties

The following table describes properties for the cache element.

Table 5-29 cache Properties

Property	Default	Description
cacheClassName	com.sun.appserv.web .cache.LruCache	Specifies the fully qualified name of the class that implements the cache functionality. The "cacheClassName Values" table below lists possible values.

Table 5-29 cache Properties *(Continued)*

Property	Default	Description
MultiLRUSegmentSize	4096	Specifies the number of entries in a segment of the cache table that should have its own LRU (least recently used) list. Applicable only if cacheClassName is set to com.sun.appserv.web.cache.MultiLruCache.
MaxSize	unlimited; Long.MAX_VALUE	Specifies an upper bound on the cache memory size in bytes (KB or MB units). Example values are 32 KB or 2 MB. Applicable only if cacheClassName is set to com.sun.appserv.web.cache.BoundedMultiLruCache.

Cache Class Names

The following table lists possible values of the cacheClassName property.

Table 5-30 cacheClassName Values

Value	Description
com.sun.appserv.web.cache .LruCache	A bounded cache with an LRU (least recently used) cache replacement policy.
com.sun.appserv.web.cache .BaseCache	An unbounded cache suitable if the maximum number of entries is known.
com.sun.appserv.web.cache .MultiLruCache	A cache suitable for a large number of entries (>4096). Uses the MultiLRUSegmentSize property.
com.sun.appserv.web.cache .BoundedMultiLruCache	A cache suitable for limiting the cache size by memory rather than number of entries. Uses the MaxSize property.

cache-helper

Specifies a class that implements the CacheHelper interface. For details, see "CacheHelper Interface" on page 271.

Subelements

The following table describes subelements for the cache-helper element.

Table 5-31 cache-helper Subelements

Element	Required	Description
property	zero or more	Specifies a property, which has a name and a value.

Attributes

The following table describes attributes for the cache-helper element.

Table 5-32 cache-helper Attributes

Attribute	Default	Description
name	default	Specifies a unique name for the helper class, which is referenced in the cache-mapping element.
class-name	none	Specifies the fully qualified class name of the cache helper, which must implement the com.sun.appserv.web.CacheHelper interface.

default-helper

Allows you to change the properties of the built-in default cache-helper class.

Subelements

The following table describes subelements for the default-helper element.

Table 5-33 default-helper Subelements

Element	Required	Description
property	zero or more	Specifies a property, which has a name and a value.

Attributes

none

Properties

The following table describes properties for the default-helper element.

Table 5-34 `default-helper` Properties

Property	Default	Description
`cacheKeyGeneratorAttrName`	Uses the built-in `default` `cache-helper` key generation, which concatenates the servlet path with `key-field` values, if any.	The caching engine looks in the `ServletContext` for an attribute with a name equal to the value specified for this property to determine whether a customized `CacheKeyGenerator` implementation is used. An application may provide a customized key generator rather than using the `default` helper. See "CacheKeyGenerator Interface" on page 273.

cache-mapping

Maps a URL pattern or a servlet name to its cacheability constraints.

Subelements

The following table describes subelements for the `cache-mapping` element.

Table 5-35 `cache-mapping` Subelements

Element	Required	Description
`servlet-name`	requires one `servlet-name` or `url-pattern`	Contains the name of a servlet.
`url-pattern`	requires one `servlet-name` or `url-pattern`	Contains a servlet URL pattern for which caching is enabled.
`cache-helper-ref`	required if `timeout`, `refresh-field`, `http-method`, `key-field`, and `constraint-field` are not used	Contains the name of the `cache-helper` used by the parent `cache-mapping` element.
`timeout`	zero or one if `cache-helper-ref` is not used	Contains the `cache-mapping` specific maximum amount of time in seconds that an entry can remain in the cache after it is created or refreshed.
`refresh-field`	zero or one if `cache-helper-ref` is not used	Specifies a field that gives the application component a programmatic way to refresh a cached entry.

Table 5-35 cache-mapping Subelements *(Continued)*

Element	Required	Description
http-method	zero or more if cache-helper-ref is not used	Contains an HTTP method that is eligible for caching.
key-field	zero or more if cache-helper-ref is not used	Specifies a component of the key used to look up and extract cache entries.
constraint-field	zero or more if cache-helper-ref is not used	Specifies a cacheability constraint for the given url-pattern or servlet-name.

Attributes

none

url-pattern

Contains data that specifies a servlet URL pattern for which caching is enabled. See the Servlet 2.3 specification section SRV. 11.2 for applicable patterns.

Subelements

none

Attributes

none

cache-helper-ref

Contains data that specifies the name of the cache-helper used by the parent cache-mapping element.

Subelements

none

Attributes

none

timeout

Contains data that specifies the `cache-mapping` specific maximum amount of time in seconds that an entry can remain in the cache after it is created or refreshed. If not specified, the default is the value of the `timeout` attribute of the `cache` element.

Subelements

none

Attributes

The following table describes attributes for the `timeout` element.

Table 5-36 `timeout` Attributes

Attribute	Default	Description
name	none	Specifies the timeout input parameter, whose value is interpreted in seconds. The field's type must be `java.lang.Long` or `java.lang.Integer`.
`scope`	`request.attribute`	(optional) Specifies the scope from which the input parameter is to be retrieved. Allowed values are `context.attribute`, `request.header`, `request.parameter`, `request.cookie`, `request.attribute`, and `session.attribute`.

refresh-field

Specifies a field that gives the application component a programmatic way to refresh a cached entry.

Subelements

none

Attributes

The following table describes attributes for the `refresh-field` element.

Table 5-37 `refresh-field` Attributes

Attribute	Default	Description
name	none	Specifies the input parameter name.

Table 5-37 `refresh-field` Attributes *(Continued)*

Attribute	Default	Description
`scope`	`request.parameter`	(optional) Specifies the scope from which the input parameter is to be retrieved. Allowed values are `context.attribute`, `request.header`, `request.parameter`, `request.cookie`, `session.id`, and `session.attribute`.

http-method

Contains data that specifies an HTTP method that is eligible for caching. The default is `GET`.

Subelements

none

Attributes

none

key-field

Specifies a component of the key used to look up and extract cache entries. The web container looks for the named parameter, or field, in the specified scope.

If this element is not present, the web container uses the Servlet Path (the path section that corresponds to the servlet mapping that activated the current request). See the Servlet 2.3 specification, section SRV 4.4, for details on the Servlet Path.

Subelements

none

Attributes

The following table describes attributes for the `key-field` element.

Table 5-38 `key-field` Attributes

Attribute	Default	Description
`name`	none	Specifies the input parameter name.
`scope`	`request.parameter`	(optional) Specifies the scope from which the input parameter is to be retrieved. Allowed values are `context.attribute`, `request.header`, `request.parameter`, `request.cookie`, `session.id`, and `session.attribute`.

constraint-field

Specifies a cacheability constraint for the given url-pattern or servlet-name.

All constraint-field constraints must pass for a response to be cached. If there are value constraints, at least one of them must pass.

Subelements

The following table describes subelements for the constraint-field element.

Table 5-39 constraint-field Subelements

Element	Required	Description
value	zero or more	Contains a value to be matched to the input parameter value.

Attributes

The following table describes attributes for the constraint-field element.

Table 5-40 constraint-field Attributes

Attribute	Default	Description
name	none	Specifies the input parameter name.
scope	request.parameter	(optional) Specifies the scope from which the input parameter is to be retrieved. Allowed values are context.attribute, request.header, request.parameter, request.cookie, request.attribute, and session.attribute.
cache-on-match	true	(optional) If true, caches the response if matching succeeds. Overrides the same attribute in a value subelement.
cache-on-match-failure	false	(optional) If true, caches the response if matching fails. Overrides the same attribute in a value subelement.

value

Contains data that specifies a value to be matched to the input parameter value. The matching is case sensitive. For example:

```
<value match-expr="in-range">1-60</value>
```

Subelements

none

Attributes

The following table describes attributes for the `value` element.

Table 5-41 `value` Attributes

Attribute	Default	Description
`match-expr`	`equals`	(optional) Specifies the type of comparison performed with the value. Allowed values are `equals`, `not-equals`, `greater`, `lesser`, and `in-range`. If `match-expr` is `greater` or `lesser`, the value must be a number. If `match-expr` is `in-range`, the value must be of the form *n1*-*n2*, where *n1* and *n2* are numbers.
`cache-on-match`	`true`	(optional) If `true`, caches the response if matching succeeds.
`cache-on-match-failure`	`false`	(optional) If `true`, caches the response if matching fails.

Classloader Elements

Classloader elements are as follows:

- `class-loader`

class-loader

Configures the classloader for the web module.

Subelements

none

Attributes

The following table describes attributes for the `class-loader` element.

Table 5-42 `class-loader` Attributes

Attribute	Default	Description
`extra-class-path`	null	(optional) Specifies additional classpath settings for this web module.

Table 5-42 `class-loader` Attributes *(Continued)*

Attribute	Default	Description
`delegate`	`true`	(optional) If `true`, the web module follows the standard classloader delegation model and delegates to its parent classloader first before looking in the local classloader. You must set this to `true` for a web application that accesses EJB components or that acts as a web service client or endpoint. If `false`, the web module follows the delegation model specified in the Servlet specification and looks in its classloader before looking in the parent classloader. It's safe to set this to `false` only for a web module that does not interact with any other modules.

NOTE If the `delegate` element is set to `false`, the classloader delegation behavior complies with the Servlet 2.3 specification, section 9.7.2. If set to its default value of `true`, classes and resources residing in container-wide library JAR files are loaded in preference to classes and resources packaged within the WAR file.

Portable programs that use this element should not be packaged with any classes or interfaces that are a part of the J2EE specification. The behavior of a program that includes such classes or interfaces in its WAR file is undefined.

JSP Elements

JSP elements are as follows:

- `jsp-config`

jsp-config

Specifies JSP configuration information.

Subelements

The following table describes subelements for the `jsp-config` element.

Table 5-43 jsp-config Subelements

Element	Required	Description
property	zero or more	Specifies a property.

Attributes

none

Properties

The default property values are tuned for development of JSP pages at the cost of performance. To maximize performance, set jsp-config properties to these non-default values:

- development - false
- reloading - false
- mappedfile - false
- trimSpaces - true
- suppressSmap - true
- fork - false (on Solaris)
- classdebuginfo - false

The following table describes properties for the jsp-config element.

Table 5-44 jsp-config Properties

Property	Default	Description
ieClassId	clsid:8AD9C840-044E-11D1-B3E9-00805F499D93	Specifies the Java plug-in COM class ID for Internet Explorer. Used by the <jsp:plugin> tags.
javaEncoding	UTF8	Specifies the encoding for the generated Java servlet. This encoding is passed to the Java compiler used to compile the servlet as well. By default, the web container tries to use UTF8. If that fails, it tries to use the javaEncoding value. For encodings you can use, see: http://java.sun.com/j2se/1.4/docs/guide/intl/encoding.doc.html
classdebuginfo	true	Specifies whether the generated Java servlets should be compiled with the debug option set (-g for javac).

Table 5-44 `jsp-config` Properties *(Continued)*

Property	Default	Description
`keepgenerated`	`true`	If set to `true`, keeps the generated Java files. If `false`, deletes the Java files.
`mappedfile`	`true`	If set to `true`, generates static content with one print statement per input line, to ease debugging.
`scratchdir`	The default work directory for the web application	Specifies the working directory created for storing all the generated code.
`checkInterval`	`300`	Specifies the time in seconds between checks to see if a JSP page needs to be recompiled. Applicable if `development` is `false` and `reloading` is `true`, which enables background recompiles.
`compiler`	`javac`	Specifies the compiler Ant uses to compile JSP pages. See the Ant documentation for more information: `http://computing.ee.ethz.ch/sepp/ant-1.5.4-ke/manual/index.html`
`classpath`	created dynamically based on the current web application	Specifies the classpath to use when compiling generated servlets.
`development`	`true`	If set to `true`, checks JSP pages for modification on every access.
`enablePooling`	`true`	If set to `true`, tag handler pooling is enabled.
`fork`	`true`	Specifies that Ant forks compiles of JSP pages so that a separate JVM is used for JSP page compiles from the one in which Tomcat is running.
`trimSpaces`	`false`	If set to `true`, trims white spaces in template text between actions or directives.
`reloading`	`true`	If set to `true`, checks for modified JSP pages.
`suppressSmap`	`false`	If set to `true`, generation of SMAP information for JSR 45 debugging is suppressed.
`dumpSmap`	`false`	If set to `true`, dumps SMAP information for JSR 45 debugging to a file. Set to `false` if `suppressSmap` is `true`.
`genStrAsCharArray`	`false`	If set to `true`, generates text strings as `char` arrays, which improves performance in some cases.
`errorOnUseBeanInvalidClassAttribute`	`false`	If set to `true`, issues an error when the value of the `class` attribute in a `useBean` action is not a valid bean class.
`xpoweredBy`	`true`	If set to `true`, the X-Powered-By response header is added by the generated servlet.

Internationalization Elements

Internationalization elements are as follows:

- locale-charset-info
- locale-charset-map
- parameter-encoding

locale-charset-info

Specifies information about the application's internationalization settings.

Subelements

The following table describes subelements for the locale-charset-info element.

Table 5-45 locale-charset-info Subelements

Element	Required	Description
locale-charset-map	one or more	Maps a locale and an agent to a character encoding. Provided for backward compatibility. Used only for request processing, and only if no parameter-encoding is defined.
parameter-encoding	zero or one	Determines the default request character encoding and how the web container decodes parameters from forms according to a hidden field value.

Attributes

The following table describes attributes for the locale-charset-info element.

Table 5-46 locale-charset-info Attributes

Attribute	Default	Description
default-locale	none	Although a value is required, the value is ignored. Use the default-charset attribute of the parameter-encoding element.

locale-charset-map

Maps locales and agents to character encodings. Provided for backward compatibility. Used only for request processing. Used only if the character encoding is not specified in the request and cannot be derived from the optional `parameter-encoding` element.

For encodings you can use, see:

`http://java.sun.com/j2se/1.4/docs/guide/intl/encoding.doc.html`

Subelements

The following table describes subelements for the `locale-charset-map` element.

Table 5-47 `locale-charset-map` Subelements

Element	Required	Description
`description`	zero or one	Specifies an optional text description of a mapping.

Attributes

The following table describes attributes for the `locale-charset-map` element.

Table 5-48 `locale-charset-map` Attributes

Attribute	Default	Description
`locale`	none	Specifies the locale name.
`agent`	none	(optional) Specifies the type of client that interacts with the application server. For a given locale, different agents may have different preferred character encodings. The value of this attribute must exactly match the value of the `user-agent` HTTP request header sent by the client. See the "Example agent Attribute Values" table for more information.
`charset`	none	Specifies the character encoding to which the locale maps.

Example Agents

The following table specifies example `agent` attribute values.

Table 5-49 Example `agent` Attribute Values

Agent	user-agent Header and agent Attribute Value
Internet Explorer 5.00 for Windows 2000	`Mozilla/4.0 (compatible; MSIE 5.01; Windows NT 5.0)`
Netscape 4.7.7 for Windows 2000	`Mozilla/4.77 [en] (Windows NT 5.0; U)`

Table 5-49 Example `agent` Attribute Values *(Continued)*

Agent	user-agent Header and agent Attribute Value
Netscape 4.7 for Solaris	`Mozilla/4.7 [en] (X11; u; Sun OS 5.6 sun4u)`

parameter-encoding

Specifies the default request character encoding and how the web container decodes parameters from forms according to a hidden field value.

For encodings you can use, see:

http://java.sun.com/j2se/1.4/docs/guide/intl/encoding.doc.html

Subelements

none

Attributes

The following table describes attributes for the `parameter-encoding` element.

Table 5-50 `parameter-encoding` Attributes

Attribute	Default	Description
`form-hint-field`	none	(optional) The name of the hidden field in the form that specifies the character encoding the web container uses for `request.getParameter` and `request.getReader` calls when the charset is not set in the request's `content-type` header.
`default-charset`	`ISO-8859-1`	(optional) The default request character encoding.

Sample sun-web.xml File

```
<?xml version="1.0" encoding="UTF-8"?>

<!DOCTYPE sun-web-app PUBLIC '-//Sun Microsystems, Inc.//DTD Application
Server 8.0 Servlet 2.4//EN'
'http://www.sun.com/software/appserver/dtds/sun-web-app_2_4-0.dtd'>

<sun-web-app>

    <session-config>

        <session-manager/>

    </session-config>
    <resource-ref>
        <res-ref-name>mail/Session</res-ref-name>
        <jndi-name>mail/Session</jndi-name>
    </resource-ref>
    <jsp-config/>
</sun-web-app>
```

The sun-ejb-jar.xml File

This section describes the XML elements in the `sun-ejb-jar.xml` file and provides an example file in the following sections:

- General Elements
- Role Mapping Elements
- Reference Elements
- Messaging Elements
- Security Elements
- Persistence Elements
- Pooling and Caching Elements
- Class Elements
- Web Service Elements
- Sample sun-ejb-jar.xml File

NOTE If any configuration for an enterprise bean is not specified in the `sun-ejb-jar.xml` file, it can default to a corresponding value in the `ejb-container` element of the `domain.xml` file if an equivalency exists. You can change the default values in the `domain.xml` file; these changes will be reflected in any enterprise bean that does not have that value defined.

General Elements

General elements are as follows:

- `description`
- `ejb`
- `ejb-name`
- `enterprise-beans`
- `is-read-only-bean`
- `name`
- `property`
- `refresh-period-in-seconds`
- `sun-ejb-jar`
- `unique-id`
- `value`

description

Contains data that specifies a text description of the containing element.

Subelements

none

ejb

Defines runtime properties for a single enterprise bean within the application. The subelements listed below apply to particular enterprise beans as follows:

- All types of beans: `ejb-name`, `ejb-ref`, `resource-ref`, `resource-env-ref`, `cmp`, `ior-security-config`, `gen-classes`, `jndi-name`
- Stateless session beans and message-driven beans: `bean-pool`
- Stateful session beans and entity beans: `bean-cache`
- Entity beans: `commit-option`, `bean-cache`, `bean-pool`, `is-read-only-bean` (BMP only), `refresh-period-in-seconds` (BMP only)
- Message-driven beans: `mdb-connection-factory`, `jms-durable-subscription-name`, `jms-max-messages-load`, `bean-pool`

Subelements

The following table describes subelements for the `ejb` element.

Table 5-51 `ejb` Subelements

Subelement	Required	Description
`ejb-name`	only one	Matches the `ejb-name` in the corresponding `ejb-jar.xml` file.
`jndi-name`	zero or more	Specifies the absolute `jndi-name`.
`ejb-ref`	zero or more	Maps the absolute JNDI name to the `ejb-ref` element in the corresponding J2EE XML file.
`resource-ref`	zero or more	Maps the absolute JNDI name to the `resource-ref` in the corresponding J2EE XML file.
`resource-env-ref`	zero or more	Maps the absolute JNDI name to the `resource-env-ref` in the corresponding J2EE XML file.
`service-ref`	zero or more	Specifies runtime settings for a web service reference.
`pass-by-reference`	zero or one	Specifies the passing method used by an enterprise bean calling a remote interface method in another bean that is co-located within the same process.
`cmp`	zero or one	Specifies runtime information for a container-managed persistence (CMP) EntityBean object for EJB1.1 and EJB2.1 beans.
`principal`	zero or one	Specifies the principal (user) name in an enterprise bean that has the `run-as` role specified.
`mdb-connection-factory`	zero or one	Specifies the connection factory associated with a message-driven bean.
`jms-durable-subscription-name`	zero or one	Contains data that specifies the durable subscription associated with a message-driven bean.
`jms-max-messages-load`	zero or one	Specifies the maximum number of messages to load into a Java Message Service session at one time for a message-driven bean to serve. The default is 1.
`ior-security-config`	zero or one	Specifies the security information for the IOR.
`is-read-only-bean`	zero or one	Specifies that this bean is read-only (BMP only).
`refresh-period-in-seconds`	zero or one	Specifies the rate at which a read-only-bean must be refreshed from the data source.
`commit-option`	zero or one	Contains data that has valid values of B or C. Default value is B.
`cmt-timeout-in-seconds`	zero or one	Contains data that overrides the Transaction Timeout setting of the Transaction Service for an individual bean.
`use-thread-pool-id`	zero or one	This element is not implemented.

Table 5-51 `ejb` Subelements *(Continued)*

Subelement	Required	Description
`gen-classes`	zero or one	Specifies all the generated class names for a bean.
`bean-pool`	zero or one `bean-pool`	Specifies the bean pool properties. Used for stateless session beans, entity beans, and message-driven bean pools.
`bean-cache`	zero or one `bean-pool`	Specifies the bean cache properties. Used only for stateful session beans and entity beans
`mdb-resource-adapter`	zero or one	Specifies runtime configuration information for a message-driven bean.
`webservice-endpoint`	zero or more	Specifies information about a web service endpoint.

Example

```
<ejb>
    <ejb-name>CustomerEJB</ejb-name>
    <jndi-name>customer</jndi-name>
    <resource-ref>
        <res-ref-name>jdbc/SimpleBank</res-ref-name>
        <jndi-name>jdbc/PointBase</jndi-name>
    </resource-ref>
    <is-read-only-bean>false</is-read-only-bean>
    <commit-option>B</commit-option>
    <bean-pool>
        <steady-pool-size>10</steady-pool-size>
        <resize-quantity>10</resize-quantity>
        <max-pool-size>100</max-pool-size>
        <pool-idle-timeout-in-seconds>600</pool-idle-timeout-in-seconds>
    </bean-pool>
    <bean-cache>
        <max-cache-size>100</max-cache-size>
        <resize-quantity>10</resize-quantity>
        <removal-timeout-in-seconds>3600</removal-timeout-in-seconds>
        <victim-selection-policy>LRU</victim-selection-policy>
    </bean-cache>
</ejb>
```

ejb-name

Matches the `ejb-name` in the corresponding `ejb-jar.xml` file. The name must be unique among the names of the enterprise beans in the same EJB JAR file.

There is no architected relationship between the `ejb-name` in the deployment descriptor and the JNDI name that the deployer assigns to the EJB component's home.

Subelements

none

Example

```
<ejb-name>EmployeeService</ejb-name>
```

enterprise-beans

Specifies all the runtime properties for an EJB JAR file in the application.

Subelements

The following table describes subelements for the `enterprise-beans` element.

Table 5-52 `enterprise-beans` Subelements

Subelement	Required	Description
`name`	zero or one	Specifies the name string.
`unique-id`	zero or one	Specifies a unique system identifier. This data is automatically generated and updated at deployment/redeployment. Developers should not specify or edit this value.
`ejb`	zero or more	Defines runtime properties for a single enterprise bean within the application.
`pm-descriptors`	zero or one	Specifies one or more persistence manager descriptors, but only one of them must be in use at any given time. If none are specified, the Sun CMP persistence manager is used.
`cmp-resource`	zero or one	Specifies the database to be used for storing container-managed persistence (CMP) beans in an EJB JAR file.
`message-destination`	zero or more	Specifies the name of a logical message destination.
`webservice-description`	zero or more	Specifies a name and optional publish location for a web service.

Example

```
<enterprise-beans>
    <ejb>
        <ejb-name>CustomerEJB</ejb-name>
        <jndi-name>customer</jndi-name>
        <resource-ref>
            <res-ref-name>jdbc/SimpleBank</res-ref-name>
            <jndi-name>jdbc/PointBase</jndi-name>
        </resource-ref>
        <is-read-only-bean>false</is-read-only-bean>
        <commit-option>B</commit-option>
        <bean-pool>
            <steady-pool-size>10</steady-pool-size>
            <resize-quantity>10</resize-quantity>
            <max-pool-size>100</max-pool-size>
            <pool-idle-timeout-in-seconds>600</pool-idle-timeout-in-seconds>
        </bean-pool>
        <bean-cache>
            <max-cache-size>100</max-cache-size>
            <resize-quantity>10</resize-quantity>
            <removal-timeout-in-seconds>3600</removal-timeout-in-seconds>
            <victim-selection-policy>LRU</victim-selection-policy>
        </bean-cache>
    </ejb>
</enterprise-beans>
```

is-read-only-bean

Specifies that this bean is a read-only bean (BMP only).

Subelements

none

Example

```
<is-read-only-bean>false</is-read-only-bean>
```

name

Contains data that specifies the name of the entity.

Subelements

none

property

Specifies the name and value of a property.

Subelements

The following table describes subelements for the `property` element.

Table 5-53 `property` subelements

Element	Required	Description
`name`	only one	Specifies the name of the entity.
`value`	only one	Specifies the value of the entity.

refresh-period-in-seconds

Specifies the rate at which a read-only-bean must be refreshed from the data source. If the value is less than or equal to zero, the bean is never refreshed; if the value is greater than zero, the bean instances are refreshed at specified intervals. This rate is just a hint to the container. Default is 0 (no refresh).

Subelements

none

sun-ejb-jar

Defines the Sun Java System Application Server-specific configuration for an EJB JAR file in the application. This is the root element; there can only be one `sun-ejb-jar` element in an `sun-ejb-jar.xml` file.

Refer to “Sample sun-web.xml File” on page 183 for example of this file.

Subelements

The following table describes subelements for the `sun-ejb-jar` element.

Table 5-54 `sun-ejb-jar` Subelements

Subelement	Required	Description
`security-role-mapping`	zero or more	Maps a role in the corresponding J2EE XML file to a user or group.
`enterprise-beans`	only one	Describes all the runtime properties for an EJB JAR file in the application.

unique-id

Specifies a unique system identifier. This data is automatically generated and updated at deployment/redeployment. Developers should not specify or edit this value.

Subelements

none

value

Contains data that specifies the value of the entity.

Subelements

none

Role Mapping Elements

The role mapping element maps a role, as specified in the EJB JAR `role-name` entries, to a environment-specific user or group. If it maps to a user, it must be a concrete user which exists in the current realm who can log into the server using the current authentication method. If it maps to a group, the realm must support groups and it must be a concrete group which exists in the current realm. To be useful, there must be at least one user in that realm who belongs to that group.

Role mapping elements are as follows:

- `group-name`
- `principal`
- `principal-name`
- `role-name`
- `security-role-mapping`
- `server-name`

group-name

Specifies the group name.

Subelements

none

principal

Defines a node that specifies a user name on the platform.

Subelements

The following table describes subelements for the `principal` element.

Table 5-55 `principal` Subelements

Subelement	Required	Description
`name`	only one	Specifies the name of the user.

principal-name

Specifies the principal (user) name in an enterprise bean that has the `run-as` role specified.

Subelements

none

role-name

Specifies the `role-name` in the `security-role` element of the `ejb-jar.xml` file.

Subelements

none

Example

```
<role-name>employee</role-name>
```

security-role-mapping

Maps roles to users and groups.

Subelements

The following table describes subelements for the `security-role-mapping` element.

Table 5-56 `security-role-mapping` Subelements

Subelement	Required	Description
`role-name`	only one	Specifies the `role-name` from the `ejb-jar.xml` file being mapped.

Table 5-56 `security-role-mapping` Subelements *(Continued)*

Subelement	Required	Description
`principal-name`	requires at least one `principal-name` or `group-name`	Specifies the principal (user) name in a bean that has the run-as role specified.
`group-name`	requires at least one `principal-name` or `group-name`	Specifies the group name.

server-name

Specifies the name of the server where the application is being deployed.

Subelements

none

Reference Elements

Reference elements are as follows:

- `ejb-ref`
- `ejb-ref-name`
- `jndi-name`
- `pass-by-reference`
- `res-ref-name`
- `resource-env-ref`
- `resource-env-ref-name`
- `resource-ref`
- `message-destination`
- `message-destination-name`

ejb-ref

Maps the absolute `jndi-name` name to the `ejb-ref` element in the corresponding J2EE XML file, `ejb-jar.xml`. The `ejb-ref` element is used for the declaration of a reference to an EJB's home. Applies to session beans or entity beans.

Subelements

The following table describes subelements for the `ejb-ref` element.

Table 5-57 `ejb-ref` Subelements

Subelement	Required	Description
`ejb-ref-name`	only one	Specifies the `ejb-ref-name` in the corresponding J2EE EJB JAR file `ejb-ref` entry.
`jndi-name`	only one	Specifies the absolute `jndi-name`.

ejb-ref-name

Specifies the `ejb-ref-name` in the corresponding J2EE XML file `ejb-ref` entry. The name must be unique within the enterprise bean, and should be prefixed with `ejb/`.

Subelements

none

Example

```
<ejb-ref-name>ejb/Payroll</ejb-ref-name>
```

jndi-name

Specifies the absolute `jndi-name`.

For entity beans and session beans, this value specifies the global JNDI name of the `EJBHome` object. It is only needed if the entity or session bean exposes a remote view.

For JMS message-driven beans, this is the JNDI name of the JMS resource from which the message-driven bean should consume JMS messages. This information can alternatively be specified within the `activation-config` subelement of the `mdb-resource-adapter` element. For more information about JMS resources, see Chapter 14, “Using the Java Message Service.”

Subelements

none

Example

```
<jndi-name>ejb/OrderEJB</jndi-name>
```

pass-by-reference

Specifies the passing method used by a servlet or enterprise bean calling a remote interface method in another bean that is co-located within the same process.

- If `false` (the default if this element is not present), this application uses pass-by-value semantics.
- If `true`, this application uses pass-by-reference semantics.

NOTE The `pass-by-reference` element only applies to remote calls. As defined in the EJB 2.1 specification, section 5.4, calls to local interfaces use pass-by-reference semantics.

If the `pass-by-reference` element is set to its default value of `false`, the passing semantics for calls to remote interfaces comply with the EJB 2.1 specification, section 5.4. If set to `true`, remote calls involve pass-by-reference semantics instead of pass-by-value semantics, contrary to this specification.

Portable programs should not assume that a copy of the object is made during such a call, and thus that it's safe to modify the original. Nor should they assume that a copy is not made, and thus that changes to the object are visible to both caller and callee. When this element is set to `true`, parameters and return values should be considered read-only. The behavior of a program that modifies such parameters or return values is undefined.

When a servlet or enterprise bean calls a remote interface method in another bean that is co-located within the same process, by default the Sun Java System Application Server makes copies of all the call parameters in order to preserve the pass-by-value semantics. This increases the call overhead and decreases performance.

However, if the calling method does not mutate the object being passed as a parameter, it is safe to pass the object itself without making a copy of it. To do this, set the pass-by-reference value to `true`.

To apply pass-by-reference semantics to an entire J2EE application containing multiple EJB modules, you can set the same element in the `sun-application.xml` file. If you want to use `pass-by-reference` at both the bean and application level, the bean level takes precedence. For information about the `sun-application.xml` file, see "The sun-application.xml File" on page 147.

Subelements

none

res-ref-name

Specifies the `res-ref-name` in the corresponding J2EE `ejb-jar.xml` file `resource-ref` entry. The `res-ref-name` element specifies the name of a resource manager connection factory reference. The name must be unique within an enterprise bean.

Subelements

none

Example

```
<res-ref-name>jdbc/SimpleBank</res-ref-name>
```

resource-env-ref

Maps the `resource-env-ref-name` in the corresponding J2EE `ejb-jar.xml` file `resource-env-ref` entry to an absolute `jndi-name` in the `resources` element in the `domain.xml` file. The `resource-env-ref` element contains a declaration of an enterprise bean's reference to an administered object associated with a resource in the bean's environment.

Used in entity, message-driven, and session beans.

Subelements

The following table describes subelements for the `resource-env-ref` element.

Table 5-58 `resource-env-ref` Subelements

Subelement	Required	Description
`resource-env-ref-name`	only one	Specifies the `resource-env-ref-name` in the corresponding J2EE `ejb-jar.xml` file `resource-env-ref` entry.
`jndi-name`	only one	Specifies the absolute `jndi-name`.

Example

```
<resource-env-ref>
    <resource-env-ref-name>
    jms/StockQueueName
    </resource-env-ref-name>
    <jndi-name>jms/StockQueue</jndi-name>
</resource-env-ref>
```

resource-env-ref-name

Specifies the `resource-ref-name` in the corresponding J2EE `ejb-jar.xml` file `resource-env-ref` entry. The `resource-env-ref-name` element specifies the name of a resource environment reference; its value is the environment entry name used in the EJB code. The name must be unique within an enterprise bean.

Subelements

none

Example

```
<resource-env-ref-name>jms/StockQueue</resource-env-ref-name>
```

resource-ref

Maps the `res-ref-name` in the corresponding J2EE `ejb-jar.xml` file `resource-ref` entry to the absolute `jndi-name` in the `resources` element in the `domain.xml` file. The `resource-ref` element contains a declaration of an EJB's reference to an external resource. Used in entity, message-driven, and session beans.

NOTE Connections acquired from JMS connection factories are not shareable in the current release of the Sun Java System Application Server. The `res-sharing-scope` element in the `ejb-jar.xml` file `resource-ref` element is ignored for JMS connection factories.

When `resource-ref` specifies a JMS connection factory for the Sun Java System Message Queue, the `default-resource-principal` (name/password) must exist in the Sun Java System Message Queue user repository. Refer to the Security Management chapter in the *Sun Java System Message Queue Administrator's Guide* for information on how to manage the Sun Java System Message Queue user repository.

Subelements

The following table describes subelements for the `resource-ref` element.

Table 5-59 `resource-ref` Subelements

Subelement	Required	Description
`res-ref-name`	only one	Specifies the `res-ref-name` in the corresponding J2EE `ejb-jar.xml` file `resource-ref` entry.
`jndi-name`	only one	Specifies the absolute `jndi-name`.

Table 5-59 `resource-ref` Subelements *(Continued)*

Subelement	Required	Description
`default-resource-principal`	zero or one	Specifies the default sign-on (name/password) to the resource manager.

Example

```
<resource-ref>
    <res-ref-name>jdbc/EmployeeDBName</res-ref-name>
    <jndi-name>jdbc/EmployeeDB</jndi-name>
</resource-ref>
```

message-destination

Specifies the name of a logical `message-destination` defined within an application. The `message-destination-name` matches the corresponding `message-destination-name` in the `ejb-jar.xml` file.

Subelements

The following table describes subelements for the `message-destination` element.

Table 5-60 `message-destination` subelements

Element	Required	Description
`message-destination-name`	only one	Specifies the name of a logical message destination defined within the corresponding `ejb-jar.xml` file.
`jndi-name`	only one	Specifies the `jndi-name` of the associated entity.

message-destination-name

Contains data that specifies the name of a logical message destination defined within the corresponding `ejb-jar.xml` file.

Subelements

none

Messaging Elements

This section contains the following elements associated with messaging:

- `activation-config`
- `activation-config-property`
- `activation-config-property-name`
- `activation-config-property-value`
- `jms-durable-subscription-name`
- `jms-max-messages-load`
- `mdb-connection-factory`
- `mdb-resource-adapter`
- `message-destination`
- `message-destination-name`
- `resource-adapter-mid`

activation-config

Specifies an activation configuration, which includes the runtime configuration properties of the message-driven bean in its operational environment. For example, this may include information about the name of a physical JMS destination. Matches and overrides the `activation-config` element in the `ejb-jar.xml` file.

Subelements

The following table describes subelements for the `activation-config` element.

Table 5-61 `activation-config` subelements

Element	Required	Description
`description`	zero or one	Specifies a text description of the activation configuration.
`activation-config-property`	one or more	Specifies an activation configuration property.

activation-config-property

Specifies the name and value of an activation configuration property.

Subelements

The following table describes subelements for the `activation-config-property` element.

Table 5-62 `activation-config-property` subelements

Element	Required	Description
`activation-config-property-name`	only one	Specifies the name of an activation configuration property.
`activation-config-property-value`	only one	Specifies the value of an activation configuration property.

activation-config-property-name

Contains data that specifies the name of an activation configuration property.

Subelements

none

activation-config-property-value

Contains data that specifies the value of an activation configuration property.

Subelements

none

jms-durable-subscription-name

Specifies the durable subscription associated with a message-driven bean class. Only applies to the Java Message Service Topic Destination type, and only when the message-driven bean deployment descriptor subscription durability is Durable.

Subelements

none

jms-max-messages-load

Specifies the maximum number of messages to load into a Java Message Service session at one time for a message-driven bean to serve. The default is 1.

Subelements

none

mdb-connection-factory

Specifies the connection factory associated with a message-driven bean. Queue or Topic type must be consistent with the Java Message Service Destination type associated with the message-driven bean class.

Subelements

The following table describes subelements for the `mdb-connection-factory` element.

Table 5-63 `mdb-connection-factory` Subelements

Subelement	Required	Description
`jndi-name`	only one	Specifies the absolute `jndi-name`.
`default-resource-principal`	zero or one	Specifies the default sign-on (name/password) to the resource manager.

mdb-resource-adapter

Specifies runtime configuration information for a message-driven bean.

Subelements

The following table describes subelements for the `mdb-resource-adapter` element.

Table 5-64 `mdb-resource-adapter` subelements

Element	Required	Description
`resource-adapter-mid`	zero or one	Specifies a resource adapter module ID.
`activation-config`	one or more	Specifies an activation configuration.

resource-adapter-mid

Contains data that specifies the module ID of the resource adapter that is responsible for delivering messages to the message-driven bean.

Subelements

none

Security Elements

This section describes the elements that are associated with authentication, authorization, and general security. The following elements are included:

- as-context
- auth-method
- caller-propagation
- confidentiality
- default-resource-principal
- establish-trust-in-client
- establish-trust-in-target
- integrity
- ior-security-config
- name
- password
- realm
- required
- sas-context
- transport-config

as-context

Specifies the authentication mechanism that will be used to authenticate the client. If specified, it will be USERNAME_PASSWORD.

Subelements

The following table describes subelements for the as-context element.

Table 5-65 as-context Subelements

Subelement	Required	Description
auth-method	only one	Specifies the authentication method. The only supported value is USERNAME_PASSWORD.
realm	only one	Specifies the realm in which the user is authenticated.

Table 5-65 `as-context` Subelements *(Continued)*

Subelement	Required	Description
`required`	only one	Specifies if the authentication method specified is required to be used for client authentication. If so, the EstablishTrustInClient bit will be set in the target_requires field of as-context. The value is true or false.

auth-method

Specifies the authentication method. The only supported value is `USERNAME_PASSWORD`.

Subelements

none

caller-propagation

Specifies if the target will accept propagated caller identities. The values are NONE, SUPPORTED, or REQUIRED.

Subelements

none

confidentiality

Specifies if the target supports privacy-protected messages. The values are NONE, SUPPORTED, or REQUIRED.

Subelements

none

default-resource-principal

Specifies the default sign-on (name/password) to the resource manager.

Subelements

The following table describes subelements for the `default-resource-principal` element.

