



Sun Java System Directory Server Enterprise Edition 6.2 Administration Guide



Sun Microsystems, Inc.
4150 Network Circle
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Preface

The *Administration Guide*, provides procedural information for configuring Directory Server and Directory Proxy Server features from the command line. Instructions for configuring these feature by using the web-based interface (Directory Service Control Center) are provided in the online help.

Who Should Use This Book

This *Administration Guide* is intended for administrators of Directory Server and Directory Proxy Server software.

Before You Read This Book

This book does not provide information on installing the software. For installation information, see the *Sun Java System Directory Server Enterprise Edition 6.2 Installation Guide*.

If you are migrating from an older version of Directory Server or Directory Proxy Server, see the *Sun Java System Directory Server Enterprise Edition 6.2 Migration Guide* for instructions on migrating servers. If you are unfamiliar with the new features in this version, it might be useful to read the *Sun Java System Directory Server Enterprise Edition 6.2 Evaluation Guide* for an overview of the new features.

How This Book Is Organized

[Part I](#), provides procedural information on administering Directory Server.

[Part II](#), provides procedural information on administering Directory Proxy Server

Examples Used in This Guide

For consistency reasons, the same example data is used throughout this guide. Replace these values with the appropriate values for your system.

TABLE P-1 Default Values Used in Examples

Variable	Values used in examples
Suffix (SUFFIX_DN)	dc=example,dc=com
Instance path (INSTANCE_PATH)	For Directory Server: /local/ds/ For Directory Proxy Server: /local/dps/
Hostnames (HOST)	host1, host2, host3
Port (PORT)	LDAP: Default for root: 389. Default for non-root: 1389 SSL default: Default for root: 636. Default for non-root: 1636

Directory Server Enterprise Edition Documentation Set

This Directory Server Enterprise Edition documentation set explains how to use Sun Java System Directory Server Enterprise Edition to evaluate, design, deploy, and administer directory services. In addition, it shows how to develop client applications for Directory Server Enterprise Edition. The Directory Server Enterprise Edition documentation set is available at <http://docs.sun.com/coll/1224.3>.

For an introduction to Directory Server Enterprise Edition, review the following documents in the order in which they are listed.

TABLE P-2 Directory Server Enterprise Edition Documentation

Document Title	Contents
<i>Sun Java System Directory Server Enterprise Edition 6.2 Release Notes</i>	Contains the latest information about Directory Server Enterprise Edition, including known problems.
<i>Sun Java System Directory Server Enterprise Edition 6.2 Documentation Center</i>	Contains links to key areas of the documentation set.
<i>Sun Java System Directory Server Enterprise Edition 6.2 Evaluation Guide</i>	Introduces the key features of this release. Demonstrates how these features work and what they offer in the context of a fictional deployment that you can implement on a single system.

TABLE P-2 Directory Server Enterprise Edition Documentation (Continued)

Document Title	Contents
<i>Sun Java System Directory Server Enterprise Edition 6.2 Deployment Planning Guide</i>	Explains how to plan and design highly available, highly scalable directory services based on Directory Server Enterprise Edition. Presents the basic concepts and principles of deployment planning and design. Discusses the solution life cycle, and provides high-level examples and strategies to use when planning solutions based on Directory Server Enterprise Edition.
<i>Sun Java System Directory Server Enterprise Edition 6.2 Installation Guide</i>	<p>Explains how to install the Directory Server Enterprise Edition software. Shows how to select which components to install, configure those components after installation, and verify that the configured components function properly.</p> <p>For instructions on installing Directory Editor, go to http://docs.sun.com/coll/DirEdit_05q1.</p> <p>Make sure you read the information in <i>Sun Java System Directory Server Enterprise Edition 6.2 Release Notes</i> related to Directory Editor before you install Directory Editor.</p>
<i>Sun Java System Directory Server Enterprise Edition 6.2 Migration Guide</i>	Provides instructions for upgrading components from earlier versions of Directory Server, Directory Proxy Server, and Identity Synchronization for Windows.
<i>Sun Java System Directory Server Enterprise Edition 6.2 Administration Guide</i>	<p>Provides command-line instructions for administering Directory Server Enterprise Edition.</p> <p>For hints and instructions on using the Directory Service Control Center (DSCC) to administer Directory Server Enterprise Edition, see the online help provided in DSCC.</p> <p>For instructions about administering Directory Editor, go to http://docs.sun.com/coll/DirEdit_05q1.</p> <p>For instructions about installing and configuring Identity Synchronization for Windows, see Part II, “Installing Identity Synchronization for Windows,” in <i>Sun Java System Directory Server Enterprise Edition 6.2 Installation Guide</i>.</p>
<i>Sun Java System Directory Server Enterprise Edition 6.2 Developer’s Guide</i>	Provides instructions for developing directory client applications with the tools and APIs that are provided as part of Directory Server Enterprise Edition.
<i>Sun Java System Directory Server Enterprise Edition 6.2 Reference</i>	Introduces the technical and conceptual foundations of Directory Server Enterprise Edition. Describes its components, architecture, processes, and features. Also provides a reference to the developer APIs.
<i>Sun Java System Directory Server Enterprise Edition 6.2 Man Page Reference</i>	Describes the command-line tools, schema objects, and other public interfaces that are available through Directory Server Enterprise Edition. Individual sections of this document can be installed as online manual pages.
<i>Sun Java System Directory Server Enterprise Edition 6.2 Troubleshooting Guide</i>	Provides information for defining the scope of the problem, gathering data, and troubleshooting the problem areas using various tools.
<i>Sun Java System Identity Synchronization for Windows 6.0 Deployment Planning Guide</i>	Provides general guidelines and best practices for planning and deploying Identity Synchronization for Windows.

Related Reading

The SLAMD Distributed Load Generation Engine is a Java™ application that is designed to stress test and analyze the performance of network-based applications. It was originally developed by Sun Microsystems, Inc. to benchmark and analyze the performance of LDAP directory servers. SLAMD is available as an open source application under the Sun Public License, an OSI-approved open source license. To obtain information about SLAMD, go to <http://www.slamd.com/>. SLAMD is also available as a java.net project. See <https://slamd.dev.java.net/>.

Java Naming and Directory Interface (JNDI) technology supports accessing the Directory Server using LDAP and DSML v2 from Java applications. For information about JNDI, see <http://java.sun.com/products/jndi/>. The *JNDI Tutorial* contains detailed descriptions and examples of how to use JNDI. This tutorial is at <http://java.sun.com/products/jndi/tutorial/>.

Directory Server Enterprise Edition can be licensed as a standalone product, as a component of Sun Java Enterprise System, as part of a suite of Sun products, such as the Sun Java Identity Management Suite, or as an add-on package to other software products from Sun. Java Enterprise System is a software infrastructure that supports enterprise applications distributed across a network or Internet environment. If Directory Server Enterprise Edition was licensed as a component of Java Enterprise System, you should be familiar with the system documentation at <http://docs.sun.com/coll/1286.3>.

Identity Synchronization for Windows uses Message Queue with a restricted license. Message Queue documentation is available at <http://docs.sun.com/coll/1307.2>.

Identity Synchronization for Windows works with Microsoft Windows password policies.

- Information about password policies for Windows 2003 is available in the [Microsoft documentation](#) online.
- Information about changing passwords, and about group policies in Windows 2003 is available in the [Microsoft documentation](#) online.
- Information about the Microsoft Certificate Services Enterprise Root certificate authority is available in the [Microsoft support documentation](#) online.
- Information about configuring LDAP over SSL on Microsoft systems is available in the [Microsoft support documentation](#) online.

Redistributable Files

Directory Server Enterprise Edition does not provide any files that you can redistribute.

Default Paths and Command Locations

This section explains the default paths used in the documentation, and gives the locations of commands on different operating systems and deployment types.

Default Paths

The table in this section describes the default paths that are used in this document. For complete descriptions of the files installed, see the following product documentation.

- Chapter 14, “Directory Server File Reference,” in *Sun Java System Directory Server Enterprise Edition 6.2 Reference*
- Chapter 25, “Directory Proxy Server File Reference,” in *Sun Java System Directory Server Enterprise Edition 6.2 Reference*
- Appendix A, “Directory Server Resource Kit File Reference,” in *Sun Java System Directory Server Enterprise Edition 6.2 Reference*

TABLE P-3 Default Paths

Placeholder	Description	Default Value
<i>install-path</i>	<p>Represents the base installation directory for Directory Server Enterprise Edition software.</p> <p>The software is installed in directories below this base <i>install-path</i>. For example, Directory Server software is installed in <i>install-path/ds6/</i>.</p>	<p>When you install from a zip distribution using <code>dsee_deploy(1M)</code>, the default <i>install-path</i> is the current directory. You can set the <i>install-path</i> using the <code>-i</code> option of the <code>dsee_deploy</code> command. When you install from a native package distribution, such as you would using the Java Enterprise System installer, the default <i>install-path</i> is one of the following locations:</p> <ul style="list-style-type: none"> ■ Solaris systems - <code>/opt/SUNWdsee/</code>. ■ Red Hat systems - <code>/opt/sun/</code>. ■ Windows systems - <code>C:\Program Files\Sun\JavaES5\DSEE</code>.

TABLE P-3 Default Paths (Continued)

Placeholder	Description	Default Value
<i>instance-path</i>	Represents the full path to an instance of Directory Server or Directory Proxy Server. The documentation uses <code>/local/ds/</code> for Directory Server and <code>/local/dps/</code> for Directory Proxy Server.	No default path exists. Instance paths must nevertheless always be found on a <i>local</i> file system. The following directories are recommended: <code>/var</code> on Solaris systems <code>/global</code> if you are using Sun Cluster
<i>serverroot</i>	Represents the parent directory of the Identity Synchronization for Windows installation location	Depends on your installation. Note the concept of a <i>serverroot</i> no longer exists for Directory Server.
<i>i sw -hostname</i>	Represents the Identity Synchronization for Windows instance directory	Depends on your installation
<i>/path/to/cert8.db</i>	Represents the default path and file name of the client's certificate database for Identity Synchronization for Windows	<i>current-working-dir/cert8.db</i>
<i>serverroot/i sw -hostname/logs/</i>	Represents the default path to the Identity Synchronization for Windows local logs for the System Manager, each connector, and the Central Logger	Depends on your installation
<i>serverroot/i sw -hostname/logs/central/</i>	Represents the default path to the Identity Synchronization for Windows central logs	Depends on your installation

Command Locations

The table in this section provides locations for commands that are used in Directory Server Enterprise Edition documentation. To learn more about each of the commands, see the relevant man pages.

TABLE P-4 Command Locations

Command	Java ES, Native Package Distribution	Zip Distribution
cacaoadm	Solaris - /usr/sbin/cacaoadm	Solaris - <i>install-path/dsee6/ cacao_2/usr/sbin/cacaoadm</i>
	Red Hat - /opt/sun/cacao/bin/cacaoadm	Red Hat- <i>install-path/dsee6/ cacao_2/cacao/bin/cacaoadm</i>
	Windows - <i>install-path\share\ cacao_2\bin\cacaoadm.bat</i>	Windows - <i>install-path\ dsee6\cacao_2\bin\cacaoadm.bat</i>
certutil	Solaris - /usr/sfw/bin/certutil	<i>install-path/dsee6/bin/certutil</i>
	Red Hat- /opt/sun/private/bin/certutil	
dpadm(1M)	<i>install-path/dps6/bin/dpadm</i>	<i>install-path/dps6/bin/dpadm</i>
dpconf(1M)	<i>install-path/dps6/bin/dpconf</i>	<i>install-path/dps6/bin/dpconf</i>
dsadm(1M)	<i>install-path/ds6/bin/dsadm</i>	<i>install-path/ds6/bin/dsadm</i>
dscmcom(1M)	<i>install-path/dscc6/bin/dscmcom</i>	<i>install-path/dscc6/bin/dscmcom</i>
dsccreg(1M)	<i>install-path/dscc6/bin/dsccreg</i>	<i>install-path/dscc6/bin/dsccreg</i>
dscctest(1M)	<i>install-path/dscc6/bin/dscctest</i>	<i>install-path/dscc6/bin/dscctest</i>
dsconf(1M)	<i>install-path/ds6/bin/dsconf</i>	<i>install-path/ds6/bin/dsconf</i>
dsee_deploy(1M)	Not provided	<i>install-path/dsee6/bin/dsee_deploy</i>
dsmig(1M)	<i>install-path/ds6/bin/dsmig</i>	<i>install-path/ds6/bin/dsmig</i>
entrycmp(1)	<i>install-path/ds6/bin/entrycmp</i>	<i>install-path/ds6/bin/entrycmp</i>
fildif(1)	<i>install-path/ds6/bin/fildif</i>	<i>install-path/ds6/bin/fildif</i>
idsktune(1M)	Not provided	At the root of the unzipped zip distribution
insync(1)	<i>install-path/ds6/bin/insync</i>	<i>install-path/ds6/bin/insync</i>
ns-accountstatus(1M)	<i>install-path/ds6/bin/ns-accountstatus</i>	<i>install-path/ds6/bin/ns-accountstatus</i>
ns-activate(1M)	<i>install-path/ds6/bin/ns-activate</i>	<i>install-path/ds6/bin/ns-activate</i>
ns-inactivate(1M)	<i>install-path/ds6/bin/ns-inactivate</i>	<i>install-path/ds6/bin/ns-inactivate</i>

TABLE P-4 Command Locations (Continued)

Command	Java ES, Native Package Distribution	Zip Distribution
repldisc(1)	<i>install-path</i> /ds6/bin/repldisc	<i>install-path</i> /ds6/bin/repldisc
schema_push(1M)	<i>install-path</i> /ds6/bin/schema_push	<i>install-path</i> /ds6/bin/schema_push
smcwebserver	Solaris and Linux- /usr/sbin/smcwebserver	This command pertains only to DSCC when it is installed using native packages distribution.
	Windows - <i>install-path</i> \share\ webconsole\bin\smcwebserver	
wadmin	Solaris and Linux- /usr/sbin/wadmin	This command pertains only to DSCC when it is installed using native packages distribution.
	Windows - <i>install-path</i> \share\ webconsole\bin\wadmin	

Typographic Conventions

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

TABLE P-5 Typographic Conventions

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

Shell Prompts in Command Examples

The following table shows default system prompts and superuser prompts.

TABLE P-6 Shell Prompts

Shell	Prompt
C shell on UNIX and Linux systems	machine_name%
C shell superuser on UNIX and Linux systems	machine_name#
Bourne shell and Korn shell on UNIX and Linux systems	\$
Bourne shell and Korn shell superuser on UNIX and Linux systems	#
Microsoft Windows command line	C:\

Symbol Conventions

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

TABLE P-7 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/) (<http://www.sun.com/documentation/>)
- [Support](http://www.sun.com/support/) (<http://www.sun.com/support/>)
- [Training](http://www.sun.com/training/) (<http://www.sun.com/training/>)

Searching Sun Product Documentation

Besides searching Sun product documentation from the docs.sun.comSM 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.

Sun Welcomes Your Comments

Sun is interested in improving its documentation and welcomes your comments and suggestions. To share your comments, go to <http://docs.sun.com> and click Send Comments. In the online form, provide the full document title and part number. The part number is a 7-digit or 9-digit number that can be found on the book's title page or in the document's URL. For example, the part number of this book is 820-2491.

PART I

Directory Server Administration

Directory Server Tools

Sun Java™ System Directory Server Directory Server Enterprise Edition provides a browser interface and command-line tools for administering multiple servers, instances, and suffixes in a replicated environment. This chapter provides overview information about Directory Server administration tools.

This chapter covers the following topics:

- “Directory Server Administration Overview” on page 41
- “Deciding When to Use DSCC and When to Use the Command Line” on page 42
- “Directory Service Control Center Interface” on page 43
- “Directory Server Command-Line Tools” on page 48

Directory Server Administration Overview

Information about the Directory Server administration framework is provided in other guides in this documentation set.

- For an overview of the Directory Server administration framework, see “Directory Server Enterprise Edition Administration Model” in *Sun Java System Directory Server Enterprise Edition 6.2 Deployment Planning Guide*.
- For more detailed reference information about the Directory Server administration framework, see Chapter 1, “Directory Server Overview,” in *Sun Java System Directory Server Enterprise Edition 6.2 Reference*.

Deciding When to Use DSCC and When to Use the Command Line

Directory Server Enterprise Edition provides two user interfaces for managing Directory Servers and Directory Proxy Servers: a browser interface, Directory Service Control Center (DSCC), and a command-line interface.

Determining Whether a Procedure Can Be Done Using DSCC

Most procedures in this guide can be performed using either the command line or DSCC. The procedures in this guide show how to use the command line to accomplish the procedure. In most cases DSCC can be used to perform the same task. If DSCC can be used for a particular procedure, a statement to that effect appears at the beginning of the procedure.

The DSCC online help provides detailed instructions on how to use DSCC to perform the procedures in this guide.

Cases Where Using DSCC Is Better

DSCC enables you to perform some operations and tasks more easily than you can perform them from the command line, as explained in the following sections. In general, any command that must be applied to several servers is best performed using DSCC.

Viewing Servers and Suffix Replication Status

DSCC displays tables that show all server instances that have been registered in DSCC, all suffixes that have been configured, and the status of each.

The servers table is on the Directory Servers tab and shows the operational status of the server. For a complete list of possible server states, see the Directory Server online help.

The suffixes table is on the Suffixes tab and shows replication status information, such as the number of entries and the number and age of any missing changes. For more information about the information displayed in this table, see the Directory Server online help.

Managing Groups of Servers

Server groups assist you in monitoring and configuring servers. You can create groups and assign servers to the groups. For example, you can group servers by geographical location, or by function. If you have a large number of servers, you can filter the servers shown on the Directory Servers tab so that only the servers in the group are shown. You can also copy the

server configuration (for example index or cache settings) of one server to all other servers in a group. For instructions on how to set up and use a server group, see the Directory Server online help.

Copying Configuration Settings

DSCC enables you to copy the configuration settings of an existing server, suffix, or replication agreement to one or more other servers, suffixes, or replication agreements. For information about how to perform each of these tasks, see the Directory Server online help.

Configuring Replication

With DSCC, you can set up a replication topology quickly and easily. Simply create the server instances, then use the steps provided by DSCC to designate the role of each server. DSCC automatically creates the replication agreements for you. For more information about how to configure replication using DSCC, see the Directory Server online help.

Directory Service Control Center Interface

Directory Service Control Center (DSCC) is a user interface that enables you to manage Directory Servers and Directory Proxy Servers by using a browser.

To configure DSCC, see [“Configuring DSCC” on page 70](#). For information about using DSCC, see the following sections.

Administration Users for DSCC

DSCC has a few administration logins.

- **OS user.** Creates a server instance and is the only user who has the right to run operating system commands on a server instance by using the `dsadm` command. DSCC might request the OS user password in some cases. This user must have a password and must be able to create directory server instances.
- **Directory Manager.** The LDAP superuser for a server. The default DN is `cn=Directory Manager`.
- **Directory Administrator.** Administers a Directory Server. This user has the same rights as the Directory Manager but are subject to access controls, password policies, and authentication requirements. You can create as many Directory Administrators as you need.
- **Directory Service Manager.** Manages server configuration and data on multiple machines through DSCC. This user has the same rights as the Directory Manager for each of the servers registered in DSCC and is a member of the Directory Administrators Group.

▼ To Access DSCC

If you experience any difficulty accessing DSCC, see “To Troubleshoot Directory Service Control Center Access” in *Sun Java System Directory Server Enterprise Edition 6.2 Installation Guide*.

- 1 **Ensure that DSCC has been correctly installed, as described in “Software Installation” in *Sun Java System Directory Server Enterprise Edition 6.2 Installation Guide*.**
- 2 **If you have installed DSCC with the native package installation, follow these steps:**
 - a. **Open a browser, and type the DSCC host URL in the following format:**

`https://hostname:6789`

For example:

`https://host1:6789`

where hostname is the system on which you installed the DSCC software.

The Sun Java Web Console default port is 6789.

The following figure shows a Sun Java Web Console login window.

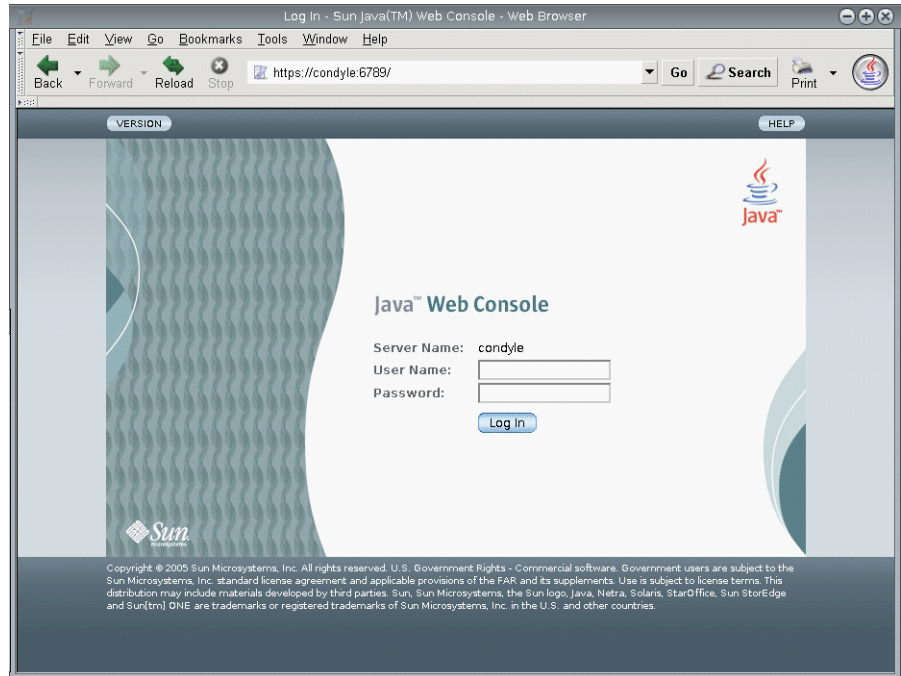


FIGURE 1-1 Sun Java Web Console Login Window

b. Log in to the Sun Java Web Console.

