Sun Java System Application Server 9.1 High Availability Administration Guide

Sun Microsystems, Inc.
4150 Network Circle
Santa Clara, CA 95054
U.S.A.

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080801@20490

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Preface

This book describes the high-availability features in Application Server, including HTTP load balancing, clusters, session persistence and failover, and High Availability Database (HADB).

This preface contains information about and conventions for the entire Sun Java™ System Application Server documentation set.

Application Server Documentation Set

The Application Server documentation set describes deployment planning and system installation. The Uniform Resource Locator (URL) for Application Server documentation is `http://docs.sun.com/coll/1343.4`. For an introduction to Application Server, refer to the books in the order in which they are listed in the following table.

TABLE P–1 Books in the Application Server Documentation Set

Book Title	Description
Documentation Center	Application Server documentation topics organized by task and subject.
Release Notes	Late-breaking information about the software and the documentation. Includes a comprehensive, table-based summary of the supported hardware, operating system, Java Development Kit (JDK™), and database drivers.
Quick Start Guide	How to get started with the Application Server product.
Installation Guide	Installing the software and its components.
Deployment Planning Guide	Evaluating your system needs and enterprise to ensure that you deploy the Application Server in a manner that best suits your site. General issues and concerns that you must be aware of when deploying the server are also discussed.
Application Deployment Guide	Deployment of applications and application components to the Application Server. Includes information about deployment descriptors.
Developer's Guide	Creating and implementing Java Platform, Enterprise Edition (Java EE platform) applications intended to run on the Application Server that follow the open Java standards model for Java EE components and APIs. Includes information about developer tools, security, debugging, and creating lifecycle modules.

TABLE P–1 Books in the Application Server Documentation Set *(Continued)*

Book Title	Description
Java EE 5 Tutorial	Using Java EE 5 platform technologies and APIs to develop Java EE applications.
Java WSIT Tutorial	Developing web applications using the Web Service Interoperability Technologies (WSIT). Describes how, when, and why to use the WSIT technologies and the features and options that each technology supports.
Administration Guide	System administration for the Application Server, including configuration, monitoring, security, resource management, and web services management.
High Availability Administration Guide	Post-installation configuration and administration instructions for the high-availability database.
Administration Reference	Editing the Application Server configuration file, `domain.xml`.
Upgrade and Migration Guide	Upgrading from an older version of Application Server or migrating Java EE applications from competitive application servers. This guide also describes differences between adjacent product releases and configuration options that can result in incompatibility with the product specifications.
Performance Tuning Guide	Tuning the Application Server to improve performance.
Troubleshooting Guide	Solving Application Server problems.
Error Message Reference	Solving Application Server error messages.
Reference Manual	Utility commands available with the Application Server; written in man page style. Includes the `asadmin` command line interface.

Related Documentation

Application Server can be purchased by itself or as a component of Sun Java Enterprise System (Java ES), a software infrastructure that supports enterprise applications distributed across a network or Internet environment. If you purchased Application Server as a component of Java ES, you should be familiar with the system documentation at `http://docs.sun.com/coll/1286.3`. The URL for all documentation about Java ES and its components is `http://docs.sun.com/prod/entsys.5`.

For documentation about other stand-alone Sun Java System server products, go to the following:

- Message Queue documentation (`http://docs.sun.com/coll/1343.4`)
- Directory Server documentation (`http://docs.sun.com/coll/1224.1`)
- Web Server documentation (`http://docs.sun.com/coll/1308.3`)

A Javadoc™ tool reference for packages provided with the Application Server is located at `http://glassfish.dev.java.net/nonav/javaee5/api/index.html`. Additionally, the following resources might be useful:

- The Java EE 5 Specifications (`http://java.sun.com/javaee/5/javatech.html`)
- The Java EE Blueprints (`http://java.sun.com/reference/blueprints/index.html`)

For information on creating enterprise applications in the NetBeans™ Integrated Development Environment (IDE), see `http://www.netbeans.org/kb/55/index.html`.

For information about the Java DB database included with the Application Server, see `http://developers.sun.com/javadb/`.

The GlassFish Samples project is a collection of sample applications that demonstrate a broad range of Java EE technologies. The GlassFish Samples are bundled with the Java EE Software Development Kit (SDK), and are also available from the GlassFish Samples project page at `https://glassfish-samples.dev.java.net/`.

Default Paths and File Names

The following table describes the default paths and file names that are used in this book.

TABLE P–2 Default Paths and File Names

Placeholder	Description	Default Value

as-install	Represents the base installation directory for Application Server.	Java ES installations on the Solaris™ operating system:
		`/opt/SUNWappserver/appserver`
		Java ES installations on the Linux operating system:
		`/opt/sun/appserver/`
		Other Solaris and Linux installations, non-root user:
		user's-home-directory`/SUNWappserver`
		Other Solaris and Linux installations, root user:
		`/opt/SUNWappserver`
		Windows, all installations:
		SystemDrive`:\Sun\AppServer`

TABLE P–2 Default Paths and File Names *(Continued)*

Placeholder	Description	Default Value

domain-root-dir	Represents the directory containing all domains.	Java ES Solaris installations:
		`/var/opt/SUNWappserver/domains/`
		Java ES Linux installations:
		`/var/opt/sun/appserver/domains/`
		All other installations:
		as-install`/domains/`

domain-dir	Represents the directory for a domain. In configuration files, you might see *domain-dir* represented as follows: `${com.sun.aas.instanceRoot}`	*domain-root-dir*`/`*domain-dir*
instance-dir	Represents the directory for a server instance.	*domain-dir*`/`*instance-dir*

Typographic Conventions

The following table describes the typographic changes that are used in this book.

TABLE P–3 Typographic Conventions

Typeface	Meaning	Example
`AaBbCc123`	The names of commands, files, and directories, and onscreen computer output	Edit your `.login` file. Use `ls -a` to list all files. `machine_name% you have mail.`
`AaBbCc123`	What you type, contrasted with onscreen computer output	`machine_name%` **`su`** `Password:`
AaBbCc123	A placeholder to be replaced with a real name or value	The command to remove a file is `rm` *filename*.
AaBbCc123	Book titles, new terms, and terms to be emphasized (note that some emphasized items appear bold online)	Read Chapter 6 in the *User's Guide*. A *cache* is a copy that is stored locally. Do *not* save the file.

Symbol Conventions

The following table explains symbols that might be used in this book.

TABLE P–4 Symbol Conventions

Symbol	Description	Example	Meaning
`[ ]`	Contains optional arguments and command options.	`ls [-l]`	The `-l` option is not required.
`{ | }`	Contains a set of choices for a required command option.	`-d {y|n}`	The `-d` option requires that you use either the `y` argument or the `n` argument.
`${ }`	Indicates a variable reference.	`${com.sun.javaRoot}`	References the value of the `com.sun.javaRoot` variable.
-	Joins simultaneous multiple keystrokes.	Control-A	Press the Control key while you press the A key.
+	Joins consecutive multiple keystrokes.	Ctrl+A+N	Press the Control key, release it, and then press the subsequent keys.
→	Indicates menu item selection in a graphical user interface.	File → New → Templates	From the File menu, choose New. From the New submenu, choose Templates.

Documentation, Support, and Training

The Sun web site provides information about the following additional resources:

- Documentation (`http://www.sun.com/documentation/`)
- Support (`http://www.sun.com/support/`)
- Training (`http://www.sun.com/training/`)

Searching Sun Product Documentation

Besides searching Sun product documentation from the docs.sun.com℠ web site, you can use a search engine by typing the following syntax in the search field:

search-term `site:docs.sun.com`

For example, to search for “broker,” type the following:

```
broker site:docs.sun.com
```

To include other Sun web sites in your search (for example, java.sun.com, www.sun.com, and developers.sun.com), use `sun.com` in place of `docs.sun.com` in the search field.

Third-Party Web Site References

Third-party URLs are referenced in this document and provide additional, related information.

Note – Sun is not responsible for the availability of third-party web sites mentioned in this document. Sun does not endorse and is not responsible or liable for any content, advertising, products, or other materials that are available on or through such sites or resources. Sun will not be responsible or liable for any actual or alleged damage or loss caused or alleged to be caused by or in connection with use of or reliance on any such content, goods, or services that are available on or through such sites or resources.

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◆ ◆ ◆ CHAPTER 1

High Availability in Application Server

This chapter describes the high availability features in the Sun Java System Application Server that are available with the cluster profile and the enterprise profile.

Note – The HADB software is supplied with the Application Server standalone distribution of Sun Java System Application Server. For information about available distributions of Sun Java System Application Server, see "Distribution Types and Their Components" in *Sun Java System Application Server 9.1 Installation Guide*. HADB features are available only in the enterprise profile. For information about profiles, see "Usage Profiles" in *Sun Java System Application Server 9.1 Administration Guide*.

This chapter contains the following topics.

Overview of High Availability

High availability applications and services provide their functionality continuously, regardless of hardware and software failures. Such applications are sometimes referred to as providing *five nines* of reliability, because they are intended to be available 99.999% of the time.

Application Server provides the following high availability features:

- High Availability Session Persistence
- High Availability Java Message Service
- RMI-IIOP Load Balancing and Failover

High Availability Session Persistence

Application Server provides high availability of HTTP requests and session data (both HTTP session data and stateful session bean data).

Java EE applications typically have significant amounts of session state data. A web shopping cart is the classic example of a session state. Also, an application can cache frequently-needed data in the session object. In fact, almost all applications with significant user interactions need to maintain session state. Both HTTP sessions and stateful session beans (SFSBs) have session state data.

Preserving session state across server failures can be important to end users. For high availability, Application Server provides the following types of storage for session state data:

- In-memory replication on other servers in the cluster
- High-availability database (HADB)

If the Application Server instance hosting the user session experiences a failure, the session state can be recovered, and the session can continue without loss of information.

For a detailed description of how to set up high availability session persistence, see Chapter 9, "Configuring High Availability Session Persistence and Failover"

High Availability Java Message Service

The Java Message Service (JMS) API is a messaging standard that allows Java EE applications and components to create, send, receive, and read messages. It enables distributed communication that is loosely coupled, reliable, and asynchronous. The Sun Java System Message Queue (MQ), which implements JMS, is tightly integrated with Application Server, enabling you to create components that rely on JMS, such as message-driven beans (MDBs).

JMS is made highly available through connection pooling and failover and MQ clustering. For more information, see Chapter 10, "Java Message Service Load Balancing and Failover."

Connection Pooling and Failover

Application Server supports JMS connection pooling and failover. The Application Server pools JMS connections automatically. By default, Application Server selects its primary MQ broker randomly from the specified host list. When failover occurs, MQ transparently transfers the load to another broker and maintains JMS semantics.

For more information about JMS connection pooling and failover, see "Connection Pooling and Failover" on page 217.

MQ Clustering

MQ Enterprise Edition supports multiple interconnected broker instances known as a *broker cluster*. With broker clusters, client connections are distributed across all the brokers in the cluster. Clustering provides horizontal scalability and improves availability.

For more information about MQ clustering, see "Using MQ Clusters with Application Server" on page 219.

RMI-IIOP Load Balancing and Failover

With RMI-IIOP load balancing, IIOP client requests are distributed to different server instances or name servers, which spreads the load evenly across the cluster, providing scalability. IIOP load balancing combined with EJB clustering and availability also provides EJB failover.

When a client performs a JNDI lookup for an object, the Naming Service essentially binds the request to a particular server instance. From then on, all lookup requests made from that client are sent to the same server instance, and thus all `EJBHome` objects will be hosted on the same target server. Any bean references obtained henceforth are also created on the same target host. This effectively provides load balancing, since all clients randomize the list of target servers when performing JNDI lookups. If the target server instance goes down, the lookup or EJB method invocation will failover to another server instance.

IIOP Load balancing and failover happens transparently. No special steps are needed during application deployment. If the Application Server instance on which the application client is deployed participates in a cluster, the Application Server finds all currently active IIOP endpoints in the cluster automatically. However, a client should have at least two endpoints specified for bootstrapping purposes, in case one of the endpoints has failed.

For more information on RMI-IIOP load balancing and failover, see Chapter 11, "RMI-IIOP Load Balancing and Failover."

More Information

For information about planning a high-availability deployment, including assessing hardware requirements, planning network configuration, and selecting a topology, see *Sun Java System Application Server 9.1 Deployment Planning Guide*. This manual also provides a high-level introduction to concepts such as:

- Application server components such as node agents, domains, and clusters
- IIOP load balancing in a cluster
- HADB architecture
- Message queue failover

For more information about developing applications that take advantage of high availability features, see *Sun Java System Application Server 9.1 Developer's Guide*.

Tuning High Availability Servers and Applications

For information on how to configure and tune applications and Application Server for best performance with high availability, see *Sun Java System Application Server 9.1 Performance Tuning Guide*, which discusses topics such as:

- Tuning persistence frequency and persistence scope
- Checkpointing stateful session beans
- Configuring the JDBC connection pool
- Session size
- Tuning HADB disk use, memory allocation, performance, and operating system configuration
- Configuring load balancer for best performance

How Application Server Provides High Availability

Application Server provides high availability through the following sub-components and features:

- "Load Balancer Plug-in" on page 24
- "Storage for Session State Data" on page 25
- "Highly Available Clusters" on page 26

Load Balancer Plug-in

The load balancer plug-in accepts HTTP / HTTPS requests and forwards them to application server instances in a cluster. If an instance fails, becomes unavailable (due to network faults), or becomes unresponsive, the load balancer redirects requests to existing, available machines. The load balancer can also recognize when a failed instance has recovered and redistribute the load accordingly. Application Server provides the load balancer plug-in for the Sun Java System Web Server and the Apache Web Server, and Microsoft Internet Information Server.

By distributing workload among multiple physical machines, the load balancer increases overall system throughput. It also provides higher availability through failover of HTTP requests. For HTTP session information to persist, you must configure HTTP session persistence.

For simple, stateless applications a load-balanced cluster may be sufficient. However, for mission-critical applications with session state, use load balanced clusters with HADB.

Server instances and clusters participating in load balancing have a homogenous environment. Usually that means that the server instances reference the same server configuration, can access the same physical resources, and have the same applications deployed to them. Homogeneity assures that before and after failures, the load balancer always distributes load evenly across the active instances in the cluster.

For information on configuring load balancing and failover, see Chapter 5, "Configuring HTTP Load Balancing"

Storage for Session State Data

Storing session state data enables the session state to be recovered after the failover of a server instance in a cluster. Recovering the session state enables the session to continue without loss of information. Application Server provides the following types of high availability storage for HTTP session and stateful session bean data:

- In-memory replication on other servers in the cluster
- High availability database

In-Memory Replication on Other Servers in the Cluster

In-memory replication on other servers provides lightweight storage of session state data without the need to obtain a separate database, such as HADB. This type of replication uses memory on other servers for high availability storage of HTTP session and stateful session bean data. Clustered server instances replicate session state in a ring topology. Each backup instance stores the replicated data in memory. Replication of session state data in memory on other servers enables sessions to be distributed.

The use of in-memory replication requires the Group Management Service (GMS) to be enabled. For more information about GMS, see "Group Management Service" on page 159.

If server instances in a cluster are located on different machines, ensure that the following prerequisites are met:

- To ensure that GMS and in-memory replication function correctly, the machines must be on the same subnet.
- To ensure that in-memory replication functions correctly, the system clocks on all machines in the cluster must be synchronized as closely as possible.

High Availability Database

Note – The HADB software is supplied with the Application Server standalone distribution of Sun Java System Application Server. For information about available distributions of Sun Java System Application Server, see "Distribution Types and Their Components" in *Sun Java System Application Server 9.1 Installation Guide*. HADB features are available only in the enterprise profile. For information about profiles, see "Usage Profiles" in *Sun Java System Application Server 9.1 Administration Guide*.

Application Server provides the High Availability Database (HADB) for high availability storage of HTTP session and stateful session bean data. HADB is designed to support up to 99.999% service and data availability with load balancing, failover, and state recovery. Generally, you must configure and manage HADB independently of Application Server.

Keeping state management responsibilities separated from Application Server has significant benefits. Application Server instances spend their cycles performing as a scalable and high performance application containers delegating state replication to an external high availability state service. Due to this loosely coupled architecture, Application Server instances can be very easily added to or deleted from a cluster. The HADB state replication service can be independently scaled for optimum availability and performance. When an Application Server instance also performs replication, the performance of Java EE applications can suffer and can be subject to longer garbage collection pauses.

For information on planning and setting up your application server installation for high availability with HADB, including determining hardware configuration, sizing, and topology, see "Planning for Availability" in *Sun Java System Application Server 9.1 Deployment Planning Guide* and Chapter 3, "Selecting a Topology," in *Sun Java System Application Server 9.1 Deployment Planning Guide*.

Highly Available Clusters

A *cluster* is a collection of Application Server instances that work together as one logical entity. A cluster provides a runtime environment for one or more Java EE applications. A *highly available cluster* integrates a state replication service with clusters and load balancer.

Using clusters provides the following advantages:

- **High availability**, by allowing for failover protection for the server instances in a cluster. If one server instance goes down, other server instances take over the requests that the unavailable server instance was serving.
- **Scalability**, by allowing for the addition of server instances to a cluster, thus increasing the capacity of the system. The load balancer plug-in distributes requests to the available server instances within the cluster. No disruption in service is required as an administrator adds more server instances to a cluster.

All instances in a cluster:

- Reference the same configuration.
- Have the same set of deployed applications (for example, a Java EE application EAR file, a web module WAR file, or an EJB JAR file).
- Have the same set of resources, resulting in the same JNDI namespace.

Every cluster in the domain has a unique name; furthermore, this name must be unique across all node agent names, server instance names, cluster names, and configuration names. The

name must not be `domain`. You perform the same operations on a cluster (for example, deploying applications and creating resources) that you perform on an unclustered server instance.

Clusters and Configurations

A cluster's settings are derived from a named configuration, which can potentially be shared with other clusters. A cluster whose configuration is not shared by other server instances or clusters is said to have a *stand-alone configuration* . By default, the name of this configuration is *cluster_name* `-config`, where *cluster_name* is the name of the cluster.

A cluster that shares its configuration with other clusters or instances is said to have a *shared configuration*.

Clusters, Instances, Sessions, and Load Balancing

Clusters, server instances, load balancers, and sessions are related as follows:

- A server instance is not required to be part of a cluster. However, an instance that is not part of a cluster cannot take advantage of high availability through transfer of session state from one instance to other instances.
- The server instances within a cluster can be hosted on one or multiple machines. You can group server instances across different machines into a cluster.
- A particular load balancer can forward requests to server instances on multiple clusters. You can use this ability of the load balancer to perform an online upgrade without loss of service. For more information, see "Using Multiple Clusters for Online Upgrades Without Loss of Service" in the chapter "Configuring Clusters"
- A single cluster can receive requests from multiple load balancers. If a cluster is served by more than one load balancer, you must configure the cluster in exactly the same way on each load balancer.
- Each session is tied to a particular cluster. Therefore, although you can deploy an application on multiple clusters, session failover will occur only within a single cluster.

The cluster thus acts as a safe boundary for session failover for the server instances within the cluster. You can use the load balancer and upgrade components within the Application Server without loss of service.

Recovering from Failures

Using Sun Cluster

Sun Cluster provides automatic failover of the domain administration server, node agents, Application Serverinstances, Message Queue, and HADB. For more information, see *Sun Cluster Data Service for Sun Java System Application Server Guide for Solaris OS*.

Use standard Ethernet interconnect and a subset of Sun Cluster products. This capability is included in Java ES.

Manual Recovery

You can use various techniques to manually recover individual subcomponents:

Recovering the Domain Administration Server

Loss of the Domain Administration Server (DAS) affects only administration. Application Server clusters and applications will continue to run as before, even if the DAS is not reachable

Use any of the following methods to recover the DAS:

- Run `asadmin` backup commands periodically, so you have periodic snapshots. After a hardware failure, install App Server on a new machine, with the same network identity and run `asadmin` restore from the back up created earlier. For more information, see "Recreating the Domain Administration Server" on page 31.
- Put the domain installation and configuration on a shared and robust file system (NFS for example). If the primary DAS machine fails, a second machine is brought up with the same IP address and will take over with manual intervention or user supplied automation. Sun cluster uses a similar approach for making DAS fault-tolerant.
- Zip the Application Serverinstallation and domain root directory. Restore it on the new machine, assigning it the same network identity. This may be the simplest approach if you are using the file-based installation.

- Restore from DAS backup. See the AS8.1 UR2 patch 4 instructions

Recovering Node Agents and Server Instances

There are two methods for recovering node agents and sever instances.

Keep a backup zip file. There are no explicit commands to back up the node agent and server instances. Simply create a zip file with the contents of the node agents directory. After failure, unzip the saved backup on a new machine with same host name and IP address. Use the same install directory location, OS, and so on. A file-based install, package-based install, or restored backup image must be present on the machine.

Manual recovery. You must use a new host with the same IP address.

1. Install the Application Server node agent bits on the machine.
2. See the instructions for AS8.1 UR2 patch 4 installation
3. Recreate the node agents. You do not need to create any server instances.
4. Synchronization will copy and update the configuration and data from the DAS.

Recovering Load Balancer and Web Server

There are no explicit commands to back up only a web server configuration. Simply zip the web server installation directory. After failure, unzip the saved backup on a new machine with the same network identity. If the new machine has a different IP address, update the DNS server or the routers.

Note – This assumes that the web server is either reinstalled or restored from an image first.

The load balancer plugin (plugins directory) and configurations are in the web server installation directory, typically `/opt/SUNWwbsvr`. The `web-install/web-instance/config` directory contains the `loadbalancer.xml` file.

Recovering Message Queue

Message Queue (MQ) configurations and resources are stored in the DAS and can be synchronized to the instances. Any other data and configuration information is in the MQ directories, typically under `/var/imq`, so backup and restore these directories as required. The new machine must already contain the MQ installation. Be sure to start the MQ brokers as before when you restore a machine.

Recovering HADB

Note – The HADB software is supplied with the Application Server standalone distribution of Sun Java System Application Server. For information about available distributions of Sun Java System Application Server, see "Distribution Types and Their Components" in *Sun Java System Application Server 9.1 Installation Guide*. HADB features are available only in the enterprise profile. For information about profiles, see "Usage Profiles" in *Sun Java System Application Server 9.1 Administration Guide*.

If you have two active HADB nodes, you can configure two spare nodes (on separate machines), that can take over in case of failure. This is a cleaner method because backup and restore of HADB may result in stale sessions being restored.

For information on creating a database with spare nodes, see "Creating a Database" on page 67. For information on adding spare nodes to a database, see "Adding Nodes" on page 90. If recovery and self-repair fail, then the spare node takes over automatically.

Using Netbackup

Note – This procedure has not been tested by Sun QA.

Use Veritas Netbackup to save an image of each machine. In the case of BPIP backup the four machines with web servers and Application Servers.

For each restored machine use the same configuration as the original, for example the same host name, IP address, and so on.

For file-based products such as Application Server, backup and restore just the relevant directories. However, for package-based installs such as the web server image, you must backup and restore the entire machine. Packages are installed into the Solaris package database. So, if you only back up the directories and subsequently restore on to a new system, the result will be a "deployed" web server with no knowledge in the package database. This may cause problems with future patching or upgrading.

Do not manually copy and restore the Solaris package database. The other alternative is to backup an image of the machine after the components are installed, for example, web server. Call this the baseline tar file. When you make changes to the web server, back up these directories for example, under `/opt/SUNWwbsvr`. To restore, start with the baseline tar file and then copy over the web server directories that have been modified. Similarly, you can use this procedure for MQ (package-based install for BPIP). If you upgrade or patch the original machine be sure to create a new baseline tar file.

If the machine with the DAS goes down there will be a time when it is unavailable until you restore it.

The DAS is the central repository. When you restore server instances and restart them they will be synchronized with information from the DAS only. Hence, all changes must be performed via `asadmin` or Admin Console.

Daily backup image of HADB may not work, since the image may contain old application session state.

Recreating the Domain Administration Server

If the machine hosting the domain administration server (DAS) fails, you can recreate the DAS if you have previously backed up the DAS. To recreate a working copy of the DAS, you must have:

- One machine (machine1) that contains the original DAS.
- A second machine (machine2) that contains a cluster with server instances running applications and catering to clients. The cluster is configured using the DAS on the first machine.
- A third backup machine (machine3) where the DAS needs to be recreated in case the first machine crashes.

Note – You must maintain a backup of the DAS from the first machine. Use `asadmin backup-domain` to backup the current domain.

▼ To migrate the DAS

The following steps are required to migrate the Domain Administration Server from the first machine (machine1) to the third machine (machine3).

1 Install the application server on the third machine just as it is installed on the first machine.

This is required so that the DAS can be properly restored on the third machine and there are no path conflicts.

a. Install the application server administration package using the command-line (interactive) mode.

To activate the interactive command-line mode, invoke the installation program using the `console` option:

`./`*bundle-filename* **`-console`**

You must have root permission to install using the command-line interface.

b. Deselect the option to install default domain.

Restoration of backed up domains is only supported on two machines with same architecture and **exactly** the same installation paths (use same *as-install* and *domain-root-dir* on both machines).

2 Copy the backup ZIP file from the first machine into the *domain-root-dir* on the third machine.

You can also FTP the file.

3 Restore the ZIP file onto the third machine.

```
asadmin restore-domain --filename domain-root-dir/sjsas_backup_v00001.zip
--clienthostname machine3 domain1
```

Note – By specifying the `--clienthostname` option, you avoid the need to modify the `jmx-connector` element's `client-hostname` property in the `domain.xml` file.

You can backup any domain. However, while recreating the domain, the domain name should be same as the original.

4 Change *domain-root-dir*`/domain1/generated/tmp` directory permissions on the third machine to match the permissions of the same directory on first machine.

The default permissions of this directory are: `drwx------` (or 700).

For example:

```
chmod 700 domain-root-dir/domain1/generated/tmp
```

The example above assumes you are backing up `domain1`. If you are backing up a domain by another name, you should replace `domain1` above with the name of the domain being backed up.

5 In the *domain-root-dir*`/domain1/config/domain.xml` file on the third machine, update the value of the `jms-service` element's `host` attribute.

The original setting of this attribute is as follows:

```
<jms-service... host=machine1.../>
```

Modify the setting of this attribute as follows:

```
<jms-service... host=machine3.../>
```

6 Start the restored domain on machine3:

```
asadmin start-domain --user admin-user --password admin-password domain1
```

The DAS contacts all running node agents and provides the node agents with information for contacting the DAS. The node agents use this information to communicate with the DAS.

7 **For any node agents that are not running when the DAS is restarted, change** `agent.das.host` **property value in** *as-install*`/nodeagents/`*nodeagent*`/agent/config/das.properties` **on machine2.**

This step is not required for node agents that are running when the DAS is restarted.

8 **Restart the node agent on machine2.**

Note – Start the cluster instances using the `asadmin start-instance` command to allow them to synchronize with the restored domain.

◆ ◆ ◆ CHAPTER 2

Installing and Setting Up High Availability Database

Note – The HADB software is supplied with the Application Server standalone distribution of Sun Java System Application Server. For information about available distributions of Sun Java System Application Server, see "Distribution Types and Their Components" in *Sun Java System Application Server 9.1 Installation Guide*. HADB features are available only in the enterprise profile. For information about profiles, see "Usage Profiles" in *Sun Java System Application Server 9.1 Administration Guide*.

This chapter covers the following topics:

Preparing for HADB Setup

This section discusses the following topics:

After performing these tasks, see Chapter 3, "Administering High Availability Database."

For the latest information on HADB, see *Sun Java System Application Server 9.1 Release Notes*.

Prerequisites and Restrictions

Before setting up and configuring HADB, make sure your network and hardware environment meets the requirements described in the *Sun Java System Application Server 9.1 Release Notes*. Additionally, there are restrictions with certain file systems; for example, with Veritas. For more information, see the Release Notes.

HADB uses Intimate Shared Memory (SHM_SHARE_MMU flag) when it creates and attaches to its shared memory segments. The use of this flag essentially locks the shared memory segments into physical memory and prevents them from being paged out. Therefore, HADB's shared memory is locked into physical memory, which can easily impact installations on low-end machines. Ensure you have the recommended amount of memory when co-locating Application Server and HADB.

Configuring Network Redundancy

Configuring a redundant network will enable HADB to remain available, even if there is a single network failure. You can configure a redundant network in two ways:

- On Solaris 9, by setting up network multipathing.
- On all platforms except Windows Server 2003, by configuring a double network.

Setting Up Network Multipathing

Before setting up network multipathing, refer to the Administering Network Multipathing section in *IP Network Multipathing Administration Guide*.

▼ To Configure HADB Host Machines that Already Use IP Multipathing

1 Set network interface failure detection time.

For HADB to properly support multipathing failover, the network interface failure detection time must not exceed one second (1000 milliseconds), as specified by the `FAILURE_DETECTION_TIME` parameter in `/etc/default/mpathd`. Edit the file and change the value of this parameter to 1000 if the original value is higher:

```
FAILURE_DETECTION_TIME=1000
```

To put the change into effect, use this command:

```
pkill -HUP in.mpathd
```

2 Set up IP addresses to use with HADB.

As described in the *IP Network Multipathing Administration Guide*, multipathing involves grouping physical network interfaces into multipath interface groups. Each physical interface in such a group has two IP addresses associated with it:

- a physical interface address used for transmitting data.
- a test address for Solaris internal use only.

Specify only one physical interface address from the multipath group when you use `hadbm create --hosts`.

Example 2–1 Setting up Multipathing

Suppose there are two host machines named host1 and host2. If they each have two physical network interfaces, then set up the two interfaces as a multipath group. Run `ifconfig -a` on each host.

The output on host1 is:

```
bge0: flags=1000843<UP,BROADCAST,RUNNING,MULTICAST,IPv4>
mtu 1500 index 5 inet 129.159.115.10 netmask ffffff00 broadcast 129.159.115.255
groupname mp0

bge0:1: flags=9040843<UP,BROADCAST,RUNNING,MULTICAST,DEPRECATED,IPv4,NOFAILOVER>
mtu 1500 index 5 inet 129.159.115.11 netmask ffffff00 broadcast 129.159.115.255

bge1: flags=1000843<UP,BROADCAST,RUNNING,MULTICAST,IPv4>
mtu 1500 index 6 inet 129.159.115.12 netmask ffffff00 broadcast 129.159.115.255
groupname mp0

bge1:1: flags=9040843<UP,BROADCAST,RUNNING,MULTICAST,DEPRECATED,IPv4,NOFAILOVER>
mtu 1500 index 6 inet 129.159.115.13 netmask ff000000 broadcast 129.159.115.255
```

The output on host2 is:

```
bge0: flags=1000843<UP,BROADCAST,RUNNING,MULTICAST,IPv4>
mtu 1500 index 3 inet 129.159.115.20 netmask ffffff00 broadcast 129.159.115.255
groupname mp0

bge0:1: flags=9040843<UP,BROADCAST,RUNNING,MULTICAST,DEPRECATED,IPv4,NOFAILOVER>
mtu 1500 index 3 inet 129.159.115.21 netmask ff000000 broadcast 129.159.115.255

bge1: flags=1000843<UP,BROADCAST,RUNNING,MULTICAST,IPv4>
mtu 1500 index 4 inet 129.159.115.22 netmask ffffff00 broadcast 129.159.115.255
groupname mp0

bge1:1: flags=9040843<UP,BROADCAST,RUNNING,MULTICAST,DEPRECATED,IPv4,NOFAILOVER>
mtu 1500 index 4 inet 129.159.115.23 netmask ff000000 broadcast 129.159.115.255
```

In this example, the physical network interfaces on both hosts are listed after `bge0` and `bge1`. Those listed after `bge0:1` and `bge1:1` are multipath test interfaces (marked DEPRECATED in the `ifconfig` output), as described in the *IP Network Multipathing Administration Guide*.

To set up HADB in this environment, select one physical interface address from each host. In this example, HADB uses IP address 129.159.115.10 from host1 and 129.159.115.20 from host2. To create a database with one database node per host, use the command `hadbm create --hosts`. For example

```
hadbm create --hosts 129.159.115.10,129.159.115.20
```

To create a database with two database nodes on each host, use the command:

```
hadbm create --hosts 129.159.115.10,129.159.115.20,
129.159.115.10,129.159.115.20
```

In both cases, you must configure the agents on host1 and host2 with separate parameters to specify which interface on the machines the agents should use. So, on host1 use:

```
ma.server.mainternal.interfaces=129.159.115.10
```

And on host2 use:

```
ma.server.mainternal.interfaces=129.159.115.20
```

For information on the `ma.server.mainternal.interfaces` variable, see "Configuration File" on page 60.

Configuring Double Networks

To enable HADB to tolerate single network failures, use IP multipathing if the operating system (for example, Solaris) supports it. Do not configure HADB with double networks on Windows Server 2003—the operating system does not work properly with double networks.

If your operating system is not configured for IP multipathing, and HADB hosts are equipped with two NICs, you can configure HADB to use double networks. For every host, the IP addresses of each of the network interface card (NIC) must be on separate IP subnets.

Within a database, all nodes must be connected to a single network, or all nodes must be connected to two networks.

Note – Routers between the subnets must be configured to forward UDP multicast messages between subnets.

When creating an HADB database, use the –hosts option to specify two IP addresses or host names for each node: one for each NIC IP address. For each node, the first IP address is on net-0 and the second on net-1. The syntax is as follows, with host names for the same node separated by a plus sign (+):

```
--hosts=node0net0name+node0net1name
,node1net0name+node1net1name
,node2net0name+node2net1name
, ...
```

For example, the following argument creates two nodes, each with two network interfaces. The following host option is used to create these nodes:

```
--hosts 10.10.116.61+10.10.124.61,10.10.116.62+10.10.124.62
```

Thus, the network addresses

- For node0 are `10.10.116.61` and `10.10.124.61`
- For node1 are `10.10.116.62` and `10.10.124.62`

Notice that `10.10.116.61` and `10.10.116.62` are on the same subnet, and `10.10.124.61` and `10.10.124.62` are on the same subnet.

In this example, the management agents must use the same subnet. Thus, the configuration variable `ma.server.mainternal.interfaces` must be set to, for example, `10.10.116.0/24`. This setting can be used on both agents in this example.

Configuring Shared Memory and Semaphores

You must configure shared memory and semaphores before installing HADB. The procedure depends on your operating system.

If you run other applications than HADB on the hosts, calculate these applications' use of shared memory and semaphores, and add them to the values required by HADB. The values recommended in this section are sufficient for running up to six HADB nodes on each host. You need only increase the values if you either run more than six HADB nodes, or the hosts are running applications that require additional shared memory and semaphores.

If the number of semaphores is too low, HADB can fail and display this error message: `No space left on device`. This can occur either while starting the database, or during run time.

▼ To configure shared memory and semaphores on Solaris

Since the semaphores are a global operating system resource, the configuration depends on all processes running on the host, and not HADB alone. On Solaris, configure the semaphore settings by editing the `/etc/system` file.

1 Log in as root.

2 Configure shared memory.

- Set `shminfo_shmmax`, which specifies the maximum size of a single shared memory segment on the host. Set this value to the total amount of RAM installed on the HADB host machine, expressed as a hexadecimal value, but no more than 2 GB.

  For example, for 2 GB of RAM, set the value as follows in the `/etc/system` file:

  ```
  set shmsys:shminfo_shmmax=0x80000000
  ```

  Note – To determine a host machine's memory, use this command:

  ```
  prtconf | grep Memory
  ```

- On Solaris 8 or earlier, set `shminfo_shmseg`, the maximum number of shared memory segments to which one process can attach. Set the value to six times the number of nodes per host. For up to six nodes per host, add the following to the `/etc/system` file:

  ```
  set shmsys:shminfo_shmseg=36
  ```

  On Solaris 9 and later, `shmsys:shminfo_shmseg` is obsolete.
- Set `shminfo_shmmni`, the maximum number of shared memory segments in entire system. Since each HADB node allocates six shared memory segments, the value required by HADB must be at least six times the number of nodes per host. On Solaris 9, for up to six nodes per host, there is no need to change the default value.

3 Configure semaphores.

Check the `/etc/system` file for the following semaphore configuration entries, for example:

```
set semsys:seminfo_semmni=10
set semsys:seminfo_semmns=60
set semsys:seminfo_semmnu=30
```

If the entries are present, increment the values as indicated below.

If the `/etc/system` file does not these entries, add them at the end of the file:

- Set `seminfo_semmni`, the maximum number of semaphore identifiers. Each HADB node needs one semaphore identifier. On Solaris 9, for up to six nodes per host, there is no need to change the default value. For example:

  ```
  set semsys:seminfo_semmni=10
  ```
- Set `seminfo_semmns`, the maximum number of semaphores in the entire system. Each HADB node needs eight semaphores. On Solaris 9, or up to six nodes per host, there is no need to change the default value. For example:

  ```
  set semsys:seminfo_semmns=60
  ```

- Set `seminfo_semmnu`, the maximum number of undo structures in the system. One undo structure is needed for each connection (configuration variable `NumberOfSessions`, default value 100). For up to six nodes per host, set it to 600:

  ```
  set semsys:seminfo_semmnu=600
  ```

4 **Reboot the machine.**

▼ To configure shared memory on Linux

On Linux, you must configure shared memory settings. You do not need to adjust the default semaphore settings.

1 **Log in as root.**

2 **Edit the file `/etc/sysctl.conf`.**

With Redhat Linux, you can also modify `sysctl.conf` to set the kernel parameters.

3 **Set the values of `kernel.shmax` and `kernel.shmall`, as follows:**

```
echo MemSize > /proc/sys/shmmax
echo MemSize > /proc/sys/shmall
```

where *MemSize* is the number of bytes.

The `kernel.shmax` parameter defines the maximum size in bytes for a shared memory segment. The `kernel.shmall` parameter sets the total amount of shared memory in pages that can be used at one time on the system. Set the value of both of these parameters to the amount physical memory on the machine. Specify the value as a decimal number of bytes.

For example, to set both values to 2GB, use the following:

```
echo 2147483648 > /proc/sys/kernel/shmmax
echo 2147483648 > /proc/sys/kernel/shmall
```

4 **Reboot the machine using this command:**

```
sync; sync; reboot
```

Procedure for Windows

Windows does not require any special system settings. However, if you want to use an existing J2SE installation, set the `JAVA_HOME` environment variable to the location where the J2SE is installed.

Synchronizing System Clocks

You must synchronize clocks on HADB hosts, because HADB uses time stamps based on the system clock. HADB uses the system clock to manage timeouts and to time stamp events logged to history files. For troubleshooting, you must analyze all the history files together, since HADB is a distributed system. So, it is important that all the hosts' clocks be synchronized

Do not adjust system clocks on a running HADB system. Doing so can cause problems in the operating system or other software components that can in turn cause problems such as hangs or restarts of HADB nodes. Adjusting the clock backward can cause some HADB server processes to hang as the clock is adjusted.