Table 5-66 `default-resource-principal` Subelements

Subelement	Required	Description
`name`	only one	Specifies the default resource principal name used to sign on to a resource manager.

Table 5-66 `default-resource-principal` Subelements *(Continued)*

Subelement	Required	Description
`password`	only one	Specifies password of the default resource principal.

establish-trust-in-client

Specifies if the target is capable of authenticating a client. The values are NONE, SUPPORTED, or REQUIRED.

Subelements

none

establish-trust-in-target

Specifies if the target is capable of authenticating *to* a client. The values are NONE, SUPPORTED, or REQUIRED.

Subelements

none

integrity

Specifies if the target supports integrity-protected messages. The values are NONE, SUPPORTED, or REQUIRED.

Subelements

none

ior-security-config

Specifies the security information for the input-output redirection (IOR).

Subelements

The following table describes subelements for the `ior-security-config` element.

Table 5-67 `ior-security-config` Subelements

Subelement	Required	Description
`transport-config`	zero or one	Specifies the security information for transport.
`as-context`	zero or one	Describes the authentication mechanism that will be used to authenticate the client. If specified, it will be `USERNAME_PASSWORD`.

Table 5-67 `ior-security-config` Subelements *(Continued)*

Subelement	Required	Description
`sas-context`	zero or one	Describes the sas-context fields.

name

Specifies the name of an entity.

Subelements

none

password

Specifies the password that security needs to complete authentication.

Subelements

none

realm

Specifies the realm in which the user is authenticated.

Subelements

none

required

Specifies if the authentication method specified is required to be used for client authentication. If so, the `EstablishTrustInClient` bit will be set in the `target_requires` field of `as-context`. The value is either true or false.

Subelements

none

sas-context

Describes the sas-context fields.

Subelements

The following table describes subelements for the `sas-context` element.

Table 5-68 `sas-context` Subelements

Subelement	Required	Description
`caller-propagation`	only one	Specifies if the target will accept propagated caller identities. The values are NONE, SUPPORTED, or REQUIRED.

transport-config

Specifies the security transport information.

Subelements

The following table describes subelements for the `transport-config` element.

Table 5-69 `transport-config` Subelements

Subelement	Required	Description
`integrity`	only one	Specifies if the target supports integrity-protected messages. The values are NONE, SUPPORTED, or REQUIRED.
`confidentiality`	only one	Specifies if the target supports privacy-protected messages. The values are NONE, SUPPORTED, or REQUIRED.
`establish-trust-in-target`	only one	Specifies if the target is capable of authenticating *to* a client. The values are NONE, SUPPORTED, or REQUIRED.
`establish-trust-in-client`	only one	Specifies if the target is capable of authenticating a client. The values are NONE, SUPPORTED, or REQUIRED.

Persistence Elements

This section describes the elements associated with container-managed persistence (CMP), the persistence manager, and the persistence vendor. For information on using these elements, refer to Chapter 8, “Using Container-Managed Persistence for Entity Beans.”

The following elements are included:

- `cmp`
- `cmp-resource`
- `create-tables-at-deploy`
- `database-vendor-name`

- `drop-tables-at-undeploy`
- `finder`
- `is-one-one-cmp`
- `mapping-properties`
- `method-name`
- `one-one-finders`
- `pm-class-generator`
- `pm-config`
- `pm-descriptor`
- `pm-descriptors`
- `pm-identifier`
- `pm-inuse`
- `pm-mapping-factory`
- `pm-version`
- `query-filter`
- `query-ordering`
- `query-params`
- `query-variables`
- `schema-generator-properties`

cmp

Describes runtime information for a CMP entity bean object for EJB1.1 and EJB2.1 beans.

Subelements

The following table describes subelements for the `cmp` element.

Table 5-70 `cmp` Subelements

Subelement	Required	Description
`mapping-properties`	zero or one	This element is not implemented.
`is-one-one-cmp`	zero or one	This element is not implemented.

Table 5-70 `cmp` Subelements *(Continued)*

Subelement	Required	Description
`one-one-finders`	zero or one	Describes the finders for CMP 1.1 beans.

cmp-resource

Specifies the database to be used for storing CMP beans. For more information about this element, see "Configuring the Resource Manager" on page 318.

Subelements

The following table describes subelements for the `cmp-resource` element.

Table 5-71 `cmp-resource` Subelements

Subelement	Required	Description
`jndi-name`	only one	Specifies the absolute `jndi-name`.
`default-resource-principal`	zero or one	Specifies the default runtime bindings of a resource reference.
`property`	zero or more	Specifies a property name and value.
`create-tables-at-deploy`	zero or one	If `true`, specifies that database tables are created for beans that are automatically mapped by the EJB container.
`drop-tables-at-undeploy`	zero or one	If `true`, specifies that database tables that were automatically created when the bean(s) were last deployed are dropped when the bean(s) are undeployed.
`database-vendor-name`	zero or one	Specifies the name of the database vendor for which tables can be created.
`schema-generator-properties`	zero or one	Specifies field-specific type mappings and allows you to set the `use-unique-table-names` property.

create-tables-at-deploy

Contains data that specifies whether database tables are created for beans that are automatically mapped by the EJB container. If `true`, creates tables in the database. If `false`, does not create tables.

This element can be overridden during deployment. See Table 8-2 on page 310.

Subelements

none

database-vendor-name

Contains data that specifies the name of the database vendor for which tables can be created. Allowed values are db2, mssql, oracle, pointbase, and sybase, case-insensitive.

If no value is specified, a connection is made to the resource specified by the jndi-name subelement of the cmp-resource element, and the database vendor name is read. If the connection cannot be established, or if the value is not recognized, SQL-92 compliance is presumed.

This element can be overridden during deployment. See Table 8-2 on page 310.

Subelements

none

drop-tables-at-undeploy

Contains data that specifies whether database tables that were automatically created when the bean(s) were last deployed are dropped when the bean(s) are undeployed. If true, drops tables from the database. If false, does not drop tables.

This element can be overridden during deployment. See Table 8-2 on page 310.

Subelements

none

finder

Describes the finders for CMP 1.1 with a method name and query.

Subelements

The following table describes subelements for the finder element.

Table 5-72 finder Subelements

Subelement	Required	Description
method-name	only one	Specifies the method name for the finder.
query-params	zero or one	Specifies the query parameters for the CMP 1.1 finder.
query-filter	zero or one	Specifies the query filter for the CMP 1.1 finder.
query-variables	zero or one	Specifies variables in query expression for the CMP 1.1 finder.

Table 5-72 `finder` Subelements *(Continued)*

Subelement	Required	Description
`query-ordering`	zero or one	Specifies the query ordering for the CMP 1.1 finder.

is-one-one-cmp

This element is not implemented.

Subelements

none

mapping-properties

This element is not implemented.

Subelements

none

method-name

Specifies the method name for the finder. The `method-name` element contains a name of an EJB method.

Examples

```
<method-name>findTeammates</method-name>
```

```
<method-name>*</method-name>
```

Subelements

none

one-one-finders

Describes the finders for CMP 1.1 beans.

Subelements

The following table describes subelements for the `one-one-finders` element.

Table 5-73 one-one-finders Subelements

Subelement	Required	Description
finder	one or more	Describes the finders for CMP 1.1 with a method name and query.

pm-class-generator

Specifies which vendor-specific concrete class generator is to be used. This is the name of the class specific to the vendor.

Subelements

none

pm-config

Specifies the vendor-specific configuration file to be used.

Subelements

none

pm-descriptor

Describes the properties of the persistence manager associated with an entity bean.

Subelements

The following table describes subelements for the pm-descriptor element.

Table 5-74 pm-descriptor Subelements

Subelement	Required	Description
pm-identifier	only one	Specifies the vendor who provided the persistence manager implementation. For example, this could be Sun Java System Application Server CMP or a third-party vendor.
pm-version	only one	Specifies which version of the persistence manager vendor product is to be used.
pm-config	zero or one	Specifies the vendor-specific configuration file to be used.
pm-class-generator	zero or one	Specifies which vendor-specific concrete class generator is to be used. This is the name of the class specific to the vendor.

Table 5-74 `pm-descriptor` Subelements *(Continued)*

Subelement	Required	Description
`pm-mapping-factory`	zero or one	Specifies which vendor-specific mapping factory is to be used. This is the name of the class specific to the vendor.

pm-descriptors

Specifies one or more persistence manager descriptors, but only one of them must be in use at any given time. If none are specified, the Sun CMP persistence manager is used.

Subelements

The following table describes subelements for the `pm-descriptors` element.

Table 5-75 `pm-descriptors` Subelements

Subelement	Required	Description
`pm-descriptor`	one or more	Describes the properties of the persistence manager associated with an entity bean.
`pm-inuse`	only one	Specifies whether this particular persistence manager must be used or not.

pm-identifier

Specifies the vendor who provided the persistence manager implementation. For example, this could be Sun Java System Application Server CMP or a third-party vendor.

Subelements

none

pm-inuse

Specifies whether this particular persistence manager must be used or not.

Subelements

The following table describes subelements for the `pm-inuse` element.

Table 5-76 `pm-insue` Subelements

Subelement	Required	Description
`pm-identifier`	only one	Contains data that specifies the vendor who provided the persistence manager implementation. For example, this could be Sun Java System Application Server CMP or a third-party vendor.
`pm-version`	only one	Contains data that specifies which version of the persistence manager vendor product is to be used.

pm-mapping-factory

Specifies which vendor-specific mapping factory is to be used. This is the name of the class specific to the vendor.

Subelements

none

pm-version

Specifies which version of the persistence manager vendor product is to be used.

Subelements

none

query-filter

Specifies the query filter for the CMP 1.1 finder.

Subelements

none

query-ordering

Specifies the query ordering for the CMP 1.1 finder.

Subelements

none

query-params

Specifies the query parameters for the CMP 1.1 finder.

Subelements

none

query-variables

Specifies variables in query expression for the CMP 1.1 finder.

Subelements

none

schema-generator-properties

Specifies field-specific type mappings in `property` subelements.

Also allows you to set the `use-unique-table-names` property. If `true`, this property specifies that generated table names are unique within each application server domain. The default is `false`. This property can be overridden during deployment. See Table 8-2 on page 310.

Subelements

The following table describes subelements for the `schema-generator-properties` element.

Table 5-77 `schema-generator-properties` Subelements

Subelement	Required	Description
`property`	zero or more	Specifies a property name and value.

Example

```
<schema-generator-properties>
    <property>
        <name>
            Employee.firstName.jdbc-type
        </name>
        <value>char</value>
    </property>
    <property>
        <name>
            Employee.firstName.jdbc-maximum-length
        </name>
        <value>25</value>
    </property>
    <property>
        <name>
            use-unique-table-names
        </name>
        <value>true</value>
    </property>
</schema-generator-properties>
```

Pooling and Caching Elements

This section describes the elements associated with cache, timeout, and the EJB pool. These elements are used to control memory usage and performance tuning. For more information, refer to the *Sun Java System Application Server Performance Tuning Guide*.

The following elements are discussed:

- bean-cache
- bean-pool
- cache-idle-timeout-in-seconds
- cmt-timeout-in-seconds
- commit-option
- is-cache-overflow-allowed
- max-cache-size
- max-pool-size
- max-wait-time-in-millis
- pool-idle-timeout-in-seconds
- removal-timeout-in-seconds
- resize-quantity
- steady-pool-size
- victim-selection-policy

bean-cache

Specifies the entity bean cache properties. Used for entity beans and stateful session beans.

Subelements

The following table describes subelements for the bean-cache element.

Table 5-78 bean-cache Subelements

Subelement	Required	Description
max-cache-size	zero or one	Specifies the maximum number of beans allowable in cache.
is-cache-overflow-allowed	zero or one	Deprecated.
cache-idle-timeout-in-seconds	zero or one	Specifies the maximum time that a stateful session bean or entity bean is allowed to be idle in cache before being passivated. Default value is 10 minutes (600 seconds).
removal-timeout-in-seconds	zero or one	Specifies the amount of time a bean remains before being removed. If removal-timeout-in-seconds is less than idle-timeout, the bean is removed without being passivated.
resize-quantity	zero or one	Specifies the number of beans to be created if the pool is empty (subject to the max-pool-size limit). Values are from 0 to MAX_INTEGER.
victim-selection-policy	zero or one	Specifies the algorithm that must be used by the container to pick victims. Applies only to stateful session beans.

Example

```
<bean-cache>
    <max-cache-size>100</max-cache-size>
    <cache-resize-quantity>10</cache-resize-quantity>
    <removal-timeout-in-seconds>3600</removal-timeout-in-seconds>
    <victim-selection-policy>LRU</victim-selection-policy>
        <cache-idle-timeout-in-seconds>
        600
        </cache-idle-timeout-in-seconds>
    <removal-timeout-in-seconds>5400</removal-timeout-in-seconds>
</bean-cache>
```

bean-pool

Specifies the pool properties of stateless session beans, entity beans, and message-driven bean.

Subelements

The following table describes subelements for the bean-pool element.

Table 5-79 bean-pool Subelements

Subelement	Required	Description
steady-pool-size	zero or one	Specifies the initial and minimum number of beans maintained in the pool. Default is 32.
resize-quantity	zero or one	Specifies the number of beans to be created if the pool is empty (subject to the max-pool-size limit). Values are from 0 to MAX_INTEGER.
max-pool-size	zero or one	Specifies the maximum number of beans in the pool. Values are from 0 to MAX_INTEGER. Default is to domain.xml or 60.
max-wait-time-in-millis	zero or one	Deprecated.
pool-idle-timeout-in-seconds	zero or one	Specifies the maximum time that a bean is allowed to be idle in the pool. After this time, the bean is removed. This is a hint to the server. Default time is 600 seconds (10 minutes).

Example

```
<bean-pool>
    <steady-pool-size>10</steady-pool-size>
    <resize-quantity>10</resize-quantity>
    <max-pool-size>100</max-pool-size>
    <pool-idle-timeout-in-seconds>600</pool-idle-timeout-in-seconds>
</bean-pool>
```

cache-idle-timeout-in-seconds

Specifies the maximum time that a bean can remain idle in the cache. After this amount of time, the container can passivate this bean. A value of 0 specifies that beans may never become candidates for passivation. Default is 600.

Applies to stateful session beans and entity beans.

Subelements

none

cmt-timeout-in-seconds

Contains data that overrides the Transaction Timeout setting of the Transaction Service for an individual bean. The default value, `0`, specifies that the default Transaction Service timeout is used. If positive, this value is used for all methods in the bean that start a new container-managed transaction. This value is *not* used if the bean joins a client transaction.

Subelements

none

commit-option

Specifies the commit option that will be used on transaction completion. Valid values for the Sun Java System Application Server are B or C. Default value is B.

NOTE Commit option A is not supported for the Sun Java System Application Server 8 release.

Applies to entity beans.

Subelements

none

Example

```
<commit-option>B</commit-option>
```

is-cache-overflow-allowed

This element is deprecated and should not be used.

max-cache-size

Specifies the maximum number of beans allowable in cache. A value of zero indicates an unbounded cache. In reality, there is no hard limit. The max-cache-size limit is just a hint to the cache implementation. Default is 512.

Applies to stateful session beans and entity beans.

Subelements

none

Example

```
<max-cache-size>100</max-cache-size>
```

max-pool-size

Specifies the maximum number of bean instances in the pool. Values are from 0 (1 for message-driven bean) to MAX_INTEGER. A value of 0 means the pool is unbounded. Default is 64.

Applies to all beans.

Subelements

none

Example

```
<max-pool-size>100</max-pool-size>
```

max-wait-time-in-millis

This element is deprecated and should not be used.

pool-idle-timeout-in-seconds

Specifies the maximum time, in seconds, that a bean instance is allowed to remain idle in the pool. When this timeout expires, the bean instance in a pool becomes a candidate for passivation or deletion. This is a hint to the server. A value of 0 specifies that idle beans can remain in the pool indefinitely. Default value is 600.

Applies to stateless session beans, entity beans, and message-driven beans.

NOTE For a stateless session bean or a message-driven bean, the bean can be removed (garbage collected) when the timeout expires.

Subelements

none

Example

```
<pool-idle-timeout-in-seconds>600</pool-idle-timeout-in-seconds>
```

removal-timeout-in-seconds

Specifies the amount of time a bean instance can remain idle in the container before it is removed (timeout). A value of 0 specifies that the container does not remove inactive beans automatically. The default value is 5400.

If `removal-timeout-in-seconds` is less than or equal to `cache-idle-timeout-in-seconds`, beans are removed immediately without being passivated.

Applies to stateful session beans.

For related information, see `cache-idle-timeout-in-seconds`.

Subelements

none

Example

```
<removal-timeout-in-seconds>3600</removal-timeout-in-seconds>
```

resize-quantity

Specifies the number of bean instances to be:

- Created, if a request arrives when the pool has less than `steady-pool-size` quantity of beans (applies to pools only for creation). If the pool has more than `steady-pool-size` minus `resize-quantity` of beans, then `resize-quantity` is still created.
- Removed, when the `pool-idle-timeout-in-seconds` timer expires and a cleaner thread removes any unused instances.
    - For caches, when `max-cache-size` is reached, `resize-quantity` beans will be selected for passivation using `victim-selection-policy`. In addition, the `cache-idle-timeout-in-seconds` or `cache-remove-timeout-in-seconds` timers will passivate beans from the cache.
    - For pools, when the `max-pool-size` is reached, `resize-quantity` beans will be selected for removal. In addition the `pool-idle-timeout-in-seconds` timer will remove beans until `steady-pool-size` is reached.

Values are from 0 to MAX_INTEGER. The pool is not resized below the `steady-pool-size`. Default is 16.

Applies to stateless session beans, entity beans, and message-driven beans.

For EJB pools, the default value can be the value of the `ejb-container` element `pool-resize-quantity` in the `domain.xml` file. Default is 16.

For EJB caches, the default value can be the value of the `ejb-container` element `cache-resize-quantity` in the `domain.xml` file. Default is 32.

For message-driven beans, the default can be the value of the `mdb-container` `pool-resize-quantity` element in the `domain.xml` file. Default is 2.

Subelements

none

Example

```
<resize-quantity>10</resize-quantity>
```

steady-pool-size

Specifies the initial and minimum number of bean instances that should be maintained in the pool. Default is 32. Applies to stateless session beans and message-driven beans.

Subelements

none

Example

```
<steady-pool-size>10</steady-pool-size>
```

victim-selection-policy

Specifies how stateful session beans are selected for passivation. Possible values are First In, First Out (FIFO), Least Recently Used (LRU), Not Recently Used (NRU). The default value is NRU, which is actually pseudo-LRU.

NOTE The user cannot plug in his own victim selection algorithm.

The victims are generally passivated into a backup store (typically a file system or database). This store is cleaned during startup, and also by a periodic background process that removes idle entries as specified by `removal-timeout-in-seconds`. The backup store is monitored by a background thread (or sweeper thread) to remove unwanted entries.

Applies to stateful session beans.

Subelements

none

Example

```
<victim-selection-policy>LRU</victim-selection-policy>
```

Class Elements

This section describes the elements associated with classes. The following elements are included:

- gen-classes
- local-home-impl
- local-impl
- remote-home-impl
- remote-impl

gen-classes

Specifies all the generated class names for a bean.

NOTE This is automatically generated by the server at deployment/redeployment time. It should not be specified by the developer or changed after deployment.

Subelements

The following table describes subelements for the `gen-class` element.

Table 5-80 `gen-classes` Subelements

Subelement	Required	Description
remote-impl	zero or one	Specifies the fully-qualified class name of the generated `EJBObject` impl class.
local-impl	zero or one	Specifies the fully-qualified class name of the generated `EJBLocalObject` impl class.
remote-home-impl	zero or one	Specifies the fully-qualified class name of the generated EJBHome impl class.
local-home-impl	zero or one	Specifies the fully-qualified class name of the generated `EJBLocalHome` impl class.

local-home-impl

Specifies the fully-qualified class name of the generated `EJBLocalHome impl` class.

NOTE This is automatically generated by the server at deployment/redeployment time. It should not be specified by the developer or changed after deployment.

Subelements

none

local-impl

Specifies the fully-qualified class name of the generated `EJBLocalObject impl` class.

NOTE This is automatically generated by the server at deployment/redeployment time. It should not be specified by the developer or changed after deployment.

Subelements

none

remote-home-impl

Specifies the fully-qualified class name of the generated `EJBHome impl` class.

NOTE This is automatically generated by the server at deployment/redeployment time. It should not be specified by the developer or changed after deployment.

Subelements

none

remote-impl

Specifies the fully-qualified class name of the generated `EJBObject impl` class.

NOTE This is automatically generated by the server at deployment/redeployment time. It should not be specified by the developer or changed after deployment.

Subelements

none

Sample sun-ejb-jar.xml File

For information on these elements, refer to "The sun-ejb-jar.xml File" on page 184.

```
<?xml version="1.0" encoding="UTF-8"?>

<!DOCTYPE sun-ejb-jar PUBLIC '-//Sun Microsystems, Inc.//DTD Application Server 8.0 EJB
2.1//EN' 'http://www.sun.com/software/appserver/dtds/sun-ejb-jar_2_1-0.dtd'>

<sun-ejb-jar>
    <display-name>First Module</display-name>
    <enterprise-beans>
        <ejb>
            <ejb-name>CustomerEJB</ejb-name>
            <jndi-name>customer</jndi-name>
            <bean-pool>
                <steady-pool-size>10</steady-pool-size>
                <resize-quantity>10</resize-quantity>
                <max-pool-size>100</max-pool-size>
                <pool-idle-timeout-in-seconds>600</pool-idle-timeout-in-seconds>
            </bean-pool>
            <bean-cache>
                <max-cache-size>100</max-cache-size>
                <resize-quantity>10</resize-quantity>
                <removal-timeout-in-seconds>3600</removal-timeout-in-seconds>
                <victim-selection-policy>LRU</victim-selection-policy>
            </bean-cache>
        </ejb>
        <cmp-resource>
            <jndi-name>jdbc/PointBase</jndi-name>
            <create-tables-at-deploy>true</create-tables-at-deploy>
            <drop-tables-at-undeploy>true</drop-tables-at-undeploy>
        </cmp-resource>
    </enterprise-beans>
</sun-ejb-jar>
```

The sun-cmp-mappings.xml File

This section describes the XML elements in the `sun-cmp-mappings.xml` file and provides database schema and XML file examples in the following sections:

- `check-all-at-commit`
- `check-modified-at-commit`
- `cmp-field-mapping`
- `cmr-field-mapping`
- `cmr-field-name`
- `column-name`
- `column-pair`
- `consistency`
- `ejb-name`
- `entity-mapping`
- `fetched-with`
- `field-name`
- `level`
- `lock-when-loaded`
- `lock-when-modified`
- `named-group`
- `none`
- `read-only`
- `schema`
- `secondary-table`
- `sun-cmp-mapping`
- `sun-cmp-mappings`
- `table-name`
- Sample Database Schema Definition
- Sample sun-cmp-mappings.xml File

"Persistence Elements" on page 206 provides information on persistence-related elements in the sun-ejb-jar.xml file.

check-all-at-commit

This element is not implemented. Do not use.

Subelements

none

check-modified-at-commit

Checks concurrent modification of fields in modified beans at commit time.

Subelements

none

cmp-field-mapping

The cmp-field-mapping element associates a field with one or more columns that it maps to. The column can be from a bean's primary table or any defined secondary table. If a field is mapped to multiple columns, the column listed first in this element is used as a source for getting the value from the database. The columns are updated in the order they appear. There is one cmp-field-mapping element for each cmp-field element defined in the ejb-jar.xml file.

Subelements

The following table describes subelements for the cmp-field-mapping element.

Table 5-81 cmp-field-mapping Subelements

Subelement	Required	Description
field-name	only one	Specifies the Java identifier of a field. This identifier must match the value of the field-name subelement of the cmp-field that is being mapped.
column-name	one or more	Specifies the name of a column from the primary table, or the qualified table name (TABLE.COLUMN) of a column from a secondary or related table.
read-only	zero or one	Specifies that a field is read-only.
fetched-with	zero or one	Specifies the fetch group for this CMP field's mapping.

cmr-field-mapping

A container-managed relationship field has a name and one or more column pairs that define the relationship. There is one `cmr-field-mapping` element for each `cmr-field` element in the `ejb-jar.xml` file. A relationship can also participate in a fetch group.

Subelements

The following table describes subelements for the `cmr-field-mapping` element.

Table 5-82 `cmr-field-mapping` Subelements

Subelement	Required	Description
`cmr-field-name`	only one	Specifies the Java identifier of a field. Must match the value of the `cmr-field-name` subelement of the `cmr-field` that is being mapped.
`column-pair`	one or more	Specifies the pair of columns that determine the relationship between two database tables.
`fetched-with`	zero or one	Specifies the fetch group for this CMR field's relationship.

cmr-field-name

Specifies the Java identifier of a field. Must match the value of the `cmr-field-name` subelement of the `cmr-field` element in the `ejb-jar.xml` file.

Subelements

none

column-name

Specifies the name of a column from the primary table, or the qualified table name (TABLE.COLUMN) of a column from a secondary or related table.

Subelements

none

column-pair

Specifies the pair of columns that determine the relationship between two database tables. Each `column-pair` must contain exactly two `column-name` subelements, which specify the column's names. The first `column-name` element names the table that this bean is mapped to, and the second `column-name` names the column in the related table.

Subelements

The following table describes subelements for the `column-pair` element.

Table 5-83 `column-pair` Subelements

Subelement	Required	Description
`column-name`	two	Specifies the name of a column from the primary table, or the qualified table name (TABLE.COLUMN) of a column from a secondary or related table.

consistency

Specifies container behavior in guaranteeing transactional consistency of the data in the bean.

Subelements

The following table describes subelements for the `consistency` element.

Table 5-84 `consistency` Subelements

Subelement	Required	Description
`check-all-at-commit`	exactly one of these elements is required	This element is not implemented. Do not use.
`check-modified-at-commit`		Checks concurrent modification of fields in modified beans at commit time.
`lock-when-loaded`		Obtains an exclusive lock when the data is loaded.
`lock-when-modified`		This element is not implemented. Do not use.
`none`		No consistency checking occurs.

ejb-name

Specifies the `ejb-name` of the entity bean in the `ejb-jar.xml` file to which the container-managed persistence (CMP) beans corresponds.

Subelements

none

entity-mapping

Specifies the mapping a bean to database columns.

Subelements

The following table describes subelements for the `entity-mapping` element.

Table 5-85 `entity-mapping` Subelements

Subelement	Required	Description
`ejb-name`	only one	Specifies the name of the entity bean in the `ejb-jar.xml` file to which the CMP bean corresponds.
`table-name`	only one	Specifies the name of a database table. The table must be present in the database schema file.
`cmp-field-mapping`	one or more	Associates a field with one or more columns that it maps to.
`cmr-field-mapping`	zero or more	A container-managed relationship field has a name and one or more column pairs that define the relationship.
`secondary-table`	zero or more	Describes the relationship between a bean's primary and secondary table.
`consistency`	zero or one	Specifies container behavior in guaranteeing transactional consistency of the data in the bean.

fetched-with

Specifies the fetch group configuration for fields and relationships. The `fetched-with` element has different default values based on its parent element.

- If there is no `fetched-with` subelement of a `cmp-field-mapping`, the default value is assumed to be:

  ```
  <fetched-with><level>0</level></fetched-with>
  ```

  The CMP field is placed into a default fetch group, which means it is fetched any time the bean is loaded from a database.

- If there is no `fetched-with` subelement of a `cmr-field-mapping`, the default value is assumed to be:

  ```
  <fetched-with><none/></fetched-with>
  ```

The CMR field is placed into a separate fetch group, which means it is loaded from a database the first time it is accessed in this transaction.

Subelements

The following table describes subelements for the `fetched-with` element.

Table 5-86 `fetched-with` Subelements

Subelement	Required	Description
`level`	exactly one of these elements is required	Specifies the name of a hierarchical fetch group.
`named-group`		Specifies the name of an independent fetch group.
`none`		Specifies that this field or relationship is fetched by itself.

field-name

Specifies the Java identifier of a field. This identifier must match the value of the `field-name` subelement of the `cmp-field` element in the `ejb-jar.xml` file.

Subelements

none

level

Specifies the name of a hierarchical fetch group. The name must be an integer. Fields and relationships that belong to a hierarchical fetch group of equal (or lesser) value are fetched at the same time. The value of level must be greater than zero. Only one is allowed.

Subelements

none

lock-when-loaded

Places a database update lock on the rows corresponding to the bean whenever the bean is loaded. How the lock is placed is database-dependent. The lock is released when the transaction finishes (commit or rollback). While the lock is placed, other database users have read access to the bean.

Subelements

none

lock-when-modified

This element is not implemented. Do not use.

Subelements

none

named-group

Specifies the name of an independent fetch group. All the fields and relationships that are part of a named group are fetched at the same time. A field can only belong to one fetch group, regardless of what type of fetch group is used. One is allowed.

Subelements

none

none

Specifies that this field or relationship is fetched by itself, with no other fields or relationships.

Subelements

none

read-only

Specifies that a field is read-only.

Subelements

none

schema

Specifies the file that contains a description of the database schema to which the beans in this `sun-cmp-mappings.xml` file are mapped. If this element is empty, the database schema file is automatically generated at deployment time. Otherwise, the `schema` element should name a `.dbschema` file with a pathname relative to the directory containing the `sun-cmp-mappings.xml` file, but without the `.dbschema` extension. For example:

```
<schema/> <!-- use automatic schema generation -->
```

```
<schema>CompanySchema</schema> <!-- use "CompanySchema.dbschema" -->
```

See "Capturing the Database Schema Automatically" on page 316.

Subelements

none

secondary-table

Specifies a bean’s secondary table(s).

Subelements

The following table describes subelements for the `secondary-table` element.

Table 5-87 `secondary table` Subelements

Subelement	Required	Description
`table-name`	only one	Specifies the name of a database table.
`column-pair`	one or more	Specifies the pair of columns that determine the relationship between two database tables.

sun-cmp-mapping

Specifies beans mapped to a particular database schema.

NOTE A bean cannot be related to a bean that maps to a different database schema, even if the beans are deployed in the same EJB JAR file.

Subelements

The following table describes subelements for the `sun-cmp-mapping` element.

Table 5-88 `sun-cmp-mapping` Subelements

Subelement	Required	Description
`schema`	only one	Specifies the file that contains a description of the database schema.
`entity-mapping`	one or more	Specifies the mapping of a bean to database columns.

sun-cmp-mappings

Specifies the set of sun-cmp-mapping elements for all the beans that are mapped in an EJB JAR collection.

Subelements

The following table describes subelements for the sun-cmp-mappings element.

Table 5-89 sun-cmp-mappings Subelements

Subelement	Required	Description
sun-cmp-mapping	one or more	Specifies beans mapped to a particular database schema.

table-name

Specifies the name of a database table. The table must be present in the database schema file. See "Capturing the Database Schema Automatically" on page 316.

Subelements

none

Sample Database Schema Definition

```
create table TEAMEJB (
    TEAMID varchar2(256) not null,
    NAME varchar2(120) null,
    CITY char(30) not null,
    LEAGUEEJB_LEAGUEID varchar2(256) null,
    constraint PK_TEAMEJB primary key (TEAMID)
)

create table PLAYEREJB (
    POSITION varchar2(15) null,
    PLAYERID varchar2(256) not null,
    NAME char(64) null,
    SALARY number(10, 2) not null,
    constraint PK_PLAYEREJB primary key (PLAYERID)
)
```

```
create table LEAGUEEJB (
    LEAGUEID varchar2(256) not null,
    NAME varchar2(256) null,
    SPORT varchar2(256) null,
    constraint PK_LEAGUEEJB primary key (LEAGUEID)
)

create table PLAYEREJBTEAMEJB (
    PLAYEREJB_PLAYERID varchar2(256) null,
    TEAMEJB_TEAMID varchar2(256) null
)

alter table TEAMEJB
    add constraint FK_LEAGUE foreign key (LEAGUEEJB_LEAGUEID)
    references LEAGUEEJB (LEAGUEID)

alter table PLAYEREJBTEAMEJB
    add constraint FK_TEAMS foreign key (PLAYEREJB_PLAYERID)
    references PLAYEREJB (PLAYERID)

alter table PLAYEREJBTEAMEJB
    add constraint FK_PLAYERS foreign key (TEAMEJB_TEAMID)
    references TEAMEJB (TEAMID)
```

Sample sun-cmp-mappings.xml File

The following mapping would be in a deployable EJB JAR file's `META-INF/sun-cmp-mappings.xml` file:

```
<?xml version="1.0" encoding="UTF-8"?>
<sun-cmp-mappings>
    <sun-cmp-mapping>
        <schema>Roster</schema>
        <entity-mapping>
            <ejb-name>TeamEJB</ejb-name>
            <table-name>TEAMEJB</table-name>
            <cmp-field-mapping>
                <field-name>teamId</field-name>
                <column-name>TEAMEJB.TEAMID</column-name>
            </cmp-field-mapping>
            <cmp-field-mapping>
                <field-name>name</field-name>
                <column-name>TEAMEJB.NAME9</column-name>
            </cmp-field-mapping>
            <cmp-field-mapping>
                <field-name>city</field-name>
            <column-name>TEAMEJB.CITY</column-name>
        </cmp-field-mapping>
        <cmr-field-mapping>
            <cmr-field-name>league</cmr-field-name>
            <column-pair>
                <column-name>TEAMEJB.LEAGUEEJB_LEAGUEID</column-name>
                <column-name>LEAGUEEJB.LEAGUEID</column-name>
            </column-pair>
            <fetched-with>
                <none/>
            </fetched-with>
        </cmr-field-mapping>
        <cmr-field-mapping>
            <cmr-field-name>players</cmr-field-name>
            <column-pair>
                <column-name>TEAMEJB.TEAMID</column-name>
                <column-name>PLAYEREJBTEAMEJB.TEAMEJB_TEAMID</column-name>
            </column-pair>
            <column-pair>
                <column-name>PLAYEREJBTEAMEJB.PLAYEREJB_PLAYERID</column-name>
                <column-name>PLAYEREJB.PLAYERID</column-name>
            </column-pair>
            <fetched-with>
                <none/>
            </fetched-with>
        </cmr-field-mapping>
    </entity-mapping>
    <entity-mapping>
        <ejb-name>PlayerEJB</ejb-name>
        <table-name>PLAYEREJB</table-name>
        <cmp-field-mapping>
            <field-name>position</field-name>
            <column-name>PLAYEREJB.POSITION9</column-name>
        </cmp-field-mapping>
        <cmp-field-mapping>
            <field-name>playerId</field-name>
            <column-name>PLAYEREJB.PLAYERID</column-name>
        </cmp-field-mapping>
        <cmp-field-mapping>
            <field-name>name</field-name>
            <column-name>PLAYEREJB.NAME9</column-name>
        </cmp-field-mapping>
        <cmp-field-mapping>
            <field-name>salary</field-name>
            <column-name>PLAYEREJB.SALARY</column-name>
            </cmp-field-mapping>
            <cmr-field-mapping>
                <cmr-field-name>teams</cmr-field-name>
                <column-pair>
                    <column-name>PLAYEREJB.PLAYERID</column-name>
                    <column-name>PLAYEREJBTEAMEJB.PLAYEREJB_PLAYERID</column-name>
                </column-pair>
                <column-pair>
                    <column-name>PLAYEREJBTEAMEJB.TEAMEJB_TEAMID</column-name>
                    <column-name>TEAMEJB.TEAMID</column-name>
                </column-pair>
                <fetched-with>
                    <none/>
                </fetched-with>
            </cmr-field-mapping>
        </entity-mapping>
        <entity-mapping>
            <ejb-name>LeagueEJB</ejb-name>
            <table-name>LEAGUEEJB</table-name>
            <cmp-field-mapping>
                <field-name>leagueId</field-name>
                <column-name>LEAGUEEJB.LEAGUEID</column-name>
            </cmp-field-mapping>
            <cmp-field-mapping>
                <field-name>name</field-name>
                <column-name>LEAGUEEJB.NAME9</column-name>
            </cmp-field-mapping>
            <cmp-field-mapping>
                <field-name>sport</field-name>
                <column-name>LEAGUEEJB.SPORT</column-name>
            </cmp-field-mapping>
            <cmr-field-mapping>
                <cmr-field-name>teams</cmr-field-name>
                <column-pair>
                    <column-name>LEAGUEEJB.LEAGUEID</column-name>
                    <column-name>TEAMEJB.LEAGUEEJB_LEAGUEID</column-name>
                </column-pair>
                <fetched-with>
                    <none/>
                </fetched-with>
            </cmr-field-mapping>
        </entity-mapping>
    </sun-cmp-mapping>
</sun-cmp-mappings>
```

The sun-application-client.xml file

This section describes the XML elements in the `sun-application-client.xml` file in the following sections:

- `sun-application-client`
- `resource-ref`
- `res-ref-name`
- `default-resource-principal`
- `name`
- `password`
- `ejb-ref`
- `ejb-ref-name`
- `resource-env-ref`
- `resource-env-ref-name`
- `message-destination`
- `message-destination-name`
- `jndi-name`
- Web Service Elements (`service-ref` and subelements only)

sun-application-client

This is the root element describing all the runtime bindings of a single application client.

Subelements

The following table describes subelements for the `sun-application-client` element.

Table 5-90 `sun-application-client` subelements

Element	Required	Description
`ejb-ref`	zero or more	Maps the absolute JNDI name to the `ejb-ref` in the corresponding J2EE XML file.
`resource-ref`	zero or more	Maps the absolute JNDI name to the `resource-ref` in the corresponding J2EE XML file.

Table 5-90 `sun-application-client` subelements *(Continued)*

Element	Required	Description
`resource-env-ref`	zero or more	Maps the absolute JNDI name to the `resource-env-ref` in the corresponding J2EE XML file.
`service-ref`	zero or more	Specifies runtime settings for a web service reference.
`message-destination`	zero or more	Specifies the name of a logical message destination.

resource-ref

Maps the absolute JNDI name to the `resource-ref` element in the corresponding J2EE XML file.

Subelements

The following table describes subelements for the `resource-ref` element.

Table 5-91 `resource-ref` subelements

Element	Required	Description
`res-ref-name`	only one	Specifies the `res-ref-name` in the corresponding J2EE `application-client.xml` file.
`jndi-name`	only one	Specifies the absolute jndi name of a resource.
`default-resource-principal`	zero or more	Specifies the default principal (user) that the container uses to access a resource.

res-ref-name

Specifies the `res-ref-name` in the corresponding J2EE `application-client.xml` file `resource-ref` entry.

Subelements

none

default-resource-principal

Specifies the default principal (user) that the container uses to access a resource.