- If this is the first time that you log in to Sun Java Web Console, log in as root on the system where you installed the DSCC software.
- If this is a subsequent login, type your operating system user name and password. This user should have the privileges to start, stop, and manage Directory Server instances.

When you log in, you see a list of applications.

c. Select Directory Service Control Center (DSCC).

The DSCC login window is displayed.

3 If you have installed DSCC with a zip installation, follow these steps:

- a. Access DSCC directly in your preferred application server by typing the DSCC host URL. DSCC host URL can be any of the following depending on the configuration of your application server.**

`https://hostname:6789`

or

`http://hostname:6789`

b. Initialize DSCC using the following command.

```
$ install path/dsc6/bin/dscsetup ads-create
```

4 Log in to DSCC.

If this is the first time that you log in to DSCC, you must set the Directory Service Manager password. On subsequent logins, use the password that you set on the first login.

You are now logged into DSCC and at the Common Tasks tab.

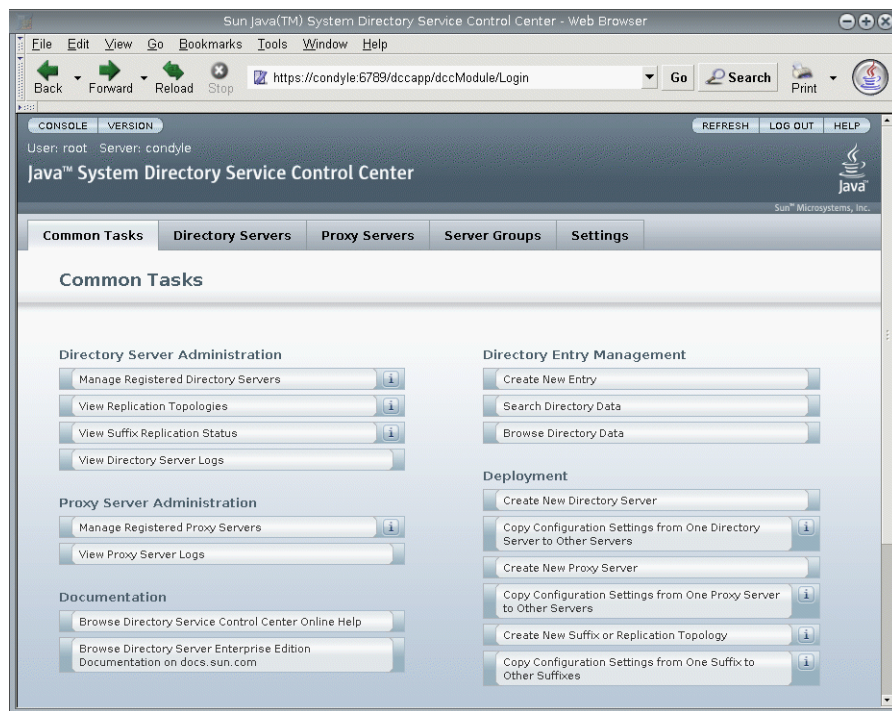


FIGURE 1-2 DSCC Common Tasks Tab

5 Navigate by using the tabs.

- The Common Tasks tab contains shortcuts to commonly used windows and wizards.
- The Directory Servers tab displays all Directory Servers managed by DSCC. To see more options for managing and configuring a particular server, click the server name.
- The Proxy Servers tab displays all Directory Proxy Servers managed by DSCC. To see more options for managing and configuring a particular server, click the server name.

Note – For instructions on how to perform tasks using DSCC, see the DSCCOnline help.

DSCC Tabs Description

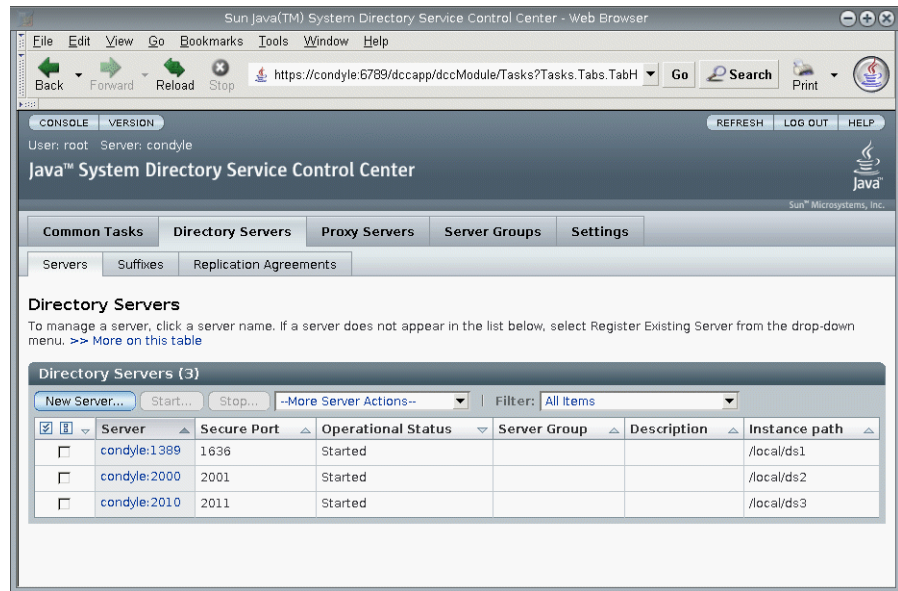


FIGURE 1-3 List of Directory Servers On the Servers Sub Tab

Use the tabs in DSCC to navigate the interface.

Common Tasks Tab

The Common Tasks tab (see [Figure 1-2](#)) is the first interface that you see when opening DSCC. It contains links to commonly used administrative tasks, such as searching directory data, checking logs, and managing servers.

Directory Servers Tab

The Directory Servers tab (see [Figure 1-3](#)) lists all directory servers registered in DSCC. For each server, you can see the server status and instance path, which shows where the instance is located.

When you click a server name, you see another window with a different set of tabs that relate only to that server.

Proxy Servers Tab

The Proxy Servers tab lists all the directory proxy servers that are registered in DSCC. For each server, you can see the server status and the server instance path, which shows where the instance resides.

When you click a server name, you see another window with a different set of tabs that relate only to that server.

Server Groups Tab

The Server Groups tab enables you to assign servers to groups, to make server management easier. If you have numerous servers, you can use filters to display only the servers in a certain group. You can also copy the server configuration (for example index or cache settings) from one server to all other servers in a group.

Settings Tab

This tab displays DSCC port numbers and allows you to create and delete Directory Service Managers.

DSCC Online Help

The online help provides the following:

- Context-sensitive help for the page you are currently using.
- General help for performing administration and configuration procedures using DSCC.

You can access help from most pages by clicking the Help button on the top right corner of the screen. From within a wizard, you can access help by clicking the Help tab. You can also access the online help from the Common Tasks tab.

Directory Server Command-Line Tools

Most tasks you perform on DSCC can be performed using command-line tools. These tools enable you to manage Directory Server directly from the command line, and to manage your server by using scripts.

The main directory server commands are `dsadm` and `dsconf`. You can use these commands to perform backups, export to LDIF, manage certificates, and so on. For information about these commands, see the `dsadm(1M)` and `dsconf(1M)` man pages.

This section contains the following information about Directory Server command-line tools:

- “Location of Directory Server Commands” on page 49
- “Setting Environment Variables for `dsconf`” on page 49
- “Comparison of `dsadm` and `dsconf`” on page 49
- “Obtaining Help for Using `dsadm` and `dsconf`” on page 50
- “Modifying Configuration Properties by Using `dsconf`” on page 51
- “Man Pages” on page 52

Location of Directory Server Commands

The Directory Server command-line tools are contained in a default installation directory:

```
install-path/ds6/bin
```

The directory for your installation depends on your operating system. Installation paths for all operating systems are listed in “Default Paths and Command Locations” on page 33.

Setting Environment Variables for `dsconf`

The `dsconf` command requires some options that you can preset by using environment variables. If you do not specify an option when using the command, or do not set the environment variable, the default setting is used. You can configure environment variables for the following options:

<code>-D user DN</code>	User bind DN. Environment variable: <code>LDAP_ADMIN_USER</code> . Default: <code>cn=Directory Manager</code> .
<code>-w password-file</code>	Password file for the user bind DN. Environment variable: <code>LDAP_ADMIN_PWF</code> . Default: Prompt for password.
<code>-h host</code>	Host name. Environment variable: <code>DIRSERV_HOST</code> . Default: <code>local host</code> .
<code>-p LDAP-port</code>	LDAP port number. Environment variable: <code>DIRSERV_PORT</code> . Default: 389.
<code>-e, --unsecured</code>	Specifies that <code>dsconf</code> should open a clear connection by default. Environment variable: <code>DIRSERV_UNSECURED</code> . If this variable is not set, <code>dsconf</code> opens a secure connection by default.

For more details, see the `dsconf(1M)` man page.

Comparison of `dsadm` and `dsconf`

The following table shows a comparison of the `dsadm` and `dsconf` commands.

TABLE 1-1 Comparison of the dsadm and dsconf Commands

	dsadm Command	dsconf Command
Description	Administration commands that must be run directly on the local host. For example: <ul style="list-style-type: none"> ■ Starting and stopping the server ■ Creating a server instance 	Administration commands that can be run from a remote host. For example: <ul style="list-style-type: none"> ■ Enabling replication ■ Setting cache size
Notes	The server must be stopped (except for the dsadm stop and dsadm info commands). The server is identified by the server instance path (<i>instance-path</i>). You must have OS access permissions to the server instance path.	The server must be running. The server is identified by host name (-h) port (-p) or LDAPS secure port (-P). If you do not specify a port number, dsconf uses the default port (389 for LDAP). You must have LDAP access permissions to configuration data, for example, as the user cn=admin,cn=Administrators,cn=config.

Obtaining Help for Using dsadm and dsconf

For complete information about how to use the dsadm and dsconf commands, see the dsadm(1M) and dsconf(1M) man pages.

- To obtain a list of subcommands, type the appropriate command:

```
$ dsadm --help
```

```
$ dsconf --help
```

- To obtain information about how to use a subcommand, type the appropriate command:

```
$ dsadm subcommand --help
```

```
$ dsconf subcommand --help
```

Modifying Configuration Properties by Using `dsconf`

Many of the `dsconf` subcommands enable you to view and modify configuration properties.

- To list the configuration properties used in Directory Server, type:

```
$ dsconf help-properties
```

- To find a particular property, search the output of the help properties.

For example, if you are using a UNIX® platform and you want to search for all properties relating to referrals, use the following command.

```
$ dsconf help-properties | grep -i referral
SER referral-url rw M LDAP_URL | undefined
  Referrals returned to clients requesting a DN not stored in this
  Directory Server (Default: undefined)
SUF referral-mode rw disabled|enabled|only-on-write
  Specifies how referrals are used for requests involving the suffix
  (Default: disabled)
SUF referral-url rw M LDAP_URL | undefined
  Server(s) to which updates are referred (Default: undefined)
SUF repl-rewrite-referrals-enabled rw on|off
  Specifies whether automatic referrals are overwritten (Default: off)
```

Note that the properties are grouped by targeted objects, such as suffixes (SUF) and server (SER). The `rw` keyword indicates that the property is readable and writable. The `M` keyword indicates that the property is multi-valued.

- To see the server attribute, use verbose mode. For example, on a UNIX system, type:

```
$ dsconf help-properties -v | grep -i referral-mode
SUF referral-mode rw disabled|enabled|only-on-write nsslapd-state
  Specifies how referrals are used for requests involving the suffix
  (Default: disabled)
```

For more information about individual properties, see the man page for that property. The man pages are in *Sun Java System Directory Server Enterprise Edition 6.2 Man Page Reference*.

Setting Multi-Valued Properties With `dsconf`

Certain Directory Server properties can take multiple values. The syntax to specify these values is as follows:

```
$ dsconf set-container-prop -h host -p port container-name \
  property:value1 property:value2
```

For example, to set multiple encryption ciphers for a server, use the following command:

```
$ dsconf set-server-prop -h host1 -p 1389 ssl-cipher-family:SSL_RSA_WITH_RC4_128_MD5 \  
ssl-cipher-family:SSL_DHE_RSA_WITH_3DES_EDE_CBC_SHA
```

To add a value to a multi-valued property that already contains values, use the following syntax:

```
$ dsconf set-container-prop -h host -p port container-name property+:value
```

To remove a value from a multi-valued property that already contains values, use the following syntax:

```
$ dsconf set-container-prop -h host -p port container-name property-:value
```

For example, in the scenario described previously, to add the SHA encryption cipher to the list of ciphers, run this command:

```
$ dsconf set-server-prop -h host1 -p 1389 \  
ssl-cipher-family+:TLS_ECDHE_ECDSA_WITH_AES_256_CBC_SHA
```

To remove the MD5 cipher from the list, run this command:

```
$ dsconf set-server-prop -h host1 -p 1389 ssl-cipher-family-:SSL_RSA_WITH_RC4_128_MD5
```

Man Pages

The man pages provide descriptions of all commands and attributes used in Directory Server. In addition, the man pages show some useful examples of how to use the commands in deployment.

Legacy Tools

Legacy tools are included with the regular Directory Server tools for backwards compatibility. These tools are present but deprecated.

Directory Server Instances and Suffixes

This chapter describes how to create and manage Directory Server instances and suffixes. Many other directory administration tasks are configured at the suffix level, but they are covered in other chapters in this book.

This chapter covers the following topics:

- “Quick Procedure for Creating Server Instances and Suffixes” on page 53
- “Creating and Deleting a Directory Server Instance” on page 53
- “Starting, Stopping, and Restarting a Directory Server Instance” on page 57
- “Creating Suffixes” on page 58
- “Disabling or Enabling a Suffix” on page 60
- “Setting Referrals and Making a Suffix Read-Only” on page 61
- “Deleting a Suffix” on page 62
- “Compacting a Suffix” on page 63

Quick Procedure for Creating Server Instances and Suffixes

This chapter contains detailed information about how to create server instances and suffixes. If you need to quickly create a Directory Server instance and suffix, and import some example data, see “Server Instance Creation” in *Sun Java System Directory Server Enterprise Edition 6.2 Installation Guide*.

Creating and Deleting a Directory Server Instance

This section shows how to create and delete a Directory Server instance.

▼ To Create a Directory Server Instance

Before you can administer data, you must create a Directory Server instance by using command-line tools or the browser interface Directory Service Control Center (DSCC). In DSCC, a Directory Server instance is often referred to simply as a “Directory Server”.

When you create a Directory Server instance, the files and directories required for your Directory Server are created in the *instance-path* that you specify.

You can use DSCC to perform this task. For information, see [“Directory Service Control Center Interface” on page 43](#) and the DSCC online help.

If you use DSCC to create a new server instance, you can choose to copy some or all server configuration settings from an existing server.

1 Create a new Directory Server instance and set the instance path.

```
$ dsadm create instance-path
```

You are prompted to set a password for the Directory Manager for this server.

To specify a non-default port number for the server instance, or any other parameter, see the dsadm(1M) man page.

For example, to create a new instance in the directory `/local/ds`, use this command:

```
$ dsadm create /local/ds
Choose the Directory Manager password:
Confirm the Directory Manager password:
Use 'dsadm start /local/ds' to start the instance
```

2 Check that the server instance has been created correctly.

```
$ dsadm info instance-path
```

For example:

```
$ dsadm info /local/ds1
Instance Path:      /local/ds1
Owner:              user1(group1)
Non-secure port:   1389
Secure port:       1636
Bit format:        64-bit
State:              Running
Server PID:        22555
DSCC url:           -
SMF application name: -
Start at boot:     Disabled
Instance version:  D-A00
```

- 3 (Optional) If you installed Directory Server using the Java Enterprise System installer or a native package installation, and your OS provides a service management solution, you can enable the server to be managed as a service, as shown in this table.

Operating System	Command
Solaris 10	If you are operating in a Sun Cluster environment, use this command: <code>dsadm enable-service --type CLUSTER instance-path resource-group</code> Otherwise: <code>dsadm enable-service --type SMF instance-path</code>
Solaris 9	If you are operating in a Sun Cluster environment, use this command: <code>dsadm enable-service --type CLUSTER instance-path resource_group</code> Otherwise: <code>dsadm autostart instance-path</code>
Linux, HP-UX	<code>dsadm autostart instance-path</code>
Windows	<code>dsadm enable-service --type WIN_SERVICE instance-path</code>

4 Start Directory Server.

```
$ dsadm start instance-path
```

Note – The server is running but does not contain data or a suffix. Use `dsconf` to create a suffix.

5 (Optional) Register the server instance using one of these methods:

- Access the URL `https://host:6789` and register the server through DSCC.
- Use the command `dscereg add-server`.
 For details, see the `dscereg(1M)` man page.

6 If you want to use a password policy and your Directory Server instance is standalone, or if it belongs to a replication topology that has already been migrated to DS6-only password policy mode, move the instance to that mode.

```
$ dsconf pwd-compat -h host -p port to-DS6-migration-mode
```

```
## Beginning password policy compatibility changes .
## Password policy compatibility changes finished.
```

```
Task completed (slapd exit code: 0).
```

```
$ dsconf pwd-compat -h host -p port to-DS6-mode
```

```
## Beginning password policy compatibility changes .
```

```
## Password policy compatibility changes finished.
```

```
Task completed (slapd exit code: 0).
```

▼ To Delete a Directory Server Instance

You can use DSCC to perform this task. For information, see [“Directory Service Control Center Interface” on page 43](#) and the DSCC online help.

1 Stop the Directory Server.

```
$ dsadm stop instance-path
```

2 If you have previously used DSCC to manage the server, use the command line to unregister the server.

```
$ dsccreg remove-server /local/ds
Enter DSCC administrator's password:
/local/ds is an instance of DS
Enter password of "cn=Directory Manager" for /local/ds:
This operation will restart /local/ds.
Do you want to continue ? (y/n) y
Unregistering /local/ds from DSCC on localhost.
Connecting to /local/ds
Disabling DSCC access to /local/ds
Restarting /local/ds
```

For details, see the dsccreg(1M) man page.

3 (Optional) If you previously enabled the server instance in a service management solution, disable the server from being managed as a service.

Operating System	Command
Solaris 10	<p>If you are operating in a Sun Cluster environment, use this command:</p> <pre>dsadm disable-service --type CLUSTER <i>instance-path</i></pre> <p>Otherwise:</p> <pre>dsadm disable-service --type SMF <i>instance-path</i></pre>
Solaris 9	<p>If you are operating in a Sun Cluster environment, use this command:</p> <pre>dsadm disable-service --type CLUSTER <i>instance-path</i></pre> <p>Otherwise:</p> <pre>dsadm autostart --off <i>instance-path</i></pre>

Operating System	Command
Linux, HP-UX	<code>dsadm autostart --off instance-path</code>
Windows	<code>dsadm disable-service --type WIN_SERVICE instance-path</code>

4 Delete the server instance.

```
$ dsadm delete instance-path
```



Caution – This command removes everything, including the database and the data.

If the instance has been enabled as a service, or if the instance is started automatically at system startup, `dsadm delete` requires root access.

Starting, Stopping, and Restarting a Directory Server Instance

To start, stop or restart, the server from the command line, use the commands `dsadm start`, `dsadm stop`, and `dsadm restart`, respectively.

Note – When you stop and restart a Directory Server instance with a large cache in memory configured to hold entries, the cache takes some time to refill. While the cache fills again, the instance responds more slowly.

These commands must be run by the same UID and GID that created the Directory Server, or run by root. For example, if Directory Server runs as `user1`, you should run the `start`, `stop`, and `restart` utilities as `user1`.

Note – On Solaris, role-based access control allows you to run Directory Server as a user other than root.

▼ To Start, Stop, and Restart Directory Server

You can use DSCC to perform this task. For information, see [“Directory Service Control Center Interface” on page 43](#) and the DSCC online help. However, this does not apply to the step for enabling and disabling service management. Enabling and disabling service management must be done at the command line when starting and stopping Directory Server.

- To start, stop, or restart Directory Server, do one of the following:

- To start the server, type:

```
$ dsadm start instance-path
```

For example, to start a server with the instance path `/local/ds`, use this command:

```
$ dsadm start /local/ds
```

- To stop the server, type:

```
$ dsadm stop instance-path
```

For example:

```
$ dsadm stop /local/ds
```

- To restart the server, type:

```
$ dsadm restart instance-path
```

For example:

```
$ dsadm restart /local/ds
```

Creating Suffixes

After you have created your Directory Server instance, you must create one or more suffixes for the server's Directory Information Tree (DIT). The DIT consists of all of the entries in your server, as identified by their distinguished names (DNs). The hierarchical nature of a DN creates branches and leaves that structure the data in the tree. The DIT is defined and managed administratively in terms of suffixes and sub-suffixes. DSCC provides controls for creating and administering all of these elements. Alternatively, you can use command-line tools.