To synchronize clocks:

- On Solaris, use `xntpd` (network time protocol daemon).
- On Linux, use `ntpd`.
- On Windows, use `NTPTime` on Windows

If HADB detects a clock adjustment of more than one second, it logs it to the node history file, for example:

```
NSUP INF 2003-08-26 17:46:47.975 Clock adjusted.
 Leap is +195.075046 seconds.
```

Installation

In general, you can install HADB on the same system as Application Server (co-located topology) or on separate hosts (separate tier topology). For more information on these two options, see Chapter 3, "Selecting a Topology," in *Sun Java System Application Server 9.1 Deployment Planning Guide*.

You must install the HADB management client to be able to set up high availability with the `asadmin configure-ha-cluster` command. When using the Java Enterprise System installer, you must install an entire HADB instance to install the management client, even if the nodes are to be installed on a separate tier.

HADB Installation

On a single or dual CPU system, you can install both HADB and Application Server if the system has at least two Gbytes of memory. If not, install HADB on a separate system or use additional hardware. To use the `asadmin configure-ha-cluster command` , you must install both HADB and Application Server.

Each HADB node requires 512 Mbytes of memory, so a machine needs one Gbyte of memory to run two HADB nodes. If the machine has less memory, set up each node on a different machine. For example, you can install two nodes on:

- Two single-CPU systems, each with 512 Mbytes to one Gbyte of memory
- A single or dual CPU system with one Gbyte to two Gbytes of memory

  You can install HADB with either the Java Enterprise System installer or the Application Server standalone installer. In either installer, choose the option to install HADB (called High Availability Session Store in Java ES) in the Component Selection page. Complete the installation on your hosts. If you are using the Application Server standalone installer, and choose two separate machines to run HADB, you must choose an identical installation directory on both machines.

Default Installation Directories

Throughout this manual, *HADB_install_dir* represents the directory in which HADB is installed. The default installation directory depends on whether you install HADB as part of the Java Enterprise System. For Java Enterprise System, the default installation directory is `/opt/SUNWhadb/4`. For the standalone Application Server installer, it is `/opt/SUNWappserver/hadb/4`.

Node Supervisor Processes Privileges

The node supervisor processes (NSUP) ensure the availability of HADB by exchanging "I'm alive" messages with each other. The NSUP executable files must have root privileges so they can respond as quickly as possible. The `clu_nsup_srv` process does not consume significant CPU resources, has a small footprint, and so running it with real-time priority does not affect performance.

Note – The Java Enterprise System installer automatically sets the NSUP privileges properly, so you do not need to take any further action. However, with the standalone Application Server (non-root) installer, you must set the privileges manually before creating a database.

Symptoms of Insufficient Privileges

If NSUPs do not have the proper privileges, you might notice symptoms of resource starvation such as:

- False network partitioning and node restarts, preceded by a warning "Process blocked for *n* seconds" in HADB history files.
- Aborted transactions and other exceptions.

Restrictions

If NSUP cannot set the real-time priority `errno` is set to EPERM on Solaris and Linux. On Windows it issues the warning "Could not set real-time priority". The error is written to the `ma.log` file, and the process continues without real-time priority.

Setting real-time priorities is not possible when:

- HADB is installed in Solaris 10 non-global zones
- `PRIV_PROC_LOCK_MEMORY` (allow a process to lock pages in physical memory) and/or `PRIV_PROC_PRIOCNTL` privileges are revoked in Solaris 10
- Users turn off setuid permission
- Users install the software as tar files (the non-root installation option for the Application Server)

▼ To Give Node Supervisor Processes Root Privileges

1. **Log in as root.**
2. **Change your working directory to** *HADB_install_dir*`/lib/server`**.**

   The NSUP executable file is `clu_nsup_srv` .
3. **Set the file's** `suid` **bit with this command:**

   ```
   chmod u+s clu_nsup_srv
   ```
4. **Set the file's ownership to root with this command:**

   ```
   chown root clu_nsup_srv
   ```

   This starts the `clu_nsup_srv` process as root, and enables the process to give itself realtime priority.

   To avoid any security impact, the real-time priority is set immediately after the process is started and the process falls back to the effective UID once the priority has been changed. Other HADB processes run with normal priority.

Setting up High Availability

This section provides the steps for creating a highly available cluster, and testing HTTP session persistence.

This section discusses the following topics:

▼ To Prepare the System for High Availability

1 **Install Application Server instances and the Load Balancer Plug-in.**

For more information, see the *Java Enterprise System Installation Guide* (if you are using Java ES) or *Sun Java System Application Server 9.1 Installation Guide* (if you are using the standalone Application Server installer).

2 **Create Application Server domains and clusters.**

For information on how to create a domain , see "Creating a Domain" in *Sun Java System Application Server 9.1 Administration Guide*. For information on how to create a cluster, see "To Create a Cluster" on page 161.

3 **Install and configure your web server software.**

4 **Setup and configure load balancing.**

For more information, see "Setting Up HTTP Load Balancing" on page 128.

Starting the HADB Management Agent

The management agent, `ma`, executes management commands on HADB hosts and ensures availability of the HADB node supervisor processes by restarting them if they fail.

You can start the management agent two ways:

- As a service, for production use. See "Starting the Management Agent as a Service" on page 54. To ensure availability of the management agent, make sure it is restarted automatically when the system reboots. See "Ensuring Automatic Restart of the Management Agent" on page 56.
- As a regular process (in console mode), for evaluation, testing, or development. See "Starting the Management Agent in Console Mode" on page 57.

  In each case, the procedures are different depending on whether you are using Java Enterprise System or the standalone Application Server.

Configuring a Cluster for High Availability

Before starting this section, you must have created one or more Application Server clusters. For information on how to create a cluster, see "To Create a Cluster" on page 161.

From the machine on which the Domain Administration Server is running, configure the cluster to use HADB using this command:

asadmin configure-ha-cluster --user admin --hosts *hadb_hostname1*,*hadb_hostname2* **[,...] --devicesize 256** *clusterName*

Replace *hadb_hostname1*, *hadb_hostname2*, and so forth, with the host name of each machine where HADB is running, and *clusterName* with the name of the cluster. For example:

```
asadmin configure-ha-cluster --user admin --hosts host1,host2,host1,host2
--devicesize 256 cluster1
```

This example creates two nodes on each machine, which are highly available even in case of HADB failover. Note that the order of the host names following the –hosts option is significant, so the previous example would be different than **--hosts host1,host1,host2,host2**.

If you are using just one machine, you must provide the host name twice. In production settings, using more than one machine is recommended.

Configuring an Application for High Availability

In Admin Console, select the application under Applications > Enterprise Applications. Set Availability Enabled and then click Save.

Restarting a Cluster

To restart a cluster in Admin Console, choose Clusters > *cluster-name*. Click Stop Instances. Once the instances have stopped, click "Start Instances."

Alternatively, use these `asadmin` commands:

```
asadmin stop-cluster --user admin cluster-name
asadmin start-cluster --user admin cluster-name
```

For more information on these commands, see `stop-cluster`(1) and `start-cluster`(1).

Restarting the Web Server

To restart the Web Server, type this Web Server command:

```
web_server_root/https-hostname/reconfig
```

Replace *web_server_root* with your Web Server root directory and *hostname* with the name of your host machine.

▼ To Clean Up the Web Server Instance Acting as Load Balancer

1. **Delete the Load Balancer configuration:**

```
asadmin delete-http-lb-ref --user admin --config MyLbConfig FirstCluster

asadmin delete-http-lb-config --user admin MyLbConfig
```

2. **If you created a new Web Server instance you can delete it by:**

   a. **Log on to the Web Server's Administration Console.**

   b. **Stop the instance.**

      Delete the instance.

Upgrading HADB

HADB is designed to provide "always on" service that is uninterrupted by upgrading the software. This section describes how to upgrade to a new version of HADB without taking the database offline or incurring any loss of availability. This is known as an *online upgrade*.

The following sections describe how to upgrade your HADB installation:

▼ To upgrade HADB to a newer version

1. **Install new version of HADB.**

2. **Register the new HADB version, as described in "Registering HADB Packages" on page 48**

   Registering the HADB package in the HADB management domain makes it easy to upgrade or change HADB packages. The management agent keeps track of where the software packages are located, as well as the version information for the hosts in the domain. The default package name is a string starting with V and containing the version number of the `hadbm` program.

3 **Change the package the database uses.**

Enter the following command:

```
hadbm set PackageName=package
```

where *package* is the version number of the new HADB package.

4 **Un-register your existing HADB installation as described in "Un-registering HADB Packages" on page 49**

5 **If necessary, replace the management agent startup script.**

For more information, see "Replacing the Management Agent Startup Script" on page 50

6 **Verify the results, as described in "Verifying HADB Upgrade" on page 50.**

7 **(Optional) Remove the binary files for the old HADB version.**

After verifying that HADB has been upgraded properly, you can delete the old HADB packages.

Registering HADB Packages

Use the `hadbm registerpackage` command to register the HADB packages that are installed on the hosts in the management domain. HADB packages can also be registered when creating a database with `hadbm create`.

Before using the `hadm registerpackage` command, ensure that all management agents are configured and running on all the hosts in the hostlist, the management agent's repository is available for updates, and no software package is already registered with the same package name.

The command syntax is:

```
hadbm registerpackage --packagepath=path [--hosts=hostlist]
[--adminpassword=password | --adminpasswordfile=file] [--agent=maurl]
[[package-name]]
```

The *package-name* operand is the name of the package.

The following table describes the special `hadbm registerpackage` command option. See "Security Options" on page 63 and "General Options" on page 64 for a description of other command options.

TABLE 2–1 `hadbm registerpackage` Options

Option	Description
--hosts=*hostlist* -H	List of hosts, either comma-separated or enclosed in double quotes and space separated.
--packagepath=*path* -L	Path to the HADB software package.

For example, the following command registers software package v4 on hosts host1, host2, and host3:

```
hadbm registerpackage
--packagepath=hadb_install_dir/SUNWHadb/4.4
--hosts=host1,host2,host3 v4
```

The response is:

```
Package successfully registered.
```

If you omit the `--hosts` option, the command registers the package on all enabled hosts in the domain.

Un-registering HADB Packages

Use the `hadbm unregisterpackage` command to remove HADB packages that are registered with the management domain.

Before using the `hadbm unregisterpackage` command, ensure that:

- All management agents are configured and running on all the hosts in the `hostlist`.
- The management agent's repository is available for updates.
- The new HADB package is registered in the management domain
- No existing databases are configured to run on the package about to be unregistered.

The command syntax is:

```
hadbm unregisterpackage
--hosts=hostlist
[--adminpassword=password | --adminpasswordfile= file]
[--agent= maurl]
[package-name ]
```

The *package-name* operand is the name of the package.

See "Registering HADB Packages" on page 48 for a description of the `--hosts` option. If you omit the `--hosts` option, the hostlist defaults to the enabled hosts where the package is registered. See "Security Options" on page 63 and "General Options" on page 64 for a description of other command options.

EXAMPLE 2–2 Example of un-registering HADB

To un-register software package v4 from specific hosts in the domain:

```
hadbm unregisterpackage --hosts=host1,host2,host3 v4
```

The response is:

```
Package successfully unregistered.
```

Replacing the Management Agent Startup Script

When you install a new version of HADB, you may need to replace the management agent startup script in `/etc/init.d/ma-initd`. Check the contents of the file, *HADB_install_dir*`/lib/ma-initd`. If it is different from the old `ma-initd` file, replace the old file with the new file.

▼ Verifying HADB Upgrade

Follow this procedure to verify that HADB has been properly upgraded:

1. **Confirm the version of the running HADB processes.**

   Enter the following commands on all HADB nodes to display the HADB version:

   new-path`/bin/ma -v`

   new-path`/bin/hadbm -v`

   where *new-path* is the path to the new HADB installation.

   The results should show the new HADB version number.

2. **Confirm the database is running.**

   Enter this command:

   new-path`/bin/hadbm status -n`

   If the upgrade is successful, the results will show all the HADB nodes in `running` state.

3. **Ensure that products using HADB have changed their configuration settings to the new HADB path.**

4 **Run any upgrade tests for the products using HADB.**

◆ ◆ ◆ CHAPTER 3

Administering High Availability Database

Note – The HADB software is supplied with the Application Server standalone distribution of Sun Java System Application Server. For information about available distributions of Sun Java System Application Server, see "Distribution Types and Their Components" in *Sun Java System Application Server 9.1 Installation Guide*. HADB features are available only in the enterprise profile. For information about profiles, see "Usage Profiles" in *Sun Java System Application Server 9.1 Administration Guide*.

This chapter describes the high availability database (HADB) in the Sun Java System Application Server environment. It explains how to configure and administer the HADB. Before you can create and administer the HADB, you must first determine the topology of your systems and install the HADB software on the various machines.

This chapter discusses the following topics:

Using the HADB Management Agent

The management agent, `ma`, executes management commands on HADB hosts. The management agent also ensures availability of the HADB node supervisor processes by restarting them if they fail.

Starting the Management Agent

You can start the management agent:

- As a service, for production use. See "Starting the Management Agent as a Service" on page 54 To ensure availability of the management agent, make sure it is restarted automatically when the system reboots. See "Ensuring Automatic Restart of the Management Agent" on page 56.
- As a regular process (in console mode), for evaluation, testing, or development. See "Starting the Management Agent in Console Mode" on page 57.
- With the service management facility (SMF) on Solaris 10. See "Running the Management Agent with the Solaris 10 Service Management Facility" on page 59.

In each case, the procedures are different depending on whether you are using Java Enterprise System or the standalone Application Server.

Starting the Management Agent as a Service

Starting the management agent as a service ensures that it will continue to run until the system shuts down or you explicitly stop it. The command depends on your installation and platform:

Java Enterprise System on Solaris or Linux

To start the management agent as a service, use this command:

```
/etc/init.d/ma-initd start
```

To stop the service, use this command:

```
/etc/init.d/ma-initd stop
```

Java Enterprise System on Windows

To start the management agent as a Windows service, use this command:
HADB_install_dir`\bin\ma -i [`*config-file* `]`

The optional argument *config-file* specifies the management agent configuration file. Use a configuration file only if you want to change the default management agent configuration. For more information, see "Customizing Management Agent Configuration" on page 60

To stop the management agent and remove (deregister) it as a service, use the command:
HADB_install_dir`\bin\ma -r [`*config-file* `]`

To perform administration, choose Administrative Tools | Services, which enables you to start and stop the service, disable automatic startup, and so on.

Standalone Application Server on Solaris or Linux

To start the management agent as a service, use this command:

HADB_install_dir`/bin/ma-initd start`

To stop the service, use this command:

HADB_install_dir`/bin/ma-initd stop`

To change the default values, edit the shell script *HADB_install_dir*`/bin/ma-initd`. Copy `ma-initd` to the directory `/etc/init.d`. Replace the default values of HADB_ROOT and HADB_MA_CFG in the script to reflect your installation:

- HADB_ROOT is the HADB installation directory, *HADB_install_dir*.
- HADB_MA_CFG is the location of the management agent configuration file. For more information, see "Customizing Management Agent Configuration" on page 60

Standalone Application Server on Windows

To start the management agent as a Windows service, use this command:
HADB_install_dir`\bin\ma -i [`*config-file* `]`

The optional argument *config-file* specifies the management agent configuration file. Use a configuration file only if you want to change the default management agent configuration.

To stop the management agent and remove (deregister) it as a service, use the command:
HADB_install_dir`\bin\ma -r [`*config-file* `]`

To perform administration, choose Administrative Tools | Services, which enables you to start and stop the service, disable automatic startup, and so on.

Ensuring Automatic Restart of the Management Agent

In a production deployment, configure the management agent to restart automatically. Doing so ensures the availability of the management agent in case the `ma` process fails or the operating system reboots.

On Windows platforms, once you have started the management agent as a service, use the Windows administrative tools to set the service Startup type to "Automatic," and then set desired Recovery options.

On Solaris and Linux platforms, use the procedures in this section, to configure automatic restart of the management agent. These procedures ensure the management agent starts only when the system enters:

- Runlevel 3 on Solaris (the default).
- Runlevel 5 on RedHat Linux (the default in graphical mode).

Entering other runlevels stops the management agent.

▼ To Configure Automatic Restart with Java Enterprise System on Solaris or Linux

Before You Begin This section assumes you have a basic understanding of operating system initialization and runlevels. For information on these topics, see your operating system documentation.

1. **Ensure that your system has a default runlevel of 3 or 5.**

   To check the default runlevel of your system, inspect the file `/etc/inittab` , and look for a line near the top similar to this:

   ```
   id:5:initdefault:
   ```

   This example shows a default runlevel of 5.

2. **Create soft links to the file `/etc/init.d/ma-initd`, as described in "Creating soft links" on page 57.**

3. **Reboot the machine.**

Next Steps To deactivate automatic start and stop of the agent, remove the links or change the letters K and S in the link names to lowercase.

▼ To Configure Automatic Restart with Standalone Application Server on Solaris or Linux

1. **In a shell, change your current directory to** *HADB_install_dir* `/bin`**.**
2. **Edit the shell script** `ma-initd`**.**

   Make sure the default values of HADB_ROOT and HADB_MA_CFG in the script to reflect your installation:

   - HADB_ROOT is the HADB installation directory, *HADB_install_dir*.
   - HADB_MA_CFG is the location of the management agent configuration file. For more information, see "Customizing Management Agent Configuration" on page 60
3. **Copy** `ma-initd` **to the directory** `/etc/init.d`
4. **Create soft links to the file** `/etc/init.d/ma-initd`**, as described in** **"Creating soft links" on page 57****.**

Next Steps To deactivate automatic start and stop of the agent, remove the links or change the letters K and S in the link names to lowercase.

Creating soft links

On Solaris, create the following softlinks:

```
/etc/rc0.d/K20ma-initd
/etc/rc1.d/K20ma-initd
/etc/rc2.d/K20ma-initd
/etc/rc3.d/S99ma-initd
/etc/rc5.d/K20ma-initd (only for Sun 4m and 4u architecture)
/etc/rc6.d/K20ma-initd
/etc/rcS.d/K20ma-initd
```

On Linux, create the following softlinks:

```
/etc/rc0.d/K20ma-initd
/etc/rc1.d/K20ma-initd
/etc/rc3.d/S99ma-initd
/etc/rc5.d/S99ma-initd
/etc/rc6.d/K20ma-initd
```

Starting the Management Agent in Console Mode

You may wish to start the management agent in console mode for evaluation or testing. Do not start the management agent this way in a production environment, because the `ma` process will

not restart after a system or process failure and will terminate when the command window is closed. The command depends on your platform and installation:

- "Java Enterprise System on Solaris or Linux" on page 58
- "Java Enterprise System on Windows" on page 58
- "Standalone Application Server on Windows" on page 58
- "Standalone Application Server on Solaris or Linux" on page 58

Java Enterprise System on Solaris or Linux

To start the HADB management agent in console mode, use the command:

```
opt/SUNWhadb/bin/ma [config-file]
```

The default management agent configuration file is `/etc/opt/SUNWhadb/mgt.cfg`

To stop the management agent, kill the process or close the shell window.

Java Enterprise System on Windows

To start the management agent in console mode, use the command:

```
HADB_install_dir\bin\ma [config-file]
```

The optional argument *config-file* is the name of the management agent configuration file. For more information on the configuration file, see "Customizing Management Agent Configuration" on page 60.

To stop the agent, kill the process.

Standalone Application Server on Windows

To start the management agent in console mode, use the command:

```
HADB_install_dir\bin\ma [config-file]
```

The optional argument *config-file* is the name of the management agent configuration file; for more information, see "Customizing Management Agent Configuration" on page 60

To stop the management agent, kill the process.

Standalone Application Server on Solaris or Linux

To start the HADB management agent in console mode, use the command:

```
HADB_install_dir/bin/ma [config-file]
```

The default management agent configuration file is *HADB_install_dir* `/bin/ma.cfg`

To stop the management agent, kill the process or close the shell window.

Running the Management Agent with the Solaris 10 Service Management Facility

Service Management Facility (SMF) provides mechanisms to restart, view, and manage services on Solaris 10. You can use SMF to start, restart, and manage the HADB management agent.

The fault management resource identifier (FMRI) for the management agent is `svc:/application/hadb-ma`.

Management Agent Command Syntax

The syntax of the management agent `ma` command is:

```
ma [common-options]
[ service-options]
config-file
```

Where:

- *common-options* is one or more of the common options described in "Management Agent Command Syntax" on page 59.
- *service-options* is one of the Windows service options described in "Management Agent Command Syntax" on page 59.
- *config-file* is the full path to the management agent configuration file. For more information, see "Customizing Management Agent Configuration" on page 60.

TABLE 3–1 Management Agent Common Options

Option	Description	Default
--define *name*=*value*-D	Assign *value* to property *name*, where property is one of the properties defined in "Configuration File" on page 60. This option can be repeated multiple times.	None
--help-?	Display help information.	False
--javahome *path*-j	Use Java Runtime Environment (1.4 or later) located at *path*.	None
--systemroot *path*-y	Path to the operating system root as normally set in %SystemRoot%.	None
--version-V	Display version information.	False

Table 3–2 describes options for starting the management agent as a Windows service. The -i, -r, and -s options are mutually exclusive; that is, use only one of them at a time.

On Windows, when specifying paths for property values in the configuration file or on the command line, escape file paths containing spaces with double quotes ("). Escape drive and directory separators, : and \, with double quotes and a backslash: "\: and \".

TABLE 3–2 Management Agent Service Options (Windows Only)

Option	Description	Default
--install-i	Install the agent as a Windows service and start the service. Use only one of -i, -r, and -s options.	False
--name *servicename*-n	Use specified name for the service when running multiple agents on a host.	HADBMgmtAgent
--remove-r	Stop the service and delete the agent from the Windows service manger. Use only one of -i, -r, and -s options.	False
--service-s	Run the agent as a Windows service. Use only one of -i, -r, and -s options.	False

Customizing Management Agent Configuration

HADB includes a configuration file that you can use to customize the management agent settings. When you start the management agent without specifying a configuration file, it uses default values. If you specify a configuration file, the management agent will use the settings in that file. You can re-use the configuration file on all hosts in a domain.

▼ To Customize Management Agent configuration on HADB Hosts

1. **Edit the management agent configuration file and set the values as desired.**
2. **Start the management agent, specifying the customized configuration file as the argument.**

Configuration File

With Java Enterprise System, all the entries in the configuration file are commented out. No changes are required to use the default configuration. To customize the management agent configuration, remove the comments from the file, change the values as desired, then start the management agent specifying the configuration file as an argument.

The management agent configuration file is installed to:

- Solaris and Linux: `/etc/opt/SUNWhadb/mgt.cfg`.
- Windows: *install_dir* `\lib\mgt.cfg`.

With the standalone installer, the management agent configuration file is installed to:

- Solaris and Linux: *HADB_install_dir* `/bin/ma.cfg` .
- Windows: *HADB_install_dir* `\bin\ma.cfg`.

The following table describes the settings in the configuration file.

TABLE 3–3 Configuration File Settings

Setting Name	Description	Default
console.loglevel	Console log level. Valid values are SEVERE, ERROR, WARNING, INFO, FINE, FINER, FINEST	WARNING
logfile.loglevel	Log file log level. Valid values are SEVERE, ERROR, WARNING, INFO, FINE, FINER, FINEST	INFO
logfile.name	Name and location of log file. Must be a valid path with read/write access.	Solaris and Linux:`/var/opt/SUNWhadb/ma/ma.log` Windows: *HADB_install_dir*`\ma.log`
ma.server.type	Client protocol. Only JMXMP is supported.	jmxp
ma.server. jmxmp.port	Port number for internal (UDP) and external (TCP) communication. Must be a positive integer. Recommended range is 1024-49151.	1862
ma.server. mainternal.interfaces	Interfaces for internal communication for machines with multiple interfaces. Must be a valid IPv4 address mask. All management agents in a domain must use the same subnet For example, if a host has two interfaces, 10.10.116.61 and 10.10.124.61, use 10.10.116.0/24 to use the first interface. The number after the slash indicates the number of bits in the subnet mask.	None
ma.server. dbdevicepath	Path to store HADB device information.	Solaris and Linux: `/var/opt/SUNWhadb/4` Windows: *HADB_install_dir* `\device`
ma.server. dbhistorypath	Path to store HADB history files.	Solaris and Linux: `/var/opt/SUNWhadb` Windows: REPLACEDIR (replaced by the actual URL at runtime.)
ma.server. dbconfigpath	Path to store node configuration data.	Solaris and Linux: `/var/opt/SUNWhadb/dbdef` Windows: `C:\Sun\SUNWhadb\dbdef`
repository.dr.path	Path to domain repository files.	Solaris and Linux: `/var/opt/SUNWhadb/repository` Windows: `C:\Sun\SUNWhadb\repository`

Using the hadbm Management Command

Use the `hadbm` command-line utility to manage an HADB domain, its database instances, and nodes. The `hadbm` utility (also called the management client) sends management requests to the specified management agent, acting as a management server, which has access to the database configuration from the repository.

This section describes the hadbm command-line utility, with the following topics:

Command Syntax

The `hadbm` utility is located in the *HADB_install_dir* `/bin` directory. The general syntax of the `hadbm` command is:

`hadbm` *subcommand*
[*-short-option* [*option-value*]]
[*--long-option* [*option-value*]]
[*operands*]

The subcommand identifies the operation or task to perform. Subcommands are case-sensitive. Most subcommands have one operand (usually `dbname`).

Options modify how `hadbm` performs a subcommand. Options are case-sensitive. Each option has a long form and a short form. Precede the short form with a single dash (`-`); precede the long forms with two dashes (`--`). Most options require argument values, except for boolean options, which must be present to switch a feature on. Options are not required for successful execution of the command.

If a subcommand requires a database name, and you do not specify one, `hadbm` will use the default database, `hadb`.

EXAMPLE 3–1 Example of hadbm command

The following illustrates the `status` subcommand:

```
hadbm status --nodes
```

Security Options

For security reasons, all `hadbm` commands require an administrator password. Use the `--adminpassword` option to set the password when you create a database or domain. From then on, you must specify that password when you perform operations on the database or domain.

For enhanced security, use the `--adminpasswordfile` option to specify a file containing the password, instead of entering it on the command line. Define the password in the password file with the following line:

`HADBM_ADMINPASSWORD=`*password*

Replace *password* with the password. Any other content in the file is ignored.

If you specify both the `--adminpassword` and `--adminpasswordfile` options, the `--adminpassword` takes precedence. If a password is required, but is not specified in the command, `hadbm` prompts you for a password.

Note – You can set the administrator password only when you create a database or domain, and you cannot later change it.

In addition to the administrator password, HADB also requires a database password to perform operations that modify the database schema. You must use both passwords when using the following commands: `hadbm create`, `hadbm addnodes`, and `hadbm refragment`.

Specify the database password on the command line with the `--dbpassword` option. Similar to the administrator password, you can also put the password in a file and use the `--dbpasswordfile` option, specifying the file location. Set the password in the password file with the following line:

`HADBM_DBPASSWORD=`*password*

For testing or evaluation, you can turn off password authentication with the `--no-adminauthentication` option when you create a database or domain. For more information, see "Creating a Database" on page 67 and "Creating a Management Domain" on page 67

The following table summarizes the `hadbm` security command line options.

TABLE 3–4 `hadbm` Security Options

Option (Short Form)	Description
--adminpassword=*password* -w	Specifies administrator password for the database or domain. If you use this option when you create a database or domain, then you must provide the password each time you use hadbm to operate on the database or domain. Use either this option or --adminpasswordfile, but not both.
--adminpasswordfile=*filepath* -W	Specifies file that contains the administrator password for the database or domain. If you use this option when you create a database or domain, then you must provide the password each time you use hadbm to operate on the database or domain. Use either this option or --adminpassword, but not both.
--no-adminauthentication -U	Use this option when you create a database or domain to specify that no administrator password is required. For security reasons, do not use this option in a production deployment.
--dbpassword= *password* -p	Specifies the database password. If you use this option when you create the database, then you must provide the password each time you use an `hadbm` command to operate on the database. Creates a password for the HADB system user. Must be at least 8 characters. Use either this option or --dbpasswordfile, but not both.
--dbpasswordfile= *filepath* -P	Specifies a file that contains the password for the HADB system user. Use either this option or --dbpassword, but not both.

General Options

General command options can be used with any `hadbm` subcommand. All are boolean options that are false by default. The following table describes the `hadbm` general command options.

TABLE 3–5 `hadbm` General Options

Option(Short Form)	Description
--quiet -q	Execute the subcommand silently without any descriptive messages.
--help -?	Display a brief description of this command and all the supported subcommands. No subcommand is required.
--version -V	Display the version details of the `hadbm` command. No subcommand is required.
--yes -y	Execute the subcommand in non-interactive mode.

TABLE 3–5 `hadbm` General Options *(Continued)*

Option(Short Form)	Description
--force -f	Execute the command non-interactively and does not throw an error if the command's post condition is already achieved.
--echo -e	Display the subcommand with all the options and their user-defined values or the default values, then executes the subcommand.
--agent=*URL* -m	URL to the management agents. *URL* is: *hostlist*:*port*, where *hostlist* is a comma separated list of hostnames or IP-addresses, and port is the port number on which the management agent is operating. Default is localhost:1862. NOTE: This option is not valid with `hadbm addnodes`.

Environment Variables

For convenience, you can set an environment variable instead of specifying a command option. The following table describes environment variables that correspond to `hadbm` command options.

TABLE 3–6 HADB Options and Environment Variables

Long Form	Short Form	Default	Environment Variable
--adminpassword	-w	none	$HADBM_ADMINPASSWORD
--agent	--m	localhost:1862	$HADBM_AGENT
--datadevices	-a	1	$HADBM_DATADEVICES
dbname	none	`hadb`	$HADBM_DB
--dbpassword	-p	none	$HADBM_DBPASSWORD
--dbpasswordfile	-P	none	$HADBM_DBPASSWORDFILE
--devicepath	-d	Solaris and Linux: `/var/opt/SUNWhadb` Windows: `C:\Sun\AppServer\SUNWhadb\`*vers*, where *vers* is the HADB version number.	$HADBM_DEVICEPATH
--devicesize	-z	none	$HADBM_DEVICESIZE
--echo	-e	False	$HADBM_ECHO

TABLE 3–6 HADB Options and Environment Variables *(Continued)*

Long Form	Short Form	Default	Environment Variable
--fast	-F	False	$HADBM_FAST
--force	-f	False	$HADBM_FORCE
--help	-?	False	$HADBM_HELP
--historypath	-t	Solaris and Linux: `/var/opt/SUNWhadb` Windows: REPLACEDIR, replaced by the actual URL at runtime.	$HADBM_HISTORYPATH
--hosts	-H	none	$HADBM_HOSTS
--interactive	-i	True	$HADBM_INTERACTIVE
--no-refragment	-r	False	$HADBM_NOREFRAGMENT
--portbase	-b	15200	$HADBM_PORTBASE
--quiet	-q	False	$HADBM_QUIET
--repair	-R	True	$HADBM_REPAIR
--rolling	-g	True	$HADBM_ROLLING
--saveto	-o	none	$HADBM_SAVETO
--set	-S	none	$HADBM_SET
--spares	-s	0	$HADBM_SPARES
--startlevel	-l	normal	$HADBM_STARTLEVEL
--version	-V	False	$HADBM_VERSION
--yes	-y	False	$HADBM_YES

Configuring HADB

This section describes the following basic HADB configuration tasks:

- "Creating a Management Domain" on page 67
- "Creating a Database" on page 67
- "Viewing and Modifying Configuration Attributes" on page 72
- "Configuring the JDBC Connection Pool" on page 77

Creating a Management Domain

The command `hadbm createdomain` creates a management domain containing the specified HADB hosts. The command initializes internal communication channels between hosts and the persistence configuration store.

The syntax of the command is:

```
hadbm createdomain
 [--adminpassword=password |--adminpasswordfile=
file | --no-adminauthentication] [--agent=maurl]
 hostlist
```

The *hostlist* operand is a comma-separated list of HADB hosts, each of which is a valid IPv4 network address. Include all the hosts that you want to be in the new domain in the *hostlist*.

See "General Options" on page 64 for a description of the command options.

Before using this command, be sure an HADB management agent is running on every host in the *hostlist*. Additionally, the management agents must:

- Not be members of an existing domain.
- Be configured to use the same port.
- Be able to reach each other over UDP, TCP, and with IP multicast.

After `hadbm` creates the management domain, it enables all the hosts in the domain. Then the management agents are ready to manage databases. After creating HADB domains, the next step is to create the HADB database. For more information on creating HADB databases, see "Creating a Database" on page 67 .

EXAMPLE 3–2 Creating an HADB Management Domain

The following example creates a management domain on the four specified hosts:

`hadbm createdomain --adminpassword=` *password* `host1,host2,host3,host4`

After `hadbm` successfully executes the command, you will see the message:

```
Domain host1,host2,host3, host4 created.
```

After creating HADB domains, register the path and version of the HADB packages with the management agents.

Creating a Database

Use the `hadbm create` command to create a database manually.

Before you use this command to create a database, create the management domain and register the HADB package. If you have not performed these two steps when you run `hadbm create` , it implicitly performs them. Although this might seem like less work, failures in any of the commands can make debugging difficult. Besides, `hadbm create` is not atomic, that is, if one of the implicit commands fails, the commands that executed successfully will not be rolled back. Therefore, it is best to create the database only after creating the domain and registering the HADB package.

For example, if `hadbm createdomain` and `hadbm registerpackage` execute successfully but `hadbm create database` fails, the changes made by `hadbm createdomain` and `hadbm registerpackage` will persist.

▼ To create a database

1. **Create the management domain.**

   For more information, see "Creating a Management Domain" on page 67

2. **Register the HADB package.**

   For more information, see "Registering HADB Packages" on page 48 for more information.

3. **Use the hadbm create command to create the database.**

   For information on command syntax, see the following section.

`hadbm create` Command Syntax

`hadbm create` **[**`--package=`*name*`]` **[**`--packagepath=`*path*`]` **[**`--historypath=`*path*`]** **[**`--devicepath=`*path*`]` **[**`--datadevices=`*number* `]` **[**`--portbase=`*number*`]** **[**`--spares=`*number*`]` **[**`--set=`*attr-val-list*`]` **[**`--agent=`*maurl*`]` **[**`--no-cleanup`**]** **[** `--no-clear` **]** **[** `--devicesize =`*size*`]` **[**`--dbpassword=`*password* **|** `--dbpasswordfile=`*file* **]** `--hosts=`*host list* **[**`--adminpassword=`*password* **|** `--adminpasswordfile=`*file* **|** `--no-adminauthentication` **]** [*dbname*]

The *dbname* operand specifies the database name, which must be unique. To make sure the database name is unique, use the `hadbm list` command to list existing database names. Use the default database name unless you need to create multiple databases. For example, to create multiple clusters with independent databases on the same set of HADB machines, use a separate database name for each cluster.

The `hadbm create` command writes error messages to the console, not log files.

Table 3–7 describes the special `hadbm create` command options. See "General Options" on page 64 for a description of additional command options.

TABLE 3–7 hadbm create Options

Option(Short Form)	Description	Default
--datadevices= *number* -a	Number of data devices on each node, between one and eight inclusive. Data devices are numbered starting at 0.	1
--devicepath= *path* -d	Path to the devices. There are four devices: ■ `DataDevice` ■ `NiLogDevice` (node internal log device) ■ `RelalgDevice` (relational algebra query device) ■ `NoManDevice` (node manager device). This path must exist and be writable. To set this path differently for each node or each device, see "Setting Heterogeneous Device Paths" on page 71	Solaris and Linux: `/var/opt/SUNWhadb` Windows: `C:\Sun\AppServer\SUNWhadb\`*vers*, where *vers* is the HADB version number. Default is specified by `ma.server.dbdevicepath` in management agent configuration file. For more details, see "Configuration File" on page 60
--devicesize= *size* -z	Device size for each node. For more information, see "Specifying Device Size" on page 71. Increase the device size as described in "Adding Storage Space to Existing Nodes" on page 89	1024MB Maximum size is lesser of maximum operating system file size or 256 GB. Minimum size is: (4 x `LogbufferSize` + 16MB) / *n* Where *n* is the number of data devices given by the option `--datadevices`.
--historypath= *path* -t	Path to the history files. This path must already exist and be writable. For more information on history files, see "Clearing and Archiving History Files" on page 103	Default is specified by `ma.server.dbhistorypath` in management agent configuration file. For details, see "Configuration File" on page 60 Solaris and Linux:`/var/opt/SUNWhadb` On Windows: REPLACEDIR (replaced by the actual URL at runtime.)
--hosts= *hostlist* -H	Comma-separated list of host names or IP addresses (IPv4 only) for the nodes in the database. Use IP addresses to avoid dependence on DNS lookups. Host names must be absolute. You cannot use `localhost` or `127.0.0.1` as a host name. Host names See "Specifying Hosts" on page 70 for more information.	None

TABLE 3–7 hadbm create Options *(Continued)*

Option(Short Form)	Description	Default
--package=*name* -k	Name of the HADB package (version). If the package is not found, a default package is registered. This option is deprecated. Use the hadbm registerpackage command to register a package in the domain.	None
--packagepath=*path*-L	Path to the HADB software package. Use only if the package is not registered in the domain. This option is deprecated. Use the hadbm registerpackage command to register a package in the domain.	None
--portbase= *number* -b	Port base number used for node 0. Successive nodes are automatically assigned port base numbers in steps of 20 from this number. Each node uses its port base number and the next five consecutively numbered ports. To run several databases on the same machine, have a plan for allocating port numbers explicitly.	15200
--spares= *number* -s	Number of spare nodes. This number must be even and must be less than the number of nodes specified in the `--hosts` option.	0
--set=*attr-val-list* -S	Comma-separated list of database configuration attributes in *name =value* format. For explanations of database configuration attributes, see "Clearing and Archiving History Files" on page 103	None

EXAMPLE 3–3 Example of creating a database

The following command is an example of creating a database:

```
hadbm create --spares 2 --devicesize 1024  --hosts n0,n1,n2,n3,n4,n5
```

Specifying Hosts

Use the `--hosts` option to specify a comma-separated list of host names or IP addresses for the nodes in the database. The `hadbm create` command creates one node for each host name (or IP address) in the list. The number of nodes must be even. Use duplicate host names to create multiple nodes on the same machine with different port numbers. Make sure that nodes on the same machine are not mirror nodes, and not from different DRUs..

Nodes are numbered starting at zero in the order listed in this option. The first mirrored pair are nodes zero (0) and one (1), the second two (2) and three (3), and so on. Odd numbered nodes are in one DRU, even numbered nodes in the other. With `--spares` option, spare nodes are those with the highest numbers.