If this element is used in conjunction with a JMS Connection Factory resource, the `name` and `password` subelements must be valid entries in Sun Java System Message Queue's broker user repository. See the "Security Management" chapter in the *Sun Java System Message Queue Administrator's Guide* for details.

Subelements

The following table describes subelements for the `default-resource-principal` element.

Table 5-92 `default-resource-principal` subelements

Element	Required	Description
`name`	only one	Specifies the name of the principal.
`password`	only one	Specifies the password for the principal.

name

Contains data that specifies the name of the entity.

Subelements

none

password

Contains data that specifies the password for the principal.

Subelements

none

ejb-ref

Maps the `ejb-ref-name` in the corresponding J2EE `application-client.xml` file `ejb-ref` entry to the absolute `jndi-name` of a bean.

Subelements

The following table describes subelements for the `ejb-ref` element.

Table 5-93 `ejb-ref` subelements

Element	Required	Description
`ejb-ref-name`	only one	Specifies the name of a ejb reference in the corresponding J2EE `application-client.xml` file.
`jndi-name`	only one	Specifies the absolute JNDI name of a bean.

ejb-ref-name

Contains data that specifies the `ejb-ref-name` in the corresponding J2EE `application-client.xml` file `ejb-ref` entry. This element locates the name of the EJB reference in the application.

Subelements

none

resource-env-ref

Specifies the name of a resource env reference.

Subelements

The following table describes subelements for the `resource-env-ref` element.

Table 5-94 `resource-env-ref` subelements

Element	Required	Description
`resource-env-ref-name`	only one	Specifies the `res-ref-name` in the corresponding J2EE `application-client.xml` file `resource-env-ref` entry.
`default-resource-principal`	only one	Specifies the default principal (user) that the container uses to access a resource.
`jndi-name`	only one	Specifies the jndi-name of the associated entity.

resource-env-ref-name

Contains data that specifies the `res-ref-name` in the corresponding J2EE `application-client.xml` file `resource-env-ref` entry.

Subelements

none

message-destination

Specifies the name of a logical message-destination defined within an application. The message-destination-name matches the corresponding message-destination-name in the application-client.xml file.

Subelements

The following table describes subelements for the message-destination element.

Table 5-95 message-destination subelements

Element	Required	Description
message-destination-name	only one	Specifies the name of a logical message destination defined within the corresponding application-client.xml file.
jndi-name	only one	Specifies the jndi-name of the associated entity.

message-destination-name

Contains data that specifies the name of a logical message destination defined within the corresponding application-client.xml file.

Subelements

none

jndi-name

Contains data that specifies the absolute jndi-name of a URL resource or a resource in the application-client.xml file.

Subelements

none

The sun-acc.xml File

This section describes the XML elements in the sun-acc.xml file:

- client-container
- target-server
- description

- `client-credential`
- `log-service`
- `security`
- `ssl`
- `cert-db`
- `auth-realm`
- `property`

client-container

Defines Sun Java System Application Server specific configuration for the ACC. This is the root element; there can only be one `client-container` element in a `sun-acc.xml` file.

Subelements

The following table describes subelements for the `client-container` element.

Table 5-96 `client-container` subelements

Element	Required	Description
`target-server`	only one	Specifies the IIOP listener configuration of the target server.
`auth-realm`	zero or one	Specifies the optional configuration for JAAS authentication realm.
`client-credential`	zero or one	Specifies the default client credential that will be sent to the server.
`log-service`	zero or one	Specifies the default log file and the severity level of the message.
`property`	zero or more	Specifies a property which has a name and a value.

Attributes

The following table describes attributes for the `client-container` element.

Table 5-97 `client-container` attributes

Attribute	Default	Description
`send-password`	`true`	If `true`, specifies that client authentication credentials should be sent to the server. Without authentication credentials, all access to protected EJB components results in exceptions.

target-server

Defines the IIOP listener configuration of the target server.

Subelements

The following table describes subelements for the `target-server` element.

Table 5-98 `target-server` subelements

Element	Required	Description
`description`	zero or one	Specifies the description of the target server.
`security`	zero or one	Specifies the security configuration for the IIOP/SSL communication with the target server.

Attributes

The following table describes attributes for the `target-server` element.

Table 5-99 `target-server` attributes

Attribute	Default	Description
`name`	none	Specifies the name of the application server instance accessed by the client container.
`address`	none	Specifies the host name or IP address (resolvable by DNS) of the server this client should attach to.
`port`	none	Specifies the naming service port number (`orb.port` in `domain.xml`) of the server this client should attach to. For a new server instance, you need to assign a port number other than 3700. You can change the port number in the Administration Console. See the *Sun Java System Application Server Administration Guide* for more information.

description

Contains data that specifies a text description of the containing element.

Subelement

none

Attributes

none

client-credential

Default client credentials that are sent to the server. If this element is present, the credentials are automatically sent to the server, without prompting the user for the user name and password on the client side.

Subelements

The following table describes subelements for the `client-credential` element.

Table 5-100 `client-credential` subelement

Element	Required	Description
`property`	zero or more	Specifies a property, which has a name and a value.

Attributes

The following table describes attributes for the `client-credential` element.

Table 5-101 `client-credential` attributes

Attribute	Default	Description
`user-name`	none	The user name used to authenticate the Application client container.
`password`	none	The password used to authenticate the Application client container.
`realm`	the default realm for the domain	(optional) The realm (specified by name) where credentials are to be resolved.

log-service

Specifies configuration settings for the log file.

Subelements

The following table describes subelements for the `log-service` element.

Table 5-102 `log-service` subelement

Element	Required	Description
`property`	zero or more	Specifies a property, which has a name and a value.

Attributes

The following table describes attributes for the `log-service` element.

Table 5-103 `log-service` attributes

Attribute	Default	Description
`log-file`	*your_ACC_dir*`/logs/client.log`	(optional) Specifies the file where the application client container logging information is stored.
`level`	SEVERE	(optional) Sets the base level of severity. Messages at or above this setting get logged to the log file.

security

Defines SSL security configuration for IIOP/SSL communication with the target server.

Subelements

The following table describes subelements for the `security` element.

Table 5-104 `security` subelement

Element	Required	Description
`ssl`	only one	Specifies the SSL processing parameters.
`cert-db`	only one	Specifies the location and authentication to read the certification database.

Attributes

none

ssl

Defines SSL processing parameters.

Subelements

none

Attributes

The following table describes attributes for the SSL element.

Table 5-105 ssl attributes

Attribute	Default	Description
cert-nickname	none	(optional) The nickname of the server certificate in the certificate database or the PKCS#11 token.In the certificate, the name format is *tokenname*:*nickname*. Including the *tokenname*: part of the name in this attribute is optional.
ssl2-enabled	false	(optional) Determines whether SSL2 is enabled.
ssl2-ciphers	none	(optional) A space-separated list of the SSL2 ciphers used with the prefix + to enable or - to disable. For example, +rc4. Allowed values are rc4, rc4export, rc2, rc2export, idea, des, desede3.
ssl3-enabled	true	(optional) Determines whether SSL3 is enabled.
ssl3-tls-ciphers	none	(optional) A space-separated list of the SSL3 ciphers used, with the prefix + to enable or - to disable, for example +rsa_des_sha. Allowed SSL3 values are rsa_rc4_128_md5, , rsa_des_sha, rsa_rc4_40_md5, rsa_rc2_40_md5, rsa_null_md5. Allowed TLS values are rsa_des_56_sha, rsa_rc4_56_sha.
tls-enabled	true	(optional) Determines whether TLS is enabled.
tls-rollback-enabled	true	(optional) Determines whether TLS rollback is enabled.TLS rollback should be enabled for MicroSoft Internet Explorer 5.0 and 5.5.

If both SSL2 and SSL3 are enabled, the server tries SSL3 encryption first. If that fails, the server tries SSL2 encryption. If both SSL2 and SSL3 are enabled for a virtual server, the server tries SSL3 encryption first. If that fails, the server tries SSL2 encryption.

cert-db

Location and password to read the certificate database. Sun Java System Application Server provides utilities with which a certificate database can be created. `certutil`, distributed as part of NSS can also be used to create certificate database.

Subelement

none

Attributes

The following table describes attributes for the `cert-db` element.

Table 5-106 `cert-db` attributes

Attribute	Default	Description
`path`	none	Specifies the absolute path of the certificate database (`cert7.db`).
`password`	none	Specifies the password to access the certificate database.

auth-realm

JAAS is available on the ACC. Defines the optional configuration for JAAS authentication realm.

Authentication realms require provider-specific properties, which vary depending on what a particular implementation needs.

For more information about how to define realms, see "Realm Configuration" on page 44.

Here is an example of the default file realm:

```
<auth-realm name="file"
       classname="com.sun.enterprise.security.auth.realm.file.FileRealm">
   <property name="file" value="domain_dir/config/keyfile"/>
   <property name="jaas-context" value="fileRealm"/>
</auth-realm>
```

Which properties an `auth-realm` element uses depends on the value of the `auth-realm` element's name attribute. The file `realm` uses `file` and `jaas-context` properties. Other realms use different properties.

Subelements

The following table describes subelements for the auth-realm element.

Table 5-107 auth-realm subelement

Element	Required	Description
property	zero or more	Specifies a property, which has a name and a value.

Attributes

The following table describes attributes for the auth-realm element.

Table 5-108 auth-realm attributes

Attribute	Default	Description
name	none	Defines the name of this realm.
classname	none	Defines the Java class which implements this realm.

property

Specifies a property, which has a name and a value.

Subelement

none

Attributes

The following table describes attributes for the property element.

Table 5-109 property attributes

Attribute	Default	Description
name	none	Specifies the name of the property.
value	none	Specifies the value of the property.

Web Service Elements

The optional web service elements described here apply to the `sun-web.xml` and `sun-ejb-jar.xml` files. The `service-ref` element and its subelements also apply to the `sun-application-client.xml` file. Web service elements are as follows:

- `webservice-description`
- `webservice-description-name`
- `wsdl-publish-location`
- `service-ref`
- `service-ref-name`
- `port-info`
- `service-endpoint-interface`
- `wsdl-port`
- `namespaceURI`
- `localpart`
- `stub-property`
- `call-property`
- `name`
- `value`
- `wsdl-override`
- `service-impl-class`
- `service-qname`
- `webservice-endpoint`
- `port-component-name`
- `endpoint-address-uri`
- `login-config`
- `auth-method`
- `transport-guarantee`
- `tie-class`

- `servlet-impl-class`

webservice-description

Specifies a name and optional publish location for a web service.

Subelements

The following table describes subelements for the `webservice-description` element.

Table 5-110 `webservice-description` subelements

Element	Required	Description
`webservice-description-name`	only one	Specifies a unique name for the web service within a web or EJB module.
`wsdl-publish-location`	zero or one	Specifies the URL of a directory to which a web service's WSDL should be published during deployment.

webservice-description-name

Contains data that specifies a unique name for the web service within a web or EJB module.

Subelements

none

wsdl-publish-location

Specifies the URL of a directory to which a web service's WSDL should be published during deployment. Any required files are published to this directory, preserving their location relative to the module-specific WSDL directory (`META-INF/wsdl` or `WEB-INF/wsdl`). For example, suppose you have an `ejb.jar` file whose `webservices.xml` file's `wsdl-file` element contains the following reference:

```
META-INF/wsdl/a/Foo.wsdl
```

Suppose your `sun-ejb-jar` file contains the following element:

```
<wsdl-publish-location>file:/home/user1/publish</wsdl-publish-location>
```

The final WSDL is stored in `/home/user1/publish/a/Foo.wsdl`.

Subelements

none

service-ref

Specifies runtime settings for a web service reference. Runtime information is only needed in the following cases:

- To define the port used to resolve a container-managed port
- To define the default Stub/Call property settings for Stub objects
- To define the URL of a final WSDL document to be used instead of the one associated with the `service-ref` in the standard J2EE deployment descriptor

Subelements

The following table describes subelements for the `service-ref` element.

Table 5-111 `service-ref` subelements

Element	Required	Description
`service-ref-name`	only one	Specifies the web service reference name relative to `java:comp/env`.
`port-info`	zero or more	Specifies information for a port within a web service reference.
`call-property`	zero or more	Specifies JAX-RPC property values that should be set on a `javax.xml.rpc.Call` object before it is returned to the web service client.
`wsdl-override`	zero or one	Specifies a valid URL pointing to a final WSDL document.
`service-impl-class`	zero or one	Specifies the name of the generated service implementation class.
`service-qname`	zero or one	Specifies the WSDL service element that is being referred to.

service-ref-name

Contains data that specifies the web service reference name relative to `java:comp/env`.

Subelements

none

port-info

Specifies information for a port within a web service reference.

Either a service-endpoint-interface or a wsdl-port or both should be specified. If both are specified, wsdl-port specifies the port that the container should choose for container-managed port selection.

The same wsdl-port value must not appear in more than one port-info element within the same service-ref.

If a service-endpoint-interface is using container-managed port selection, its value must not appear in more than one port-info element within the same service-ref.

Subelements

The following table describes subelements for the port-info element.

Table 5-112 port-info subelements

Element	Required	Description
service-endpoint-interface	zero or one	Specifies the web service reference name relative to java:comp/env.
wsdl-port	zero or one	Specifies the WSDL port.
stub-property	zero or more	Specifies JAX-RPC property values that should be set on a javax.xml.rpc.Stub object before it is returned to the web service client.
call-property	zero or more	Specifies JAX-RPC property values that should be set on a javax.xml.rpc.Call object before it is returned to the web service client.

service-endpoint-interface

Contains data that specifies the web service reference name relative to java:comp/env.

Subelements

none

wsdl-port

Specifies the WSDL port.

Subelements

The following table describes subelements for the wsdl-port element.

Table 5-113 `wsdl-port` subelements

Element	Required	Description
`namespaceURI`	only one	Specifies the namespace URI.
`localpart`	only one	Specifies the local part of a QNAME.

namespaceURI

Contains data that specifies the namespace URI.

Subelements

none

localpart

Contains data that specifies the local part of a QNAME.

Subelements

none

stub-property

Specifies JAX-RPC property values that should be set on a `javax.xml.rpc.Stub` object before it is returned to the web service client. The property names can be any properties supported by the JAX-RPC `Stub` implementation.

Subelements

The following table describes subelements for the `stub-property` element.

Table 5-114 `stub-property` subelements

Element	Required	Description
`name`	only one	Specifies the name of the entity.
`value`	only one	Specifies the value of the entity.

Example

```
<service-ref>
    <service-ref-name>service/FooProxy</service-ref-name>
    <port-info>
        <service-endpoint-interface>a.FooPort</service-endpoint-interface>
        <wsdl-port>
            <namespaceURI>urn:Foo</namespaceURI>
            <localpart>FooPort</localpart>
        </wsdl-port>
        <stub-property>
            <name>javax.xml.rpc.service.endpoint.address</name>
            <value>http://localhost:8080/a/Foo</value>
        </stub-property>
    </port-info>
</service-ref>
```

call-property

Specifies JAX-RPC property values that should be set on a `javax.xml.rpc.Call` object before it is returned to the web service client. The property names can be any properties supported by the JAX-RPC `Call` implementation.

Subelements

The following table describes subelements for the `call-property` element.

Table 5-115 `call-property` subelements

Element	Required	Description
`name`	only one	Specifies the name of the entity.
`value`	only one	Specifies the value of the entity.

name

Contains data that specifies the name of the entity.

Subelements

none

value

Contains data that specifies the value of the entity.

Subelements

none

wsdl-override

Contains data that specifies a valid URL pointing to a final WSDL document. If not specified, the WSDL document associated with the `service-ref` in the standard J2EE deployment descriptor is used.

Subelements

none

Example

```
// available via HTTP
<wsdl-override>http://localhost:8000/myservice/myport?WSDL</wsdl-override>

// in a file
<wsdl-override>file:/home/user1/myfinalwsdl.wsdl</wsdl-override>
```

service-impl-class

Contains data that specifies the name of the generated service implementation class.

Subelements

none

service-qname

Specifies the WSDL service element that is being referred to.

Subelements

The following table describes subelements for the `service-qname` element.

Table 5-116 `service-qname` subelements

Element	Required	Description
`namespaceURI`	only one	Specifies the namespace URI.
`localpart`	only one	Specifies the local part of a QNAME.

webservice-endpoint

Specifies information about a web service endpoint.

Subelements

The following table describes subelements for the `webservice-endpoint` element.

Table 5-117 `webservice-endpoint` subelements

Element	Required	Description
`port-component-name`	only one	Specifies a unique name for a port component within a web or EJB module.
`endpoint-address-uri`	zero or one	Specifies the automatically generated endpoint address.
`login-config`	zero or one	Specifies the authentication configuration for an EJB web service endpoint.
`transport-guarantee`	zero or one	Specifies that the communication between client and server should be `NONE`, `INTEGRAL`, or `CONFIDENTIAL`.
`service-qname`	zero or one	Specifies the WSDL service element that is being referred to.
`tie-class`	zero or one	Specifies the automatically generated name of a tie implementation class for a port component.
`servlet-impl-class`	zero or one	Specifies the automatically generated name of the generated servlet implementation class.

port-component-name

Contains data that specifies a unique name for a port component within a web or EJB module.

Subelements

none

endpoint-address-uri

Contains data that specifies the relative path combined with the web server root to form the fully qualified endpoint address for a web service endpoint. This is a required element for EJB endpoints and an optional element for servlet endpoints.

For servlet endpoints, this value is relative to the web application context root. For EJB endpoints, the URI is relative to root of the web server (the first portion of the URI is a context root). The context root portion should not conflict with the context root of any web application deployed to the same web server.

In all cases, this value must be a fixed pattern (no '*' allowed).

If the web service endpoint is a servlet that implements only a single endpoint and has only one `url-pattern`, it is not necessary to set this value, because the web container can derive it from the `web.xml` file.

Subelements

none

Example

If the web server is listening at `http://localhost:8080`, the following endpoint-address-uri:

```
<endpoint-address-uri>StockQuoteService/StockQuotePort</endpoint-address-uri>
```

results in the following target endpoint address:

```
http://localhost:8080/StockQuoteService/StockQuotePort
```

login-config

Specifies the authentication configuration for an EJB web service endpoint. Not needed for servlet web service endpoints. A servlet's security configuration is contained in the `web.xml` file.

Subelements

The following table describes subelements for the `login-config` element.

Table 5-118 `login-config` subelements

Element	Required	Description
`auth-method`	only one	Specifies the authentication mechanism.

auth-method

Contains data that specifies the authentication mechanism for the web service endpoint. As a prerequisite to gaining access to any web resources protected by an authorization constraint, a user must have authenticated using the configured mechanism.

Subelements

none

transport-guarantee

Contains data specifying that the communication between client and server should be `NONE`, `INTEGRAL`, or `CONFIDENTIAL`.

- `NONE` means the application does not require any transport guarantees.
- `INTEGRAL` means the application requires that the data sent between client and server be sent in such a way that it can’t be changed in transit.
- `CONFIDENTIAL` means the application requires that the data be transmitted in a fashion that prevents other entities from observing the contents of the transmission.

In most cases, a value of `INTEGRAL` or `CONFIDENTIAL` indicates that the use of SSL is required.

Subelements

none

tie-class

Contains data that specifies the automatically generated name of a tie implementation class for a port component.

Subelements

none

servlet-impl-class

Contains data that specifies the automatically generated name of the servlet implementation class.

Subelements

none

Part II

Developing Application Components

Chapter 6

Developing Web Applications

This chapter describes how web applications are supported in Sun Java System Application Server 8 and includes the following sections:

- Introducing Web Applications
- Using Servlets
- Using JavaServer Pages
- Creating and Managing User Sessions

For general information about web applications, see the J2EE tutorial:

`http://java.sun.com/j2ee/1.4/docs/tutorial/doc/WebApp.html#wp76431`

Introducing Web Applications

This section includes summaries of the following topics:

- Internationalization Issues
- Virtual Servers
- Default Web Modules
- Configuring Logging in the Web Container

Internationalization Issues

This section covers internationalization as it applies to the following:

- The Server
- Servlets

The Server

To set the default locale of the entire Sun Java System Application Server, which determines the locale of the Administration Console, the logs, and so on, do one of the following:

- Use the Administration Console:

  a. Login to the Administration Console by going to the following URL in your web browser:

  `http://`*host*`:`*port*`/asadmin`

  For example:

  `http://localhost:4848/asadmin`

  b. Go to the Application Server page.

  c. Click on the Advanced tab.

  d. Type a value in the Locale field.

  e. Select Save.

- Set the `locale` attribute of the `domain` element in the `domain.xml` file, then restart the server. For more information about this file, see the *Sun Java System Application Server Reference*.

Servlets

This section explains how the Sun Java System Application Server determines the character encoding for the servlet request and the servlet response.

For encodings you can use, see:

`http://java.sun.com/j2se/1.4/docs/guide/intl/encoding.doc.html`

Servlet Request

When processing a servlet request, the server uses the following order of precedence, first to last, to determine the request character encoding:

- The `setCharacterEncoding()` method.
- A hidden field in the form, specified by the `form-hint-field` attribute of the `parameter-encoding` element in the `sun-web.xml` file.
- The character encoding set in the `default-charset` attribute of the `parameter-encoding` element in the `sun-web.xml` file.
- The default, which is `ISO-8859-1`.

For more information about the `parameter-encoding` element, see "parameter-encoding" on page 183.

Servlet Response

When processing a servlet response, the server uses the following order of precedence, first to last, to determine the response character encoding:

- The `setCharacterEncoding()` or `setContentType()` method.
- The `setLocale()` method.
- The default, which is `ISO-8859-1`.

Virtual Servers

A virtual server, also called a virtual host, is a virtual web server that serves content targeted for a specific URL. Multiple virtual servers may serve content using the same or different host names, port numbers, or IP addresses. The HTTP service can direct incoming web requests to different virtual servers based on the URL.

When you first install Sun Java System Application Server, a default virtual server is created. (You can also assign a default virtual server to each new HTTP listener you create. For details, see the *Sun Java System Application Server Administration Guide*.)

Web applications and J2EE applications containing web components can be assigned to virtual servers. You can assign virtual servers in either of these ways:

- Using the Administration Console
- Editing the domain.xml File

Using the Administration Console

To use the Administration Console to assign virtual servers:

1. Deploy the application or web module and assign the desired virtual server to it as described in "Tools for Deployment" on page 106.
2. Login to the Administration Console by going to the following URL in your web browser:

   `http://`*host*`:`*port*`/asadmin`

   For example:

   `http://localhost:4848/asadmin`
3. Open the HTTP Service component.
4. Open the Virtual Servers component under the HTTP Service component.
5. Select the virtual server to which you want to assign a default web module.
6. Select the application or web module from the Default Web Module drop-down list.
7. Select the Save button.

For more information, see "Default Web Modules" on page 265.

Editing the domain.xml File

When a web module is deployed as part of an application, a `j2ee-application` element is created for it in `domain.xml` during deployment. When a web module is deployed as an individual module, a `web-module` element is created for it in `domain.xml` during deployment. The `j2ee-application` and `web-module` elements both have a `virtual-servers` attribute, which specifies a list of virtual server IDs. The `virtual-servers` attribute is empty by default, which means that the web application is assigned to all virtual servers.

Each `virtual-server` element in `domain.xml` has a `default-web-module` attribute, which allows you to configure a default web module for each virtual server. A default web module for the default virtual server is provided at installation. For more information, see "Default Web Modules" on page 265.

For more information about `domain.xml` and virtual servers, see the *Sun Java System Application Server Reference*.

Default Web Modules

You can assign a default web module to the default virtual server and to each new virtual server you create. For details, see "Virtual Servers" on page 263. To access the default web module for a virtual server, point your browser to the URL for the virtual server, but do not supply a context root. For example:

```
http://myvserver:3184/
```

A virtual server with no default web module assigned serves HTML or JSP content from its document root, which is usually *domain_dir*/`docroot`. To access this HTML or JSP content, point your browser to the URL for the virtual server, do not supply a context root, but specify the target file.

For example:

```
http://myvserver:3184/hellothere.jsp
```

Configuring Logging in the Web Container

You can configure logging in the web container for the entire server in these ways:

- By using the Administration Console; see the *Sun Java System Application Server Administration Guide*.
- By editing the `domain.xml` file; see the *Sun Java System Application Server Reference*.

Using Servlets

Sun Java System Application Server supports the Java Servlet Specification version 2.4.

NOTE Servlet API version 2.4 is fully backward compatible with version 2.3, so all existing servlets will continue to work without modification or recompilation.

To develop servlets, use Sun Microsystems' Java Servlet API. For information about using the Java Servlet API, see the documentation provided by Sun Microsystems at:

`http://java.sun.com/products/servlet/index.html`

This section describes how to create effective servlets to control application interactions running on a Sun Java System Application Server, including standard servlets. In addition, this section describes the Sun Java System Application Server features to use to augment the standards.

This section contains the following topics:

- Handling Threading Issues
- Invoking a Servlet with a URL
- Servlet Output
- Caching Servlet Results
- About the Servlet Engine

Handling Threading Issues

By default, servlets are not thread-safe. One way to make a servlet (or a block within a servlet) thread-safe is to use the `javax.servlet.SingleThreadModel` class to create a single-threaded servlet. When a single-threaded servlet is deployed to the Sun Java System Application Server, the servlet engine creates a servlet instance pool used for incoming requests (multiple copies of the same servlet in memory).

You can change the number of servlet instances in the pool by setting the `singleThreadedServletPoolSize` property of the `sun-web-app` element in the `sun-web.xml` file. For more information on `sun-web.xml`, see "The sun-web.xml File" on page 151.

A single-threaded servlet is slower under load because new requests must wait for a free servlet instance in order to proceed, but this is not a problem with distributed, load-balanced applications since the load automatically shifts to a less busy process.

NOTE The `javax.servlet.SingleThreadModel` class is deprecated in the Servlet API version 2.4.

Invoking a Servlet with a URL

You can call servlets deployed to the Sun Java System Application Server by using URLs embedded as links in an application's HTML or JSP pages. The format of these URLs is as follows:

`http://`*server*`:`*port*`/`*context_root*`/`*servlet_name*`?`*name*`=`*value*

The following table describes each URL section.

Table 6-1 URL Fields for Servlets Within an Application

URL element	Description
server:*port*	The IP address (or host name) and optional port number. To access the default web module for a virtual server, specify only this URL section. You do not need to specify the *context_root* or *servlet_name* unless you also wish to specify name-value parameters.
context_root	For an application, the context root is defined in the `context-root` element of the `application.xml` or `sun-application.xml` file. For an individually deployed web module, you specify the context root during deployment.
servlet_name	The `servlet-name` (or `servlet-mapping` if defined) as configured in the `web.xml` file.
?*name*=*value*...	Optional servlet name-value parameters.

In this example, `localhost` is the host name, `MortPages` is the context root, and `calcMortgage` is the servlet name:

```
http://localhost:8080/MortPages/calcMortgage?rate=8.0&per=360&bal=180000
```

Servlet Output

`ServletContext.log` messages are sent to the server log.

By default, the `System.out` and `System.err` output of servlets are sent to the server log, and during start-up server log messages are echoed to the `System.err` output. Also by default, there is no Windows-only console for the `System.err` output. You can change these defaults in these ways:

- Using the Administration Console
- Editing the domain.xml File

Using the Administration Console

Use the Administration Console as follows:

1. Login to the Administration Console by going to the following URL in your web browser:

   `http://`*host*`:`*port*`/asadmin`

   For example:

   ```
   http://localhost:4848/asadmin
   ```

2. Select the Application Server page.
3. Click on the Logging tab.
4. Check or uncheck these boxes:
   - Log Messages to Standard Error - If checked, `System.err` output is sent to the server log.
   - Write to System Log - If checked, `System.out` output is sent to the server log.
5. Select Save.

For more information, see the *Sun Java System Application Server Administration Guide*.

Editing the domain.xml File

Edit the `domain.xml` file, entering the desired `true` or `false` values, then restart the server:

```
<log-service   use-system-logging=true
               log-to-console=true />
```

For more information about `domain.xml`, see the *Sun Java System Application Server Reference*.

Caching Servlet Results

The Sun Java System Application Server can cache the results of invoking a servlet, a JSP, or any URL pattern to make subsequent invocations of the same servlet, JSP, or URL pattern faster. The Sun Java System Application Server caches the request results for a specific amount of time. In this way, if another data call occurs, the Sun Java System Application Server can return the cached data instead of performing the operation again. For example, if your servlet returns a stock quote that updates every 5 minutes, you set the cache to expire after 300 seconds.

Whether to cache results and how to cache them depends on the data involved. For example, it makes no sense to cache the results of a quiz submission, because the input to the servlet is different each time. However, you could cache a high level report showing demographic data taken from quiz results that is updated once an hour.

You can define how a Sun Java System Application Server web application handles response caching by editing specific fields in the `sun-web.xml` file. In this way, you can create portable servlets that still take advantage of this valuable Sun Java System Application Server feature.

For more information about JSP caching, see "JSP Caching" on page 276.

The rest of this section covers the following topics:

- Caching Features
- Default Cache Configuration
- Caching Example
- CacheHelper Interface
- CacheKeyGenerator Interface

Caching Features

Sun Java System Application Server 8 has the following web application response caching capabilities:

- Caching is configurable based on the servlet name or the URI.
- When caching is based on the URI, this includes user specified parameters in the query string. For example, a response from `/garden/catalog?category=roses` is different from a response from `/garden/catalog?category=lilies`. These responses are stored under different keys in the cache.
- Cache size, entry timeout, and other caching behaviors are configurable.
- Entry timeout is measured from the time an entry is created or refreshed. You can override this timeout for an individual cache mapping by specifying the `cache-mapping` subelement `timeout`.
- You can determine caching criteria programmatically by writing a cache helper class. For example, if a servlet only knows when a back end data source was last modified, you can write a helper class to retrieve the last modified timestamp from the data source and decide whether to cache the response based on that timestamp. See "CacheHelper Interface" on page 271.

- You can determine cache key generation programmatically by writing a cache key generator class. See "CacheKeyGenerator Interface" on page 273.
- All non-ASCII request parameter values specified in cache key elements must be URL encoded. The caching subsystem attempts to match the raw parameter values in the request query string.
- Since newly updated classes impact what gets cached, the web container clears the cache during dynamic deployment or reloading of classes.
- The following `HttpServletRequest` request attributes are exposed:
    - `com.sun.appserv.web.cachedServletName`, the cached servlet target
    - `com.sun.appserv.web.cachedURLPattern`, the URL pattern being cached

Default Cache Configuration

If you enable caching but do not provide any special configuration for a servlet or JSP, the default cache configuration is as follows:

- The default cache timeout is 30 seconds.
- Only the HTTP GET method is eligible for caching.
- HTTP requests with cookies or sessions automatically disable caching.
- No special consideration is given to `Pragma:`, `Cache-control:`, or `Vary:` headers.
- The default key consists of the Servlet Path (minus `pathInfo` and the query string).
- A "least recently used" list is maintained to evict cache entries if the maximum cache size is exceeded.
- Key generation concatenates the servlet path with key field values, if any are specified.

Caching Example

Here is an example cache element in the `sun-web.xml` file:

```
<cache max-capacity="8192" timeout="60">
    <cache-helper name="myHelper" class-name="MyCacheHelper"/>
    <cache-mapping>
        <servlet-name>myservlet</servlet name
        <timeout name="timefield">120</timeout>
        <http-method>GET</http-method>
        <http-method>POST</http-method>
    </cache-mapping>
    <cache-mapping>
        <url-pattern> /catalog/* </url-pattern>
        <!-- cache the best selling category; cache the responses to
          -- this resource only when the given parameters exist. cache
          -- only when the catalog parameter has 'lilies' or 'roses'
          -- but no other catalog varieties:
          -- /orchard/catalog?best&category='lilies'
          -- /orchard/catalog?best&category='roses'
          -- but not the result of
          -- /orchard/catalog?best&category='wild'
        -->
        <constraint-field name='best' scope='request.parameter'/>
        <constraint-field name='category' scope='request.parameter'>
            <value> roses </value>
            <value> lilies </value>
        </constraint-field>
        <!-- Specify that a particular field is of given range but the
          -- field doesn't need to be present in all the requests -->
        <constraint-field name='SKUnum' scope='request.parameter'>
            <value match-expr='in-range'> 1000 - 2000 </value>
        </constraint-field>
        <!-- cache when the category matches with any value other than
          -- a specific value -->
        <constraint-field name="category" scope="request.parameter>
            <value match-expr="equals" cache-on-match-failure="true">bogus</value>
        </constraint-field>
    </cache-mapping>
    <cache-mapping>
        <servlet-name> InfoServlet </servlet name>
        <cache-helper-ref>myHelper</cache-helper-ref>
    </cache-mapping>
</cache>
```

For more information about the `sun-web.xml` caching settings, see "Caching Elements" on page 168.

CacheHelper Interface

Here is the `CacheHelper` interface:

```
package com.sun.appserv.web.cache;

import java.util.Map

import javax.servlet.ServletContext;
import javax.servlet.http.HttpServletRequest;

/** CacheHelper interface is an user-extensible interface to customize:
 *  a) the key generation b) whether to cache the response.
 */
public interface CacheHelper {

    // name of request attributes
    public static final String ATTR_CACHE_MAPPED_SERVLET_NAME =
                                 "com.sun.appserv.web.cachedServletName";
    public static final String ATTR_CACHE_MAPPED_URL_PATTERN =
                                 "com.sun.appserv.web.cachedURLPattern";

    public static final int TIMEOUT_VALUE_NOT_SET = -2;

    /** initialize the helper
     *  @param context the web application context this helper belongs to
     *  @exception Exception if a startup error occurs
     */
    public void init(ServletContext context, Map props) throws Exception;

    /** getCacheKey: generate the key to be used to cache this request
     *  @param request incoming <code>HttpServletRequest</code> object
     *  @returns the generated key for this requested cacheable resource.
     */
    public String getCacheKey(HttpServletRequest request);

    /** isCacheable: is the response to given request cachebale?
     *  @param request incoming <code>HttpServletRequest</code> object
     *  @returns <code>true</code> if the response could be cached. or
     *  <code>false</code> if the results of this request must not be cached.
     */
    public boolean isCacheable(HttpServletRequest request);

    /** isRefreshNeeded: is the response to given request be refreshed?
     *  @param request incoming <code>HttpServletRequest</code> object
     *  @returns <code>true</code> if the response needs to be refreshed.
     *  or return <code>false</code> if the results of this request
     *  don't need to be refreshed.
     */
    public boolean isRefreshNeeded(HttpServletRequest request);

    /** get timeout for the cached response.
     *  @param request incoming <code>HttpServletRequest</code> object
     *  @returns the timeout in seconds for the cached response; a return
     *  value of -1 means the response never expires and a value of -2 indicates
     *  helper cannot determine the timeout (container assigns default timeout)
     */
    public int getTimeout(HttpServletRequest request);

    /**
     * Stop the helper from active use
     * @exception Exception if an error occurs
     */
    public void destroy() throws Exception;
}
```

CacheKeyGenerator Interface

The built-in default CacheHelper implementation allows web applications to customize the key generation. An application component (in a servlet or JSP) can set up a custom CacheKeyGenerator implementation as an attribute in the ServletContext.

The name of the context attribute is configurable as the value of the cacheKeyGeneratorAttrName property in the default-helper element of the sun-web.xml deployment descriptor. For more information, see "default-helper" on page 171.

Here is the CacheKeyGenerator interface:

```
package com.sun.appserv.web.cache;

import javax.servlet.ServletContext;
import javax.servlet.http.HttpServletRequest;

/** CacheKeyGenerator: a helper interface to generate the key that
 *  is used to cache this request.
 *
 * Name of the ServletContext attribute implementing the
 * CacheKeyGenerator is configurable via a property of the
 * default-helper in sun-web.xml:
 * <default-helper>
 *   <property
 *     name="cacheKeyGeneratorAttrName"
 *     value="com.acme.web.MyCacheKeyGenerator" />
 * </default-helper>
 *
 * Caching engine looks up the specified attribute in the servlet
 * context; the result of the lookup must be an implementation of the
 * CacheKeyGenerator interface.
 */

public interface CacheKeyGenerator {
    /** getCacheKey: generate the key to be used to cache the
     *  response.
     *  @param context the web application context
     *  @param request incoming <code>HttpServletRequest</code>
     *  @returns key string used to access the cache entry.
     *  if the return value is null, a default key is used.
     */
    public String getCacheKey(ServletContext context,
                                 HttpServletRequest request);
}
```

About the Servlet Engine

Servlets exist in and are managed by the servlet engine in the Sun Java System Application Server. The servlet engine is an internal object that handles all servlet meta functions. These functions include instantiation, initialization, destruction, access from other components, and configuration management. This section covers the following topics:

- Instantiating and Removing Servlets
- Request Handling
- Allocating Servlet Engine Resources

Instantiating and Removing Servlets

After the servlet engine instantiates the servlet, the servlet engine runs its `init()` method to perform any necessary initialization. Override this method to perform an initialization function for the servlet's life, such as initializing a counter.

When a servlet is removed from service, the servlet engine calls the `destroy()` method in the servlet so that the servlet can perform any final tasks and deallocate resources. Override this method to write log messages or clean up any lingering connections that won't be caught in garbage collection.

Request Handling

When a request is made, the Sun Java System Application Server hands the incoming data to the servlet engine. The servlet engine processes the request's input data, such as form data, cookies, session information, and URL name-value pairs, into an `HttpServletRequest` request object type.

The servlet engine also creates an `HttpServletResponse` response object type. The engine then passes both as parameters to the servlet's `service()` method.

In an HTTP servlet, the default `service()` method routes requests to another method based on the HTTP transfer method: `POST`, `GET`, `DELETE`, `HEAD`, `OPTIONS`, `PUT`, or `TRACE`. For example, HTTP `POST` requests are sent to the `doPost()` method, HTTP `GET` requests are sent to the `doGet()` method, and so on. This enables the servlet to process request data differently, depending on which transfer method is used. Since the routing takes place in the service method, you generally do not override `service()` in an HTTP servlet. Instead, override `doGet()`, `doPost()`, and so on, depending on the request type you expect.

To perform the tasks to answer a request, override the `service()` method for generic servlets, and the `doGet()` or `doPost()` methods for HTTP servlets. Very often, this means accessing EJB components to perform business transactions, collating the information in the request object or in a JDBC `ResultSet` object, and then passing the newly generated content to a JSP for formatting and delivery back to the user.

Allocating Servlet Engine Resources

By default, the servlet engine creates a thread for each new request. This is less resource intensive than instantiating a new servlet copy in memory for each request. Avoid threading issues, since each thread operates in the same memory space where servlet object variables can overwrite each other.