For conceptual information about structuring directory data and about suffixes in general, refer to the *Sun Java System Directory Server Enterprise Edition 6.2 Deployment Planning Guide*.

As explained in the following procedure, you can use the `dsconf create-suffix` command to create a suffix configuration in your directory. Because root suffixes and sub-suffixes are managed internally in the same way, the procedure for creating them from the command line is nearly the same. The procedure shows the `dsconf create-suffix` command used only with the required options. For more information about other options of this command, see the `dsconf(1M)` man page or run the following command:

```
$ dsconf create-suffix --help
```

The configuration entries can be created by any administration user. However, the top entry of the suffix *must* be created by the Directory Manager or as a Directory Administrator, such as `cn=admin,cn=Administrators,cn=config`.

▼ To Create a Suffix

You can use DSCC to perform this task. For information, see [“Directory Service Control Center Interface” on page 43](#) and the DSCC online help.

If you use DSCC to create a new suffix, you can choose to copy some or all suffix configuration settings from an existing suffix.

1 Create the root suffix.

Ensure that your server is running, then type this command:

```
$ dsconf create-suffix -h host -p port suffix-DN
```

where the *suffix-DN* is the full DN of the new suffix. For a root suffix, the convention is to use the domain-component (dc) naming attribute.

For example, to create a suffix for the DN `dc=example,dc=com`, use this command:

```
$ dsconf create-suffix -h host1 -p 1389 dc=example,dc=com
```

This command creates the new suffix as follows:

- The top level (or base) entry of the root suffix is created.
- The configuration entries in `cn=config` for both the suffix and the database are created.
- The default database name is based on the suffix DN.

For information about the all of the suffixes, including the new suffix that has been created, use this command:

```
$ dsconf list-suffixes -h host -p port -v
```

The `-v` option displays verbose mode, which shows how many entries are on the suffix, and any replication information.

Note – If you have more than one Directory Server instance, use the `-h host name` and `-p port number` options to specify which server instance the suffix should belong to.

If you want to specify a non-default path for the database files, use the `-L` option. You can change the suffix database path at a later stage. To do this, use the command `dsconf set-suffix-prop suffix-DN db-path:new-db-path`, then stop the server, move the database files manually, and restart the server.

To see all the options that you can use when creating suffixes, refer to the `dsconf(1M)` man page.

2 If required, create the sub-suffix:

```
$ dsconf create-suffix -h host -p port subSuffix-DN
```

then attach the sub-suffix to the root suffix.

```
$ dsconf set-suffix-prop -h host -p port subSuffix-DN parent-suffix-dn:parentSuffix-DN
```

where *parentSuffix-DN* must have the same value as *suffix-DN* in the previous step. The *suffix-DN* for the sub-suffix includes the relative distinguished name (RDN) of the sub-suffix and the DN of its parent suffix.

For example, to create the sub-suffix `ou=Contractors,dc=example,dc=com`, and to attach the sub-suffix to the root suffix, type:

```
$ dsconf create-suffix -h host1 -p 1389 ou=Contractors,dc=example,dc=com
$ dsconf set-suffix-prop -h host1 -p 1389 ou=Contractors,dc=example,dc=com \
  parent-suffix-dn:dc=example,dc=com
```

When this entry is added to the directory, the database module of the server automatically creates the database files in the following directory:

```
instance-path/db/database-name
```

where *database-name* is the name automatically built from a part of the suffix. For example, in the previous example, the *database-name* would be `Contractors`

- 3 (Optional) Initialize the suffix with data. See [“Initializing a Suffix” on page 201](#).

Disabling or Enabling a Suffix

Sometimes, you might need to make a suffix unavailable for maintenance, or to make its contents unavailable for security reasons. The action of disabling a suffix prevents the server from reading or writing the contents of the suffix in response to any client operations. When you disable a suffix, you no longer have access to that suffix, and the referral mode is automatically set to disabled.

▼ To Disable then Enable a Suffix

You can use DSCC to perform this task. For information, see [“Directory Service Control Center Interface” on page 43](#) and the DSCC online help.

- 1 Disable the suffix.

```
$ dsconf set-suffix-prop -h host -p port suffix-DN enabled:off
```

Note – You cannot disable a suffix on which replication is enabled because most properties of a replicated suffix are determined by the replication mechanism.

2 Enable the suffix.

```
$ dsconf set-suffix-prop -h host -p port suffix-DN enabled:on
```

Setting Referrals and Making a Suffix Read-Only

If you want to limit access to a suffix without disabling the suffix completely, you can modify the access permissions to allow read-only access. In this case you must define a referral to another server for write operations. You can also deny both read and write access, and define a referral for all operations on the suffix.

Referrals can also be used to temporarily point a client application to a different server. For example, while backing up the contents of the suffix, you might add a referral to another suffix.

If your suffix is a consumer in a replicated environment, the replication mechanism determines the value of the referral setting. Although you can manually modify the referral setting, the referral will be overwritten at the next replication update. For information about setting replication referrals, see [“To Perform Advanced Consumer Configuration” on page 235](#).

Referrals are labeled URLs, that is, an LDAP URL optionally followed by a space character and a label. For example:

```
ldap://phonebook.example.com:389/
```

Or:

```
ldap://phonebook.example.com:389/ou=All%20People,dc=example,dc=com
```

Because space characters are significant, any space characters in the URL part of the referral must be escaped using %20.

▼ To Set Referrals to Make a Suffix Read-Only

You can use DSCC to perform this task. For information, see [“Directory Service Control Center Interface” on page 43](#) and the DSCC online help.

1 Set the referral URL.

```
$ dsconf set-suffix-prop -h host -p port suffix-DN referral-url:LDAP-URL
```

where *LDAP-URL* is a valid URL containing the host name, port number, and DN of the target.

For example:

```
$ dsconf set-suffix-prop -h host1 -p 1389 dc=example,dc=com \  
referral-url:ldap://phonebook.example.com:389/
```

You can specify any number of LDAP URLs.

2 Set the referral mode in order to make the suffix read-only.

```
$ dsconf set-suffix-prop -h host -p port suffix-DN referral-mode:only-on-write
```

To make the suffix unavailable for both read and write operations, and to return referrals for all requests, set the `referral-mode` to `enabled`.

3 As soon as the command is successful, the suffix is read-only or inaccessible and ready to return referrals.

4 (Optional) When the suffix becomes available, disable the referrals to make the suffix read-write again.

```
$ dsconf set-suffix-prop -h host -p port suffix-DN referral-mode:disabled
```

When referrals are disabled, the suffix automatically becomes read-write, unless you have disabled the suffix itself by setting the `enabled` property of the suffix to `off`.

Deleting a Suffix

Deleting a suffix removes its entire branch from the DIT.

Note – When you delete a suffix, you permanently remove all of its data entries from the directory. You also remove all suffix configuration information, including its replication configuration.

You cannot delete a parent suffix and keep its sub-suffixes in the DIT as new root suffixes. If you want to delete an entire branch that contains sub-suffixes, you must also delete the sub-suffixes of the deleted parent and their possible sub-suffixes.

▼ To Delete a Suffix

You can use DSCC to perform this task. For information, see [“Directory Service Control Center Interface” on page 43](#) and the DSCC online help.

● **Remove the suffix configuration entry:**

```
$ dsconf delete-suffix -h host -p port [subSuffix-DN] suffix-DN
```

This command removes the suffix from the server, starting with the base entry at the *suffix-DN*. The suffix is no longer visible or accessible in the directory.

Compacting a Suffix

Directory Server 6.2 supports the compaction of suffixes offline. Online compaction is not supported in this release. If storage space is available, compacting a suffix reduces the size of the database by reorganizing the database keys.

▼ To Compact a Suffix Offline

Stop the server and backup your database before performing this task.

- **Compact the required suffix.**

```
$ dsadm repack instance-path suffix-dn
```

All `.db3` files related to the specified suffix are compacted.

If you run this command with the `-b` option, you can specify a back end database name, instead of a suffix DN. At least one suffix, or one back end must be specified.

Directory Server Configuration

This chapter describes how to configure Directory Server. You can use the `dsconf` command (see the `dsconf(1M)` man page).

You can also use Directory Service Control Center (DSCC), which is the preferred method. DSCC makes additional checks during the configuration process, which can minimize errors. In addition, DSCC enables you to copy the configuration of one server instance to another server instance. For more information about using DSCC, see the DSCC online help.

Displaying the Configuration of Directory Server Instance

To display the configuration of Directory Server instance, run `dsconf info`.

```
$ dsconf info -h host -p port
Instance path      : instance path
Global State      : read-write
Host Name         : host
Port              : port
Secure port       : secure port
Total entries     : 20844

Suffixes          : suffix-DN

Dest. Servers     : host:port

On-Going Tasks   : import
Finished Tasks    : backup
```

The above output assumes that you have created suffixes, and replication agreements with the destination servers. It also displays the ongoing import operation and finished backup operation.

Modifying the Configuration Using DSCC

The recommended method for modifying the configuration is to use DSCC. This browser interface provides task-based controls to help you set up your configuration quickly and efficiently. Using DSCC, you can modify a configuration setting on one server and then copy that configuration setting to other servers. In addition, the DSCC interface manages the complexity and interdependence of the configuration for you. Detailed procedures for modifying the configuration using DSCC can be found in the DSCC online help.

Modifying the Configuration From the Command Line

You can automate configuration tasks by writing scripts that use command-line tools.

Modify the configuration through the command line by using the `dsconf` command. This command uses LDAP to modify the `cn=config` subtree. For more information about `dsconf`, see [“Directory Server Command-Line Tools” on page 48](#).

For any tasks that you cannot perform using `dsconf`, use the `ldapmodify` command.

Note – If you want to modify the server configuration properties by using the command `dsconf set-server-prop`, you need to know which properties you can modify and their default values. Use this command to display help on all properties:

```
$ dsconf help-properties -v
```

Search the property help for the item that you need. For example, on a UNIX platform, type the following to search for memory cache properties:

```
$ dsconf help-properties -v | grep cache
```

For more information about configuration entries in `cn=config` and for a complete description of all configuration entries and attributes, including the range of allowed values, see *Sun Java System Directory Server Enterprise Edition 6.2 Reference*.

Modifying the `dse.ldif` File

Directory Server stores all of its configuration information in this file:

```
instance-path/config/dse.ldif
```



Caution – Modifying the configuration by editing the contents of the `dse.ldif` file directly is prone to error and is not recommended. However, if you choose to edit this file manually, stop the server before you edit the file and restart it after you have finished editing.

The `dse.ldif` file is in the LDAP Data Interchange Format (LDIF). LDIF is a textual representation of entries, attributes, and their values, and is a standard format described in RFC 2849 (<http://www.ietf.org/rfc/rfc2849>).

The Directory Server configuration in the `dse.ldif` file consists of the following:

- The attributes and values of the `cn=config` entry.
- All of the entries in the subtree below `cn=config` and their attributes and values.
- The object classes and access control instructions of the root entry ("") and the `cn=monitor` entry. The other attributes of these entries are generated by the server.

Only the system user who owns the Directory Server instance has the rights to read and write the file.

Directory Server makes all configuration settings readable and writable through LDAP. By default, the `cn=config` branch of the directory can be read by anyone with authorization and can be written to only by the Directory Manager (`cn=Directory Manager`) and to the administrative users under `cn=Administrators,cn=config`. The administration user can view and modify the configuration entries just like any other directory entry.

Do not create non-configuration entries under the `cn=config` entry because they will be stored in the `dse.ldif` file, which is not the same highly scalable database as regular entries. As a result, if many entries, and particularly entries that are likely to be updated frequently, are stored under `cn=config`, performance will likely be degraded. However, it can be useful to store special user entries such as the Replication Manager (supplier bind DN) entry under `cn=config`, to centralize configuration information.

Configuring Administration Users

Directory Server contains default administration users, the Directory Manager and the `cn=admin,cn=Administrators,cn=config` user. Both of these users have the same access rights, but `cn=admin,cn=Administrators,cn=config` is subject to ACIs.

This section explains how to create an administration user with root access, and how to configure the Directory Manager.

▼ To Create an Administration User with Root Access

If you want to create a new administration user with the same rights as `cn=admin, cn=Administrators, cn=config`, create the new user in the group `cn=Administrators, cn=config`. All users in this group are subject to a global ACI that allows the same access as the Directory Manager.

You cannot use DSCC to perform this task. Use the command line, as described in this procedure.

● Create a new administration user.

For example, to create a new user `cn=Admin24, cn=Administrators, cn=config`, type:

```
$ ldapmodify -h host1 -p 1389 -D cn=admin,cn=Administrators,cn=config -w -  
dn: cn=admin24,cn=Administrators,cn=config  
changetype: add  
objectclass: top  
objectclass: person  
userPassword: password  
description: Administration user with the same access rights as Directory Manager.
```

The `-D` and `-w` options give the bind DN and password, respectively, of a user with permissions to create this entry.

▼ To Configure the Directory Manager

The Directory Manager is the privileged server administrator, comparable to the root user on UNIX systems. Access control does not apply to the Directory Manager.

For most administration tasks, you are not required to use the Directory Manager. Instead, you can use the user `cn=admin, cn=Administrators, cn=config`, or any other user that you create beneath `cn=Administrators, cn=config`. The only tasks that require the Directory Manager are changing the root ACI, and replication troubleshooting tasks, such as repairing replication and searching tombstones.

You can change the Directory Manager DN and password, as well as create a file from which the password can be automatically read.

You cannot use DSCC to perform this task. Use the command line, as described in this procedure.

1 Find the existing Directory Manager DN.

```
$ dsconf get-server-prop -h host -p port root-dn  
root-dn:cn=Directory Manager
```

2 Modify the Directory Manager settings as required.

- To modify the Directory Manager DN, type:

```
$ dsconf set-server-prop -h host -p port root-pwd-file:new-root-dn-password-file
```

Use quotes if there are spaces in the Directory Manager DN. For example:

```
$ dsconf set-server-prop -h host1 -p 1389 root-dn:"cn=New Directory Manager"
```

- To change the Directory Manager password, type:

```
$ dsconf set-server-prop -h host -p port root-pwd:new-root-dn-password
```

If for security reasons you do not want to pass the clear text password as a command-line argument, create a temporary file for setting the password.

```
$ echo password > /tmp/pwd.txt
```

This file is read once, and the password is stored for future use. Set the server root password file property.

```
$ dsconf set-server-prop -h host -p port root-pwd-file:/tmp/pwd.txt
```

This command prompts the server to read the password file. Remove the temporary password file after you have set the password file property.

```
$ rm /tmp/pwd.txt
```

Protecting Configuration Information

The root Directory Server entry (the entry returned for a base object search with a zero-length DN "") and the subtrees below `cn=config`, `cn=monitor`, and `cn=schema` contain access control instructions (ACIs) that are automatically generated by Directory Server. These ACIs are used to determine user permissions to directory entries. These ACIs are sufficient for evaluation purposes. However, for any production deployment, you need to evaluate your access control requirements and design your own access controls.

If you want to hide the existence of one or more additional subtrees and protect your configuration information for security reasons, you must place additional ACIs on the DIT.

- Place an ACI attribute in the entry at the base of the subtree you want to hide.
- Place an ACI in the root DSE entry on the `namingContexts` attribute. The root DSE entry attribute called `namingContexts` contains a list of the base DNs for each of the Directory Server databases.
- Place an ACI on the `cn=config` and `cn=monitor` subtrees. The subtree DNs are also stored in the mapping tree entries below `cn=config` and `cn=monitor`.

For more information about creating ACIs, see [Chapter 6, “Directory Server Access Control.”](#)

Configuring DSCC

This section provides the following information about configuring DSCC:

- [“To Change the Common Agent Container Port Number” on page 70](#)
- [“To Reset the Directory Service Manager Password” on page 71](#)
- [“To Extend the DSCC Session Automatic Timeout Delay” on page 71](#)
- [“Configuring Failover for DSCC” on page 72](#)
- [“Troubleshooting DSCC” on page 72](#)

▼ To Change the Common Agent Container Port Number

The default common agent container port number is 11162. The common agent container defines the DSCC agent port as `jmxmp-connector-port`. If for administrative reasons you need to use a different port number for the DSCC agent and common agent container, use the following procedure.

You cannot use DSCC to perform this task. Use the command line, as described in this procedure.

1 As root, verify the existing port number for `jmxmp-connector-port`.

```
$ su
Password:
# cacoadm list-params
...
jmxmp-connector-port=11162
...
```

2 Change the DSCC agent port number.

The common agent container must be stopped when changing the DSCC agent port number.

```
# cacoadm stop
# cacoadm set-param jmxmp-connector-port=new-port
# cacoadm start
```

For the location of this command, see [“Command Locations” on page 34](#).

3 In DSCC, unregister your servers, and then reregister them using the new DSCC agent port number.

In addition, when you create a new server, you must specify the non-default DSCC agent port number.

▼ To Reset the Directory Service Manager Password

To reset the Directory Service Manager password, use DSCC, as described in this procedure.

- 1 Access DSCC as described in [“To Access DSCC” on page 44](#).
- 2 Click the **Settings** tab, then choose **Directory Service Managers**.
- 3 Click the name of the **Directory Service Manager** for which you want to change the password.
- 4 In the properties screen, enter the new password.

Confirm the new password by typing it again in the **Confirm Password** field. Click **OK** to save your changes.

▼ To Extend the DSCC Session Automatic Timeout Delay

After a period of time, your DSCC session will time out, and you will be logged out of DSCC. Use this procedure to extend the timeout delay. Note that this procedure extends the timeout for DSCC and for all other applications in Sun Java Web Console.

You cannot use DSCC to perform this task. Use the command line, as described in this procedure.

- 1 **As root, extend the timeout delay.**

```
# wadmin add -p -a ROOT session.timeout.value=mm
```

where *mm* is the number of minutes before timeout.

For example, to set the timeout to two hours, type:

```
$ su
Password:
# wadmin add -p -a ROOT session.timeout.value=120
Set 1 properties for the ROOT application.
# wadmin list -p
Shared service properties (name, value):
    session.timeout.value 120
    ...
```

- 2 **Restart Sun Java Web Console.**

```
# smcwebserver restart
Shutting down Sun Java(TM) Web Console Version 3.0.2 ...
Starting Sun Java(TM) Web Console Version 3.0.2 ...
The console is running.
```

For the location of these commands, see [“Command Locations” on page 34](#).

Configuring Failover for DSCC

DSCC displays the servers that you have registered in DSCC.

If the machine on which you have installed DSCC fails, you can install DSCC on another machine and then reregister your servers. However, this can be time-consuming. If you want to have immediate access to your servers through DSCC, you can configure DSCC failover.

To configure DSCC failover, take the following considerations into account:

- All information for registered servers is stored in the DSCC registry. This registry is a Directory Server instance. You can use the administration commands `dsadm` and `dsconf` to manage the registry.
- The DSCC registry has the following default characteristics:

Server instance	Solaris — <code>/var/opt/SUNWdsee/dscc6/dcc/ads</code> Linux and HP-UX — <code>/var/opt/sun/dscc6/dcc/ads</code> Windows — <code>C:\Program Files\Sun\DSEE\var\dscc6\dcc\ads</code>
Suffix	<code>cn=dscc</code>
Port	LDAP 3998, LDAPS 3999

- After you have installed DSCC on two or more machines, you can set up replication between the DSCC registry suffixes. Use the replication command-line procedures described in [Chapter 10, “Directory Server Replication.”](#) Alternatively, for an example of setting up a simple replication configuration, `dsconf(1M)` man page.

After replication is set up, you can access the same servers that are registered in DSCC from different machines. For example, if you set up replication between the DSCC registry suffixes on `host1` and `host2`, you can manage the same servers using DSCC on either `https://host1:6789` or `https://host2:6789`. In case of host failure, access DSCC from the other host.

Troubleshooting DSCC

For information about troubleshooting DSCC, see “To Troubleshoot Directory Service Control Center Access” in *Sun Java System Directory Server Enterprise Edition 6.2 Installation Guide*.

Changing Directory Server Port Numbers

You can modify the LDAP port or the LDAPS secure port number of your user directory server by using DSCC or by using the `dsconf set -server-prop` command.

If you change a port number, be aware of the following:

- If you set a non-privileged port number and Directory Server is installed on a machine to which other users have access, you might expose the port to a hijack risk by another application. In other words, another application can bind to the same address/port pair. This rogue application might then be able to process requests intended for Directory Server. That is, the rogue application could be used to capture passwords used in the authentication process, to alter client requests or server responses, or to produce a denial of service attack. To avoid this security risk, use the `listen-address` or `secure-listen-address` properties to specify the interface (address) on which Directory Server listens.

If you change the port number by using the command line, be aware of the following:

- If the Directory Server is referenced in replication agreements that are defined on other servers, the replication agreements must be updated to use the new port number.
- If you have used DSCC previously to manage the server, the server will be temporarily unable to be viewed after the change in port number. To view the server again, you must unregister the server and then register it again in DSCC using the new port number.

▼ To Modify a Port Number, Enable a Port, and Disable a Port

You can use DSCC to perform this task. For information, see [“Directory Service Control Center Interface” on page 43](#) and the DSCC online help.

Note – Once you make your modifications, you must restart the server for the changes to take effect.