For information about configuring double network interfaces, see "Configuring Network Redundancy" on page 36

Specifying Device Size

Specify the device size using the `--devicesize` option. The recommended device size is:

$(4x / nd + 4l/d) / 0.99$

Where

- x is the total size of user data
- n is the number of nodes (given by the `--hosts` option)
- d is the number of devices per node (given by the `--datadevices` option)
- l is the log buffer size (given by the attribute `LogBufferSize`)

  If re-fragmentation might occur (for example, using `hadbm addnodes`), then the recommended device size is:

  (8x / nd + 4l/d) / 0.99

Setting Heterogeneous Device Paths

To set a different device path for each node or service, use the `-- set` option of `hadbm create`. There are four types of devices: the `DataDevice`, the `NiLogDevice` (node internal log device), the `RelalgDevice` (relational algebra query device), and the `NoManDevice` (node manager device). The syntax for each *name* =*value* pair is as follows, where -*devno* is required only if the *device* is `DataDevice`:

```
node-nodeno.device-devno.Devicepath
```

For example:

```
--set Node-0.DataDevice-0.DevicePath=/disk0,
Node-1.DataDevice-0.DevicePath=/disk 1
```

You can also set a heterogeneous path to history files, as follows:

`node-`*nodeno*`.historypath=`*path*

For information on history files, see "Clearing and Archiving History Files" on page 103

Any device path that is not set for a particular node or device defaults to the `--devicepath` value.

Note – Change device paths and location of history files using `hadbm set` and `hadbm addnodes` commands.

Troubleshooting

If you have difficulty creating a database, check the following:

- Ensure you have started the management agents on all the hosts and defined an HADB domain. For details, see "Starting the Management Agent" on page 54
- File and directory permissions must be set to allow read, write, and execute access to the install, history, device, and config paths for the following users:
  - Sun Java System Application Server administrative user (set during installation)
  - HADB system user

    For details about setting user permissions, see "Preparing for HADB Setup" on page 35

  Application Server and HADB port assignments must not conflict with other port assignments on the same machine. Default recommended port assignments are:

  - Sun Java SystemMessage Queue: 7676
  - IIOP: 3700
  - HTTP server: 80
  - Administration server: 4848
  - HADB nodes: Each node uses six consecutive ports. For example, for default port 15200, node 0 uses 15200 through 15205 , node 1 uses 15220 through 15225, and so on.

  Disk space must be adequate; see *Sun Java System Application Server 9.1 Release Notes*.

Viewing and Modifying Configuration Attributes

You can view and modify database configuration attributes with the `hadbm get` and `hadbm set` commands, respectively.

Getting the Values of Configuration Attributes

To get the values of configuration attributes, use the `hadbm get` command. For a list of valid attributes, see "Configuration Attributes" on page 74. The command syntax is:

```
hadbm get attribute-list | --all
[dbname]
[--adminpassword=password | --adminpasswordfile=file]
[--agent=maurl]
```

The *dbname* operand specifies the database name. The default is `hadb`.

The *attribute-list* operand is a comma-separated or quote-enclosed space-separated list of attributes. The `--all` option displays values for all attributes. For a list of all attributes for `hadbm get`, see "Configuration Attributes" on page 74.

See "General Options" on page 64 for a description of command options.

EXAMPLE 3–4 Example of using hadbm get

```
hadbm get JdbcUrl,NumberOfSessions
```

Setting the Values of Configuration Attributes

To set the values of configuration attributes, use the `hadbm get` command. For a list of valid attributes, see "Configuration Attributes" on page 74

```
hadbm set [dbname] attribute
=value[,attribute=
value...]
 [--adminpassword=password | --adminpasswordfile=file]
 [--agent=maurl]
```

The *dbname* operand specifies the database name. The default is `hadb`.

The *attribute=value* list is a comma-separated or quote-enclosed space-separated list of attributes.

See "General Options" on page 64 for a description of command options.

If this command executes successfully, it restarts the database in the state it was in previously, or in a better state. For information about database states, see "Getting the Status of HADB" on page 95. Restart HADB as described in "Restarting a Database" on page 86.

You cannot set the following attributes with `hadbm set`. Instead, set them when you create a database (see "Creating a Database" on page 67).

- DatabaseName
- DevicePath
- HistoryPath
- NumberOfDatadevices
- Portbase
- JdbcUrl (its value is set during database creation based on the `--hosts` and `--portbase` options).

Note – Using `hadbm set` to set any configuration attribute, except `ConnectionTrace` or `SQLTraceMode`, causes a rolling restart of HADB. In a rolling restart, each node is stopped, and started with the new configuration, one at a time; HADB services are not interrupted.

If you set `ConnectionTrace` or `SQLTraceMode`, no rolling restart occurs, but the change only takes effect for new HADB connections made from an Application Server instance.

Configuration Attributes

The following table lists the configuration attributes that you can modify with `hadbm set` and retrieve with `hadbm get`.

TABLE 3–8 Configuration Attributes

Attribute	Description	Default	Range
ConnectionTrace	If true, records a message in the HADB history files when a client connection (JDBC, ODBC) is initiated or terminated.	False	True or False
CoreFile	Do not change the default value.	False	True or False
DatabaseName	Name of the database.	hadb	
DataBufferPoolSize	Size of the data buffer pool allocated in shared memory.	200MB	16 - 2047 MB
DataDeviceSize	Specifies the device size for the node. For information on the recommended `DataDeviceSize`, see "Specifying Device Size" on page 71 The maximum value is the smaller of 256GB or the maximum operating system file size. The minimum value is: (4 x LogbufferSize + 16MB) / *n* where *n* is number of data devices.	1024MB	32 - 262144 MB
PackageName	Name of HADB software package used by the database.	V4.x.x.x	None

TABLE 3–8 Configuration Attributes *(Continued)*

Attribute	Description	Default	Range
DevicePath	Location of the devices. Devices are: ■ Data device (`DataDevice`) ■ Node internal log device (`NiLogDevice`) ■ Relational algebra query device (`RelalgDevice`)	Solaris and Linux: `/var/opt/SUNWhadb` Windows: `C:\Sun\AppServer\SUNWhadb\`*vers*, where *vers* is the HADB version number.	
EagerSessionThreshold	Determines whether normal or eager idle session expiration is used. In normal idle session expiration, sessions that are idle for more than `SessionTimeout` seconds are expired. When the number of concurrent sessions exceeds the `EagerSessionThreshold` percentage of the maximum number of sessions, sessions that are idle for more than `EagerSessionTimeout` seconds are expired.	Half of NumberOfSessions attribute	0 - 100
EagerSessionTimeout	The time in seconds a database connection can be idle before it expires when eager session expiration is used.	120 seconds	0-2147483647 seconds
EventBufferSize	Size of the event buffer, where database events are logged. If set to `0`, no event buffer logging is performed. During failures, the event buffer is dumped. This gives valuable information on the cause of the failures and is useful during trial deployment. Writing events to memory has a performance penalty.	`0 MB`	0-2097152 MB
HistoryPath	Location of the HADB history files, which contain information, warnings, and error messages. This is a read-only attribute.	Solaris and Linux: `/var/opt/SUNWhadb` Windows: REPLACEDIR (replaced by the actual URL at runtime.)	
InternalLogbufferSize	Size of the node internal log device, which keeps track of operations related to storing data.	12MB	4 - 128 MB

TABLE 3–8 Configuration Attributes *(Continued)*

Attribute	Description	Default	Range
JdbcUrl	The JDBC connection URL for the database. This is a read-only attribute.	none	
LogbufferSize	Size of the log buffer, which keeps track of operations related to data.	48MB	4 - 2048 MB
MaxTables	Maximum number of tables allowed in an HADB database.	1100	100 - 1100
NumberOfDatadevices	Number of data devices used by an HADB node. This is a read-only attribute.	1	1 - 8
NumberOfLocks	Number of locks allocated by an HADB node.	50000	20000-1073741824
NumberOfSessions	Maximum number of sessions (database connections) that can be opened for an HADB node.	100	1 - 10000
PortBase	Base port number used to create different port numbers for different HADB processes. This is a read-only attribute.	15200	10000 - 63000
RelalgDeviceSize	Size of the device used in relational algebra queries.	128 MB	32 - 262144 MB
SessionTimeout	Amount of time a database connection can be idle before it expires when normal session expiration is used.	1800 seconds	0-2147483647 seconds
SQLTraceMode	Amount of information about executed SQL queries written to the history files. If `SHORT`, login and logout of SQL sessions are recorded. If `FULL`, all SQL queries being prepared and executed, including parameter values, are recorded.	NONE	NONE/SHORT/ FULL
StartRepairDelay	Maximum time a spare node allows for a failed active node to perform a node recovery. If the failed node cannot recover within this time interval, the spare node starts copying data from the failed node's mirror and becomes active. Changing the default value is not recommended.	20 seconds	0 - 100000 seconds

TABLE 3–8 Configuration Attributes *(Continued)*

Attribute	Description	Default	Range
StatInterval	Interval at which an HADB node writes throughput and response time statistics to its history file. To disable, set to 0. Here is an example of a statistics line: `Req-reply time: # 123, min= 69 avg= 1160 max= 9311 %=100.0` The number after the has sign (`#`) is the number of requests serviced over the `StatInterval`. The next three numbers are the minimum, average, and maximum time in microseconds taken by transactions completed over the `StatInterval`. The number afer the percent sign (`%`) is the number of transactions completed successfully within 15 milliseconds over the `StatInterval`.	600 seconds	0 - 600 seconds
SyslogFacility	Facility used when reporting to `syslog`. The `syslog` daemon should be configured (see `man syslogd.conf` for details). Use a facility that is not used by other applications running on the same machine. Set to `none` to disable `syslog` logging.	local0	local0, local1, local2, local3, local4, local5, local6, local7, kern, user, mail, daemon, auth, syslog, lpr, news, uucp, cron, none
SysLogging	If true, an HADB node writes information to the operating system's `syslog` files.	True	True or False
SysLogLevel	Minimum level of HADB message saved to operating system's `syslog` files. All messages of that level or higher will be logged. For example, "info" logs all messages.	warning	nonealert errorwarninginfo
SyslogPrefix	Text string inserted before all `syslog` messages written by the HADB.	hadb -dbname	
TakeoverTime	Time between when a node fails and when its mirror takes over. Do not change the default value.	10000 (milliseconds)	500 - 16000 milliseconds

Configuring the JDBC Connection Pool

Application Server communicates with HADB using the Java Database Connectivity (JDBC) API. The `asadmin configure-ha-cluster` command automatically creates a JDBC connection

pool for use with HADB (for a cluster *cluster-name*). The name of the connection pool is "*cluster-name*-hadb-pool". The JNDI URL of JDBC resource is "jdbc/*cluster-name*-hastore".

The initial configuration of the connection pool is normally sufficient. When you add a node, change the steady pool size so that there are eight connections for each HADB active node. See "Adding Nodes" on page 90.

This chapter covers the following topics:

- "Getting the JDBC URL" on page 78
- "Creating a Connection Pool" on page 78
- "Creating a JDBC Resource" on page 80

For general information about connection pools and JDBC resources, see *Sun Java System Application Server 9.1 High Availability Administration Guide*.

Getting the JDBC URL

Before you can set up the JDBC connection pool, you need to determine the JDBC URL of HADB using the `hadbm get` command as follows:

```
hadbm get JdbcUrl [dbname]
```

For example:

```
hadbm get JdbcUrl
```

This command displays the JDBC URL, which is of he following form:

```
jdbc:sun:hadb:host:port,
host:port,...
```

Remove the `jdbc:sun:hadb:` prefix and use the *host*`:`*port*`,` *host*`:`*port*`...` part as the value of the `serverList` connection pool property, described in Table 3–10.

Creating a Connection Pool

The following table summarizes connection pool settings required for the HADB. Change the Steady Pool Size when adding nodes, but do not change other settings.

TABLE 3–9 HADB Connection Pool Settings

Setting	Required Value for HADB
Name	The HADB JDBC resource's Pool Name setting must refer to this name

TABLE 3–9 HADB Connection Pool Settings *(Continued)*

Setting	Required Value for HADB
Database Vendor	HADB 4.4
Global Transaction Support	Unchecked/false
DataSource Classname	`com.sun.hadb.jdbc.ds.HadbDataSource`
Steady Pool Size	Use 8 connections for each active HADB node. For more detailed information, see the *System Deployment Guide*.
Connection Validation Required	Checked/true
Validation Method	`meta-data`
Table Name	Do not specify
Fail All Connections	Unchecked/false
Transaction Isolation	`repeatable-read`
Guarantee Isolation Level	Checked/true

The following table summarizes connection pool properties required for the HADB. Change `serverList` when adding nodes, but do not change other properties.

TABLE 3–10 HADB Connection Pool Properties

Property	Description
username	Name of the `storeuser` to use in the `asadmin create-session-store` command.
password	Password (`storepassword`) to us in the `asadmin create-session-store` command.
serverList	JDBC URL of the HADB. To determine this value, see "Getting the JDBC URL" on page 78 You must change this value if you add nodes to the database. See "Adding Nodes" on page 90.
cacheDatabaseMetaData	When `false` , as required, ensures that calls to `Connection.getMetaData()` make calls to the database, which ensures that the connection is valid.
eliminateRedundantEndTransaction	When `true` , as required, improves performance by eliminating redundant commit and rollback requests and ignoring these requests if no transaction is open.
maxStatement	Maximum number of statements per open connection that are cached in the driver statement pool. Set this property to `20`.

EXAMPLE 3–5 Creating a Connection Pool

Here is an example `asadmin create-jdbc-connection-pool` command that creates an HADB JDBC connection pool:

```
asadmin create-jdbc-connection-pool
--user adminname --password secret
--datasourceclassname com.sun.hadb.jdbc.ds.HadbDataSource
--steadypoolsize=32
--isolationlevel=repeatable-read
--isconnectvalidatereq=true
--validationmethod=meta-data
--property username=storename:password=secret456:serverList=
host\:port,host\:port,
host\\:port,host\:port,
host\:port,host\:port
:cacheDatabaseMetaData=false:eliminateRedundantEndTransaction=true hadbpool
```

On Solaris, escape colon characters (`:`) within property values with double backslashes (`\\`). On Windows, escape colon characters (`:`) with single backslashes (`\`).

Creating a JDBC Resource

The following table summarizes JDBC resource settings required for HADB.

TABLE 3–11 HADB JDBC Resource Settings

Setting	Description
JNDI Name	The following JNDI name is the default in the session persistence configuration: `jdbc/hastore`. You can use the default name or a different name. You must also specify this JNDI name as the value of the `store-pool-jndi-name` Persistence Store property when you activate the availability service.
Pool Name	Select from the list the name (or ID) of the HADB connection pool used by this JDBC resource. For more information, see "Configuring Network Redundancy" on page 36
Data Source Enabled	Checked/true

Managing HADB

You generally need to perform management operations when you replace or upgrade your network, hardware, operating system, or HADB software. The following sections explain various management operations:

- "Managing Databases" on page 84
- "Recovering from Session Data Corruption" on page 88

Managing Domains

You can perform the following operations on an HADB domain:

- Creating a Domain: For more information, see "Creating a Management Domain" on page 67
- "Extending a Domain" on page 81
- "Deleting a Domain" on page 81
- "Listing Hosts in a Domain" on page 82
- "Removing Hosts from a Domain" on page 81

See "Security Options" on page 63 and "General Options" on page 64 for a description of command options.

Extending a Domain

Use `extenddomain` to add hosts to an existing management domain. The command syntax is:

```
hadbm extenddomain
[--adminpassword=password | --adminpasswordfile=file]
[--agent=maurl]
hostlist
```

IP addresses of HADB hosts must be IPv4 addresses.

For more information, see `hadbm-extenddomain`(1).

Deleting a Domain

Use `deletedomain` to remove a management domain. The command syntax is:

```
hadbm deletedomain
[--adminpassword=password | --adminpasswordfile=file]
[--agent=maurl]
```

For more information, see `hadbm-deletedomain`(1).

Removing Hosts from a Domain

Use `reducedomain` to remove hosts from the management domain. The command syntax is:

```
hadbm reducedomain
[--adminpassword=password | --adminpasswordfile=file]
[--agent=maurl]
host_list
```

For more information, see `hadbm-reducedomain`(1).

Listing Hosts in a Domain

Use `listdomain` to list all hosts defined in the management domain. The command syntax is:

```
hadbm listdomain
[--adminpassword=password | --adminpasswordfile=file]
[--agent=maurl]
```

For more information, see `hadbm-listdomain`(1).

Managing Nodes

You can perform the following operations on individual nodes:

- "Starting a Node" on page 82
- "Stopping a Node" on page 83
- "Restarting a Node" on page 84

Starting a Node

You might need to manually start an HADB node that was stopped because its host was taken off-line for a hardware or software upgrade or replacement. Also, you might need to manually start a node if it fails to restart for some reason (other than a double failure). For more information on how to recover from double failures, see "Clearing a database" on page 86.

In most cases, you should first attempt to start the node using the `normal` start level. You must use the `repair` start level if the `normal` start level fails or times out.

To start a node in the database, use the `hadbm startnode` command. The syntax is:

```
hadbm startnode
 [--adminpassword=password | --adminpasswordfile=file]
 [--agent=maurl]
 [--startlevel=level]
 nodeno
 [dbname]
```

The *dbname* operand specifies the database name. The default is `hadb`.

The *nodeno* operand specifies the number of the node to start. Use `hadbm status` to display the numbers of all nodes in a database.

For more information, see `hadbm-startnode`(1).

Start level option

The `hadbm startnode` command has one special option, `--startlevel` (short form `-l`), that specifies the level at which to start the node.

Node start levels are:

- **normal** (default): starts the node with the data found locally on the node (in the memory and in the data device file on the disk) and synchronizes it with the mirror for recent updates it missed.
- **repair**: forces the node to discard local data and copy it from its mirror.
- **clear**: reinitializes the devices for the node and forces a repair of data from its mirror node. Use when the device files need to be initialized, necessary if they are damaged or the disk that contained the device files is replaced.

See "General Options" on page 64 for a description of other command options.

EXAMPLE 3–6 Example of starting a node

```
hadbm startnode 1
```

Stopping a Node

You might need to stop a node to repair or upgrade the host machine's hardware or software. To stop a node, use the `hadbm stopnode` command. The command syntax is:

```
hadbm stopnode
[--adminpassword=password | --adminpasswordfile=file]
[--agent=maurl]
[--no-repair]
nodeno
[dbname]
```

The *nodeno* operand specifies the number of the node to stop. The mirror node of this node number must be running. Use `hadbm status` to display the numbers of all nodes in a database.

The *dbname* operand specifies the database name. The default is `hadb`.

The `hadbm stopnode` command has one special option, `--no-repair` (short form `-R`) that indicates no spare node is to replace the stopped node. Without this option, a spare node starts up and takes over the functioning of the stopped node.

See "General Options" on page 64 for a description of other command options. For more information, see `hadbm-stopnode`(1).

EXAMPLE 3–7 Example of stopping a node

```
hadbm stopnode 1
```

Restarting a Node

You might have to restart a node if you notice unusual behavior such as excessive CPU consumption.

To restart a node in the database, use the `hadbm restartnode` command. The command syntax is:

```
hadbm restartnode
[--adminpassword=password | --adminpasswordfile=file]
[--agent=maurl]
[--startlevel=level]
nodeno
[dbname]
```

The *dbname* operand specifies the database name. The default is `hadb`.

The *nodeno* operand specifies the number of the node to restart. Use `hadbm status` to display the numbers of all nodes in a database.

The `hadbm restartnode` command has one special option, `--startlevel` (short form `-l`), that specifies the level at which to start the node. See "Start level option" on page 83 for more information.

See "General Options" on page 64 for a description of other command options. For more information, see `hadbm-restartnode(1)`.

EXAMPLE 3–8 Example of restarting a node

```
hadbm restartnode 1
```

Managing Databases

You can perform the following operations on HADB databases:

Starting a Database

To start a database, use the `hadbm start` command. This command starts all nodes that were running before the database was stopped. Individually stopped (offline) nodes are not started when the database is started after a stop.

The command syntax is:

```
hadbm start
[--adminpassword=password | --adminpasswordfile=file]
[--agent=maurl]
[dbname]
```

The *dbname* operand specifies the database name. The default is `hadb`.

See "General Options" on page 64 for a description of command options. For more information, see `hadbm-start`(1).

EXAMPLE 3–9 Example of starting a database

```
hadbm start
```

Stopping a Database

When you stop and start a database in separate operations, data is unavailable while it is stopped. To keep data available, you can restart a database as described in "Restarting a Database" on page 86.

Stop a database to:

- Remove the database.
- Perform system maintenance that affects all HADB nodes.

Before stopping a database, either stop dependent Application Server instances that are using the database, or configure them to use a Persistence Type other than `ha`.

When you stop the database, all the running nodes in the database are stopped and the status of the database becomes Stopped. For more information about database states, see "Database States" on page 95.

To stop a database, use the `hadbm stop` command. The command syntax is:

```
hadbm stop
[--adminpassword=password | --adminpasswordfile= file]
[--agent=maurl]
[dbname]
```

The *dbname* operand specifies the database name. The default is `hadb`.

See "General Options" on page 64 for a description of command options. For more information, see `hadbm-stop`(1).

EXAMPLE 3–10 Example of stopping a database

```
hadbm stop
```

Restarting a Database

You might want to restart a database if you notice strange behavior (for example consistent timeout problems). In some cases, a restart may solve the problem.

When you restart a database, y, the database and its data remain available. When you stop and start HADB in separate operations, data and database services are unavailable while HADB is stopped. This is because by default `hadbm restart` performs a rolling restart of nodes: it stops and starts the nodes one by one. In contrast, `hadbm stop` stops all nodes simultaneously.

To restart a database, use the `hadbm restart` command. The command syntax is:

```
hadbm restart
[--adminpassword=password | --adminpasswordfile=file]
[--agent=maurl]
[--no-rolling]
[dbname]
```

The *dbname* operand specifies the database name. The default is `hadb`.

The special option `--no-rolling` (short form `-g`) specifies to restart all nodes at once, which causes loss of service. Without this option, this command restarts each of the nodes in the database to the current state or a better state.

See "General Options" on page 64 for a description of other command options. For more information, see `hadbm-restart`(1).

For example:

```
hadbm restart
```

Listing Databases

To list all the databases in an HADB instance, use the `hadbm list` command. The command syntax is:

```
hadbm list
[--agent=maurl]
[--adminpassword=password | --adminpasswordfile=file]
```

See "General Options" on page 64 for a description of command options. For more information, see `hadbm-list`(1).

Clearing a database

Clear a database when:

- The `hadbm status` command reveals that the database is non-operational or if See "Getting the Status of HADB" on page 95.

- Multiple nodes do not respond and are in waiting state for a long time.
- Recovering from session data corruption. See "Recovering from Session Data Corruption" on page 88

The `hadbm clear` command stops the database nodes, clears the database devices, then starts the nodes. This command erases the Application Server schema data store in HADB, including tables, user names, and passwords. After running `hadbm clear`, use `asadmin configure-ha-cluster` to recreate the data schema, reconfigure the JDBC connection pool, and reload the session persistence store.

The command syntax is:

```
hadbm clear  [--fast]  [--spares=number]
[--dbpassword=password | --dbpasswordfile= file]
[--adminpassword=password | --adminpasswordfile= file]
[--agent=maurl]
[dbname]
```

The *dbname* operand specifies the database name. The default is `hadb`.

The following table describes the special `hadbm clear` command options. See "General Options" on page 64 for a description of other options.

For more information, see `hadbm-clear`(1).

TABLE 3–12 `hadbm clear` Options

Option	Description	Default
--fast -F	Skips device initialization while initializing the database. Do not use if the disk storage device is corrupted.	Not applicable
--spares= *number* -s	Number of spare nodes the reinitialized database will have. Must be even and less than the number of nodes in the database.	Previous number of spares

For example:

```
hadbm clear --fast --spares=2
```

Removing a Database

To remove an existing database, use the `hadbm delete` command. This command deletes the database's configuration files, device files, and history files, and frees shared memory resources. The database you want to remove must exist and must be stopped. See "Stopping a Database" on page 85.

The command syntax is:

```
hadbm delete
[--adminpassword=password | --adminpasswordfile=file]
[--agent=maurl]
[dbname]
```

The *dbname* operand specifies the database name. The default is `hadb`.

See "General Options" on page 64 for a description of command options. For more information, see `hadbm-delete`(1).

EXAMPLE 3–11 Example of removing a database

The command:

```
hadbm delete
```

deletes the default database, `hadb`.

Recovering from Session Data Corruption

The following are indications that session data may be corrupted:

- Error messages appear in the Application Server system log (`server.log`) every time an application tries to save session state.
- Error messages in the server log indicate that the session could not be found or could not be loaded during session activation.
- Sessions that are activated after previously being passivated contain empty or incorrect session data.
- When an instance fails, failed-over sessions contain empty or incorrect session data.
- When an instance fails, instances that try to load a failed-over session cause an error in the server log indicating the session could not be found or could not be loaded.

▼ To bring the session store back to a consistent state

If you determine that the session store has been corrupted, bring it back to a consistent state by following this procedure:

1 Clear the session store.

Determine if this action corrects the problem. If it does, then stop. If not—for example, if you continue to see errors in the server log—then continue.

2 Re-initialize the data space on all the nodes and clear the data in the database.

See "Clearing a database" on page 86 .

Determine if this action corrects the problem. If it does, then stop. If not—for example, if you continue to see errors in the server log—then continue.

3 **Delete and then recreate the database.**

See "Removing a Database" on page 87 and "Creating a Database" on page 67

Expanding HADB

There are two reasons to expand your original HADB configuration:

- Volume of session data being saved increases beyond existing storage space in data devices. Transactions may start aborting due to full data devices.
- User load increases, exhausting system resources. You need to add more hosts.

This section describes how you can expand HADB without shutting down your Application Server cluster or database, in particular:

Also see related information in "Maintaining HADB Machines" on page 101 .

Adding Storage Space to Existing Nodes

Add HADB storage space:

- If user transactions repeatedly abort with one of the following error messages:
  - `4592: No free blocks on data devices`
  - `4593: No unreserved blocks on data devices`
- If the `hadbm deviceinfo` command consistently reports insufficient free size. See "Getting Device Information" on page 97.

You may also want to add storage space to existing nodes if there is unused disk space on the nodes or when you add disk capacity. For information on the recommended data device size, see "Specifying Device Size" on page 71

To add storage space to nodes, use the `hadbm set` command to increase data device size.

The command syntax is:

```
hadbm set DataDeviceSize=size
```

where *size* is the data device size in MBytes.

See "General Options" on page 64 for a description of command options.

Changing the data device size for a database in a `FaultTolerant` or higher state upgrades the system without loss of data or availability. The database remains in operational during the reconfiguration. Changing device size on a system that is not `FaultTolerant` or better causes loss of data. For more information about database states, see "Database States" on page 95.

EXAMPLE 3–12 Example of setting data device size

The following command is an example of setting data device size:

```
hadbm set DataDeviceSize=1024
```

Adding Machines

You may want to add machines if HADB requires more processing or storage capacity. To add a new machine on which to run HADB, install HADB packages with or without the Application Serveras described in Chapter 2, "Installing and Setting Up High Availability Database." For an explanation of node topology alternatives, see Chapter 3, "Selecting a Topology," in *Sun Java System Application Server 9.1 Deployment Planning Guide*.

▼ To add new machines to an existing HADB instance

1. **Start management agents on the new nodes.**
2. **Extend the management domain to the new hosts.**

   For details, see `hadbm extenddomain` command.
3. **Start the new nodes on these hosts.**

   For details, see "Adding Nodes" on page 90

Adding Nodes

To increase processing and storage capacity of an HADB system, create new nodes and add them to the database.

After you add nodes, update the following properties of the HADB JDBC connection pool:

- The `serverlist` property.
- Steady pool size. Generally, you add 8 more connections for each new node. For more information, see "System Sizing" in *Sun Java System Application Server 9.1 Deployment Planning Guide*.

To add nodes, use the `hadbm addnodes` command. The command syntax is:

```
hadbm addnodes  [--no-refragment]  [--spares=sparecount]
[--historypath=path]
[--devicepath=path]
[--set=attr-name-value-list]
[--dbpassword=password | --dbpasswordfile=file ]
[--adminpassword=password | --adminpasswordfile=file]
--hosts=hostlist  [dbname]
```

The *dbname* operand specifies the database name. The default is `hadb`. The database must be in `HAFaultTolerant` or `FaultTolerant` state. For more information about database states, see "Database States" on page 95.

If you do not specify the `--devicepath` and `--historypath` options, the new nodes will have the same device path and use the same history files as the existing database.

Adding nodes performs a refragmentation and redistribution of the existing data to include the new nodes in the system. Online refragmenting requires that the disks for the HADB nodes have enough space to contain the old data and the new data simultaneously until refragmenting is finished, that is, the user data size must not exceed 50% of the space available for user data. For details, see "Getting Device Information" on page 97

Note – The best time to add nodes is when the system is lightly loaded.

EXAMPLE 3–13 Example of adding nodes

For example:

```
hadbm addnodes -adminpassword=password --hosts n6,n7,n8,n9
```

The following table describes the special `hadbm addnodes` command options. See "General Options" on page 64 for a description of other options.

TABLE 3–13 `hadbm addnodes` Options

Option	Description	Default
--no-refragment -r	Do not refragment the database during node creation; In this case, refragment the database later using the `hadbm refragment` command to use the new nodes. For details about refragmentation, see "Refragmenting the Database" on page 92 If you do not have sufficient device space for refragmentation, recreate the database with more nodes. See "Adding Nodes by Recreating the Database" on page 93	Not applicable
--spares= *number* -s	Number of new spare nodes in addition to those that already exist. Must be even and not greater than the number of nodes added.	0
--devicepath= *path* -d	Path to the devices. Devices are: ■ `DataDevice` ■ `NiLogDevice` (node internal log device) ■ `RelalgDevice` (relational algebra query device) This path must already exist and be writable. To set this path differently for each node or each device, see "Setting Heterogeneous Device Paths" on page 71	Solaris and Linux: *HADB_install_dir*`/device` Windows: `C:\Sun\AppServer\SUNWhadb\`*vers*, where *vers* is the HADB version number.
--hosts= *hostlist* -H	Comma-separated list of new host names for the new nodes in the database. One node is created for each comma-separated item in the list. The number of nodes must be even. IP addresses of HADB hosts must be IPv4 addresses. Using duplicate host names creates multiple nodes on the same machine with different port numbers. Make sure that nodes on the same machine are not mirror nodes. Odd numbered nodes are in one DRU, even numbered nodes in the other. If `--spares` is used, new spare nodes are those with the highest numbers. If the database was created with double network interfaces, the new nodes must be configured in the same way. See "Configuring Network Redundancy" on page 36 .	None

Refragmenting the Database

Refragment the database to store data in newly-created nodes. Refragmentation distributes data evenly across all active nodes.

To refragment the database, use the `hadbm refragment` command. The command syntax is:

```
hadbm refragment  [--dbpassword=password | --dbpasswordfile=file]
[--adminpassword=password | --adminpasswordfile=file]
[--agent=maurl]
[dbname]
```

The *dbname* operand specifies the database name. The default is `hadb`. The database must be in `HAFaultTolerant` or `FaultTolerant` state. For more information about database states, see "Getting the Status of HADB" on page 95.

See "General Options" on page 64 for a description of command options. For more information, see `hadbm-refragment`(1).

Online refragmentation requires that the disks for the HADB nodes have enough space to contain the old data and the new data simultaneously until refragmenting is finished, that is, the user data size must not exceed 50% of the space available for user data. For details, see "Getting Device Information" on page 97

Note – The best time to refragment the database is when the system is lightly loaded.

If this command fails after multiple attempts, see "Adding Nodes by Recreating the Database" on page 93

EXAMPLE 3–14 Example of refragmenting the database

For example:

```
hadbm refragment
```

Adding Nodes by Recreating the Database

If online refragmentation fails persistently when you add new nodes (either due to lack of data device space or other reasons), recreate the database with new nodes. This will lead to the loss of existing user data and schema data.

▼ To add nodes by recreating the database

This procedure enables you to maintain HADB availability throughout the process.

1. **For each Application Server instance:**

   a. **Disable the Application Server instance in the load balancer.**

   b. **Disable session persistence.**

   c. **Restart the Application Server instance.**

d. Re-enable the Application Server instance in the load balancer.

If you do not need to maintain availability, you can disable and re-enable all the server instances at once in the load balancer. This saves time and prevents failover of outdated session data.

2 Stop the database as described in "Stopping a Database" on page 85 .

3 Delete the database as described in "Removing a Database" on page 87 .

4 Recreate the database with the additional nodes as described in "Creating a Database" on page 67.

5 Reconfigure the JDBC connection pool as described in "Configuring the JDBC Connection Pool" on page 77.

6 Reload the session persistence store.

7 For each Application Server instance:

a. Disable the Application Server instance in the load balancer.

b. Enable session persistence.

c. Restart the Application Server instance.

d. Re-enable the Application Server instance in the load balancer.

If you do not need to maintain availability, you can disable and re-enable all the server instances at once in the load balancer. This saves time and prevents failover of outdated session data.

Monitoring HADB

You can monitor the activities of HADB by:

- "Getting the Status of HADB" on page 95
- "Getting Device Information" on page 97
- "Getting Runtime Resource Information" on page 98

These sections briefly describe the `hadbm status`, `hadbm deviceinfo`, and `hadbm resourceinfo` commands. For information on interpreting HADB information, see "Performance" in *Sun Java System Application Server 9.1 Performance Tuning Guide*.

Getting the Status of HADB

Use the `hadbm status` command to display the status of the database or its nodes. The command syntax is:

```
hadbm status
[--nodes]
[--adminpassword=password | --adminpasswordfile=file]
[--agent=maurl]
[dbname]
```

The *dbname* operand specifies the database name. The default is `hadb`.

The `--nodes` option (short form `-n`) displays information on each node in the database. For more information , see "Node Status" on page 96. See "General Options" on page 64 for a description of other command options.

For more information, see `hadbm-status`(1).

EXAMPLE 3–15 Example of getting HADB status

For example:

```
hadbm status --nodes
```

Database States

A database's *state* summarizes its current condition. The following table describes the possible database states.

TABLE 3–14 HADB States

Database State	Description
High-Availability Fault Tolerant (HAFaultTolerant)	Database is fault tolerant and has at least one spare node on each DRU.
Fault Tolerant	All the mirrored node pairs are up and running.
Operational	At least one node in each mirrored node pair is running.
Non Operational	One or more mirrored node pairs is missing both nodes. If the database is non-operational, clear the database as described in "Clearing a database" on page 86.
Stopped	No nodes are running in the database.
Unknown	Cannot determine the state of the database.

Node Status

Use the `--nodes` option to make the `hadbm status` command display the following information for each node in the database:

- Node number
- Name of the machine where the node is running
- Port number of the node
- Role of the node. For a list of roles and their meanings, see "Roles of a Node" on page 96
- State of the node. For a list of states and their meanings, see "States of a Node" on page 96
- Number of the corresponding mirror node.

A node's role and state can change as described in these sections:

- "Roles of a Node" on page 96
- "States of a Node" on page 96

Roles of a Node

A node is assigned a role during its creation and can take any one of these roles:

- **Active:** Stores data and allows client access. Active nodes are in mirrored pairs.
- **Spare:** Allows client access, but does not store data. After initializing data devices, monitors other data nodes to initiate repair if another node becomes unavailable.
- **Offline:** Provide no services until their role changes. When placed back online, its role can change back to its former role.
- **Shutdown:** An intermediate step between active and offline, waiting for a spare node to take over its functioning. After the spare node has taken over, the node is taken offline.

States of a Node

A node can be in any one of the following states:

- **Starting:** The node is starting.
- **Waiting:** The node cannot decide its start level and is offline. If a single node is in this state for more than two minutes, stop the node and then start it at the `repair` level; see "Stopping a Node" on page 83 and "Starting a Node" on page 82 "Clearing a database" on page 86.
- **Running:** The node is providing all services that are appropriate for its role.
- **Stopping:** The node is in the process of stopping.
- **Stopped:** The node is inactive. Repair of a stopped node is prohibited.
- **Recovering:** The node is being recovered. When a node fails, the mirror node takes over the functions of the failed node. The failed node tries to recover by using the data and log records in main memory or on disk. The failed node uses the log records from the mirror node to catch up with the transactions performed when it was down. If recovery is successful, the node becomes active. If recovery fails, the node state changes to repairing.

- **Repairing:** The node is being repaired. This operation reinitializes the node and copies the data and log records from the mirror node. Repair is more time consuming than recovery.

Getting Device Information

Monitor free space in HADB data (disk storage) devices:

- Routinely, to check the trend in disk space use.
- As part of preventive maintenance: if the user load has increased and you want to resize or scale the database configuration.
- As part of scaling up the database: Before running `hadbm addnodes` to add new nodes to the system, check whether there is enough device space. Remember, you need around 40-50% free space on the existing nodes to add nodes.
- When you see messages in the history files and `server.log` file such as
  - `No free blocks on data devices`
  - `No unreserved blocks on data devices .`

Use the `hadbm deviceinfo` command to get information about free space in data devices. This command displays the following information for each node of the database:

- Total device size allocated, in MB (Totalsize).
- Free space in MB (Freesize).
- Percent of device currently being used (Usage)

The command syntax is:

```
hadbm deviceinfo  [--details]
[--adminpassword=password | --adminpasswordfile=file]
[--agent=maurl]  [dbname]
```

The *dbname* operand specifies the database name. The default is `hadb`.

The `--details` option displays the following additional information:

- Number of read operations by the device.
- Number of write operations by the device.
- Name of the device.

See "General Options" on page 64 for a description of other command options.

For more information, see `hadbm-deviceinfo`(1).

To determine the space available for user data, take the total device size, then subtract the space reserved for HADB: four times the `LogBufferSize` + `1%` of the device size. If you do not know the size of the log buffer, use the command `hadbm get logbufferSize`. For example, if the total

device size is 128 MB and the `LogBufferSize` is 24 MB, the space available for user data is 128 – (4 x 24) = 32 MB. Of the 32 MB, half is used for replicated data and around one percent is used for the indices, and only 25 percent is available for the real user data.

The space available for user data is the difference between the total size and reserved size. If the data is refragmented in the future, the free size must be approximately equal to 50% of the space available for user data. If refragmentation is not relevant, the data devices can be exploited to their maximum. Resource consumption warnings are written to the history files when the system is running short on device space.

For more information about tuning HADB, see the *Sun Java System Application Server Performance Tuning Guide*.

EXAMPLE 3–16 Example of getting device information

The following command:

```
hadbm deviceinfo --details
```

Displays the following example results:

```
NodeNO Totalsize Freesize Usage NReads NWrites DeviceName
0      128       120      6%    10000  5000    C:\Sun\SUNWhadb\hadb.data.0
1      128       124      3%    10000  5000    C:\Sun\SUNWhadb\hadb.data.1
2      128       126      2%     9500  4500    C:\Sun\SUNWhadb\hadb.data.2
3      128       126      2%     9500  4500    C:\Sun\SUNWhadb\hadb.data.3
```

Getting Runtime Resource Information

The `hadbm resourceinfo` command displays HADB runtime resource information. You can use this information to help identify resource contention, and reduce performance bottlenecks. For details, see "Tuning HADB" in *Sun Java System Application Server 9.1 Performance Tuning Guide*.

The command syntax is:

```
hadbm resourceinfo  [--databuf]  [--locks]  [--logbuf]  [--nilogbuf]
[--adminpassword=password | --adminpasswordfile=file]
[--agent=maurl]
[dbname]
```

The *dbname* operand specifies the database name. The default is `hadb`.