If a servlet is specifically written as a single thread, the servlet engine creates a pool of servlet instances to be used for incoming requests. If a request arrives when all instances are busy, it is queued until an instance becomes available. The number of pool instances is configurable in the `sun-web.xml` file, in the `singleThreadedServletPoolSize` property of the `sun-web-app` element.

For more information about the `sun-web.xml` file, see "The sun-web.xml File" on page 151. For more information on threading issues, see "Handling Threading Issues" on page 266.

Using JavaServer Pages

Sun Java System Application Server 8 supports the following JSP features:

- JavaServer Pages (JSP) Specification version 2.0
- Precompilation of JSPs, which is especially useful for production servers
- JSP tag libraries and standard portable tags

For information about creating JSPs, see Sun Microsystem's JavaServer Pages web site at:

`http://java.sun.com/products/jsp/index.html`

For information about Java Beans, see Sun Microsystem's JavaBeans web page at:

`http://java.sun.com/beans/index.html`

This section describes how to use JavaServer Pages (JSPs) as page templates in a Sun Java System Application Server web application. This section contains the following topics:

- JSP Tag Libraries and Standard Portable Tags
- JSP Caching
- Compiling JSPs: The Command-Line Compiler

JSP Tag Libraries and Standard Portable Tags

Sun Java System Application Server supports tag libraries and standard portable tags. For more information, see the JavaServer Pages Standard Tag Library (JSTL) page:

`http://java.sun.com/products/jsp/jstl/index.jsp`

Web applications don't need to bundle copies of the `jsf-impl.jar` or `appserv-jstl.jar` JSP tag libraries (in *install_dir*`/lib`) to use JavaServer™ Faces technology or JSTL, respectively. These tag libraries are automatically available to all web applications.

However, the *install_dir*`/lib/appserv-tags.jar` tag library for JSP caching is not automatically available to web applications. See "JSP Caching," next.

JSP Caching

JSP caching lets you cache JSP page fragments within the Java engine. Each can be cached using different cache criteria. For example, suppose you have page fragments to view stock quotes, weather information, and so on. The stock quote fragment can be cached for 10 minutes, the weather report fragment for 30 minutes, and so on.

For more information about response caching as it pertains to servlets, see "Caching Servlet Results" on page 268.

JSP caching is implemented by a tag library packaged into the *install_dir*`/lib/appserv-tags.jar` file, which you can copy into the `WEB-INF/lib` directory of your web application. The `appserv-tags.tld` tag description file is in this JAR file.

NOTE Web applications that use this tag library are not portable.

To allow all web applications to share this tag library, change the following element in the `domain.xml` file:

```
<jvm-options>-Dcom.sun.enterprise.taglibs=appserv-jstl.jar,jsf-impl.jar</jvm-options>
```

to this:

```
<jvm-options>-Dcom.sun.enterprise.taglibs=appserv-jstl.jar,jsf-impl.jar,appserv-tags.jar
</jvm-options>
```

For more information about the `domain.xml` file, see the *Sun Java System Application Server Reference*.

You refer to these tags in your JSP files as follows:

`<%@ taglib prefix="`*prefix*`" uri="Sun ONE Application Server Tags" %>`

Subsequently, the cache tags are available as `<`*prefix*`:cache>` and `<`*prefix*`:flush>`. For example, if your *prefix* is `mypfx`, the cache tags are available as `<mypfx:cache>` and `<mypfx:flush>`.

If you wish to use a different URI for this tag library, you can use an explicit `<taglib>` element in your `web.xml` file.

The tags are as follows:

- cache
- flush

cache

The cache tag caches the body between the beginning and ending tags according to the attributes specified. The first time the tag is encountered, the body content is executed and cached. Each subsequent time it is run, the cached content is checked to see if it needs to be refreshed and if so, it is executed again, and the cached data is refreshed. Otherwise, the cached data is served.

Attributes

The following table describes attributes for the `cache` tag.

Table 6-2 `cache` Attributes

Attribute	Default	Description
`key`	*ServletPath_Suffix*	(optional) The name used by the container to access the cached entry. The cache key is suffixed to the servlet path to generate a key to access the cached entry. If no key is specified, a number is generated according to the position of the tag in the page.

Table 6-2 cache Attributes *(Continued)*

Attribute	Default	Description
`timeout`	`60s`	(optional) The time in seconds after which the body of the tag is executed and the cache is refreshed. By default, this value is interpreted in seconds. To specify a different unit of time, add a suffix to the timeout value as follows: s for seconds, `m` for minutes, h for hours, d for days. For example, 2h specifies two hours.
`nocache`	`false`	(optional) If set to `true`, the body content is executed and served as if there were no cache tag. This offers a way to programmatically decide whether the cached response should be sent or whether the body has to be executed, though the response is not cached.
`refresh`	`false`	(optional) If set to `true`, the body content is executed and the response is cached again. This lets you programmatically refresh the cache immediately regardless of the `timeout` setting.

Example

The following example represents a cached JSP page:

```
<%@ taglib prefix="mypfx" uri="Sun ONE Application Server Tags" %>

<%
    String cacheKey = null;
    if (session != null)
        cacheKey = (String)session.getAttribute("loginId");

    // check for nocache
    boolean noCache = false;
    String nc = request.getParameter("nocache");
    if (nc != null)
        noCache = "true";

    // force reload
    boolean reload=false;
    String refresh = request.getParameter("refresh");
    if (refresh != null)
        reload = true;
%>

<mypfx:cache key="<%= cacheKey %>" nocache="<%= noCache %>" refresh="<%=
reload %>" timeout="10m">
```

```
<%
    String page = request.getParameter("page");
    if (page.equals("frontPage") {
        // get headlines from database
    } else {
        .....
%>
</mypfx:cache>

<mypfx:cache timeout="1h">
<h2> Local News </h2>
<%
    // get the headline news and cache them
%>
</mypfx:cache>
```

flush

Forces the cache to be flushed. If a `key` is specified, only the entry with that key is flushed. If no key is specified, the entire cache is flushed.

Attributes

The following table describes attributes for the `flush` tag.

Table 6-3 `flush` Attributes

Attribute	Default	Description
`key`	*ServletPath_Suffix*	(optional) The name used by the container to access the cached entry. The cache key is suffixed to the servlet path to generate a key to access the cached entry. If no key is specified, a number is generated according to the position of the tag in the page.

Examples

To flush the entry with `key="foobar"`:

```
<mypfx:flush key="foobar"/>
```

To flush the entire cache:

```
<c:if test="${empty sessionScope.clearCache}">
    <mypfx:flush />
</c:if>
```

Compiling JSPs: The Command-Line Compiler

Sun Java System Application Server provides the following ways of compiling JSP 2.0 compliant source files into servlets:

- JSPs are automatically compiled at runtime.
- The `asadmin deploy` command has a `precompilejsp` option; see "asadmin deploy" on page 107.
- The `sun-appserv-jspc` Ant task allows you to precompile JSPs; see "sun-appserv-jspc" on page 125.
- The `jspc` command line tool, described in this section, allows you to precompile JSPs at the command line.

The `jspc` command line tool is located under *install_dir*`/bin` (make sure this directory is in your path). The format of the `jspc` command is as follows:

`jspc [`*options*`]` *file_specifier*

The following table shows what *file_specifier* can be in the `jspc` command.

Table 6-4 File Specifiers for the `jspc` Command

File Specifier	Description
files	One or more JSP files to be compiled.
`-webapp` *dir*	A directory containing a web application. All JSPs in the directory and its subdirectories are compiled. You cannot specify a WAR, JAR, or ZIP file; you must first extract it to an open directory structure.
`-uriroot` *dir*	Same as `-webapp`.

The following table shows the *options* for the `jspc` command.

Table 6-5 `jspc` Options

Option	Description
`-d` *dir*	Specifies the output directory for the compiled JSPs. Package directories are automatically generated based on the directories containing the uncompiled JSPs. The default top-level directory is the directory from which `jspc` is invoked.

Table 6-5 `jspc` Options *(Continued)*

Option	Description
`-p` *name*	Specifies the name of the target package for all specified JSPs, overriding the default package generation performed by the `-d` option.
`-c` *name*	Specifies the target class name of the first JSP compiled. Subsequent JSPs are unaffected. Useful only with the *files* file specifier.
`-v`	Enables verbose mode.
`-mapped`	Generates separate `write` calls for each HTML line and comments that describe the location of each line in the JSP file. By default, all adjacent `write` calls are combined and no location comments are generated.
`-die [`*code*`]`	Returns the error number specified by *code* if an error occurs. If the *code* is absent or unparseable it defaults to `1`. If the *code* is not `0`, any exception during precompilation causes a call to `java.lang.System.exit()` with the specified *code*.
`-webinc` *file*	Creates partial servlet mappings for the `-webapp` option, which can be pasted into a `web.xml` file.
`-webxml` *file*	Creates an entire `web.xml` file for the `-webapp` option.
`-ieplugin` *class_id*	Specifies the Java plug-in COM class ID for Internet Explorer. Used by the `<jsp:plugin>` tags.
`-xpoweredBy`	Causes an `X-Powered-By: JSP/2.0` response header to be added to JSP generated responses. This may be useful for gathering statistical information about JSP technology.

For example, this command compiles all the JSP files in the web application under `webappdir` into class files under `webappdir/classes` and creates the `web.xml` file:

```
jspc -d webappdir/classes -webapp webappdir -webxml web.xml
```

To use these precompiled JSPs in a web application, put the classes under `webappdir/classes` into a JAR file, and place the JAR file under `WEB-INF/lib`.

The presence of both the precompiled classes and the servlet mappings in `web.xml` prevents the JSP compiler from being invoked when the web application is invoked.

Creating and Managing User Sessions

This chapter describes how to create and manage a session that allows users and transaction information to persist between interactions.

This chapter contains the following sections:

- Configuring Sessions
- Session Managers

Configuring Sessions

You can configure whether and how sessions use cookies and URL rewriting by editing the `session-properties` and `cookie-properties` elements in the `sun-web.xml` file for an individual web application. See "session-properties" on page 161 and "cookie-properties" on page 162 for more about the properties you can configure.

Session Managers

A session manager automatically creates new session objects whenever a new session starts. In some circumstances, clients do not join the session, for example, if the session manager uses cookies and the client does not accept cookies.

Sun Java System Application Server gives you these session management options, determined by the `session-manager` element's `persistence-type` attribute in the `sun-web.xml` file:

- The memory Persistence Type, the default
- The file Persistence Type, which uses a file to store session data

NOTE If the session manager configuration contains an error, the error is written to the server log and the default (`memory`) configuration is used.

The memory Persistence Type

This persistence type is not designed for a production environment. It provides no session persistence. However, you can configure it so that the session state in memory is written to the file system prior to server shutdown.

To specify the memory persistence type for a specific web application, edit the sun-web.xml file as in the following example. The persistence-type property is optional, but must be set to memory if included.

```
<sun-web-app>
    ...
    <session-config>
        <session-manager persistence-type=memory>
            <manager-properties>
                <property name="reapIntervalSeconds" value="20" />
            </manager-properties>
        </session-manager>
        ...
    </session-config>
    ...
</sun-web-app>
```

The memory persistence type supports all the manager properties listed under "manager-properties" on page 159.

For more information about the sun-web.xml file, see "The sun-web.xml File" on page 151.

The file Persistence Type

This persistence type provides session persistence to the local file system, and allows a single server domain to recover the session state after a failure and restart. The session state is persisted in the background, and the rate at which this occurs is configurable. The store also provides passivation and activation of the session state to help control the amount of memory used. This option is not supported in a production environment.

To specify the file persistence type for a specific web application, edit the sun-web.xml file as in the following example. Note that persistence-type must be set to file.

```
<sun-web-app>
    ...
    <session-config>
        <session-manager persistence-type=file>
            <store-properties>
                <property name=directory value=sessiondir />
            </store-properties>
        </session-manager>
        ...
    </session-config>
    ...
</sun-web-app>
```

The `file` persistence type supports all the manager properties listed under "manager-properties" on page 159 except `sessionFilename`, and the `directory` store property listed under "store-properties" on page 160.

For more information about the `sun-web.xml` file, see "The sun-web.xml File" on page 151.

Chapter 7

Using Enterprise JavaBeans Technology

This section provides an overview of how the Java™ 2 Platform, Enterprise Edition (J2EE™ platform) Enterprise JavaBeans™ (EJB™) technology works in the application programming model of the Sun Java™ System Application Server environment. This section addresses the following topics:

- Summary of EJB 2.1 Changes
- Value Added Features
- EJB Timer Service
- Using Session Beans
- Using Read-Only Beans
- Using Message-Driven Beans
- Handling Transactions with Enterprise Beans

Summary of EJB 2.1 Changes

Sun Java System Application Server supports the Sun Microsystems Enterprise JavaBeans (EJB) architecture as defined by the Enterprise JavaBeans Specification, v2.1 and is compliant with the Enterprise JavaBeans Specification, v2.0.

NOTE You can deploy existing 2.0 beans in the Sun Java System Application Server, but new beans should be developed as 2.1 enterprise beans.

The changes in the Enterprise JavaBeans Specification, v2.1 that impact enterprise beans in the Sun Java System Application Server environment are as follows:

- **EJB Timer Service:** This is a container-managed, reliable, and transactional notification service that provides methods to allow callbacks to be scheduled for time-based events. See "EJB Timer Service" on page 289.
- **Message-driven beans:** This type of enterprise bean can consume any inbound messages from a Connector 1.5 inbound resource adapter, primarily but not exclusively JMS messages. See "Using Message-Driven Beans" on page 296.
- **EJB Web Services:** A stateless session bean can serve as a web service endpoint. In addition, all EJB component types can act as web service clients. For details, see the web service elements in the `sun-ejb-jar.xml` file, described in "The sun-ejb-jar.xml File" on page 184.

Value Added Features

The Sun Java System Application Server provides a number of value additions that relate to EJB development. These capabilities are discussed in the following sections (references to more in-depth material are included):

- Read-Only Beans
- pass-by-reference
- Pooling and Caching
- Bean-Level Container-Managed Transaction Timeouts

Read-Only Beans

Another feature that the Sun Java System Application Server provides is the *read-only bean*, an entity bean that is never modified by an EJB client. Read-only beans avoid database updates completely. A read-only bean must use bean-managed persistence and is not portable.

A read-only bean can be used to cache a database entry that is frequently accessed but rarely updated (externally by other beans). When the data that is cached by a read-only bean is updated by another bean, the read-only bean can be notified to refresh its cached data.

The Sun Java System Application Server provides a number of ways by which a read-only bean's state can be refreshed. By setting the `refresh-period-in-seconds` element in the `sun-ejb-jar.xml` file and the `trans-attribute` element in the `ejb-jar.xml` file, it is easy to configure a read-only bean that is (a) always refreshed, (b) periodically refreshed, (c) never refreshed, or (d) programmatically refreshed.

Read-only beans are best suited for situations where the underlying data never changes, or changes infrequently. For further information and usage guidelines, see "Using Read-Only Beans" on page 292.

pass-by-reference

The `pass-by-reference` element in the `sun-ejb-jar.xml` file allows you to specify the parameter passing semantics for co-located remote EJB invocations. This is an opportunity to improve performance. Use of this feature can result in non-portable applications. See "pass-by-reference" on page 195.

Pooling and Caching

The EJB container of the Sun Java System Application Server pools anonymous instances (message-driven beans, stateless session beans, and entity beans) to reduce the overhead of creating and destroying objects. The EJB container maintains the free pool for each bean that is deployed. Bean instances in the free pool have no identity (that is, no primary key associated) and are used to serve the method calls of the home interface. The free beans are also used to serve all methods for stateless session beans.

Bean instances in the free pool transition from a Pooled state to a Cached state after `ejbCreate` and the business methods run. The size and behavior of each pool can be controlled using pool-related properties in the `domain.xml` and `sun-ejb-jar.xml` files.

In addition, the Sun Java System Application Server supports a number of tunable parameters that can be used to control the number of "stateful" instances (stateful session beans and entity beans) cached as well as the duration they are cached. Multiple bean instances that refer to the same database row in a table can be cached. The EJB container maintains a cache for each bean that is deployed.

To achieve scalability, the container will selectively evicts some bean instances from the cache, usually when cache overflows. These evicted bean instances return to the free bean pool. The size and behavior of each cache can be controlled using the cache-related properties in the `domain.xml` and `sun-ejb-jar.xml` files.

Pooling and caching parameters for the `sun-ejb-jar.xml` file are discussed in "Pooling and Caching Elements" on page 215.

Pooling Parameters

One of the most important parameters of Sun Java System Application Server pooling is `steady-pool-size`. When `steady-pool-size` is set to greater than 0, the container not only pre-populates the bean pool with the specified number of beans, but also attempts to ensure that there is always this many beans in the free pool. This ensures that there are enough beans in the ready to serve state to process user requests.

This parameter does not necessarily guarantee that no more than `steady-pool-size` instances exist at a given time. It only governs the number of instances that are pooled over a long period of time. For example, suppose an idle stateless session container has a fully-populated pool with a `steady-pool-size` of `10`. If 20 concurrent requests arrive for the EJB component, the container creates 10 additional instances to satisfy the burst of requests. The advantage of this is that it prevents the container from blocking any of the incoming requests. However, if the activity dies down to 10 or fewer concurrent requests, the additional 10 instances are discarded.

Another parameter, `pool-idle-timeout-in-seconds`, allows the administrator to specify, through the amount of time a bean instance can be idle in the pool. When `pool-idle-timeout-in-seconds` is set to greater than 0, the container removes/destroys any bean instance that is idle for this specified duration.

Caching Parameters

Sun Java System Application Server provides a way that completely avoids caching of entity beans, using commit-C option. Commit-C option is particularly useful if beans are accessed in large number but very rarely reused. For additional information, refer to "Commit Options" on page 303.

The Sun Java System Application Server caches can be either bounded or unbounded. *Bounded caches* have limits on the number of beans that they can hold beyond which beans are passivated. For stateful session beans, there are three ways (LRU, NRU and FIFO) of picking victim beans when cache overflow occurs. Caches can also be configured to passivate beans that were idle (not accessed for a specified duration) to be passivated.

Bean-Level Container-Managed Transaction Timeouts

The default transaction timeout for the domain is specified using the Transaction Timeout setting of the Transaction Service. A transaction started by the container must commit (or rollback) within this time, regardless of whether the transaction is suspended (and resumed), or the transaction is marked for rollback.

You can override this timeout for an individual bean using the optional cmt-timeout-in-seconds element in sun-ejb-jar.xml. The default value, 0, specifies that the default Transaction Service timeout is used. The value of cmt-timeout-in-seconds is used for all methods in the bean that start a new container-managed transaction. This value is *not* used if the bean joins a client transaction.

EJB Timer Service

The EJB Timer Service uses a database to store persistent information about EJB timers. By default, the EJB Timer Service in Sun Java System Application Server is preconfigured to use an embedded version of PointBase. You can change the EJB Timer Service configuration to store persistent timer information in any database supported by the Sun Java System Application Server CMP container. See “Configurations for Specific JDBC Drivers” on page 364.

To change the database used by the EJB Timer Service, set the EJB Timer Service’s Timer Datasource setting to a valid JDBC resource. You must also create the timer database table. DDL files for PointBase (ejbtimer_pointbase.sql) and Oracle (ejbtimer_oracle.sql) are located in *install_dir*/lib/install/databases.

Using the EJB Timer Service is equivalent to interacting with a single JDBC resource manager. If an EJB component or application accesses a database either directly through JDBC or indirectly (for example, through an entity bean’s persistence mechanism), and also interacts with the EJB Timer Service, its data source must be configured with an XA JDBC driver.

You can change the following EJB Timer Service settings. You must restart the server for the changes to take effect.

- Minimum Delivery Interval - Specifies the minimum time in milliseconds before an expiration for a particular timer can occur. This guards against extremely small timer increments that can overload the server. The default is 7000.
- Maximum Redeliveries - Specifies the maximum number of times the EJB timer service attempts to redeliver a timer expiration due for exception or rollback. The default is 1.
- Redelivery Interval - Specifies how long in milliseconds the EJB timer service waits after a failed ejbTimeout delivery before attempting a redelivery. The default is 5000.
- Timer Datasource - Specifies the database used by the EJB Timer Service. The default is jdbc/__TimerPool.

Using Session Beans

This section provides guidelines for creating session beans in the Sun Java System Application Server 8 environment. This section addresses the following topics:

- About the Session Bean Containers
- Restrictions and Optimizations

Extensive information on session beans is contained in the chapters 6, 7, and 8 of the Enterprise JavaBeans Specification, v2.1.

About the Session Bean Containers

Like an entity bean, a session bean can access a database through Java™ Database Connectivity (JDBC™) calls. A session bean can also provide transaction settings. These transaction settings and JDBC calls are referenced by the session bean's container, allowing it to participate in transaction managed by the container.

A container managing stateless session beans has a different charter from a container managing stateful session beans.

Stateless Container

The *stateless container* manages the stateless session beans, which, by definition, do not carry client-specific states. Therefore, all session beans (of a particular type) are considered equal.

A stateless session bean container uses a bean pool to service requests. The Sun Java System Application Server-specific deployment descriptor file, `sun-ejb-jar.xml`, contains the properties that define the pool:

- `steady-pool-size`
- `resize-quantity`
- `max-pool-size`
- `pool-idle-timeout-in-seconds`

For more information about `sun-ejb-jar.xml`, see "The sun-ejb-jar.xml File" on page 184.

Stateful Container

The *stateful container* manages the stateful session beans, which, by definition, carry the client-specific state. There is a one-to-one relationship between the client and the stateful session beans. At creation, each stateful session bean is given a unique session ID that is used to access the session bean so that an instance of a stateful session bean is accessed by a single client only.

Stateful session beans are managed using cache. The size and behavior of stateful session beans cache can be controlled by specifying the following `sun-ejb-jar.xml` parameters:

- `max-cache-size`
- `resize-quantity`
- `cache-idle-timeout-in-seconds`
- `removal-timeout-in-seconds`
- `victim-selection-policy`

The `max-cache-size` element specifies the maximum number of session beans that are held in cache. If the cache overflows (when the number of beans exceeds `max-cache-size`), the container then passivates some beans or writes out the serialized state of the bean into a file. The directory in which the file is created is obtained from the `domain.xml` file using the configuration APIs.

For more information about `sun-ejb-jar.xml`, see "The sun-ejb-jar.xml File" on page 184.

The passivated beans are stored on the file system.The Session Store Location setting in the EJB container allows the administrator to specify the directory where passivated beans are stored. By default, passivated stateful session beans are stored in application-specific subdirectories created under *domain_dir*/`session-store`.

Restrictions and Optimizations

This section discusses restrictions on developing session beans and provides some optimization guidelines:

- Optimizing Session Bean Performance
- Restricting Transactions

Optimizing Session Bean Performance

For stateful session beans, co-locating the stateful beans with their clients so that the client and bean are executing in the same process address space will improve performance.

Restricting Transactions

The following restrictions on transactions are enforced by the container and must be observed as you develop session beans:

- A session bean can participate in, at most, a single transaction at a time.
- If a session bean is participating in a transaction, a client cannot invoke a method on the bean such that the `trans-attribute` element in the `ejb-jar.xml` file would cause the container to execute the method in a different or unspecified transaction context or an exception is thrown.
- If a session bean instance is participating in a transaction, a client cannot invoke the `remove` method on the session object’s home or component interface object or an exception is thrown.

Using Read-Only Beans

A *read-only bean* is an entity bean that is never modified by an EJB client. The data that a read-only bean represents may be updated externally by other enterprise beans, or by other means, such as direct database updates.

NOTE For this release of Sun Java System Application Server, only entity beans that use bean-managed persistence can be designated as read-only.

Read-only beans are specific to Sun Java System Application Server and are not part of the Enterprise JavaBeans Specification, v2.1. Use of this feature results in a non-portable application.

Read-only beans are best suited for situations where the underlying data never changes, or changes infrequently. The following topics are addressed in this section:

- Read-Only Bean Characteristics and Life Cycle
- Read-Only Bean Good Practices
- Refreshing Read-Only Beans
- Deploying Read Only Beans

Read-Only Bean Characteristics and Life Cycle

Read-only beans are best suited for situations where the underlying data never changes, or changes infrequently. For example, a read-only bean can be used to represent a stock quote for a particular company, which is updated externally. In such a case, using a regular entity bean may incur the burden of calling `ejbStore`, which can be avoided by using a read-only bean.

Read-only beans have the following characteristics:

- Only entity beans can be read-only beans.
- Only bean-managed persistence is allowed.
- Only container-managed transactions are allowed; read-only beans cannot start their own transactions.
- Read-only beans don’t update any bean state.
- `ejbStore` is never called by the container.
- `ejbLoad` is called only when a transactional method is called or when the bean is initially created (in the cache), or at regular intervals controlled by the bean’s `refresh-period-in-seconds` element in the `sun-ejb-jar.xml` file.
- The home interface can have any number of find methods. The return type of the find methods must be the primary key for the same bean type (or a collection of primary keys).
- If the data that the bean represents can change, then `refresh-period-in-seconds` must be set to refresh the beans at regular intervals. `ejbLoad` is called at this regular interval.

A read-only bean comes into existence using the appropriate find methods.

Read-only beans are cached and have the same cache properties as entity beans. When a read-only bean is selected as a victim to make room in the cache, `ejbPassivate` is called and the bean is returned to the free pool. When in the free pool, the bean has no identity and will be used only to serve any finder requests.

Read-only beans are bound to the naming service like regular read-write entity beans, and clients can look up read-only beans the same way read-write entity beans are looked up.

Read-Only Bean Good Practices

- Avoid having any `create` or `remove` methods in the home interface
- Use any of the valid EJB 2.1 transaction attributes for the `trans-attribute` element

  The reason for having `TX_SUPPORTED` is to allow reading uncommitted data in the same transaction. Also, the transaction attributes can be used to force `ejbLoad`.

Refreshing Read-Only Beans

There are several ways of refreshing read-only beans as addressed in the following sections:

- Invoking a Transactional Method
- Refreshing Periodically
- Refreshing Programmatically

Invoking a Transactional Method

Invoking any transactional method will invoke `ejbLoad`.

Refreshing Periodically

Read-only beans can be refreshed periodically by specifying the `refresh-period-in-seconds` element in the `sun-ejb-jar.xml` file.

- If the value specified in `refresh-period-in-seconds` is zero or not specified, which is the default, the bean is never refreshed (unless a transactional method is accessed).
- If the value is greater than zero, the bean is refreshed at the rate specified.

NOTE This is the only way to refresh the bean state if the data can be modified external to the Sun Java System Application Server.

Refreshing Programmatically

Typically, beans that update any data that is cached by read-only beans need to notify the read-only beans to refresh their state. You can use `ReadOnlyBeanNotifier` to force the refresh of read-only beans.

To do this, invoke the following methods on the ReadOnlyBeanNotifier bean:

```
public interface ReadOnlyBeanNotifier
    extends java.rmi.Remote
{
    refresh(Object PrimaryKey)
        throws RemoteException;
}
```

The implementation of the ReadOnlyBeanNotifier interface is provided by the container. The user can look up ReadOnlyBeanNotifier using a fragment of code such as the following example:

```
com.sun.appserv.ejb.ReadOnlyBeanHelper helper = new
com.sun.appserv.ejb.ReadOnlyBeanHelper();
com.sun.appserv.ejb.ReadOnlyBeanNotifier notifier =
helper.getReadOnlyBeanNotifier("java:comp/env/ejb/ReadOnlyCustomer");
notifier.refresh(PrimaryKey);
```

For a local read-only bean notifier, the lookup has this modification:

```
helper.getReadOnlyBeanLocalNotifier("java:comp/env/ejb/LocalReadOnlyCustomer");
```

Beans that update any data that is cached by read-only beans need to call the refresh methods. The next (non-transactional) call to the read-only bean invokes ejbLoad.

Deploying Read Only Beans

Read-only beans are deployed in the same manner as other entity beans. However, in the entry for the bean in the Sun Java System Application Server-specific XML file, the is-read-only-bean element must be set to true. That is:

```
<is-read-only-bean>true</is-read-only-bean>
```

Also, the refresh-period-in-seconds element in the sun-ejb-jar.xml file may be set to some value that specifies the rate at which the bean is refreshed. If this element is missing, no refresh occurs.

All requests with the same transaction context are routed to the same read-only bean instance. The deployer can specify if such multiple requests have to be serialized by setting the allow-concurrent-access element to either true (to allow concurrent accesses) or false (to serialize concurrent access to the same read-only bean). The default is false.

For further information on these elements, refer to the *Sun Java System Application Server Reference*.

Using Message-Driven Beans

This section describes message-driven beans and explains the requirements for creating them in the Sun Java System Application Server 8 environment. This section contains the following topics:

- Message-Driven Bean Configuration
- Restrictions and Optimizations
- Sample Message-Driven Bean XML Files

Message-Driven Bean Configuration

This section addresses the following configuration topics:

- Connection Factory and Destination
- Message-Driven Bean Pool
- Domain-Level Settings
- Automatic Reconnection to JMS Provider

Connection Factory and Destination

A message-driven bean is a client to a Connector 1.5 inbound resource adapter. The message-driven bean container uses the JMS service integrated into the Sun Java System Application Server for message-driven beans that are JMS clients. JMS clients use JMS Connection Factory- and Destination-administered objects. A JMS Connection Factory administered object is a resource manager Connection Factory object that is used to create connections to the JMS provider.

The `mdb-connection-factory` element in the `sun-ejb-jar.xml`file for a message-driven bean can be used to specify the connection factory used by the container to create the container connection to the JMS provider.

If the `mdb-connection-factory` element is not specified, a default one created at server startup is used. This provides connection to the built-in Sun Java System Message Queue broker on the port that is specified in the `jms-service` element (if enabled) in the `domain.xml` file, using the default user name/password (resource principal) of the Sun Java System Message Queue. Refer to the *Sun Java System Message Queue Developer’s Guide* for more information.

The jndi-name element of the ejb element in the sun-ejb-jar.xml file specifies the JNDI name of the administered object for the JMS Queue or Topic destination that is associated with the message-driven bean.

Message-Driven Bean Pool

The container manages a pool of message-driven beans for the concurrent processing of a stream of messages. The sun-ejb-jar.xml file contains the elements that define the pool (that is, the bean-pool element):

- steady-pool-size
- resize-quantity
- max-pool-size
- pool-idle-timeout-in-seconds

For more information about sun-ejb-jar.xml, see "The sun-ejb-jar.xml File" on page 184.

Domain-Level Settings

You can control the following domain-level message-driven bean settings in the EJB container:

- Initial and Minimum Pool Size - Specifies the initial and minimum number of beans maintained in the pool. The default is 0.
- Maximum Pool Size - Specifies the maximum number of beans that can be created to satisfy client requests. The default is 32.
- Pool Resize Quantity - Specifies the number of beans to be created if a request arrives when the pool is empty (subject to the Initial and Minimum Pool Size), or the number of beans to remove if idle for more than the Idle Timeout. The default is 8.
- Idle Timeout - Specifies the maximum time in seconds that a bean can remain idle in the pool. After this amount of time, the bean is destroyed. The default is 600 (10 minutes). A value of 0 means a bean can remain idle indefinitely.

For information on monitoring message-driven beans, see the Sun Java System Application Server Administration Console online help and *Administration Guide*.

NOTE Running monitoring when it is not need may impact performance, so you may choose to turn monitoring off using the asadmin command or the Administration Console when it is not in use.

Automatic Reconnection to JMS Provider

When the Sun Java System Application Server is started, for each deployed message-driven bean that is a JMS client, its container keeps a connection to the JMS provider. When the connection is broken, the container is not able to receive messages from the JMS provider and, therefore, is unable to deliver messages to its message-driven bean instances. When the auto reconnection feature is enabled, the container automatically tries to reconnect to the JMS provider if the connection is broken.

The `mdb-container` element in the `domain.xml` file contains auto reconnection properties. By default, `reconnect-enabled` is set to `false` and `reconnect-delay-in-seconds` is set to `60` seconds. That is, there is a delay of 60 seconds before each attempt to reconnect, and `reconnect-max-retries` is set to `60`.

The container logs messages for each reconnect attempt.

NOTE Depending on where the message processing stage is, if the connection is broken, the `onMessage` method may not be able to complete successfully, or the transaction may be rolled back due to a JMS exception. When the container reestablishes connection to the JMS provider, JMS message redelivery semantics apply.

Refer to the *Sun Java System Application Server Reference* for information on auto reconnect properties of the `mdb-container` element in the `domain.xml` file.

Restrictions and Optimizations

This section discusses the following restrictions and performance optimizations that you should be aware of in developing message-driven beans:

- Pool Tuning and Monitoring
- onMessage Runtime Exception

Pool Tuning and Monitoring

The message-driven bean pool is also a pool of threads, with each message-driven bean instance in the pool associating with a server session, and each server session associating with a thread. Therefore, a large pool size also means a high number of threads, which will impact performance and server resources.

When configuring message-driven bean pool properties, you must consider factors such as message arrival rate and pattern, `onMessage` method processing time, overall server resources (threads, memory, and so on), and any concurrency requirements and limitations from other resources that the message-driven bean may access.

Performance and resource usage tuning should also consider potential JMS provider properties for the connection factory that is used by the container (`mdb-connection-factory` element in deployment descriptor). For example, the Sun Java System Message Queue flow control related properties for connection factory should be tuned in situations where the message incoming rate is much higher than `max-pool-size` can handle.

Refer to the *Sun Java System Application Server Administration Guide* for information on how to get message-driven bean pool statistics.

onMessage Runtime Exception

Message-driven beans, like other well-behaved MessageListeners, should not, in general, throw runtime exceptions. If a message-driven bean's `onMessage` method encounters a system-level exception or error that does not allow the method to successfully complete, the Enterprise JavaBeans Specification, v2.1 provides the following guidelines:

- If the bean method encounters a runtime exception or error, it should simply propagate the error from the bean method to the container.
- If the bean method performs an operation that results in a checked exception that the bean method cannot recover, the bean method should throw the `javax.ejb.EJBException` that wraps the original exception.
- Any other unexpected error conditions should be reported using `javax.ejb.EJBException` (`javax.ejb.EJBException` is a subclass of `java.lang.RuntimeException`).

Under container-managed transaction demarcation, upon receiving a runtime exception from a message-driven bean's `onMessage` method, the container rolls back the container-started transaction and the message is redelivered. This is because the message delivery itself is part of the container-started transaction. By default, the Sun Java System Application Server container closes the container's connection to the JMS provider when the first runtime exception is received from a message-driven bean instance's `onMessage` method. This avoids potential message redelivery looping and protects server resources if the message-driven bean's `onMessage` method continues misbehaving. This default container behavior can be changed using the `cmt-max-runtime-exceptions` property of the `mdb-container` element in the `domain.xml` file.

The `cmt-max-runtime-exceptions` property specifies the maximum number of runtime exceptions allowed from a message-driven bean's `onMessage` method before the container starts to close the container's connection to the message source. By default this value is 1; -1 disables this container protection.

A message-driven bean's `onMessage` method can use the `javax.jms.Message getJMSRedelivered` method to check whether a received message is a redelivered message.

NOTE The `cmt-max-runtime-exceptions` property may be deprecated in the future.

Sample Message-Driven Bean XML Files

This section includes the following sample files:

- Sample ejb-jar.xml File
- Sample sun-ejb-jar.xml File

For general information on the `sun-ejb-jar.xml` file, see "The sun-ejb-jar.xml File" on page 184.

Sample ejb-jar.xml File

```
<?xml version="1.0" encoding="UTF-8"?>

<!DOCTYPE ejb-jar PUBLIC '-//Sun Microsystems, Inc.//DTD Enterprise JavaBeans 2.0//EN'
'http://java.sun.com/dtd/ejb-jar_2_0.dtd'>

<ejb-jar>
    <enterprise-beans>
    <message-driven>
        <ejb-name>MessageBean</ejb-name>
        <ejb-class>samples.mdb.ejb.MessageBean</ejb-class>
        <transaction-type>Container</transaction-type>
        <message-driven-destination>
        <destination-type>javax.jms.Queue</destination-type>
        </message-driven-destination>
        <resource-ref>
        <res-ref-name>jms/QueueConnectionFactory</res-ref-name>
        <res-type>javax.jms.QueueConnectionFactory</res-type>
        <res-auth>Container</res-auth>
        </resource-ref>
    </message-driven>
    </enterprise-beans>
    <assembly-descriptor>
        <container-transaction>
        <method>
            <ejb-name>MessageBean</ejb-name>
            <method-intf>Bean</method-intf>
            <method-name>onMessage</method-name>
            <method-params>
            <method-param>javax.jms.Message</method-param>
            </method-params>
        </method>
        <trans-attribute>NotSupported</trans-attribute>
    </container-transaction>
    </assembly-descriptor
</ejb-jar>
```

Sample sun-ejb-jar.xml File

```
<?xml version="1.0" encoding="UTF-8"?>

<!DOCTYPE sun-ejb-jar PUBLIC '-//Sun Microsystems, Inc.//DTD Application Server 8.0 EJB
2.1//EN' 'http://www.sun.com/software/appserver/dtds/sun-ejb-jar_2_1-0.dtd'>

<sun-ejb-jar>
    <enterprise-beans>
    <ejb>
        <ejb-name>MessageBean</ejb-name>
        <jndi-name>jms/sample/Queue</jndi-name>
        <resource-ref>
        <res-ref-name>jms/QueueConnectionFactory</res-ref-name>
        <jndi-name>jms/sample/QueueConnectionFactory</jndi-name>
        <default-resource-principal>
            <name>guest</name>
            <password>guest</password>
        </default-resource-principal>
        </resource-ref>
        <mdb-connection-factory>
        <jndi-name>jms/sample/QueueConnectionFactory</jndi-name>
        <default-resource-principal>
            <name>guest</name>
            <password>guest</password>
        </default-resource-principal>
        </mdb-connection-factory>
    </ejb>
    </enterprise-beans>
</sun-ejb-jar>
```

Handling Transactions with Enterprise Beans

This section describes the transaction support built into the Enterprise JavaBeans (EJBs) programming model for Sun Java System Application Server 8.

As a developer, you can write an application that updates data in multiple databases which may be distributed across multiple sites. The site may use EJB servers from different vendors. This section provides overview information on the following topics:

- Flat Transactions
- Global and Local Transactions
- Commit Options
- Administration and Monitoring

Flat Transactions

The Enterprise JavaBeans Specification, v2.1 requires support for flat (as opposed to nested) transactions. In a flat transaction, each transaction is decoupled from and independent of other transactions in the system. You cannot start another transaction in the same thread until the current transaction ends.