1 Verify the existing settings for your port.

```
$ dsconf get-server-prop -h host -p port port-type
```

Where *port-type* is one of the following:

<code>ldap-port</code>	LDAP default port
<code>ldap-secure-port</code>	LDAPS secure port
<code>dsm1-port</code>	DSML default port

`dsml-secure-port` DSML secure port

For example, to display the LDAPS secure port, type:

```
$ dsconf get-server-prop -h host1 -p 2501 ldap-secure-port
Enter "cn=Directory Manager" password:
ldap-secure-port : 2511
```

If the returned result is an integer, the port is enabled. If the returned result is disabled, the port is disabled.

Note – You can also list the LDAP default port and LDAPS secure port using the `dsadm`

2 If required, modify a port number or enable a port.

```
$ dsconf set-server-prop -h host -p port port-type:new-port
```

For example, to change the LDAP port number from 1389 to 1390, use this command:

```
$ dsconf set-server-prop -h host1 -p 1389 ldap-port:1390
```

To enable the DSML secure port on port number 2250, use this command:

```
$ dsconf set-server-prop -h host1 -p 1389 dsml-secure-port:2250
```

3 If required, disable a port.

```
$ dsconf set-server-prop -h host -p port port-type:disabled
```

For example, to disable the DSML secure port, use the command:

```
$ dsconf set-server-prop -h host1 -p 1389 dsml-secure-port:disabled
```

Configuring DSML

In addition to processing requests in the Lightweight Directory Access Protocol (LDAP), Directory Server also responds to requests sent in the Directory Service Markup Language version 2 (DSMLv2). DSML is another way for a client to encode directory operations. The server processes DSML as any other request, with all of the same access control and security features. DSML processing allows many other types of clients to access your directory contents.

Directory Server supports the use of DSMLv2 over the Hypertext Transfer Protocol (HTTP/1.1) and uses the Simple Object Access Protocol (SOAP) version 1.1 as a programming protocol to transport the DSML content. For more information about these protocols and for examples of DSML requests, see Chapter 10, “Directory Server DSMLv2,” in *Sun Java System Directory Server Enterprise Edition 6.2 Reference*.

This section covers the following topics:

- “To Enable the DSML-over-HTTP Service” on page 75
- “To Disable the DSML-over-HTTP Service” on page 75
- “DSML Identity Mapping” on page 77

▼ To Enable the DSML-over-HTTP Service

You can use DSCC to perform this task. For information, see “[Directory Service Control Center Interface](#)” on page 43 and the DSCC online help.

1 Set the DSML mode to on.

```
$ dsconf set-server-prop -h host -p port dsml-enabled:on
```

2 Set the secure DSML port.

```
$ dsconf set-server-prop -h host -p port dsml-secure-port:port
```

3 Set the non—secure DSML port.

```
$ dsconf set-server-prop -h host -p port dsml-port:port
```

By default, this port is set to disabled

4 Restart the server.

```
$ dsadm restart instance-path
```

Next Steps According to the parameters and attribute values you defined, DSML clients may use the following URLs to send requests to this server:

```
http://host:DSML-port/relative-URL
```

```
https://host:secure-DSML-port/relative-URL
```

Note – The *relative-URL* can be read and set using the `dsml-relative-root-url` property.

▼ To Disable the DSML-over-HTTP Service

You can use DSCC to perform this task. For information, see “[Directory Service Control Center Interface](#)” on page 43 and the DSCC online help.

1 Set the DSML mode to off.

```
$ dsconf set-server-prop -h host -p port dsml-enabled:off
```

2 Set the secure DSML port to disabled.

```
$ dsconf set-server-prop -h host -p port dsml-secure-port:disabled
```

3 Restart the server.

```
$ dsasm restart instance-path
```

▼ To Configure DSML Security

You can configure the level of security that is required to accept DSML requests. To do this, you must configure DSML client authentication.

● Set the DSML client authentication mode.

```
$ dsconf set-server-prop -h host -p port dsml-client-auth-mode:dsml-mode
```

By default the `dsml-client-auth-mode` property is set to `client-cert-first`.

dsml-mode can be one of:

- `http-basic-only` - This is the default value. The server uses the contents of the HTTP Authorization header to find a user name that can be mapped to an entry in the directory. This process and its configuration are encrypted through SSL but do not use client certification. This is described in [“DSML Identity Mapping” on page 77](#).
- `client-cert-only` - The server uses credentials from the client certificate to identify the client. With this value, all DSML clients must use the secure HTTPS port to send DSML requests and provide a certificate. The server checks that the client certificate matches an entry in the directory. See [Chapter 5, “Directory Server Security,”](#) for more information.
- `client-cert-first` - The server will attempt to authenticate clients first with a client certificate if one is provided. Otherwise, the server will authenticate clients using the contents of the Authorization header.

If no certificate and no Authorization header is provided in the HTTP request, the server performs the DSML request with anonymous binding. Anonymous binding is also used in the following cases:

- The client provides a valid Authorization header but no certificate when `client-cert-only` is specified.
- The client provides a valid certificate but no Authorization header when `http-basic-only` is specified.

Regardless of the client authentication method, if a certificate is provided but it cannot be matched to an entry, or if the HTTP Authorization header is specified but cannot be mapped to a user entry, the DSML request is rejected with error message 403: “Forbidden”.

DSML Identity Mapping

When performing basic authentication without a certificate, Directory Server uses a mechanism called *identity mapping* to determine the bind DN to use when accepting DSML requests. This mechanism extracts information from the Authorization header of the HTTP request to determine the identity to use for binding.

The default identity mapping for DSML/HTTP is given by the following entry in your server configuration.

```
dn: cn=default,cn=HTTP-BASIC,cn=identity mapping,cn=config
objectClass: top
objectClass: nsContainer
objectClass: dsIdentityMapping
cn: default
dsSearchBasedN: ou=people
dsSearchFilter: (uid=${Authorization})
```

This configuration indicates that the server should use the HTTP user ID as the `uid` value for a DN stored in a Directory Server suffix. For example, if the HTTP user is `bjensen`, the server tries to execute the bind using the DN `uid=bjensen,ou=people`.

For the mapping to work properly you must therefore complete the value of `dsSearchBasedN`. For example, you can change the value of `dsSearchBasedN` to `ou=people,dc=example,dc=com`. Then if the HTTP user is `bjensen`, the server tries to execute the bind using the DN `uid=bjensen,ou=people,dc=example,dc=com`.

```
dn: cn=default,cn=HTTP-BASIC,cn=identity mapping,cn=config
objectClass: top
objectClass: nsContainer
objectClass: dsIdentityMapping
cn: default
dsSearchBasedN: ou=people,dc=example,dc=com
dsSearchFilter: (uid=${Authorization})
```

Within the mapping entry attribute `dsSearchFilter`, you can use placeholders of the format `${header}` where *header* is the name of an HTTP header.

The following are the most common headers used in DSML mappings.

<code>\${Authorization}</code>	This string is replaced with the user name contained in an HTTP Authorization header. An authorization header contains both a username and its password, but only the user name is substituted in this placeholder.
<code>\${From}</code>	This string is replaced with the email address that might be contained in an HTTP From header.

`${host}` This string is replaced with the hostname and port number in the URL of the DSML request, which are those of the server.

To have DSML requests perform a different kind of identity mapping, define a new identity mapping for HTTP headers.

▼ To Define a New Identity Mapping for HTTP Headers

1 Edit the default DSML-over-HTTP identity mapping or create custom mappings for this protocol.

The mapping entries must be located below the entry `cn=HTTP-BASIC, cn=identity mapping, cn=config`.

Use the `ldapmodify` command to add this entry from the command line, as described in [“Adding Entries Using ldapmodify” on page 86](#).

2 Restart Directory Server for your new mappings to take effect.

Custom mappings are evaluated first. If no custom mapping is successful, the default mapping is evaluated. If all mappings fail to determine the bind DN for the DSML request, the DSML request is forbidden and rejected (error 403).

Setting the Server as Read-Only

Each suffix in your directory can be placed in read-only mode independently and can return a specific referral if one is defined. Directory Server also provides a read-only mode for the server that applies to all suffixes and can return a global referral when one is defined.

The server read-only mode is designed to allow administrators to prevent modifications to the directory contents while performing tasks such as reindexing the suffixes. For this reason, server read-only mode does not apply to the following configuration branches:

- `cn=config`
- `cn=monitor`
- `cn=schema`

These branches should be protected at all times by access control instructions (ACIs) against modifications by non-administration users, regardless of the read-only setting (see [Chapter 6, “Directory Server Access Control,”](#)). Global read-only mode prevents update operations on all other suffixes in the directory, including update operations initiated by the Directory Manager.

Read-only mode also interrupts replication on a suffix if it is enabled. A master replica no longer has any changes to replicate, although it continues to replicate any changes that were made before read-only mode was enabled. A consumer replica does not receive updates until

read-only mode is disabled. A master in a multi master replication environment does not have any changes to replicate and is not able to receive updates from the other masters.

▼ To Enable or Disable the Server Read-Only Mode

You can use DSCC to perform this task. For information, see “[Directory Service Control Center Interface](#)” on page 43 and the DSCC online help.

1 Enable the global read-only mode.

```
$ dsconf set-server-prop -h host -p port read-write-mode:read-only
```

2 When you are ready, disable the read-only mode.

```
$ dsconf set-server-prop -h host -p port read-write-mode:read-write
```

Configuring Memory

This section provides information about managing different types of memory. For a description of the different types of cache and for information about cache tuning, see Chapter 5, “[Directory Server Data Caching](#),” in *Sun Java System Directory Server Enterprise Edition 6.2 Reference*.

Priming Caches

To prime caches means to fill the caches with data so that subsequent Directory Server behavior reflects normal operational performance, rather than ramp-up performance. Priming caches is useful for arriving at reproducible results when benchmarking, and for measuring and analyzing potential optimizations.

If possible, do not actively prime the caches. Let the caches be primed by normal or typical client interaction with Directory Server before you measure performance.

Tools for priming database cache can be found at <http://www.slamd.com>.

▼ To Modify Database Cache



Caution – Modifying cache can severely impact server performance. Use caution when modifying cache.

You can use DSCC to perform this task. For information, see [“Directory Service Control Center Interface” on page 43](#) and the DSCC online help.

1 Obtain the current database cache level.

```
$ dsconf get-server-prop -h host -p port db-cache-size
```

2 Change the database cache level.

```
$ dsconf set-server-prop -h host -p port db-cache-size:size
```

where *size* can be expressed in gigabytes (G), megabytes (M), kilobytes (k) or bytes (b). The size you specify must be supported by your machine.

▼ To Monitor Database Cache

The default level of cache at installation is suited to a test environment, not a production environment. For tuning purposes, you might want to monitor the database cache for your server.

You can use DSCC to perform this task. For information, see [“Directory Service Control Center Interface” on page 43](#) and the DSCC online help.

● **Monitor database cache.**

```
$ ldapsearch -h host -p port -D cn=admin,cn=Administrators,cn=config -w - \
  -b "cn=monitor,cn=ldb database,cn=plugins,cn=config" "(objectclass=*)"
```

If the database cache size is large enough and it has been primed, the hit ratio (dbcachehitratio) should be high. In addition, the number of pages that are read in (dbcachepagein) and the clean pages that are written out (dbcacheroevict) should be low. Here, “high” and “low” are relative to the deployment constraints.

▼ To Monitor Entry Cache

For tuning purposes, you might want to check the entry cache for one or more suffixes. Use this procedure to view the entry cache levels.

You can use DSCC to perform this task. For information, see [“Directory Service Control Center Interface” on page 43](#) and the DSCC online help.

● **Monitor entry cache.**

```
$ ldapsearch -h host -p port -D cn=admin,cn=Administrators,cn=config -w - \
  -b "cn=monitor,cn=db-name,cn=ldb database,cn=plugins,cn=config" "(objectclass=*)"
```


If the entry cache for a suffix is large enough to hold most of the entries in the suffix and if the cache is primed, the hit ratio (`entrycachehitratio`) should be high.

If you have primed the cache, you will see that as the previously empty entry cache fills, entry cache size (`currententrycachesize`) approaches the maximum entry cache size (`maxentrycachesize`). Ideally, the size in entries (`currententrycachecount`) should be either equal to or very close to the total number of entries in the suffix (`ldapentrycachecount`).

▼ To Modify Entry Cache



Caution – Modifying cache can severely impact server performance. Use caution when modifying cache.

You can use DSCC to perform this task. For information, see “[Directory Service Control Center Interface](#)” on page 43 and the DSCC online help.

1 Obtain the current entry cache level.

```
$ dsconf get-suffix-prop -h host -p port suffix-DN entry-cache-count entry-cache-size
```

2 Change the entry cache count.

```
$ dsconf set-suffix-prop -h host -p port suffix-DN entry-cache-count:integer
```

where *integer* is the number of entries to be stored in the cache.

3 Change the entry cache size.

```
$ dsconf set-suffix-prop -h host -p port suffix-DN entry-cache-size:size
```

where *size* is the cache size expressed in gigabytes (G), megabytes (M), kilobytes (k) or bytes (b). The size you specify must be supported by your machine.

▼ To Configure Heap Memory Threshold

If you want to limit the amount of heap memory used by the `nsldapd` process, you can set threshold values for the dynamic memory footprint. You might set this threshold when Directory Server is running on a machine where resources are shared or sparse.

Note – This threshold can only be set on Solaris and Linux platforms.

For information about memory sizing, see “Directory Server and Memory” in *Sun Java System Directory Server Enterprise Edition 6.2 Deployment Planning Guide*.

You cannot use DSCC to perform this task. Use the command line, as described in this procedure.

Note – By default, the `heap-high-threshold-size` and `heap-low-threshold-size` properties are undefined.

1 Set the maximum heap high memory threshold.

```
$ dsconf set-server-prop -h host -p port heap-high-threshold-size:value
```

where *value* is either undefined or a memory size expressed in gigabytes (G), megabytes (M), kilobytes (k) or bytes (b). The size you specify must be supported by your machine.

For recommendations on the values to use for `heap-high-threshold-size`, see the `server(5dsconf)` man page.

2 Optionally, set the maximum heap low memory threshold.

```
$ dsconf set-server-prop -h host -p port heap-low-threshold-size:value
```

where *value* is either undefined or a memory size expressed in gigabytes (G), megabytes (M), kilobytes (k) or bytes (b). The size you specify must be supported by your machine.

For recommendations on the values to use for `heap-low-threshold-size`, see the `server(5dsconf)` man page.

Setting Resource Limits For Each Client Account

You can control search operation resource limits on the server for each client account. You set such limits in operational attributes on an account, and Directory Server then enforces them based on the account a client uses to bind to the directory.

The following limits can be set:

- The look-through limit specifies the maximum number of entries examined for a search operation.
- The size limit specifies the maximum number of entries returned in response to a search operation.
- The time limit specifies the maximum time spent processing a search operation.
- The idle timeout specifies the maximum time a client connection can remain idle before the connection is dropped.

Note – The Directory Manager can use unlimited resources by default.

The resource limits that you set on specific user accounts take precedence over the resource limits set in the server-wide configuration. This section provides information about setting resource limits for each account.

The examples given in this section set resource limits directly in the attributes of the entry. You can also set resource limits on account using the Class of Service (CoS) mechanism. The CoS mechanism generates computed attributes as an entry is retrieved for a client application. For more information about defining CoS, see “[Class of Service](#)” on page 218.

▼ To Configure the Heap Memory Threshold

You can use DSCC to perform this task. For information, see “[Directory Service Control Center Interface](#)” on page 43 and the DSCC online help.

- 1 Use the `dsconf get-server-prop` command to read the resource limit server properties.

```
$ dsconf get-server-prop -h host -p port look-through-limit search-size-limit \
  search-time-limit idle-timeout
look-through-limit : 5000
search-size-limit  : 2000
search-time-limit  : 3600
idle-timeout      : none
```

The output shows that searches look through a maximum of 5000 entries, return a maximum of 2000 entries, and use a maximum of one hour (3600 seconds) of server time to process the search.

- 2 Change the look-through limit.

```
$ dsconf set-server-prop -h host -p port look-through-limit:integer
```

where *integer* is the maximum number of entries examined for a search operation.

- 3 Change the search size limit.

```
$ dsconf set-server-prop -h host -p port search-size-limit:integer
```

where *integer* is the maximum number of entries returned by a search operation.

- 4 Change the search time limit.

```
$ dsconf set-server-prop -h host -p port serach-time-limit:integer
```

where *integer* is the maximum time spent processing a search operation.

5 Change the idle timeout.

```
$ dsconf set-server-prop -h host -p port idle-timeout:integer
```

where *integer* is the maximum time a client connection can remain idle before the connection is dropped.

Directory Server Entries

This chapter discusses how to manage the data entries in your directory. It also describes how to set referrals and to encrypt attribute values.

When planning a directory deployment, you need to characterize the types of data that the directory will contain. Read the relevant chapters in the *Sun Java System Directory Server Enterprise Edition 6.2 Deployment Planning Guide* before creating entries and modifying the default schema.

You cannot modify your directory unless the appropriate access control instructions (ACIs) have been defined. For further information, see [Chapter 6, “Directory Server Access Control.”](#)

This chapter covers the following topics:

- “[Managing Entries](#)” on page 85
- “[Setting Referrals](#)” on page 97
- “[Checking Valid Attribute Syntax](#)” on page 99
- “[Tracking Modifications to Directory Entries](#)” on page 100
- “[Encrypting Attribute Values](#)” on page 100

Managing Entries

The best way to manage entries depends on the context:

- If you mostly use DSCC for administration and you want to search or modify just a few entries, use DSCC. For more information about DSCC, see “[Directory Service Control Center Interface](#)” on page 43.
- If you do not perform any administrative tasks on Directory Server and you want to search or modify just a few entries, use Directory Editor. For information about Directory Editor, see the *Sun Java System Directory Editor 1 2005Q1 Installation and Configuration Guide*.
- If you want to search or modify a large number of entries, use the command-line utilities `ldapmodify` and `ldapdelete`.

Managing Entries Using DSCC

DSCC enables you to view all readable attributes of an entry and to edit its writable attributes. It also enables you to add and remove attributes, set multi-valued attributes, and manage the object classes of the entry. For more information about how to use DSCC to manage entries, see the DSCC online help. For more information about DSCC in general, see [“Directory Service Control Center Interface” on page 43](#).

Managing Entries Using Directory Editor

Directory Editor is an easy-to-use directory editing tool that enables administrators and end-users to search, create and edit data. This data is in the form of users, groups, and containers.

Managing Entries Using `ldapmodify` and `ldapdelete`

The `ldapmodify` and `ldapdelete` command-line utilities provide full functionality for adding, editing, and deleting your directory contents. You can use these utilities to manage both the configuration entries of the server and the data in the user entries. The utilities can also be used to write scripts to perform bulk management of one or more directories.

The `ldapmodify` and `ldapdelete` commands are used in procedures throughout this book. The following sections describe the basic operations that you will need to perform procedures. For more information about the `ldapmodify` and `ldapdelete` commands, see *Sun Java System Directory Server Enterprise Edition 6.2 Reference*.

Input to the command-line utilities is always in LDIF, and it can be provided either directly from the command-line or through an input file. The following section provides information about LDIF input, and subsequent sections describe the LDIF input for each type of modification.

For information about formatting LDIF input correctly, see the “Guidelines for Providing LDIF Input” in *Sun Java System Directory Server Enterprise Edition 6.2 Reference*.

The following sections describe these basic operations:

- [“Adding Entries Using `ldapmodify`” on page 86](#)
- [“Modifying Entries Using `ldapmodify`” on page 88](#)
- [“Deleting Entries Using `ldapdelete`” on page 92](#)
- [“Deleting Entries Using `ldapmodify`” on page 93](#)
- [“Searching Entries Using `ldapsearch`” on page 93](#)

Adding Entries Using `ldapmodify`

You can use DSCC to perform this task. For information, see [“Directory Service Control Center Interface” on page 43](#) and the DSCC online help.

You can add one or more entries to the directory by using the `-a` option of `ldapmodify`. The following example creates a structural entry to contain users and then creates a user entry:

```
$ ldapmodify -a -h host1 -p 1389 -D cn=admin,cn=Administrators,cn=config -w -
Enter bind password:
dn: ou=People,dc=example,dc=com
objectclass: top
objectclass: organizationalUnit
ou: People
description: Container for user entries

dn: uid=bjensen,ou=People,dc=example,dc=com
objectclass: top
objectclass: person
objectclass: organizationalPerson
objectclass: inetorgPerson
uid: bjensen
givenName: Barbara
sn: Jensen
cn: Babs Jensen
telephoneNumber: (408) 555-3922
facsimileTelephoneNumber: (408) 555-4000
mail: bjensen@example.com
userPassword: secret
```

The `-D` and `-w` options give the bind DN and password, respectively, of a user with permissions to create these entries. The `-a` option indicates that all entries in the LDIF will be added. Then each entry is listed by its DN and its attribute values, with a blank line between each entry. The `ldapmodify` utility creates each entry after it is entered, and the utility reports any errors.

By convention, the LDIF of an entry lists the following attributes:

1. The DN of the entry.
2. The list of object classes.
3. The naming attribute (or attributes). This is the attribute used in the DN, and it is not necessarily one of the required attributes.
4. The list of required attributes for all object classes.
5. Any allowed attributes that you want to include.

When typing a value for the `userPassword` attribute, provide the clear text version of the password. The server will encrypt this value and store only the encrypted value. Be sure to limit read permissions to protect clear passwords that appear in LDIF files.