The following table describes the `hadbm resourceinfo` special command options. See "General Options" on page 64 for a description of other command options.

For more information, see `hadbm-resourceinfo`(1).

TABLE 3–15 hadbm resourceinfo Command Options

Option	Description
--databuf	Display data buffer pool information.
-d	See "Data Buffer Pool Information" on page 99 below for more information.
--locks	Display lock information.
-l	See "Lock Information" on page 100 below for more information.
--logbuf	Display log buffer information.
-b	See "Log Buffer Information" on page 100 below for more information.
--nilogbuf	Display node internal log buffer information.
-n	See "Node Internal Log Buffer Information" on page 101 below for more information.

Data Buffer Pool Information

Data buffer pool information contains the following:

- `NodeNo`: Node number.
- `Avail`: Total space available in the pool, in MBytes.
- `Free`: Free space available, in MBytes.
- `Access`: Cumulative number of accesses to the data buffer from database, from start until now.
- `Misses`: Cumulative number of page faults that have occurred from database start until now.
- `Copy-on-Write`: Cumulative number of pages copied internally in the data buffer due to checkpointing.

When a user transaction performs an operation on a record, the page containing the record must be in the data buffer pool. If it is not, a `miss` or a page fault occurs. The transaction then has to wait until the page is retrieved from the data device file on the disk.

If the miss rate is high, increase the data buffer pool. Since the misses are cumulative, run `hadbm resourceinfo` periodically and use the difference between two runs to see the trend of miss rate. Do not be concerned if free space is very small, since the checkpointing mechanism will make new blocks available.

EXAMPLE 3–17 Example data buffer pool information

For example:

```
NodeNO Avail Free Access Misses Copy-on-Write
0 256 128 100000 50000 10001 256 128 110000 45000 950
```

Lock Information

Lock information is as follows:

- `NodeNo`: Node Number.
- `Avail`: Total number of locks available on the node.
- `Free`: Number of free locks.
- `Waits`: Number of transactions waiting to acquire locks. This is cumulative.

One single transaction cannot use more than 25% of the available locks on a node. Therefore, transactions performing operations in large scale should be aware of this limitation. It is best to perform such transactions in batches, where each batch must be treated as a separate transaction, that is, each batch commits. This is needed because read operations running with `repeatable read` isolation level, and `delete`, `insert`, and `update` operations use locks that are released only after the transaction terminates.

To change the `NumberOfLocks`, see "Clearing and Archiving History Files" on page 103.

EXAMPLE 3–18 Example lock information

For example:

```
NodeNO Avail Free Waits
0 50000 20000 101 50000 20000 0
```

Log Buffer Information

Log buffer information is:

- `NodeNo`: Node Number
- `Available`: amount of memory allocated for the log buffer in MB
- `Free`: amount of free memory in MB

Do not worry if free space is very small, since HADB starts compressing the log buffer. HADB starts compression from the head of the ring buffer and performs it on consecutive log records. Compression cannot proceed when HADB encounters a log record that has not been executed by the node and received by the mirror node

EXAMPLE 3–19 Example of log buffer information

For example:

```
NodeNO Avail Free
0 16 21 16 3
```

Node Internal Log Buffer Information

Node internal log buffer information is:

- Node Number
- Available: amount of memory allocated for the log device in MB
- Free: amount of free memory in MB

EXAMPLE 3–20 Example of internal log buffer information

For example:

```
NodeNO Avail Free

0 16 21 16 3
```

Maintaining HADB Machines

HADB achieves fault tolerance by replicating data on mirror nodes. In a production environment, a mirror node is on a separate DRU from the node it mirrors, as described in *Sun Java System Application Server 9.1 Deployment Planning Guide*.

A *failure* is an unexpected event such as a hardware failure, power failure, or operating system reboot. The HADB tolerates single failures: of one node, one machine (that has no mirror node pairs), one or more machines belonging to the same DRU, or even one entire DRU. However, HADB does *not* automatically recover from a double failure, which is the simultaneous failure of one or more mirror node pairs. If a double failure occurs, you must clear HADB and recreate its session store, which erases all its data.

There are different maintenance procedures, depending on whether you need to work on a single machine or multiple machines.

▼ To perform maintenance on a single machine

This procedure is applicable to both planned and unplanned maintenance, and does not interrupt HADB availability.

1. **Perform the maintenance procedure and get the machine up and running.**

2. **Ensure that `ma` is running.**

   If `ma` runs as a Windows service or under `init.d` scripts (recommended for deployment), it should have been started by the operating system. If not start it manually. See "Starting the Management Agent" on page 54.

3 **Start all nodes on the machine.**

For more information, see "Starting a Node" on page 82.

4 **Check whether the nodes are active and running.**

For more information, see "Getting the Status of HADB" on page 95

▼ To perform planned maintenance on all HADB machines

Planned maintenance includes operations such as hardware and software upgrades. This procedure does not interrupt HADB availability.

1 **For each spare machine in the first DRU, repeat the single machine procedure as described in "To perform maintenance on a single machine" on page 101, one by one, for each machine.**

2 **For each active machine in the first DRU, repeat the single machine procedure as described in "To perform maintenance on a single machine" on page 101, one by one, for each machine.**

3 **Repeat step 1 and step 2 for the second DRU.**

▼ To perform planned maintenance on all HADB machines

This procedure is applicable when HADB is on single or multiple machines. It interrupts HADB service during the maintenance procedure.

1 **Stop HADB. See "Stopping a Database" on page 85 .**

2 **Perform the maintenance procedure and get all the machines up and running.**

3 **Ensure `ma` is running.**

4 **Start HADB.**

For more information, see "Starting a Database" on page 84.

After you complete the last step, HADB data becomes available again.

▼ To perform unplanned maintenance in the event of a failure

- **Check the database state.**

  See "Getting the Status of HADB" on page 95

  - **If the database state is Operational or better:**

    The machines needing unplanned maintenance *do not* include mirror nodes. Follow the single machine procedure for each failed machine, one DRU at a time. HADB service is not interrupted.

  - **If the database state is Non-Operational:**

    The machines needing unplanned maintenance include mirror nodes. One such case is when the entire HADB is on a single failed machine. Get all the machines up and running first. Then clear HADB and recreate the session store. See "Clearing a database" on page 86. This interrupts HADB service.

Clearing and Archiving History Files

HADB history files record all database operations and error messages. HADB appends to the end of existing history files, so the files grow over time. To save disk space and prevent files from getting too large, periodically clear and archive history files.

To clear a database's history files, use the `hadbm clearhistory` command.

The command syntax is:

```
hadbm clearhistory
[--saveto=path]
[dbname]
[--adminpassword=password | --adminpasswordfile=file]
[--agent=maurl]
```

The *dbname* operand specifies the database name. The default is `hadb`.

Use the `--saveto` option (short form `-o`) to specify the directory in which to store the old history files. This directory must have appropriate write permissions. See "General Options" on page 64 for a description of other command options.

For more information, see `hadbm-clearhistory`(1).

The `--historypath` option of the `hadbm create` command determines the location of the history files. The names of the history files are of the format *dbname*`.out.` *nodeno*. For information on `hadbm create`, see "Creating a Database" on page 67

History File Format

Each message in the history file contains the following information:

- The abbreviated name of the HADB process that produced the message.
- The type of message:
  - `INF` - general information
  - `WRN` - warnings
  - `ERR` - errors
  - `DBG` - debug information
- A timestamp. The time is obtained from the host machine system clock.
- The service set changes occurring in the system when a node stops or starts.

Messages about resource shortages contain the string "HIGH LOAD."

You do not need a detailed knowledge of all entries in the history file. If for any reason you need to study a history file in greater detail, contact Sun customer support.

◆ ◆ ◆ CHAPTER 4

Configuring Web Servers for Load Balancing

This chapter explains how to configure the web servers supported by the load balancer plug-in available with Application Server 9.1 and GlassFish v2. The load balancer plug-in available with Application Server 9.1 supports the following web servers:

- Sun Java System Web Server 6.1 and 7.0
- Apache Web Server 2.0.x
- Microsoft IIS 5.0 and 6.0

Note – GlassFish v2 supports only Sun Java System Web Server (versions 6.1 and 7.0). To use the load balancer plug-in with GlassFish v2, you need to manually install and configure the load balancer plug-in. For more information about installing the load balancer plug-in with GlassFish v2, see Chapter 1, "Installing Application Server Software," in *Sun Java System Application Server 9.1 Installation Guide*.

The load balancer plug-in installation program, which is a part of the Application Server 9.1 installation program, makes a few modifications to the web server's configuration files. These changes depend upon the web server you are using. In addition, for some web servers you must make manual configurations in order for the load balancer to work properly.

Note – The load balancer plug-in can be installed either along with Sun Java System Application Server 9.1, or separately, on a machine running the supported web server. For complete details on the installation procedure, see Chapter 1, "Installing Application Server Software," in *Sun Java System Application Server 9.1 Installation Guide*.

Configuring Sun Java System Web Server

For Sun Java System Web Server, when you install the load balancer plug-in using the Sun Java System Application Server 9.1 installation wizard, the installation wizard automatically does all the necessary configuration. No manual configuration is required. The load balancer plug-in bundled with Application Server 9.1 supports the following versions of Sun Java System Web Server:

- Sun Java System Web Server 6.1
- Sun Java System Web Server 7.0

But, if you are using GlassFish v2, you must download the Application Server load balancer plug-in separately from `http://download.java.net/javaee5/external/SunOS_X86/aslb/jars/aslb-9.1-MS4-b7.jar` and make some manual changes to set it up. For detailed steps on how to install and set up the plug-in for GlassFish v2, refer to the section "To Install the Load Balancing Plug-in (standalone)" in *Sun Java System Application Server 9.1 Installation Guide*.

▼ To Configure Sun Java System Web Server

Before You Begin

Note – The following steps are automatically performed by the installation program for Application Server 9.1. But, if you are using GlassFish v2, you will need to perform these steps manually.

1 To the web server instance's `magnus.conf` file, add the following lines:

```
##BEGIN EE LB Plug-in Parameters
Init fn="load-modules"
shlib="web-server-install-dir/plugins/lbplugin/bin/libpassthrough.so"
funcs="init-passthrough,service-passthrough,name-trans-passthrough" Thread="no"
Init fn="init-passthrough"
##END EE LB Plug-in Parameters=
```

2 Append the following line if it does not exist already:

```
Init fn="load-modules" shlib=".../libj2eeplugin.so" shlib_flags="(global|now)"
```

3 In the file `web-server-install-dir/config/obj.conf`, insert the following in a single line before the first occurrence of the string `nametrans`:

```
Nametrans fn="name-trans-passthrough" name="lbplugin"
config-file="web-server-install-dir/config/loadbalancer.xml"
```

The order in which `NameTrans` entries appear in `obj.conf` is very important. The installer puts the `NameTrans` entries in the correct location, but if you are editing `obj.conf` for other purposes you must ensure that the order remains correct. In particular, the load balancer info must come

before the `document-root` function. For more information on the `obj.conf` file, see *Sun Java System Web Server 7.0 Administrator's Configuration File Reference*.

4 **Append the following lines to the file** `web-server-install-dir/config/obj.conf`**:**

```
<Object name = "lbplugin">
ObjectType fn="force-type" type="magnus-internal/lbplugin"
PathCheck fn="deny-existence" path="*/WEB-INF/*"
Service type="magnus-internal/lbplugin" fn="service-passthrough"
Error reason="Bad Gateway" fn="send-error" uri="$docroot/badgateway.html"
</Object>
```

5 **Edit the** *web-server-install-dir*`/start` **script to update the** `LD_LIBRARY_PATH` **value to include** *app-server-install-dir*`/lib/lbplugin/lib`**.**

The *app-server-install-dir*`/lib/lbplugin/lib` directory contains binaries that the load balancer plug-in requires.

6 **(Optional) For the new DAS-based Load Balancer Administration, configure the web server for SSL.**

For detailed instructions for Web Server 6.1 , see "To Set Up the Load Balancer in SSL Mode for Sun Java System Web Server 6.1" on page 108.

For detailed instructions for Web Server 7, see "Setting up the Load Balancer in SSL Mode for Web Server 7" on page 111.

7 **If the web server is not already running, start the web server.**

Configuring Sun Java System Web Server to Use Auto Apply

Auto Apply is a feature provided by Application Server 9.1 to send the load balancer configuration automatically over the wire to the web server configuration directory. For more information about this feature, see "Auto Apply" on page 125. The following procedures explain how to configure Sun Java System Web Server (versions 6 and 7) to use this feature.

▼ To Set Up the Load Balancer in SSL Mode for Sun Java System Web Server 6.1

Note – You need to perform the steps in this section only if you want to use the Auto Apply feature of the load balancer plug-in. This feature helps to send the load balancer configuration automatically over the wire to the web server configuration directory.

1. **Using a browser, access the Admin Console of Web Server and login.**

2. **Select your server instance and click on Manage.**

3. **Click on the Security tab.**

4. **Initialize the trust database by giving the username and password. This could be done using either the `certutil` command or the GUI. The following options of the `certutil` command could be used to initialize the trust database:**

   ```
   certutil -N -P  "https-instance-name-hostname-" -d .
   ```

   - When prompted by `certutil`, enter the password to encrypt your keys. Enter a password, which will be used to encrypt your keys. The password should be at least eight characters long, and should contain at least one non-alphabetic character.
   - When prompted to enter a new password, specify your password.

5. **Create a sample local Certificate Authority (CA) using the following command:**

   ```
   certutil -S -P "https-boqueron.virkki.com-boqueron-"
   -d . -n SelfCA -s "CN=Self CA,OU=virkki.com,C=US"
   -x -t "TC,TC,TC" -m 101 -v 99 -5
   ```

   a. **When prompted to enter 0-7 for the type of certificate, type 5 for SSL CA. When the prompt reappears, specify 9.**

   b. **When queried "Is this a critical extension [y/n]?," specify "y."**

6. **Use the above sample CA to generate a certificate**

   ```
   certutil -S -P "https-instance-name-hostname-"
   -d . -n MyServerCert -s "CN=boqueron.virkki.com,C=US"
   -c SelfCA -t "u,u,u" -m 102 -v 99 -5
   ```

   a. **When prompted to enter 0-7 for the type of certificate, type 1 for SSL Server. When the prompt reappears, specify 9.**

   b. **When queried "Is this a critical extension [y/n]?," specify "y."**

7. **Create an HTTPS listener as explained in the following steps:**

   a. **Log on to the web server's Administration Server.**

   b. **Select a server and click Manage.**

   c. **Click Add Listen Socket. In the Add Listen Socket page, do the following:**

      i. **Specify a port number.**

      ii. **Ensure that the fully qualified domain name (FQDN) of the server is specified for the Server Name. For example, if the host name is machine1, and the domain name is server.example.com, then the FQDN is machine1.server.example.com.**

      iii. **Select Enable from the Security drop-down list.**

      iv. **Click OK.**

   d. **Go to Edit Listen Sockets page and select the Listen Socket that you just created.**

   e. **In the Listen Socket page, verify if the Server Certificate name is the same as the certificate name that you provided in Step 6.**

▼ To Export and Import the DAS Certificate for Sun Java System Web Server 6.1

1. **If you are using Application Server 9.1, export the DAS certificate by executing the command:**

   ```
   <appserver_install_dir>/lib/upgrade/pk12util -d <domain root>/config -o sjsas.p12-W
   <file password> -K <master password> -n s1as
   ```

   - **If you are using GlassFish v2, you must use the following commands to export the DAS certificate:**

     ```
     <JAVA_HOME>/bin/keytool -export -rfc -alias s1as -keystore
     <GLASSFISH_HOME>/domains/<DOMAIN_NAME>/config/keystore.jks-file s1as.rfc
     ```

     where, <GLASSFISH_HOME> indicates the Application Server installation directory and <DOMAIN_NAME> refers to the domain whose certificate is being exported.

   - **Copy the certificate file to the web server configuration directory.**

2 **Import the DAS certificate.**

- **If you are using Application Server 9.1, import the DAS certificate into the Web Server instance using the following commands:**

```
<webserver_install_dir>/bin/https/admin/bin/pk12util-i sjsas.p12 -d
<webserver_install_dir>/alias -W<file password> -K <webserver security db password> -P
<instance-name>-<hostname>-
```

```
<webserver_install_dir>/bin/https/admin/bin/certutil -M -n s1as -t "TCu"
-d <webserver_install_dir>/alias -P <instance-name>-<hostname>-
```

These commands make the Application Server CA a trusted CA to sign both client and server certificates.

- **If you are using GlassFish v2, import the DAS certificate from the `rfc` file created using certutil, the NSS security tool.**

```
<webserver_install_dir>/bin/certutil -A -a -n s1as -t "TCu" -i s1as.rfc
-d <webserver_install_dir>/alias -P <instance-name>-<hostname>-
```

You can check the presence of this certificate by using the following command, which would list the s1as certificate along with other CA certificates including the default server certificate. Ensure that you type the command in a single line.

```
<WS_INSTALL_ROOT>/bin/certutil -L
-d <webserver_install_dir>/alias -P <instance-name>-<hostname>-
```

3 **If `obj.conf` does not contain the following lines, please append them at the end of the file. (If you are using Application Server 9.1, this step is automatically performed by the installation program.)**

```
<Object ppath="*lbconfigupdate*">
PathCheck fn="get-client-cert" dorequest="1" require="1"
<Object>
<Object ppath="*lbgetmonitordata*">
PathCheck fn="get-client-cert" dorequest="1" require="1"
</Object>
```

4 **You can verify the above set up from the DAS using the steps provided in the section "Verifying the Setup" on page 122. Instead of using the local CA, you can use any other CA and server certificate. In that case you can skip steps 5 and 6 listed in the previous section, but need to import the server certificate that you obtained from other CAs.**

Setting up the Load Balancer in SSL Mode for Web Server 7

1. Start the Web Server's Administration Server using the following command.

   webserver-install-dir`/admin_server/bin/startserv`

2. Create an HTTPS listener as explained in the following steps. If an HTTP listener already exists, you can skip the following steps and proceed to the section "To Export and Import the DAS Certificate for Sun Java System Web Server 7" on page 112.

   a. Log in to Web Server Admin console.

   b. Select the default configuration. Generally, the default configuration name will be identical to the host name. To do this from the Common Tasks page, select the configuration from the Select Configurations list and click Edit Configuration. Alternatively, open the Configurations page and click on the default configuration name in Configurations table.

   c. If you are in the Common Tasks page, click Request Server Certificate. Else, if you are in the Configuration page, open the Certificates page and click the Request button from the Server Certificates table. This is required to create a self signed server certificate for this default configuration.

   d. Provide the details requested by the Request Server Certificate window.

      While doing so, just ensure that the value provided for "*Server Name (cn)" is the fully qualified domain name (FQDN) of the machine where the web server is installed. For example, if the host name is machine1, and the domain name is server.example.com, then the FQDN is machine1.server.example.com. Select the defaults wherever provided.

      You can also create a self-signed certificate using the following command. Make sure that you type the command in a single line.

      webserver-install-dir`/bin/wadm create-selfsigned-cert --user=`
      admin-user `--server-name=`*host-name*
      `--nickname=ServerCert --token=internal --config=`*config-name*

   e. Go back to the selected configuration page.

   f. Open the HTTP Listeners page and click the New button. This is to create an SSL-enabled HTTP listener.

   g. Provide the details sought by the New HTTP Listener wizard. Ensure that the server name is the FQDN provided in the earlier step. Select the SSL button and from the Certificate list, select the previously created server certificate. For example, cert-machine1.server.example.com.

      You can also create an HTTP listener using the following commands. Make sure that you type each command in a single line.

```
webserver-install-dir/bin/wadm create-http-listener
--user=admin-user --server-name=host-name
--default-virtual-server-name=default-virtual-server-name
--listener-port=8090 --config=config-name http-listener-ssl

webserver-install-dir/bin/wadm set-ssl-prop
--user=admin-user --http-listener=http-listener-ssl
--config=config-name enabled=true server-cert-nickname=ServerCert
```

h. Once you have performed the steps listed above, you would see the alert "Deployment Pending" on the top right corner of the Admin console. Click on it and follow the instructions to complete the deployment. This step ensures that the changes to the config store in the web server's Administration Server are copied to the web server instance.

▼ To Export and Import the DAS Certificate for Sun Java System Web Server 7

By exporting and importing the DAS certificate, you can make the DAS a trusted client of Web Server. Client authentication using a DAS certificate ensures that only the DAS connects to Web Server as a trusted client.

1 Open a terminal window and set the LD_LIBRARY_PATH using the following command:

```
export LD_LIBRARY_PATH=/opt/SUNWappserver/lib
```

2 Export the DAS certificate.

- **If you are using Application Server 9.1, export the DAS certificate by executing the command. The DAS certificate acts as both the server certificate as well as the client certificate.**

  ```
  <appserver_install_dir>/lib/upgrade/pk12util -d <domain root>/config -o s1as.p12 -W
  <s1as.pk12-file-password> -K <master password> -n s1as
  ```

- **If you are using GlassFish v2, export the DAS certificate, named with the alias "s1as" using the Java SE 5.0 security tool called keytool. While doing so, select the -rfc option to export the certificate in the printable encoding format, as defined by the Internet RFC 1421 standard.**

  From the command line, you can use the following commands to export the DAS certificate:

  ```
  <JAVA_HOME>/bin/keytool -export -rfc -alias s1as -keystore
  <GLASSFISH_HOME>/domains/<DOMAIN_NAME>/config/keystore.jks-file s1as.rfc
  ```

  where, <GLASSFISH_HOME> indicates the Application Server installation directory and <DOMAIN_NAME> refers to the domain whose certificate is being exported.

3 After exporting, copy the certificate file to the web server configuration directory.

4 Import the DAS certificate.

- **If you are using Application Server 9.1, import the DAS certificate into the Web Server instance and set the trust attributes for the certificate using the following commands:**

```
<webserver_install_dir>/bin/pk12util -i <path_to_s1as.pk12-file>
-d <webserver_install_dir>/admin-server/config-store/<default-config-name>/config
-K <webserver security db password> -W <s1as.pk12-file-passwd>

<webserver_install_dir>/bin/certutil -M -n s1as -t "TCu"
-d <webserver_install_dir>/admin-server/config-store/<default-config-name>/config
```

  These commands make the Application Server CA be a trusted CA to sign both client and server certificates.

- **If you are using GlassFish v2, import the DAS certificate from the `rfc` file created using certutil, the NSS security tool.**

```
<webserver_install_dir>/bin/certutil -A -a -n s1as -t "TCu" -i s1as.rfc -d
<webserver_install_dir>/admin-server/config-store/<CONFIG_NAME>/config
```

  where, <webserver_install_dir> refers to the web server installation directory and <CONFIG_NAME> refers to the configuration name created for the default web server instance.

  You can check the presence of this certificate by using the following command, which would list the s1as certificate along with other CA certificates including the default server certificate. Make sure that you type the entire command in a single line.

```
<webserver_install_dir>/bin/certutil -L -d
<webserver_install_dir>/admin-server/config-store/
<DEFAULT_CONFIG_NAME>/config
```

  You can also use the Web Server Admin Console to view this. Select the configuration to which the certificate has been imported to (default config, in this case), and then select the Certificates tab. To look at all the certificates available, select the Certificate Authorities sub tab.

5 Make the following configuration changes to Web Server 7 if you are using GlassFish v2. You can skip to the next step if you are using Application Server 9.1.

a. Append the following lines to `obj.conf` file located at `<WS_INSTALL_ROOT>/admin-server/config-store/<DEFAULT_CONFIG_NAME>/config/`. Make sure that you type in these lines without any trailing spaces.

```
 <Object ppath="*lbconfigupdate*">
 PathCheck fn="get-client-cert" dorequest="1" require="1"
</Object>
<Object ppath="*lbgetmonitordata*">
```

```
 PathCheck fn="get-client-cert" dorequest="1" require="1"
</Object>
```

6 **Deploy the configuration. While doing the changes listed in the previous steps, the Admin Console would mark this configuration to be deployed.**

   a. **Select the icon for Deployment Pending in the Web Server Admin Console. You can also deploy this configuration using the CLI utility `wadm` as follows:**

   ```
   <webserver_install_dir>/bin/wadm deploy-config --user=<admin> <DEFAULT_CONFIG_NAME>
   ```

7 **Test this setup from the GlassFish DAS to see if it communicates with the configured HTTP Load Balancer over SSL. For more information, see "Verifying the Setup" on page 122.**

Using Apache Web Server

The load balancer plug-in bundled with Application Server 9.1 supports Apache Web Server 2.0.x. To use Apache Web Server, you must perform certain configuration steps before and after installing the load balancer plug-in. The load balancer plug-in installation also makes additional modifications to the Apache Web Server. After the plug-in is installed, you must perform additional configuration steps.

Note – Apache 2 has multithreaded behavior if compiled with the `--with-mpm=worker` option.

Requirements for Using Apache Web Server

For the Apache Web Server, your installation must meet the minimum requirements.

With Apache, the load balancer plug-in requires:

- `openssl-0.9.7e (source)`
- `httpd-2.0.59 (source)`
- `gcc-3.3-sol9-sparc-local` packages (for Solaris 9 SPARC).
- `gcc-3.3-sol9-intel-local` packages (for Solaris 9 x86)
- The pre-installed `gcc` (for Solaris 10)
- `flex-2.5.4a-sol9-sparc-local` packages (for Solaris 9 SPARC)
- `flex-2.5.4a-sol9-intel-local` packages (for Solaris 9 x86)

- The pre-installed `flex` (for Solaris 10)

The software sources are available at `http://www.sunfreeware.com`

In addition, before compiling Apache:

- On the Linux platform, install Sun Java System Application Server on the same machine.
- On the Solaris 9 operating system, use `pkgadd` to install `gcc` and `flex`. Note that `pkgadd` requires root access.
- On the Solaris 9 operating system, ensure that `gcc` version 3.3 and `make` are in the `PATH`, and `flex` is installed.
- On the Solaris 10 operating system, before running `make` for OpenSSL, run `mkheaders`, located in `/usr/local/lib/gcc-lib/sparc-sun-solaris2.9/3.3/install-tools` on Solaris SPARC or `/usr/local/lib/gcc-lib/i386-pc-solaris2.9/3.3/install-tools` on Solaris x86.
- If you are using `gcc` on Red Hat Enterprise Linux Advanced Server 2.1, the version must be later than `gcc` 3.0.

Note – To use a C compiler other than `gcc`, set the path of the C compiler and `make` utility in the PATH environment variable.

Applying the Apache Web Server Patch

Before installing the load balancer plug-in for Apache, apply the patch for the Apache Web Server issue 12355. More details about this issue are available at `http://issues.apache.org/bugzilla/show_bug.cgi?id=12355`. This patch is required for the Auto Apply feature to work. To apply the patch, follow these steps.

1. Untar `http-2.0.59.tar` and go to the directory httpd-2.0.59.
2. Download the patch from `http://issues.apache.org/bugzilla/attachment.cgi?id=16495` and save it as a file, for example, `12355.diff`.
3. From the directory `httpd-2.0.59/modules/ssl`, run the following command:

   ```
   patch < 12355.diff
   ```

Configuring Apache before Installing the Load Balancer Plug-in

The Apache source must be compiled and built to run with SSL. This section describes the minimum requirements and high-level steps needed to successfully compile Apache Web

Server to run the load balancer plug-in. These requirements and steps only apply to the Solaris and Linux versions of the software. For information on the Windows version of Apache, see the Apache web site.

Note – The instructions included here are adapted from the instructions at `http://httpd.apache.org/docs`. For detailed instructions on installing SSL-aware Apache, please see that web site.

▼ To Install SSL-aware Apache

Before You Begin You must have already downloaded and uncompressed the Apache software.

1. **Download and unpack the OpenSSL source, available at `http://openssl.org`.**

2. **Compile and build OpenSSL.**

   For full installation instructions, see the file named `INSTALL` in the directory where you uncompressed OpenSSL. That file has information on installing OpenSSL in a user-specified location.

   For more information about OpenSSL, see the `http://www.openssl.org/`.

3. **Download and unpack Apache.**

   Apache is available from `http://httpd.apache.org`.

4. **Compile and build Apache. Configure the source tree:**

   a. **`cd http-2.0_`*x*.**

   b. **Run the following command:**

      `./configure --with-ssl=` *OpenSSL-install-path* `--prefix=` *Apache-install-path* `--enable-ssl --enable-so`

      In the above commands, *x* is the Apache version number, *open-ssl-install-path* is the absolute path to directory where OpenSSL is installed, and *Apache-install-path* is the directory in which to install Apache.

      Note that you only need to use the `--enable-ssl --enable-so` options if your Apache 2 server will be accepting HTTPS requests.

5. **For Apache on Linux 2.1, before compiling:**

   a. **Open `src/MakeFile` and find the end of the automatically generated section.**

b. Add the following lines after the first four lines after the automatically generated section:

```
LIBS+= -licuuc -licui18n -lnspr4 -lpthread -lxerces-c
-lsupport -lnsprwrap -lns-httpd40
LDFLAGS+= -L/application-server-install-dir/lib -L/opt/sun/private/lib
```

Note that `-L/opt/sun/private/lib` is only required if you installed Application Server as part of a Java Enterprise System installation.

For example:

```
## (End of automatically generated section)
##
CFLAGS=$(OPTIM) $(CFLAGS1) $(EXTRA_CFLAGS)
LIBS=$(EXTRA_LIBS) $(LIBS1)
INCLUDES=$(INCLUDES1) $(INCLUDES0) $(EXTRA_INCLUDES)
LDFLAGS=$(LDFLAGS1) $(EXTRA_LDFLAGS)
"LIBS+= -licuuc -licui18n -lnspr4 -lpthread
-lxerces-c -lsupport -lnsprwrap -lns-httpd40
LDFLAGS+= -L/application-server-install-dir /lib -L/opt/sun/private/lib
```

c. Set environment variable `LD_LIBRARY_PATH`.

With stand–alone installations, set it to the Application Server: *as-install*`/lib`

With Java Enterprise System installations, set it to the Application Server: *as-install*`/lib:opt/sun/private/lib`.

If you are using Solaris 9, add `/usr/local/lib` to the `LD_LIBRARY_PATH`.

6 Compile Apache as described in the installation instructions for the version you are using.

For more information, see the `http://httpd.apache.org/`

In general, the steps are:

a. `make`

b. `make install`

7 Make sure Apache's `ssl.conf` and `httpd.conf` files contain the correct values for your environment.

- In `ssl.conf`, for `VirtualHost default:`*port* replace the default hostname and port with the hostname of the local system where Apache is installed and the server's port number.

  Without this change, the load balancer will not work. On Solaris Apache may not start and on Linux, HTTPS requests may not work.
- In `ssl.conf`, for `ServerName www.example.com:443`, replace `www.example.com` with the hostname of the local system where Apache is installed.

Without this change, the following warning appears when you start Apache if a security certificate is installed:

```
[warn] RSA server certificate CommonName (CN)
hostname does NOT match server name!
```

For more information on installing certificates for Apache, see "To Create a Security Certificate for Apache " on page 120.

- In `httpd.conf`, for `ServerName` `www.example.com:80`, replace `www.example.com` with the hostname of the local system where Apache is installed.

  Without this change, you see warnings when you start Apache that the system could not determine the server's fully qualified domain name, and that there are overlapping VirtualHost entries.

8 Ensure that the Apache user has the required access permissions to the *apache-install-location*`/conf/` directory and files in this directory.

The Apache user is the UNIX user under which the Apache server responds to requests. This user is defined in the file `httpd.conf`.

If you installed Apache as a root user, read the note about configuring the Apache user and group in *apache-install-location*`/conf/httpd.conf`.

Note – Ensure that your configuration of users and groups meets the security requirements for this directory. For example, to restrict access to this directory, add the Apache user to the same user group as the owner of the directory.

---

a. To ensure that the Auto Apply feature operates correctly, grant the Apache user read access, write access, and execute access to the *apache-install-location*`/conf/` directory.

- **If the Apache user is in the same group as the owner of this directory, change the mode to 775.**
- **If the Apache user is in a different group than the owner of this directory, change the mode to 777.**

b. To ensure that the load balancer plug-in is initialized when Apache is started, grant the Apache user read access and write access to the following files:

- *apache-install-location*`/conf/loadbalancer.xml`
- *apache-install-location*`/conf/sun-loadbalancer_1_2.dtd`

Exporting and Importing the DAS Certificate

You must manually export the DAS certificate using the following command:

appserver-install-dir`/lib/upgrade/certutil -L -d` *appserver-instance-dir*`/config -n s1as -a -o sjsas.crt`

This certificate will be required at the time of installing the load balancer plug-in.

The Application Server 9.1 installation program performs the following tasks for you.

- Imports the DAS certificate by copying `sjsas.crt` to the *apache-install-dir*/conf/ssl.crt directory.
- Appends the following lines to `httpd.conf`.

```
<Location /lbconfigupdate>
SSLVerifyClient require
SSLVerifyDepth 1
SSLRequireSSL
SSLCACertificateFile apache-install-dir//conf/ssl.crt/sjsas.crt
SSLRequire ( %{SSL_CIPHER} !~ m/^(EXP|NULL)-/ \
and %{SSL_CLIENT_S_DN_O} eq "Sun Microsystems" \
and %{SSL_CLIENT_S_DN_OU} eq "Sun Java System Application Server" \
and %{SSL_CLIENT_M_SERIAL} eq "<*serial number*>" )
</Location>
<Location /getmonitordata>
SSLVerifyClient require
SSLVerifyDepth 1
SSLRequireSSL
SSLCACertificateFile apache-install-dir/conf/ssl.crt/sjsas.crt
SSLRequire ( %{SSL_CIPHER} !~ m/^(EXP|NULL)-/ \
and %{SSL_CLIENT_S_DN_O} eq "Sun Microsystems" \
and %{SSL_CLIENT_S_DN_OU} eq "Sun Java System Application Server" \
and %{SSL_CLIENT_M_SERIAL} eq "<*serial number*>" )
</Location>
```

Modifications Made by the Load Balancer Plug-in Installer

The load balancer plug-in installation program extracts the necessary files to the `modules` directory in the web server's root directory:

It adds the following entries to the web server instance's `httpd.conf` file:

```
##BEGIN EE LB Plugin Parameters
LoadModule apachelbplugin_module modules/mod_loadbalancer.so
#AddModule mod_apachelbplugin.cpp
```

```
<IfModule mod_apachelbplugin.cpp>
  config-file webserver-instance/httpd/conf/loadbalancer.xml
  locale en
</IfModule>
<VirtualHost machine-ip-address>
  DocumentRoot "webserver-instance/httpd/htdocs"
  ServerName server-name
</VirtualHost>
##END EE LB Plugin Parameters
```

Configuring Apache After Installing the Load Balancer Plug-In

Apache Web Server must have the correct security files to work with the load balancer plug-in. The load balancer depends on the NSS (Network Security Service) library, which requires these security database files. You need to get these security database files from Application Server, so an installation of Application Server must be available in a location accessible by the Web Server.

To configure Apache security files to work with the load balancer, do the following:

Append `/usr/lib/mps` to `LD_LIBRARY_PATH` in the *Apache-install-dir*`/bin/apachectl` script.

▼ To Create a Security Certificate for Apache

These steps are required to support HTTPS requests on Apache.

For detailed information on setting up a security certificate on Apache, see the instructions on `http://httpd.apache.org/docs/2.2/ssl/ssl_faq.html` and `http://www.modssl.org/docs/2.8/ssl_faq.html`. The following procedure is adapted from those web sites.

1. **Set up the following environment variable:**

   `OPENSSL_CONF=`*OpenSSL-installation-directory*`/apps/openssl.cnf`.

2. **Create the server certificate and key by executing the following command:**

   ```
   openssl req -new -x509 -keyout newreq.pem -out newreq.pem -days 365
   ```

   When asked for a common name, give the host name on which you plan to run Apache. For all other prompts, enter values that meet any specific requirements you have.

   This command creates `newreq.pem`.

3. **Open the newly-created `newreq.pem` from the location where the `openssl` command was run.**

4. **Copy the lines beginning with BEGIN CERTIFICATE and ending with END CERTIFICATE and paste them in** *Apache-install-dir*`/conf/ssl.crt/server.crt`**. For example:**

```
-----BEGIN CERTIFICATE-----
....
...
-----END CERTIFICATE-----
```

5. **Copy the lines beginning with BEGIN RSA PRIVATE KEY and END RSA PRIVATE KEY and paste them in** *Apache-install-dir*`/conf/ssl.key/server.key`**. For example:**

```
-----BEGIN RSA PRIVATE KEY-----
...
...
...
-----END RSA PRIVATE KEY-----
```

6. **Make sure that the variables** `SSLCertificateKeyFile` **and** `SSLCertificateFile` **in** *Apache-install-dir*`/conf/ssl.conf` **have the correct values.**

7. **Ensure that the ServerName is not www.example.com. The ServerName should be the actual host name where Apache will run, matching the Common Name you entered when creating the server certificate and key.**

Modifying httpd.conf parameters to enable sticky round robin

For the sticky round robin feature to work, in the `httpd.conf` file, under the section `prefork MPM`, ensure that the values of the parameters `StartServers` and `maxclients` are set to 1. Otherwise, every new session request will spawn a new Apache process and the load balancer plug-in will be initialized resulting in requests landing in the same instance.

Starting Apache on Solaris and Linux

In general, you should start Apache with the same user that installed the Application Server. You must start Apache as root under the following circumstances:

- If you are a Java Enterprise System user.
- If you've used port numbers which are less than 1024.
- If Apache runs as a different user from the user that starts it.

To start Apache in SSL mode, use one of the following commands:

`apachetl startssl` or **`apachetl -k start -DSSL`**

If needed, check the Apache web site for the latest information on starting the Apache server.

Verifying the Setup

1. Install the load balancer plug-in. For detailed steps to install the plug-in, see *Sun Java System Application Server 9.1 Installation Guide*. During the installation, provide the path to the DAS certificate.
2. Log in to the Application Server Admin Console and create a new cluster. For steps to create a new cluster, refer to the Admin Console Online Help.
3. Create a new HTTP Load Balancer. While creating the load balancer, specify the FQDN of the web server host as the device host name, web server SSL Port as the device port and select the cluster you created in the previous step as the target. For detailed steps to create a new HTTP Load Balancer, refer to the Admin Console Online Help.
4. To verify that the communication between the DAS and the web server is working properly, in the Admin Console, navigate to the HTTP Load Balancers node and click the HTTP Load Balancer. In the Load Balancer Device Settings page that appears, press the Test Connection button.

   If you have not enabled the Automatically Apply Changes option while creating a load balancer, then you must manually export the load balancer configuration by going to the Export tab and clicking Apply Changes now.
5. If the test connection fails, be sure to check the Application Server domain logs and the web server logs to troubleshoot the problem. Also check if all the configuration steps have been performed correctly.

Using Microsoft IIS

To use Microsoft Internet Information Services (IIS) with the load balancer plug-in, follow the steps provided in these sections.

▼ To Configure Microsoft IIS to use the Load Balancer Plug-in

1 Open the Internet Services Manager.

2 Select the web site for which you want to enable the plug-in.

This web site is typically named the Default Web Site.