Flat transactions are the most prevalent model and are supported by most commercial database systems. Although nested transactions offer a finer granularity of control over transactions, they are supported by far fewer commercial database systems.

Global and Local Transactions

Understanding the distinction between global and local transactions is crucial in understanding the Sun Java System Application Server support for transactions. See "Transaction Scope" on page 380.

Both local and global transactions are demarcated using the `javax.transaction.UserTransaction` interface, which the client must use. Local transactions bypass the transaction manager and are faster. For more information, see "Naming Environment for J2EE Application Components" on page 388.

Commit Options

The EBJ protocol is designed to give the container the flexibility to select the disposition of the instance state at the time a transaction is committed. This allows the container to best manage caching an entity object's state and associating an entity object identity with the EJB instances.

There are three commit-time options:

- **Option A:** The container caches a ready instance between transactions. The container ensures that the instance has exclusive access to the state of the object in persistent storage.

  In this case, the container does *not* have to synchronize the instance's state from the persistent storage at the beginning of the next transaction.

NOTE Commit option A is not supported for Sun Java System Application Server 8.

- **Option B:** The container caches a ready instance between transactions, but the container does *not* ensure that the instance has exclusive access to the state of the object in persistent storage. This is the default.

  In this case, the container must synchronize the instance's state by invoking `ejbLoad` from persistent storage at the beginning of the next transaction.

- **Option C:** The container does *not* cache a ready instance between transactions, but instead returns the instance to the pool of available instances after a transaction has completed.

  The life cycle for every business method invocation under commit option C looks like this:

  ```
  ejbActivate->
      ejbLoad ->
          business method ->
              ejbStore ->
                  ejbPassivate
  ```

  If there is more than one transactional client concurrently accessing the same entity `EJBObject`, the first client gets the ready instance and subsequent concurrent clients get new instances from the pool.

The Sun Java System Application Server deployment descriptor has an element, `commit-option`, that specifies the commit option to be used. Based on the specified commit option, the appropriate handler is instantiated.

Administration and Monitoring

An administrator can control a number of domain-level Transaction Service settings. For details, see "Configuring the Transaction Service" on page 382.

The Transaction Timeout setting can be overridden by a bean. See "Bean-Level Container-Managed Transaction Timeouts" on page 288.

In addition, the administrator can monitor transactions using statistics from the transaction manager that provide information on such activities as the number of transactions completed, rolled back, or recovered since server startup, and transactions presently being processed.

For information on administering and monitoring transactions, see the Sun Java System Application Server Administration Console online help and the *Sun Java System Application Server Administration Guide*.

Chapter 8

Using Container-Managed Persistence for Entity Beans

This section contains information on how container-managed persistence (CMP) works in the Sun Java System Application Server environment in the following topics:

- Sun Java System Application Server Support
- Container-Managed Persistence Mapping
- Configuring the Resource Manager
- Configuring Queries for 1.1 Finders
- Restrictions and Optimizations

Extensive information on CMP is contained in chapters 10, 11, and 14 of the Enterprise JavaBeans Specification, v2.1.

Sun Java System Application Server Support

Sun Java System Application Server support for CMP includes:

- Full support for the J2EE v 1.4 specification's CMP model.
    - Support for commit options B and C for transactions as defined in the Enterprise JavaBeans Specification, v2.1. See "Commit Options" on page 303.
    - The primary key class must be a subclass of `java.lang.Object`. This ensures portability, and is noted because some vendors allow primitive types (such as `int`) to be used as the primary key class.

- The Sun Java System Application Server CMP implementation, which provides:
  - An Object/Relational (O/R) mapping tool that creates XML deployment descriptors for EJB JAR files that contain beans that use CMP
  - Support for compound (multi-column) primary keys
  - Support for sophisticated custom finder methods
  - Standards-based query language (EJB QL)
  - CMP runtime support. For a list of JDBC driver and database combinations that are supported for Sun Java System Application Server, see "Configurations for Specific JDBC Drivers" on page 364. These combinations have been tested with the Sun Java System Application Server and are found to be J2EE compatible. Other drivers have been used with Sun Java System Application Server, but J2EE compliance tests have not been completed with these drivers.

    For an up to date list of the JDBC drivers supported by the Sun Java System Application Server, see the *Sun Java System Application Server Release Notes*.

Container-Managed Persistence Mapping

Implementation for entity beans that use CMP is mostly a matter of mapping CMP fields and CMR fields (relationships) to the database. This section addresses the following topics:

- The Mapping Deployment Descriptor File
- Mapping Capabilities
- Automatic Mapping Options
- Supported Data Types for Mapping
- BLOB Support
- CLOB Support
- Capturing the Database Schema Automatically
- Using the capture-schema Utility

The Mapping Deployment Descriptor File

Each module with CMP beans must have the following files:

- `ejb-jar.xml`: Contains information such as the transactional attributes of the beans and the fields of a bean that are going to be container-managed.
- `sun-ejb-jar.xml`: The Sun Java System Application Server standard file for assembling enterprise beans. For a detailed description, see "The sun-ejb-jar.xml File" on page 184.
- `sun-cmp-mappings.xml`: The file for mapping CMP. This file can be automatically generated and does not have to exist prior to deployment. For a detailed description, see "The sun-cmp-mappings.xml File" on page 225.

The `sun-cmp-mappings.xml` file maps CMP fields and CMR fields (relationships) to the database. A primary table must be selected for each CMP bean, and optionally, multiple secondary tables. CMP fields are mapped to columns in either the primary or secondary table(s). CMR fields are mapped to pairs of column lists (normally, column lists are the list of columns associated with pairs of primary and foreign keys).

The `sun-cmp-mappings.xml` file conforms to the `sun-cmp-mapping_1_1.dtd` file and is packaged with the user-defined bean classes in the EJB JAR file under the `META-INF` directory.

The Sun Java System Application Server or the deploytool creates the mappings in the `sun-cmp-mappings.xml` file automatically during deployment if the file is not present. For information on how to use the deploytool for mapping, see the deploytool online help.

Automatic generation of the `sun-cmp-mappings.xml` file can be controlled by deployment options specified in the `sun-ejb-jar.xml` file and during deployment (see "Automatic Mapping Options" on page 308). If you use automatic mapping, you only need to understand the Java programming language objects; you do not need to know or understand the underlying database schema.

You can map the fields and relationships of your entity beans manually, by editing the `sun-cmp-mappings.xml` deployment descriptor. You should only do this if you are proficient in editing XML.

A listing of the mapping elements in the CMP deployment descriptors is contained in "The sun-cmp-mappings.xml File" on page 225. A sample XML file is contained in "Sample Database Schema Definition" on page 233.

The mapping information is developed in conjunction with the database schema (`.dbschema`) file, which can be automatically captured when you deploy the bean (see "Capturing the Database Schema Automatically" on page 316). You can manually generate the schema using the `capture-schema` utility ("Using the capture-schema Utility" on page 316).

Mapping Capabilities

Mapping refers to the ability to tie an object-based model to a relational model of data, usually the schema of a relational database. The CMP implementation provides the ability to tie a set of interrelated beans containing data and associated behaviors to the schema. You can then use this object representation of the database as part of a Java application. You can also customize this mapping to optimize these beans for the particular needs of an application. The result is a single data model through which you can access both persistent database information and regular transient program data.

The mapping capabilities provided by the Sun Java System Application Server include:

- Mapping a CMP bean to one or more tables
- Mapping CMP fields to one or more columns
- Mapping CMP fields to different column types
- Mapping tables with compound primary keys
- Mapping CMP relationships to foreign key columns
- Mapping tables with overlapping primary and foreign keys

Automatic Mapping Options

You can control automatic mapping in the following ways using deployment descriptor elements or command line options. You can:

- Create tables during deployment
- Drop tables during undeployment
- Create and drop tables during redeployment
- Specify the database vendor
- Specify that table names are unique
- Specify type mappings for individual CMP fields

The following optional data subelements of the `cmp-resource` element in the `sun-ejb-jar.xml` file control the automatic creation of database tables at deployment. For more information about the `cmp-resource` element, see "Configuring the Resource Manager" on page 318.

Table 8-1 `sun-ejb-jar.xml` Mapping Elements

Element	Default	Description
`create-tables-at-deploy`	`false`	If `true`, causes database tables to be created for beans that are automatically mapped by the EJB container. If `false`, does not create tables.
`drop-tables-at-undeploy`	`false`	If `true`, causes database tables that were automatically created when the bean(s) were last deployed to be dropped when the bean(s) are undeployed. If `false`, does not drop tables.
`database-vendor-name`	none	Specifies the name of the database vendor for which tables can be created. Allowed values are `db2`, `mssql`, `oracle`, `pointbase`, and `sybase`, case-insensitive. If no value is specified, a connection is made to the resource specified by the `jndi-name` subelement of the `cmp-resource` element in the `sun-ejb-jar.xml` file, and the database vendor name is read. If the connection cannot be established, or if the value is not recognized, SQL-92 compliance is presumed.

`schema-generator-properties`	none	Allows you to specify field-specific type mappings in `property` subelements.
		Also allows you to set the `use-unique-table-names` property. If `true`, this property specifies that generated table names are unique within each application server domain. The default is `false`.
		For example:
		`<schema-generator-properties>`
		`    <property>`
		`        <name>`
		`            Employee.firstName.jdbc-type`
		`        </name>`
		`        <value>char</value>`
		`    </property>`
		`    <property>`
		`        <name>`
		`        Employee.firstName.jdbc-maximum-length`
		`        </name>`
		`        <value>25</value>`
		`    </property>`

Table 8-1 `sun-ejb-jar.xml` Mapping Elements

Element	Default	Description

		`  <property>`
		`    <name>`
		`      use-unique-table-names`
		`    </name>`
		`    <value>true</value>`
		`  </property>`
		`</schema-generator-properties>`

The following options of the `asadmin deploy` or `asadmin deploydir` command control the automatic creation of database tables at deployment:

Table 8-2 `asadmin deploy` and `asadmin deploydir` Mapping Options

Option	Default	Description
`--createtables`	none	If `true`, causes database tables to be created for beans that need them. If `false`, does not create tables. If not specified, the value of the `create-tables-at-deploy` attribute in `sun-ejb-jar.xml` is used.
`--dropandcreatetables`	none	If `true`, and if tables were automatically created when this application was last deployed, tables from the earlier deployment are dropped and fresh ones are created. If `true`, and if tables were *not* automatically created when this application was last deployed, no attempt is made to drop any tables. If tables with the same names as those that would have been automatically created are found, the deployment proceeds, but a warning indicates that tables could not be created. If `false`, settings of `create-tables-at-deploy` or `drop-tables-at-undeploy` in the `sun-ejb-jar.xml` file are overridden.
`--uniquetablenames`	none	If `true`, specifies that table names are unique within each application server domain. If not specified, the value of the `use-unique-table-names` property in `sun-ejb-jar.xml` is used.

Table 8-2 `asadmin deploy` and `asadmin deploydir` Mapping Options

Option	Default	Description
`--dbvendorname`	none	Specifies the name of the database vendor for which tables can be created. Allowed values are `db2`, `mssql`, `oracle`, `pointbase`, and `sybase`, case-insensitive. If not specified, the value of the `database-vendor-name` attribute in `sun-ejb-jar.xml` is used. If no value is specified, a connection is made to the resource specified by the `jndi-name` subelement of the `cmp-resource` element in the `sun-ejb-jar.xml` file, and the database vendor name is read. If the connection cannot be established, or if the value is not recognized, SQL-92 compliance is presumed.

If you have manually mapped one or more of the beans in the module and you use any of the `asadmin deploy` or `asadmin deploydir` options, the deployment is not harmed in any way, but the options have no effect, and you get a warning in the server log.

If you used the deploytool to map one or more of the beans, the `--uniquetablenames` option has no effect when you run `asadmin deploy` or `asadmin deploydir`. The uniqueness of the table names was established when deploytool created the mapping.

The following options of the `asadmin undeploy` command control the automatic removal of database tables at undeployment:

Table 8-3 `asadmin undeploy` Mapping Options

Option	Default	Description
`--droptables`	none	If `true`, causes database tables that were automatically created when the bean(s) were last deployed to be dropped when the bean(s) are undeployed. If `false`, does not drop tables. If not specified, the value of the `drop-tables-at-undeploy` attribute in `sun-ejb-jar.xml` is used.

For more information about the `asadmin deploy`, `asadmin deploydir`, and `asadmin undeploy` commands, see “The asadmin Command” on page 107

When command line and `sun-ejb-jar.xml` options are both specified, the `asadmin` options take precedence.

Supported Data Types for Mapping

CMP supports a set of JDBC data types that are used in mapping Java data fields to SQL types. Supported JDBC data types are as follows:

```
BIGINT          BIT             BLOB            CHAR            CLOB
DATE            DECIMAL         DOUBLE          FLOAT           INTEGER
LONGVARBINARY   LONGVARCHAR     NUMERIC         REAL            SMALLINT
TIME            TIMESTAMP       TINYINT         VARCHAR
```

The following table contains suggested Java type to JDBC type mappings.

Table 8-4 Suggested Java Type to JDBC Type Mappings

Java Type	JDBC Type	Nullability
`boolean`	`BIT`	No
`java.lang.Boolean`	`BIT`	Yes
`byte`	`TINYINT`	No
`java.lang.Byte`	`TINYINT`	Yes
`double`	`DOUBLE`	No
`java.lang.Double`	`DOUBLE`	Yes
`float`	`REAL`	No
`java.lang.Float`	`REAL`	Yes
`int`	`INTEGER`	No
`java.lang.Integer`	`INTEGER`	Yes
`long`	`BIGINT`	No
`java.lang.Long`	`BIGINT`	Yes
`short`	`SMALLINT`	No
`java.lang.Short`	`SMALLINT`	Yes
`java.math.BigDecimal`	`DECIMAL`	Yes
`java.math.BigInteger`	`DECIMAL`	Yes
`char`	`CHAR`	No
`java.lang.char`	`CHAR`	Yes

Table 8-4 Suggested Java Type to JDBC Type Mappings *(Continued)*

Java Type	JDBC Type	Nullability
`java.lang.StringBuffer`	`VARCHAR`	Yes
`java.lang.String`	`VARCHAR`	Yes
`java.lang.String`	`CLOB`	Yes
`Serializable`	`BLOB`	Yes
`byte[]`	`BLOB`	Yes
`java.util.Date`	`TIMESTAMP`	Yes
`java.sql.Time`	`TIME`	Yes
`java.sql.Date`	`DATE`	Yes
`java.sql.Timestamp`	`TIMESTAMP`	Yes

NOTE Java types assigned to CMP fields must be restricted to Java primitive types, Java `Serializable` types, `java.util.Date`, `java.sql.Date`, `java.sql.Time`, or `java.sql.Timestamp`. An entity bean local interface type (or a collection of such) can be the type of a CMR field.

The following table contains suggested mappings of JDBC types to database vendor specific types. For more information about the JDBC driver and database combinations that are supported for Sun Java System Application Server, see "Configurations for Specific JDBC Drivers" on page 364.

Table 8-5 Suggested Mappings of JDBC Types to Database Vendor Specific Types

JDBC Type	PointBase	Oracle	DB2	Sybase ASE 12.5	MS-SQL Server
`BIT`	`BOOLEAN`	`SMALLINT`	`SMALLINT`	`BIT`	`BIT`
`BOOLEAN`	`BOOLEAN`	`SMALLINT`	`SMALLINT`	`TINYINT`	`BIT`
`TINYINT`	`SMALLINT`	`SMALLINT`	`SMALLINT`	`TINYINT`	`TINYINT`
`SMALLINT`	`SMALLINT`	`SMALLINT`	`SMALLINT`	`SMALLINT`	`SMALLINT`
`INTEGER`	`INTEGER`	`INTEGER`	`INTEGER`	`INTEGER`	`INT`
`BIGINT`	`BIGINT`	`NUMBER`	`BIGINT`	`NUMERIC`	`DECIMAL`
`REAL`	`REAL`	`REAL`	`REAL`	`REAL`	`REAL`
`FLOAT`	`FLOAT`	`FLOAT`	`FLOAT`	`FLOAT`	`FLOAT`

Table 8-5 Suggested Mappings of JDBC Types to Database Vendor Specific Types *(Continued)*

JDBC Type	PointBase	Oracle	DB2	Sybase ASE 12.5	MS-SQL Server
DOUBLE	DOUBLE PRECISION	DOUBLE PRECISION	DOUBLE	DOUBLE PRECISION	DOUBLE PRECISION
NUMERIC(p,s)	NUMERIC(p,s)	NUMBER(p,s)	DECIMAL(p,s)	NUMERIC(p,s)	NUMERIC(p,s)
DECIMAL(p,s)	NUMERIC(p,s)	NUMBER(p,s)	DECIMAL(p,s)	DECIMAL(p,s)	DECIMAL(p,s)
VARCHAR	VARCHAR	VARCHAR2	VARCHAR	VARCHAR	VARCHAR
DATE	DATE	DATE	DATE	DATETIME, SMALLDATETIME	DATETIME, SMALLDATETIME
TIME	TIME	DATE	TIME	DATETIME, SMALLDATETIME	DATETIME, SMALLDATETIME
TIMESTAMP	TIMESTAMP	TIMESTAMP	TIMESTAMP	DATETIME	DATETIME
BLOB	BLOB	BLOB	BLOB	IMAGE	IMAGE
CLOB	CLOB	CLOB	CLOB	TEXT	TEXT

NOTE The mappings in Table 8-5 are suggested and not supported. If these mappings don’t work, please refer to your database and JDBC driver documentation.

BLOB Support

Binary Large Object (BLOB) is a data type used to store and retrieve complex object fields. BLOBs are binary or `Serializable` objects, such as pictures, that translate into large byte arrays which are then serialized into CMP fields.

If a CMP field is defined as `Serializable`, it is serialized into a `byte[]` before being stored in the database. Similarly, the value fetched from the database is deserialized. However, if a CMP field is defined as `byte[]`, it is stored directly instead of being serialized and deserialized when stored and fetched, respectively.

To enable BLOB support in the Sun Java System Application Server environment, define a CMP field of type `byte[]` or a user-defined type that implements the `java.io.Serializable` interface. If you map the CMP bean to an existing database schema, map the field to a column of type BLOB.

If you are using the Oracle Inet driver for CMP, you need to set a special property if you are using BLOB or CLOB datatypes. For details, see “Inet Oraxo JDBC Driver for Oracle 8.1.7 and 9.x Databases” on page 366.

If you use automatic mapping, you might need to change the default BLOB column length for the generated schema using the `schema-generator-properties` element in `sun-ejb-jar.xml`. See your database vendor documentation to determine whether you need to specify the length. For example:

```
<schema-generator-properties>
    <property>
        <name>Employee.voiceGreeting.jdbc-type</name>
        <value>BLOB</value>
    </property>
    <property>
        <name>Employee.voiceGreeting.jdbc-maximum-length</name>
        <value>10240</value>
    </property>
    ...
</schema-generator-properties>
```

CLOB Support

Character Large Object (CLOB) is a data type used to store and retrieve very long text fields. CLOBs translate into long strings.

To enable CLOB support in the Sun Java System Application Server environment, define a CMP field of type `java.lang.String`. If you map the CMP bean to an existing database schema, map the field to a column of type CLOB.

If you are using the Inet driver for CMP, you need to set a special property if you are using BLOB or CLOB datatypes. For details, see “Inet Oraxo JDBC Driver for Oracle 8.1.7 and 9.x Databases” on page 366.

If you use automatic mapping, you might need to change the default CLOB column length for the generated schema using the `schema-generator-properties` element in `sun-ejb-jar.xml`. See your database vendor documentation to determine whether you need to specify the length. For example:

```
<schema-generator-properties>
    <property>
        <name>Employee.resume.jdbc-type</name>
        <value>CLOB</value>
    </property>
    <property>
```

```
        <name>Employee.resume.jdbc-maximum-length</name>
        <value>10240</value>
    </property>
    ...
</schema-generator-properties>
```

Capturing the Database Schema Automatically

You can configure a CMP bean in the deploytool or Sun Java System Application Server to automatically capture the database metadata and save it in a `.dbschema` file during deployment. If the `sun-cmp-mappings.xml` file contains an empty `<schema/>` entry, the `cmp-resource` entry in the `sun-ejb-jar.xml` file is used to get a connection to the database, and automatic generation of the schema is performed. When the `sun-cmp-mappings.xml` file is itself automatically generated, it contains the `<schema/>` entry by default. If the database table structure is changed, you must redeploy the beans to automatically remap the CMP fields and relationships.

Using the capture-schema Utility

You can use the `capture-schema` command to manually generate the database metadata (`.dbschema`) file.

NOTE An Oracle database user running the `capture-schema` command needs ANALYZE ANY TABLE privileges if that user does not own the schema. These privileges are granted to the user by the database administrator.

The `capture-schema` utility does *not* modify the schema in any way. Its only purpose is to provide the persistence engine with information about the structure of the database (the schema).

The name of a `.dbschema` file must be unique across all deployed modules in a domain.

Syntax

`capture-schema -username` *name* `-password` *password* `-dburl` *url* `-driver` *jdbcdriver* `-out` *filename* `[-schemaname` *schemaname*`] [-table` *tablename*`]*`

Where:

- `-username` *name*: Specifies the user name for authenticating access to a database.
- `-password` *password*: Specifies the password for accessing the selected database.
- `-dburl` *url*: Specifies the JDBC URL expected by the driver for accessing a database.
- `-driver` *jdbcdriver:* Specifies the JDBC driver class name. This class must be in your CLASSPATH.
- `-out` *filename*: Specifies the output target. If the output file name does not have an extension, `.dbschema` is appended. If the output file name has a different extension, `.dbschema` is appended in addition to the specified extension, and a warning is displayed.

  For CMP mapping, the `-out` parameter correlates to the `schema` subelement of the `sun-cmp-mapping` element in the `sun-cmp-mappings.xml` file. In this file, this file name must be specified without the `.dbschema` suffix. For example:

  ```
  <schema>RosterSchema</schema>
  ```
- `-schemaname` *schemaname*: Specifies the name of the user schema being captured. If not specified, the default is to capture metadata for all tables from all the schemas accessible to this user.

NOTE If more than one schema is accessible for this user, more than one table with the same name might be captured if this parameter is not set.

- `-table` *tablename*: Specifies a table name. You can use this parameter multiple times to capture metadata for multiple tables. If not specified, all the tables in the database schema are captured.

Example

```
capture-schema -dburl jdbc:pointbase:server://localhost:9092/sample
-username public -password public -driver
com.pointbase.jdbc.jdbcUniversalDriver -out RosterSchema.dbschema
```

Configuring the Resource Manager

The resource manager used by the CMP implementation is `PersistenceManagerFactory`, which is configured using the Sun Java System Application Server XML file, `domain.xml`. Refer to the *Sun Java System Application Server Administration Guide* for information on creating a new persistence manager.

To deploy an EJB module that contains CMP beans, you need to specify the JNDI name of the Persistence Manager's resource in the `jndi-name` subelement of the `cmp-resource` element in the `sun-ejb-jar.xml` file. The Persistence Manager's resource is a `jdbc-resource` or `persistence-manager-factory-resource` entry in the `domain.xml` file. Using a `jdbc-resource` is recommended. This name is used at run time to manage persistent resources.

If the JNDI name refers to a `jdbc-resource` entry, you can also set `PersistenceManagerFactory` properties as properties of the `cmp-resource` element in the `sun-ejb-jar.xml` file.

For example, if you have the following entry in the `domain.xml` file:

```
<jdbc-resource
    jndi-name="jdbc/pmf"
    pool-name="jdbc/oracle_pool">
```

Set the CMP resource in the `sun-ejb-jar.xml` file as follows:

```
<cmp-resource>
    <jndi-name>jdbc/pmf</jndi-name>
</cmp-resource>
```

For another example, if you have the following entry in the `domain.xml` file:

```
<persistence-manager-factory-resource
factory-class="com.sun.jdo.spi.persistence.support.sqlstore.impl.PersistenceManagerFactoryImpl"
    enabled="true"
    jndi-name="jdo/pmf"
    jdbc-resource-jndi-name="jdbc/pmfPM">
```

Set the CMP resource in the `sun-ejb-jar.xml` file as follows:

```
<cmp-resource>
    <jndi-name>jdo/pmf</jndi-name>
</cmp-resource>
```

Configuring Queries for 1.1 Finders

This section contains the following topics:

- About JDOQL Queries
- Query Filter Expression
- Query Parameters
- Query Variables

About JDOQL Queries

The Enterprise JavaBeans Specification, v1.1 spec does not specify the format of the finder method description. The Sun Java System Application Server uses an extension of Java Data Objects Query Language (JDOQL) queries to implement finder and selector methods. For EJB 2.1, the container automatically maps an EJB QL query to JDOQL. For EJB 1.1, this mapping is done by the developer. You can specify the following elements of the underlying JDOQL query:

- **Filter expression:** A Java-like expression that specifies a condition that each object returned by the query must satisfy. Corresponds to the WHERE clause in EJB QL.
- **Query parameter declaration:** Specifies the name and the type of one or more query input parameters. Follows the syntax for formal parameters in the Java language.
- **Query variable declaration:** Specifies the name and type of one or more query variables. Follows the syntax for local variables in the Java language. Query variables might be used in the filter to implement joins.
- **Query ordering declaration:** Specifies the ordering expression of the query. Corresponds to the ORDER BY clause of EJBQL.

The Sun Java System Application Server-specific deployment descriptor (`sun-ejb-jar.xml`) provides the following elements to store the EJB 1.1 finder method settings:

```
query-filter
query-params
query-variables
query-ordering
```

The Sun Java System Application Server constructs a JDOQL query of the EJB 1.1 entity bean. It adds the filter, parameter declarations, and variable declaration and ordering as specified by the developer to the JDOQL query. It executes the query using the finder method parameters. The objects from the JDOQL query result set are converted into primary key instances to be returned by the EJB 1.1 `ejbFind` method.

The JDO specification (see JSR 12) provides a comprehensive description of JDOQL. The following information summarizes the elements used to define EJB 1.1 finders.

Query Filter Expression

The filter expression is a String containing a boolean expression evaluated for each instance of the candidate class. If the filter is not specified, it defaults to true. Rules for constructing valid expressions follow the Java language, with the following differences:

- Equality and ordering comparisons between primitives and instances of wrapper classes are valid.
- Equality and ordering comparisons of Date fields and Date parameters are valid.
- Equality and ordering comparisons of String fields and String parameters are valid.
- White space (non-printing characters space, tab, carriage return, and line feed) is a separator and is otherwise ignored.
- The following assignment operators are not supported:
    - =, +=, etc.
    - pre- and post-increment
    - pre- and post-decrement
- Methods, including object construction, are not supported, except for:

    ```
    Collection.contains(Object o)
    Collection.isEmpty()
    String.startsWith(String s)
    String.endsWith(String e)
    ```

    In addition, the Sun Java System Application Server supports the following non-standard JDOQL methods:

```
String.like(String pattern)
String.like(String pattern, char escape)
String.substring(int start, int length)
String.indexOf(String str), String.indexOf(String str, int
start)
String.length()
Math.abs(numeric n), and Math.sqrt(double d)
```

- Navigation through a null-valued field, which would throw `NullPointerException`, is treated as if the subexpression returned false.

NOTE Comparisons between floating point values are by nature inexact. Therefore, equality comparisons (== and !=) with floating point values should be used with caution. Identifiers in the expression are considered to be in the name space of the candidate class, with the addition of declared parameters and variables. As in the Java language, this is a reserved word, and refers to the current instance being evaluated.

The following expressions are supported:

- Operators applied to all types where they are defined in the Java language:
  - relational operators (==, !=, >, <, >=, <=)
  - boolean operators (&, &&, |, ||, ~, !)
  - arithmetic operators (+, -, *, /)

  String concatenation is supported only for String + String.
- Parentheses to explicitly mark operator precedence
- Cast operator
- Promotion of numeric operands for comparisons and arithmetic operations. The rules for promotion follow the Java rules (see the numeric promotions of the Java language specification) extended by BigDecimal, BigInteger, and numeric wrapper classes.

Query Parameters

The parameter declaration is a String containing one or more parameter type declarations separated by commas. This follows the Java syntax for method signatures.

Query Variables

The type declarations follow the Java syntax for local variable declarations.

Example1

The following query returns all players called Michael. It defines a filter that compares the name field with a string literal:

```
name == "Michael"
```

The `finder` element of the `sun-ejb-jar.xml` file would look like this:

```
<finder>
   <method-name>findPlayerByName</method-name>
   <query-filter>name == "Michael"</query-filter>
</finder>
```

Example 2

This query returns all products in a specified price range. It defines two query parameters which are the lower and upper bound for the price: double low, double high. The filter compares the query parameters with the price field:

```
low < price && price < high
```

Query ordering is set to `price ascending`.

The `finder` element of the `sun-ejb-jar.xml` file would look like this:

```
<finder>
   <method-name>findInRange</method-name>
   <query-params>double low, double high</query-params>
   <query-filter>low &lt; price &amp;&amp; price &lt high</query-filter>
   <query-ordering>price ascending</query-ordering>
</finder>
```

Example 3

This query returns all players having a higher salary than the player with the specified name. It defines a query parameter for the name `java.lang.String name`. Furthermore, it defines a variable for the player to compare with. It has the type of the persistence capable class that corresponds to the bean:

```
   mypackage.PlayerEJB_170160966_JDOState player
```

The filter compares the salary of the current player denoted by this keyword with the salary of the player with the specified name:

```
   (this.salary > player.salary) && (player.name == name)
```

The finder element of the sun-ejb-jar.xml file would look like this:

```
<finder>
    <method-name>findByHigherSalary</method-name>
    <query-params>java.lang.String name</query-params>
    <query-filter>
        (this.salary &gt; player.salary) &amp;&amp; (player.name == name)
    </query-filter>
    <query-variables>mypackage.PlayerEJB_170160966_JDOState player</query-variables>
</finder>
```

Restrictions and Optimizations

This section discusses any restrictions and performance optimizations you should be aware of in using CMP entity beans.

- Eager Loading of Field State
- Restrictions on Remote Interfaces
- Sybase Finder Limitation
- Date and Time Fields as CMP Field Types

Eager Loading of Field State

By default, the EJB container loads the state for all CMP fields (except BLOB and CLOB fields) before invoking the ejbLoad method of the abstract bean. This approach may not be optimal for entity objects with large state if most business methods require access to only parts of the state. If this is an issue, use the fetched-with element in sun-cmp-mappings.xml for fields that are used infrequently.

Restrictions on Remote Interfaces

The following restrictions apply to the remote interface of an entity bean that uses CMP:

- Do not expose the get and set methods for CMR fields or the persistence collection classes that are used in container-managed relationships through the remote interface of the bean.

  However, you are free to expose the get and set methods that correspond to the CMP fields of the entity bean through the bean’s remote interface.

- Do not expose the container-managed collection classes that are used for relationships through the remote interface of the bean.
- Do not expose local interface types or local home interface types through the remote interface or remote home interface of the bean.

Dependent value classes can be exposed in the remote interface or remote home interface, and can be included in the client EJB JAR file.

Sybase Finder Limitation

If you execute any finder method with an input greater than 255 characters and map the primary key column to a VARCHAR column, Sybase attempts to convert type VARCHAR to type TEXT and generates the following error:

```
com.sybase.jdbc2.jdbc.SybSQLException: Implicit conversion from datatype 'TEXT' to
'VARCHAR' is not allowed.  Use the CONVERT function to run this query.
```

To avoid this error, make sure your finder method input is less than 255 characters.

Date and Time Fields as CMP Field Types

If a CMP field type is a Java date or time type (`java.util.Date`, `java.sql.Date`, `java.sql.Time`, `java.sql.Timestamp`), make sure that the field value exactly matches the value in the database.

For example, the following code uses a `java.sql.Date` type as a primary key field:

```
java.sql.Date myDate = new java.sql.Date(System.currentTimeMillis())
beanHome.create(myDate, ...);
```

For some databases, this code results in only the year, month, and date portion of the field value being stored in the database. Later on if the client tries to find this bean by primary key as follows:

```
myBean = beanHome.findByPrimaryKey(myDate);
```

the bean is not found in the database because the value does not match the one that is stored in the database.

Similar problems can happen if the database truncates the timestamp value while storing it, or if a custom query has a date or time value comparison in its WHERE clause.

When you use automatic mapping and an Oracle database, all fields of type `java.util.Date`, `java.sql.Date`, `java.sql.Time`, and `java.sql.Timestamp` are mapped to Oracle’s DATE data type.

Chapter 9

Developing Java Clients

This chapter describes how to develop, assemble, and deploy J2EE Application Clients in the following sections:

- Introducing the Application Client Container
- Developing Clients Using the ACC
- Developing Clients Without the ACC
- Configuring the ORB

Introducing the Application Client Container

The Application Client Container (ACC) includes a set of Java classes, libraries, and other files that are required for and distributed with Java client programs that execute in their own Java Virtual Machine (JVM). The ACC manages the execution of J2EE application client components, which are used to access a variety of J2EE services (such as JMS resources, EJB components, web services, security, and so on.) from a JVM outside the Sun Java System Application Server.

The ACC communicates with the Application Server using RMI/IIOP protocol and manages the details of RMI/IIOP communication using the client ORB that is bundled with it. Compared to other J2EE containers, the ACC is lightweight.

Security

The ACC is responsible for collecting authentication data such as the username and password and sending the collected data to the Application Server. The server then processes the authentication data using the configured Java™ Authentication and Authorization Service (JAAS) module. See "Authenticating an Application Client" on page 330.

Authentication techniques are provided by the client container, and are not under the control of the application client component. The container integrates with the platform's authentication system. When you execute a client application, it displays a login window and collects authentication data from the user. It also support SSL (Secure Socket Layer)/IIOP if configured and when necessary.

Naming

The client container enables the application clients to use the Java Naming and Directory Interface (JNDI) to look up J2EE services (such as JMS resources, EJB components, web services, security, and so on.) and to reference configurable parameters set at the time of deployment.

Developing Clients Using the ACC

This section describes the procedure to develop, assemble, and deploy client applications using the ACC. This section describes the following topics:

- Using an Application Client to Access an EJB Component
- Using an Application Client to Access a JMS Resource
- Authenticating an Application Client
- Running an Application Client Using the ACC
- Packaging an Application Client Using the ACC

For information about Java-based clients that are not packaged using the ACC, see "Developing Clients Without the ACC" on page 334.

Using an Application Client to Access an EJB Component

To access an EJB component from an application client, perform the following steps:

1. In your client code, instantiate the `InitialContext` using the default (no argument) constructor:

   ```
   InitialContext ctx = new InitialContext();
   ```

   It is not necessary to explicitly instantiate a naming context that points to the CosNaming service.

2. In your client code, look up the home object by specifying the JNDI name of the home object as specified in the `ejb-jar.xml` file. For example:

```
Object ref = ctx.lookup("beanA_JNDI_name");
BeanAHome = (BeanAHome)PortableRemoteObject.narrow(ref,BeanAHome.class);
```

   For more information about naming and lookups, see "Accessing the Naming Context" on page 387.

3. Define the `ejb-ref` elements in the `application-client.xml` file and the corresponding `sun-application-client.xml` file.

   For more information on the `sun-application-client.xml` file, see "The sun-application-client.xml file" on page 237. For a general explanation of how to map JNDI names using reference elements, see "Mapping References" on page 395.

4. Deploy the application client and EJB component together in an application. For more information on deployment, see "Tools for Deployment" on page 106. You can use the `--retrieve` option to get the client JAR file.

   You can also use the `asadmin get-client-stubs` command to retrieve the stubs and ties whether or not you requested their generation during deployment. The syntax is as follows:

   `asadmin get-client-stubs --user` *user* `--appname` *app_name* *local_dirpath*

5. Ensure that the client JAR file includes the following files:

   - a Java class to access the bean
   - `application-client.xml` - J2EE 1.4 application client deployment descriptor
   - `sun-application-client.xml` - Sun Java System Application Server specific client deployment descriptor. For information on the `sun-application-client.xml` file, see "The sun-application-client.xml file" on page 237.
   - `The MANIFEST.MF` file. This file contains the main class, which states the complete package prefix and classname of the Java client.

   You can package the application client using the `package-appclient` script. This is optional. See "Packaging an Application Client Using the ACC" on page 331.

6. Copy the following JAR files to the client machine and include them in the classpath on the client side:

   - `appserv-rt.jar` - available at *install_dir*/`lib`
   - `j2ee.jar` - available at *install_dir*/`lib`
   - The client JAR file

7. If you need to access EJB components that are residing in a remote system other than the system where the application client is being developed, make the following changes to the sun-acc.xml file:

   - Define the <target-server> address attribute to reference the remote server machine.
   - Define the <target-server> port attribute to reference the ORB port on the remote server.

   This information can be obtained from the domain.xml file on the remote system. For more information on domain.xml file, see the *Sun Java System Application Server Reference*.

   For more information about the sun-acc.xml file, see "The sun-acc.xml File" on page 241.

8. Run the application client. See "Running an Application Client Using the ACC" on page 330.

Using an Application Client to Access a JMS Resource

To access a JMS resource from an application client, perform the following steps:

1. Create a JMS client. For detailed instructions on developing a JMS client, see the J2EE tutorial:

   http://java.sun.com/j2ee/1.4/docs/tutorial/doc/JMS.html#wp84181

2. Next, configure a JMS resource on the Sun Java System Application Server. For information on configuring JMS resources, see "Creating JMS Resources: Destinations and Connection Factories" on page 403.

3. Set the environment variable LD_LIBRARY_PATH. This variable should point to the Application Server, the Sun Java System Message Queue JAR files, and shared libraries:

   ```
   LD_LIBRARY_PATH=/usr/lib/mps:/opt/SUNWappserver/lib:/usr/lib
   ```

   If the Application Server is on a different system, copy all the JAR files and shared libraries from the /opt/SUNWappserver/lib, /usr/share/lib/imq, and /usr/lib/mps directories to the target system.

4. Define the `resource-ref` elements in the `application-client.xml` file and the corresponding `sun-application-client.xml` file.

   For more information on the `sun-application-client.xml` file, see "The sun-application-client.xml file" on page 237. For a general explanation of how to map JNDI names using reference elements, see "Mapping References" on page 395.

5. Ensure that the client JAR file includes the following files:

   - a Java class to access the resource
   - `application-client.xml -` J2EE 1.4 application client deployment descriptor
   - `sun-application-client.xml -` Sun Java System Application Server specific client deployment descriptor. For information on the `sun-application-client.xml` file, see "The sun-application-client.xml file" on page 237.
   - `The MANIFEST.MF` file. This file contains the main class, which states the complete package prefix and classname of the Java client.

   You can package the application client using the `package-appclient` script. This is optional. See "Packaging an Application Client Using the ACC" on page 331.