You can also use an alternate form of the LDIF that does not require the `-a` option on the command line. The advantage of this form is that you can combine entry addition statements and entry modification statements, as shown in the following example.

```
$ ldapmodify -h host1 -p 1389 -D cn=admin,cn=Administrators,cn=config -w -
Enter bind password:
dn: ou=People,dc=example,dc=com
changetype: add
objectclass: top
objectclass: organizationalUnit
ou: People
description: Container for user entries

dn: uid=bjensen,ou=People,dc=example,dc=com
changetype: add
objectclass: top
objectclass: person
objectclass: organizationalPerson
objectclass: inetorgPerson
uid: bjensen
givenName: Barbara
sn: Jensen
cn: Barbara Jensen
telephoneNumber: (408) 555-3922
facsimileTelephoneNumber: (408) 555-4000
mail: bjensen@example.com
userPassword: secret
```

The `changetype: add` keyword indicates that the entry with the given DN should be created with all of the subsequent attributes. All other options and LDIF conventions are the same as explained earlier in this section.

In both examples, you can use the `-f filename` option to read the LDIF from a file instead of from the terminal input. The LDIF file must contain the same format as used for the terminal input, depending upon your use of the `-a` option.

Modifying Entries Using `ldapmodify`

You can use DSCC to perform this task. For information, see [“Directory Service Control Center Interface” on page 43](#) and the DSCC online help.

Use the `changetype: modify` keyword to add, replace, or remove attributes and their values in an existing entry. When you specify `changetype: modify`, you must also provide one or more change operations to indicate how the entry is to be modified. The three possible LDIF change operations are shown in the following example:

```
dn: entryDN
changetype: modify
add: attribute
attribute: value...
-
replace: attribute
```



```

attribute: newValue...
-
delete: attribute
[attribute: value]
...

```

Use a hyphen (-) on a line to separate operations on the same entry, and use a blank line to separate groups of operations on different entries. You can also give several *attribute: value* pairs for each operation.

Adding an Attribute Value

You cannot use DSCC to perform this task. Use the command line, as described in this procedure.

The following example shows how you can use the same add LDIF syntax to add values to existing multi-valued attribute and to attributes that do not yet exist:

```

$ ldapmodify -h host1 -p 1389 -D cn=admin,cn=Administrators,cn=config -w -
Enter bind password:
dn: uid=bjensen,ou=People,dc=example,dc=com
changetype: modify
add: cn
cn: Babs Jensen
-
add: mobile
mobile: (408) 555-7844

```

This operation might fail and the server will return an error if any of the following are true:

- The given value already exists for an attribute.
- The value does not follow the syntax defined for the attribute.
- The attribute type is not required or allowed by the entry's object classes.
- The attribute type is not multi-valued and a value already exists for it.

Using the Binary Attribute Subtype

You can use DSCC to perform this task. For information, see [“Directory Service Control Center Interface” on page 43](#) and the DSCC online help.

The *attribute;binary* subtype indicates that attribute values must be transported over LDAP as binary data, regardless of their actual syntax. This subtype is designed for complex syntax that does not have LDAP string representations, such as `userCertificate`. The binary subtype should not be used outside of this purpose.

When used with the `ldapmodify` command, appropriate subtypes can be added to attribute names in any of the LDIF statements.

To enter a binary value, you may type it directly in the LDIF text or read it from another file. The LDIF syntax for reading it from a file is shown in the following example:

```
$ ldapmodify -h host1 -p 1389 -D cn=admin,cn=Administrators,cn=config -w -
Enter bind password:
version: 1
dn: uid=bjensen,ou=People,dc=example,dc=com
changetype: modify
add: userCertificate;binary
userCertificate;binary:< file:///local/cert-file
```

To use the `<` syntax to specify a file name, you must begin the LDIF statement with the line `version: 1`. When `ldapmodify` processes this statement, it will set the attribute to the value that is read from the entire contents of the given file.

Adding an Attribute With a Language Subtype

You can use DSCC to perform this task. For information, see [“Directory Service Control Center Interface” on page 43](#) and the DSCC online help.

Language and pronunciation subtypes of attributes designate localized values. When you specify a language subtype for an attribute, the subtype is added to the attribute name as follows:

```
attribute;lang-CC
```

where *attribute* is an existing attribute type, and *cc* is the two-letter country code to designate the language. You may optionally add a pronunciation subtype to a language subtype to designate a phonetic equivalent for the localized value. In this case the attribute name is as follows:

```
attribute;lang-CC;phonetic
```

To perform an operation on an attribute with a subtype, you must explicitly match its subtype. For example, if you want to modify an attribute value that has the `lang-fr` language subtype, you must include `lang-fr` in the modify operation as follows:

```
$ ldapmodify -h host1 -p 1389 -D cn=admin,cn=Administrators,cn=config -w -
Enter bind password:
dn: uid=bjensen,ou=People,dc=example,dc=com
changetype: modify
add: homePostalAddress;lang-fr
homePostalAddress;lang-fr: 34, rue de la Paix
```

Note – If the attribute value contains non-ASCII characters, they must be UTF-8 encoded.

Modifying Attribute Values

You can use DSCC to perform this task. For information, see [“Directory Service Control Center Interface” on page 43](#) and the DSCC online help.

The following example shows how to change the value of an attribute by using the `replace` syntax in LDIF:

```
$ ldapmodify -h host1 -p 1389 -D cn=admin,cn=Administrators,cn=config -w -
Enter bind password:
dn: uid=bjensen,ou=People,dc=example,dc=com
changetype: modify
replace: sn
sn: Morris
-
replace: cn
cn: Barbara Morris
cn: Babs Morris
```

All current values of the specified attributes are removed, and all given values are added.

After changing an attribute value, you can use the `ldapsearch` command to verify the change.

Trailing Spaces in Attribute Values

When you modify an attribute value, do not unintentionally include trailing spaces at the end of the value. Trailing spaces might result in the value appearing in base-64 encoding (such as `34xy57eg`).

If the attribute value ends with a trailing space, the trailing space is encoded as part of the attribute value. When you verify the change using DSCC or the `ldapsearch` command, the value you see might be plain text, but it might also appear as base-64 encoded text. This depends on which Directory Server client you use.

Deleting an Attribute Value

You can use DSCC to perform this task. For information, see [“Directory Service Control Center Interface” on page 43](#) and the DSCC online help.

The following example shows how to delete an attribute entirely and to delete only one value of a multi valued attribute:

```
$ ldapmodify -h host1 -p 1389 -D cn=admin,cn=Administrators,cn=config -w -
Enter bind password:
dn: uid=bjensen,ou=People,dc=example,dc=com
changetype: modify
delete: facsimileTelephoneNumber
```

```
-
delete: cn
cn: Babs Morris
```

When using the delete syntax without specifying an *attribute: value* pair, all values of the attribute are removed. If you specify an *attribute: value* pair, only that value is removed.

Modifying One Value of a Multi Valued Attribute

You can use DSCC to perform this task. For information, see [“Directory Service Control Center Interface” on page 43](#) and the DSCC online help.

To modify one value of a multi valued attribute with the `ldapmodify` command, you must perform two operations as shown in the following example:

```
$ ldapmodify -h host1 -p 1389 -D cn=admin,cn=Administrators,cn=config -w -
Enter bind password:
dn: uid=bjensen,ou=People,dc=example,dc=com
changetype: modify
delete: mobile
mobile: (408) 555-7845
-
add: mobile
mobile: (408) 555-5487
```

Deleting Entries Using `ldapdelete`

You can use DSCC to perform this task. For information, see [“Directory Service Control Center Interface” on page 43](#) and the DSCC online help.

Use the `ldapdelete` command-line utility to delete entries from the directory. This utility binds to the directory server and deletes one or more entries based on their DN. You must provide a bind DN that has permission to delete the specified entries.

You cannot delete an entry that has children. The LDAP protocol forbids the situation where child entries would no longer have a parent. For example, you cannot delete an organizational unit entry unless you have first deleted all entries that belong to the organizational unit.

The following example shows only one entry in the organizational unit. This entry and then its parent entry can be deleted.

```
$ ldapdelete -h host1 -p 1389 -D cn=admin,cn=Administrators,cn=config -w -
Enter bind password:
uid=bjensen,ou=People,dc=example,dc=com
ou=People,dc=example,dc=com
```

Deleting Entries Using `ldapmodify`

You can use DSCC to perform this task. For information, see [“Directory Service Control Center Interface” on page 43](#) and the DSCC online help.

When using the `ldapmodify` utility, you can also use the `changetype: delete` keywords to delete entries. All of the same limitations apply as when using `ldapdelete`, as described in the previous section. The advantage of using LDIF syntax for deleting entries is that you can perform a mix of operations in a single LDIF file.

The following example performs the same delete operations as the previous example:

```
$ ldapmodify -h host1 -p 1389 -D cn=admin,cn=Administrators,cn=config -w -
dn: uid=bjensen,ou=People,dc=example,dc=com
changetype: delete

dn: ou=People,dc=example,dc=com
changetype: delete
```

Searching Entries Using `ldapsearch`

You can use DSCC to perform this task. For information, see [“Directory Service Control Center Interface” on page 43](#) and the DSCC online help.

You can use the `ldapsearch` command-line utility to locate and retrieve directory entries. Note that the `ldapsearch` utility is not the utility provided with the Solaris platform, but is part of the Directory Server Resource Kit.

For more information about using `ldapsearch`, common `ldapsearch` options, accepted formats, and examples, refer to *Sun Java System Directory Server Enterprise Edition 6.2 Reference*.

▼ To Move or Rename an Entry Using `ldapmodify`

This procedure uses the modify DN operation. Before starting this operation, ensure that you are familiar with the section [“Guidelines and Limitations for Using the Modify DN Operation” on page 95](#).

For parts of this procedure, you can use DSCC to perform this task. For information, see [“Directory Service Control Center Interface” on page 43](#) and the DSCC online help. Other parts of the procedure can only be done using the command line.

Note – When modifying the DNs of entries that are a uniquemember of a group, you must have the referential integrity plug-in enabled. Referential integrity ensures that the group members get adjusted when the entry is moved. For information about how to enable and configure the referential integrity plug-in, see [“To Configure the Referential Integrity Plug-In” on page 230.](#)

1 If you are moving an entry from one parent to another, extend ACL rights on the parent entries.

- On the current parent entry of the entry to be moved, ensure that the ACL allows the export operations by using the syntax `allow (export ...)`
- On the future parent entry of the entry to be moved, ensure that the ACL allows the import operations. by using the syntax `allow (import ...)`

For information about using ACLs, see [Chapter 6, “Directory Server Access Control.”](#)

2 Ensure that the modify DN operation is enabled globally, or at least for the suffix or suffixes that will be affected by the move operation.

To ensure compatibility with previous releases of Directory Server, the modify DN operation is not enabled by default.

If you have already enabled the modify DN operation previously, go to the next step.

To enable the modify DN operation globally for a server, use this command:

```
$ dsconf set-server-prop -h host -p port moddn-enabled:on
```

3 Run the `ldapmodify` command.

This step uses the modify DN operation. Do one of the following:

- Move the entry.

For example, the following command moves the entry `uid=bjensen` from the subtree for contractors, `ou=Contractors,dc=example,dc=com` to the subtree for employees, `ou=People,dc=example,dc=com`:

```
$ ldapmodify -h host1 -p 1389 -D cn=admin,cn=Administrators,cn=config -w -
Enter bind password:
dn: uid=bjensen,ou=Contractors,dc=example,dc=com
changetype: modrdn
newrdn: uid=bjensen
deleteoldrdn: 0
newsuperior: ou=People,dc=example,dc=com
```

- Rename the entry.

For example, the following command renames the entry `uid=bbjensen` to `uid=bjensen`:

```
$ ldapmodify -h host1 -p 1389 -D cn=admin,cn=Administrators,cn=config -w -
Enter bind password:
dn: uid=bbjensen,ou=People,dc=example,dc=com
```

```
changetype: modrdn
newrdn: uid=bjensen
deleteolddn: 1
```

Pay attention to the following attributes when writing the LDIF statement:

- `dn` - Specifies the entry to rename or move.
- `changetype: modrdn` - Specifies that a modify DN operation is to be used.
- `newrdn` - Gives the new naming attribute.
- `deleteolddn` - Indicates whether the previous naming attribute should be removed from the entry (1 is yes, 0 is no).

Note that you cannot remove a naming attribute from the entry if that attribute is obligatory in the entry definition.

- `newsuperior` - Specifies the new superior attribute of the entry.

For information about the `ldapmodify` command and its options, see the `ldapmodify(1)` man page.

- 4 If you encounter resource limit errors when moving or renaming subtrees that contain a large number of entries, increase the number of locks that can be used by the database.**

```
$ dsconf set-server-prop -h host -p port db-lock-count:value
```

If you modify this property, you must restart the server for the change to take effect.

Guidelines and Limitations for Using the Modify DN Operation

When you use the modify DN operation, as described in the previous section, use the guidelines described in the following sections.

General Guidelines for Using the Modify DN Operation

- Do not use the modify DN operation to move an entry from one suffix to another suffix, or to rename or move the root suffix.
- Ensure that you are running Directory Server 5.2 2005Q1 or later. The modify DN operation cannot be used on versions of Directory Server prior to Directory Server 5.2 2005Q1.
- Do not use the `entryid` operational attribute in your application because it is reserved for internal use only. The `entryid` attribute of an entry can change when an entry is moved.
- Enable the modify DN operation globally for all suffixes on a server, or individually on each suffix where you wish to run the operation. By default the modify DN operation is disabled.

- Extend the ACI rights on each suffix where you wish to run the modify DN operation. The Import access right allows an entry to be imported to the specified DN. The Export access right allows an entry to be exported from the specified DN.
- Before performing a modify DN operation, ensure that the operation would not break client authentication. If you move an entry that refers to a client certificate, client authentication will break. After moving an entry, validate your certificates.
- Before performing a modify DN operation, ensure that the operation would not break your application. The rename or move of an entry can affect several suffixes, or can change the following characteristics of the entry:
 - The scope of a filtered role of an entry.
 - The nested role of an entry, where the nested role contains a filtered role.
 - The dynamic group membership of an entry.

Guidelines for Using the Modify DN Operation With Replication



Caution – Using the modify DN operation without complying with the following requirements can break replication and bring down your directory service.

- Ensure that all servers in your replication topology are running at least Directory Server 5.2. You cannot use the modify DN operation on versions of Directory Server prior to Directory Server 5.2.
- Enable the modify DN operation on all servers in your replication topology. If the modify DN operation is supported on the master server but not on the consumer server, replication will fail. A message similar to the following will be written to the error log on the supplier server:

```
Unable to start a replication session with MODDN enabled
```

To restart replication, reconfigure the replication topology to enable the modify DN operation on all servers. and then start a replication session in one of the following ways:

- By following the instructions in [“To Force Replication Updates” on page 264](#).
- By changing an entry on the supplier server. The change is replicated to the consumer servers.
- Enable and configure the referential integrity plug-in on all master replicas in the topology. This action ensures that the server maintains referential integrity for groups and roles. For information about how to enable and configure the referential integrity plug-in, see [“To Configure the Referential Integrity Plug-In” on page 230](#).

After performing a modify DN operation, allow time for the referential integrity plug-in to replicate its changes.

Setting Referrals

You can use referrals to tell client applications which server to contact if the information is not available locally. Referrals are pointers to a remote suffix or entry that Directory Server returns to the client, in place of a result. The client must then perform the operation again on the remote server named in the referral.

Redirection occurs in three cases:

- When a client application requests an entry that does not exist on the local server, and the server has been configured to return the default referral.
- When an entire suffix has been disabled for maintenance or security reasons.

The server will return the referrals defined by that suffix. The suffix-level referrals are described in “[Setting Referrals and Making a Suffix Read-Only](#)” on page 61. Read-only replicas of a suffix also return referrals to the master servers when a client requests a write operation.

- When a client specifically accesses a smart referral.

A *smart referral* is an entry that you create. The server will return the referral that the smart referral defines.

In all cases, a referral is an LDAP URL that contains the host name, port number, and optionally a DN on another server. For example, `ldap://east.example.com:389`.

For conceptual information about how you can use referrals in your directory deployment, see the *Sun Java System Directory Server Enterprise Edition 6.2 Deployment Planning Guide*.

The following sections describe the procedures for setting your directory’s default referrals and for creating and defining smart referrals.

Setting the Default Referrals

Default referrals are returned to client applications that submit operations on a DN that is not contained on a suffix maintained by your Directory Server. The server will return all referrals that are defined, but the order in which they are returned is not defined.

▼ To Set a Default Referral

You can use DSCC to perform this task. For information, see “[Directory Service Control Center Interface](#)” on page 43 and the DSCC online help.

- **Use the `dsconf` command-line utility to set one or more default referrals.**

```
$ dsconf set-server-prop -h host -p port suffix-DN referral-url:referral-URL
```

For example:

```
$ dsconf set-server-prop -h host1 -p 1389 dc=example,dc=com \
  referral-url:ldap://east.example.com:1389
```

Setting Smart Referrals

Smart referrals allow you to map a directory entry or a directory tree to a specific LDAP URL. Using smart referrals, you can refer client applications to a specific server or to a specific entry on a specific server.

Often, a smart referral points to an actual entry with the same DN on another server. However, you may define the smart referral to any entry on the same server or on a different server. For example, you can define the entry with the following DN to be a smart referral:

```
uid=bjensen,ou=People,dc=example,dc=com
```

The smart referral points to another entry on the server `east.example.com`:

```
cn=Babs Jensen,ou=Sales,o=east,dc=example,dc=com
```

The way the directory uses smart referrals conforms to the standard specified in section 4.1.10 of RFC 4511 (<http://www.ietf.org/rfc/rfc4511.txt>).

▼ To Create and Modify a Smart Referral

You can use DSCC to perform this task. For information, see “[Directory Service Control Center Interface](#)” on page 43 and the DSCC online help.

1 To create a smart referral, create an entry with `referral` and `extensibleObject` object classes.

The `referral` object class allows the `ref` attribute that is expected to contain an LDAP URL. The `extensibleObject` object class allows you to use any schema attribute as the naming attribute, in order to match the target entry.

For example, to define the following entry to return a smart referral instead of the entry `uid=bjensen`, use this command:

```
$ ldapmodify -a -h host1 -p 1389 -D cn=admin,cn=Administrators,cn=config -w -
Enter bind password:
dn: uid=bjensen,ou=People,dc=example,dc=com
objectclass: top
objectclass: extensibleObject
objectclass: referral
uid: bjensen
ref: ldap://east.example.com/cn=Babs%20Jensen,ou=Sales,o=east,dc=example,dc=com
```

Note – Any information after a space in an LDAP URL is ignored by the server. Thus, you must use `%20` instead of spaces in any LDAP URL that you intend to use as a referral. Other special characters must be escaped.

After you have defined the smart referral, modifications to the `uid=bjensen` entry will actually be performed on the `cn=Babs Jensen` entry on the other server. The `ldapmodify` command will automatically follow the referral, for example:

```
$ ldapmodify -h host1 -p 1389 -D cn=admin,cn=Administrators,cn=config -w -
Enter bind password:
dn: uid=bjensen,ou=People,dc=example,dc=com
changetype: replace
replace: telephoneNumber
telephoneNumber: (408) 555-1234
```

2 (Optional) To modify the smart referral entry, use the `-M` option of `ldapmodify`:

```
$ ldapmodify -M -h host1 -p 1389 -D cn=admin,cn=Administrators,cn=config -w -
Enter bind password:
dn: uid=bjensen,ou=People,dc=example,dc=com
changetype: replace
replace: ref
ref: ldap://east.example.com/cn=Babs%20Jensen,ou=Marketing,o=east,dc=example,dc=com
```

Checking Valid Attribute Syntax

Directory Server allows you to check the integrity of your attributes whenever you perform the following operations:

- Importing data using `dsadm import` or `dsconf import`.
- Using LDAP or DSML to add entries, modify entries, or modify the DN of an entry.

The checks ensure that the attribute values conform to IETF recommendations. All nonconforming attributes are rejected and logged in the errors log. The log messages include the connection and operation ID, if applicable.

By default, the server automatically checks the syntax of the previously mentioned operations. If you want to turn syntax checking off, use the following procedure.

Note – Syntax checking is not the same as schema checking. For information about schema checking, see [“Managing Schema Checking” on page 277](#).

▼ To Turn Off Automatic Syntax Checking

You cannot use DSCC to perform this task. Use the command line, as described in this procedure.

- **To turn off automatic syntax checking, use this command:**

```
$ dsconf set-server-prop -h host -p port check-syntax-enabled:off
```

Tracking Modifications to Directory Entries

By default, the server maintains special attributes for newly created or modified entries, as specified in the LDAP v3 specification. These special attributes are stored on the entry in the suffix and include the following:

- `creatorsName` — the DN of the user who initially created the entry.
- `createTimestamp` — the timestamp for when the entry was created, in GMT format.
- `modifiersName` — the DN of the user who last modified the entry.
- `modifyTimestamp` — the timestamp for when the entry was modified, in GMT format.

▼ To Turn Off Entry Modification Tracking

You can use DSCC to perform this task. For information, see [“Directory Service Control Center Interface” on page 43](#) and the DSCC online help.



Caution – Turning off entry modification tracking results in non-compliant data. As many applications rely on these attributes and as disabling this feature results in only minimal performance gains, we recommend that you do not turn off entry modification tracking.

- **Turn off entry modification tracking for the server.**

```
$ dsconf set-server-prop -h host -p port suffix-DN mod-tracking-enabled:off
```

Encrypting Attribute Values

Attribute encryption protects sensitive data while it is stored in the directory. Attribute encryption allows you to specify that certain attributes of an entry are stored in an encrypted format. This prevents data from being readable while stored in database files, backup files, and exported LDIF files.