3 Right click on the web site and select Properties to open the Properties notebook.

4 Add a new ISAPI filter, following these steps:

a. Open the ISAPI Filters tab.

b. **Click Add.**

c. **In the Filter Name field, enter `Application Server`**

d. **In the Executable field, type `C:\Inetpub\wwwroot\sun-passthrough\sun-passthrough.dll`.**

e. **Click OK, and close the Properties notebook.**

5 **Create and configure a new virtual directory:**

a. **Right click on the default web site, select New, and then Virtual Directory.**
The Virtual Directory Creation Wizard opens.

b. **In the Alias field, type `sun-passthrough` .**

c. **In the Directory field, type `C:\Inetpub\wwwroot\sun-passthrough`.**

d. **Check the Execute Permission checkbox.**
Leave all other permission-related check boxes are left unchecked.

e. **Click Finish.**

6 **Add the path of the `sun-passthrough.dll` file, the Application Server *as-install*`/bin` and the Application Server *as-install*`/lib` to the system's `PATH` environment variable.**

7 **For IIS 6.0 users, configure the Load Balancer Web Service Extension to run in IIS 6 using the following steps:**

a. **In the IIS manager, expand the local computer, and click Web Service Extensions.**

b. **In the Tasks pane, select Add a new Web Service Extension.**

c. **Enter the name of the Extension as `Sun-Passthrough` and click Add.**

d. **Type the path to `sun-passthrough.dll`, `C:\Inetpub\wwwroot\sun-passthrough`.**

e. **Click OK.**

f. **Select Set extension status to Allowed.**

8 **For IIS 6.0 users, create the file `C:\inetput\wwwroot\sun-passthrough\lb.log` and give NTFS write and modify permissions to the group `IIS_WPG` on the file.**

Because IIS 6.0 runs in Worker Process Isolation Mode, it runs the IIS server with the security privileges of the group `IIS_WPG`.

9 **For all IIS users, restart the machine.**

10 **Verify that the web server, load balancer plug-in, and Application Server are operating correctly.**

Type the following in a web browser to access the web application context root: **`http://`***web-server-name*`/`*web-application*, where *web-server-name* is the host name or IP address of the web server and *web-application* is the context root that you listed in the `C:\Inetpub\wwwroot\sun-passthrough\sun-passthrough.properties` file.

Tip – The ISAPI filter status should be green. To check the filter status, access the web site's Properties notebook and click the ISAPI Filters tab. If the status is not green, try sending any HTTP request to the IIS HTTP port. It is OK if the request fails. Recheck the ISAPI filter status.

Automatically configured sun-passthrough properties

The installer automatically configures the following properties in `sun-passthrough.properties`. You can change the default values.

Property	Definition	Default Value
`lb-config-file`	Path to the load balancer configuration file	*IIS-www-root*`\sun-passthrough\loadbalancer.xml`
`log-file`	Path to the load balancer log file	*IIS-www-root*`\sun-passthrough\lb.log`
`log-level`	Log level for the web server	INFO

Note – The Auto Apply feature of Application Server 9.1 is not currently supported with IIS.

◆ ◆ ◆ CHAPTER 5

Configuring HTTP Load Balancing

This chapter describes the HTTP load balancer plug-in. It includes the following topics:

For information on other types of load balancing, see Chapter 10, "Java Message Service Load Balancing and Failover"and Chapter 11, "RMI-IIOP Load Balancing and Failover."

This section discusses using the HTTP load balancing plug-in included with the Application Server. Another HTTP load balancing option is to use the Sun Secure Application Switch with the Application Server for a hardware-based load balancing solution. For a tutorial on configuring this solution, see the article Clustering and Securing Web Applications: A Tutorial (`http://developers.sun.com/prodtech/appserver/reference/techart/load-balancing.html`).

What's New in the Load Balancer Plug-in

In Sun Java System Application Server 9.1, the functionality of the load balancer is enhanced to provide increased flexibility and ease-of-use through the following features.

Auto Apply

Application Server allows changes to the load balancer configuration made from the Admin Console to be automatically sent over the wire to the Web Server configuration directory. With

previous versions of Application Server, the load balancer configuration had to be exported and then copied over to the web server configuration directory.

Weighted Round Robin

The load balancer enables improved distribution of HTTP requests. The administrator can use an attribute called 'weight' to specify how requests will be proportionately routed to an instance. For example, suppose a cluster has two instances, and the administrator has assigned a weight of 100 to instance x and a weight of 400 to instance y. Now, for every 100 requests, 20 will go to instance x and 80 will go to instance y.

User–defined Load Balancing

Application Server enables the administrator to define a custom policy for distributing HTTP requests. A custom policy defines the load balancing algorithm that the load balancer plug-in must use. In other words, the Administrator can define which Application Server instance will handle an HTTP request. To use this feature, the administrator needs to develop a shared library, which can, for example, be used to evaluate the headers of incoming requests provided to it and in accordance to some criteria, select the instance that can serve the request. This shared library would be loaded by the load balancer.

The shared library must implement an interface as defined in `loadbalancer.h`, which is available under `appserver_install_dir/lib/install/templates`.

Application Server also bundles a sample module `roundrobin.c` that implements the basic round robin algorithm. The administrator can use this sample module as a template to build the shared library. This sample module is also available under `appserver_install_dir/lib/install/templates`.

▼ To Configure User-defined Load Balancing

1. **Copy `roundrobin.c` from `appserver_install_dir/lib/install/templates` to a work directory (for example:`/home/user/workspacelb`).**

2. **Compile `roundrobin.c` with an ANSI C/C++ compiler (for example Sun Studio compiler or GCC). Be sure to build a dynamic shared library and not a static executable.**

   a. **If you are using Sun Studio CC Compiler, use the following command to compile:**

      ```
      cc -G -I<appserver install dir>/lib/install/templates roundrobin.c -o roundrobin.so
      ```

b. If you are using GCC, compile the shared library with this command:

```
gcc -shared -I<appserver install dir>/lib/install/templates
roundrobin.c -o roundrobin.so
```

Note – If you encounter a relocation error, compile again using the option "-fPIC." The command will look like this:

```
gcc -shared -fPIC -I <appserver install dir>/lib/install/templates
roundrobin.c -o roundrobin.so
```

On Microsoft Windows, download the Cygwin utility from `http://www.redhat.com/services/custom/cygwin`. This utility has GCC bundled with it. Use the following GCC command to create a dynamic link library (dll):

```
gcc -shared -I<appserver_install_dir>/lib/install/templates
roundrobin.c -o roundrobin.dll
```

3 **Change `loadbalancer.xml` to point to the newly built module. This is how `loadbalancer.xml` will look after the edit.**

```
<cluster name="cluster1" policy="user-defined"
policy-module="home/user/workspacelb/roundrobin.so">
```

4 **Copy `roundrobin.so` to the web server instance directory.**

5 **Start the web server if it is not running or wait till the load balancer is re-configured.**

How the HTTP Load Balancer Works

The load balancer attempts to evenly distribute the workload among multiple Application Server instances (either stand-alone or clustered), thereby increasing the overall throughput of the system.

The HTTP Load Balancer enables high availability of services deployed on Java EE Application Servers. While doing so, it fails over a session request to another server instance if the original servicing instance is detected to be unavailable or unhealthy to service a request. For HTTP session information to persist, you must be using the Cluster profile, have installed and set up the HADB, and configured HTTP session persistence. For more information, see Chapter 9, "Configuring High Availability Session Persistence and Failover."

Note – The load balancer does not handle URI/URLs that are greater than 8k.

HTTP Load Balancing Algorithm

The Sun Java System Application Server load balancer, by default, uses a *sticky round robin algorithm* to load balance incoming HTTP and HTTPS requests.

When a new HTTP request is sent to the load balancer plug-in, it is forwarded to an application server instance based on a simple round robin scheme. If the request is for a session-based application, then this also includes a request for a new session. Subsequent requests from the same client for the same session-based application are considered assigned or sticky requests and are routed by the load balancer to the same instance. Hence, the name sticky round robin. Requests to a non session-based application and the first request for a session-based application are called unassigned requests. Stickiness is achieved by using cookies, or explicit URL rewriting. The load balancer determines the method of stickiness automatically.

The load balancer plug-in uses the following methods to determine session stickiness:

- **Cookie Method**: the load balancer plug-in uses a separate cookie to record the route information. The HTTP client (typically, the web browser) must support cookies to use the cookie based method. If the HTTP client is unable to accept cookies, the plug-in uses the following method.
- **Explicit URL Rewriting**: the sticky information is appended to the URL. This method works even if the HTTP client does not support cookies.

From the sticky information, the load balancer plug-in first determines the instance to which the request was previously forwarded. If that instance is found to be healthy, the load balancer plug-in forwards the request to that specific application server instance. Therefore, all requests for a given session are sent to the same application server instance.

Setting Up HTTP Load Balancing

This section describes how to set up the load balancer plug-in and includes the following sections:

Prerequisites for Setting Up Load Balancing

Before configuring your load balancer, you must:

- Install a supported web server and configure it. For more information on configuring a supported web server, see Chapter 4, "Configuring Web Servers for Load Balancing."
- Install the load balancer plug-in.

  For information on the installation procedure, see *Sun Java System Application Server 9.1 Installation Guide*.
- Create Application Server clusters or server instances to participate in load balancing.
- Deploy applications to these clusters or instances.

Note – If you have a deployment scenario where the Application Server instances and the load balancer are installed on different network domains, then you must create the node agent by specifying the fully qualified domain name using the option, `--agentproperties`. For example, `asadmin create-node-agent --agentproperties remoteclientaddress=machine1.server.example.com test-na`. For more information about this command, see `create-node-agent`(1).

Procedure to Set Up Load Balancing

Use the Admin Console GUI or the `asadmin` tool to configure load balancing in your environment. The following sections provide you more information.

▼ To Set Up Load Balancing Using the Admin Console

1 Create a load balancer configuration.

In the Admin Console, on the left frame, click HTTP Load Balancers and then click New. In the New HTTP Load Balancer page, provide the device details and also select the target cluster or instances.

2 Add a reference to a cluster or stand-alone server instance for the load balancer to manage.

To do this using the Admin Console, on the left frame, click the HTTP Load Balancers node and then click the desired load balancer listed under the node. Open the Targets tab, click Manage Targets and in the Manage Targets page, select the required target.

If you created the load balancer configuration with a target, and that target is the only cluster or stand-alone server instance the load balancer references, skip this step.

3 **Enable the cluster or stand-alone server instance referenced by the load balancer.**

To enable a stand-alone server instance using the Admin Console, on the left frame, click the HTTP Load Balancers node and then click the desired load balancer listed under the node. Open the Targets tab and in the Targets table, click the check box next to the instance you want to enable and click Enable.

To enable a server instance in a cluster, select the load balancer as explained above and in the Targets tab, click the desired cluster. Now open the Instances tab, select the desired instance, and from the Load Balancer Actions drop down list, select Enable Load Balancing.

The equivalent command to enable a cluster or a stand-alone instance is `asadmin enable-http-lb-server`.

4 **Enable applications for load balancing.**

To do this using the Admin Console, open the Targets tab as mentioned above and click the required cluster. Now, open the Applications tab, select the required application and from the More Actions drop-down list, and select Load Balancer Enable.

These applications must already be deployed and enabled for use on the clusters or stand-alone instances that the load balancer references. Enabling applications for load balancing is a separate step from enabling them for use.

5 **Create a health checker.**

To do this using the Admin Console, open the Targets tab for the load balancer as mentioned in the previous step and in the Targets table, click Edit Health Checker.

The health checker monitors unhealthy server instances so that when they become healthy again, the load balancer can send new requests to them.

Note – If you are using Sun Java System Web Server (6.1 or 7.0), instead of performing steps 6 and 7, you can generate the load balancer configuration file and send the data over the wire to the Web Server in a single step.

To do this using the Admin Console, click the desired load balancer and then open the Export tab. In this tab, click Apply Changes Now. This sends the data to the Web Server configuration directory.

---

6 **Generate the load balancer configuration file.**

To do this using the Admin Console, click the load balancer and then open the Export tab. In this tab, click Export Now.

This command generates a configuration file to use with the load balancer plug-in shipped with the Sun Java System Application Server.

7 **Copy the load balancer configuration file to your web server `config` directory where the load balancer plug-in configuration files are stored.**

Note – To generate the load balancer configuration file automatically and send the data over the wire to the Web Server in a single step, you need to configure Web server for SSL setup and import the DAS certificate. For information on configuring Sun Java System Web Server, see "Configuring Sun Java System Web Server" on page 106.

▼ To Set Up Load Balancing Using the `asadmin` Tool

1 Create a load balancer configuration.

To do this, use the command, `asadmin create-http-lb-config`.

Note – You can perform all the following steps (Step 2 through Step 7) using a single `asadmin` command, `create-http-lb` and its options. For more information about this command, see `create-http-lb`(1).

2 Add a reference to a cluster or stand-alone server instance for the load balancer to manage.

To do this, use the command, `asadmin create-http-lb-ref`. For more information about this command, see `create-http-lb-ref`(1).

If you created the load balancer configuration with a target, and that target is the only cluster or stand-alone server instance the load balancer references, skip this step.

3 Enable the cluster or stand-alone server instance referenced by the load balancer.

To do this, use the command `asadmin enable-http-lb-server`. For more information about this command, see `enable-http-lb-server`(1).

4 Enable applications for load balancing.

To do this, use the command `asadmin enable-http-lb-application`. For more information about this command, see `enable-http-lb-application`(1).

These applications must already be deployed and enabled for use on the clusters or stand-alone instances that the load balancer references. Enabling applications for load balancing is a separate step from enabling them for use.

5 Create a health checker.

To do this, use the command, `asadmin create-http-health-checker`. For more information about this command, see `create-http-health-checker`(1).

The health checker monitors unhealthy server instances so that when they become healthy again, the load balancer can send new requests to them.

Note – If you are using Sun Java System Web Server (6.1 or 7.0), instead of performing steps 6 and 7, you can generate the load balancer configuration file and send the data over the wire to the Web Server in a single step.

To do this using the `asadmin` tool, set the `--autoapplyenabled` option of the `create-http-lb` command to `true`. For more information about this command, see `create-http-lb`(1).

6 **Generate the load balancer configuration file.**

To do this, use the command `asadmin export-http-lb-config`. For more information about this command, see `export-http-lb-config`(1). This command generates a configuration file to use with the load balancer plug-in shipped with the Sun Java System Application Server.

7 **Copy the load balancer configuration file to your web server `config` directory where the load balancer plug-in configuration files are stored.**

Note – To generate the load balancer configuration file automatically and send the data over the wire to the Web Server in a single step, you need to configure Web server for SSL setup and import the DAS certificate. For information on configuring Sun Java System Web Server, see "Configuring Sun Java System Web Server" on page 106.

HTTP Load Balancer Deployments

You can configure your load balancer in different ways, depending on your goals and environment, as described in the following sections:

Using Clustered Server Instances

The most common way to deploy the load balancer is with a cluster or clusters of server instances. By default all the instances in a cluster have the same configuration and the same applications deployed to them. The load balancer distributes the workload between the server instances and requests fail over from an unhealthy instance to a healthy one. If you've configured HTTP session persistence, session information persists when the request is failed over.

If you have multiple clusters, requests can be load balanced across clusters but are only failed over between the instances in a single cluster. Use multiple clusters in a load balancer to easily enable rolling upgrades of applications. For more information, see "Upgrading Applications Without Loss of Availability" on page 147.

Note – Requests cannot be load balanced across clusters and stand-alone instances.

Using Multiple Stand-Alone Instances

It is also possible to configure your load balancer to use multiple stand-alone instances, and load balance and failover requests between them. However, in this configuration, you must manually ensure that the stand-alone instances have homogenous environments and the same applications deployed to them. Because clusters automatically maintain a homogenous environment, for most situations it is better and easier to use clusters.

Configuring the Load Balancer

Load balancer configuration is maintained in the `domain.xml` file. Configuring a load balancer is extremely flexible:

- A load balancer services only one domain, though a domain can have multiple load balancers associated with it.
- Each load balancer configuration can have multiple load balancers associated with it, though each load balancer has only one load balancer configuration.

These sections describe, in more detail, how to create, modify, and use a load balancer configuration:

Configuring an HTTP Load Balancer on the DAS

In Application Server 9.1, you can create a load balancer configuration on the DAS using the Admin Console or the `asadmin` command `create-http-lb`. The following steps explain how

you to do that. If you want more information about the asadmin commands `create-http-lb`, `delete-http-lb`, and `list-http-lbs`, see *Sun Java System Application Server 9.1 Reference Manual*.

In the Admin Console, scroll down the left frame, click the HTTP Load Balancers node and then in the HTTP Load balancers page on the right, click New. In the New HTTP Load Balancer page, provide the following details of the machine hosting the load balancer.

Field	Description
Name	A name for the load balancer configuration.
Enabled	Click the Enabled check box to automatically push the load balancer configuration changes to the physical load balancer residing in the web server configuration directory.
Host	The server on which the web server instance is installed.
Admin Port	The secure HTTP listener port.
Proxy Host	The server on which the proxy server instance is installed.
Proxy Port	The port number used by the proxy server.

You can also create a load balancer configuration using the `asadmin` command `create-http-lb-config`. Table 5–1 describes the parameters. See *Sun Java System Application Server 9.1 Reference Manual* for more information on the commands, `create-http-lb-config`, `delete-http-lb-config`, and `list-http-lb-configs`.

TABLE 5–1 Load Balancer Configuration Parameters

Parameter	Description
response timeout	Time in seconds within which a server instance must return a response. If no response is received within the time period, the server is considered unhealthy. The default is 60.
HTTPS routing	Whether HTTPS requests to the load balancer result in HTTPS or HTTP requests to the server instance. For more information, see "Configuring HTTPS Routing" on page 142.
reload interval	Interval between checks for changes to the load balancer configuration file `loadbalancer.xml`. When the check detects changes, the configuration file is reloaded. A value of 0 disables reloading. For more information, see "Enabling Dynamic Reconfiguration" on page 139.
monitor	Whether monitoring is enabled for the load balancer.
routecookie	Name of the cookie the load balancer plug-in uses to record the route information. The HTTP client must support cookies. If your browser is set to ask before storing a cookie, the name of the cookie is JROUTE.

TABLE 5–1 Load Balancer Configuration Parameters *(Continued)*

Parameter	Description
target	Target for the load balancer configuration. If you specify a target, it is the same as adding a reference to it. Targets can be clusters or stand-alone instances.

Creating an HTTP Load Balancer Reference

When you create a reference in the load balancer to a stand-alone server or cluster, the server or cluster is added to the list of target servers and clusters the load balancer controls. The referenced server or cluster still needs to be enabled before requests to it are load balanced. If you created the load balancer configuration with a target, that target is already added as a reference.

To create a reference using the Admin Console, on the left frame, click the HTTP Load Balancers node and then click the desired load balancer listed under the node. Open the Targets tab, click Manage Targets and in the Manage Targets page, select the required target. Alternatively, you can create a reference using `create-http-lb-ref`. You must supply the load balancer configuration name and the target server instance or cluster.

To delete a reference, use `delete-http-lb-ref`. Before you can delete a reference, the referenced server or cluster must be disabled using `disable-http-lb-server` .

For more information on these commands, see *Sun Java System Application Server 9.1 Reference Manual*.

Enabling Server Instances for Load Balancing

After creating a reference to the server instance or cluster, enable the server instance or cluster using `enable-http-lb-server`. If you used a server instance or cluster as the target when you created the load balancer configuration, you must enable it. To do this using the Admin Console, on the left frame, click the HTTP Load Balancers node and then click the desired load balancer listed under the node. Now, open the Targets tab and in the Targets table, click the check box next to the instance you want to enable and click Enable.

For more information on this command, see `enable-http-lb-server`(1).

Enabling Applications for Load Balancing

All servers managed by a load balancer must have homogenous configurations, including the same set of applications deployed to them. Once an application is deployed and enabled for access (this happens during or after the deployment step) you must enable it for load balancing. If an application is not enabled for load balancing, requests to it are not load balanced and failed over, even if requests to the servers the application is deployed to are load balanced and failed over.

When enabling the application, specify the application name and target. If the load balancer manages multiple targets (for example, two clusters), enable the application on all targets.

To enable an application using the Admin Console, on the left frame, click the HTTP Load Balancers node and then click the desired load balancer listed under the node. Open the Targets tab as mentioned above and click the required cluster. Now, open the Applications tab, select the required application and from the More Actions drop-down list, and select Load Balancer Enable. If you want to do this from the command line, you can use the command `asadmin enable-http-lb-application`. For more information, see `enable-http-lb-application`(1).

If you deploy a new application, you must also enable it for load balancing and export the load balancer configuration again.

Creating the HTTP Health Checker

The load balancer's health checker periodically checks all the configured Application Server instances that are marked as unhealthy. A health checker is not required, but if no health checker exists, or if the health checker is disabled, the periodic health check of unhealthy instances is not performed. The load balancer will not be able to determine when an unhealthy instance becomes healthy.

The load balancer's health check mechanism communicates with the application server instance using HTTP. The health checker sends an HTTP request to the URL specified and waits for a response. A status code in the HTTP response header between 100 and 500 means the instance is healthy.

Note – If you have a deployment scenario where the load balancer is the front–end for a cluster that has instances using a secured port with client certificate authentication enabled, the health checker will not be able to perform a health check of the instances. Hence, those instances will always be marked unhealthy and no requests will be sent to them.

Creating a Health Checker

To specify the health checker properties, you can use the Admin Console or the `asadmin create-http-health-checker` command. To do this in the Admin Console, navigate to the HTTP Load Balancers node, expand it and select the load balancer. Then, open the Target tab, and in the Targets table, click the Edit Health Checker link for the desired target. Specify the following parameters.

TABLE 5–2 Health Checker Parameters

Parameter	Description	Default
Load Balancer	Click the Enabled check box to make the selected server available for load balancing.	False/Disabled
Disable Timeout	The amount of time, in minutes, this server takes to reach a quiescent state after having been disabled .	30 minutes
url	Specifies the listener's URL that the load balancer checks to determine its state of health.	"/"
interval	Specifies the interval in seconds at which health checks of instances occur. Specifying 0 disables the health checker.	30 seconds
timeout	Specifies the timeout interval in seconds within which a response must be obtained for a listener to be considered healthy.	10 seconds

If an application server instance is marked as unhealthy, the health checker polls the unhealthy instances to determine if the instance has become healthy. The health checker uses the specified URL to check all unhealthy application server instances to determine if they have returned to the healthy state.

If the health checker finds that an unhealthy instance has become healthy, that instance is added to the list of healthy instances.

For more information about the commands, see `create-http-health-checker`(1) and `delete-http-health-checker`(1).

Additional Health Check Properties for Healthy Instances

The health checker created by `create-http-health-checker` only checks unhealthy instances. To periodically check healthy instances, set some additional properties in your exported `loadbalancer.xml` file.

Note – These properties can only be set by manually editing `loadbalancer.xml` *after* you've exported it. There is no equivalent `asadmin` command to use.

To check healthy instances, set the following properties.

TABLE 5–3 Health-checker Manual Properties

Property	Definition
active-healthcheck-enabled	True/false flag indicating whether to ping healthy server instances to determine whether they are healthy. To ping server instances, set the flag to true.
number-healthcheck-retries	Specifies how many times the load balancer's health checker pings an unresponsive server instance before marking it unhealthy. Valid range is between 1 and 1000. A default value to set is 3.

Set the properties by editing the `loadbalancer.xml` file. For example:

```
<property name="active-healthcheck-enabled" value="true"/>
<property name="number-healthcheck-retries" value="3"/>
```

If you add these properties, then subsequently edit and export the `loadbalancer.xml` file again, the newly exported configuration won't contain these properties. You must add these properties again to the newly exported configuration.

Exporting the Load Balancer Configuration File

The load balancer plug-in available with Sun Java System Application Server uses a configuration file called `loadbalancer.xml`. After configuring the load balancer, you can export the configuration details from `domain.xml` to the `loadbalancer.xml` file. You can do this using the Admin Console or the asadmin utility.

▼ To Export the Load Balancer Configuration Using the Admin Console

1. **Navigate to the HTTP Load Balancers node and expand it.**
2. **Click the desired load balancer.**

   All the load balancer configuration details are displayed in the General, Settings and Target tabs.
3. **Open the Export tab and click Export now.**
4. **Copy the exported load balancer configuration file to the web server's configuration directory.**

▼ To Export the Load Balancer Configuration Using the asadmin tool

1 **Export a `loadbalancer.xml` file using the `asadmin` command `export-http-lb-config`. For more information on the command, see `export-http-lb-config`(1).**

Export the `loadbalancer.xml` file for a particular load balancer configuration. You can specify a path and a different file name. If you don't specify a file name, the file is named `loadbalancer.xml.` *load-balancer-config-name*. If you don't specify a path, the file is created in the *domain-dir*`/generated` directory.

To specify a path on Windows, use quotes around the path. For example, `"C:\Sun\AppServer\loadbalancer.xml"`.

2 **Copy the exported load balancer configuration file to the web server's configuration directory.**

For example, for the Sun Java System Web Server, that location usually is *web-server-root*`/config`.

The load balancer configuration file in the web server's configuration directory must be named `loadbalancer.xml`. If your file has a different name, such as `loadbalancer.xml.` *load-balancer-config-name*, you must rename it.

Changing the Load Balancer Configuration

If you change a load balancer configuration by creating or deleting references to servers, deploying new applications, enabling or disabling servers or applications, and so on, export the load balancer configuration file again and copy it to the web server's `config` directory. For more information, see "Exporting the Load Balancer Configuration File" on page 138

The load balancer plug-in checks for an updated configuration periodically based on the reload interval specified in the load balancer configuration. After the specified amount of time, if the load balancer discovers a new configuration file, it starts using that configuration.

Enabling Dynamic Reconfiguration

With dynamic reconfiguration, the load balancer plug-in periodically checks for an updated configuration.

To enable dynamic reconfiguration:

- When creating a load balancer configuration, use the `--reloadinterval` option with `asadmin create-http-lb`. For more information on the command, see `create-http-lb`(1).

  This option sets the amount of time between checks for changes to the load balancer configuration file `loadbalancer.xml`. A value of 0 disables dynamic reconfiguration. By default, dynamic reconfiguration is enabled, with a reload interval of 60 seconds.
- If you have previously disabled it, or to change the reload interval, use the `asadmin set` command.

  After changing the reload interval, export the load balancer configuration file again and copy it to the web server's `config` directory, then restart the web server.

Note – If the load balancer encounters a hard disk read error while attempting reconfiguration, it uses the configuration that is currently in memory. The load balancer also ensures that the modified configuration data is compliant with the DTD before over writing the existing configuration.

If a disk read error is encountered, a warning message is logged to the web server's error log file.

The error log for Sun Java System Web Server' is at:
web-server-install-dir`/`*web-server-instance*`/logs/`.

Disabling (Quiescing) a Server Instance or Cluster

Before stopping an application server for any reason, the instance should complete serving requests. The process of gracefully disabling a server instance or cluster is called quiescing.

The load balancer uses the following policy for quiescing application server instances:

- If an instance (either stand-alone or part of a cluster) is disabled, and the timeout has not expired, sticky requests continue to be delivered to that instance. New requests, however, are not sent to the disabled instance.
- When the timeout expires, the instance is disabled. All open connections from the load balancer to the instance are closed. The load balancer does not send any requests to this instance, even if all sessions sticking to this instance were not invalidated. Instead, the load balancer fails over sticky requests to another healthy instance.

▼ To disable a server instance or cluster

1 **Run `asadmin disable-http-lb-server`, setting the timeout (in minutes). For more information on the command, see `disable-http-lb-server`(1).**

2. **Export the load balancer configuration file using `asadmin export-http-lb-config`. For more information on the command, see `export-http-lb-config`(1).**

3. **Copy the exported configuration to the web server `config` directory.**

4. **Stop the server instance or instances.**

Disabling (Quiescing) an Application

Before you undeploy a web application, the application should complete serving requests. The process of gracefully disabling an application is called quiescing. When you quiesce an application, you specify a timeout period. Based on the timeout period, the load balancer uses the following policy for quiescing applications:

- If the timeout has not expired, the load balancer does not forward new requests to the application, but returns them to the web server. However, the load balancer continues to forward sticky requests until the timeout expires.
- When the timeout expires, the load balancer does not accept any requests for the application, including sticky requests.

  When you disable an application from every server instance or cluster the load balancer references, the users of the disabled application experience loss of service until the application is enabled again. If you disable the application from one server instance or cluster while keeping it enabled in another server instance or cluster, users can still access the application. For more information, see "Upgrading Applications Without Loss of Availability" on page 147.

▼ To disable an application

1. **Use `asadmin disable-http-lb-application`, specifying the following:**

   - Timeout (in minutes).
   - Name of the application to disable.
   - Target cluster or instance on which to disable it.

   For more information on the command, see `disable-http-lb-application`(1).

2. **Export the load balancer configuration file using `asadmin export-http-lb-config`. For more information on the command, see `export-http-lb-config`(1).**

3. **Copy the exported configuration to the web server `config` directory.**

Configuring HTTP and HTTPS Failover

The load balancer plug-in fails over HTTP/HTTPS sessions to another application server instance if the original application server instance to which the session was connected becomes unavailable. This section describes how to configure the load balancer plug-in to enable HTTP/HTTPS routing and session failover.

HTTPS Routing

The load balancer plug-in routes all incoming HTTP or HTTPS requests to application server instances. However, if HTTPS routing is enabled, an HTTPS request will be forwarded by the load balancer plug-in to an application server using an HTTPS port only. HTTPS routing is performed on both new and sticky requests.

If an HTTPS request is received and no session is in progress, then the load balancer plug-in selects an available application server instance with a configured HTTPS port, and forwards the request to that instance.

In an ongoing HTTP session, if a new HTTPS request for the same session is received, then the session and sticky information saved during the HTTP session is used to route the HTTPS request. The new HTTPS request is routed to the same server where the last HTTP request was served, but on the HTTPS port.

Configuring HTTPS Routing

The `httpsrouting` option of the `create-http-lb-config` command controls whether HTTPS routing is turned on or off for all the application servers that are participating in load balancing. If this option is set to false, all HTTP and HTTPS requests are forwarded as HTTP. If set to true, HTTPS are forwarded as HTTPS requests. Set HTTPS routing when creating a new load balancer configuration, or change it later using the `asadmin set` command.

Note –

- For HTTPS routing to work, one or more HTTPS listeners must be configured.
- If `https-routing` is set to `true`, and a new or a sticky request comes in where there are no healthy HTTPS listeners in the cluster, then that request generates an error.

Known Issues

The Load Balancer has the following limitations with HTTP/HTTPS request processing.

- If a session uses a combination of HTTP and HTTPS requests, then the first request must be an HTTP Request. If the first request is an HTTPS request, it cannot be followed by an HTTP request. This is because the cookie associated with the HTTPS session is not returned by the browser. The browser interprets the two different protocols as two different servers, and initiates a new session. This limitation is valid only if `httpsrouting` is set to true.

- If a session has a combination of HTTP and HTTPS requests, then the application server instance must be configured with both HTTP and HTTPS listeners. This limitation is valid only if `httpsrouting` is set to `true`.
- If a session has a combination of HTTP and HTTPS requests, then the application server instance must be configured with HTTP and HTTPS listeners that use standard port numbers, that is, 80 for HTTP, and 443 for HTTPS. This limitation applies regardless of the value set for `httpsrouting`.

Using Redirects with the Load Balancer

Use redirects to redirect a request from one URL to another URL. For example, use redirects to send users to a different web site (for example, redirecting from an old version of an application to a newer version) or from HTTP to HTTPS or from HTTPS to HTTP. Redirects can be enabled in a number of ways in the application (for example, servlet-based redirects, `web.xml` redirects). However, sending a redirect URL through the load balancer may require some additional configuration of the Application Server or the load balancer. Note that redirects are different from requests that are forwarded using HTTPS Routing. When using redirects, set `httpsrouting` to false. If configuring HTTPS requests to be forwarded to HTTP, use "HTTPS Routing" on page 142.

The following properties affect redirects: the `authPassthroughEnabled` and `proxyHandler` properties of the HTTP service or HTTP listener, and the `rewrite-location` property in the `loadbalancer.xml` file.

The authPassthroughEnabled Property

When the Application Server `authPassthroughEnabled` property is set to true, information about the original client request (such as client IP address, SSL keysize, and authenticated client certificate chain) is sent to the HTTP listeners using custom request headers. The `authPassThroughEnabled` property allows you to take advantage of a hardware accelerator for faster SSL authentication if you have one installed. It is easier to configure a hardware accelerator on the load balancer than on each clustered Application Server instance.

Caution – Set `authPassthroughEnabled` to true only if the Application Server is behind a firewall.

Use the `asadmin set` command to set the `authPassthroughEnabled` property on the HTTP service or the individual HTTP listener. The setting for the individual HTTP listener takes precedence over the setting for the HTTP service.

To set the `authPassthroughEnabled` property on all HTTP/HTTPS listeners, use the following command:

```
asadmin set
cluster-name-config.http-service.property.authPassthroughEnabled=true
```

To set it on an individual listener, use the following command:

```
asadmin set cluster-name-config.http-service.http-listener.listener-name.property.
authPassthroughEnabled=true
```

The proxyHandler Property

The proxy handler for the Application Server is responsible for retrieving information about the original client request that was intercepted by a proxy server (in this case, a load balancer) and forwarded to the Application Server, and for making this information available to the web application (deployed on the Application Server) that is the target of the client request. If the intercepting proxy server is SSL-terminating, the proxy handler retrieves and makes available additional information about the original request, such as whether the original request was an HTTPS request, and whether SSL client authentication is enabled. Use the `proxyHandler` property only if `authPassThroughEnabled` is set to true.

The proxy handler inspects incoming requests for the custom request headers through which the proxy server conveys the information about the original client request, and makes this information available to the web application on the Application Server using standard `ServletRequest` APIs.

The proxy handler implementation is configurable, either globally at the HTTP service level or for individual HTTP listeners, with the `proxyHandler` property, whose value specifies the fully-qualified class name of an implementation of the `com.sun.appserv.ProxyHandler` abstract class. Configurable proxy handler implementations allow the Application Server to work with any proxy server, as long as the proxy handler implementation knows about the HTTP request header names, and understands the format of their values, through which the proxy server conveys information about the original client request.

The proxy handler for the Application Server reads and parses the SSL certificate chain from the request header. This allows a back-end application server instance to retrieve information about the original client request that was intercepted by an SSL-terminating proxy server (in this case, a load balancer). You can use the default proxy handler settings, or configure your own using the `proxyHandler` property of the HTTP service or HTTP/HTTPS listener. The `proxyHandler` property specifies the fully-qualified class name of a custom implementation of the `com.sun.appserv.ProxyHandler` abstract class used by the listener or all listeners.

An implementation of this abstract class inspects a given request for the custom request headers through which the proxy server communicates the information about the original client request to the Application Server instance, and returns that information to its caller. The default implementation reads the client IP address from an HTTP request header named `Proxy-ip`, the SSL keysize from an HTTP request header named `Proxy-keysize`, and the SSL client certificate chain from an HTTP request header named `Proxy-auth-cert`. The `Proxy-auth-cert` value

must contain the BASE-64 encoded client certificate chain without the BEGIN CERTIFICATE and END CERTIFICATE boundaries and with `\n` replaced with `%d%a`.

You can only use this property if `authPassThroughEnabled` is set to true. If you set the `proxyHandler` property on an individual HTTP or HTTPS listener, it overrides the default setting for all listeners.

Use the `asadmin set` command to set the `proxyHandler` property on the HTTP service or the individual HTTP listener.

To set the `proxyHandler` property on all HTTP/HTTPS listeners, use the following command:

`asadmin set` *cluster-name*`-config.http-service.property.proxyHandler=`*classname*

To set it on an individual listener, use the following command:

`asadmin set`
cluster-name`-config.http-service.http-listener.`*listener-name*`.property.proxyHandler=`
classname

The rewrite-location Property

If set to true, the `rewrite-location` property rewrites the original request information and includes the protocol (HTTP or HTTPS), host, and port information By default, the `rewrite-location` property is set to true to maintain backward compatibility with previous Application Server releases.

The `rewrite-location` property is not available through the `asadmin create-http-lb-config` or `asadmin set` commands. To use the property, manually add it to the `loadbalancer.xml` file after exporting your load balancer configuration. For example, add the following to the exported `loadbalancer.xml` file:

```
<property name="rewrite-location" value="false"/>
```

Set the `rewrite-location` property with the following points in mind:

- If `httpsrouting` is false and `authPassthroughEnabled` is not enabled on the Application Server, set the `rewrite-location` property to true. When `authPassthroughEnabled` is not enabled, the Application Server will not be aware of the protocol (HTTP or HTTPS) of the original request. By setting `rewrite-location` to true the load balancer modifies the protocol part of the rewrite location suitably. That is, if the client is sending HTTPS requests, then the load balancer redirects the client to a HTTPS-enabled listener port on the load balancer. The process is the same for HTTP requests.
- If `httpsrouting` is false, and `authPassthroughEnabled` is enabled on the Application Server, then `rewrite-location` can be set to true or false because the Application Server is aware of whether the client request is HTTP or HTTPS. When `authPassthroughEnabled` is enabled, the Application Server modifies the protocol part of rewrite location suitably. If `rewrite-location` is set to false, the load balancer does not rewrite the location of the redirected URL. If set to true, it rewrites the location of the redirected URL. But this rewrite is not needed as the Application Server was aware of HTTPS connections from the client. Also, if the application needs to redirect HTTP to HTTPS or HTTPS to HTTP, you must set the `rewrite-location` parameter to false.

Configuring Idempotent URLs

An *idempotent* request is one that does not cause any change or inconsistency in an application when retried. In HTTP, some methods (such as GET) are idempotent, while other methods (such as POST) are not. Retrying an idempotent URL must not cause values to change on the server or in the database. The only difference is a change in the response received by the user.

Examples of idempotent requests include search engine queries and database queries. The underlying principle is that the retry does not cause an update or modification of data.

To enhance the availability of deployed applications, configure the environment to retry failed idempotent HTTP requests on all the application server instances serviced by a load balancer. This option is used for read-only requests, for example, to retry a search request.

Configure idempotent URLs in the `sun-web.xml` file. When you export the load balancer configuration, idempotent URL information is automatically added to the `loadbalancer.xml` file.

For more information on configuring idempotent URLs, see "Configuring Idempotent URL Requests" in *Sun Java System Application Server 9.1 Developer's Guide*.

Configuring Multiple Web Server Instances

The Sun Java System Application Server installer does not allow the installation of multiple load balancer plug-ins on a single machine. To have multiple web servers with the load balancer plug-in on a single machine, in either a single cluster or multiple clusters, a few manual steps are required to configure the load balancer plug-in.

▼ To Configure Multiple Web Server Instances

1. **Configure the new web server instance to use the load balancer plug-in.**

   For detailed instructions, see "Configuring Sun Java System Web Server" on page 106.