6. Copy the following JAR files to the client machine and include them in the classpath on the client side:

   - `appserv-rt.jar` - available at *install_dir*/`lib`
   - `j2ee.jar` - available at *install_dir*/`lib`
   - The client JAR file

7. Set the values for the Java Virtual Machine startup options:

   ```
   jvmarg value = "-Dorg.omg.CORBA.ORBInitialHost=${ORBhost}"
   jvmarg value = "-Dorg.omg.CORBA.ORBInitialPort=${ORBport}"
   ```

   Here *ORBhost* is the Application Server hostname and *ORBport* is the ORB port number (default `3700`).

   This information can be obtained from the `domain.xml` file. For more information on `domain.xml` file, see the *Sun Java System Application Server Reference*.

8. Run the application client. See "Running an Application Client Using the ACC" on page 330.

Authenticating an Application Client

Using the JAAS module, you can provide security in your application client code. See "Authenticating an Application Client Using the JAAS Module" on page 67.

Running an Application Client Using the ACC

To run an application client, launch the ACC using the `appclient` script.

`appclient -client` *client_application_jar* `[-mainclass` *client_application_main_class_name*`|-name` *display_name*`][-xml sun-acc.xml] [-textauth] [-user` *user_name*`] [-password` *password*`] [`*app_args*`]`

- `-client`: Specifies the name and location of the client JAR file. This is a required parameter.
- `-mainclass`: Specifies the class name whose `main()` method is to be invoked. By default, the class specified in the client JAR's `Main-class` attribute of the `MANIFEST` file is used. This is optional.

NOTE The class name must be the full name, for example, `com.sun.test.AppClient`.

- `-name`: Specifies the display name that is located in the client JAR file. By default, the display name is specified in the client JAR `application-client.xml` file and identified by the `display-name` attribute. This is optional.

NOTE The `-mainclass` and `-name` parameters are optional for a single client application. For multiple client applications, you must use either the `-classname` option or the `-name` option.

- `-xml`: Specifies the name and location of the ACC configuration XML file, which is required if you are not using the default domain. By default, the ACC uses *domain_dir*`/config/sun-acc.xml` for clients running on the application server, or *install_dir*`/lib/appclient/sun-acc.xml` for clients that are packaged using the `package-applclient` script.
- `-textauth`: Specifies authentication using the text format. This is optional.
- `-user`: Specifies the user.

- `-password`: Specifies the user's password.
- *app_args*: Specifies the arguments passed to the client's `main()` method. This is optional.

The following example shows how to run the sample application client, `rmiConverter`:

```
appclient -client rmi-simpleClient.jar
```

Packaging an Application Client Using the ACC

The `package-appclient` script, located in the *install_dir/*`bin` directory, is used to package a client application into a single `appclient.jar` file. Packaging an application client involves the following main steps:

- Editing the Configuration File
- Editing the appclient Script
- Editing the sun-acc.xml File
- Setting Security Options
- Using the package-appclient Script

Editing the Configuration File

Modify the environment variables in `asenv.conf` file located in the *default-config_dir* directory as shown below:

- `$AS_INSTALL` to reference the location where the package was un-jared plus `/appclient`. For example: `$AS_INSTALL=/`*install_dir*`/appclient`.
- `$AS_NSS` to reference the location of the nss libs.

  For example:

  UNIX:

  `$AS_NSS=/`*install_dir*`/appclient/lib`

  WINDOWS:

  `%AS_NSS%=\`*install_dir*`\appclient\bin`

- `$AS_JAVA` to reference the location where you have installed the JDK.
- `$AS_ACC_CONFIG` to reference the configuration xml (`sun-acc.xml`). The `sun-acc.xml` is located at *install_dir*`/config`.

- `$AS_IMQ_LIB` to reference the imq home. It should be: *domain_dir*`/imq/lib`.

Editing the appclient Script

Modify the `appclient` script file as follows:

UNIX:

Change `$CONFIG_HOME/asenv.conf` to *your_ACC_dir*`/config/asenv.conf`.

Windows:

Change `%CONFIG_HOME%\config\asenv.bat` to *your_ACC_dir*`\config\asenv.bat`

Editing the sun-acc.xml File

Modify `sun-acc.xml` file to set the following attributes:

- Ensure that the `DOCTYPE` references `%%%SERVER_ROOT%%%/lib/dtds` to *your_ACC_dir*`/lib/dtds`.
- Ensure that the `<target-server> address` attribute references the remote server machine.
- Ensure that the `<target-server> port` attribute references the ORB port on the remote server.
- If you want to log the messages in a file, specify a file name for the `<log-service> file` attribute. You can also set the log level. For example:

```
<?xml version="1.0" encoding="UTF-8"?>

<!DOCTYPE client-container SYSTEM "file:{Your installed server
root}/lib/dtds/sun-application-client-container_1_0.dtd">

<client-container>

    <target-server name="qasol-e1" address="qasol-e1" port="3700">

    <log-service level="WARNING"/>

</client-container>
```

For more information on the `sun-acc.xml` file, see “The sun-acc.xml File” on page 241.

Setting Security Options

You can run the application client using SSL with certificate authentication. In order to set the security options, modify the `sun-acc.xml` file as shown in the code illustration below. For more information on the `sun-acc.xml` file, see “The sun-acc.xml File” on page 241.

```
<?xml version="1.0" encoding="UTF-8"?>
```

```
<!DOCTYPE client-container SYSTEM
"file:////opt/SUNWappserver/lib/dtds/sun-application-client-container_1_0.dtd">

<client-container>

    <target-server name="qasol-e1" address="qasol-e1" port="3700">

        <security>

            <ssl   cert-nickname="cts"

                   ssl2-enabled="false"

                   ssl2-ciphers="-rc4,-rc4export,-rc2,-rc2export,-des,-desede3"

                   ssl3-enabled="true"

ssl3-tls-ciphers="+rsa_rc4_128_md5,-rsa_rc4_40_md5,+rsa3_des_sha,+rsa_des_sha,-rsa_rc2_40
_md5,-rsa_null_md5,-rsa_des_56_sha,-rsa_rc4_56_sha"

                   tls-enabled="true"

                   tls-rollback-enabled="true"/>

            <cert-db path="/export3/ctsdata/ctscertdb" password="changeit"/>

        </security>

    </target-server>

    <client-credential user-name="j2ee" password="j2ee"/>

    <log-service level="WARNING"/>

</client-container>
```

Using the package-appclient Script

The following steps describe the procedure to use the `package-appclient` script that is bundled with Sun Java System Application Server:

1. Under *install_dir/*`bin` directory, run the `package-appclient` script. This creates an `appclient.jar` file and stores it under *install_dir/*`lib/appclient/` directory.

NOTE The `appclient.jar` file provides an application client container package targeted at remote hosts and does not contain a server installation. You can run this file from a remote machine with the same operating system as where it is created. That is, `appclient.jar` created on a Solaris platform will not function on Windows.

2. Copy the *install_dir*/lib/appclient/appclient.jar file to the desired location. The appclient.jar file contains the following files:

    - appclient/bin - contains the appclient script which you use to launch the ACC.
    - appclient/lib - contains the JAR and runtime shared library files.
    - appclient/lib/appclient - contains the following files:
        - sun-acc.xml - the ACC configuration file.
        - client.policy file- the security manager policy file for the ACC.
        - appclientlogin.conf file - the login configuration file.
        - client.jar file - is created during the deployment of the client application.
    - appclient/lib/dtds - contains sun-application_client-container_1_0.dtd which is the DTD corresponding to sun-acc.xml.

client.policy

client.policy file is the J2SE policy file used by the application client. Each application client has a client.policy file. The default policy file limits the permissions of J2EE deployed application clients to the minimal set of permissions required for these applications to operate correctly. If you develop an application client that requires more than this default set of permissions, you can edit the client.policy file to add the custom permissions that your applications need. You can use the J2SE standard policy tool or any text editor to edit this file.

For more information on using the J2SE policy tool, visit the following URL:

http://java.sun.com/docs/books/tutorial/security1.2/tour2/index.html

For more information about the permissions you can set in the client.policy file, visit the following URL:

http://java.sun.com/j2se/1.4/docs/guide/security/permissions.html

Developing Clients Without the ACC

This section describes the procedure to create, assemble, and deploy a Java-based client that is not packaged using the Application Client Container (ACC). This section describes the following topics:

- Using a Stand-Alone Client to Access an EJB Component

- Using a Stand-Alone Client to Access a JMS Resource
- Authenticating a Stand-Alone Client

For information about using the ACC, see "Developing Clients Using the ACC" on page 326.

Using a Stand-Alone Client to Access an EJB Component

To access an EJB component from a stand-alone client, perform the following steps:

1. In your client code, instantiate the `InitialContext` using the default (no argument) constructor:

   ```
   InitialContext ctx = new InitialContext();
   ```

   It is not necessary to explicitly instantiate a naming context that points to the CosNaming service.

2. In your client code, look up the home object by specifying the interoperable name of the home object. For example:

```
Object ref = ctx.lookup("beanA_interop_name");
BeanAHome = (BeanAHome)PortableRemoteObject.narrow(ref,BeanAHome.class);
```

   For more information about naming and lookups, see "Accessing the Naming Context" on page 387.

3. Deploy the EJB component to be accessed. For more information on deployment, see "Tools for Deployment" on page 106. You can use the `--retrieve` option to get the client JAR file.

   You can also use the `asadmin get-client-stubs` command to retrieve the stubs and ties whether or not you requested their generation during deployment. The syntax is as follows:

   ```
   asadmin get-client-stubs --user user --appname app_name local_dirpath
   ```

4. Ensure that the client JAR file includes the following files:
   - a Java class to access the bean
   - The `MANIFEST.MF` file. This file contains the main class, which states the complete package prefix and classname of the Java client.

5. Copy the following JAR files to the client machine and include them in the classpath on the client side:

- appserv-rt.jar - available at *install_dir*/lib
- j2ee.jar - available at *install_dir*/lib
- The client JAR file

6. If you need to access EJB components that are residing in a remote system other than the system where the application client is being developed, set the values for the Java Virtual Machine startup options:

   ```
   jvmarg value = "-Dorg.omg.CORBA.ORBInitialHost=${ORBhost}"
   jvmarg value = "-Dorg.omg.CORBA.ORBInitialPort=${ORBport}"
   ```

   Here *ORBhost* is the Application Server hostname and *ORBport* is the ORB port number (default 3700).

   This information can be obtained from the domain.xml file on the remote system. For more information on domain.xml file, see the *Sun Java System Application Server Reference*.

7. Run the stand-alone client. As long as the client environment is set appropriately and you are using a compatible JVM, you merely need to run the main class.

Using a Stand-Alone Client to Access a JMS Resource

To access a JMS resource from a stand-alone client, perform the following steps:

1. Create a JMS client. For detailed instructions on developing a JMS client, see the J2EE tutorial:

   http://java.sun.com/j2ee/1.4/docs/tutorial/doc/JMS.html#wp84181

2. Next, configure a JMS resource on the Sun Java System Application Server. For information on configuring JMS resources, see “Creating JMS Resources: Destinations and Connection Factories” on page 403.

3. Set the environment variable LD_LIBRARY_PATH. This variable should point to the Application Server, the Sun Java System Message Queue JAR files, and shared libraries:

   ```
   LD_LIBRARY_PATH=/usr/lib/mps:/opt/SUNWappserver/lib:/usr/lib
   ```

   If the Application Server is on a different system, copy all the JAR files and shared libraries from the /opt/SUNWappserver/lib, /usr/share/lib/imq, and /usr/lib/mps directories to the target system.

4. Ensure that the client JAR file includes the following files:

   - a Java class to access the resource
   - The `MANIFEST.MF` file. This file contains the main class, which states the complete package prefix and classname of the Java client.

5. Copy the following JAR files to the client machine and include them in the classpath on the client side:

   - `appserv-rt.jar` - available at *install_dir*/`lib`
   - `j2ee.jar` - available at *install_dir*/`lib`
   - The client JAR file

6. Set the values for the Java Virtual Machine startup options:

   ```
   jvmarg value = "-Dorg.omg.CORBA.ORBInitialHost=${ORBhost}"
   jvmarg value = "-Dorg.omg.CORBA.ORBInitialPort=${ORBport}"
   ```

   Here *ORBhost* is the Application Server hostname and *ORBport* is the ORB port number (default `3700`).

   This information can be obtained from the `domain.xml` file. For more information on `domain.xml` file, see the *Sun Java System Application Server Reference*.

7. Run the stand-alone client. As long as the client environment is set appropriately and you are using a compatible JVM, you merely need to run the `main` class.

Authenticating a Stand-Alone Client

This section describes the necessary steps and procedure to create a client that accesses secure EJBs from outside the ACC.

First, you must setup your client development environment using the following steps:

1. Set `org.omg.CORBA.ORBInitialHost` to the host on which the IIOP listener is running.

   ```
   env.setProperty("org.omg.CORBA.ORBInitialHost", "name service
   hostname");
   ```

2. Set `org.omg.CORBA.ORBInitialPort` to the port on which the IIOP listener is listening (usually 3700).

   ```
   env.setProperty("org.omg.CORBA.ORBInitialPort", "3700");
   ```

3. Set the following property:

   ```
   env.setProperty("com.sun.CORBA.connection.ORBSocketFactory",
   "com.sun.enterprise.iiop.IIOPSSLSocketFactory");
   ```

4. Set `java.security.auth.login.config` to *install_dir*`/lib/appclient/appclientlogin.conf`

NOTE Do not set `java.naming.factory.initial`. The default JNDI provider is by default picked from the set classpath.

Next, add the following code to the client application:

1. Obtain a username and a password. To obtain a username and a password, you can either write your own JAAS login callback handler or use the standard one provided with Sun Java System Application Server (`com.sun.enterprise.security.auth.login.LoginCallbackHandler`).

   The following code line illustrates the use of standard handler using GUI-based authentication:

   ```
   LoginCallbackHandler handler = new LoginCallbackHandler(true);
   ```

   The following code line illustrates the use of standard handler using the text authentication:

   ```
   LoginCallbackHandler handler = new LoginCallbackHandler(false);
   ```

   The following code line is an example code for writing your own login callback handler:

   ```
   import javax.security.auth.callback.CallbackHandler;
   import javax.security.auth.callback.UnsupportedCallbackException;
   import javax.security.auth.callback.Callback;
   import javax.security.auth.callback.NameCallback;
   import javax.security.auth.callback.PasswordCallback;

   public class LoginCallbackHandler implements CallbackHandler {

   private String username = "j2ee";
   private String password = "j2ee";

   public void handle(Callback[] callbacks) throws
   UnsupportedCallbackException {
   try {
       for (int i = 0; i <callbacks.length; i++) {
       if (callbacks[i] instanceof NameCallback) {
           NameCallback nc = (NameCallback)callbacks[i];
   ```

```
            nc.setName(username);
            } else if(callbacks[i] instanceof PasswordCallback) {
                PasswordCallback pc = (PasswordCallback)callbacks[i];
                pc.setPassword(password.toCharArray());
            }
        }

        } catch (Exception ex) {
            ex.printStackTrace();
        }
        }
    }
```

2. Pass an instance of your handler to the security infrastructure using the following call:

   ```
   LoginContextDriver.doClientLogin(AppContainer.USERNAME_PASSWORD,
   handler);
   ```

   The following two imports are required for the above call:

   ```
   import com.sun.enterprise.appclient.AppContainer;
   import com.sun.enterprise.security.auth.LoginContextDriver;
   ```

Configuring the ORB

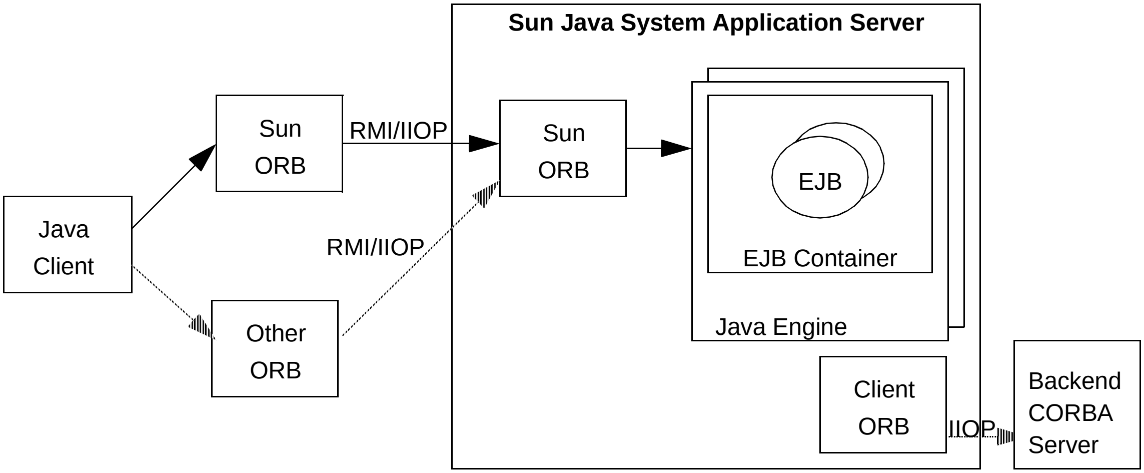
This section describes how to configure the built-in ORB or a third party ORB in the following topics:

- ORB Support Architecture
- Configuring Load-Balancing for EJB Client Applications
- Third Party ORB Support

ORB Support Architecture

CORBA client support in the Application Server involves communication between the ORB on the client and the ORB on the server, as shown in the following figure.

Figure 9-1 ORB Support Architecture



You can use the ORB that is bundled as part of the Application Server, or you can use a third-party ORB (ORBIX 2000 or ORBacus 4.1).

Configuring Load-Balancing for EJB Client Applications

If you are using built-in Sun Java System Application Server ORB, you can configure client-side load balancing using the Round Robin DNS approach.

To implement a simple load balancing scheme without making source code changes to your client, you can leverage the round robin feature of DNS. In this approach, you define a single virtual host name representing multiple physical IP addresses on which server instance ORBs are listening. Assuming that you configure all of the ORBs to listen on a common IIOP port number, the client applications can use a single `host_name: IIOP port` during the JNDI lookup. The DNS server resolves the host name to a different IP address each time the client is executed.

You can also implement client-side load balancing using the Sun Java System Application Server-specific naming factory class `SIASCtxFactory`. You can use this class both on the client-side and on the server-side which maintains a pool of ORB instances in order to limit the number of ORB instances that are created in a given process.

The following code illustrates the use of `S1ASCtxFactory` class:

```
Properties env = new Properties();

env.setProperty("java.naming.factory.initial","com.sun.appserv.naming.S1AS
CtxFactory");

env.setProperty("org.omg.CORBA.ORBInitialHost","name service
hostname");

env.setProperty("org.omg.CORBA.ORBInitialPort", "name service port
number");

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

If you set a single URL property for the host and port above, your code would look like this:

```
Properties env = new Properties();

env.setProperty("java.naming.factory.initial",
"com.sun.appserv.naming.S1ASCtxFactory");

env.setProperty("java.naming.provider.url", "iiop://"name service
hostname:name service port number");

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

If you prefer, you may set the host and port values and the URL value as Java System properties, instead of setting them in the environment as shown in the above code illustration. The values set in your code will, however, override any System property settings. Also, if you set both the URL and the host and port properties, the URL takes precedence.

Note that the `[name service hostname]` value mentioned above could be a name that maps to multiple IP addresses. The `S1ASCtxFactory` will appropriately round robin ORB instances across all the IP addresses everytime a user calls new `InitialContext()` method.

You can also use the following property of `S1ASCtxFactory` class to implement client-side load balancing:

`com.sun.appserv.iiop.loadbalancingpolicy=roundrobin,`*host1*`:`*port1*`,`*host2*`:`*port2*`...`

This property provides you with a list of *host:port* combinations to round robin the ORBs. These host names may also map to multiple IP addresses. If you use this property along with `org.omg.CORBA.ORBInitialHost` and `org.omg.CORBA.ORBInitialPort` as system properties, the round robin algorithm will round robin across all the values provided. If, however, you provide a host name and port number in your code, in the environment object, that value will override any such system property settings.

Third Party ORB Support

Sun Java System Application Server provides a built-in ORB to support IIOP access to the EJBs. For information on configuring the built-in ORB for supporting CORBA clients, see the *Sun Java System Application Server Administration Guide*.

You can also install and configure a third party ORB to use IIOP with Application Server. J2EE components (such as Servlet and EJBs) deployed to Sun Java System Application Server can access backend CORBA objects through third party Object Request Brokers (ORBs). This support enables J2EE applications to leverage investments in the existing CORBA-based business components. In addition to supporting server side access to backend CORBA objects, you can also use the built-in ORB for RMI/IIOP-based access to EJB components from Java or C++ application clients as explained in the RMI/IIOP samples.

Configuring the Orbix ORB with the Sun Java System Application Server involves the following steps:

- Installing Orbix
- Configuring Sun Java System Application Server to Use Orbix
- Overriding the Built-in ORB

Installing Orbix

To install Orbix, perform the following steps:

- Ensure that you have the Orbix 2000 software available for installation.
- Install the software. For instructions, read the *Orbix Installation Guide*.
- Verify that the Orbix configuration is correct.

Configuring Sun Java System Application Server to Use Orbix

You must configure the runtime environment to enable the Sun Java System Application Server to load the Orbix ORB classes. Add the following to the classpath:

- Orbix classes
- OMG classes
- Directory containing the Orbix license file

To edit the classpath using the Administration Console:

1. Login to the Administration Console by going to the following URL in your web browser:

   http://*host*:*port*/asadmin

   For example:

   ```
   http://localhost:4848/asadmin
   ```
2. Go to the Application Server page.
3. Click on the JVM Settings tab, then click on Path Settings.
4. Append the following to the Classpath Suffix text field, all on one line:

   ```
   /etc/opt/iona/:/opt/iona/orbix_art/1.2/classes/orbix2000.jar:/opt/iona/
   orbix_art/1.2/classes/omg.jar
   ```
5. Click Save.

Overriding the Built-in ORB

Sun Java System Application Server relies on a built-in ORB to support RMI/IIOP access to EJB components from Java application clients. When implementing servlets and EJB components that access backend CORBA-based applications residing outside of the application server, you may need to override the built-in ORB classes with the ORB classes from third party products such as Orbix 2000.

You can use any of the following approaches to override the built-in ORB classes with ORB classes from third party products:

- ORB.init() Properties Approach
- orb.properties Approach
- Providing JVM Start-up Arguments

ORB.init() Properties Approach

The code illustration given below overrides the built-in ORB classes with ORB classes from IONA's ORBIX 2000.

```
...
Properties orbProperties = new Properties();
orbProperties.put("org.omg.CORBA.ORBClass","com.iona.corba.art.artimpl.ORBImpl");
orbProperties.put("org.omg.CORBA.ORBSingletonClass","com.iona.corba.art.artimpl.ORBSingleton");
orb = ORB.init(args, orbProperties);
...
```

The advantage of this approach is that RMI/IIOP access to EJB components housed in the application server will still be performed using the built-in ORB classes while only access from servlets and EJB components to backend CORBA-based applications will use the third party ORB classes. This is the efficient method of supporting simultaneous use of multiple ORBs in the application server environment.

orb.properties Approach

In Java 2 1.2.1 environment, the JVM's `orb.properties` file contains property settings to identify the ORB implementation classes that are used by default throughout the JVM. To override the use of the built-in ORB classes, you can simply modify the `orb.properties` file to specify third party ORB classes and restart the application server.

For example, to set the implementation classes to specify the Orbix 2000 classes, make the following modification to the `orb.properties` file located at *install_dir/*`jdk/jre/lib/`.

Before:

```
org.omg.CORBA.ORBClass=com.sun.corba.se.internal.Interceptors.PIOR

org.omg.CORBA.ORBSingletonClass=com.sun.corba.se.internal.corba.ORBSingleton
```

After:

```
org.omg.CORBA.ORBClass=com.iona.corba.art.artimpl.ORBImpl

org.omg.CORBA.ORBSingletonClass=com.iona.corba.art.artimpl.ORBSingleton
```

The `javax.rmi` classes are used to support RMI/IIOP client access to EJB components housed in the application server. Since these classes are not used to access backend CORBA servers, you do not need to override these settings.

The main advantage of this approach is that it involves only one time setting for all applications deployed to the application server. There is no need for each servlet and/or EJB component that is acting as a client to a backend CORBA application to specify the ORB implementation classes.

Providing JVM Start-up Arguments

You can also specify the ORB implementation classes as server's JVM_ARGS in the `domain.xml` file.

Go to *domain_dir/*`config` and edit the `domain.xml` file and add these JVM options as a subelement under `<java-config>` element.

```
<jvm-options>
    -Dorg.omg.CORBA.ORBClass=com.iona.corba.art.artimpl.ORBImpl
</jvm-options>
<jvm-options>
    -Dorg.omg.CORBA.ORBSingletonClass=com.iona.corba.art.artimpl.ORBSingleton
</jvm-options>
```

This approach gives the benefit of specifying the ORB implementation classes only once, but the main advantage when compared to changing the `orb.properties` file is that, the changes made to server's configuration file are specific to server instance and are applicable to all the applications running on a particular instance only.

Chapter 10

Developing Lifecycle Listeners

Lifecycle listener modules provide a means of running short or long duration Java-based tasks within the application server environment, such as instantiation of singletons or RMI servers. These modules are automatically initiated at server startup and are notified at various phases of the server life cycle.

The following sections describe how to create and use a lifecycle module:

Server Life Cycle Events

A lifecycle module listens for and performs its tasks in response to the following events in the server life cycle:

- During the `INIT_EVENT`, the server reads the configuration, initializes built-in subsystems (such as security and logging services), and creates the containers.
- During the `STARTUP_EVENT`, the server loads and initializes deployed applications.
- During the `READY_EVENT`, the server is ready to service requests.
- During the `SHUTDOWN_EVENT`, the server destroys loaded applications and stops.

- During the TERMINATION_EVENT, the server closes the containers, the built-in subsystems, and the server runtime environment.

These events are defined in the LifecycleEvent class.

The lifecycle modules that listen for these events implement the LifecycleListener interface and are configured in the domain.xml file.

The LifecycleListener Interface

To create a lifecycle module is to configure a customized class that implements the com.sun.appserv.server.LifecycleListener interface. You can create and simultaneously execute multiple lifecycle modules.

The LifecycleListener interface defines this method:

- public void handleEvent(com.sun.appserv.server.LifecycleEvent event) throws ServerLifecycleException

  This method responds to a lifecycle event and throws a com.sun.appserv.server.ServerLifecycleException if an error occurs.

A sample implementation of the LifecycleListener interface is the LifecycleListenerImpl.java file, which you can use for testing lifecycle events:

```
package com.sun.appserv.server;

import java.util.Properties;

/**
 *  LifecycleListenerImpl is a dummy implementation for the LifecycleListener
 * interface.This implementaion stubs out various lifecycle interface methods.
 */

public class LifecycleListenerImpl implements LifecycleListener {

    /** receive a server lifecycle event
     *  @param event associated event
     *  @throws <code>ServerLifecycleException</code> for exceptional condition.
     *
     *  Configure this module as a lifecycle-module in domain.xml:
     *
     *  <applications>
     *     <lifecycle-module name="test"
     *                 class-name="com.sun.appserv.server.LifecycleListenerImpl"
     *                 is-failure-fatal="false">
 *         <property name="foo" value="fooval"/>
 *     </lifecycle-module>
 *  </applications>
 *
 *  Set<code>is-failure-fatal</code>in domain.xml to <code>true</code> for
 *  fatal conditions.
 */
public void handleEvent(LifecycleEvent event) throws ServerLifecycleException
{
    LifecycleEventContext context = event.getLifecycleEventContext();

    context.log("got event" + event.getEventType() + " event data: "
        + event.getData());

    Properties props;

    if (LifecycleEvent.INIT_EVENT == event.getEventType()) {
        context.log("LifecycleListener: INIT_EVENT");

        props = (Properties) event.getData();

        // handle INIT_EVENT
        return;
    }

    if (LifecycleEvent.STARTUP_EVENT == event.getEventType()) {
        context.log("LifecycleListener: STARTUP_EVENT");

        // handle STARTUP_EVENT
        return;
    }

    if (LifecycleEvent.READY_EVENT == event.getEventType()) {

        context.log("LifecycleListener: READY_EVENT");

        // handle READY_EVENT
        return;
    }

    if (LifecycleEvent.SHUTDOWN_EVENT== event.getEventType()) {
        context.log("LifecycleListener: SHUTDOWN_EVENT");

        // handle SHUTDOWN_EVENT
        return;
        }

        if (LifecycleEvent.TERMINATION_EVENT == event.getEventType()) {
            context.log("LifecycleListener: TERMINATE_EVENT");

            // handle TERMINATION_EVENT
            return;
        }
    }
}
```

The LifecycleEvent Class

The `com.sun.appserv.server.LifecycleEvent` class defines a server life cycle event. The following methods are associated with the event:

- `public java.lang.Object getData()`

  This method returns the data associated with the event.

- `public int getEventType()`

  This method returns the event type, which is `INIT_EVENT`, `STARTUP_EVENT`, `READY_EVENT`, `SHUTDOWN_EVENT`, or `TERMINATION_EVENT`.

- `public com.sun.appserv.server.LifecycleEventContext getLifecycleEventContext()`

  This method returns the lifecycle event context, described next.

A `LifecycleEvent` instance is passed to the `LifecycleListener.handleEvent` method.

The Server Lifecycle Event Context

The `com.sun.appserv.server.LifecycleEventContext` interface exposes runtime information about the server. The lifecycle event context is created when the `LifecycleEvent` class is instantiated at server initialization. The `LifecycleEventContext` interface defines these methods:

- `public java.lang.String[] getCmdLineArgs()`

  This method returns the server startup command-line arguments.

- `public java.lang.String getInstallRoot()`

This method returns the server installation root directory.

- `public java.lang.String getInstanceName()`

  This method returns the server instance name.

- `public javax.naming.InitialContext getInitialContext()`

  This method returns the initial JNDI naming context. The naming environment for lifecycle modules is installed during the `STARTUP_EVENT`. A lifecycle module can look up any resource defined in the `domain.xml` file by its `jndi-name` attribute after the `STARTUP_EVENT` is complete.

NOTE To avoid collisions with names of other enterprise resources in JNDI, and to avoid portability problems, all names in a Sun Java System Application Server lifecycle module should begin with the string `java:comp/env`.

  If a lifecycle module needs to look up resources, it can do so in the `READY_EVENT`. It can use the `getInitialContext()` method to get the initial context to which all the resources are bound.

- `public void log(java.lang.String message)`

  This method writes the specified message to the server log file. The `message` parameter is a String specifying the text to be written to the log file.

- `public void log(java.lang.String message, java.lang.Throwable throwable)`

  This method writes an explanatory message and a stack trace for a given `Throwable` exception to the server log file. The `message` parameter is a String that describes the error or exception. The `throwable` parameter is the `Throwable` error or exception.

Assembling and Deploying a Lifecycle Module

You assemble a lifecycle module as described in "Assembling a Lifecycle Module" on page 98. You deploy a lifecycle module as described in "Deploying a Lifecycle Module" on page 111.

During lifecycle module deployment, a `lifecycle-module` element is created in the `domain.xml` file. You can edit this file to change its configuration. The `property` subelement allows you to specify input parameters. For example:

```
<lifecycle-module     name="customStartup"
                      enabled="true"
                      class-name="com.acme.CustomStartup"
                      classpath="/apps/customStartup"
                      load-order="200"
                      is-failure-fatal="true">
    <description>custom startup module to do my tasks</description>
    <property name="rmiServer" value="acme1:7070" />
    <property name="timeout" value="30" />
</lifecycle-module>
```

Note that if `is-failure-fatal` is set to `true` (the default is `false`), lifecycle module failure prevents server initialization or startup, but not shutdown or termination.

For more information about the `domain.xml` file, see the *Sun Java System Application Server Reference*.

After you deploy a lifecycle module, you must restart the server to activate it. The server instantiates it and registers it as a lifecycle event listener at server initialization.

Considerations for Lifecycle Modules

The resources allocated during initialization or startup should be freed during shutdown or termination. The lifecycle module classes are called synchronously from the main server thread, therefore it is important to ensure that these classes don’t block the server. Lifecycle modules may create threads if appropriate, but these threads must be stopped in the shutdown and termination phases.

The LifeCycleModule Classloader is the parent classloader for lifecycle modules. Each lifecycle module’s `classpath` in `domain.xml` is used to construct its classloader. All the support classes needed by a lifecycle module must be available to the LifeCycleModule Classloader or its parent, the Connector Classloader.

You must ensure that the `server.policy` file is appropriately set up, or a lifecycle module trying to perform a `System.exec()` may cause a security access violation. For details, see “The server.policy File” on page 60.

The configured properties for a lifecycle module are passed as properties in the `INIT_EVENT`. The JNDI naming context is not available in the `INIT_EVENT`. If a lifecycle module requires the naming context, it can get this in the `STARTUP_EVENT`, `READY_EVENT`, or `SHUTDOWN_EVENT`.

Part III

Using Services and APIs

Chapter 11, “Using the JDBC API for Database Access”

Chapter 12, “Using the Transaction Service”

Chapter 13, “Using the Java Naming and Directory Interface”

Chapter 14, “Using the Java Message Service”

Chapter 15, “Using the JavaMail API”

Chapter 11

Using the JDBC API for Database Access

This chapter describes how to use the Java™ Database Connectivity (JDBC™) API for database access with the Sun Java™ System Application Server. This chapter also provides high level JDBC implementation instructions for servlets and EJB™ components using the Sun Java System Application Server. The Sun Java System Application Server supports the JDBC 3.0 API, which encompasses the JDBC 2.0 Optional Package API.

- General Steps for Creating a JDBC Resource
- Configurations for Specific JDBC Drivers
- Creating Applications That Use the JDBC API

The JDBC specifications are available here:

`http://java.sun.com/products/jdbc/download.html`

A useful JDBC tutorial is located here:

`http://java.sun.com/docs/books/tutorial/jdbc/index.html`

For explanations of two-tier and three-tier database access models, see the *Sun Java System Application Server Administration Guide*.

NOTE Sun Java System Application Server does not support connection pooling or transactions for an application's database access if it does not use standard J2EE™ `DataSource` objects.

General Steps for Creating a JDBC Resource

To prepare a JDBC resource for use in J2EE applications deployed to the Sun Java System Application Server, perform the following tasks:

- Integrating the JDBC Driver
- Creating a Connection Pool
- Testing a Connection Pool
- Creating a JDBC Resource

For information about how to configure some specific JDBC drivers, see "Configurations for Specific JDBC Drivers" on page 364.

Integrating the JDBC Driver

To use JDBC features, you must choose a JDBC driver to work with the Sun Java System Application Server, then you must set up the driver. This section covers these topics:

- Supported Database Drivers
- Making the JDBC Driver JAR Files Accessible

Supported Database Drivers

Supported JDBC drivers are those that have been fully tested by Sun. For a list of the JDBC drivers currently supported by the Sun Java System Application Server, see the *Sun Java System Application Server Platform Edition 8 Release Notes*.

For configurations of supported and other drivers, see "Configurations for Specific JDBC Drivers" on page 364.

NOTE Because the drivers and databases supported by the Sun Java System Application Server are constantly being updated, and because database vendors continue to upgrade their products, always check with Sun technical support for the latest database support information.

Making the JDBC Driver JAR Files Accessible

To integrate the JDBC driver into a Sun Java System Application Server domain, copy the JAR files into the *domain_dir*/`lib/ext` directory, then restart the server. This makes classes accessible to any application or module across the domain. For more information about Sun Java System Application Server classloaders, see "Classloaders" on page 85.

Creating a Connection Pool

When you create a connection pool that uses JDBC technology ("JDBC connection pool") in the Sun Java System Application Server, you can define many of the characteristics of your database connections.

You can create a connection pool in one of these ways:

- Using the Administration Console
- Using the Command Line Interface

The "Using the Administration Console" section describes each connection pool setting. The "Using the Command Line Interface" section merely lists syntax and default values.

For additional information about connection pools, including connection pool monitoring, see the *Sun Java System Application Server Administration Guide*.

Using the Administration Console

To create a JDBC connection pool using the Administration Console, perform these tasks:

1. Login to the Administration Console by going to the following URL in your web browser:

   `http://`*host*`:`*port*`/asadmin`

   For example:

   `http://localhost:4848/asadmin`

2. Open the JDBC component.
3. Click Connection Pools.
4. Click the New button.
5. Enter the following information:

   ❍ Name (required) - Enter a name (or ID) for the connection pool.

- Resource Type - Select the JDBC driver's DataSource interface name if the DataSource class implements more than one DataSource type (`DataSource`, `XADataSource`, or `ConnectionPoolDataSource`). Leave blank if the class implements only one interface.
- Database Vendor - Select the database vendor from the drop-down list.

6. Click the Next button.
7. Enter the following information:
   - Datasource Classname (required) - Enter the vendor-supplied `DataSource` class name.
8. Click the Next button.
9. Enter a text Description if desired.
10. You can change the pool settings listed in the following table.

Table 11-1 Pool Settings

Setting	Default	Description
Steady Pool Size	8	Specifies the initial and minimum number of connections maintained in the pool.
Max Pool Size	32	Specifies the maximum number of connections that can be created to satisfy client requests.
Pool Resize Quantity	2	Specifies the number of connections to be destroyed if the existing number of connections is above the Steady Pool Size (subject to the Max Pool Size limit). This is enforced periodically at the Idle Timeout interval. An idle connection is one that has not been used for a period specified by Idle Timeout.
Idle Timeout (secs)	`300`	Specifies the minimum time that a connection can remain idle in the free pool. After this amount of time, the pool can close this connection.
Max Wait Time	`60000`	Specifies the amount of time, in milliseconds, that the caller is willing to wait to acquire a connection. If `0`, the caller is blocked indefinitely until a resource is available or an error occurs.

11. You can change the connection validation settings listed in the following table. All of these settings are optional.

Table 11-2 Connection Validation Settings

Setting	Default	Description
Connection Validation Required	Unchecked	Specifies whether connections have to be validated before being given to the application. If a resource's validation fails, it is destroyed, and a new resource is created and returned.
connectionPool Validation Method	`auto-commit`	Specifies the method used to validate connections if Connection Validation Required is selected. Legal values are as follows: • `auto-commit` (default), which uses `Connection.setAutoCommit()` • `meta-data`, which uses `Connection.getMetaData()` • `table`, which performs a query on the table specified in the Table Name setting
Table Name	none	Specifies the table name to be used to perform a query to validate a connection. This setting is mandatory if and only if the Validation Method is set to `table`.
On Any Failure Close All Connections	Unchecked	If checked, closes all connections in the pool if a single validation check fails. Recovery of a minimum number of connections (specified by the Steady Pool Size setting) is attempted. This setting is mandatory if and only if Connection Validation Required is checked. If Connection Validation Required is unchecked, this setting is ignored.