With this feature, attribute values are encrypted before they are stored in the Directory Server database, and decrypted back to their original value before being returned to the client. You must use access controls to prevent clients from accessing such attributes without permission,

and SSL to encrypt the attribute values when in transit between the client and Directory Server. For an architectural overview of data security in general and attribute encryption in particular, see *Sun Java System Directory Server Enterprise Edition 6.2 Reference*.

Attribute encryption is active only when SSL is configured and enabled on the server. However, no attributes are encrypted by default. Attribute encryption is configured at the suffix level, which means that an attribute is encrypted in every entry in which it appears in the suffix. If you want to encrypt an attribute in an entire directory, you must enable encryption for that attribute in every suffix.



Caution – Attribute encryption affects all data and index files associated with a suffix. If you modify the encryption configuration of an existing suffix, you *must* first export its contents, make the configuration change, and then re-import the contents. DSCC can help you perform these steps. For more information about using DSCC, see [“Directory Service Control Center Interface” on page 43](#).

For additional security, when turning on encryption for any attribute, you should manually delete the database cache files and database log file that might still contain unencrypted values. The procedure for deleting these files is described in [“To Configure Attribute Encryption” on page 103](#).

You should enable any encrypted attributes before loading or creating data in a new suffix.

If you choose to encrypt an attribute that some entries use as a naming attribute, values that appear in the DN will not be encrypted. Values that are stored in the entry will be encrypted.

Even though you can select the `userPassword` attribute for encryption, no real security benefit is realized unless the password needs to be stored in the clear. Such is the case for DIGEST-MD5 SASL authentication. If the password already has an encryption mechanism defined in the password policy, further encryption provides little additional security, but, it will impact the performance of every bind operation.

When in storage, encrypted attributes are prefaced with a cipher tag that indicates the encryption algorithm used. An encrypted attribute using the DES encryption algorithm would appear as follows:

```
{CKM_DES_CBC}3hakc&j la+=snda%
```

When importing data online with a view to encrypting it, you will already have provided the key database password to authenticate to the server and will not be prompted a second time. If you are importing data offline, Directory Server will prompt you for the password before it allows you to encrypt the data you are importing. When decrypting data (a more security-sensitive operation), Directory Server automatically prompts you for the key database password, regardless of whether the export operation is online or offline. This provides an additional security layer.

Note – As long as the certificate or private key does not change, the server will continue to generate the same key. Thus, data can be transported (exported then imported) from one server instance to another, provided both server instances have used the same certificate.

Attribute Encryption and Performance

While attribute encryption offers increased data security, it does impact system performance. Think carefully about which attributes require encryption, and encrypt only those attributes that you consider to be particularly sensitive.

Because sensitive data can be accessed directly through index files, the index keys that correspond to the encrypted attributes must be encrypted to ensure that the attributes are fully protected. Given that indexing already has an impact on Directory Server performance (without the added cost of encrypting index keys), configure attribute encryption *before* data is imported or added to the database for the first time. This procedure will ensure that encrypted attributes are indexed as such from the outset.

Attribute Encryption Usage Considerations

Consider the following when implementing the attribute encryption feature:

- As a general best practice when modifying attribute encryption configuration, you should export your data, make the configuration changes, and then import the newly configured data.

This will ensure that all configuration changes are taken into account in their entirety, without any loss in functionality. Failing to do so could result in some functionality loss and thus compromise the security of your data.

- Modifying attribute encryption configuration on an existing database can have a significant impact on system performance.

For example, imagine that you have a database instance with existing data. The database contains previously stored entries with an attribute called `mySensitiveAttribute`. The value of this attribute is stored in the database and in the index files in clear text. If you later decide to encrypt the `mySensitiveAttribute` attribute, all the data in the database instance must be exported and re-imported into the database to ensure that the server updates the database and index files with the attribute encryption configuration. The resulting performance impact could have been avoided had the attribute been encrypted from the beginning.

- When exporting data in decrypted format, the export is refused if an incorrect password is used.

As a security measure, the server prompts users for passwords if they want to export data in decrypted format. Should users provide an incorrect password, the server refuses the decrypted export operation. Passwords can be entered directly or by providing the path to a file that contains the password. Note that this file has the same syntax as the SSL password file. See “[Configuring the Certificate Database Password](#)” on page 114.

- Algorithm changes are supported, but the result can be lost indexing functionality if they are not made correctly.

To change the algorithm used to encrypt data, export the data, modify the attribute encryption configuration, and then import the data. If you do not follow this procedure, the indexes that were created on the basis of the initial encryption algorithm will no longer function.

Because the encrypted attributes are prefaced with a cipher tag that indicates the encryption algorithm used, the internal server operations take care of importing the data. Directory Server therefore enables you to export data in encrypted form before making the algorithm change.

- Changing the server’s SSL certificate results in your not being able to decrypt encrypted data.

The server’s SSL certificate is used by the attribute encryption feature to generate its own key, which is then used to perform the encryption and decryption operations. Thus, the SSL certificate is required to decrypt encrypted data. If you change the certificate without decrypting the data beforehand, you cannot decrypt the data. To avoid this, export your data in decrypted format, change the certificate, and then re-import the data.

- To transport data in encrypted format, that is, to export and import it from one server instance to another, both server instances must use the same certificate.

For information, see “Encrypting Attribute Values” in the *Sun Java System Directory Server Enterprise Edition 6.2 Administration Guide*.

▼ To Configure Attribute Encryption

You can use DSCC to perform this task. For information, see “[Directory Service Control Center Interface](#)” on page 43 and the DSCC online help.

- 1 If the suffix on which you want to configure attribute encryption contains any entries whatsoever, you must first export the contents of that suffix to an LDIF file.**

If the suffix contains encrypted attributes and you plan to re-initialize the suffix using the exported LDIF file, you can leave the attributes encrypted in the exported LDIF .

- 2 To enable encryption for an attribute, use this command:**

```
$ dsconf create-encrypted-attr -h host -p port suffix-DN attr-name cipher-name
```

where *cipher-name* is one of the following:

- des - DES block cipher
- des3 - Triple-DES block cipher
- rc2 - RC2 block cipher
- rc4 - RC4 stream cipher

For example:

```
$ dsconf create-encrypted-attr -h host1 -p 1389 dc=example,dc=com uid rc4
```

3 To return an encrypted attribute to its original state, use this command:

```
$ dsconf delete-encrypted-attr -h host -p port suffix-DN attr-name
```

4 If you have changed the configuration to encrypt one or more attributes, and these attributes had values before the import operation, clear the database cache and remove the log.

Any unencrypted values will not be visible in the database cache and database log.

Note – If you delete these files, you will lose some tracking information. In addition, after you delete these files, the server will be in recovery mode, and might take a long time to restart.

To clear the database cache and remove the log:

a. Stop Directory Server as described in “Starting, Stopping, and Restarting a Directory Server Instance” on page 57.

b. As root or a user with administrator privileges, delete the database cache files from your file system.

```
# rm instance-path/db/__.db.*
```

c. Delete the database log file from your file system.

```
# rm instance-path/db/log.0000000001
```

d. Restart Directory Server.

The server will automatically create new database cache files. Performance of operations in this suffix might be slightly impacted until the cache is filled again.

5 Initialize the suffix with an LDIF file as described in “Initializing a Suffix” on page 201.

As the file is loaded and the corresponding indexes are created, all values of the specified attributes will be encrypted.

Directory Server Security

Directory Server supports several mechanisms that provide secure and trusted communications over the network. LDAPS is the standard LDAP protocol that runs on top of the Secure Sockets Layer (SSL). LDAPS encrypts data and optionally uses certificates for authentication. When the term SSL is used in this chapter, it means the supported protocols SSL2, SSL3 and TLS 1.0.

Directory Server also supports the Start Transport Layer Security (Start TLS) extended operation to enable TLS on an LDAP connection that was originally not encrypted.

In addition, Directory Server supports the Generic Security Service API (GSSAPI) over the Simple Authentication and Security Layer (SASL). The GSSAPI allows you to use the Kerberos Version 5 security protocol on the Solaris Operating System (Solaris OS). An identity mapping mechanism then associates the Kerberos principal with an identity in the directory.

For additional security information, see the NSS web site at <http://www.mozilla.org/projects/security/pki/nss/> (<http://www.mozilla.org/projects/security/pki/nss/>).

This chapter provides procedures for configuring security through SSL. For information about ACIs, see Chapter 6, “Directory Server Access Control.” For information about user access and passwords, see Chapter 7, “Directory Server Password Policy.”

This chapter covers the following topics:

- “Using SSL With Directory Server” on page 106
- “Managing Certificates” on page 107
- “Configuring SSL Communication” on page 115
- “Configuring Credential Levels and Authentication Methods” on page 117
- “Configuring LDAP Clients to Use Security” on page 125
- “Pass-Through Authentication” on page 139

Using SSL With Directory Server

The Secure Sockets Layer (SSL) provides encrypted communications and optional authentication between a Directory Server and its clients. SSL can be used over LDAP or with DSML-over-HTTP. SSL is enabled by default over LDAP, but if you are using DSML-over-HTTP, you can easily enable SSL. In addition, replication can be configured to use SSL for secure communications between servers.

Using SSL with simple authentication (bind DN and password) encrypts all data sent to and from the server. Encryption guarantees confidentiality and data integrity. Optionally, clients can use a certificate to authenticate to Directory Server or to a third-party security mechanism through the Simple Authentication and Security Layer (SASL). Certificate-based authentication uses public-key cryptography to prevent forgery and impersonation of either the client or the server.

Directory Server is capable of simultaneous SSL and non-SSL communications on separate ports. For security reasons, you can also restrict all communications to the LDAP secure port. Client authentication is also configurable. You can set client authentication to required or to allowed. This setting determines the level of security you enforce.

SSL enables support for the Start TLS extended operation that provides security on a regular LDAP connection. Clients can bind to the standard LDAP port and then use the Transport Layer Security protocol to secure the connection. The Start TLS operation allows more flexibility for clients, and can help simplify port allocation.

The encryption mechanisms provided by SSL are also used for attribute encryption. Enabling SSL allows you to configure attribute encryption on your suffixes, which protects data while it is stored in the directory. For more information, see [“Encrypting Attribute Values” on page 100](#).

For additional security, you can set access control to directory contents through access control instructions (ACIs). ACIs require a specific authentication method and ensure that data can only be transmitted over a secure channel. Set the ACIs to compliment your use of SSL and certificates. For more information, see [Chapter 6, “Directory Server Access Control.”](#)

SSL is enabled by default over LDAP, and you can easily enable SSL for DSML-over-HTTP. In addition, there are some aspects of the SSL configuration that you might want to modify, as described in the following sections.

Managing Certificates

This section describes how to manage SSL certificates in Directory Server.

To run SSL on Directory Server, you must either use a self-signed certificate or a Public Key Infrastructure (PKI) solution.

The PKI solution involves an external Certificate Authority (CA). For a PKI solution, you need a CA-signed server certificate, which contains both a public key and a private key. This certificate is specific to one Directory Server. You also need a trusted CA certificate, which contains a public key. The trusted CA certificate ensures that all server certificates from your CA are trusted. This certificate is sometimes called a CA root key or root certificate.

Note – If you are using certificates for test purposes, you probably want to use self-signed certificates. However, in production, using self-signed certificates is not very secure. In production, use trusted Certificate Authority (CA) certificates.

The procedures in this section use the `dsadm` and `dsconf` commands. For information about these commands, see the `dsadm(1M)` and `dsconf(1M)` man pages.

This section provides the following information about configuring certificates on Directory Server:

- [“To View the Default Self-Signed Certificate” on page 107](#)
- [“To Manage Self-Signed Certificates” on page 108](#)
- [“To Request a CA-Signed Server Certificate” on page 108](#)
- [“To Add the CA-Signed Server Certificate and the Trusted CA Certificate” on page 110](#)
- [“To Renew an Expired CA-Signed Server Certificate” on page 112](#)
- [“To Export and Import a CA-Signed Server Certificate” on page 113](#)
- [“Configuring the Certificate Database Password” on page 114](#)
- [“Backing Up and Restoring the Certificate Database for Directory Server” on page 114](#)

▼ To View the Default Self-Signed Certificate

When a Directory Server instance is first created, it contains a default self-signed certificate. A *self-signed certificate* is a public and private key pair, where the public key is signed by the private key. A self-signed certificate is valid for three months.

You can use DSCC to perform this task. For information, see [“Directory Service Control Center Interface” on page 43](#) and the DSCC online help.

- **To view the default self-signed certificate, use this command:**

```
$ dsadm show-cert instance-path defaultCert
```

▼ To Manage Self-Signed Certificates

When you create a Directory Server instance, a default self-signed certificate is automatically provided.

You can use DSCC to perform this task. For information, see [“Directory Service Control Center Interface” on page 43](#) and the DSCC online help.

1 To create a self-signed certificate with non-default settings, use this command:

```
$ dsadm add-selfsign-cert instance-path cert-alias
```

Where *cert-alias* is a name that you provide to identify your certificate.

To see all the options for this command, see the dsadm(1M) man page or the command-line help:.

```
$ dsadm add-selfsign-cert --help
```

2 When your self-signed certificate expires, stop the server instance and renew the certificate.

```
$ dsadm stop instance-path
$ dsadm renew-selfsign-cert instance-path cert-alias
```

3 Restart the server instance.

```
$ dsadm start instance-path
```

▼ To Request a CA-Signed Server Certificate

This procedure explains how to request and install a CA-signed server certificate for use with Directory Server.

You can use DSCC to perform this task. For information, see [“Directory Service Control Center Interface” on page 43](#) and the DSCC online help.

1 Generate a CA-signed server certificate request.

```
$ dsadm request-cert [-W cert-pwd-file] {-S DN | --name name [--org org] \
  [--org-unit org-unit] [--city city] [--state state] [--country country] \
  [-o output-file] [-F format] instance-path
```

For example, to request a CA-signed server certificate for the Example company, use this command:

```
$ dsadm request-cert --name host1 --org Example --org-unit Marketing \
  -o my_cert_request_file /local/ds
```

In order to completely identify the server, Certificate Authorities might require all of the attributes that are shown in this example. For a description of each attribute, see the `dsadm(1M)` man page.

When you request a certificate by using `dsadm request -cert`, the resulting certificate request is a binary certificate request unless you specify ASCII as output format. If you specify ASCII, the resulting certificate request is a PKCS #10 certificate request in PEM format. PEM is the Privacy Enhanced Mail format specified by RFCs 1421 through 1424 (<http://www.ietf.org/rfc/rfc1421.txt>) and is used to represent a base64-encoded certificate request in US-ASCII characters. The content of the request looks similar to the following example:

```
-----BEGIN NEW CERTIFICATE REQUEST-----
MIIBrjCCARcCAQAwbjELMAkGA1UBhMCVXMxEzARBgNVBAGTCkNBELGT1JOSUExLD
AqBgVBAoTI25ldHNjYXBlIGNvb11bmLjYXRpb25zIGNvcnBvcnF0aWUuMRwwGgYDV
QQDEXNtZWxs24umV0c2NhcGUuY29tMIGfMA0GCSqGSIb3DQEBAUAA4GNADCBiQK
BgCwAbSkGh6SKY0gHy+UCSLnm3ok3X3u83Us7u0EfgSLR0f+K41eNqqWRftGR83e
mqPLDof0ZLTLjVGJaHJn4l1gG+Jdf/n/zMyahxtV7+T8G0FFigFfuxJaxMjr2j7I
vELlxQ4IfZgwqCm4qQecv3G+N9YdbjveMVXW0v4XwIDAQABAADQYJKoZIhvcNAQ
EEBQADgYEAYZAm8UmpP9PQYwNy4Pmypo79t2nvzKbwKVb97G+MT/gw1pLRsuBoKi
nmfLgKp1Q38K5Py2VGW1E47/rhm3yVQrIiwV+Z8Lcc=
-----END NEW CERTIFICATE REQUEST-----
```

2 Transmit the certificate request to your Certificate Authority, according to its procedures.

The process for obtaining your Certificate Authority certificate depends on the certificate authority that you use. Some commercial CAs provide a website that allows you to automatically download the certificate. Other CAs will send it to you in email upon request.

After you have sent your request, you must wait for the CA to respond with your certificate. Response time for your request varies. For example, if your CA is internal to your company, the CA might only take a day or two to respond to your request. If your selected CA is external to your company, the CA could take several weeks to respond to your request.

3 Save the certificate that you receive from the Certificate Authority.

Back up your certificates in a safe location. If you ever lose the certificates, you can reinstall them by using your backup file. You can save them in text files. The PKCS #11 certificate in PEM format looks similar to the following example:

```
-----BEGIN CERTIFICATE-----
MIICjCCA ZugAwIBAgICCEEdQYJKoZIhKqvcNAQFBQAwfDELMkGA1UEBhMCVVMx
IzAhBgNVBAoG1BhbG9a2FWaWxsZGwSBXAwRnZXRzLkCBjbmMuMR0wGwYDVQQLExRX
awRnZXQgTW3FrZXJzICdSjyBVczEpMCCGAX1UEAXgVGVzdCBUN0IFRlLc3QgVGVz
dCBUZXR0IFlcl3QgQ0EswHhcNOTgwMzEyMDIzMzUwHhcNOTgwMzI2MDIzMpZU3WjBP
MQswcYDDVQQGEWJVUzEoMCMYGA1UEChMfTmV0c2NhcGUuRGlyZn0b3J5VIFB1Ymxp
Y2F0aw9uczEwMmB4QGA1UEAxMNZHVh49dq2tLNvbjTBaMA0GCSqGSIb3DQEBAQUA
A0kAMEYkCQCKsMR/aLGFp4m00iGgijG5Kg0sYRNvWGYW7kfW+8mmijDtZarjYNj
jcgpf3Vn1bxbclX9LvjJNLC5737XZdAgEdozYwpNDARBglghkgBhvhCEAQEEBAMC
```

```

APAwHkwYDVR0jBBgwFAU67URjwCaGqZHUpSpdLxLzwJKiMwDQYJKoZIhQvcNAQEF
BQADgYEAJ+BfVem3vB0PBveNdLGfjLb9hucgmaMcQa9FA/db8qimKT/ue9UG0JqL
bwbMKBBopsDn56p2yV3PLIsBgrcuSoBCuFFnxBnqSiTS7YiYgCWqWauA0ExJFmD6
6hBLseqkSWulk+hXHN7L/NrVi0+7zNtKcaZLLFPf7d7j2MgX4Bo=
-----END CERTIFICATE-----

```

▼ To Add the CA-Signed Server Certificate and the Trusted CA Certificate

This procedure explains how to install the CA-signed server certificate and trusted CA certificates for use with Directory Server.

You can use DSCC to perform this task. For information, see [“Directory Service Control Center Interface” on page 43](#) and the DSCC online help.

1 Add the CA-signed server certificate.

```
$ dsadm add-cert --ca instance-path cert-alias cert-file
```

Where *cert-alias* is a name that you provide to identify your certificate, and *cert-file* is the text file that contains the PKCS #11 certificate in PEM format.

For example, to install a CA-signed server certificate, you might use a command similar to this:

```
$ dsadm add-cert --ca /local/ds server-cert /local/safepace/serv-cert-file
```

The certificate is now installed, but is not yet trusted. To trust the CA-signed server certificate, you must install the Certificate Authority certificate.

2 Add the trusted Certificate Authority certificate.

```
$ dsadm add-cert --ca -C instance-path cert-alias cert-file
```

The `-C` option indicates that the certificate is a trusted Certificate Authority certificate.

For example, to install a trusted certificate from a Certificate Authority, you might use this command:

```
$ dsadm add-cert --ca -C /local/ds CA-cert /local/safepace/ca-cert-file
```

3 (Optional) Verify your installed certificates.

- To list all server certificates and to display their validity dates and aliases, type:

```
$ dsadm list-certs instance-path
```

For example:

```

$ dsadm list-certs /local/ds1
Enter the certificate database password:
Alias      Valid from Expires on Self-  Issued by      Issued to
          18:13      18:13          signed?
-----
serverCert 2000/11/10 2011/02/10 n      CN=CA-Signed Cert, CN=Test Cert,
          18:13      18:13          OU=CA,0=com     dc=example,dc=com
defaultCert 2006/05/18 2006/08/18 y      CN=host1,CN=DS,  Same as issuer
          16:28      16:28          dc=example,dc=com
2 certificates found

```

By default, an instance of Directory Proxy Server contains a default server certificate called `defaultCert`. The text `Same as issuer` indicates that the default certificate is a self-signed server certificate.