2. **Copy the DTD file `sun-loadbalancer_1_1.dtd` from the existing web server instance's `config` directory to the new instance's `config` directory.**

3. **Set up the load balancer configuration file. Either:**

   - **Copy the existing load balancer configuration.**

     Use an existing load balancer configuration, copy the `loadbalancer.xml` file from the existing web server instance's `config` directory to the new instance's `config` directory.

   - **Create a new load balancer configuration:**

     a. **Use `asadmin create-http-lb-config` to create a new load balancer configuration.**

     b. **Export the new configuration to a `loadbalancer.xml` file using `asadmin export http-lb-config`.**

     c. **Copy that `loadbalancer.xml` file to the new web server's `config` directory.**

     For information on creating a load balancer configuration and exporting it to a `loadbalancer.xml` file, see " Configuring an HTTP Load Balancer on the DAS" on page 133

Upgrading Applications Without Loss of Availability

Upgrading an application to a new version without loss of availability to users is called a *rolling upgrade*. Carefully managing the two versions of the application across the upgrade ensures that current users of the application complete their tasks without interruption, while new users transparently get the new version of the application. With a rolling upgrade, users are unaware that the upgrade occurs.

Application Compatibility

Rolling upgrades pose varying degrees of difficulty depending on the magnitude of changes between the two application versions.

If the changes are superficial, for example, changes to static text and images, the two versions of the application are *compatible* and can both run at once in the same cluster.

Compatible applications must:

- Use the same session information
- Use compatible database schemas
- Have generally compatible application-level business logic
- Use the same physical data source

You can perform a rolling upgrade of a compatible application in either a single cluster or multiple clusters. For more information, see "Upgrading In a Single Cluster" on page 148.

If the two versions of an application do not meet all the above criteria, then the applications are considered *incompatible.* Executing incompatible versions of an application in one cluster can corrupt application data and cause session failover to not function correctly. The problems depend on the type and extent of the incompatibility. It is good practice to upgrade an incompatible application by creating a "shadow cluster" to which to deploy the new version and slowly quiesce the old cluster and application. For more information, see "Upgrading Incompatible Applications" on page 152.

The application developer and administrator are the best people to determine whether application versions are compatible. If in doubt, assume that the versions are incompatible, since this is the safest approach.

Upgrading In a Single Cluster

You can perform a rolling upgrade of an application deployed to a single cluster, providing the cluster's configuration is not shared with any other cluster.

▼ To upgrade an application in a single cluster

1 Save an old version of the application or back up the domain.

To back up the domain use the `asadmin backup-domain` command. For more information on the command, see `backup-domain`(1).

2 Turn off dynamic reconfiguration (if enabled) for the cluster.

To do this with Admin Console:

a. Expand the Configurations node.

b. **Click the name of the cluster's configuration.**

c. **On the Configuration System Properties page, uncheck the Dynamic Reconfiguration Enabled box.**

d. **Click Save**

Alternatively, use this command:

asadmin set --user *user* **--passwordfile** *password-file* *cluster-name***-config.dynamic-reconfiguration-enabled=false**

3 **Redeploy the upgraded application to the target** `domain`**.**

If you redeploy using the Admin Console, the domain is automatically the target. If you use `asadmin`, specify the target `domain`. Because dynamic reconfiguration is disabled, the old application continues to run on the cluster.

4 **Enable the redeployed application for the instances using** `asadmin enable-http-lb-application`**. For more information on the command, see** `enable-http-lb-application`**(1).**

5 **Quiesce one server instance in the cluster from the load balancer.**

Follow these steps:

a. **Disable the server instance using** `asadmin disable-http-lb-server`**. For more information on the command, see** `disable-http-lb-server`**(1).**

b. **Export the load balancer configuration file using** `asadmin export-http-lb-config`**. For more information on the command, see** `export-http-lb-config`**(1).**

c. **Copy the exported configuration file to the web server instance's configuration directory.**

For example, for Sun Java System Web Server, the location is *web-server-install-dir*`/https-`*host-name*`/config/loadbalancer.xml`. To ensure that the load balancer loads the new configuration file, be sure that dynamic reconfiguration is enabled by setting the `reloadinterval` in the load balancer configuration.

d. **Wait until the timeout has expired.**

Monitor the load balancer's log file to make sure the instance is offline. If users see a retry URL, skip the quiescing period and restart the server immediately.

6 **Restart the disabled server instance while the other instances in the cluster are still running.**

Restarting causes the server to synchronize with the domain and update the application.

7 **Test the application on the restarted server to make sure it runs correctly.**

8. **Re-enable the server instance in load balancer.**

   Follow these steps:

   a. **Enable the server instance using** `asadmin enable-http-lb-server`**. For more information on the command, see** `enable-http-lb-server`**(1).**

   b. **Export the load balancer configuration file using** `asadmin export-http-lb-config`**. For more information on the command, see** `export-http-lb-config`**(1).**

   c. **Copy the configuration file to the web server's configuration directory.**

9. **Repeat steps 5 through 8 for each instance in the cluster.**

10. **When all server instances have the new application and are running, you can enable dynamic reconfiguration for the cluster again.**

Upgrading in Multiple Clusters

▼ To Upgrade a Compatible Application in Two or More Clusters:

1. **Save an old version of the application or back up the domain.**

   To back up the domain, use the `asadmin backup-domain` command. For more information on the command, see `backup-domain`(1).

2. **Turn off dynamic reconfiguration (if enabled) for all clusters.**

   To do this with Admin Console:

   a. **Expand the Configurations node.**

   b. **Click the name of one cluster's configuration.**

   c. **On the Configuration System Properties page, uncheck the Dynamic Reconfiguration Enabled box.**

   d. **Click Save**

   e. **Repeat for the other clusters**

   Alternatively, use this command:

   `asadmin set --user` *user* `--passwordfile` *password-file* *cluster-name*`-config.dynamic-reconfiguration-enabled=false`

3. **Redeploy the upgraded application to the target `domain`.**

   If you redeploy using the Admin Console, the domain is automatically the target. If you use `asadmin`, specify the target `domain`. Because dynamic reconfiguration is disabled, the old application continues to run on the clusters.

4. **Enable the redeployed application for the clusters using `asadmin enable-http-lb-application`. For more information on the command, see `enable-http-lb-application`(1).**

5. **Quiesce one cluster from the load balancer**

   a. **Disable the cluster using `asadmin disable-http-lb-server`. For more information on the command, see `disable-http-lb-server`(1).**

   b. **Export the load balancer configuration file using `asadmin export-http-lb-config`. For more information on the command, see `export-http-lb-config`(1).**

   c. **Copy the exported configuration file to the web server instance's configuration directory.**

      For example, for Sun Java System Web Server, the location is *web-server-install-dir*`/https-`*host-name*`/config/loadbalancer.xml`. Dynamic reconfiguration must be enabled for the load balancer (by setting the `reloadinterval` in the load balancer configuration), so that the new load balancer configuration file is loaded automatically.

   d. **Wait until the timeout has expired.**

      Monitor the load balancer's log file to make sure the instance is offline. If users see a retry URL, skip the quiescing period and restart the server immediately.

6. **Restart the disabled cluster while the other clusters are still running.**

   Restarting causes the cluster to synchronize with the domain and update the application.

7. **Test the application on the restarted cluster to make sure it runs correctly.**

8. **Enable the cluster in the load balancer:**

   a. **Enable the cluster using `asadmin enable-http-lb-server`. For more information on the command, see `enable-http-lb-server`(1).**

   b. **Export the load balancer configuration file using `asadmin export-http-lb-config`. For more information on the command, see `export-http-lb-config`(1).**

   c. **Copy the configuration file to the web server's configuration directory.**

9 **Repeat steps 5 through 8 for the other clusters.**

10 **When all server instances have the new application and are running, you can enable dynamic reconfiguration for all clusters again.**

Upgrading Incompatible Applications

If the new version of the application is incompatible with the old version, use the following procedure. For information on what makes applications compatible, see "Application Compatibility" on page 148. Also, you must upgrade incompatible application in two or more clusters. If you have only one cluster, create a "shadow cluster" for the upgrade, as described below.

When upgrading an incompatible application:

- Give the new version of the application a different name from the old version of the application. The steps below assume that the application is renamed.
- If the data schemas are incompatible, use different physical data sources after planning for data migration.
- Deploy the new version to a different cluster from the cluster where the old version is deployed.
- Set an appropriately long timeout for the cluster running the old application before you take it offline, because the requests for the application won't fail over to the new cluster. These user sessions will simply fail.

▼ To Upgrade an Incompatible Application by Creating a Second Cluster

1 **Save an old version of the application or back up the domain.**

To back up the domain use the `asadmin backup-domain` command. For more information on the command, see `backup-domain`(1).

2 **Create a "shadow cluster" on the same or a different set of machines as the existing cluster. If you already have a second cluster, skip this step.**

a. **Use the Admin Console to create the new cluster and reference the existing cluster's named configuration.**

Customize the ports for the new instances on each machine to avoid conflict with existing active ports.

b. **For all resources associated with the cluster, add a resource reference to the newly created cluster using `asadmin create-resource-ref`. For more information on the command, see `create-resource-ref`(1).**

c. **Create a reference to all other applications deployed to the cluster (except the current redeployed application) from the newly created cluster using** `asadmin create-application-ref`**. For more information on the command, see** `create-application-ref`**(1).**

d. **Configure the cluster to be highly available using** `asadmin configure-ha-cluster`**. For more information on the command, see** `configure-ha-cluster`**(1).**

e. **Create reference to the newly-created cluster in the load balancer configuration file using** `asadmin create-http-lb-ref`**. For more information on the command, see** `create-http-lb-ref`**(1).**

3 **Give the new version of application a different name from the old version.**

4 **Deploy the new application with the new cluster as the target. Use a different context root or roots.**

5 **Enable the deployed new application for the clusters using** `asadmin enable-http-lb-application`**. For more information on the command, see** `enable-http-lb-application`**(1).**

6 **Start the new cluster while the other cluster is still running.**

The start causes the cluster to synchronize with the domain and be updated with the new application.

7 **Test the application on the new cluster to make sure it runs correctly.**

8 **Disable the old cluster from the load balancer using** `asadmin disable-http-lb-server`**. For more information on the command, see** `disable-http-lb-server`**(1).**

9 **Set a timeout for how long lingering sessions survive.**

10 **Enable the new cluster from the load balancer using** `asadmin enable-http-lb-server`**. For more information on the command, see** `enable-http-lb-server`**(1).**

11 **Export the load balancer configuration file using** `asadmin export-http-lb-config`**. For more information on the command, see** `export-http-lb-config`**(1).**

12 **Copy the exported configuration file to the web server instance's configuration directory.**

For example, for Sun Java System Web Server, the location is *web-server-install-dir*`/https-`*host-name*`/config/loadbalancer.xml`. Dynamic reconfiguration must be enabled for the load balancer (by setting the `reloadinterval` in the load balancer configuration), so that the new load balancer configuration file is loaded automatically.

13 **After the timeout period expires or after all users of the old application have exited, stop the old cluster and delete the old application.**

Monitoring the HTTP Load Balancer Plug-in

Configuring Log Messages

The load balancer plug-in uses the web server's logging mechanism to write log messages. The default log level on the Application Server is set to the default logging level on Sun Java System Web Server (`INFO`), Apache Web Server (`WARN`) and Microsoft IIS (`INFO`). The application server log levels, `FINE`, `FINER`, and `FINEST`, map to the `DEBUG` level on the web server.

These log messages are written to the web server log files, and are in the form of raw data that can be parsed using scripts, or imported into spreadsheets to calculate required metrics.

Types of Log Messages

The load balancer plug-in generates the following types of log messages:

Load Balancer Configurator Log Messages

These messages will be logged when you are using idempotent URLs and error page settings.

An output for idempotent URL pattern configuration contains the following information:

- When the log level is set to FINE:

  ```
  CONFxxxx: IdempotentUrlPattern configured <url-pattern> <no-of-retries> for
  web-module : <web-module>
  ```

- When the log level is set to SEVERE:

  ```
  CONFxxxx: Duplicate entry of Idempotent URL element <url-pattern> for
  webModule <web-module> in loadbalancer.xml."
  ```

- When the log level is set to WARN:

```
CONFxxxx: Invalid IdempotentUrlPatternData <url-pattern> for web-module
<web-module>
```

An output for error page URL configuration contains the following information (log level set to WARN):

```
CONFxxxx: Invalid error-url for web-module <web-module>
```

Request Dispatch and Runtime Log Messages

These log messages are generated while a request is being load balanced and dispatched.

- An output for standard logging for each method start contains the following information (log level set to FINE):

  ```
  ROUTxxxx: Executing Router method <method_name>
  ```

- An output for router logs for each method start contains the following information (log level set to INFO):

  ```
  ROUTxxxx: Successfully Selected another ServerInstance for idempotent request
  <Request-URL>
  ```

- An output for runtime logs contains the following information (log level set to INFO):

  ```
  RNTMxxxx: Retrying Idempotent <GET/POST/HEAD> Request <Request-URL>
  ```

Configurator Error Messages

These errors appear if there are configuration problems, for example, if the custom error page referenced is missing.

- Log level set to INFO:

  ```
  ROUTxxxx: Non Idempotent Request <Request-URL> cannot be retried
  ```

  For example: `ROUTxxxx: Non Idempotent Request http://sun.com/addToDB?x=11&abc=2 cannot be retried`

- Log level set to FINE:

  ```
  RNTMxxxx: Invalid / Missing Custom error-url / page: <error-url> for
  web-module: <web-module>
  ```

  For example: `RNTMxxxx: Invalid / Missing Custom error-url / page: myerror1xyz for web-module: test`

Enabling Load Balancer Logging

The load balancer plug-in logs the following information:

- Request start/stop information for every request.
- Failed-over request information when the request fails over from an unhealthy instance to a healthy instance.
- List of unhealthy instances at the end of every health check cycle.

Note – When load balancer logging is enabled, and if the web server logging level is set to `DEBUG` or to print verbose messages, the load balancer writes HTTP session IDs in the web server log files. Therefore, if the web server hosting the load balancer plug-in is in the DMZ, do not use the `DEBUG` or similar log level in production environments.

If you must use the `DEBUG` logging level, turn off load balancer logging by setting `require-monitor-data` property to `false` in `loadbalancer.xml`.

▼ To Turn on Load Balancer Logging

1 Set the logging options in the web server. The procedure depends on the web server:

- **With Sun Java System Web Server**

  In the server's Admin console, go to the `Magnus Editor` tab and set the `Log Verbose` option to `On`.

- **For Apache Web Server, set the log level to `DEBUG`.**

- **For Microsoft IIS, set the log level to `FINE` in the `sun-passthrough.properties` file.**

2 Set the load balancer configuration's `monitor` option to true.

Use the `asadmin create-http-lb-config` command to set monitoring to true when you initially create the load balancer configuration, or use the `asadmin set` command to set it to true later. Monitoring is disabled by default.

Understanding Monitoring Messages

The format of the load balancer plug-in log messages is as follows.

- The start of an HTTP request contains the following information:

  ```
  RequestStart Sticky(New) <req-id> <time-stamp> <URL>
  ```

  The timestamp value is the number of milliseconds from January 1, 1970. For example:

  ```
  RequestStart New 123456 602983
  http://austen.sun.com/Webapps-simple/servlet/Example1
  ```

- The end of an HTTP request contains the `RequestExit` message, as follows:

  ```
  RequestExit Sticky(New) <req-id> <time-stamp> <URL> <listener-id>
  <response-time> Failure-<reason for error>(incase of a failure)
  ```

  For example:

  ```
  RequestExit New 123456 603001
  http://austen.sun.com/Webapps-simple/servlet/Example1 http://austen:2222 18
  ```

  Note – In the `RequestExit` message, *response-time* indicates the total request turnaround time in milliseconds, from the perspective of the load balancer plug-in.

- The list of unhealthy instances, as follows:

  ```
  UnhealthyInstances <cluster-id> <time-stamp> <listener-id>, <listener-id>...
  ```

  For example:

  ```
  UnhealthyInstances cluster1 701923 http://austen:2210, http://austen:3010
  ```

- A list of failed-over requests, as follows:

  ```
  FailedoverRequest <req-id> <time-stamp> <URL> <session-id>
  <failed-over-listener-id> <unhealthy-listener-id>
  ```

  For example:

  ```
  FailedoverRequest 239496 705623
  http://austen.sun.com/Apps/servlet/SessionTest 16dfdac3c7e80a40
  http://austen:4044 http://austen:4045
  ```

◆ ◆ ◆ CHAPTER 6

Using Application Server Clusters

This chapter describes how to use Application Server clusters. It contains the following sections:

Overview of Clusters

A *cluster* is a named collection of server instances that share the same applications, resources, and configuration information. You can group server instances on different machines into one logical cluster and administer them as one unit. You can easily control the lifecycle of a multi-machine cluster with the DAS.

Clusters enable horizontal scalability, load balancing, and failover protection. By definition, all the instances in a cluster have the same resource and application configuration. When a server instance or a machine in a cluster fails, the load balancer detects the failure, redirects traffic from the failed instance to other instances in the cluster, and recovers the user session state. Since the same applications and resources are on all instances in the cluster, an instance can failover to any other instance in the cluster.

Group Management Service

The Group Management Service (GMS) is an infrastructure component that is enabled for the instances in a cluster. When GMS is enabled, if a clustered instance fails, the cluster and the Domain Administration Server are aware of the failure and can take action when failure occurs. Many features of Application Server depend upon GMS. For example, GMS is used by the IIOP failover, in-memory replication, transaction service, and timer service features.

If server instances in a cluster are located on different machines, ensure that the machines are on the same subnet.

Note – The GMS feature is not available in the developer profile. In the cluster profile and the enterprise profile, GMS is enabled by default.

GMS is a core service of the Shoal framework. For more information about Shoal, visit the Project Shoal home page (`https://shoal.dev.java.net/`).

▼ To Enable or Disable GMS for a Cluster

1. **In the tree component, select Clusters.**
2. **Click the name of the cluster.**
3. **Under General Information, ensure that the Heartbeat Enabled checkbox is checked or unchecked as required.**
   - **To enable GMS, ensure that the Heartbeat Enabled checkbox is checked.**
   - **To disable GMS, ensure that the Heartbeat Enabled checkbox is unchecked.**
4. **If you are enabling GMS and require different values for these defaults, change the default port and IP address for GMS.**
5. **Click Save.**

Configuring GMS

Configure GMS for your environment by changing the settings that determine how frequently GMS checks for failures. For example, you can change the timeout between failure detection attempts, the number of retries on a suspected failed member, or the timeout when checking for members of a cluster.

To configure monitoring in the Admin Console, go to Application Server node –> Configuration –> Group Management Service.

The equivalent asadmin commands are `get` and `set`.

Working with Clusters

▼ To Create a Cluster

1 **In the tree component, select the Clusters node.**

2 **On the Clusters page, click New.**

The New Cluster page appears.

3 **In the Name field, type a name for the cluster.**

The name must:

- Consist only of uppercase and lowercase letters, numbers, underscores, hyphens, and periods (.)
- Be unique across all node agent names, server instance names, cluster names, and configuration names
- Not be `domain`

4 **In the Configuration field, choose a configuration from the drop-down list.**

- **To create a cluster that does not use a shared configuration, choose `default-config`.**

  Leave the radio button labeled "Make a copy of the selected Configuration" selected. The copy of the default configuration will have the name *cluster_name*`-config`.

- **To create a cluster that uses a shared configuration, choose the configuration from the drop-down list.**

  Select the radio button labeled "Reference the selected Configuration" to create a cluster that uses the specified existing shared configuration.

5 **Optionally, add server instances.**

You can also add server instances after the cluster is created.

Before you create server instances for the cluster, first create one or more node agents or node agent placeholders. See "To Create a Node Agent Placeholder" on page 187

To create server instances:

a. **In the Server Instances To Be Created area, click Add.**

b. **Type a name for the instance in the Instance Name field**

c. **Choose a node agent from the Node Agent drop-down list.**

6 **Click OK.**

More Information

Equivalent asadmin command

```
create-cluster
```

See Also

- "To Configure a Cluster" on page 163
- "To Create Server Instances for a Cluster" on page 162
- "To Configure Applications for a Cluster" on page 165
- "To Configure Resources for a Cluster" on page 165
- "To Delete a Cluster" on page 166
- "To Upgrade Components Without Loss of Service" on page 167

For more details on how to administer clusters, server instances, and node agents, see "Deploying Node Agents" on page 179.

▼ To Create Server Instances for a Cluster

Before You Begin Before you can create server instances for a cluster, you must first create a node agent or node agent placeholder. See "To Create a Node Agent Placeholder" on page 187

1 **In the tree component, expand the Clusters node.**

2 **Select the node for the cluster.**

3 **Click the Instances tab to bring up the Clustered Server Instances page.**

4 **Click New to bring up the Create Clustered Server Instance page.**

5 **In the Name field, type a name for the server instance.**

6. **Choose a node agent from the Node Agents drop-down list.**

7. **Click OK.**

More Information

Equivalent asadmin command

`create-instance`

See Also

- "What is a Node Agent?" on page 177
- "To Create a Cluster" on page 161
- "To Configure a Cluster" on page 163
- "To Configure Applications for a Cluster" on page 165
- "To Configure Resources for a Cluster" on page 165
- "To Delete a Cluster" on page 166
- "To Upgrade Components Without Loss of Service" on page 167
- "To Configure Server Instances in a Cluster" on page 164

▼ To Configure a Cluster

1. **In the tree component, expand the Clusters node.**

2. **Select the node for the cluster.**

   On the General Information page, you can perform these tasks:

   - Click Start Cluster to start the clustered server instances.
   - Click Stop Cluster to stop the clustered server instances.
   - Click Migrate EJB Timers to migrate the EJB timers from a stopped server instance to another server instance in the cluster.

More Information

Equivalent asadmin command

`start-cluster`, `stop-cluster`, `migrate-timers`

See Also

- "To Create a Cluster" on page 161
- "To Create Server Instances for a Cluster" on page 162
- "To Configure Applications for a Cluster" on page 165
- "To Configure Resources for a Cluster" on page 165
- "To Delete a Cluster" on page 166
- "To Upgrade Components Without Loss of Service" on page 167
- "To Migrate EJB Timers" on page 166

▼ To Start, Stop, and Delete Clustered Instances

1. **In the tree component, expand the Clusters node.**
2. **Expand the node for the cluster that contains the server instance.**
3. **Click the Instances tab to display the Clustered Server Instances page.**

   On this page you can:

   - Select the checkbox for an instance and click Delete, Start, or Stop to perform the selected action on all the specified server instances.
   - Click the name of the instance to bring up the General Information page.

▼ To Configure Server Instances in a Cluster

1. **In the tree component, expand the Clusters node.**
2. **Expand the node for the cluster that contains the server instance.**
3. **Select the server instance node.**
4. **On the General Information page, you can:**

   - Click Start Instance to start the instance.
   - Click Stop Instance to stop a running instance.
   - Click JNDI Browsing to browse the JNDI tree for a running instance.
   - Click View Log Files to open the server log viewer.
   - Click Rotate Log File to rotate the log file for the instance. This action schedules the log file for rotation. The actual rotation takes place the next time an entry is written to the log file.
   - Click Recover Transactions to recover incomplete transactions.
   - Click the Properties tab to modify the port numbers for the instance.
   - Click the Monitor tab to change monitoring properties.

See Also

- "To Create a Cluster" on page 161
- "To Configure a Cluster" on page 163
- "To Create Server Instances for a Cluster" on page 162
- "To Configure Applications for a Cluster" on page 165
- "To Configure Resources for a Cluster" on page 165

- "To Delete a Cluster" on page 166
- "To Upgrade Components Without Loss of Service" on page 167
- "To configure how the Application Server recovers from transactions" in *Sun Java System Application Server 9.1 Administration Guide*

▼ To Configure Applications for a Cluster

1 **In the tree component, expand the Clusters node.**

2 **Select the node for the cluster.**

3 **Click the Applications tab to bring up the Applications page.**

On this page, you can:

- Click the Deploy button, select a type of application to deploy. On the Deployment page that appears, specify the application.
- From the Filter drop-down list, select a type of application to display in the list.
- To edit an application, click the application name.
- Select the checkbox next to an application and choose Enable or Disable to enable or disable the application for the cluster.

See Also
- "To Create a Cluster" on page 161
- "To Configure a Cluster" on page 163
- "To Create Server Instances for a Cluster" on page 162
- "To Configure Resources for a Cluster" on page 165
- "To Delete a Cluster" on page 166
- "To Upgrade Components Without Loss of Service" on page 167

▼ To Configure Resources for a Cluster

1 **In the tree component, expand the Clusters node.**

2 **Select the node for the cluster.**

3 **Click the Resources tab to bring up the Resources page.**

On this page, you can:

- Create a new resource for the cluster: from the New drop-down list, select a type of resource to create. Make sure to specify the cluster as a target when you create the resource.

- Enable or Disable a resource globally: select the checkbox next to a resource and click Enable or Disalbe. This action does not remove the resource.
- Display only resources of a particular type: from the Filter drop-down list, select a type of resource to display in the list.
- Edit a resource: click the resource name.

See Also
- "To Create a Cluster" on page 161
- "To Configure a Cluster" on page 163
- "To Create Server Instances for a Cluster" on page 162
- "To Configure Applications for a Cluster" on page 165
- "To Delete a Cluster" on page 166

▼ To Delete a Cluster

1 In the tree component, select the Clusters node.

2 On the Clusters page, select the checkbox next to the name of the cluster.

3 Click Delete.

More Information

Equivalent asadmin command

```
delete-cluster
```

See Also
- "To Create a Cluster" on page 161
- "To Configure a Cluster" on page 163
- "To Create Server Instances for a Cluster" on page 162
- "To Configure Applications for a Cluster" on page 165
- "To Configure Resources for a Cluster" on page 165
- "To Upgrade Components Without Loss of Service" on page 167

▼ To Migrate EJB Timers

If a server instance stops running abnormally or unexpectedly, it can be necessary to move the EJB timers installed on that server instance to a running server instance in the cluster. To do so, perform these steps:

1 In the tree component, expand the Clusters node.

2 Select the node for the cluster.

3. **On the General Information page, click Migrate EJB Timers.**

4. **On the Migrate EJB Timers page:**

   a. **From the Source drop-down list, choose the stopped server instance from which to migrate the timers.**

   b. **(Optional) From the Destination drop-down list, choose the running server instance to which to migrate the timers.**

      If you leave this field empty, a running server instance will be randomly chosen.

   c. **Click OK.**

5. **Stop and restart the Destination server instance.**

   If the source server instance is running or if the destination server instance is not running, Admin Console displays an error message.

More Information

Equivalent asadmin command

```
migrate-timers
```

See Also

- "To Configure a Cluster" on page 163
- Admin Console online help for configuring settings for the EJB timer service

▼ To Upgrade Components Without Loss of Service

You can use the load balancer and multiple clusters to upgrade components within the Application Server without any loss of service. A component can, for example, be a JVM, the Application Server, or a web application.

This approach is not possible if:

- You change the schema of the high-availability database (HADB). For more information, see Chapter 3, "Administering High Availability Database"

Note – The HADB software is supplied with the Application Server standalone distribution of Sun Java System Application Server. For information about available distributions of Sun Java System Application Server, see "Distribution Types and Their Components" in *Sun Java System Application Server 9.1 Installation Guide*. HADB features are available only in the enterprise profile. For information about profiles, see "Usage Profiles" in *Sun Java System Application Server 9.1 Administration Guide*.

- You perform an application upgrade that involves a change to the application database schema.

Caution – Upgrade all server instances in a cluster together. Otherwise, there is a risk of version mismatch caused by a session failing over from one instance to another where the instances have different versions of components running.

1. **Stop one of the clusters using the Stop Cluster button on the General Information page for the cluster.**
2. **Upgrade the component in that cluster.**
3. **Start the cluster using the Start Cluster button on the General Information page for the cluster.**
4. **Repeat the process with the other clusters, one by one.**

   Because sessions in one cluster will never fail over to sessions in another cluster, there is no risk of version mismatch caused by a session's failing over from a server instance that is running one version of the component to another server instance (in a different cluster) that is running a different version of the component. A cluster in this way acts as a safe boundary for session failover for the server instances within it.

See Also

- "To Create a Cluster" on page 161
- "To Configure a Cluster" on page 163
- "To Create Server Instances for a Cluster" on page 162
- "To Configure Applications for a Cluster" on page 165
- "To Configure Resources for a Cluster" on page 165
- "To Delete a Cluster" on page 166

◆ ◆ ◆ CHAPTER 7

Managing Configurations

This chapter describes adding, changing, and using named server configurations in Application Server. It contains the following sections:

Using Configurations

Configurations

A configuration is a set of server configuration information, including settings for things such as HTTP listeners, ORB/IIOP listeners, JMS brokers, the EJB container, security, logging, and monitoring. Applications and resources are not defined in named configurations.

Configurations exist in an administrative domain. Multiple server instances or clusters in the domain can reference the same configuration, or they can have separate configurations.

For clusters, all server instances in the cluster inherit the cluster's configuration so that a homogenous environment is assured in a cluster's instances.

Because a configuration contains so many required settings, create a new configuration by copying an existing named configuration. The newly-created configuration is identical to the configuration you copied until you change its configuration settings.

There are three ways in which clusters or instances use configurations:

- **Stand-alone:** A stand-alone server instance or cluster doesn't share its configuration with another server instance or cluster; that is, no other server instance or cluster references the named configuration. You create a stand-alone instance or cluster by copying and renaming an existing configuration.
- **Shared:** A shared server instance or cluster shares a configuration with another server instance or cluster; that is, multiple instances or clusters reference the same named configuration. You create a shared server instance or cluster by referencing (not copying) an existing configuration.
- **Clustered:** A clustered server instance inherits the cluster's configuration.

See Also:

- "The default-config Configuration" on page 170
- "Configurations Created when Creating Instances or Clusters" on page 170
- "Unique Port Numbers and Configurations" on page 171
- "To Create a Named Configuration" on page 172
- "Editing a Named Configuration's Properties" on page 172

The default-config Configuration

The `default-config` configuration is a special configuration that acts as a template for creating stand-alone server instance or stand-alone cluster configurations. Clusters and individual server instances cannot refer to `default-config`; it can only be copied to create new configurations. Edit the default configuration to ensure that new configurations copied from it have the correct initial settings.

For more information, see:

- "Configurations Created when Creating Instances or Clusters" on page 170
- "Configurations" on page 169
- "To Create a Named Configuration" on page 172
- "Editing a Named Configuration's Properties" on page 172
- "To Edit Port Numbers for Instances Referencing a Configuration" on page 174

Configurations Created when Creating Instances or Clusters

When creating a new server instance or a new cluster, either:

- Reference an existing configuration. No new configuration is added.
- Make a copy of an existing configuration. A new configuration is added when the server instance or cluster is added.

By default, new clusters or instances are created with configurations copied from the `default-config` configuration. To copy from a different configuration, specify it when creating a new instance or cluster.

For a server instance, the new configuration is named *instance_name*`-config` . For a cluster, the new configuration is named *cluster-name* `-config`.

For more information, see:

- "The default-config Configuration" on page 170
- "Configurations" on page 169
- "To Create a Named Configuration" on page 172
- "Editing a Named Configuration's Properties" on page 172

Clustered Configuration Synchronization

When you create a clustered configuration, Application Server creates a cluster configuration directory on the domain administration server at *domain-root*`/`*domain-dir*`/config/cluster-config`. This directory is used to synchronize configurations for all instances in the cluster.

Unique Port Numbers and Configurations

If multiple instances on the same host machine reference the same configuration, each instance must listen on a unique port number. For example, if two server instances reference a named configuration with an HTTP listener on port 80, a port conflict prevents one of the server instances from starting. Change the properties that define the port numbers on which individual server instances listen so that unique ports are used.

The following principles apply to port numbers:

- Port numbers for individual server instances are initially inherited from the configuration.
- If the port is already in use when you create a server instance, override the inherited default value at the instance level to prevent port conflicts.
- Assume an instance is sharing a configuration. The configuration has port number n. If you create a new instance on the machine using the same configuration, the new instance is assigned port number *n*+1, if it is available. If it is not available, the next available port after *n*+1 is chosen.
- If you change the port number of the configuration, a server instance inheriting that port number automatically inherits the changed port number.
- If you change an instance's port number and you subsequently change the configuration's port number, the instance's port number remains unchanged.

  For more information, see:

- "To Edit Port Numbers for Instances Referencing a Configuration" on page 174

- "Editing a Named Configuration's Properties" on page 172
- "Configurations" on page 169

Working with Named Configurations

▼ To Create a Named Configuration

1 **In the tree component, select the Configurations node.**

2 **On the Configurations page, click New.**

3 **On the New Configuration page, enter a unique name for the configuration.**

4 **Select a configuration to copy.**

The configuration `default-config` is the default configuration used when creating stand-alone server instance or stand-alone cluster.

More Information

Equivalent asadmin command

```
copy-config
```

See Also

- "Configurations" on page 169
- "The default-config Configuration" on page 170
- "Editing a Named Configuration's Properties" on page 172
- "To Edit Port Numbers for Instances Referencing a Configuration" on page 174
- "To view a Named Configuration's Targets" on page 174
- "To Delete a Named Configuration" on page 175

Editing a Named Configuration's Properties

The following table describes the properties predefined for a configuration.

The predefined properties are port numbers. Valid port values are 1–65535. On UNIX, creating sockets that listen on ports 1–1024 requires superuser privileges. If more than one server instance exists on a system, the port numbers must be unique.

Property Name	Description
HTTP_LISTENER_PORT	Port number for http-listener-1.
HTTP_SSL_LISTENER_PORT	Port number for http-listener-2.
IIOP_SSL_LISTENER_PORT	ORB listener port for IIOP connections on which IIOP listener `SSL` listens.
IIOP_LISTENER_PORT	ORB listener port for IIOP connections on which `orb-listener-1` listens.
JMX_SYSTEM_CONNECTOR_PORT	Port number on which the JMX connector listens.
IIOP_SSL_MUTUALAUTH_PORT	ORB listener port for IIOP connections on which the IIOP listener `SSL_MUTUALAUTH` listens.

▼ To Edit a Named Configuration's Properties

1. **In the tree component, expand the Configurations node.**
2. **Select the node for a named configuration.**
3. **On the Configuration System Properties page, choose whether to enable dynamic reconfiguration.**

   If enabled, changes to the configuration are applied to the server instances without requiring a server restart.
4. **Add, delete, or modify properties as desired.**
5. **To edit the current values of a property for all instances associated with the configuration, click Instance Values.**

More Information

Equivalent asadmin command

`set`

See Also

- "Configurations" on page 169
- "To Create a Named Configuration" on page 172
- "To view a Named Configuration's Targets" on page 174
- "To Delete a Named Configuration" on page 175

▼ To Edit Port Numbers for Instances Referencing a Configuration

Each instance referencing a named configuration initially inherits its port numbers from that configuration. Since port numbers must be unique on the system, you might need to override the inherited port numbers.

1. **In the tree component, expand the Configurations node.**
2. **Select the node for a named configuration.**

   The Admin Console displays the Configuration System Properties page.
3. **Click Instance Values next to the instance variable you want to edit.**

   For example, if you click Instance Values next to the HTTP-LISTENER-PORT instance variable, you see the value of HTTP-LISTENER-PORT for every server instance that references that configuration.
4. **Change the values as desired and click Save.**

More Information

Equivalent asadmin command

```
set
```

See Also

- "Unique Port Numbers and Configurations" on page 171
- "Configurations" on page 169
- "Editing a Named Configuration's Properties" on page 172

▼ To view a Named Configuration's Targets

The Configuration System Properties page displays a list of all targets using the configuration. For a cluster configuration, the targets are clusters. For an instance configuration, the targets are instances.

1. **In the tree component, expand the Configurations node.**
2. **Select a node for the named configuration.**

See Also

- "Unique Port Numbers and Configurations" on page 171
- "Configurations" on page 169
- "To Create a Named Configuration" on page 172
- "Editing a Named Configuration's Properties" on page 172

- "To Delete a Named Configuration" on page 175

To Delete a Named Configuration

1. **In the tree component, select the Configurations node.**
2. **On the Configurations page, select the checkbox for the named configuration to delete.**
   You cannot delete the `default-config` configuration.
3. **Click Delete.**

More Information

Equivalent asadmin command

```
delete-config
```

See Also

- "Configurations" on page 169
- "To Create a Named Configuration" on page 172
- "Editing a Named Configuration's Properties" on page 172
- "To view a Named Configuration's Targets" on page 174

◆ ◆ ◆ CHAPTER 8

Configuring Node Agents

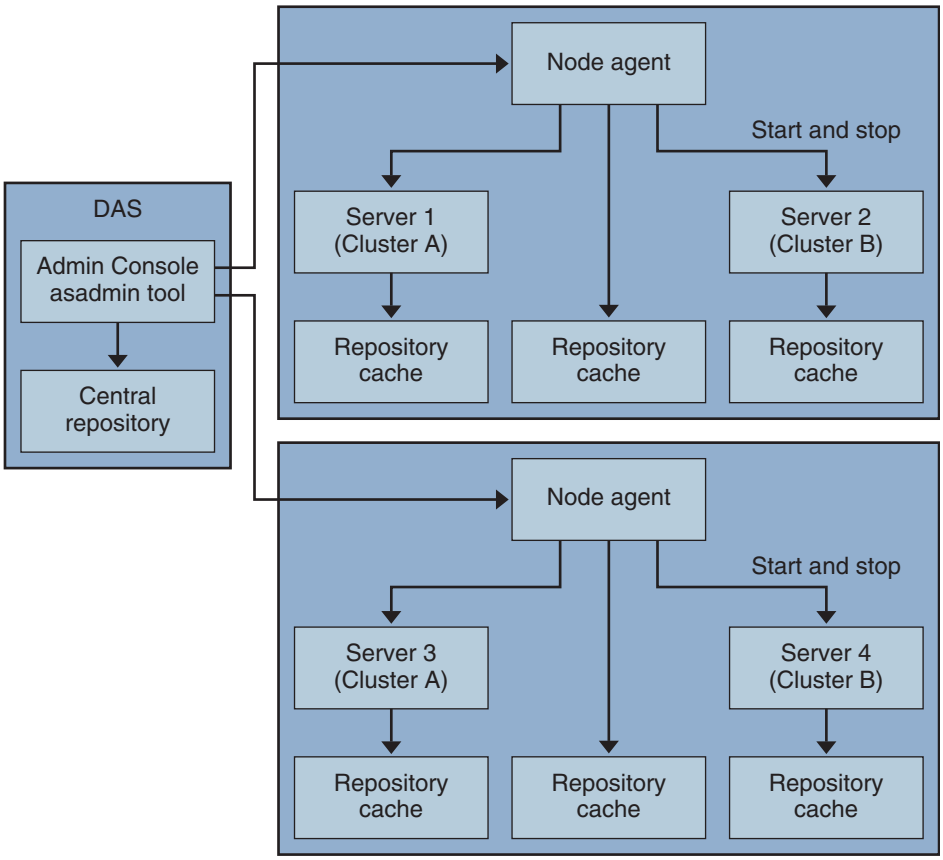
This chapter describes the node agents in Application Server. It contains the following sections:

What is a Node Agent?