12. You can change the transaction isolation settings listed in the following table. All of these settings are optional.

Table 11-3 Transaction Isolation Settings

Setting	Default	Description
Transaction Isolation	default JDBC driver isolation level	Specifies the transaction isolation level on the pooled database connections. Allowed values are `read-uncommitted`, `read-committed`, `repeatable-read`, or `serializable`. Not all databases support all these values. Applications that change the isolation level on a pooled connection programmatically risk polluting the pool, which can lead to errors. See Guarantee Isolation Level for more details.
Isolation Level Guaranteed	Checked	Applicable only when the Transaction Isolation level is explicitly set. If checked, every connection obtained from the pool is guaranteed to have the desired isolation level. This may impact performance on some JDBC drivers. You can uncheck this setting if you are certain that the hosted applications do not return connections with altered isolation levels.

13. To add a property, click the Add Property button and enter the property name and value. To delete properties, check the properties you want to delete, then click the Delete Properties button.

Specify values for any properties your JDBC driver requires. The following table lists some standard and commonly used properties. For information about the specific properties your database requires, see your database vendor’s documentation.

Table 11-4 Common Connection Pool Properties

Property	Description
`User`	Specifies the user name for this connection pool.
`Password`	Specifies the password for this connection pool.
`databaseName`	Specifies the database for this connection pool.
`serverName`	Specifies the database server for this connection pool.
`port`	Specifies the port on which the database server listens for requests.
`networkProtocol`	Specifies the communication protocol.
`roleName`	Specifies the initial SQL role name.
`datasourceName`	Specifies an underlying `XADataSource`, or a `ConnectionPoolDataSource` if connection pooling is done.
`description`	Specifies a text description.

14. Click the Finish button.

Using the Command Line Interface

To create a JDBC connection pool using the command line, use the `asadmin create-jdbc-connection-pool` command. The syntax is as follows, with defaults shown for optional parameters that have them:

```
asadmin create-jdbc-connection-pool --user user --datasourceclassname
class_name [--restype javax.sql.DataSource] [--steadypoolsize=8]
[--maxpoolsize=32] [--maxwait=60000] [--poolresize=2] [--idletimeout=300]
[--isolationlevel isolation_level] [--isisolationguaranteed=true]
[--isconnectvalidatereq=false] [--validationmethod=auto-commit]
[--validationtable table_name] [--failconnection=false] [--description text]
[--property (name=value)[:name=value]*] connection_pool_id
```

For more information about the parameters specific to `asadmin create-jdbc-connection-pool`, see "Using the Administration Console" on page 357. For more information about the optional general `asadmin` parameters (`--password`, `--passwordfile`, `--host`, `--port`, `--secure`, `--terse`, `--echo`, and `--interactive`), see the *Sun Java System Application Server Administration Guide*.

For example:

```
asadmin create-jdbc-connection-pool --user joeuser --datasourceclassname
oracle.jdbc.pool.OracleDataSource --failconnection=true
--isconnectvalidatereq=true --property
url=jdbc\\:oracle\\:thin\\:@myhost\\:1521\\:V8i:user=staging_lookup_app:pa
ssword=staging_lookup_app OraclePoollookup
```

Note that the colon characters (`:`) within property values must be escaped with double backslashes (`\\`) on Solaris™ platforms as shown, because otherwise they are interpreted as property delimiters. On Windows platforms, colon characters (`:`) must be escaped with single backslashes (`\`). For details about using escape characters, see the *Sun Java System Application Server Administration Guide*.

To delete a JDBC connection pool, use the following command:

```
asadmin delete-jdbc-connection-pool --user user [--cascade=false]
connection_pool_id
```

For example:

```
asadmin delete-jdbc-connection-pool --user joeuser OraclePoollookup
```

To list JDBC connection pools, use the following command:

```
asadmin list-jdbc-connection-pools --user user [config_name]
```

For example:

```
asadmin list-jdbc-connection-pools --user joeuser
```

Testing a Connection Pool

To test a JDBC connection pool for usability, use the following command:

```
asadmin ping-connection-pool --user user connection_pool_id
```

For more information about the optional general `asadmin` parameters (`--password`, `--passwordfile`, `--host`, `--port`, `--secure`, `--terse`, `--echo`, and `--interactive`), see the *Sun Java System Application Server Administration Guide*.

For example:

```
asadmin ping-connection-pool --user joeuser OraclePoollookup
```

This command fails and displays an error message unless it successfully connects to the connection pool.

Creating a JDBC Resource

A JDBC resource, also called a data source, lets you make connections to a database using `getConnection()`. Create a JDBC resource in one of these ways:

- Using the Administration Console
- Using the Command Line Interface

The "Using the Administration Console" section describes each JDBC resource setting. The "Using the Command Line Interface" section merely lists syntax and default values.

For general information about JDBC resources, see the *Sun Java System Application Server Administration Guide*.

Using the Administration Console

To create a JDBC resource using the Administration Console, perform these tasks:

1. Login to the Administration Console by going to the following URL in your web browser:

   `http://`*host*`:`*port*`/asadmin`

   For example:

   ```
   http://localhost:4848/asadmin
   ```

2. Open the JDBC component.
3. Click JDBC Resources.
4. Click the New button.
5. Enter the following information:

   - JNDI Name (required) - Enter the JNDI name that application components must use to access the JDBC resource.
   - Pool Name (required) - Select from the list the name (or ID) of the connection pool used by this JDBC resource. For more information, see "Creating a Connection Pool" on page 357.
   - Description (optional) - You can enter a text description of the JDBC resource.

- Status - Check the Enabled box to enable the JDBC resource.

  If a JDBC resource is disabled, no application component can connect to it, but its configuration remains in the domain.

6. Click the OK button.

Using the Command Line Interface

To create a JDBC resource using the command line, use the `asadmin create-jdbc-resource` command. The syntax is as follows, with defaults shown for optional parameters that have them:

```
asadmin create-jdbc-resource --user user --connectionpoolid connection_pool_id
[--enabled=true] [--description text] [--property (name=value)[:name=value]*]
jndi_name
```

For more information about the parameters specific to `asadmin create-jdbc-resource`, see "Using the Administration Console" on page 362.

For more information about the optional general `asadmin` parameters (`--password`, `--passwordfile`, `--host`, `--port`, `--secure`, `--terse`, `--echo`, and `--interactive`), see the *Sun Java System Application Server Administration Guide*.

For example:

```
asadmin create-jdbc-resource --user joeuser --connectionpoolid
OraclePoollookup OracleDSlookup
```

To delete a JDBC resource, use the following command:

```
asadmin delete-jdbc-resource --user user jndi_name
```

For example:

```
asadmin delete-jdbc-resource --user joeuser OracleDSlookup
```

To list JDBC resources, use the following command:

```
asadmin list-jdbc-resources --user user [config_name]
```

For example:

```
asadmin list-jdbc-resources --user joeuser
```

Configurations for Specific JDBC Drivers

Sun Java System Application Server Platform Edition 8 is designed to support connectivity to any database management system with a corresponding JDBC driver. The following JDBC driver and database combinations are supported. These combinations have been tested with Sun Java System Application Server Platform Edition 8 and are found to be J2EE compatible. They are also supported for CMP.

- PointBase Type4 Driver
- IBM DB2 8.1 Type2 Driver
- Inet Oraxo JDBC Driver for Oracle 8.1.7 and 9.x Databases
- Inet Merlia JDBC Driver for Microsoft SQL Server Databases
- Inet Sybelux JDBC Driver for Sybase Databases

For an up to date list of currently supported JDBC drivers, see the *Sun Java System Application Server Platform Edition 8 Release Notes*.

Other JDBC drivers can be used with Sun Java System Application Server Platform Edition 8, but J2EE compliance tests have not been completed with these drivers. Although Sun offers no product support for these drivers, Sun offers limited support of the use of these drivers with the Sun Java System Application Server.

- Data Direct Connect JDBC3.0/ Type4 Driver for IBM DB2 Databases
- Oracle Thin/Type4 Driver for Oracle 8.1.7 and 9.x Databases
- OCI Oracle Type2 Driver for Oracle 8.1.7 and 9.x Databases
- Data Direct Connect JDBC3.0/ Type4 Driver for Oracle 8.1.7 and 9.x Databases
- Data Direct Connect JDBC3.0/ Type4 Driver for Microsoft SQL Server Databases
- Sybase JConnect/Type4 Driver
- Data Direct Connect JDBC3.0/ Type4 Driver for Sybase Databases
- Data Direct Connect JDBC3.0/ Type4 Driver for Informix Databases
- IBM Informix Type4 Driver
- MM MySQL Type4 Driver
- CloudScape 5.1 Type4 Driver

For details about how to integrate a JDBC driver and how to use the Administration Console or the command line interface to implement the configuration, see “General Steps for Creating a JDBC Resource” on page 356.

NOTE An Oracle database user running the `capture-schema` command needs ANALYZE ANY TABLE privileges if that user does not own the schema. These privileges are granted to the user by the database administrator. For information about `capture-schema`, see "Using the capture-schema Utility" on page 316.

PointBase Type4 Driver

The PointBase JDBC driver is included with the Sun Java System Application Server by default, except for the Solaris bundled installation, which does not include PointBase. Therefore, unless you have the Solaris bundled installation, you do not need to integrate this JDBC driver with the Sun Java System Application Server. This driver is verified J2EE compatible and supported.

The JAR file for the PointBase driver is `pbclient.jar`.

Configure the connection pool using the following settings:

- **Name:** You will use this name when you configure the JDBC resource later.
- **Resource Type:** Specify the appropriate value.
- **Database Vendor:** `PointBase`
- **Datasource Classname:** one of the following:

  `com.pointbase.jdbc.jdbcDataSource`

  `com.pointbase.xa.xaDataSource`
- **Properties:**
  - **`user`** - Specify the database user.
  - **`password`** - Specify the database password.
  - **`databaseName`** - Specify the URL of the database. The syntax is as follows:

    `jdbc:pointbase:server://`*server*`:`*port*`/`*dbname*`,new`

IBM DB2 8.1 Type2 Driver

This driver is verified J2EE compatible and supported. The JAR files for the DB2 driver are `db2jcc.jar`, `db2jcc_license_cu.jar`, and `db2java.zip`. Set environment variables as follows:

```
LD_LIBRARY_PATH=/usr/db2user/sqllib/lib:${j2ee.home}/lib

DB2DIR=/opt/IBM/db2/V8.1

DB2INSTANCE=db2user

INSTHOME=/usr/db2user

VWSPATH=/usr/db2user/sqllib

THREADS_FLAG=native
```

Configure the connection pool using the following settings:

- **Name:** You will use this name when you configure the JDBC resource later.
- **Resource Type:** Specify the appropriate value.
- **Database Vendor:** `DB2`
- **Datasource Classname:** `com.ibm.db2.jcc.DB2SimpleDataSource`
- **Properties:**
  - **`user`** - Set as appropriate.
  - **`password`** - Set as appropriate.
  - **`databaseName`** - Set as appropriate.
  - **`driverType`** - Set to `2`.
  - **`deferPrepares`** - Set to `false`.

Inet Oraxo JDBC Driver for Oracle 8.1.7 and 9.x Databases

This driver is verified J2EE compatible and supported. The JAR file for the Inet Oracle driver is `Oranxo.jar`. Configure the connection pool using the following settings:

- **Name:** You will use this name when you configure the JDBC resource later.
- **Resource Type:** Specify the appropriate value.

- **Database Vendor:** `Oracle`
- **Datasource Classname:** `com.inet.ora.OraDataSource`
- **Properties:**
  - **`user`** - Specify the database user.
  - **`password`** - Specify the database password.
  - **`serviceName`** - Specify the URL of the database. The syntax is as follows:

    `jdbc:inetora:`*server*`:`*port*`:`*dbname*

    For example:

    `jdbc:inetora:localhost:1521:payrolldb`

    In this example,`localhost` is the host name of the machine running the Oracle server, `1521` is the Oracle server's port number, and `payrolldb` is the SID of the database. For more information about the syntax of the database URL, see the Oracle documentation.
  - **`serverName`** - Specify the host name or IP address of the database server.
  - **`port`** - Specify the port number of the database server.
  - **`streamstolob`** - If the size of BLOB or CLOB datatypes exceeds 4 KB and this driver is used for CMP, this property must be set to `true`.
  - **`xa-driver-does-not-support-non-tx-operations`** - Set to the value `true`. Optional: only needed if both non-XA and XA connections are retrieved from the same connection pool. May degrade performance.

    As an alternative to setting this property, you can create two connection pools, one for non-XA connections and one for XA connections.

Inet Merlia JDBC Driver for Microsoft SQL Server Databases

This driver is verified J2EE compatible and supported. The JAR file for the Inet Microsoft SQL Server driver is `Merlia.jar`. Configure the connection pool using the following settings:

- **Name:** You will use this name when you configure the JDBC resource later.
- **Resource Type:** Specify the appropriate value.
- **Database Vendor:** `mssql`

- **Datasource Classname:** `com.inet.tds.TdsDataSource`
- **Properties:**
  - **`serverName`** - Specify the host name or IP address and the port of the database server.
  - **`port`** - Specify the port number of the database server.
  - **`user`** - Set as appropriate.
  - **`password`** - Set as appropriate.

Inet Sybelux JDBC Driver for Sybase Databases

This driver is verified J2EE compatible and supported. The JAR file for the Inet Sybase driver is `Sybelux.jar`. Configure the connection pool using the following settings:

- **Name:** You will use this name when you configure the JDBC resource later.
- **Resource Type:** Specify the appropriate value.
- **Database Vendor:** `Sybase`
- **Datasource Classname:** `com.inet.syb.SybDataSource`
- **Properties:**
  - **`serverName`** - Specify the host name or IP address of the database server.
  - **`portNumber`** - Specify the port number of the database server.
  - **`user`** - Set as appropriate.
  - **`password`** - Set as appropriate.
  - **`databaseName`** - Set as appropriate. Do not specify the complete URL, only the database name.

Data Direct Connect JDBC3.0/ Type4 Driver for IBM DB2 Databases

This driver is not verified J2EE compatible and not fully supported. Configure the connection pool using the following settings:

- **Name:** You will use this name when you configure the JDBC resource later.
- **Resource Type:** Specify the appropriate value.
- **Database Vendor:** `DB2`
- **Datasource Classname:** `com.ddtek.jdbcx.db2.DB2DataSource`
- **Properties:**
  - **`serverName`** - Specify the host name or IP address of the database server.
  - **`portNumber`** - Specify the port number of the database server.
  - **`user`** - Set as appropriate.
  - **`password`** - Set as appropriate.

Oracle Thin/Type4 Driver for Oracle 8.1.7 and 9.x Databases

This driver is not verified J2EE compatible and not fully supported. The JAR file for the Oracle driver is `ojdbc14.jar`. Configure the connection pool using the following settings:

- **Name:** You will use this name when you configure the JDBC resource later.
- **Resource Type:** Specify the appropriate value.
- **Database Vendor:** `Oracle`
- **Datasource Classname:** one of the following:

  `oracle.jdbc.pool.OracleDataSource`

  `oracle.jdbc.xa.client.OracleXADataSource`
- **Properties:**
  - **`user`** - Set as appropriate.
  - **`password`** - Set as appropriate.

- **`URL`** - Specify the complete database URL using the following syntax:

  `jdbc:oracle:thin:[`*user/password*`]@//`*host*`[:`*port*`]/`*service*

  For example:

  ```
  jdbc:oracle:thin:@//localhost:1521:customer_db
  ```

- **`xa-driver-does-not-support-non-tx-operations`** - Set to the value `true`. Optional: only needed if both non-XA and XA connections are retrieved from the same connection pool. May degrade performance.

  As an alternative to setting this property, you can create two connection pools, one for non-XA connections and one for XA connections.

NOTE You must set the `oracle-xa-recovery-workaround` property in the Transaction Service for recovery of global transactions to work correctly. For details, see Chapter 12, "Using the Transaction Service."

When using this driver, it is not possible to insert more than 2000 bytes of data into a column. To circumvent this problem, use the OCI driver (JDBC type 2).

OCI Oracle Type2 Driver for Oracle 8.1.7 and 9.x Databases

This driver is not verified J2EE compatible and not fully supported. The JAR file for the OCI Oracle driver is `ojdbc14.jar`. Make sure that the shared library is available through LD_LIBRARY_PATH and that the ORACLE_HOME property is set. Configure the connection pool using the following settings:

- **Name:** You will use this name when you configure the JDBC resource later.
- **Resource Type:** Specify the appropriate value.
- **Database Vendor:** `Oracle`
- **Datasource Classname:** one of the following:

  `oracle.jdbc.pool.OracleDataSource`

  `oracle.jdbc.xa.client.OracleXADataSource`

- **Properties:**
  - **`user`** - Set as appropriate.

- **`password`** - Set as appropriate.
- **`URL`** - Specify the complete database URL using the following syntax:

  `jdbc:oracle:oci:[`*user*`/`*password*`]@//`*host*`[:`*port*`]/`*service*

  For example:

  `jdbc:oracle:oci:@//localhost:1521:customer_db`
- **`xa-driver-does-not-support-non-tx-operations`** - Set to the value `true`. Optional: only needed if both non-XA and XA connections are retrieved from the same connection pool. May degrade performance.

  As an alternative to setting this property, you can create two connection pools, one for non-XA connections and one for XA connections.

Data Direct Connect JDBC3.0/ Type4 Driver for Oracle 8.1.7 and 9.x Databases

This driver is not verified J2EE compatible and not fully supported. The JAR files for the Oracle driver are `base.jar`, `oracle.jar`, and `util.jar`. Configure the connection pool using the following settings:

- **Name:** You will use this name when you configure the JDBC resource later.
- **Resource Type:** Specify the appropriate value.
- **Database Vendor:** `Oracle`
- **Datasource Classname:** `com.ddtek.jdbcx.oracle.OracleDataSource`
- **Properties:**
  - **`serverName`** - Specify the host name or IP address of the database server.
  - **`portNumber`** - Specify the port number of the database server.
  - **`user`** - Set as appropriate.
  - **`password`** - Set as appropriate.
  - **`SID`** - Set as appropriate.

Data Direct Connect JDBC3.0/ Type4 Driver for Microsoft SQL Server Databases

This driver is not verified J2EE compatible and not fully supported. The JAR files for the Microsoft SQL Server driver are `util.jar`, `sqlserver.jar`, and `base.jar`. Configure the connection pool using the following settings:

- **Name:** You will use this name when you configure the JDBC resource later.
- **Resource Type:** Specify the appropriate value.
- **Database Vendor:** `mssql`
- **Datasource Classname:** `com.ddtek.jdbcx.sqlserver.SQLServerDataSource`
- **Properties:**
  - **`serverName`** - Specify the host name or IP address and the port of the database server.
  - **`user`** - Set as appropriate.
  - **`password`** - Set as appropriate.
  - **`selectMethod`** - Set to `cursor`.

Sybase JConnect/Type4 Driver

This driver is not verified J2EE compatible and not fully supported. The JAR file for the Sybase driver is `jconn2.jar`. Configure the connection pool using the following settings:

- **Name:** You will use this name when you configure the JDBC resource later.
- **Resource Type:** Specify the appropriate value.
- **Database Vendor:** `Sybase`
- **Datasource Classname:** one of the following:

  `com.sybase.jdbc2.jdbc.SybDataSource`

  `com.sybase.jdbc2.jdbc.SybXADataSource`
- **Properties:**
  - **`serverName`** - Specify the host name or IP address of the database server.
  - **`portNumber`** - Specify the port number of the database server.

- **`user`** - Set as appropriate.
- **`password`** - Set as appropriate.
- **`databaseName`** - Set as appropriate. Do not specify the complete URL, only the database name.
- **`BE_AS_JDBC_COMPLIANT_AS_POSSIBLE`** - Set to `true`.
- **`FAKE_METADATA`** - Set to `true`.

Data Direct Connect JDBC3.0/ Type4 Driver for Sybase Databases

This driver is not verified J2EE compatible and not fully supported. Configure the connection pool using the following settings:

- **Name:** You will use this name when you configure the JDBC resource later.
- **Resource Type:** Specify the appropriate value.
- **Database Vendor:** `Sybase`
- **Datasource Classname:** `com.ddtek.jdbcx.sybase.SybaseDataSource`
- **Properties:**
  - **`serverName`** - Specify the host name or IP address of the database server.
  - **`portNumber`** - Specify the port number of the database server.
  - **`user`** - Set as appropriate.
  - **`password`** - Set as appropriate.
  - **`databaseName`** - Set as appropriate. This is optional.

Data Direct Connect JDBC3.0/ Type4 Driver for Informix Databases

This driver is not verified J2EE compatible and not fully supported. Configure the connection pool using the following settings:

- **Name:** You will use this name when you configure the JDBC resource later.
- **Resource Type:** Specify the appropriate value.

- **Database Vendor:** `Informix`
- **Datasource Classname:** `com.ddtek.jdbcx.informix.InformixDataSource`
- **Properties:**
  - **`serverName`** - Specify the host name or IP address of the database server.
  - **`portNumber`** - Specify the port number of the database server.
  - **`user`** - Set as appropriate.
  - **`password`** - Set as appropriate.
  - **`InformixServer`** - Set as appropriate.

IBM Informix Type4 Driver

This driver is not verified J2EE compatible and not fully supported. Configure the connection pool using the following settings:

- **Name:** You will use this name when you configure the JDBC resource later.
- **Resource Type:** Specify the appropriate value.
- **Database Vendor:** `Informix`
- **Datasource Classname:** one of the following:

  `com.informix.jdbcx.IfxDataSource`

  `com.informix.jdbcx.IfxXADataSource`
- **Properties:**
  - **`serverName`** - Specify the Informix database server name.
  - **`portNumber`** - Specify the port number of the database server.
  - **`user`** - Set as appropriate.
  - **`password`** - Set as appropriate.
  - **`databaseName`** - Set as appropriate. This is optional.
  - **`IfxIFXHost`** - Specify the host name or IP address of the database server.

MM MySQL Type4 Driver

This driver is not verified J2EE compatible and not fully supported. Configure the connection pool using the following settings:

- **Name:** You will use this name when you configure the JDBC resource later.
- **Resource Type:** Specify the appropriate value.
- **Database Vendor:** `mysql`
- **Datasource Classname:** one of the following:

  `com.mysql.jdbc.jdbc2.optional.MysqlConnectionPoolDataSource`

  `com.mysql.jdbc.jdbc2.optional.MysqlXaConnectionPoolDataSource`
- **Properties:**
  - **`serverName`** - Specify the host name or IP address of the database server.
  - **`port`** - Specify the port number of the database server.
  - **`user`** - Set as appropriate.
  - **`password`** - Set as appropriate.
  - **`databaseName`** - Set as appropriate.
  - **`URL`** - If you are using global transactions, you can set this property instead of `serverName`, `port`, and `databaseName`. The MM MySQL Type4 driver does not provide a method to set the required `relaxAutoCommit` property, so you must set it indirectly by setting the **`URL`** property as in:

    `jdbc:mysql://`*host*`:`*port*`/`*database*`?relaxAutoCommit="true"`

CloudScape 5.1 Type4 Driver

This driver is not verified J2EE compatible and not fully supported. The JAR files for the CloudScape driver are `db2j.jar`, `db2jtools.jar`, `db2jcview.jar`, `jh.jar`, `db2jcc.jar`, and `db2jnet.jar`. Configure the connection pool using the following settings:

- **Name:** You will use this name when you configure the JDBC resource later.
- **Resource Type:** Specify the appropriate value.
- **Database Vendor:** `Cloudscape`
- **Datasource Classname:** `com.ibm.db2.jcc.DB2DataSource`

- **Properties:**
  - **`user`** - Set as appropriate.
  - **`password`** - Set as appropriate.
  - **`databaseName`** - Set as appropriate.

Creating Applications That Use the JDBC API

An application that uses the JDBC API is an application that looks up and connects to one or more databases. This section covers these topics:

- Sharing Connections
- Using JDBC Transaction Isolation Levels

Sharing Connections

When multiple connections acquired by an application use the same JDBC resource, the connection pool provides connection sharing within the same transaction scope. For example, suppose Bean_A starts a transaction and obtains a connection, then calls a method in Bean_B. If Bean_B acquires a connection to the same JDBC resource with the same sign-on information, and if Bean_A completes the transaction, the connection can be shared.

Connections obtained through a resource are shared only if the resource reference declared by the J2EE component allows it to be shareable. This is specified in a component’s deployment descriptor by setting the `res-sharing-scope` element to `Shareable` for the particular resource reference. To turn off connection sharing, set `res-sharing-scope` to `Unshareable`.

For general information about connections and JDBC URLs, see the *Sun Java System Application Server Administration Guide*.

Using JDBC Transaction Isolation Levels

For general information about transactions, see Chapter 12, “Using the Transaction Service,” and the *Sun Java System Application Server Administration Guide*.

Not all database vendors support all transaction isolation levels available in the JDBC API. The Sun Java System Application Server permits specifying any isolation level your database supports, but throws an exception against values your database does not support.

The following table defines transaction isolation levels.

Table 11-5 Transaction Isolation Levels

Transaction Isolation Level	Description
`TRANSACTION_READ_UNCOMMITTED`	Dirty reads, non-repeatable reads and phantom reads can occur.
`TRANSACTION_READ_COMMITTED`	Dirty reads are prevented; non-repeatable reads and phantom reads can occur.
`TRANSACTION_REPEATABLE_READ`	Dirty reads and non-repeatable reads are prevented; phantom reads can occur.
`TRANSACTION_SERIALIZABLE`	Dirty reads, non-repeatable reads and phantom reads are prevented.

Specify or examine the transaction isolation level for a connection using the `Connection.setTransactionIsolation()` and `Connection.getTransactionIsolation()` methods, respectively. Note that you cannot call `setTransactionIsolation()` during a transaction.

You can set the default transaction isolation level for a JDBC connection pool. For details, see “Creating a Connection Pool” on page 357.

To verify that a level is supported by your database management system, test your database programmatically using the `supportsTransactionIsolationLevel()` method in `java.sql.DatabaseMetaData`, as shown in the following example:

```
java.sql.DatabaseMetaData db;
if (db.supportsTransactionIsolationLevel(TRANSACTION_SERIALIZABLE)
   { Connection.setTransactionIsolation(TRANSACTION_SERIALIZABLE); }
```

For more information about these isolation levels and what they mean, see the JDBC 3.0 API specification.

NOTE Applications that change the isolation level on a pooled connection programmatically risk polluting the pool, which can lead to errors.

Chapter 12

Using the Transaction Service

The J2EE™ platform provides several abstractions that simplify development of dependable transaction processing for applications. This chapter discusses J2EE transactions and transaction support in the Sun Java ™ System Application Server.

This chapter contains the following sections:

- Transaction Resource Managers
- Transaction Scope
- Configuring the Transaction Service
- Transaction Logging

For more information about the Java™ Transaction API (JTA) and Java™ Transaction Service (JTS), see the *Sun Java System Application Server Administration Guide* and the following sites:

`http://java.sun.com/products/jta/`

`http://java.sun.com/products/jts/`

You may also want to read the chapter on transactions in the J2EE tutorial:

`http://java.sun.com/j2ee/tutorial/1_3-fcs/index.html`

Transaction Resource Managers

There are three types of transaction resource managers:

- Databases - Use of transactions prevents databases from being left in inconsistent states due to incomplete updates. Sun Java System Application Server supports a variety of JDBC™ XA drivers, listed in "Configurations for Specific JDBC Drivers" on page 364. For information about JDBC transaction isolation levels, see "Using JDBC Transaction Isolation Levels" on page 377.
- Java™ Message Service (JMS) Providers - Use of transactions ensures that messages are reliably delivered. Sun Java System Application Server is integrated with Sun Java System Message Queue, a fully capable JMS provider. For more information about transactions and the JMS API, see Chapter 14, "Using the Java Message Service."
- J2EE™ Connector Architecture (CA) components - Use of transactions prevents legacy EIS systems from being left in inconsistent states due to incomplete updates.

For details about how transaction resource managers, the transaction service, and applications interact, see the *Sun Java System Application Server Administration Guide*.

NOTE In the Sun Java System Application Server, the transaction manager is a privileged interface. However, applications can access `UserTransaction`. For more information, see "Naming Environment for J2EE Application Components" on page 388.

Transaction Scope

A *local* transaction involves only one non-XA resource and requires that all participating application components execute within one process. Local transaction optimization is specific to the resource manager and is transparent to the J2EE application.

In Sun Java System Application Server, a JDBC resource is non-XA if it meets any of the following criteria:

- In the JDBC connection pool configuration, the datasource class does not implement the `javax.sql.XADataSource` interface.
- The Global Transaction Support box is not checked, or the `res-type` attribute in `domain.xml` does not exist or is not set to `javax.sql.XADataSource`.

A transaction remains local if the following conditions remain true:

- One and only one non-XA resource is used. If any additional non-XA or XA resource is used, the transaction is aborted.
- No transaction importing or exporting occurs.

Transactions that involve multiple resources (which must all be XA), or multiple participant processes, are *distributed* or *global* transactions.

If only one XA resource is used in a transaction, one-phase commit occurs, otherwise the transaction is coordinated with a two-phase commit protocol.

A two-phase commit protocol between the transaction manager and all the resources enlisted for a transaction ensures that either all the resource managers commit the transaction or they all abort. When the application requests the commitment of a transaction, the transaction manager issues a `PREPARE_TO_COMMIT` request to all the resource managers involved. Each of these resources may in turn send a reply indicating whether it is ready for commit (`PREPARED`) or not (`NO`). Only when all the resource managers are ready for a commit does the transaction manager issue a commit request (`COMMIT`) to all the resource managers. Otherwise, the transaction manager issues a rollback request (`ABORT`) and the transaction is rolled back.

Sun Java System Application Server provides workarounds for some known issues with the recovery implementations of the following JDBC drivers. These workarounds are not used unless explicitly set.

- Oracle thin driver - The `XAResource.recover` method repeatedly returns the same set of in-doubt Xids regardless of the input flag. According to the XA specifications, the Transaction Manager should initially call this method with TMSTARTSCAN and then with TMNOFLAGS repeatedly until no Xids are returned. The `XAResource.commit` method also has some issues.

  To enable the Sun Java System Application Server workaround, set the `oracle-xa-recovery-workaround` property value to `true`. For details about how to set this property, see "Configuring the Transaction Service" on page 382.

NOTE These workarounds do not imply support for any particular JDBC driver.

Configuring the Transaction Service

You can configure the transaction service in Sun Java System Application Server in the following ways:

- Using the Administration Console
- Using the Command Line Interface

The "Using The Administration Console" section describes each transaction service setting. The "Using The Command Line Interface" section merely lists syntax and default values.

This section covers basic configuration. For details about monitoring and other administration topics, see the *Sun Java System Application Server Administration Guide*.

Using the Administration Console

To configure the transaction service using the Administration Console, perform the following tasks:

1. Login to the Administration Console by going to the following URL in your web browser:

   `http://`*host*`:`*port*`/asadmin`

   For example:

   `http://localhost:4848/asadmin`

2. Open the Transaction Service.

3. Edit the following information if desired. All of these settings are optional.

   - Recover on Restart - Check this box if you want the server to attempt transaction recovery during startup. By default, recovery is not attempted.

   - Transaction Timeout - Specifies the amount of time after which the transaction is aborted. If set to `0` (the default), the transaction never times out.

     This is the domain-level timeout. To set the `XAResource` timeout, use the `xaresource-txn-timeout` property, described in Step 4.

     You can override the Transaction Timeout setting for an individual enterprise bean. See "Bean-Level Container-Managed Transaction Timeouts" on page 288.

- Retry Timeout - Specifies the retry timeout in the following scenarios:

    - If a transaction is being recovered.
    - If transient exceptions occur in the second phase of two-phase commit protocol.

  A negative value indicates continuous retries. A value of zero indicates no retries. A positive value indicates the number of seconds between retries. The default is `600` (10 minutes), which may be appropriate for a database being restarted.

- Transaction Log Location - Sets the location of the transaction log directory. The directory in which the transaction logs are kept must be writable by whatever user account the server runs as. The default location is *domain_dir*`/logs`.

- Heuristic Decision - During recovery, if the outcome of a transaction cannot be determined from the logs, this property determines the outcome. The default is `rollback`. The other choice is `commit`.

- Keypoint Interval - Specifies the number of transactions between keypoint operations in the log. Keypoint operations reduce the size of the transaction log file by compressing it. A larger value for this attribute (for example, `4096`) results in a larger transaction log file, but fewer keypoint operations and potentially better performance. A smaller value (for example, `100`) results in smaller log files, but slightly reduced performance due to the greater frequency of keypoint operations.

4. To add a property, click the Add Property button and enter the property name and value. To delete properties, check the properties you want to delete, then click the Delete Properties button. The following table lists the transaction service properties for Sun Java System Application Server.

Table 12-1 Transaction Service Properties

Property	Default	Description
`oracle-xa-recovery-workaround`	`false`	If `true`, the Oracle XA Resource workaround is used in transaction recovery. For details, see "Transaction Scope" on page 380.
`disable-distributed-transaction-logging`	`false`	If `true`, disables transaction logging, which may improve performance. If `false`, the transaction service writes transactional activity into transaction logs so that transactions can be recovered. If Recover on Restart is checked, this property is ignored. Use *only* if performance is more important than transaction recovery.

Table 12-1 Transaction Service Properties *(Continued)*

Property	Default	Description
`xaresource-txn-timeout`	specific to the `XAResource` used	Changes the `XAResource` timeout. In some cases, the `XAResource` default timeout causes transactions to be aborted, so it is desirable to change it. To set the application level timeout, use the Transaction Timeout setting, described in Step 3.

5. Click the Save button.

Using the Command Line Interface

To configure the transaction service using the command line interface, use the `asadmin set` command. The syntax is as follows, with defaults shown for optional parameters that have them:

```
asadmin set --user user attribute_name=value [attribute_name=value] *
```

For more information about the optional general `asadmin` parameters (`--password`, `--passwordfile`, `--host`, `--port`, `--secure`, `--terse`, `--echo`, and `--interactive`), see the *Sun Java System Application Server Administration Guide*.

The *attribute_name* is a hierarchical name that looks like this:

```
server.transaction-service.ts_attribute_name
```

The *ts_attribute_name* is the transaction service attribute that needs to be configured. For example:

```
server.transaction-service.timeout-in-seconds
```

To view the list of transaction service attribute names that can be configured using the `asadmin set` command, use the `asadmin get` command with a wildcard. The `asadmin get` command has the same syntax as the `asadmin set` command. For example:

```
asadmin get --user joeuser "server.transaction-service.*"
```

A list of attribute names for configuring the transaction service of the `server1` application server instance is displayed. The transaction service attributes are as follows:

```
server.transaction-service.automatic-recovery = false
server.transaction-service.heuristic-decision = rollback
server.transaction-service.keypoint-interval = 2048
server.transaction-service.retry-timeout-in-seconds = 600
server.transaction-service.timeout-in-seconds = 0
server.transaction-service.tx-log-dir = domain_dir/logs
```

Here is an example of running the `asadmin set` command:

```
asadmin set --user joeuser server.transaction-service.timeout-in-seconds=0
```

The *attribute_name* for a transaction service property is a hierarchical name that looks like this:

```
server.transaction-service.property.ts_property_name
```

The *instance* is the application server instance name. The *ts_property_name* is the transaction service property that needs to be configured. Here is an example of running the `asadmin set` command to set a transaction service property:

```
asadmin set --user joeuser server.transaction-service.property.xaresource-txn-timeout=30
```

Transaction Logging

The transaction service writes transactional activity into transaction logs so that transactions can be recovered. You can control transaction logging in these ways:

- Set the location of the transaction log files using the Transaction Log Location setting in the Administration Console or the `transactionLogFile` attribute in the command line interface.
- Turn off transaction logging by setting the `disable-distributed-transaction-logging` property to `true`. Do this *only* if performance is more important than transaction recovery.

Chapter 13

Using the Java Naming and Directory Interface

A *naming service* maintains a set of bindings, which relate names to objects. The J2EE™ naming service is based on the Java Naming and Directory Interface™ (JNDI) API. The JNDI API allows application components and clients to look up distributed resources, services, and EJB™ components. For general information about the JNDI API, see:

`http://java.sun.com/products/jndi/`

You can also see the JNDI tutorial at:

`http://java.sun.com/products/jndi/tutorial/`

This chapter contains the following sections:

- Accessing the Naming Context
- Configuring Resources
- Mapping References

Accessing the Naming Context

Sun Java ™ System Application Server provides a naming environment, or *context*, which is compliant with standard J2EE 1.4 requirements. A `Context` object provides the methods for binding names to objects, unbinding names from objects, renaming objects, and listing the bindings. The `InitialContext` is the handle to the J2EE naming service that application components and clients use for lookups.

The JNDI API also provides subcontext functionality. Much like a directory in a file system, a subcontext is a context within a context. This hierarchical structure permits better organization of information. For naming services that support subcontexts, the `Context` class also provides methods for creating and destroying subcontexts.

The rest of this section covers these topics:

- Naming Environment for J2EE Application Components
- Accessing EJB Components Using the CosNaming Naming Context
- Accessing EJB Components in a Remote Application Server
- Naming Environment for Lifecycle Modules

NOTE Each resource within a server instance must have a unique name. However, two resources in different server instances or different domains may have the same name.

Naming Environment for J2EE Application Components

The namespace for objects looked up in a J2EE environment is organized into different subcontexts, with the standard prefix `java:comp/env`.

The following table describes standard JNDI subcontexts for connection factories in the Sun Java System Application Server.