- To list trusted CA certificates, type:

```
$ dsadm list-certs -C instance-path
```

For example:

```

$ dsadm list-certs -C /local/ds1
Enter the certificate database password:
Alias  Valid from Expires on Self-  Issued by      Issued to
      18:12      18:12          signed?
-----
CA-cert 2000/11/10 2011/02/10 y      CN=Trusted CA Cert, Same as issuer
      18:12      18:12          OU=CA,0=com
1 certificate found

```

- To view the details of a certificate, including the certificate expiration date, type:

```
$ dsadm show-cert instance-path cert-alias
```

For example, to view a server certificate, type:

```

$ dsadm show-cert /local/ds1 "Server-Cert"
Enter the certificate database password:
Certificate:
  Data:
    Version: 3 (0x2)
    Serial Number: 2 (0x2)
    Signature Algorithm: PKCS #1 MD5 With RSA Encryption
    Issuer:
      "CN=Server-Cert,0=Sun,C=US"
    Validity:
      Not Before: Fri Nov 10 18:12:20 2000
      Not After : Thu Feb 10 18:12:20 2011
    Subject:

```

```

"CN=CA Server Cert,OU=ICNC,O=Sun,C=FR"
Subject Public Key Info:
  Public Key Algorithm: PKCS #1 RSA Encryption
  RSA Public Key:
    Modulus:
      bd:76:fc:29:ca:06:45:df:cd:1b:f1:ce:bb:cc:3a:f7:
      77:63:5a:82:69:56:5f:3d:3a:1c:02:98:72:44:36:e4:
      68:8c:22:2b:f0:a2:cb:15:7a:c4:c6:44:0d:97:2d:13:
      b7:e3:bf:4e:be:b5:6a:df:ce:c4:c3:a4:8a:1d:fa:cf:
      99:dc:4a:17:61:e0:37:2b:7f:90:cb:31:02:97:e4:30:
      93:5d:91:f7:ef:b0:5a:c7:d4:de:d8:0e:b8:06:06:23:
      ed:5f:33:f3:f8:7e:09:c5:de:a5:32:2a:1b:6a:75:c5:
      0b:e3:a5:f2:7a:df:3e:3d:93:bf:ca:1f:d9:8d:24:ed
    Exponent: 65537 (0x10001)
  Signature Algorithm: PKCS #1 MD5 With RSA Encryption
  Signature:
    85:92:42:1e:e3:04:4d:e5:a8:79:12:7d:72:c0:bf:45:
    ea:c8:f8:af:f5:95:f0:f5:83:23:15:0b:02:73:82:24:
    3d:de:1e:95:04:fb:b5:08:17:04:1c:9d:9c:9b:bd:c7:
    e6:57:6c:64:38:8b:df:a2:67:f0:39:f9:70:e9:07:1f:
    33:48:ea:2c:18:1d:f0:30:d8:ca:e1:29:ec:be:a3:43:
    6f:df:03:d5:43:94:8f:ec:ea:9a:02:82:99:5a:54:c9:
    e4:1f:8c:ae:e2:e8:3d:50:20:46:e2:c8:44:a6:32:4e:
    51:48:15:d6:44:8c:e6:d2:0d:5f:77:9b:62:80:1e:30
  Fingerprint (MD5):
    D9:FB:74:9F:C3:EC:5A:89:8F:2C:37:47:2F:1B:D8:8F
  Fingerprint (SHA1):
    2E:CA:B8:BE:B6:A0:8C:84:0D:62:57:85:C6:73:14:DE:67:4E:09:56

Certificate Trust Flags:
  SSL Flags:
    Valid CA
    Trusted CA
    User
    Trusted Client CA
  Email Flags:
    User
  Object Signing Flags:
    User

```

▼ To Renew an Expired CA-Signed Server Certificate

When your CA-signed server certificate (public key and private key) expires, renew it by using this procedure.

You can use DSCC to perform this task. For information, see [“Directory Service Control Center Interface” on page 43](#) and the DSCC online help.

- 1 Obtain an updated CA-signed server certificate from your Certificate Authority.
- 2 When you receive the updated certificate, stop the server instance and install the certificate.

```
$ dsadm stop instance-path
$ dsadm renew-cert instance-path cert-alias cert-file
```

- 3 Restart the server instance.

```
$ dsadm start instance-path
```

▼ To Export and Import a CA-Signed Server Certificate

In some cases you might want to export the public and private keys of a certificate so that you can later import the certificate. For example, you might want the certificate to be used by another server.

The commands in this procedure can be used with certificates that contain wild cards, for example "cn=*,o=example".

You can use DSCC to perform this task. For information, see [“Directory Service Control Center Interface” on page 43](#) and the DSCC online help.

- 1 Export the certificate.

```
$ dsadm export-cert [-o output-file] instance-path cert-alias
```

For example:

```
$ dsadm export-cert -o /tmp/first-certificate /local/ds1 "First Certificate"
$ dsadm export-cert -o /tmp/first-ca-server-certificate /local/ds1/defaultCert
Choose the PKCS#12 file password:
Confirm the PKCS#12 file password:
$ ls /tmp
first-ca-server-certificate
```

- 2 Import the certificate.

```
$ dsadm import-cert instance-path cert-file
```

For example, to import the certificate to a server instance on host1:

```
$ dsadm import-cert -h host1 /local/ds2 /tmp/first-ca-server-certificate
Enter the PKCS#12 file password:
```

- 3 (Optional) If you have imported the certificate to a server, configure the server to use the imported certificate.

```
$ dsconf set-server-prop -e -h host -p port -w - ssl-rsa-cert-name:server-cert
```

Configuring the Certificate Database Password

By default, Directory Server manages the SSL certificate database password internally through a stored password. When managing certificates, the user does not need to type a certificate password or specify the password file. This option is not very secure because the password is only hidden, not encrypted.

However, if you want to have more control over the use of certificates, you can configure the server so that the user is prompted for a password on the command line. In this case, the user must type the certificate database password for all `dsadm` subcommands except `autostart`, `backup`, `disable-service`, `enable-service`, `info`, `reindex`, `restore`, and `stop`. The certificate database is located in the directory `instance-path/alias`.

▼ To Configure the Server So the User is Prompted for a Certificate Password

You can use DSCC to perform this task. For information, see [“Directory Service Control Center Interface” on page 43](#) and the DSCC online help.

- 1 Stop the server.

```
$ dsadm stop instance-path
```

- 2 Set the password prompt flag to on.

```
$ dsadm set-flags instance-path cert-pwd-prompt=on
```

You are asked to choose a new certificate password.

- 3 Start the server.

```
$ dsadm start instance-path
```

Backing Up and Restoring the Certificate Database for Directory Server

When you back up an instance of Directory Server, you back up the Directory Server configuration and the certificates. The backed up certificates are stored in the `archive-path/alias` directory.

For information about how to back up and restore Directory Server, see [“To Make a Backup for Disaster Recovery” on page 208](#).

Configuring SSL Communication

This section contains procedures related to disabling and enabling SSL.

Disabling Non Secure Communication

When a server instance is created, both an LDAP clear port and a secure LDAP port (LDAPS) are created by default. However, there might be situations where you want to disable non-SSL communications so that the server communicates only through SSL.

The SSL connection is enabled with a default self-signed certificate. If you want to, you can install your own certificates. For instructions on managing certificates and disabling SSL after the server has been started, see [Chapter 5, “Directory Server Security.”](#) For an overview of certificates, certificate databases, and obtaining a CA-signed server certificate, see *Sun Java System Directory Server Enterprise Edition 6.2 Reference*.

▼ To Disable the LDAP Clear Port

You can use DSCC to perform this task. For information, see [“Directory Service Control Center Interface” on page 43](#) and the DSCC online help.

1 Disable the LDAP clear port.

To disable the non secure point, you must bind to the LDAP secure port. This example shows a bind to the default LDAP secure port, 1636, on the host `host1`.

```
$ dsconf set-server-prop -h host1 -P 1636 ldap-port:disabled
```

2 Restart the server for the change to take effect.

```
$ dsadm restart /local/ds
```

You can now no longer bind on the non secure port 1389.

Choosing Encryption Ciphers

A *cipher* is the algorithm used to encrypt and decrypt data. Generally speaking, the more bits that a cipher uses during encryption, the *stronger* or more secure the encryption is. Ciphers for SSL are also identified by the type of message authentication used. Message authentication is another algorithm that computes a checksum that guarantees data integrity.

When a client initiates an SSL connection with a server, the client and server must agree on a cipher to use to encrypt information. In any two-way encryption process, both parties must use the same cipher. The cipher used depends upon the current order of the cipher list kept by the server. The server chooses the first cipher presented by the client that matches a cipher in its list.

The default cipher value for Directory Server is `all`, which means all known secure ciphers supported by the underlying SSL library. However, you can modify this value to only accept certain ciphers.

For more information about the ciphers that are available with Directory Server, see *Sun Java System Directory Server Enterprise Edition 6.2 Reference*.

▼ To Choose an Encryption Cipher

You can use DSCC to perform this task. For information, see “[Directory Service Control Center Interface](#)” on page 43 and the DSCC online help.

1 Make sure that SSL is enabled for your server.

See “[Configuring SSL Communication](#)” on page 115.

2 View the available SSL ciphers.

```
$ dsconf get-server-prop -h host -p port ssl-supported-ciphers
ssl-supported-ciphers : TLS_ECDHE_ECDSA_WITH_AES_256_CBC_SHA
ssl-supported-ciphers : TLS_ECDHE_RSA_WITH_AES_256_CBC_SHA
ssl-supported-ciphers : TLS_DHE_RSA_WITH_AES_256_CBC_SHA
ssl-supported-ciphers : TLS_DHE_DSS_WITH_AES_256_CBC_SHA
...
```

3 (Optional) If you want to keep a copy of non-encrypted data, export the data before setting the SSL ciphers.

See “[Exporting to LDIF](#)” on page 198.

4 Set the SSL ciphers.

```
$ dsconf set-server-prop -h host -p port ssl-cipher-family:cipher
```

For example, to set the cipher family to `SSL_RSA_WITH_RC4_128_MD5` and `SSL_DHE_RSA_WITH_3DES_EDE_CBC_SHA`, type:

```
$ dsconf set-server-prop -h host1 -P 1636 ssl-cipher-family:SSL_RSA_WITH_RC4_128_MD5 \
ssl-cipher-family:SSL_DHE_RSA_WITH_3DES_EDE_CBC_SHA
Enter "cn=Directory Manager" password:
Before setting SSL configuration, export Directory Server data.
Do you want to continue [y/n] ? y
Directory Server must be restarted for changes to take effect.
```

5 (Optional) Add an SSL cipher to an existing list.

If you already have a list of ciphers specified, and you want to add a cipher, use this command:

```
$ dsconf set-server-prop -h host -p port ssl-cipher-family+:cipher
```

For example, to add the `SSL_DHE_RSA_WITH_3DES_EDE_CBC_SHA` cipher, type:

```
$ dsconf set-server-prop -h host1 -P 1636 \  
ssl-cipher-family+:SSL_DHE_RSA_WITH_3DES_EDE_CBC_SHA
```

6 Restart the server for the changes to take effect.

```
$ dsadm restart /local/ds
```

Configuring Credential Levels and Authentication Methods

The security model that is applied to clients is defined through a combination of the credential level and the authentication method.

Directory Server supports the following credential levels:

- **Anonymous.** Allowing anonymous access for certain parts of the directory implies that anyone with access to the directory has read access.

If you use an anonymous credential level, you need to allow read access to all the LDAP naming entries and attributes.



Caution – Do not allow anonymous write access to a directory because anyone could change information in the DIT to which they have write access, including another user's password, or their own identity.

- **Proxy.** The client authenticates or binds to the directory using a proxy account. This proxy account can be any entry that is allowed to bind to the directory. The proxy account needs sufficient access to perform the naming service functions on the directory. You need to configure the `proxyDN` and `proxyPassword` on every client using the proxy credential level. The encrypted `proxyPassword` is stored locally on the client.
- **Proxy anonymous.** A multivalued entry in which more than one credential level is defined. A client assigned the proxy anonymous level will first attempt to authenticate with its proxy identity. If the client is unable to authenticate as the proxy user for whatever reason (user lockout, password expired, for example), then the client will use anonymous access. This might lead to a different level of service, depending on how the directory is configured.

Client authentication is a mechanism for the server to verify the identity of the client.

Client authentication can be performed in one of the following ways:

- By providing a DN and a password.
- Through a certificate presented by the client.

Certificate-based authentication uses the client certificate that is obtained through the SSL protocol to find a user entry for identification. In certificate-based authentication, the client sends an SASL bind request specifying an external mechanism. The bind request relies on the SSL authentication mechanism that has already been established.

- Through a SASL-based mechanism.
 - On all operating systems, SASL through DIGEST-MD5.
 - On the Solaris Operating System, SASL through the GSSAPI mechanism which allows the authentication of a client through Kerberos V5.

When using either of the two SASL mechanisms, the server must also be configured to perform identity mapping. The SASL credentials are called the *Principal*. Each mechanism must have specific mappings to determine the bind DN from the contents of the Principal. When the Principal is mapped to a single user entry and the SASL mechanism validates that user's identity, the user's DN is the bind DN for the connection.

- Through SSL client authentication mode.

Use SSL client authentication when you want all clients to be authorized at the SSL layer. The client application authenticates by sending its SSL certificate to the server. You specify whether the server allows, requires, or does not allow SSL client authentication using the `SSL-client-auth-mode` flag. By default, clients are allowed to authenticate.

This section provides the following information about configuring the two SASL mechanisms on Directory Server.

- “[Setting SASL Encryption Levels in Directory Server](#)” on page 118
- “[SASL Authentication Through DIGEST-MD5](#)” on page 120
- “[SASL Authentication Through GSSAPI \(Solaris OS Only\)](#)” on page 122

For more information about configuring security, see “[Configuring LDAP Clients to Use Security](#)” on page 125.

Setting SASL Encryption Levels in Directory Server

Before configuring the SASL mechanism, you must specify whether you require encryption or not. Requirements for SASL encryption are set by the maximum and minimum Strength Security Factor (SSF).

The attributes `dsSaslMinSSF(5dsat)` and `dsSaslMaxSSF(5dsat)` represent the encryption key length, and they are stored in `cn=SASL`, `cn=security`, `cn=config`.

The server allows any level of encryption, including no encryption. This means that Directory Server accepts `dsSaslMinSSF` and `dsSaslMaxSSF` values greater than 256. However, no SASL mechanisms currently support an SSF greater than 128. Directory Server negotiates these values down to the highest SSF possible (128). Therefore, the highest actual SSF might be less than the configured maximum, depending on the underlying mechanisms available.

SASL security factor authentication depends two main items: the minimum and maximum factors requested by the server and client applications, and the available encryption mechanisms, which are provided by the underlying security components. In summary, the server and client attempt to use the highest available security factor that is less than or equal to the maximum factors set on both, but greater than or equal to the minimum factors on both.

The default minimum SASL security factor for Directory Server, `dsSaslMinSSF`, is 0, meaning no protection. The actual minimum depends on the client setting, unless you change the minimum for Directory Server. In practice, you should set the minimum to the lowest level that you actually want the server and client to use. If the server and client fail to negotiate a mechanism that meets the minimum requirements, the connection is not established.

▼ To Require SASL Encryption

You cannot use DSCC to perform this task. Use the command line, as described in this procedure.

- To require SASL encryption, set the `dsSaslMinSSF` value to the minimum encryption required.

```
$ ldapmodify -h host -p port -D cn=admin,cn=Administrators,cn=config -w -
Enter bind password:
dn: cn=SASL, cn=security, cn=config
changetype: modify
replace: dsSaslMinSSF
dsSaslMinSSF: 128
^D
```

▼ To Disallow SASL Encryption

You cannot use DSCC to perform this task. Use the command line, as described in this procedure.

- To disallow SASL encryption, set both the `dsSaslMinSSF` and `dsSaslMaxSSF` values to zero.

```
$ ldapmodify -h host -p port -D cn=admin,cn=Administrators,cn=config -w -
Enter bind password:
dn: cn=SASL, cn=security, cn=config
changetype: modify
replace: dsSaslMinSSF
dsSaslMinSSF: 0

replace: dsSaslMaxSSF
```

```
dsSaslMaxSSF: 0
^D
```

SASL Authentication Through DIGEST-MD5

The DIGEST-MD5 mechanism authenticates clients by comparing a hashed value sent by the client with a hash of the user's password. However, because the mechanism must read user passwords, all users that want to be authenticated through DIGEST-MD5 must have {CLEAR} passwords in the directory. When storing {CLEAR} passwords in the directory, you must ensure that access to password values is properly restricted through ACIs, as described in [Chapter 6, "Directory Server Access Control."](#) In addition, you need to configure attribute encryption in the suffix, as described in ["Encrypting Attribute Values" on page 100.](#)

▼ To Configure the DIGEST-MD5 Mechanism

The following procedure explains how to configure Directory Server to use DIGEST-MD5.

You cannot use DSCC to perform this task. Use the command line, as described in this procedure.

- 1 **Use the `ldapsearch` command to verify that DIGEST-MD5 is a value of the supportedSASLMechanisms attribute on the root entry.**

For example, the following command shows which SASL mechanisms are enabled:

```
$ ldapsearch -h host -p port -D cn=admin,cn=Administrators,cn=config -w - \
-s base -b "" "(objectclass=*)" supportedSASLMechanisms
Enter bind password:
dn:
supportedSASLMechanisms: EXTERNAL
supportedSASLMechanisms: DIGEST-MD5
supportedSASLMechanisms: GSSAPI
^D
```

- 2 **If DIGEST-MD5 is not enabled, enable it.**

```
$ ldapmodify -h host -p port -D cn=admin,cn=Administrators,cn=config -w -
Enter bind password:
dn: cn=SASL, cn=security, cn=config
changetype: modify
add: dsSaslPluginsEnable
dsSaslPluginsEnable: DIGEST-MD5
-
replace: dsSaslPluginsPath
dsSaslPluginsPath: SASL-library
^D
```

where *SASL-library* is one of the following:

JES installation /usr/lib/mps/sasl2
 Zip installation install-path/dsee6/private/lib

3 Use the default identity mapping for DIGEST-MD5, or create new ones.

For information, see “[DIGEST-MD5 Identity Mappings](#)” on page 121.

4 Ensure that the password is stored in {CLEAR} for all users who will access the server through SSL using DIGEST-MD5.

See [Chapter 7, “Directory Server Password Policy,”](#) for password storage schemes.

5 If you modified the SASL configuration entry or one of the DIGEST-MD5 identity mapping entries, restart Directory Server.

DIGEST-MD5 Identity Mappings

Identity mappings for SASL mechanisms try to match the credentials of the SASL identity with a user entry in the directory. Authentication fails if the mapping cannot find a DN that corresponds to the SASL identity. See *Sun Java System Directory Server Enterprise Edition 6.2 Reference* for a complete description of this mechanism.

The SASL identity is a string called the *Principal* that represents a user in a format specific to each mechanism. In DIGEST-MD5, clients should create a Principal that contains either a dn: prefix and an LDAP DN or a u: prefix followed by any text determined by the client. During the mapping, the Principal that is sent by the client is available in the `{Principal}` placeholder.

The following entry in your server configuration is the default identity mapping for DIGEST-MD5:

```
dn: cn=default,cn=DIGEST-MD5,cn=identity mapping,cn=config
objectClass: top
objectClass: nsContainer
objectClass: dsIdentityMapping
objectClass: dsPatternMatching
cn: default
dsMatching-pattern: \${Principal}
dsMatching-regexp: dn:(.*)
dsMappedDN: \${1}
```

This identity mapping assumes that the dn field of the Principal contains the exact DN of an existing user in the directory.

▼ To Define Your Own Identity Mappings for DIGEST-MD5

You cannot use DSCC to perform this task. Use the command line, as described in this procedure.

1 Edit the default mapping entry or create new mapping entries under

`cn=DIGEST-MD5,cn=identity mapping,cn=config`.

The following command shows how this mapping would be defined:

```
$ ldapmodify -a -h host1 -p 1389 -D cn=admin,cn=Administrators,cn=config -w -
Enter bind password:
dn: cn=unqualified-username,cn=DIGEST-MD5,cn=identity mapping
cn=config
objectclass: dsIdentityMapping
objectclass: dsPatternMatching
objectclass: nsContainer
objectclass: top
cn: unqualified-username
dsMatching-pattern: \${Principal}
dsMatching-regexp: u:(.*)@(.*)\.com
dsSearchBaseDN: dc=\$2
dsSearchFilter: (uid=\$1)
```

2 Restart Directory Server for your new mappings to take effect.

SASL Authentication Through GSSAPI (Solaris OS Only)

The Generic Security Service API (GSSAPI) over SASL allows you to use a third-party security system such as Kerberos V5 to authenticate clients. The GSSAPI library is available only for the Solaris OS SPARC® platform. Sun recommends that you install the Kerberos V5 implementation on the Sun Enterprise Authentication Mechanism™ 1.0.1 server.

The server uses the GSSAPI to validate the identity of the user. Then, the SASL mechanism applies the GSSAPI mapping rules to obtain a DN that is the bind DN for all operations during this connection.

▼ To Configure the Kerberos System

Configure the Kerberos software according to the manufacturer's instructions. If you are using the Sun Enterprise Authentication Mechanism 1.0.1 server, use this procedure.

You cannot use DSCC to perform this task. Use the command line, as described in this procedure.

- 1 **Configure the files in /etc/krb5.**
- 2 **Create the Kerberos database for storing users and services.**

- 3 **In the database, create the Principal for the LDAP service.**

```
$ ldap/server-FQDN@realm
```

where *server-FQDN* is the fully qualified domain name of your Directory Server.

- 4 **Start the Kerberos daemon processes.**

Note – The DNS must be configured on the host machine.

Refer to your software documentation for detailed instructions for each of these steps. Also, see [“Example Configuration of Kerberos Authentication Using GSSAPI With SASL” on page 128.](#)

▼ **To Configure the GSSAPI Mechanism**

The following procedure explains how to configure Directory Server to use GSSAPI on the Solaris OS:

You cannot use DSCC to perform this task. Use the command line, as described in this procedure.

- 1 **Create the default identity mapping for GSSAPI and any custom mappings as described in [“GSSAPI Identity Mappings” on page 124.](#)**
- 2 **Create a keytab to store the service keys.**

Your LDAP service key is stored in the keytab.