A node agent is a lightweight process that is required on every machine that hosts server instances, including the machine that hosts the Domain Administration Server (DAS). The node agent:

- Starts, stops, creates and deletes server instances as instructed by the Domain Administration Server.
- Restarts failed server instances.
- Provides a view of the log files of failed servers.
- Synchronizes each server instance's local configuration repository with the Domain Administration Server's central repository. Each local repository contains only the information pertinent to that server instance or node agent.

  The following figure illustrates the overall node agent architecture:



When you install the Application Server, a node agent is created by default with the host name of the machine. This node agent must be manually started on the local machine before it runs.

You can create and delete server instances even if the node agent is not running. However, the node agent must be running before you use it to start and stop server instances.

A node agent services a single domain. If a machine hosts instances running in multiple domains, it must run multiple node agents.

Server Instance Behavior After Node Agent Failure

A node agent might be stopped unexpectedly, for example, by a software failure or other error. In this situation, any server instances that the node agent was managing are no longer managed. However, such server instances continue to run and remain accessible by the DAS. Information about the server instances can still be obtained through Application Server administrative interfaces, and applications that are deployed on the server instances can still be accessed.

If the node agent is restarted, the server instances that are not managed remain unmamaged. The node agent does *not* resume the management of these server instances. If an unmanaged server instance is stopped unexpectedly, for example, by a software failure or other error, the node agent cannot restart the server instance.

If an unmanaged server instance must continue to run, you cannot resume the management of the server instance by a node agent. The only way to resume the management of an unmanaged server instance is to stop and restart the server instance after the node agent is restarted.

Deploying Node Agents

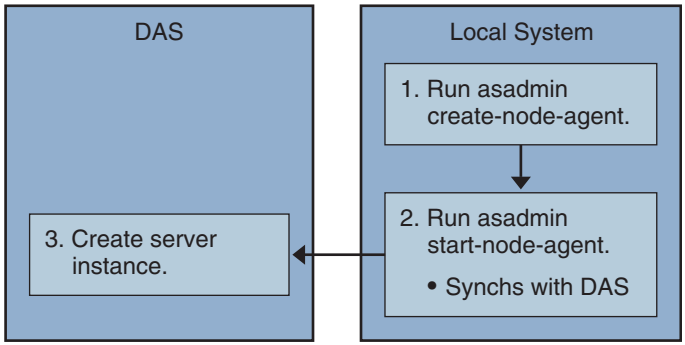
You configure and deploy node agents in two ways:

- *Online deployment*, when you know your topology and already have the hardware for your domain.
- *Offline deployment*, when you are configuring domains and server instances before setting up the full environment

▼ To Deploy Node Agents Online

Use online deployment if you already know the domain topology and have the hardware for your domain.

The following figure summarizes the online deployment of node agents:



Before You Begin Install and start the Domain Administration Server. Once the Domain Administration Server is up and running, begin either online or offline deployment.

1. **Install a node agent on every machine that will host a server instance.**

   Use the installer or the `asadmin create-node-agent` command . If a machine requires more than one node agent, use the `asadmin create-node-agent` command to create them.

   See "Creating a Node Agent" on page 188 for more information.

2. **Start the node agents using the `asadmin start-node-agent` command .**

   When started, a node agent communicates with the Domain Administration Server (DAS). When it reaches the DAS, a configuration for the node agent is created on the DAS. Once the configuration exists, the node agent is viewable in the Admin Console.

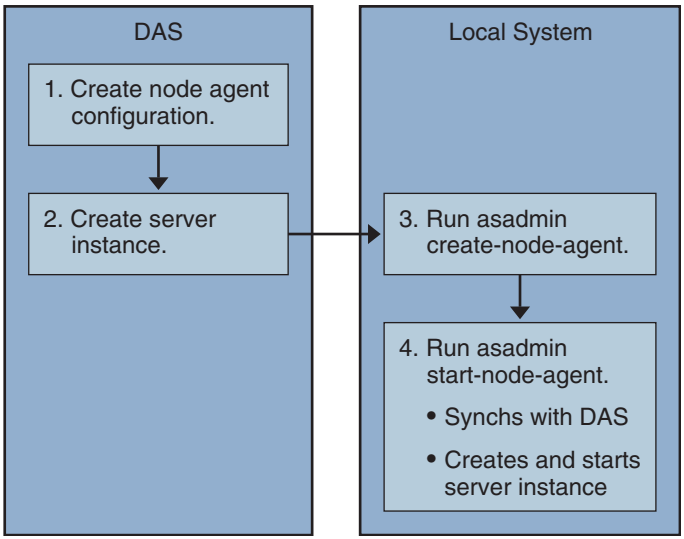
   See "Starting a Node Agent" on page 190 for more information.

3. **Configure the domain: create server instances, create clusters, and deploying applications.**

▼ To Deploy Node Agents Offline

Use offline deployment to deploy node agents in the domain before configuring the individual local machines.

The following figure summarizes the offline deployment.



Before You Begin Install and start the Domain Administration Server. Once the Domain Administration Server is up and running, begin either online or offline deployment.

1. **Create placeholder node agents in the Domain Administration Server.**

   See "To Create a Node Agent Placeholder" on page 187 for more information.

2. **Create server instances and clusters, and deploy applications.**

   When creating a server instance, make sure to assign port numbers that are not already in use. Because the configuration is being done offline, the domain cannot check for port conflicts at creation time.

3. **Install a node agent on every machine that will host a server instance.**

   Use the installer or the `asadmin create-node-agent` command . The node agents must have the same names as the placeholder node agents previously created.

   See "Creating a Node Agent" on page 188 for more information.

4. **Start the node agents using the `asadmin start-node-agent` command .**

   When a node agent is started, it binds to the Domain Administration Server and creates any server instances previously associated with the node agent.

   See "Starting a Node Agent" on page 190 for more information.

Synchronizing Node Agents and the Domain Administration Server

Because configuration data is stored in the Domain Administration Server's repository (the central repository) and also cached on the node agent's local machine, the two must be synchronized. The synchronization of cache is always done on a explicit user action through the administration tools.

This section contains the following topics:

Node Agent Synchronization

When a node agent is started for the first time, it sends a request to the Domain Administration Server (DAS) for the latest information in the central repository. Once it successfully contacts the DAS and gets configuration information, the node agent is bound to that DAS.

Note – By default, the `asadmin start-node-agent` command automatically starts the remote server instances without synchronizing with DAS. If you are starting a remote server instance that is synchronized with the central repository managed by DAS, specify the `--startinstances=false` option of the `asadmin start-node-agent` command. Then use the `asadmin start-instance` command to start the remote server instance.

If you created a placeholder node agent on the DAS, when the node agent is started for the first time it gets its configuration from the central repository of the DAS. During its initial start-up, if the node agent is unable to reach the DAS because the DAS is not running, the node agent stops and remains unbound.

If changes are made in the domain to the node agent's configuration, they are automatically communicated to the node agent on the local machine while the node agent is running.

If you delete a node agent configuration on the DAS, the next time the node agent synchronizes, it stops and marks itself as awaiting deletion. Manually delete it using the local `asadmin delete-node-agent` command.

Server Instance Synchronization

If you explicitly start a server instance with the Admin Console or `asadmin` tool, the server instance is synchronized with the central repository. If this synchronization fails, the server instance doesn't start.

If a node agent starts a server instance without an explicit request through the Admin Console or the `asadmin` tool, the repository cache for the server instance is not synchronized. The server instance runs with the configuration as stored in its cache. You must not add or remove files in the remote server instance's cache.

The remote server instance's configuration are treated as cache (all files under `nodeagents`/*na1*/*server1*) and owned by Application Server. In extreme cases, if user removes all files of a remote server instance and restarts the node agent, the remote server instance (for example, *server1*) will be recreated and all necessary files will be synchronized.

The following files and directories are kept synchronized by the Application Server.

TABLE 8–1 Files and directories synchronized among remote server instances

File or directory	Description
`applications`	All deployed applications. The parts of this directory (and sub directories) synchronized depend on the applications referred to from the server instance. The Node agent does not synchronize any of the applications because it does not reference any application.
`config`	Contains configuration files for the entire domain. All the files in this directory are synchronized except runtime temporary files, such as, `admch`, `admsn`, `secure.seed`, `.timestamp`, and `__timer_service_shutdown__.dat`.
`config/`*config_name*	Directory to store files to be shared by all instances using config named *config_name*. There will be one such directory for every config defined in domain.xml. All the files in this directory are synchronized to the server instances that are using the *config_name*.
`config/`*config_name*`/lib/ext`	Folder where Java extension classes (as zip or jar archives) can be dropped. This is used by applications deployed to server instances using config named *config_name*. These jar files are loaded using Java extension mechanism.
docroot	The HTTP document root. In out of the box configuration, all server instances in the domain use the same docroot. The docroot property of the virtual server needs to be configured to make the server instances use a different docroot.
generated	Generated files for Java EE applications and modules, for example, EJB stubs, compiled JSP classes, and security policy files. This directory is synchronized along with applications directory. Therefore, only the directories corresponding to applications referenced by a server instance are synchronized.
lib, lib/classes	Folder where common Java class files or jar and zip archives used by applications deployed to entire domain can be dropped. These classes are loaded using Application Server's class loader. The load order in class loader is: `lib/classes`, `lib/*.jar`, `lib/*.zip`.
lib/ext	Folder where Java extension classes (as zip or jar archives) used by applications deployed to entire domain can be dropped. These jar files are loaded using Java extension mechanism.
lib/applibs	Place dependent jars under `domains/<`*domain_name*`>lib/applibs` and specify a relative path to the jar file through the `libraries` option. For example, `asadmin deploy --libraries commons-coll.jar,X1.jar foo.ear`
java-web-start	The parts of this directory (and sub directories) are synchronized depending on the applications referred to from the server instance.

Synchronizing Library Files

The `--libraries` deploy time attribute for an application can be used to specify runtime dependencies of an application. When a relative path is specified, (only the jar name), Application Server attempts to find the specified library in *domain-dir*`/lib/applibs`.

To make a library available to the whole domain, you could place the JAR file in *domain-dir*`/lib` or *domain-dir*`/lib/classes`. (For more information, see "Using the Common Class Loader" in *Sun Java System Application Server 9.1 Developer's Guide*.) This is usually the case for JDBC drivers and other utility libraries that are shared by all applications in the domain.

For cluster-wide or stand alone server wide use, copy the jars into the *domain-dir*`/domain1/config/`*xyz-config*`/lib` directory. Next, add the jars in `classpath-suffix` or `classpath-prefix` element of *xyz-config*. This will synchronize the jars for all server instances using *xyz-config*.

In summary:

- `domains/domain1/lib` - domain wide scope, common class loader, adds the jars automatically.
- `domains/domain1/config/cluster1`, `config/lib` - config wide, update `classpath-prefix` or `classpath-suffix`.
- `domains/domain1/lib/applibs` - application scope, added to application class loader automatically
- `domains/domain1/config/cluster1`, `config/lib/ext` - adds to `http://java.sun.com/j2se/1.5.0/docs/guide/extensions/extensions.html` automatically.

Unique Settings and Configuration Management

Configuration files (under `domains/`*domain1*`/config` are synchronized across the domain. If you want to customize a `server.policy` file for a *server1*`-config` used by a stand alone server instance (*server1*), place the modified `server.policy` file under `domains/domain1/config/server1-config` directory.

This modified `server.policy` file will only be synchronized for the stand alone server instance, *server1*. You should remember to update the `jvm-option`. For example:

```
<java-config>
...
<jvm-options>-Djava.security.policy=${com.sun.aas.instanceRoot}/config
/server1-config/server.policy</jvm-options>
</java-config>
```

Synchronizing Large Applications

When your environment contains large applications to synchronize or available memory is constrained, you can adjust the JVM options to limit memory usage. This adjustment reduces the possibility of receiving out of memory errors. The instance synchronization JVM uses default settings, but you can configure JVM options to change them.

Set the JVM options using the `INSTANCE-SYNC-JVM-OPTIONS` property. The command to set the property is:

```
asadmin set
domain.node-agent.node_agent_name.property.INSTANCE-SYNC-JVM-OPTIONS="JVM_options"
```

For example:

```
asadmin set
domain.node-agent.node0.property.INSTANCE-SYNC-JVM-OPTIONS="-Xmx32m -Xss2m"
```

In this example, the node agent is `node0` and the JVM options are `-Xmx32m -Xss2m`.

For more information, see `http://java.sun.com/docs/hotspot/VMOptions.html`.

Note – Restart the node agent after changing the INSTANCE-SYNC-JVM-OPTIONS property, because the node agent is not automatically synchronized when a property is added or changed in its configuration.

Using the doNotRemoveList Flag

If your application requires to store and read files in the directories (applications, generated, docroot, config, lib, java-web-start) that are synchronized by the Application Server, use the `doNotRemoveList` flag. This attribute takes a coma-separated list of files or directories. Your application dependent files are not removed during server startup, even if they do not exist in the central repository managed by DAS. If the same file exists in the central repository, they will be over written during synchronization.

Use the `INSTANCE-SYNC-JVM-OPTIONS` property to pass in the doNotRemoveList attribute.

For example:

```
<node-agent name="na1" ...>

...

<property name="INSTANCE-SYNC-JVM-OPTIONS"
value="-Dcom.sun.appserv.doNotRemoveList=applications/j2ee-modules
/<webapp_context>/logs,generated/mylogdir"/>
```

```
</node–agent>
```

Viewing Node Agent Logs

Each node agent has its own log file. If you experience problems with a node agent, see the log file at:

node_agent_dir /*node_agent_name*/`agent/logs/server.log` .

Sometimes the node agent log instructs you to look at a server's log to get a detailed message about a problem.

The server logs are located at:

node_agent_dir/*node_agent_name*/ *server_name*/`logs/server.log`

The default location for *node_agent_dir* is *install_dir*/`nodeagents`.

Working with Node Agents

How to Perform Node Agent Tasks

Some node agent tasks require you to use the `asadmin`tool locally on the system where the node agent runs. Other tasks you can perform remotely using either the Admin Console or `asadmin`.

The following table summarizes the tasks and where to run them:

TABLE 8–2 How To Perform Node Agent Tasks

Task	Admin Console	asadmin Command
Createnode agent placeholder on Domain Administration Server	New Node Agent placeholder page	create-node-agent-config
Create node agent	Not available	create-node-agent
Start node agent	Not available	start-node-agent
Stop node agent	Not available	stop-node agent
Delete node agent configuration from Domain Administration Server	Node Agents page	delete-node-agent-config
Delete node agent from local machine	Not available	delete-node-agent
Edit node agent configuration	Node Agents pages	set
List node agents	Node Agents page	list-node-agents

Node Agent Placeholders

You can create and delete server instances without an existing node agent using a *node agent placeholder*. The node agent placeholder is created on the Domain Administration Server (DAS) before the node agent itself is created on the node agent's local system.

For information on creating a node agent placeholder, see "To Create a Node Agent Placeholder" on page 187

Note – Once you've created a placeholder node agent, use it to create instances in the domain. However, before starting the instances you must create and start the actual node agent locally on the machine where the instances will reside using the `asadmin` command. See "Creating a Node Agent" on page 188 and "Starting a Node Agent" on page 190

▼ To Create a Node Agent Placeholder

A node agent is a local watchdog for server instances that are running on a remote machine. Therefore, a node agent must be created on the machine that is hosting the server instances. As a result of this requirement, you can use the Admin Console to create only a placeholder for a node agent. This placeholder is a node agent configuration for which a node agent does not yet exist.

After creating a placeholder, use the `asadmin` command `create-node-agent` on the machine hosting the node agent to complete the creation. For more information, see "Creating a Node Agent" on page 188.

For a list of the steps involved in creating and using node agents, see "Deploying Node Agents" on page 179.

1 **In the tree component, select the Node Agents node.**

2 **On the Node Agents page, click New.**

3 **On the New Node Agent Placeholder page, enter a name for the new node agent.**

The name must be unique across all node agent names, server instance names, cluster names, and configuration names in the domain.

4 **Click OK.**

The placeholder for your new node agent is listed on the Node Agents page.

More Information

Equivalent asadmin command

```
create-node-agent-config
```

Creating a Node Agent

To create a node agent, run the `asadmin` command `create-node-agent` locally on the machine on which the node agent runs.

The default name for a node agent is the host name on which the node agent is created.

If you've already created a node agent placeholder, use the same name as the node agent placeholder to create the associated node agent. If you have not created a node agent placeholder, and the DAS is up and reachable, the `create-node-agent` command also creates a node agent configuration (placeholder) on the DAS.

For a complete description of the command syntax, see the online help for the command.

The DAS and a node agent might be configured to communicate securely. In this situation, when the node agent is started, it must validate the certificate that the DAS sends to the node agent. To validate the certificate, the node agent looks up the certificate in the node agent's local truststore , which is protected by a master password. To enable the node agent to be started without prompting the user for a password, save the node agent's master password to a file when you create the node agent. If you do not save the node agent's master password to a file, the user is prompted for the master password whenever the user starts the node agent.

Note – In some situations you must specify the name of a host that can be reached through DNS. For more information, see "To Create a Node Agent for a DNS-Reachable Host" on page 189.

To Create a Node Agent

- **Type the following command:**

  asadmin create-node-agent --host *das-host* **--port** *port-no* **--user** *das-user* [**--savemasterpassword=true**] *nodeagent*

  To enable the node agent to be started without prompting the user for a password, save the node agent's master password to a file. To save the node agent's master password to a file, set the `--savemasterpassword` option to `true` in the command to create the node agent.

  If you set `--savemasterpassword` to `true`, you are prompted for the master password. Otherwise, you are *not* prompted for a password.

`--host` *das-host*	Specifies the name of the host where the Domain Administration Server (DAS) is running.
`-port` *port-no*	Specifies the HTTP or HTTPS port number for administering the domain.
`--user` *das-user*	Specifies the DAS user.
nodeagent	Specifies the name of the node agent that you are creating. This name must be unique in the domain.

Example 8–1 Creating a Node Agent

```
asadmin create-node-agent --host myhost --port 4848 --user admin nodeagent1
```

This command creates a node agent that is named `nodeagent1`. The DAS with which the node agent communicates is running on the machine `myhost`. The HTTP port for administering the agent's domain is 4848. The name of the DAS user is `admin`.

To Create a Node Agent for a DNS-Reachable Host

The host where the DAS is running must be reachable through DNS in the following situations:

- Domains cross subnet boundaries, that is, the node agent and the DAS are in different domains, for example, `sun.com` and `java.com`.
- A DHCP machine is being used whose host name is not registered in DNS.

1. **In the `create-domain` command to create the domain, specify the `--domainproperties domain.hostName=`*das-host-name* option.**

   das-host-name is the name of the machine where the DAS is running.

2. **In the `create-node-agent` command to create the node agent, specify the following options:**

- `--host` *das-host-name*, where *das-host-name* is the DAS host name that you specified in Step 1. This option corresponds to the `agent.das.host` property in the file *as-install*`/nodeagents/`*nodeagentname*`/agent/config/das.properties`.
- `--agentproperties remoteclientaddress=`*node-agent-host-name*, where *node-agent-host-name* is the host name that the DAS uses to connect to the node agent. This option corresponds to the `agent.client.host` property in the file *as-install*`/nodeagents/`*nodeagentname*`/agent/config/nodeagent.properties`.

More Information

Specifying the Host by Updating the `hosts` File

Another solution is to update the `hosts` hostname/IP resolution file specific to the platform so the hostname resolves to the correct IP address. However, when reconnecting using DHCP you might get assigned a different IP address. In that case, you must update the host resolution files on each server.

Starting a Node Agent

Before a node agent can manage server instances, it must be running. Start a node agent by running the `asadmin` command `start-node-agent` locally on the system where the node agent resides.

For a complete description of the command syntax, see the online help for the command.

For example:

```
asadmin start-node-agent --user admin --startinstances=false nodeagent1
```

where `admin` is your administration user, and `nodeagent1` is the node agent being started.

By default, the cache repositories of node agent instances are not synchronized from the central repository when a node agent is restarted. To forcibly synchronize the instances' cache repositories with central repository, set the `--syncinstances` option to `true` in the `asadmin start-node-agent` command.

Note – if you set the `--syncinstances` option to `true`, the repositories of *all* instances are synchronized when the node agent is restarted.

After restarting a node agent, use the `asadmin start-instance` command to start the server instance.

Stopping a Node Agent

Run the `asadmin` command `stop-node-agent` on the system where the node agent resides to stop a running node agent. The `stop-node-agent` command stops all server instances that the node agent manages.

For a complete description of the command syntax, see the online help for the command.

For example:

```
asadmin stop-node-agent nodeagent1
```

where `nodeagent1` is the name of the node agent.

Deleting a Node Agent

Before deleting a node agent, the node agent must be stopped. You can also delete a node agent if it has never been started, or never successfully able to contact the Domain Administration Server (that is, if it is still unbound).

Run the `asadmin` command `delete-node-agent` on the system where the node agent resides to delete the node agent files.

For a complete description of the command syntax, see the online help for the command.

For example:

```
asadmin delete-node-agent nodeagent1
```

where `nodeagent1` is your node agent.

When deleting a node agent, you must also delete its configuration from the Domain Administration Server using either the Admin Console or the `asadmin delete-node-agent-config` command.

▼ To View General Node Agent Information

1. **In the tree component, select the Node Agents node.**
2. **Click the name of a node agent.**
   If a node agent already exists but does not appear here, start the node agent on the node agent's host machine using `asadmin start-node-agent`. See "Starting a Node Agent" on page 190

3 **Check the node agent's host name.**

If the host name is Unknown Host, then the node agent has not made initial contact with the Domain Administration Server (DAS).

4 **Check the node agent status.**

The status can be:

- **Running**: The node agent has been properly created and is currently running.
- **Not Running**: Either the node agent has been created on the local machine, but never started or the node agent was started but has been stopped.
- **Waiting for Rendezvous**: The node agent is a placeholder that has never been created on the local machine.

See "Creating a Node Agent" on page 188 and "Starting a Node Agent" on page 190.

5 **Choose whether to start instances on start up.**

Select Yes to start server instances associated with the node agent automatically when the node agent is started. Select No to start the instances manually.

6 **Determine whether the node agent has made contact with the Domain Administration Server.**

If the node agent has never made contact with the Domain Administration Server, it has never been successfully started.

7 **Manage server instances associated with the node agent.**

If the node agent is running, start or stop an instance by clicking the checkbox next to the instance name and clicking Start or Stop.

▼ To Delete a Node Agent Configuration

Through the Admin Console you can only delete the node agent configuration from the domain. You cannot delete the actual node agent. To delete the node agent itself, run the `asadmin` command `delete-node-agent` on the node agent's local machine. For more information, see "Deleting a Node Agent" on page 191.

Before deleting the node agent configuration, the node agent must be stopped and it must not have any associated instances. To stop a node agent, use the `asadmin` command `stop-node-agent`. See "Stopping a Node Agent" on page 191 for more information.

1 **In the tree component, select the Node Agents node.**

2 **On the Node Agents page, select the checkbox next to the node agent to be deleted.**

3 **Click delete.**

More Information Equivalent asadmin command

`delete-node-agent-config`

▼ To Edit a Node Agent Configuration

1 **In the tree component, expand the Node Agents node.**

2 **Select the node agent configuration to edit.**

3 **Check Start Instances on Startup to start the agent's server instances when the agent is started.**

You can also manually start and stop instances from this page.

If this configuration is for a placeholder node agent, when you create the actual node agent using `asadmin create-node-agent` , it picks up this configuration. For information on creating a node agent, see "Creating a Node Agent" on page 188.

If this configuration is for an existing node agent, the node agent configuration information is synchronized automatically.

▼ To Edit a Node Agent Realm

You must set an authentication realm for users connecting to the node agent. Only administration users should have access to the node agent.

1 **In the tree component, expand the Node Agents node.**

2 **Select the node agent configuration to edit.**

3 **Click the Auth Realm tab.**

4 **On the Node Agents Edit Realm page, enter a realm.**

The default is `admin-realm`, created when you create the node agent. To use a different realm, replace the realms in *all* the components controlled by the domain or the components won't communicate properly.

5 **In the Class Name field, specify the Java class that implements the realm.**

6 **Add any required properties.**

Authentication realms require provider-specific properties, which vary depending on what a particular implementation needs.

▼ To Edit the Node Agent's Listener for JMX

The node agent uses JMX to communicate with the Domain Administration Server. Therefore it must have a port to listen on for JMX requests, and other listener information.

1 **In the tree component, expand the Node Agents node.**

2 **Select the node agent configuration to edit.**

3 **Click the JMX tab.**

4 **In the Address field, enter an IP address or host name.**

Enter `0.0.0.0` if the listener listens on all IP addresses for the server using a unique port value. Otherwise, enter a valid IP address for the server.

5 **In the Port field, type the port on which the node agent's JMX connector will listen.**

If the IP address is `0.0.0.0`, the port number must be unique.

6 **In the JMX Protocol field, type the protocol that the JMX connector supports.**

The default is rmi_jrmp.

7 **Click the checkbox next to Accept All Addresses to allow a connection to all IP addresses.**

The node agent listens on a specific IP address associated to a network card or listens on all IP addresses. Accepting all addresses puts the value `0.0.0.0` in the "listening host address" property.

8 **In the Realm Name field, type the name of the realm that handles authentication for the listener.**

Click the SSL tab, configure the listener to use SSL, TLS, or both SSL and TLS security.

To set up a secure listener, do the following:

9 **Check the Enabled box in the Security field.**

Security is enabled by default.

10 **Set client authentication.**

To require clients to authenticate themselves to the server when using this listener, check the Enabled box in the Client Authentication field.

11 Enter a certificate nickname.

Enter the name of an existing server keypair and certificate in the Certificate NickName field.

For information about working with certificates and SSL, see the Admin Console online help.

12 In the SSL3/TLS section:

a. Check the security protocol(s) to enable on the listener.

You must check either SSL3 or TLS, or both protocols.

b. Check the cipher suite used by the protocol(s).

To enable the add button you need to select the cipher suite. By default the option is ADD ALL which adds all the cipher suites.

To enable all cipher suites, check All Supported Cipher Suites.

13 Click Save.

◆ ◆ ◆ CHAPTER 9

Configuring High Availability Session Persistence and Failover

This chapter explains how to enable and configure high availability session persistence.

Overview of Session Persistence and Failover

Application Server provides high availability session persistence through *failover* of HTTP session data and stateful session bean (SFSB) session data. Failover means that in the event of an server instance or hardware failure, another server instance takes over a distributed session.

Requirements

A distributed session can run in multiple Sun Java System Application Server instances, if:

- Each server instance has access to the same session state data. Application Server provides the following types of high availability storage for HTTP session and stateful session bean data:
  - In-memory replication on other servers in the cluster. In-memory replication is enabled by default with the cluster profile.

    The use of in-memory replication requires the Group Management Service (GMS) to be enabled. For more information about GMS, see "Group Management Service" on page 159.

If server instances in a cluster are located on different machines, ensure that the following prerequisites are met:

- To ensure that GMS and in-memory replication function correctly, the machines must be on the same subnet.
- To ensure that in-memory replication functions correctly, the system clocks on all machines in the cluster must be synchronized as closely as possible.

- High-availability database (HADB). For information about how to enable this database, see `configure-ha-cluster`(1).

Note – The HADB software is supplied with the Application Server standalone distribution of Sun Java System Application Server. For information about available distributions of Sun Java System Application Server, see "Distribution Types and Their Components" in *Sun Java System Application Server 9.1 Installation Guide*. HADB features are available only in the enterprise profile. For information about profiles, see "Usage Profiles" in *Sun Java System Application Server 9.1 Administration Guide*.

- Each server instance has the same distributable web application deployed to it. The `web-app` element of the `web.xml` deployment descriptor file must contain the `distributable` element.
- The web application uses high-availability session persistence. If a non-distributable web application is configured to use high-availability session persistence, the server writes an error to the log file.
- The web application must be deployed using the `deploy` or `deploydir` command with the `--availabilityenabled` option set to `true`. For more information on these commands, see `deploy`(1) and `deploydir`(1).

Restrictions

When a session fails over, any references to open files or network connections are lost. Applications must be coded with this restriction in mind.

You can only bind certain objects to distributed sessions that support failover. Contrary to the Servlet 2.4 specification, Sun Java System Application Server does not throw an `IllegalArgumentException` if an object type not supported for failover is bound into a distributed session.

You can bind the following objects into a distributed session that supports failover:

- Local home and object references for all EJB components.
- Colocated stateless session, stateful session, or entity bean reference .
- Distributed stateless session, stateful session, or entity bean reference.

- JNDI Context for `InitialContext` and `java:comp/env`.
- `UserTransaction` objects. However, if the instance that fails is never restarted, any prepared global transactions are lost and might not be correctly rolled back or committed.
- Serializable Java types.

You cannot bind the following object types into sessions that support failover:

- JDBC DataSource
- Java Message Service (JMS) `ConnectionFactory` and `Destination` objects
- JavaMail™ Session
- Connection Factory
- Administered Objects
- Web service reference

In general, for these objects, failover will not work. However, failover might work in some cases, if for example the object is serializable.

Setting Up High Availability Session Persistence

This section explains how to set up high availability session persistence, with the following topics:

- "To Set Up High Availability Session Persistence" on page 199
- "Enabling Session Availability" on page 200

▼ To Set Up High Availability Session Persistence

Before You Begin High availability session persistence is incompatible with dynamic deployment, dynamic reloading, and auto-deployment. These features are for development, not production environments, so you must disable them before enabling HA session persistence. For information about how to disable these features, see *Sun Java System Application Server 9.1 Application Deployment Guide*.

1 Create an Application Server cluster.

For more information, see "To Create a Cluster" on page 161 .

2 If you are using HADB to store session state data, create an HADB database for the cluster.

Note – The HADB software is supplied with the Application Server standalone distribution of Sun Java System Application Server. For information about available distributions of Sun Java System Application Server, see "Distribution Types and Their Components" in *Sun Java System Application Server 9.1 Installation Guide*. HADB features are available only in the enterprise profile. For information about profiles, see "Usage Profiles" in *Sun Java System Application Server 9.1 Administration Guide*.

If you are using in-memory replication on other servers in the cluster for session state data, omit this step.

For more information about creating an HADB database, see `configure-ha-cluster`(1).

3. **Set up HTTP load balancing for the cluster.**

   For more information , see "Setting Up HTTP Load Balancing" on page 128

4. **Enable availability for the desired application server instances and web or EJB containers.**

   Then configure the session persistence settings. Choose one of these approaches:

   - Use Admin Console. See "Enabling Availability for a Server Instance" on page 201.
   - Use the `asadmin` command-line utility. See `set`(1) and `configure-ha-persistence`(1).

5. **Restart each server instance in the cluster.**

   If the instance is currently serving requests, quiesce the instance before restarting it so that the instance gets enough time to serve the requests it is handling. For more information, see "Disabling (Quiescing) a Server Instance or Cluster" on page 140

6. **Enable availability for any specific SFSB that requires it.**

   Select methods for which checkpointing the session state is necessary. See "Configuring Availability for an Individual Bean" on page 210

7. **Make each web module distributable if you want it to be highly available.**

8. **Enable availability for individual applications, web modules, or EJB modules during deployment.**

   See "Configuring Availability for an Individual Application or EJB Module" on page 210

   In the Administration Console, check the Availability Enabled box, or use the `asadmin deploy` command with the `--availabilityenabled` option set to `true`.

Enabling Session Availability

You can enable session availability at five different scopes (from highest to lowest):

1. Server instance, enabled by default. Enabling session availability for the server instance means that all applications running on the server instance can have high-availability session persistence. For instructions, see next section, "Enabling Availability for a Server Instance" on page 201 .
2. Container (web or EJB), enabled by default. For information on enabling availability at the container level, see:
   - "Configuring Availability for the Web Container" on page 202
   - "Configuring Availability for the EJB Container" on page 208
3. Application, disabled by default.
4. Standalone web or EJB module, disabled by default.
5. Individual SFSB, disabled by default.

To enable availability at a given scope, you must enable it at all higher levels as well. For example, to enable availability at the application level, you must also enable it at the server instance and container levels.

The default for a given level is the setting at the next level up. For example, if availability is enabled at the container level, it is enabled by default at the application level.

When availability is disabled at the server instance level, enabling it at any other level has no effect. When availability is enabled at the server instance level, it is enabled at all levels unless explicitly disabled.

Enabling Availability for a Server Instance

To enable availability for a server instance, use the `asadmin set` command to set the configuration's `availability-service.availability-enabled` property to true.

For example, if `config1` is the configuration name:

```
asadmin set --user admin --passwordfile password.txt
--host localhost
--port 4849
config1.availability-service.availability-enabled="true"
```

▼ To Enable Availability for the Server Instance with Admin Console

1 In the tree component, expand the Configurations node.

2 Expand the node for the configuration you want to edit.

3 Select the Availability Service node.

4 **In the Availability Service page, enable instance level availability by checking the Availability Service box.**

To disable it, uncheck the box.

Additionally, you can change the Store Pool Name if you changed the JDBC resource used for connections to the HADB for session persistence. For details, see `configure-ha-cluster`(1).

Note – The HADB software is supplied with the Application Server standalone distribution of Sun Java System Application Server. For information about available distributions of Sun Java System Application Server, see "Distribution Types and Their Components" in *Sun Java System Application Server 9.1 Installation Guide*. HADB features are available only in the enterprise profile. For information about profiles, see "Usage Profiles" in *Sun Java System Application Server 9.1 Administration Guide*.

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5 **Click on the Save button.**

6 **Stop and restart the server instance.**

HTTP Session Failover

Java EE applications typically have significant amounts of session state data. A web shopping cart is the classic example of session state. Also, an application can cache frequently-needed data in the session object. In fact, almost all applications with significant user interactions need to maintain session state.

Configuring Availability for the Web Container

Note – The HADB software is supplied with the Application Server standalone distribution of Sun Java System Application Server. For information about available distributions of Sun Java System Application Server, see "Distribution Types and Their Components" in *Sun Java System Application Server 9.1 Installation Guide*. HADB features are available only in the enterprise profile. For information about profiles, see "Usage Profiles" in *Sun Java System Application Server 9.1 Administration Guide*.

If you are using HADB, enable and configure web container availability by using the `asadmin configure-ha-persistence`. For more information about this command, see `configure-ha-persistence`(1).

Alternatively, use the `asadmin set` command to set the configuration's `availability-service.web-container-availability.availability-enabled` property to true and then `configure-ha-persistence` to set properties as desired.

Note – If you are using in-memory replication to store session state data, you *must* use the `asadmin set` command to enable web container availability and to set properties. You can use the `configure-ha-persistence` command *only* with HADB.

For example, use the `set` command as follows, where `config1` is the configuration name:

```
asadmin set --user admin --passwordfile password.txt
--host localhost --port 4849
config1.availability-service.web-container-availability.availability-enabled="true"
asadmin configure-ha-persistence --user admin --passwordfile secret.txt
--type ha
--frequency web-method
--scope modified-session
--store jdbc/hastore
--property maxSessions=1000:reapIntervalSeconds=60 cluster1
```

▼ To Enable Availability for the Web Container with Admin Console

1. **In the tree component, select the desired configuration.**
2. **Click on Availability Service.**
3. **Select the Web Container Availability tab.**
   Check the Availability Service box to enable availability. To disable it, uncheck the box.
4. **Change other settings, as described in the following section,** **"Availability Settings" on page 203**
5. **Restart the server instance.**

Availability Settings

Note – The HADB software is supplied with the Application Server standalone distribution of Sun Java System Application Server. For information about available distributions of Sun Java System Application Server, see "Distribution Types and Their Components" in *Sun Java System Application Server 9.1 Installation Guide*. HADB features are available only in the enterprise profile. For information about profiles, see "Usage Profiles" in *Sun Java System Application Server 9.1 Administration Guide*.

The Web Container Availability tab of the Availability Service enables you to change these availability settings:

Persistence Type: Specifies the session persistence mechanism for web applications that have availability enabled. Allowed values are `memory` (no persistence) `file` (the file system), `replicated` (memory on other servers), and `ha` (HADB).

HADB must be configured and enabled before you can use `ha` session persistence. For configuration details, see `configure-ha-cluster`(1).

If web container availability is enabled, the default persistence type depends on the profile, as shown in the following table.

Profile	Persistence Type
Developer	`memory`
Cluster	`replicated`
Enterprise	`ha`

For production environments that require session persistence, use `ha` or `replicated`. The `memory` persistence type and the `file` persistence type do not provide high availability session persistence.

If web container availability is disabled, the default persistence type `memory`.

Persistence Frequency: Specifies how often the session state is stored. Applicable only if the Persistence Type is `ha` or `replicated`. Allowed values are:

- `web-method` - The session state is stored at the end of each web request prior to sending a response back to the client. This mode provides the best guarantee that the session state is fully updated in case of failure. This is the default.
- `time-based` - The session state is stored in the background at the frequency set by the `reapIntervalSeconds` store property. This mode provides does not guarantee that session state is fully updated. However, it can provide a significant performance improvement because the state is not stored after each request.

Persistence Scope : Specifies how much of the session object and how often session state is stored. Applicable only if the Persistence Type is `ha` or `replicated`. Allowed values are as follows:

- `session` - The entire session state is stored every time. This mode provides the best guarantee that your session data is correctly stored for any distributable web application. This is the default.
- `modified-session` - The entire session state is stored if it has been modified. A session is considered to have been modified if `HttpSession.setAttribute()` or `HttpSession.removeAttribute()` was called. You must guarantee that `setAttribute()` is called every time an attribute is changed. This is not a Java EE specification requirement, but it is required for this mode to work properly.

- `modified-attribute` - Only modified session attributes are stored. For this mode to work properly, you must follow a few guidelines:
  - Call `setAttribute()` every time the session state is modified.
  - Make sure there are no cross-references between attributes. The object graph under each distinct attribute key is serialized and stored separately. If there are any object cross references between the objects under each separate key, they are not serialized and deserialized correctly.
  - Distribute the session state across multiple attributes, or at least between a read-only attribute and a modifiable attribute.

Single Sign-On State: Check this box to enable persistence of the single sign-on state. To disable it, uncheck the box. For more information, see "Using Single Sign-on with Session Failover" on page 206

HTTP Session Store: You can change the HTTP Session Store if you changed the JDBC resource used for connections to the HADB for session persistence. For details, see `configure-ha-cluster`(1).

Configuring Availability for Individual Web Applications

To enable and configure availability for an individual web application, edit the application deployment descriptor file, `sun-web.xml`. The settings in an application's deployment descriptor override the web container's availability settings.

The `session-manager` element's `persistence-type` attribute determines the type of session persistence an application uses. It must be set to `ha` or `replicated` to enable high availability session persistence.

For more information about the `sun-web.xml` file, see "The sun-web.xml File" in *Sun Java System Application Server 9.1 Application Deployment Guide*.