Table 13-1 Standard JNDI Subcontexts for Connection Factories

Resource Manager	Connection Factory Type	JNDI Subcontext
JDBC™	`javax.sql.DataSource`	`java:comp/env/jdbc`
Transaction Service	`javax.transaction.UserTransaction`	`java:comp/UserTransaction`
JMS	`javax.jms.TopicConnectionFactory` `javax.jms.QueueConnectionFactory`	`java:comp/env/jms`
JavaMail™	`javax.mail.Session`	`java:comp/env/mail`
URL	`java.net.URL`	`java:comp/env/url`
Connector	`javax.resource.cci.ConnectionFactory`	`java:comp/env/eis`

Accessing EJB Components Using the CosNaming Naming Context

The preferred way of accessing the naming service, even in code that runs outside of a J2EE container, is to use the no-argument `InitialContext` constructor. However, if EJB client code explicitly instantiates an `InitialContext` that points to the CosNaming naming service, it is necessary to set three properties in the client JVM when accessing EJB components:

```
-Djavax.rmi.CORBA.UtilClass=com.sun.corba.ee.impl.javax.rmi.CORBA.Util
```

```
-Dorg.omg.CORBA.ORBClass=com.sun.corba.ee.impl.orb.ORBImpl
```

```
-Dorg.omg.CORBA.ORBSingletonClass=com.sun.corba.ee.impl.orb.ORBSingleton
```

Accessing EJB Components in a Remote Application Server

The recommended approach for looking up an EJB component in a remote Application Server from a client that is a servlet or EJB component is to use the Interoperable Naming Service syntax. Host and port information is prepended to any global JNDI names and is automatically resolved during the lookup. The syntax for an interoperable global name is as follows:

`corbaname:iiop:`*host*`:`*port*`#a/b/`*name*

This makes the programming model for accessing EJB components in another Application Server exactly the same as accessing them in the same server. The deployer can change the way the EJB components are physically distributed without having to change the code.

For J2EE components, the code still performs a `java:comp/env` lookup on an EJB reference. The only difference is that the deployer maps the `ejb-reference` element to an interoperable name in an Application Server deployment descriptor file instead of a simple global JNDI name.

For example, suppose a servlet looks up an EJB reference using `java:comp/env/ejb/Foo`, and the target EJB component has a global JNDI name of `a/b/Foo`.

The `ejb-ref` element in `sun-web.xml` would look like this:

```
<ejb-ref>
    <ejb-ref-name>ejb/Foo</ejb-ref-name>
    <jndi-name>corbaname:iiop:host:port#a/b/Foo</jndi-name>
<ejb-ref>
```

The code would look like this:

```
Context ic = new InitialContext();
Object o = ic.lookup("java:comp/env/ejbFoo");
```

For a client that doesn't run within a J2EE container, the code just uses the interoperable global name instead of the simple global JNDI name. For example:

```
Context ic = new InitialContext();
Object o = ic.lookup("corbaname:iiop:host:port#a/b/Foo");
```

Objects stored in the interoperable naming context and component-specific (`java:comp/env`) naming contexts are transient. On each server startup or application reloading, all relevant objects are re-bound to the namespace.

Naming Environment for Lifecycle Modules

Lifecycle listener modules provide a means of running short or long duration Java-based tasks within the application server environment, such as instantiation of singletons or RMI servers. These modules are automatically initiated at server startup and are notified at various phases of the server life cycle. For details about lifecycle modules, see Chapter 10, "Developing Lifecycle Listeners."

The configured properties for a lifecycle module are passed as properties during server initialization (the `INIT_EVENT`). The initial JNDI naming context is not available until server initialization is complete. A lifecycle module can get the `InitialContext` for lookups using the method `LifecycleEventContext.getInitialContext()` during, and only during, the `STARTUP_EVENT`, `READY_EVENT`, or `SHUTDOWN_EVENT` server life cycle events.

Configuring Resources

Sun Java System Application Server exposes the following special resources in the naming environment. Full administration details are provided in the following sections:

- External JNDI Resources
- Custom Resources

External JNDI Resources

An external JNDI resource defines custom JNDI contexts and implements the `javax.naming.spi.InitialContextFactory` interface. There is no specific JNDI parent context for external JNDI resources, except for the standard `java:comp/env/`.

Create an external JNDI resource in one of these ways:

- Using the Administration Console
- Using the Command Line Interface

The "Using The Administration Console" section describes each connection pool setting. The "Using The Command Line Interface" section merely lists syntax and default values.

Using the Administration Console

To create an external JNDI resource using the Administration Console, perform the following tasks:

1. Login to the Administration Console by going to the following URL in your web browser:

   `http://`*host*`:`*port*`/asadmin`

   For example:

   `http://localhost:4848/asadmin`

2. Open the JNDI component.
3. Click External Resources.
4. Click the New button.
5. Enter the following information:
   - JNDI Name (required) - Enter the JNDI name for the resource.
   - Resource Type (required) - Enter the fully qualified type of the resource.
   - JNDI Lookup (required) - Enter the JNDI value to look up in the external repository. For example, for a bean class, your JNDI Lookup might be `cn=mybean`.
   - Factory Class (required) - Enter the fully qualified name of the factory class.
   - Description (optional) - You can enter a text description of the external JNDI resource.

6. Check the Status Enabled box to enable the external JNDI resource. If an external JNDI resource is disabled, no application component can connect to it, but its configuration remains in the domain.

7. To add a property, click the Add Property button and enter the property name and value. To delete properties, check the properties you want to delete, then click the Delete Properties button.

8. Click the OK button.

Using the Command Line Interface

To create an external JNDI resource using the command line, use the `asadmin create-jndi-resource` command. The syntax is as follows, with defaults shown for optional parameters that have them:

```
asadmin create-jndi-resource --user user --jndilookupname lookup_name
--restype resource_type --factoryclass class_name [--enabled=true] [--description
text] [--property (name=value)[:name=value]*] jndi_name
```

For more information about the parameters specific to `asadmin create-jndi-resource`, see “Using the Administration Console” on page 391.

For more information about the optional general `asadmin` parameters (`--password`, `--passwordfile`, `--host`, `--port`, `--secure`, `--terse`, `--echo`, and `--interactive`), see the *Sun Java System Application Server Administration Guide*.

For example:

```
asadmin create-jndi-resource --user joeuser --jndilookupname cn=myBean
--restype test.myBean --factoryclass com.sun.jndi.ldap.LdapCtxFactory
test/myBean
```

To delete an external JNDI resource, use the following command:

```
asadmin delete-jndi-resource --user user jndi_name
```

For example:

```
asadmin delete-jndi-resource --user joeuser test/myBean
```

To list external JNDI resources, use the following command:

```
asadmin list-jndi-resources --user user
```

For example:

```
asadmin list-jndi-resources --user joeuser
```

Custom Resources

A custom resource specifies a custom server-wide resource object factory that implements the `javax.naming.spi.ObjectFactory` interface. There is no specific JNDI parent context for external JNDI resources, except for the standard `java:comp/env/`.

Create a custom resource in one of these ways:

- Using the Administration Console
- Using the Command Line Interface

The "Using The Administration Console" section describes each connection pool setting. The "Using The Command Line Interface" section merely lists syntax and default values.

Using the Administration Console

To create a custom resource using the Administration Console, perform the following tasks:

1. Login to the Administration Console by going to the following URL in your web browser:

   `http://`*host*`:`*port*`/asadmin`

   For example:

   `http://localhost:4848/asadmin`

2. Open the JNDI component.
3. Click Custom Resources.
4. Click the New button.
5. Enter the following information:
   - JNDI Name (required) - Enter the JNDI name for the resource.
   - Resource Type (required) - Enter the fully qualified type of the resource.
   - Factory Class (required) - Enter the fully qualified name of the factory class.
   - Description (optional) - You can enter a text description of the custom resource.
6. Check the Custom Resource Enabled box to enable the custom resource. If a custom resource is disabled, no application component can connect to it, but its configuration remains in the domain.
7. To add a property, click the Add Property button and enter the property name and value. To delete properties, check the properties you want to delete, then click the Delete Properties button.

8. Click the OK button.

Using the Command Line Interface

To create a custom resource using the command line, use the `asadmin create-custom-resource` command. The syntax is as follows, with defaults shown for optional parameters that have them:

```
asadmin create-custom-resource --user user --restype resource_type
--factoryclass class_name [--enabled=true] [--description text] [--property
(name=value)[:name=value]*] jndi_name
```

For more information about the parameters specific to `asadmin create-custom-resource`, see "Using the Administration Console" on page 391.

For more information about the optional general `asadmin` parameters (`--password`, `--passwordfile`, `--host`, `--port`, `--secure`, `--terse`, `--echo`, and `--interactive`), see the *Sun Java System Application Server Administration Guide*.

For example:

```
asadmin create-custom-resource --user joeuser --restype test.MyBean
--factoryclass test.MyBeanFactory test/myBean
```

To delete a custom resource, use the following command:

```
asadmin delete-custom-resource --user user jndi_name
```

For example:

```
asadmin delete-custom-resource --user joeuser test/myBean
```

To list custom resources, use the following command:

```
asadmin list-custom-resources --user user
```

For example:

```
asadmin list-custom-resources--user joeuser
```

Mapping References

The following XML elements map JNDI names configured in the Sun Java System Application Server to resource references in application client, EJB, and web application components:

- `resource-env-ref` - Maps the `resource-env-ref` element in the corresponding J2EE XML file to the absolute JNDI name configured in Sun Java System Application Server.
- `resource-ref` - Maps the `resource-ref` element in the corresponding J2EE XML file to the absolute JNDI name configured in Sun Java System Application Server.
- `ejb-ref` - Maps the `ejb-ref` element in the corresponding J2EE XML file to the absolute JNDI name configured in Sun Java System Application Server.

  JNDI names for EJB components must be unique. For example, appending the application name and the module name to the EJB name would be one way to guarantee unique names. In this case, `mycompany.pkging.pkgingEJB.MyEJB` would be the JNDI name for an EJB in the module `pkgingEJB.jar`, which is packaged in the `pkging.ear` application.

These elements are part of the `sun-web-app.xml`, `sun-ejb-ref.xml`, and `sun-application-client.xml` deployment descriptor files. For more information about how these elements behave in each of the deployment descriptor files, see Chapter 5, “Deployment Descriptor Files.”

The rest of this section uses an example of a JDBC resource lookup to describe how to reference resource factories. The same principle is applicable to all resources (such as JMS destinations, JavaMail sessions, and so on).

The `resource-ref` element in the `sun-web-app.xml` deployment descriptor file maps the JNDI name of a resource reference to the `resource-ref` element in the `web-app.xml` J2EE deployment descriptor file.

The resource lookup in the application code looks like this:

```
InitialContext ic = new InitialContext();
String dsName = "java:comp/env/jdbc/HelloDbDs";
DataSource ds = (javax.sql.DataSource)ic.lookup(dsName);
Connection connection = ds.getConnection();
```

The resource being queried is listed in the `res-ref-name` element of the `web.xml` file as follows:

```
<resource-ref>
    <description>DataSource Reference</description>
    <res-ref-name>jdbc/HelloDbDs</res-ref-name>
    <res-type>javax.sql.DataSource</res-type>
    <res-auth>Container</res-auth>
</resource-ref>
```

The `resource-ref` section in a Sun Java System specific deployment descriptor, for example `sun-web.xml`, maps the `res-ref-name` (the name being queried in the application code) to the JNDI name of the JDBC resource. The JNDI name is the same as the name of the JDBC resource as defined in the resource file when the resource is created.

```
<resource-ref>
    <res-ref-name>jdbc/HelloDbDs</res-ref-name>
    <jndi-name>jdbc/HelloDbDataSource</jndi-name>
</resource-ref>
```

The JNDI name in the Sun Java System specific deployment descriptor must match the JNDI name you assigned to the resource when you created and configured it.

Chapter 14

Using the Java Message Service

This chapter describes how to use the Java™ Message Service (JMS) API. The Sun Java™ System Application Server has a fully integrated JMS provider: the Sun Java™ System Message Queue software.

For general information about the JMS API, see the J2EE tutorial:

`http://java.sun.com/j2ee/1.4/docs/tutorial/doc/JMS.html#wp84181`

For detailed information about JMS concepts and JMS support in Sun Java System Application Server, see the *Sun Java System Application Server Administration Guide*.

This chapter contains the following sections:

- The JMS Provider
- Administration of the JMS Service
- Message Queue Resource Adapter
- ConnectionFactory Authentication
- Message Queue varhome Directory
- Delivering SOAP Messages Using the JMS API

The JMS Provider

Sun Java System Application Server support for JMS messaging, in general, and for message-driven beans, in particular, requires messaging middleware that implements the JMS specification: a JMS provider. Sun Java System Application Server uses the Sun Java System Message Queue software as its native JMS provider. The Sun Java System Message Queue software is tightly integrated into Sun Java System Application Server, providing transparent JMS messaging support. This support (known within Sun Java System Application Server as the *JMS Service*) requires only minimal administration.

For more information about the Sun Java System Message Queue, refer to the following documentation:

`http://docs.sun.com/db/prod/s1.s1msgqu#hic`

For general information about the JMS API, see the JMS web page at:

`http://java.sun.com/products/jms/index.html`

Administration of the JMS Service

To configure the JMS Service and prepare JMS resources for use in applications deployed to the Sun Java System Application Server, you must perform these tasks:

- Configuring the JMS Service
- Checking Whether the JMS Provider Is Running
- Creating Physical Destinations
- Creating JMS Resources: Destinations and Connection Factories

For information about other JMS administration tasks, see the *Sun Java System Application Server Administration Guide* and the Sun Java System Message Queue documentation at:

`http://docs.sun.com/db/prod/s1.s1msgqu#hic`

Configuring the JMS Service

You can edit or check the JMS Service configuration in the following ways:

- Using the Administration Console
- Using the Command Line Interface

NOTE Sun Java System Application Server should be restarted after configuration of the JMS Service.

The “Using The Administration Console” section describes each JMS Service setting. The “Using The Command Line Interface” section merely lists syntax and default values.

Using the Administration Console

To edit the JMS Service configuration using the Administration Console, perform the following tasks:

1. Login to the Administration Console by going to the following URL in your web browser:

   `http://`*host*`:`*port*`/asadmin`

   For example:

   `http://localhost:4848/asadmin`

2. Click on the Java Message Service component.

3. You can edit the following information. Defaults are displayed.

   - Start Timeout (secs) - Specifies the amount of time the server waits at startup for the corresponding JMS instance to respond. If there is no response, startup is aborted. If set to `0`, the server waits indefinitely. The default is `30` seconds.
   - Type - A value of `LOCAL` means the JMS provider is started along with the application server. A value of `REMOTE` means the JMS host is remote and is not started by the application server. A value of `NONE` means no JMS service is used.
   - Start Arguments - Specifies the string of arguments supplied for startup of the corresponding JMS instance. By default, there are no arguments.

4. To add a property, click the Add Property button and enter the property name and value. To delete properties, check the properties you want to delete, then click the Delete Properties button. The following table lists the standard JMS Service properties.

Table 14-1 JMS Service Properties

Property	Default	Description
`instance-name`	`imqbroker`	Specifies the full Sun Java System Message Queue broker instance name.
`instance-name-suffix`	none	Specifies a suffix to add to the full Sun Java System Message Queue broker instance name. The suffix is separated from the instance name by an underscore character (_). For example, if the instance name is `imqbroker`, appending the suffix `xyz` changes the instance name to `imqbroker_xyz`.
`append-version`	`false`	If `true`, appends the major and minor version numbers, preceded by underscore characters (_), to the full Sun Java System Message Queue broker instance name. For example, if the instance name is `imqbroker`, appending the version numbers changes the instance name to `imqbroker_8_0`.

5. Open on the Java Message Service component.
6. Open the JMS Hosts component and click on default_JMS_host.
7. You can edit the following information. Defaults are displayed.
   - Host - Specifies the host name of the JMS provider. The default is `localhost`.
   - Port - Specifies the port number used by the JMS provider. The default is `7676`.
   - Admin Username - Specifies the administrator user name for the JMS provider. The default is `admin`.
   - Admin Password - Specifies the administrator password for the JMS provider. The default is `admin`.
8. Click the Save button.

Using the Command Line Interface

To configure the JMS service using the command line interface, use the `asadmin set` command. The syntax is as follows, with defaults shown for optional parameters that have them:

```
asadmin set --user user attribute_name=value [attribute_name=value] *
```

For more information about the optional general `asadmin` parameters (`--password`, `--passwordfile`, `--host`, `--port`, `--secure`, `--terse`, `--echo`, and `--interactive`), see the *Sun Java System Application Server Administration Guide*.

The *attribute_name* is a hierarchical name that looks like this:

```
server.jms-service.jms_attribute_name
```

or like this:

```
server.jms-service.jms-host.default_JMS_host.jms_attribute_name
```

The *jms_attribute_name* is the JMS service attribute that needs to be configured. For example:

```
server.jms-service.jms-host.default_JMS_host.port
```

To view the list of JMS service attribute names that can be configured using the `asadmin set` command, use the `asadmin get` command with a wildcard. The `asadmin get` command has the same syntax as the `asadmin set` command. For example:

```
asadmin get --user joeuser "server.jms-service.*"
```

A list of attribute names for configuring the JMS service of the `server1` application server instance is displayed as follows:

```
server.jms-service.init-timeout-in-seconds = 60
server.jms-service.start-args = <null>
server.jms-service.type = LOCAL
```

Here are two examples of running the `asadmin set` command:

```
asadmin set --user joeuser server.jms-service.type=REMOTE
```

```
asadmin set --user joeuser server.jms-service.jms-host.default_JMS_host.port=7677
```

The *attribute_name* for a JMS property is a hierarchical name that looks like this:

```
server.jms-service.property.jms_property_name
```

The *jms_property_name* is the JMS service property that needs to be configured. Here is an example of running the `asadmin set` command to set a JMS property:

```
asadmin set --user joeuser server.jms-service.property.instance-name-suffix=xyz
```

Checking Whether the JMS Provider Is Running

You can use the `asadmin jms-ping` command to check whether a Sun Java System Message Queue instance is running. The syntax is as follows, with defaults shown for optional parameters that have them:

```
asadmin jms-ping --user user
```

For more information about the optional general `asadmin` parameters (`--password`, `--passwordfile`, `--host`, `--port`, `--secure`, `--terse`, `--echo`, and `--interactive`), see the *Sun Java System Application Server Administration Guide*.

For example:

```
asadmin jms-ping --user joeuser
```

Creating Physical Destinations

Produced messages are delivered for routing and subsequent delivery to consumers using *physical destinations* in the JMS provider. A physical destination is identified and encapsulated by an administered object (a `Topic` or `Queue` destination resource) that an application component uses to specify the destination of messages it is producing and the source of messages it is consuming.

This section describes how to create a physical destination. To create a destination resource, see "Creating JMS Resources: Destinations and Connection Factories" on page 403.

You can create a JMS physical destination in the following ways:

- Using the Administration Console
- Using the Command Line Interface

The "Using The Administration Console" section describes each physical destination setting. The "Using The Command Line Interface" section merely lists syntax and default values.

Using the Administration Console

To create a JMS physical destination using the Administration Console, perform the following tasks:

1. Login to the Administration Console by going to the following URL in your web browser:

   `http://`*host*`:`*port*`/asadmin`

   For example:

   ```
   http://localhost:4848/asadmin
   ```

2. Open the Java Message Service component.
3. Click Service, then click Physical Destinations.
4. Click the New button.
5. Enter the following information:
   - Destination Name (required) - Specify the name of the physical destination.
   - Type (required) - Select queue or topic from the list.
6. Click the OK button.

Using the Command Line Interface

To create a JMS physical destination using the command line, use the `asadmin create-jmsdest` command. The syntax is as follows, with defaults shown for optional parameters that have them:

```
asadmin create-jmsdest --user user --desttype dest_type [--property
(name=value)[:name=value]*] dest_name
```

For more information about the parameters specific to `asadmin create-jmsdest`, see "Using the Administration Console" on page 402.

For more information about the optional general `asadmin` parameters (`--password`, `--passwordfile`, `--host`, `--port`, `--secure`, `--terse`, `--echo`, and `--interactive`), see the *Sun Java System Application Server Administration Guide*.

For example:

```
asadmin create-jmsdest --user joeuser --desttype topic MyDest
```

To delete a JMS physical destination, use the following command:

```
asadmin delete-jmsdest --user user --desttype dest_type dest_name
```

For example:

```
asadmin delete-jmsdest --user joeuser --desttype topic MyDest
```

To list JMS physical destinations, use the following command:

```
asadmin list-jmsdest --user user [-desttype dest_type]
```

For example:

```
asadmin list-jmsdest --user joeuser --desttype topic
```

Creating JMS Resources: Destinations and Connection Factories

You can create two kinds of JMS resources in Sun Java System Application Server:

- **Connection Factories:** administered objects that implement the `QueueConnectionFactory` or `TopicConnectionFactory` interfaces.
- **Destination Resources:** administered objects that implement the `Queue` or `Topic` interfaces.

In either case, the steps for creating a JMS resource are the same. You can create a JMS resource in the following ways:

- Using the Administration Console
- Using the Command Line Interface

The "Using The Administration Console" section describes each JMS resource setting. The "Using The Command Line Interface" section merely lists syntax and default values.

Using the Administration Console

To create a JMS resource using the Administration Console, perform the following tasks:

1. Login to the Administration Console by going to the following URL in your web browser:

   `http://`*host*`:`*port*`/asadmin`

   For example:

   ```
   http://localhost:4848/asadmin
   ```

2. Open the Java Message Service component.

3. Click Connection Factories to create a connection factory, or click Destination Resources to create a queue or topic.

4. Click the New button.

5. Enter the following information:

   - JNDI Name (required) - Enter the JNDI name that application components must use to access the JMS resource.

   - Type (required) - Select the type of the JMS resource.

     - If you are on the Connection Factories page, the types are:

       ```
       javax.jms.TopicConnectionFactory
       javax.jms.QueueConnectionFactory
       ```

     - If you are on the Destination Resources page, the types are:

       ```
       javax.jms.Topic
       javax.jms.Queue
       ```

   - Description (optional) - You can enter a text description of the JMS resource.

6. Check the Resource Enabled box to enable the JMS resource.

   If a JMS resource is disabled, no application component can connect to it, but its configuration remains in the domain.

7. Click the OK button.

8. To add a property, click the Add Property button and enter the property name and value. To delete properties, check the properties you want to delete, then click the Delete Properties button.

The following table lists the most commonly used JMS resource properties. For a complete list of the available properties (called *administered object attributes* in Sun Java System Message Queue), see the *Sun Java System Message Queue Administration Guide*.

Table 14-2 JMS Resource Properties

Property	Default	Description
`Name`	none	Specifies the JMS physical destination name associated with this JMS resource. You must specify this property for JMS resources of the Type `javax.jms.Topic` or `javax.jms.Queue`.
`Description`	none	Specifies a text description of the JMS resource.
`MessageServiceAddressList`	none	Specifies a list of host/port combinations of the Sun Java System Message Queue. For JMS resources of the Type`javax.jms.TopicConnectionFactory` or `javax.jms.QueueConnectionFactory`.
`ClientID`	none	Specifies the JMS Client Identifier to be associated with a `Connection` created using the `createQueueConnection` and `createTopicConnection` methods of the `QueueConnectionFactory` and `TopicConnectionFactory` classes, respectively. For JMS resources of the Type`javax.jms.TopicConnectionFactory` or `javax.jms.QueueConnectionFactory`. Durable subscription names are unique and only valid within the scope of a client identifier. To create or reactivate a durable subscriber, the connection must have a valid client identifier. The JMS specification ensures that client identifiers are unique and that a given client identifier is allowed to be used by only one active connection at a time.
`UserName`	`guest`	Specifies the username for connecting to the Sun Java System Message Queue. For JMS resources of the Type`javax.jms.TopicConnectionFactory` or `javax.jms.QueueConnectionFactory`.
`Password`	`guest`	Specifies the password for connecting to the Sun Java System Message Queue. For JMS resources of the Type`javax.jms.TopicConnectionFactory` or `javax.jms.QueueConnectionFactory`.

NOTE All JMS resource properties that used to work with version 7 of the Application Server are supported for backward compatibility.

9. Click the OK button.

Using the Command Line Interface

To create a JMS resource using the command line, use the `asadmin create-jms-resource` command. The syntax is as follows, with defaults shown for optional parameters that have them:

```
asadmin create-jms-resource --user user --restype resource_type [--enabled=true]
[--description text] [--property (name=value)[:name=value]*] jndi_name
```

For more information about the parameters specific to `asadmin create-jms-resource`, see "Using the Administration Console" on page 404.

For more information about the optional general `asadmin` parameters (`--password`, `--passwordfile`, `--host`, `--port`, `--secure`, `--terse`, `--echo`, and `--interactive`), see the *Sun Java System Application Server Administration Guide*.

For example:

```
asadmin create-jms-resource --user joeuser --restype javax.jms.Topic
--property imqDestinationName=testTopic MyTopic
```

To delete a JMS resource, use the following command:

```
asadmin delete-jms-resource --user user jndi_name
```

For example:

```
asadmin delete-jms-resource --user joeuser MyTopic
```

To list JMS resources, use the following command:

```
asadmin list-jms-resources --user user [--restype resource_type]
```

For example:

```
asadmin list-jms-resources --user joeuser --restype Topic
```

Message Queue Resource Adapter

The Sun Java System Message Queue is integrated into the Sun Java System Application Server using a resource adapter that is compliant with the Connector 1.5 specification. The module name of this system resource adapter is `jmsra`. Every JMS resource is converted to a corresponding connector resource of this resource adapter as follows:

- **Connection Factory:** A connector connection pool with a `max-pool-size` of `250` and a corresponding connector resource.
- **Destination (Topic or Queue):** A connector administered object.

You can use connector configuration tools to manage JMS resources. For more information, see:

http://developers.sun.com/prodtech/appserver/reference/techart/as8_connectors

ConnectionFactory Authentication

If your web, EJB, or client module has `res-auth` set to `Container`, but you use the `ConnectionFactory.createConnection("user","password")` method to get a connection, the Sun Java System Application Server searches the container for authentication information before using the supplied user and password. Version 7 of the Application Server threw an exception in this situation.

Message Queue varhome Directory

Sun Java System Message Queue uses a default directory for storing data such as persistent messages and its log file. This directory is called `varhome`. Sun Java System Application server uses *domain_dir*`/imq` as the `varhome` directory. Thus for the default Application Server domain, Message Queue data is stored in the following location:

install_dir`/domains/domain1/imq/var/instances/imqbroker`

Version 7 of the Application Server stored this data in the following location:

install_dir`/imq/var/instances/domain1_server`

When you execute Sun Java System Message Queue scripts such as *install_dir*`/imq/bin/imqusermgr`, you should use the `-varhome` option. For example:

```
imqusermgr -varhome $AS_INSTALL/domains/domain1/imq add -u testuser -p testpassword
```

Delivering SOAP Messages Using the JMS API

Web service clients use the Simple Object Access Protocol (SOAP) to communicate with web services. SOAP uses a combination of XML-based data structuring and Hyper Text Transfer Protocol (HTTP) to define a standardized way of invoking methods in objects distributed in diverse operating environments across the Internet.

For more information about SOAP, see the Apache SOAP web site:

http://xml.apache.org/soap/index.html

You can take advantage of the JMS provider's reliable messaging when delivering SOAP messages. You can convert a SOAP message into a JMS message, send the JMS message, then convert the JMS message back into a SOAP message. The following sections explain how to do these conversions:

- Sending SOAP Messages Using the JMS API
- Receiving SOAP Messages Using the JMS API

Sending SOAP Messages Using the JMS API

You use the `MessageTransformer` utility to convert a SOAP message into a JMS message. You then send the JMS message containing the SOAP payload as you would a normal JMS message.

1. Import the library `com.sun.messaging.xml.MessageTransformer`. This is the utility whose methods you use to convert SOAP messages to JMS messages and the reverse.

   ```
   import com.sun.messaging.xml.MessageTransformer;
   ```

2. Initialize the `TopicConnectionFactory`, `TopicConnection`, `TopicSession`, and publisher.

   ```
   tcf = new TopicConnectionFactory();
   tc = tcf.createTopicConnection();
   session = tc.createTopicSession(false,Session.AUTO_ACKNOWLEDGE);
   topic = session.createTopic(topicName);
   publisher = session.createPublisher(topic);
   ```

3. Construct a SOAP message using the SOAP with Attachments API for Java (SAAJ). For more information on constructing a SOAP message, see the *Sun Java System Message Queue Developer's Guide*.

   ```
   *construct a default soap MessageFactory */
   MessageFactory mf = MessageFactory.newInstance();

   * Create a SOAP message object.*/
   SOAPMessage soapMessage = mf.createMessage();

   /** Get SOAP part.*/
   SOAPPart soapPart = soapMessage.getSOAPPart();

   /* Get SOAP envelope. */
   SOAPEnvelope soapEnvelope = soapPart.getEnvelope();

   /* Get SOAP body.*/
   SOAPBody soapBody = soapEnvelope.getBody();
   ```

```
/* Create a name object. with name space */
/* http://www.sun.com/imq. */
Name name = soapEnvelope.createName("HelloWorld", "hw",
    "http://www.sun.com/imq");

* Add child element with the above name. */
SOAPElement element = soapBody.addChildElement(name)

/* Add another child element.*/
element.addTextNode( "Welcome to Sun Java System Web Services." );

/* Create an atachment with activation API.*/
URL url = new URL ("http://java.sun.com/webservices/");
DataHandler dh = new DataHandler (url);
AttachmentPart ap = soapMessage.createAttachmentPart(dh);

/*set content type/ID. */
ap.setContentType("text/html");
ap.setContentId("cid-001");

/**  add the attachment to the SOAP message.*/
soapMessage.addAttachmentPart(ap);
soapMessage.saveChanges();
```

4. Convert the SOAP message to a JMS message by calling the `MessageTransformer.SOAPMessageintoJMSMessage()` method.

   ```
   Message m = MessageTransformer.SOAPMessageIntoJMSMessage (soapMessage,
   session );
   ```

5. Publish the JMS message.

   ```
   publisher.publish(m);
   ```

6. Close the JMS connection.

   ```
   tc.close();
   ```

Receiving SOAP Messages Using the JMS API

You receive the JMS message containing the SOAP payload as you would a normal JMS message. You then use the `MessageTransformer` utility to convert the JMS message back into a SOAP message.

1. Import the library `com.sun.messaging.xml.MessageTransformer`. This is the utility whose methods you use to convert SOAP messages to JMS messages and the reverse.

   ```
   import com.sun.messaging.xml.MessageTransformer;
   ```

2. Initialize the `TopicConnectionFactory`, `TopicConnection`, `TopicSession`, `TopicSubscriber`, and `Topic`.

```
messageFactory = MessageFactory.newInstance();
tcf = new com.sun.messaging.TopicConnectionFactory();
tc = tcf.createTopicConnection();

session = tc.createTopicSession(false, Session.AUTO_ACKNOWLEDGE);

topic = session.createTopic(topicName);
subscriber = session.createSubscriber(topic);
subscriber.setMessageListener(this);
tc.start();
```

3. Use the `OnMessage` method to receive the message. Use the `SOAPMessageFromJMSMessage` method to convert the JMS message to a SOAP message.

```
public void onMessage (Message message) {
    SOAPMessage soapMessage =
    MessageTransformer.SOAPMessageFromJMSMessage( message,
    messageFactory ); }
```

4. Retrieve the content of the SOAP message.

Chapter 15

Using the JavaMail API

This chapter describes how to use the JavaMail™ API, which provides a set of abstract classes defining objects that comprise a mail system.

This chapter contains the following sections:

Introducing JavaMail

The JavaMail API defines classes such as `Message`, `Store`, and `Transport`. The API can be extended and can be subclassed to provide new protocols and to add functionality when necessary. In addition, the API provides concrete subclasses of the abstract classes. These subclasses, including `MimeMessage` and `MimeBodyPart`, implement widely used Internet mail protocols and conform to the RFC822 and RFC2045 specifications. The JavaMail API includes support for the IMAP4, POP3, and SMTP protocols.

The JavaMail architectural components are as follows:

- The *abstract layer* declares classes, interfaces, and abstract methods intended to support mail handling functions that all mail systems support.
- The *internet implementation layer* implements part of the abstract layer using the RFC822 and MIME internet standards.

- JavaMail uses the *JavaBeans Activation Framework* (JAF) to encapsulate message data and to handle commands intended to interact with that data.

For more information, see the *Sun Java System Application Server Administration Guide* and the JavaMail specification at:

`http://java.sun.com/products/javamail/`

Creating a JavaMail Session

You can create a JavaMail session in the following ways:

- Using the Administration Console
- Using the Command Line Interface

The "Using The Administration Console" section describes each JavaMail session setting. The "Using The Command Line Interface" section merely lists syntax and default values.

Using the Administration Console

To create a JavaMail session using the Administration Console, perform these steps:

1. Login to the Administration Console by going to the following URL in your web browser:

   http://*host*:*port*/asadmin

   For example:

   `http://localhost:4848/asadmin`

2. Click on the Java Mail Sessions component.
3. Click the New button.
4. Enter the following information:
   - JNDI Name (required) - Enter the JNDI name that application components must use to access the JavaMail session. For more information, see "Looking Up a JavaMail Session" on page 415.
   - Mail Host (required) - The mail server host name.
   - Default User (required) - The mail server user name.

- Default Return Address (required) - The e-mail address the mail server uses to indicate the message sender.
- Description (optional) - You can enter a text description of the JavaMail session.

5. Check the Session Enabled box to enable the JavaMail session. If a JavaMail session is disabled, it is unavailable for lookups, but its configuration remains in the domain.
6. You can also edit the following Advanced settings:
   - Store Protocol - Specifies the storage protocol service, which connects to a mail server, retrieves messages, and saves messages in folder(s). Example values are `imap` (the default) and `pop3`.
   - Store Protocol Class - Specifies the service provider implementation class for storage. The default is `com.sun.mail.imap.IMAPStore`.
   - Transport Protocol - Specifies the transport protocol service, which sends messages. The default is `smtp`.
   - Transport Protocol Class - Specifies the service provider implementation class for transport. The default is `com.sun.mail.smtp.SMTPTransport`.
   - Debug Enabled - Enables debugging for this JavaMail session.
7. To add a property, click the Add Property button and enter the property name and value. To delete properties, check the properties you want to delete, then click the Delete Properties button. For details about JavaMail session properties, see "JavaMail Session Properties" on page 414.
8. Click the OK button.

Using the Command Line Interface

To create a JavaMail session using the command line, use the `asadmin create-javamail-resource` command. The syntax is as follows, with defaults shown for optional parameters that have them:

```
asadmin create-javamail-resource --user user --mailhost mail_host --mailuser
mail_user --fromaddress address [--storeprotocol=imap]
[--storeprotocolclass=com.sun.mail.imap.IMAPStore] [--transprotocol=smtp]
[--transprotocolclass=com.sun.mail.smtp.SMTPTransport] [--debug=false]
[--enabled=true] [--description text] [--property (name=value)[:name=value]*]
jndi_name
```

For more information about the parameters specific to `asadmin create-javamail-resource`, see "Using the Administration Console" on page 412.

For more information about the optional general asadmin parameters (--password, --passwordfile, --host, --port, --secure, --terse, --echo, and --interactive), see the *Sun Java System Application Server Administration Guide*.

For example:

```
asadmin create-javamail-resource --user joeuser --mailhost MailServer
--mailuser MailUser --fromaddress user@mailserver.com MailSession
```

To delete a JavaMail session, use the following command:

asadmin delete-javamail-resource --user *user jndi_name*

For example:

```
asadmin delete-javamail-resource --user joeuser MailSession
```

To list JavaMail sessions, use the following command:

asadmin list-javamail-resources --user *user*

For example:

```
asadmin list-javamail-resources --user joeuser
```

JavaMail Session Properties

You can set properties for a JavaMail Session object. Every property name must start with a mail- prefix. Sun Java System Application Server changes the dash (-) character to a period (.) in the name of the property and saves the property to the MailConfiguration and JavaMail Session objects. If the name of the property doesn't start with mail-, the property is ignored.

For example, if you want to define the property mail.from in a JavaMail Session object, first define the property as follows:

- Name - mail-from
- Value - john.doe@sun.com

After you get the JavaMail Session object, you can get the mail.from property to retrieve the value as follows:

```
String password = session.getProperty("mail.from");
```

Looking Up a JavaMail Session

The standard Java Naming and Directory Interface™ (JNDI) subcontext for JavaMail sessions is `java:comp/env/mail`.

Registering JavaMail sessions in the `mail` naming subcontext of a JNDI namespace, or in one of its child subcontexts, is standard. The JNDI namespace is hierarchical, like a file system's directory structure, so it is easy to find and nest references. A JavaMail session is bound to a logical JNDI name. The name identifies a subcontext, `mail`, of the root context, and a logical name. To change the JavaMail session, you can change its entry in the JNDI namespace without having to modify the application.

The resource lookup in the application code looks like this:

```
InitialContext ic = new InitialContext();
String snName = "java:comp/env/mail/MyMailSession";
Session session = (Session)ic.lookup(snName);
```

For more information about the JNDI API, see Chapter 13, "Using the Java Naming and Directory Interface."

Sending Messages Using JavaMail

To send a message using JavaMail, perform the following tasks:

1. Import the packages that you need:

   ```
   import java.util.*;
   import javax.activation.*;
   import javax.mail.*;
   import javax.mail.internet.*;
   import javax.naming.*;
   ```

2. Look up the JavaMail session, as described in "Looking Up a JavaMail Session" on page 415:

   ```
   InitialContext ic = new InitialContext();
   String snName = "java:comp/env/mail/MyMailSession";
   Session session = (Session)ic.lookup(snName);
   ```

3. Override the JavaMail session properties if necessary. For example:

   ```
   Properties props = session.getProperties();
   props.put("mail.from", "user2@mailserver.com");
   ```

4. Create a `MimeMessage`. The `msgRecipient`, `msgSubject`, and `msgTxt` variables in the following example contain input from the user:

```
Message msg = new MimeMessage(session);
msg.setSubject(msgSubject);
msg.setSentDate(new Date());
msg.setFrom();
msg.setRecipients(Message.RecipientType.TO,
InternetAddress.parse(msgRecipient, false));
msg.setText(msgTxt);
```

5. Send the message:

```
Transport.send(msg);
```

Reading Messages Using JavaMail

To read a message using JavaMail, perform the following tasks:

1. Import the packages that you need:

```
import java.util.*;
import javax.activation.*;
import javax.mail.*;
import javax.mail.internet.*;
import javax.naming.*;
```

2. Look up the JavaMail session, as described in "Looking Up a JavaMail Session" on page 415:

```
InitialContext ic = new InitialContext();
String snName = "java:comp/env/mail/MyMailSession";
Session session = (javax.mail.Session)ic.lookup(snName);
```

3. Override the JavaMail session properties if necessary. For example:

```
Properties props = session.getProperties();
props.put("mail.from", "user2@mailserver.com");
```

4. Get a `Store` object from the `Session`, then connect to the mail server using the Store object's `connect()` method. You must supply a mail server name, a mail user name, and a password.

```
Store store = session.getStore();
store.connect("MailServer", "MailUser", "secret");
```

5. Get the default folder, then get the INBOX folder:

```
Folder folder = store.getFolder("INBOX");
```

6. It is efficient to read the `Message` objects (which represent messages on the server) into an array:

```
Message[] messages = folder.getMessages();
```

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