Example

```
<sun-web-app> ...
  <session-config>
    <session-manager persistence-type=ha>
      <manager-properties>
        <property name=persistenceFrequency value=web-method />
      </manager-properties>
      <store-properties>
        <property name=persistenceScope value=session />
      </store-properties>
    </session-manager> ...
</session-config> ...
```

Using Single Sign-on with Session Failover

In a single application server instance, once a user is authenticated by an application, the user is not required to re-authenticate individually to other applications running on the same instance. This is called *single sign-on*. For more information, see "User Authentication for Single Sign-on" in *Sun Java System Application Server 9.1 Developer's Guide*.

For this feature to continue to work even when an HTTP session fails over to another instance in a cluster, single sign-on information must be persisted to the HADB. To persist single sign-on information, first, enable availability for the server instance and the web container, then enable single-sign-on state failover.

Note – The HADB software is supplied with the Application Server standalone distribution of Sun Java System Application Server. For information about available distributions of Sun Java System Application Server, see "Distribution Types and Their Components" in *Sun Java System Application Server 9.1 Installation Guide*. HADB features are available only in the enterprise profile. For information about profiles, see "Usage Profiles" in *Sun Java System Application Server 9.1 Administration Guide*.

You can enable single sign-on state failover with the Admin Console in the Web Container Availability tab of the Availability Service, as described in "Configuring Availability for the Web Container" on page 202. You can also use the `asadmin set` command to set the configuration's `availability-service.web-container-availability.sso-failover-enabled` property to true.

For example, use the `set` command as follows, where `config1` is the configuration name:

```
asadmin set --user admin --passwordfile password.txt
--host localhost --port 4849
config1.availability-service.web-container-availability.
sso-failover-enabled="true"
```

Single Sign-On Groups

Applications that can be accessed through a single name and password combination constitute a *single sign-on group*. For HTTP sessions corresponding to applications that are part of a single sign-on group, if one of the sessions times out, other sessions are not invalidated and continue to be available. This is because time out of one session should not affect the availability of other sessions.

As a corollary of this behavior, if a session times out and you try to access the corresponding application from the same browser window that was running the session, you are not required to authenticate again. However, a new session is created.

Take the example of a shopping cart application that is a part of a single sign-on group with two other applications. Assume that the session time out value for the other two applications is higher than the session time out value for the shopping cart application. If your session for the shopping cart application times out and you try to run the shopping cart application from the same browser window that was running the session, you are not required to authenticate again. However, the previous shopping cart is lost, and you have to create a new shopping cart. The other two applications continue to run as usual even though the session running the shopping cart application has timed out.

Similarly, suppose a session corresponding to any of the other two applications times out. You are not required to authenticate again while connecting to the application from the same browser window in which you were running the session.

Note – This behavior applies only to cases where the session times out. If single sign-on is enabled and you invalidate one of the sessions using `HttpSession.invalidate()`, the sessions for all applications belonging to the single sign-on group are invalidated. If you try to access any application belonging to the single sign-on group, you are required to authenticate again, and a new session is created for the client accessing the application.

Stateful Session Bean Failover

Stateful session beans (SFSBs) contain client-specific state. There is a one-to-one relationship between clients and the stateful session beans. At creation, the EJB container gives each SFSB a unique session ID that binds it to a client.

An SFSB's state can be saved in a persistent store in case a server instance fails. The state of an SFSB is saved to the persistent store at predefined points in its life cycle. This is called *checkpointing*. If enabled, checkpointing generally occurs after the bean completes any transaction, even if the transaction rolls back.

However, if an SFSB participates in a bean-managed transaction, the transaction might be committed in the middle of the execution of a bean method. Since the bean's state might be undergoing transition as a result of the method invocation, this is not an appropriate time to checkpoint the bean's state. In this case, the EJB container checkpoints the bean's state at the end of the corresponding method, provided the bean is not in the scope of another transaction when that method ends. If a bean-managed transaction spans across multiple methods, checkpointing is delayed until there is no active transaction at the end of a subsequent method.

The state of an SFSB is not necessarily transactional and might be significantly modified as a result of non-transactional business methods. If this is the case for an SFSB, you can specify a list of checkpointed methods, as described in "Specifying Methods to Be Checkpointed" on page 211

If a distributable web application references an SFSB, and the web application's session fails over, the EJB reference is also failed over.

If an SFSB that uses session persistence is undeployed while the Application Server instance is stopped, the session data in the persistence store might not be cleared. To prevent this, undeploy the SFSB while the Application Server instance is running.

Configuring Availability for the EJB Container

▼ To Enable Availability for the EJB Container

1. **Select the EJB Container Availability tab.**
2. **Check the Availability Service box.**
   To disable availability, uncheck the box.
3. **Change other settings as described in "Availability Settings" on page 209**
4. **Click on the Save button.**
5. **Restart the server instance.**

More Information

Equivalent asadmin command

To enable availability for the EJB container use the `asadmin set` command to set the following three properties for the configuration:

- `availability-service.ejb-container-availability.availability-enabled`
- `availability-service.ejb-container-availability.sfsb-persistence-type`
- `availability-service.ejb-container-availability.sfsb-ha-persistence-type`

For example, if `config1` is the configuration name, use the following commands:

```
asadmin set --user admin --passwordfile password.txt
--host localhost
--port 4849
config1.availability-service.
ejb-container-availability.availability-enabled="true"

asadmin set --user admin --passwordfile password.txt --host localhost --port
4849
config1.availability-service.
ejb-container-availability.sfsb-persistence-type="file"

asadmin set --user admin --passwordfile password.txt
--host localhost
```

```
--port 4849
config1.availability-service.
ejb-container-availability.sfsb-ha-persistence-type="ha"
```

Availability Settings

Note – The HADB software is supplied with the Application Server standalone distribution of Sun Java System Application Server. For information about available distributions of Sun Java System Application Server, see "Distribution Types and Their Components" in *Sun Java System Application Server 9.1 Installation Guide*. HADB features are available only in the enterprise profile. For information about profiles, see "Usage Profiles" in *Sun Java System Application Server 9.1 Administration Guide*.

The EJB Container Availability tab of the Availability Service enables you to change these settings:

HA Persistence Type: Specifies the session persistence and passivation mechanism for SFSBs that have availability enabled. Allowed values are `file` (the file system), `replicated` (memory on other servers), and `ha` (HADB). The default value is `ha`. For production environments that require session persistence, use `ha` or `replicated`.

SFSB Persistence Type: Specifies the passivation mechanism for SFSBs that *do not* have availability enabled. Allowed values are `file` (the default), `replicated`, and `ha`.

If either Persistence Type is set to `file`, the EJB container specifies the file system location where the passivated session bean state is stored. Checkpointing to the file system is useful for testing but is not for production environments. For information about configuring store properties, see the Admin Console online help.

HA persistence enables a cluster of server instances to recover the SFSB state if any server instance fails. HADB is also used as the passivation and activation store. Use this option in a production environment that requires SFSB state persistence. For more information, see `configure-ha-cluster`(1).

SFSB Store Pool Name: You can change the SFSB Store Pool Name if you changed the JDBC resource used for connections to the HADB for session persistence. For details, see `configure-ha-cluster`(1).

Configuring the SFSB Session Store When Availability Is Disabled

If availability is disabled, the local file system is used for SFSB state passivation, but not persistence. To change where the SFSB state is stored, change the Session Store Location setting in the EJB container. For information about configuring store properties, see the Admin Console online help.

Configuring Availability for an Individual Application or EJB Module

You can enable SFSB availability for an individual application or EJB module during deployment:

- If you are deploying with the Admin Console, check the Availability Enabled checkbox.
- If you are deploying using use the `asadmin deploy` or `asadmin deploydir` commands, set the `--availabilityenabled` option to `true`. For more information, see `deploy`(1) and `deploydir`(1).

Configuring Availability for an Individual Bean

To enable availability and select methods to be checkpointed for an individual SFSB, use the `sun-ejb-jar.xml` deployment descriptor file. .

To enable high availability session persistence, set `availability-enabled="true"` in the `ejb` element. To control the size and behavior of the SFSB cache, use the following elements:

- `max-cache-size` : specifies the maximum number of session beans that are held in cache. If the cache overflows (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 EJB container using the configuration APIs.
- `resize-quantity`
- `cache-idle-timeout-in-seconds`
- `removal-timeout-in-seconds`
- `victim-selection-policy`

For more information about `sun-ejb-jar.xml`, see "The sun-ejb-jar.xml File" in *Sun Java System Application Server 9.1 Application Deployment Guide*.

EXAMPLE 9–1 Example of an EJB Deployment Descriptor With Availability Enabled

```
<sun-ejb-jar>
    ...
    <enterprise-beans>
        ...
        <ejb availability-enabled="true">
            <ejb-name>MySFSB</ejb-name>
        </ejb>
        ...
    </enterprise-beans>
</sun-ejb-jar>
```

Specifying Methods to Be Checkpointed

If enabled, checkpointing generally occurs after the bean completes any transaction, even if the transaction rolls back. To specify additional optional checkpointing of SFSBs at the end of non-transactional business methods that cause important modifications to the bean's state, use the `checkpoint-at-end-of-method` element in the `ejb` element of the `sun-ejb-jar.xml` deployment descriptor file.

The non-transactional methods in the `checkpoint-at-end-of-method` element can be:

- `create()` methods defined in the home interface of the SFSB, if you want to checkpoint the initial state of the SFSB immediately after creation
- For SFSBs using container managed transactions only, methods in the remote interface of the bean marked with the transaction attribute TX_NOT_SUPPORTED or TX_NEVER
- For SFSBs using bean managed transactions only, methods in which a bean managed transaction is neither started nor committed

  Any other methods mentioned in this list are ignored. At the end of invocation of each of these methods, the EJB container saves the state of the SFSB to persistent store.

Note – If an SFSB does not participate in any transaction, and if none of its methods are explicitly specified in the `checkpoint-at-end-of-method` element, the bean's state is not checkpointed at all even if `availability-enabled="true"` for this bean.

For better performance, specify a *small* subset of methods. The methods should accomplish a significant amount of work or result in important modification to the bean's state.

EXAMPLE 9–2 Example of EJB Deployment Descriptor Specifying Methods Checkpointing

```
<sun-ejb-jar>
    ...
    <enterprise-beans>
        ...
        <ejb availability-enabled="true">
            <ejb-name>ShoppingCartEJB</ejb-name>
            <checkpoint-at-end-of-method>
                <method>
                    <method-name>addToCart</method-name>
                </method>
            </checkpoint-at-end-of-method>
        </ejb>
        ...
    </enterprise-beans>
</sun-ejb-jar>
```

◆ ◆ ◆ CHAPTER 10

Java Message Service Load Balancing and Failover

This chapter describes how to configure load balancing and failover of the Java Message Service (JMS) for use with the Application Server. It contains the following topics:

Overview of Java Message Service

The Java Message Service (JMS) API is a messaging standard that allows Java EE applications and components to create, send, receive, and read messages. It enables distributed communication that is loosely coupled, reliable, and asynchronous. The Sun Java System Message Queue (MQ), which implements JMS, is tightly integrated with Application Server, enabling you to create components such as message-driven beans (MDBs).

MQ is integrated with Application Server using a *connector module,* also known as a resource adapter, defined by the Java EE Connector Architecture Specification 1.5. Java EE components deployed to the Application Server exchange JMS messages using the JMS provider integrated via the connector module. Creating a JMS resource in Application Server creates a connector resource in the background. So, each JMS operation invokes the connector runtime and uses the MQ resource adapter in the background.

You can manage the Java Message Service through the Admin Console or the `asadmin` command-line utility.

Further Information

For more information on configuring JMS resources, see Chapter 4, "Configuring Java Message Service Resources," in *Sun Java System Application Server 9.1 Administration Guide*. For more

information on JMS, see Chapter 18, "Using the Java Message Service," in *Sun Java System Application Server 9.1 Developer's Guide*. For more information on connectors (resource adapters), see Chapter 12, "Developing Connectors," in *Sun Java System Application Server 9.1 Developer's Guide*.

For more information about the Sun Java System Message Queue, see the Message Queue documentation (`http://docs.sun.com/coll/1343.4`). For general information about the JMS API, see the JMS web page (`http://java.sun.com/products/jms/index.html`)

Configuring the Java Message Service

The Java Message Service configuration is available to all inbound and outbound connections to the Sun Java System Application Server cluster or instance. You can configure the Java Message Service with:

- The Administration Console. Open the Java Message Service component under the relevant configuration. For details, see Chapter 4, "Configuring Java Message Service Resources," in *Sun Java System Application Server 9.1 Administration Guide*.
- The `asadmin set` command. You can set the following attributes:

  ```
  server.jms-service.init-timeout-in-seconds = 60
  server.jms-service.type = LOCAL
  server.jms-service.start-args =
  server.jms-service.default-jms-host = default_JMS_host
  server.jms-service.reconnect-interval-in-seconds = 60
  server.jms-service.reconnect-attempts = 3
  server.jms-service.reconnect-enabled = true
  server.jms-service.addresslist-behavior = random
  server.jms-service.addresslist-iterations = 3
  server.jms-service.mq-scheme = mq
  server.jms-service.mq-service = jms
  ```

  You can also set these properties:

  ```
  server.jms-service.property.instance-name = imqbroker
  server.jms-service.property.instance-name-suffix =
  server.jms-service.property.append-version = false
  ```

  Use the `asadmin get`command to list all the Java Message Service attributes and properties. For more information on `asadmin get`, see `get`(1). For more information on `asadmin set`, see `set`(1).

You can override the Java Message Service configuration using JMS connection factory settings. For details, see "JMS Connection Factories" in *Sun Java System Application Server 9.1 Administration Guide*.

Note – You must restart the Application Server instance after changing the configuration of the Java Message Service.

For more information about JMS administration, see Chapter 4, "Configuring Java Message Service Resources," in *Sun Java System Application Server 9.1 Administration Guide*

Java Message Service Integration

MQ can be integrated with Application Server in three ways: LOCAL, REMOTE, and EMBEDDED. These modes are represented in the Admin Console by the Java Message Service Type attribute.

LOCAL Java Message Service

When the Type attribute is LOCAL (the default for cluster instances), the Application Server will start and stop the MQ broker specified as the Default JMS host. The MQ process is started out-of-process, in a separate VM, from the Application Server process. Application Server supplies an additional port to the broker . This port will be used by the broker to start the RMI registry. This port number will be equal to the configured JMS port for that instance plus 100. For example, if the JMS port number is 37676, then this additional port number will be 37776.

To create a one-to-one relationship between Application Server instances and Message Queue brokers, set the type to LOCAL and give each Application Server instance a different default JMS host. You can do this regardless of whether clusters are defined in the Application Server or MQ.

With LOCAL type, use the Start Arguments attribute to specify MQ broker startup parameters.

REMOTE Java Message Service

When the Type attribute is REMOTE, the MQ broker must be started separately. For information about starting the broker, see the *Sun Java System Message Queue Administration Guide*.

In this case, Application Server will use an externally configured broker or broker cluster. Also, you must start and stop MQ brokers separately from Application Server, and use MQ tools to configure and tune the broker or broker cluster. REMOTE type is most suitable for Application Server clusters.

With REMOTE type, you must specify MQ broker startup parameters using MQ tools. The Start Arguments attribute is ignored.

EMBEDDED Java Message Service

When the JMS Type attribute is EMBEDDED, it means that the application server and the JMS broker are co-located in the same VM and the JMS service is started in-process and managed by the Application Server. In this mode, the JMS operations by pass the networking stack leading to performance optimization.

JMS Hosts List

A JMS host represents an MQ broker. The Java Message Service contains a *JMS Hosts list* (also called `AddressList`) that contains all the JMS hosts that Application Server uses.

The JMS Hosts list is populated with the hosts and ports of the specified MQ brokers and is updated whenever a JMS host configuration changes. When you create JMS resources or deploy MDBs, they inherit the JMS Hosts list.

Note – In the Sun Java System Message Queue software, the `AddressList` property is called `imqAddressList`.

Default JMS Host

One of the hosts in the JMS Hosts list is designated the default JMS host, named `Default_JMS_host`. The Application Server instance starts the default JMS host when the Java Message Service type is configured as LOCAL.

If you have created a multi-broker cluster in the Sun Java System Message Queue software, delete the default JMS host, then add the Message Queue cluster's brokers as JMS hosts. In this case, the default JMS host becomes the first one in the JMS Hosts list.

When the Application Server uses a Message Queue cluster, it executes Message Queue specific commands on the default JMS host. For example, when a physical destination is created for a Message Queue cluster of three brokers, the command to create the physical destination is executed on the default JMS host, but the physical destination is used by all three brokers in the cluster.

Creating JMS Hosts

You can create additional JMS hosts in the following ways:

- Use the Administration Console. Open the Java Message Service component under the relevant configuration, select the JMS Hosts component, and then click New. For more information, see the Admin Console online help.
- Use the `asadmin create-jms-host` command. For details, see `create-jms-host`(1).

  The JMS Hosts list is updated whenever a JMS host configuration changes.

Connection Pooling and Failover

Application Server supports JMS connection pooling and failover. The Sun Java System Application Server pools JMS connections automatically. When the Address List Behavior attribute is `random` (the default), Application Server selects its primary broker randomly from the JMS host list. When failover occurs, MQ transparently transfers the load to another broker and maintains JMS semantics. The default value for the Address List Behavior attribute is `priority`, if the JMS type is of type LOCAL.

To specify whether the Application Server tries to reconnect to the primary broker when the connection is lost, select the Reconnect checkbox. If enabled and the primary broker goes down, Application Server tries to reconnect to another broker in the JMS Hosts list.

When Reconnect is enabled, also specify the following attributes:

- **Address List Behavior**: whether connection attempts are in the order of addresses in the JMS Hosts List (priority) or random order (random). If set to Priority, Java Message Service tries to connect to the first MQ broker specified in the JMS Hosts list and uses another one only if the first broker is not available. If set to Random, Java Message Service selects the MQ broker randomly from the JMS Hosts list. If there are many clients attempting a connection using the same connection factory, use this setting to prevent them from all attempting to connect to the same address.
- **Address List Iterations**: number of times the Java Message Service iterates through the JMS Hosts List in an effort to establish (or re-establish) a connection). A value of -1 indicates that the number of attempts is unlimited.
- **Reconnect Attempts**: the number of attempts to connect (or reconnect) for each address in the JMS hosts list before the client runtime tries the next address in the list. A value of -1 indicates that the number of reconnect attempts is unlimited (the client runtime attempts to connect to the first address until it succeeds).
- **Reconnect Interval**: number of seconds between reconnect attempts. This applies for attempts on each address in the JMS hosts list and for successive addresses in the list. If it is too short, this time interval does not give a broker time to recover. If it is too long, the reconnect might represent an unacceptable delay.

You can override these settings using JMS connection factory settings. For details, see "JMS Connection Factories" in *Sun Java System Application Server 9.1 Administration Guide*.

Load-Balanced Message Inflow

You can configure `ActivationSpec` properties of the `jmsra` resource adapter in the `sun-ejb-jar.xml` file for a message-driven bean using `activation-config-property` elements. Whenever a message-driven bean (`EndPointFactory`) is deployed, the connector

runtime engine finds these properties and configures them accordingly in the resource adapter. See "activation-config-property" in *Sun Java System Application Server 9.1 Application Deployment Guide*.

The Application Server transparently enables messages to be delivered randomly to message-driven beans having the same `ClientID` . The `ClientID` is required for durable subscribers.

For non-durable subscribers in which the `ClientID` is not configured, all instances of a specific message-driven bean that subscribe to same topic are considered equal. When a message-driven bean is deployed to multiple instances of the Application Server, only one of the message-driven beans receives the message. If multiple distinct message-driven beans subscribe to same topic, one instance of each message-driven bean receives a copy of the message.

To support multiple consumers using the same queue, set the `maxNumActiveConsumers` property of the physical destination to a large value. If this property is set, the Sun Java System Message Queue software allows up to that number of message-driven beans to consume messages from same queue. The message is delivered randomly to the message-driven beans. If `maxNumActiveConsumers` is set to `-1`, there is no limit to the number of consumers.

To ensure that local delivery is preferred, set `addresslist-behavior` to priority. This setting specifies that the first broker in the `AddressList` is selected first. This first broker is the local colocated Message Queue instance. If this broker is unavailable, connection attempts are made to brokers in the order in which they are listed in the `AddressList`. This setting is the default for Application Server instances that belong to a cluster.

Note – Clustering features are not available in the developer profile. For information about profiles, see "Usage Profiles" in *Sun Java System Application Server 9.1 Administration Guide*.

JMS Service High Availability

There are two levels of availability for JMS components:

- *Service availability* – At this level, availability of the JMS service matters, but it's not important if messages are not available for a while. As long as a connection gets failed over to a new available instance providing the service, the JMS component considers that the service is available and functions normally. This level of availability is described in "Connection Failover" in *Sun Java System Application Server 9.1 Developer's Guide*.
- *Data availability* – At this level, both availability of the service and persistent messages are required. JMS semantics of once and only once delivery and message ordering are also handled at this level.

You can enable data availability in the Sun Java System Message Queue cluster that comprises the Java Message Service (JMS). Messages are persisted to the common persistence store and are available from all the other broker instances in the cluster or from the high-availability database

(HADB) if it is installed and the enterprise profile is selected. For information about profiles, see "Usage Profiles" in *Sun Java System Application Server 9.1 Administration Guide*. You must enable availability for the Application Server instances before you can enable data availability for the corresponding brokers.

Note – Individual applications and modules cannot control or override JMS availability.

To enable data availability, select the Availability Service component under the relevant configuration in the Admin Console. Check the Availability Service box. To enable availability for the JMS service, select the JMS Availability tab, then check the Availability Service box. All instances in an Application Server cluster should have the same instance availability and JMS availability settings to ensure consistent behavior. For details, see the *Sun Java System Application Server 9.1 High Availability Administration Guide*.

Note – Clustering features are not available in the developer profile. For information about profiles, see "Usage Profiles" in *Sun Java System Application Server 9.1 Administration Guide*.

Using MQ Clusters with Application Server

MQ Enterprise Edition supports multiple interconnected broker instances known as a *broker cluster*. With broker clusters, client connections are distributed across all the brokers in the cluster. Clustering provides horizontal scalability and improves availability.

This section describes how to configure Application Server to use highly available Sun Java System Message Queue clusters. It explains how to start and configure Message Queue clusters.

For more information about the topology of Application Server and MQ deployment, see "Planning Message Queue Broker Deployment" in *Sun Java System Application Server 9.1 Deployment Planning Guide*.

Highly Available MQ Clusters

Sun Java System Message Queue 4.1 provides a highly available messaging service through a new "Highly Available" cluster type. In an MQ cluster of this type, all the broker instances would share a peer– to–peer relationship and all its broker instances would share a common persistent data store thus offering 'Data Availability.' Instances would automatically be able to detect if an instance fails and perform a takeover of the failed broker's persistent messages, dynamically through a takeover election. Application components that are deployed in the Application Server could thus leverage these availability features.

With this cluster type, there would not be any loss of transacted persistent messages to a queue or a durable topic subscription. Non-persistent messages or persistent messages to non-durable subscribers are likely to be lost when the broker that the client runtime is connected to is unavailable.

Configuring a Highly Available Broker Cluster in the Local Mode

1. Start HADB.
2. Create an Application Server domain and start it. To create a domain and start it, use the `asadmin` commands, `create-domain` and `start-domain` respectively. For more information about these commands, see `create-domain`(1) and `start-domain`(1).
3. Create a node agent and start it. To create a node agent and start it, use the `asadmin` commands, `create-node-agent` and `start-node-agent` respectively. For more information about these commands, see `create-node-agent`(1) and `start-node-agent`(1).
4. Create a cluster. You can create a cluster either using the `asadmin`command, `create-cluster` or using the Admin Console. For more information on the `create-cluster` command, see `create-cluster`(1). For information on how to create a cluster using the Admin Console, see the Admin Console Online Help.
5. Create instances in the cluster. While creating an instance, specify the JMS Provider port number being used by the remote broker. If you do not specify one, it will take the default JMS Provider port number. You can create instances using the Admin Console or the `asadmin` command, `create-instance`. For information on how to create instances using the Admin Console, see the Admin Console Online Help. For information on the `create-instance` command, see `create-instance`(1).
6. Start the cluster. You can do this from the Admin Console or using the `asadmin` command `start-cluster`. For information on how to start a cluster using the Admin Console, refer to the Admin Console Online Help. For information on the `start-cluster` command, see `start-cluster`(1).
7. Configure the HA cluster using the `asadmin` command, `configure-ha-cluster`. For more information about the command, see `configure-ha-cluster`(1).

Configuring a Highly Available Broker Cluster in the Remote Mode

1. Start HADB.
2. Create database tables.
3. Copy the HA driver if you are creating a highly available broker cluster.

```
cp $AS_HOME/hadb/4.4.3-6/lib/hadbjdbc4.jar $S1AS_HOME/imq/lib/ext
```

4. Create a domain and start it. To do this, use the commands `asadmin create-domain` and `start-domain`. For more information about these commands, see `create-domain`(1) and `start-domain`(1).
5. Create a node agent and start it. To do this, use the `asadmin` commands `create-domain` and `start-node-agent`. For more information about these commands, see `create-node-agent`(1) and `start-node-agent`(1).
6. Create a cluster. You can create a cluster either using the `asadmin` command `create-cluster` or using the Admin Console. For more information, see `create-cluster`(1). For information on how to create a cluster using the Admin Console, see the Admin Console Online Help.
7. Create instances in the cluster. While creating an instance, specify the JMS Provider port number being used by the remote broker. If you do not specify one, it will take the default JMS Provider port number.
8. Delete the default JMS Host and create JMS hosts to which the instances can connect. Be sure to add each broker as a separate JMS host. For more information on JMS Hosts, see "JMS Hosts List" on page 216.
9. Set the JMS type as Remote. You can do this using the `asadmin` command `set` or from the JMS Service page in the Admin Console.
10. Set JMS Availability to true if you are configuring a highly available broker. You can do this using the `asadmin` command `set` or from the JMS Availability page in the Admin Console.
11. Start the broker instances.
12. Start the cluster. For more information, see `start-cluster`(1).

Auto-clustering for non-HA Clusters

Till now, the administrator had to set up 'non-Highly Available' MQ clusters (MQ clusters with a master broker) separately as explained in the procedure following this section. In this release, in addition to the manual process (of type REMOTE) of setting up an MQ cluster, Application Server provides 'auto-clustering,' which means that a co-located non-HA cluster (of type LOCAL) will be created automatically when a user creates an Application Server cluster. This will be the default mode of creating MQ clusters. For example, when the administrator creates an Application Server cluster with three Application Server instances, each Application Server instance will be configured to work with a co-located broker, and as a result the three MQ broker instances will be made to form an MQ cluster transparently. The first Application Server instance's MQ broker will be set to be the master broker. Auto-clustering, however, has a disadvantage too. If the administrator adds an instance to the cluster, the MQ broker instance created automatically will not be able to take part in the cluster. This behavior also applies if an instance is removed from the cluster.

▼ To Enable MQ Clusters with Application Server Clusters

Before You Begin Perform the following steps if the cluster is of type REMOTE. If the cluster is of type LOCAL, steps 1 to 4 are not applicable .

1 Create an Application Server cluster, if one does not already exist.

For information on creating clusters, see "To Create a Cluster" on page 161.

2 Create an MQ broker cluster.

First, delete the default JMS host that refers to the broker started by the Domain Administration Server, and then create three external brokers (JMS hosts) that will be in the MQ broker cluster.

Create a JMS host with either the Admin Console or the `asadmin` command-line utility.

To use `asadmin`, the commands are for example:

```
asadmin delete-jms-host --target cluster1 default_JMS_host
asadmin create-jms-host --target cluster1
     --mqhost myhost1 --mqport 6769
     --mquser admin --mqpassword admin broker1
asadmin create-jms-host --target cluster1
     --mqhost myhost2 --mqport 6770
     --mquser admin --mqpassword admin broker2
asadmin create-jms-host --target cluster1
     --mqhost myhost3 --mqport 6771
     --mquser admin --mqpassword admin broker3
```

To create the hosts with Admin Console:

a. Navigate to the JMS Hosts node (Configurations > *config-name* > Java Message Service > JMS Hosts)

b. Delete the default broker (default_JMS_host).

Select the checkbox next to it, and then click Delete.

c. Click New to create each JMS host and enter its property values.

Fill in the values for host name, DNS name or IP address, port number, administrative user name and password.

3 Start the master MQ broker and the other MQ brokers.

In addition to the three external brokers started on JMS host machines, start one master broker on any machine. This master broker need not be part of a broker cluster. For example:

```
/usr/bin/imqbrokerd -tty -name brokerm -port 6772
 -cluster myhost1:6769,myhost2:6770,myhost2:6772,myhost3:6771
 -D"imq.cluster.masterbroker=myhost2:6772"
```

4. **Start the Application Server instances in the cluster.**

5. **Create JMS resources on the cluster:**

   a. **Create JMS physical destinations.**

      For example, using `asadmin`:

      ```
      asadmin create-jmsdest --desttype queue --target cluster1 MyQueue
      asadmin create-jmsdest --desttype queue --target cluster1 MyQueue1
      ```

      To use Admin Console:

      i. **Navigate to the JMS Hosts page (Configurations > *config-name* > Java Message Service > Physical Destinations).**

      ii. **Click New to create eachNavigate to the Physical Destination.**

      iii. **For each destination, enter its name and type (queue).**

   b. **Create JMS connection factories.**

      For example, using `asadmin`:

      ```
      asadmin create-jms-resource --target cluster1
      --restype javax.jms.QueueConnectionFactory jms/MyQcf
      asadmin create-jms-resource --target cluster1
      --restype javax.jms.QueueConnectionFactory jms/MyQcf1
      ```

      To use Admin Console:

      i. **Navigate to the JMS Connection Factories page (Resources > JMS Resources > Connection Factories).**

      ii. **To create each connection factory, click New.**

      The New JMS Connection Factory page opens.

      iii. **For each connection factory, enter JNDI Name (for example `jms/MyQcf`) and Resource Type, `javax.jms.QueueConnectionFactory`**

      iv. **Select the cluster from the list of available targets at the bottom of the page and click Add.**

      v. **Click OK to create the connection factory.**

c. Create JMS destination resources.

For example, using `asadmin`:

```
asadmin create-jms-resource --target cluster1
     --restype javax.jms.Queue
     --property imqDestinationName=MyQueue jms/MyQueue
asadmin create-jms-resource --target cluster1
     --restype javax.jms.Queue
     --property imqDestinationName=MyQueue1 jms/MyQueue1
```

To use Admin Console:

i. Navigate to the JMS Destination Resources page (Resources > JMS Resources > Destination Resources).

ii. To create each destination resource, click New.

The New JMS Destination Resource page opens.

iii. For each destination resource, enter JNDI Name (for example `jms/MyQueue`) and Resource Type `javax.jms.Queue`.

iv. Select the cluster from the list of available targets at the bottom of the page and click Add.

v. Click OK to create the destination resource.

6 Deploy the applications with the `–retrieve` option for application clients. For example:

```
asadmin deploy --target cluster1
--retrieve /opt/work/MQapp/mdb-simple3.ear
```

7 Access the application and test it to ensure it is behaving as expected.

8 If you want to return the Application Server to its default JMS configuration, delete the JMS hosts you created and recreate the default. For example:

```
asadmin delete-jms-host --target cluster1 broker1
asadmin delete-jms-host --target cluster1 broker2
asadmin delete-jms-host --target cluster1 broker3
asadmin create-jms-host --target cluster1
 --mqhost myhost1 --mqport 7676
 --mquser admin --mqpassword admin
 default_JMS_host
```

You can also perform the equivalent operation with Admin Console.

Troubleshooting If you encounter problems, consider the following:

- View the Application Server log file located at *as-install-dir*/nodeagents/*node-agent-name*/*instance-name*/logs/server.log. If you see in the log file that an MQ broker does not respond to a message, stop the broker and then restart it.
- View the broker log available at *as-install-dir*/nodeagents/*node-agent-name*/*instance-name*/imq/*imq-instance-name*/log/log.txt.
- For the Remote JMS type, always be sure to start MQ brokers first, and then the Application Server instances.
- When all MQ brokers are down, it takes 30 minutes for Application Server to go down or up, with the default values in Java Message Service. Tune Java Message Service values to get acceptable values for this timeout. For example:

```
asadmin set --user admin --password administrator
cluster1.jms-service.reconnect-interval-in-seconds=5
```

◆ ◆ ◆ CHAPTER 11

RMI-IIOP Load Balancing and Failover

This chapter describes using Sun Java System Application Server's high-availability features for remote EJB references and JNDI objects over RMI-IIOP.

Overview

With RMI-IIOP load balancing, IIOP client requests are distributed to different server instances or name servers. The goal is to spread the load evenly across the cluster, thus providing scalability. IIOP load balancing combined with EJB clustering and availability also provides EJB failover.

When a client performs a JNDI lookup for an object, the Naming Service creates a `InitialContext` (IC) object associated with a particular server instance. From then on, all lookup requests made using that IC object are sent to the same server instance. All `EJBHome` objects looked up with that `InitialContext` are hosted on the same target server. Any bean references obtained henceforth are also created on the same target host. This effectively provides load balancing, since all clients randomize the list of live target servers when creating `InitialContext` objects. If the target server instance goes down, the lookup or EJB method invocation will failover to another server instance.

IIOP load balancing and failover happens transparently. No special steps are needed during application deployment. IIOP load balancing and failover for the Application Server supports dynamically reconfigured clusters. If the Application Server instance on which the application client is deployed participates in a cluster, the Application Server finds all currently active IIOP endpoints in the cluster automatically. Therefore, you are not required to manually update the list of endpoints if a new instance is added to the cluster or deleted from the cluster. However, a client should have at least two endpoints specified for bootstrapping purposes, in case one of the endpoints has failed.

Requirements

Sun Java System Application Server provides high availability of remote EJB references and `NameService` objects over RMI-IIOP, provided all the following apply:

- Your deployment has a cluster of at least two application server instances.
- Java EE applications are deployed to all application server instances and clusters that participate in load balancing.
- RMI-IIOP client applications are enabled for load balancing.

Application Server supports load balancing for Java applications executing in the Application Client Container (ACC). See "Setting up RMI-IIOP Load Balancing and Failover" on page 229.

Note – Application Server does not support RMI-IIOP load balancing and failover over secure sockets layer (SSL).

Algorithm

Application Server uses a randomization and round-robin algorithm for RMI-IIOP load balancing and failover.

When an RMI-IIOP client first creates a new `InitialContext` object, the list of available Application Server IIOP endpoints is randomized for that client. For that `InitialContext` object, the load balancer directs lookup requests and other `InitialContext` operations to the first endpoint on the randomized list. If the first endpoint is not available then the second endpoint in the list is used, and so on.

Each time the client subsequently creates a new `InitialContext` object, the endpoint list is rotated so that a different IIOP endpoint is used for `InitialContext` operations.

When you obtain or create beans from references obtained by an `InitialContext` object, those beans are created on the Application Server instance serving the IIOP endpoint assigned to the `InitialContext` object. The references to those beans contain the IIOP endpoint addresses of all Application Server instances in the cluster.

The *primary endpoint* is the bean endpoint corresponding to the `InitialContext` endpoint used to look up or create the bean. The other IIOP endpoints in the cluster are designated as *alternate endpoints*. If the bean's primary endpoint becomes unavailable, further requests on that bean fail over to one of the alternate endpoints.

You can configure RMI-IIOP load balancing and failover to work with applications running in the ACC.

Setting up RMI-IIOP Load Balancing and Failover

You can set up RMI-IIOP load balancing and failover for applications running in the application client container (ACC). Weighted round-robin load balancing is also supported.

▼ To Set Up RMI-IIOP Load Balancing for the Application Client Container

This procedure gives an overview of the steps necessary to use RMI-IIOP load balancing and failover with the application client container (ACC). For additional information on the ACC, see "Developing Clients Using the ACC" in *Sun Java System Application Server 9.1 Developer's Guide*.

1. **Go to the** *install_dir* `/bin` **directory.**

2. **Run** `package-appclient`**.**

   This utility produces an `appclient.jar` file. For more information on `package-appclient`, see `package-appclient`(1M).

3. **Copy the** `appclient.jar` **file to the machine where you want your client and extract it.**

4. **Edit the** `asenv.conf` **or** `asenv.bat` **path variables to refer to the correct directory values on that machine.**

   The file is at *appclient-install-dir* `/config/`.

   For a list of the path variables to update, see `package-appclient`(1M).

5. **If required, make the** `appclient` **script executable.**

   For example, on UNIX use `chmod 700`.

6. **Find the IIOP listener port number of at least two instances in the cluster.**

   You specify the IIOP listeners as endpoints in Step 7.

   For each instance, obtain the IIOP listener port as follows:

   a. **In the Admin Console's tree component, expand the Clusters node.**

   b. **Expand the cluster.**

   c. **Select an instance in the cluster.**

   d. **In the right pane, click the Properties tab.**

e. Note the IIOP listener port for the instance.

7 Add at least two `target-server` elements in the `sun-acc.xml` file.

Note – Clustering features are not available in the developer profile. For information about profiles, see "Usage Profiles" in *Sun Java System Application Server 9.1 Administration Guide*.

Use the endpoints that you obtained in Step 6.

If the Application Server instance on which the application client is deployed participates in a cluster, the ACC finds all currently active IIOP endpoints in the cluster automatically. However, a client should have at least two endpoints specified for bootstrapping purposes, in case one of the endpoints has failed.

The `target-server` element specifies one or more IIOP endpoints used for load balancing. The `address` attribute is an IPv4 address or host name, and the `port` attribute specifies the port number. See "client-container" in *Sun Java System Application Server 9.1 Application Deployment Guide*.

As an alternative to using `target-server` elements, you can use the `endpoints` property as follows:

```
jvmarg value = "-Dcom.sun.appserv.iiop.endpoints=host1:port1,host2:port2,..."
```

8 If you require weighted round-robin load balancing, perform the following steps:

a. Set the load-balancing weight of each server instance.

```
asadmin set instance-name.lb-weight=weight
```

b. In the `sun-acc.xml`, set the `com.sun.appserv.iiop.loadbalancingpolicy` property of the ACC to `ic-based-weighted`.

```
...
<client-container send-password="true">
  <property name="com.sun.appserv.iiop.loadbalancingpolicy" value="ic-based-weighed"/>
...
```

9 Deploy your client application with the `--retrieve` option to get the client jar file.

Keep the client jar file on the client machine.

For example:

```
asadmin deploy --user admin --passwordfile pw.txt --retrieve /my_dir myapp
```

10 Run the application client as follows:

`appclient -client` *clientjar* `-name` *appname*

Example 11–1 Setting Load-Balancing Weights for RMI-IIOP Weighted Round-Robin Load Balancing

In this example, the load-balancing weights in a cluster of three instances are to be set as shown in the following table.

Instance Name	Load-Balancing Weight
`i1`	100
`i2`	200
`i3`	300

The sequence of commands to set these load balancing weights is as follows:

```
asadmin set i1.lb-weight=100
asadmin set i2.lb-weight=200
asadmin set i3.lb-weight=300
```

Next Steps To test failover, stop one instance in the cluster and see that the application functions normally. You can also have breakpoints (or sleeps) in your client application.

To test load balancing, use multiple clients and see how the load gets distributed among all endpoints.

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