 - a. **Ensure that the keytab is only readable by the Directory Server user.**
 - b. **Change the file name to be different from the default /etc/krb5/krb5.keytab.**
 - c. **Set the environment variable `KRB5_KTNAME` to ensure that the new keytab is used rather than the default keytab.**
- 3 **If you modified the SASL configuration entry or one of the GSSAPI identity mapping entries, restart Directory Server.**

Note that the DNS must be configured on the host machine.

GSSAPI Identity Mappings

Identity mappings for SASL mechanisms try to match credentials of the SASL identity with a user entry in the directory. Authentication fails if the mapping cannot find a DN that corresponds to the SASL identity.

The SASL identity is a string called the *Principal* that represents a user in a format specific to each mechanism. In Kerberos using GSSAPI, the Principal is an identity with the format *uid* [*/instance*] [*@realm*]. The *uid* can contain an optional *instance* identifier followed by an optional *realm* that is often a domain name. For example, the following strings are all valid user Principals:

```
bjensen
bjensen/Sales
bjensen@EXAMPLE.COM
bjensen/Sales@EXAMPLE.COM
```

Initially, no GSSAPI mappings are defined in the directory. Define a default mapping and any custom mappings that you need according to how your clients define the Principal that your clients use.

▼ To Define Identity Mappings for GSSAPI

You cannot use DSCC to perform this task. Use the command line, as described in this procedure.

1 Create new mapping entries under `cn=GSSAPI,cn=identity mapping, cn=config`.

See *Sun Java System Directory Server Enterprise Edition 6.2 Reference* for the definition of the attributes in an identity mapping entry. Examples of GSSAPI mappings are located in `instance-path/ldif/identityMapping_Examples.ldif`.

The default GSSAPI mapping in this file assumes that the Principal contains only a user ID. This mapping determines a user in a fixed branch of the directory:

```
dn: cn=default,cn=GSSAPI,cn=identity mapping,cn=config
objectclass: dsIdentityMapping
objectclass: nsContainer
objectclass: top
cn: default
dsMappedDN: uid=\${Principal},ou=people,dc=example,dc=com
```

Another example in this file shows how to determine the user ID when the user ID is contained in a Principal that includes a known realm.

```
dn: cn=same_realm,cn=GSSAPI,cn=identity mapping,cn=config
objectclass: dsIdentityMapping
objectclass: dsPatternMatching
```

```

objectclass: nsContainer
objectclass: top
cn: same_realm
dsMatching-pattern: \${Principal}
dsMatching-regexp: (.*)@EXAMPLE.COM
dsMappedDN: uid=\$1,ou=people,dc=EXAMPLE,dc=COM

```

2 Restart Directory Server for your new mappings to take effect.

Configuring LDAP Clients to Use Security

The following sections explain how to configure and use SSL in LDAP clients that want to establish secure connections with Directory Server. In an SSL connection, the server sends its certificate to the client. The client must first authenticate the server by trusting its certificate. Then, the client can optionally initiate one of the client authentication mechanisms by sending its own certificate or information for one of the two SASL mechanism. The SASL mechanisms are DIGEST-MD5 and GSSAPI using Kerberos V5.

The following sections use the `ldapsearch` tool as an example of an SSL-enabled LDAP client.

To configure SSL connections on other LDAP clients, refer to the documentation provided with your application.

Note – Some client applications implement SSL but do not verify that the server has a trusted certificate. These client applications use the SSL protocol to provide data encryption but cannot guarantee confidentiality nor protect against impersonation.

The following sections explain how to configure LDAP clients to use security:

Using SASL DIGEST-MD5 in Clients

When using the DIGEST-MD5 mechanism in clients, you do not need to install a user certificate. However, if you want to use encrypted SSL connections, you must still trust the server certificate as described in [“Managing Certificates” on page 107](#).

Specifying a Realm

A *realm* defines the namespace from which the authentication identity is selected. In DIGEST-MD5 authentication, you must authenticate to a specific realm.

Directory Server uses the fully qualified host name of the machine as the default realm for DIGEST-MD5. The server uses the lowercase value of the host name that is found in the `nsslapd-localhost` configuration attribute.

If you do not specify a realm, the default realm offered by the server is used.

Specifying Environment Variables

In the UNIX environment, you must set the `SASL_PATH` environment variable so that the LDAP tools can find the DIGEST-MD5 libraries. The DIGEST-MD5 library is a shared library that is dynamically loaded by the SASL plug-in. Set the `SASL_PATH` environment variable as follows:

```
export SASL_PATH=SASL-library
```

This path assumes that Directory Server is installed on the same host where the LDAP tools are invoked.

Examples of the `ldapsearch` Command

You can perform DIGEST-MD5 client authentication without using SSL. The following example uses the default DIGEST-MD5 identity mapping to determine the bind DN:

```
$ ldapsearch -h host1 -p 1389 \  
-o mech=DIGEST-MD5 [ \  
-o realm="example.com" ] \  
-o authid="dn:uid=bjensen,dc=example,dc=com" \  
-w - \  
-o authzid="dn:uid=bjensen,dc=example,dc=com" \  
-o secProp="minssf=56,maxssf=256,noplain" \  
-b "dc=example,dc=com" "(givenname=Richard)"
```

The preceding example shows the use of the `-o` (lowercase letter o) option to specify SASL options. The `realm` is optional, but if specified, it must be the fully qualified domain name of the server host machine. The `authid` and `authzid` must both be present and identical, although the `authzid` intended for proxy operations is not used. The `-w` password option applies to the `authid`.

The value of `authid` is the Principal used in identity mapping. The `authid` should contain either the `dn:` prefix followed by a valid user DN in the directory, or the `u:` prefix followed by any string determined by the client. This use of `authid` allows you to use the mappings that are shown in [“DIGEST-MD5 Identity Mappings” on page 121](#).

The most common configuration is for an SSL connection to provide encryption over the LDAPS secure port and DIGEST-MD5 to provide the client authentication. The following example performs the same operation over SSL:

```
$ ldapsearch -h host1 -P 1636 \
-Z -P .mozilla/bjensen/BJE6001.slt/cert8.db \
-N "cert-example" -w - \
-o mech=DIGEST-MD5 [-o realm="example.com"] \
-o authid="dn:uid=bjensen,dc=example,dc=com" \
-o authzid="dn:uid=bjensen,dc=example,dc=com" \
-o secProp="minssf=0,maxssf=0,noplain" \
-b "dc=example,dc=com" "(givenname=Richard)"
```

In this example, the `-N` and `-w` options are required by the `ldapsearch` command, as the operation is performed over SSL. However, these options are not used for client authentication. Instead, the server performs another DIGEST-MD5 identity mapping of the Principal in the `authid` value.

Using Kerberos SASL GSSAPI in Clients

When using the GSSAPI mechanism in clients, you do not need to install a user certificate, but you must configure the Kerberos V5 security system. Also, if you want to use encrypted SSL connections, you must trust the server certificate as described in [“Managing Certificates” on page 107](#).

▼ To Configure Kerberos V5 on a Host

You must configure Kerberos V5 on the host machine where your LDAP clients will run.

You cannot use DSCC to perform this task. Use the command line, as described in this procedure.

1 Install Kerberos V5 according to its installation instructions.

Sun recommends installing the Sun Enterprise Authentication Mechanism 1.0.1 client software.

2 Configure the Kerberos software.

Using the Sun Enterprise Authentication Mechanism software, configure the files under `/etc/krb5`. This configuration sets up the `kdc` server, and defines the default realm and any other configuration required by your Kerberos system.

3 If necessary, modify the file `/etc/gss/mech` so that the first value that is listed is `kerberos_v5`.

▼ To Specify SASL Options for Kerberos Authentication

You cannot use DSCC to perform this task. Use the command line, as described in this procedure.

- 1 **Before using a client application that is enabled with the GSSAPI mechanism, initialize the Kerberos security system with your user Principal.**

```
$ kinit user-principal
```

where the *user-principal* is your SASL identity, for example, `bjensen@example.com`.

- 2 **Specify SASL options for using Kerberos.**

Note that in the UNIX environment, you must set the `SASL_PATH` environment variable to the correct path for the SASL libraries. For example in the Korn shell:

```
$ export SASL_PATH=SASL-library
```

This path assumes that Directory Server is installed on the same host where the LDAP tools are invoked.

The following example of the `ldapsearch` tool shows the use of the `-o` (lowercase letter o) option to specify SASL options for using Kerberos:

```
$ ldapsearch -h www.host1.com -p 1389 -o mech=GSSAPI -o authid="bjensen@EXAMPLE.COM" \
-o authzid="bjensen@EXAMPLE.COM" -b "dc=example,dc=com" "(givenname=Richard)"
```

The `authid` can be omitted because it is present in the Kerberos cache that was initialized by the `kinit` command. If `authid` is present, `authid` and `authzid` must be identical, although the `authzid` intended for proxy operations is not used. The value of `authid` is the Principal that is used in identity mapping. The Principal must be the full Principal, including the realm. See [“GSSAPI Identity Mappings” on page 124](#).

Example Configuration of Kerberos Authentication Using GSSAPI With SASL

Configuring Kerberos for Directory Server can be complicated. Your first point of reference should be the Kerberos documentation.

For more help, use the following example procedure to get an idea of which steps to follow. Be aware, however, that this procedure is an example. You must modify the procedure to suit your own configuration and your own environment.

Additional information about configuring and using Kerberos in the Solaris OS can be found in *System Administration Guide: Security Services*. This guide is a part of the Solaris documentation set. You can also consult the man pages.

Information about this example and the steps used are as follows:

1. [“Assumptions for This Example” on page 129](#)
2. [“All Machines: Edit the Kerberos Client Configuration File” on page 130](#)
3. [“All Machines: Edit the Administration Server ACL Configuration File” on page 131](#)
4. [“KDC Machine: Edit the KDC Server Configuration File” on page 132](#)

5. “KDC Machine: Create the KDC Database” on page 132
6. “KDC Machine: Create an Administration Principal and Keytab” on page 132
7. “KDC Machine: Start the Kerberos Daemons” on page 133
8. “KDC Machine: Add Host Principals for the KDC and Directory Server Machines” on page 133
9. “KDC Machine: Add an LDAP Principal for the Directory Server” on page 134
10. “KDC Machine: Add a Test User to the KDC” on page 134
11. “Directory Server Machine: Install the Directory Server” on page 135
12. “Directory Server Machine: Configure the Directory Server to Enable GSSAPI” on page 135
13. “Directory Server Machine: Create a Directory Server Keytab” on page 136
14. “Directory Server Machine: Add a Test User to the Directory Server” on page 137
15. “Directory Server Machine: Get a Kerberos Ticket as the Test User” on page 137
16. “Client Machine: Authenticate to the Directory Server Through GSSAPI” on page 138

Assumptions for This Example

This example procedure describes the process of configuring one machine to operate as a Key Distribution Center (KDC), and a second machine to run a Directory Server. The result of this procedure is that users can perform Kerberos authentication through GSSAPI.

It is possible to run both the KDC and the Directory Server on the same machine. If you choose to run both on the same machine, use the same procedure, but omit the steps for the Directory Server machine that have already been done for the KDC machine.

This procedure makes a number of assumptions about the environment that is used. When using the example procedure, modify the values accordingly to suit your environment. These assumptions are:

- This system has a fresh installation of the Solaris 9 software with the latest recommended patch cluster installed. Kerberos authentication to the Directory Server can fail if the appropriate Solaris patches are not installed.
Note that although the documented procedure is largely the same for Solaris 10, there are some differences. The configuration file format is slightly different, and the output of some of the commands might not be the same.
- The machine that is running the Kerberos daemons has the fully qualified domain name of `kdc.example.com`. The machine must be configured to use DNS as a naming service. This configuration is a requirement of Kerberos. Certain operations might fail if other naming services such as `file` are used instead.
- The machine that is running Directory Server has the fully qualified domain name of `directory.example.com`. This machine must also be configured to use DNS as a naming service.

- The Directory Server machine serves as the client system for authenticating to the Directory Server through Kerberos. This authentication can be performed from any system that can communicate with both the Directory Server and Kerberos daemons. However, all of the necessary components for this example are provided with the Directory Server, and the authentication is performed from that system.
- Users in the Directory Server have DN's of the form `uid=username,ou=People,dc=example,dc=com`. The corresponding Kerberos principal is `username@EXAMPLE.COM`. If a different naming scheme is used, a different GSSAPI identity mapping must be used.

All Machines: Edit the Kerberos Client Configuration File

The `/etc/krb5/krb5.conf` configuration file provides information that Kerberos clients require in order to communicate with the KDC.

Edit the `/etc/krb5/krb5.conf` configuration file on the KDC machine, the Directory Server machine, and any client machines that will authenticate to the Directory Server using Kerberos.

- Replace every occurrence of `___default_realm___` with `EXAMPLE.COM`.
- Replace every occurrence of `___master_kdc___` with `kdc.example.com`.
- Remove the line that contains `___slave_kdcs___` as there will be only a single Kerberos server.
- Replace `___domain_mapping___` with `.example.com = EXAMPLE.COM` (note the initial period in `.example.com`).

The updated `/etc/krb5/krb5.conf` configuration file should look like the contents of the following example.

EXAMPLE 5-1 Edited Kerberos Client Configuration File `/etc/krb5/krb5.conf`

```
#pragma ident "@(#)krb5.conf 1.2 99/07/20 SMI"
# Copyright (c) 1999, by Sun Microsystems, Inc.
# All rights reserved.
#
# krb5.conf template
# In order to complete this configuration file
# you will need to replace the __<name>__ placeholders
# with appropriate values for your network.
#

[libdefaults]
    default_realm = EXAMPLE.COM

[realms]
    EXAMPLE.COM = {
        kdc = kdc.example.com
```

EXAMPLE 5-1 Edited Kerberos Client Configuration File `/etc/krb5/krb5.conf` (Continued)

```

        admin_server = kdc.example.com
    }
[domain_realm]
    .example.com = EXAMPLE.COM
[logging]
    default = FILE:/var/krb5/kdc.log
    kdc = FILE:/var/krb5/kdc.log
    kdc_rotate = {

# How often to rotate kdc.log. Logs will get rotated no more
# often than the period, and less often if the KDC is not used
# frequently.
        period = 1d

# how many versions of kdc.log to keep around (kdc.log.0, kdc.log.1, ...)
        versions = 10
    }

[appdefaults]
    kinit = {
        renewable = true
        forwardable = true
    }
    gkadmin = {
        help_url =
http://docs.sun.com:80/ab2/coll.384.1/SEAM/@AB2PageView/1195
    }

```

All Machines: Edit the Administration Server ACL Configuration File

Replace "`___default_realm___`" with "EXAMPLE.COM" in the `/etc/krb5/kadm5.acl` configuration file. The updated file should look like the following example.

EXAMPLE 5-2 Edited Administration Server ACL Configuration File

```

#
# Copyright (c) 1998-2000 by Sun Microsystems, Inc.
# All rights reserved.
#
# pragma ident    "@(#)kadm5.acl  1.1    01/03/19 SMI"
*/admin@EXAMPLE.COM *

```

KDC Machine: Edit the KDC Server Configuration File

Edit the `/etc/krb5/kdc.conf` file to replace `"__default_realm__"` with `"EXAMPLE.COM"`. The updated file should look like the following example.

EXAMPLE 5-3 Edited KDC Server Configuration File `/etc/krb5/kdc.conf`

```
# Copyright 1998-2002 Sun Microsystems, Inc. All rights reserved.
# Use is subject to license terms.
#
#ident "@(#)kdc.conf 1.2 02/02/14 SMI"

[kdcdefaults]
    kdc_ports = 88,750

[realms]
    EXAMPLE.COM = {
        profile = /etc/krb5/krb5.conf
        database_name = /var/krb5/principal
        admin_keytab = /etc/krb5/kadm5.keytab
        acl_file = /etc/krb5/kadm5.acl
        kadmind_port = 749
        max_life = 8h 0m 0s
        max_renewable_life = 7d 0h 0m 0s
        default_principal_flags = +preauth
    }
```

KDC Machine: Create the KDC Database

```
$ /usr/sbin/kdb5_util create -r EXAMPLE.COM -s
Initializing database '/var/krb5/principal' for realm 'EXAMPLE.COM',
master key name 'K/M@EXAMPLE.COM'
You will be prompted for the database Master Password.
It is important that you NOT FORGET this password.
Enter KDC database master key: password
Re-enter KDC database master key to verify: password
$
```

KDC Machine: Create an Administration Principal and Keytab

Use the following command to create an administration user with a Principal of `kws/admin@EXAMPLE.COM` and service keys that will be used by the administration daemon.

```
$ /usr/sbin/kadmin.local
kadmin.local: add_principal kws/admin
Enter password for principal "kws/admin@EXAMPLE.COM": secret
Re-enter password for principal "kws/admin@EXAMPLE.COM": secret
```

```
Principal "kws/admin@EXAMPLE.COM" created.
kadmin.local: ktadd -k /etc/krb5/kadm5.keytab kadmin/kdc.example.com
Entry for principal kadmin/kdc.example.com with kvno 3, encryption type
DES-CBC-CRC added to keytab WRFILE:/etc/krb5/kadm5.keytab.
kadmin.local: ktadd -k /etc/krb5/kadm5.keytab changepw/kdc.example.com

Entry for principal changepw/kdc.example.com with kvno 3, encryption type
DES-CBC-CRC added to keytab WRFILE:/etc/krb5/kadm5.keytab.
kadmin.local: ktadd -k /etc/krb5/kadm5.keytab kadmin/changepw
Entry for principal kadmin/changepw with kvno 3, encryption type
DES-CBC-CRC added to keytab WRFILE:/etc/krb5/kadm5.keytab.
kadmin.local: quit$
```

KDC Machine: Start the Kerberos Daemons

Run the following commands to start the KDC and administration daemons:

```
$ /etc/init.d/kdc start
$ /etc/init.d/kdc.master start
$
```

The KDC process will appear in the process list as `/usr/lib/krb5/krb5kdc`. The administration daemon will appear as `/usr/lib/krb5/kadmind`.

Note that in the Solaris 10 OS, the daemons are managed by the Service Management Facility (SMF) framework. Start the daemons on the Solaris 10 OS:

```
$ svcadm disable network/security/krb5kdc
$ svcadm enable network/security/krb5kdc
$ svcadm disable network/security/kadmin
$ svcadm enable network/security/kadmin
$
```

KDC Machine: Add Host Principals for the KDC and Directory Server Machines

Use the following sequence of commands to add host Principals to the Kerberos database for the KDC and Directory Server machines. The host Principal is used by certain Kerberos utilities such as `klist`.

```
$ /usr/sbin/kadmin -p kws/admin
Enter Password: secret
kadmin: add_principal -randkey host/kdc.example.com
Principal "host/kdc.example.com@EXAMPLE.COM" created.
kadmin: ktadd host/kdc.example.com
Entry for principal host/kdc.example.com with kvno 3, encryption type
DES-CBC-CRC added to keytab WRFILE:/etc/krb5/krb5.keytab.
```

```
kadmin: add_principal -randkey host/directory.example.com
Principal "host/directory.example.com@EXAMPLE.COM" created.
kadmin: ktadd host/directory.example.com
Entry for principal host/directory.example.com with kvno 3, encryption type
DES-CBC-CRC added to keytab WRFILE:/etc/krb5/krb5.keytab.
kadmin: quit
$
```

KDC Machine: Add an LDAP Principal for the Directory Server

For the Directory Server to be able to validate the Kerberos tickets that are held by authenticating users, the Directory Server must have its own Principal. Currently, the Directory Server is hard coded to require a Principal of `ldap/fqdn@realm` where *fqdn* is the fully-qualified domain name of the Directory Server and *realm* is the Kerberos realm. The *fqdn* must match the fully qualified name provided when installing the Directory Server. In this case, the Principal for the Directory Server would be `ldap/directory.example.com@EXAMPLE.COM`.

Use the following sequence of commands to create an LDAP Principal for the Directory Server:

```
$ /usr/sbin/kadmin -p kws/admin
Enter Password: secret
kadmin: add_principal -randkey ldap/directory.example.com
Principal "ldap/directory.example.com@EXAMPLE.COM" created.
kadmin: quit
$
```

KDC Machine: Add a Test User to the KDC

To perform Kerberos authentication, the user authenticating must exist in the Kerberos database. In this example, the user has the user name `kerberos-test`, which means that the Kerberos Principal is `kerberos-test@EXAMPLE.COM`.

Create the user by using the command sequence in this example:

```
$ /usr/sbin/kadmin -p kws/admin
Enter Password: secret
kadmin: add_principal kerberos-test
Enter password for principal "kerberos-test@EXAMPLE.COM": secret

Re-enter password for principal "kerberos-test@EXAMPLE.COM": secret

Principal "kerberos-test@EXAMPLE.COM" created.
kadmin: quit
$
```

Directory Server Machine: Install the Directory Server

Install Directory Server 6.0 and the latest patches. Following are example settings.

Variable Type	Example Value
Fully qualified computer name	directory.example.com
Installation directory	/opt/SUNWdsee
Instance path	/local/ds
Server user	unixuser
Server group	unixgroup
Server port	389
Suffix	dc=example,dc=com

Directory Server Machine: Configure the Directory Server to Enable GSSAPI

First, create the file `/data/ds/shared/bin/gssapi.ldif` to define the mapping that should be used by the Directory Server, and to identify which Kerberos user is authenticating, based on the Principal. Create the file contents to be the same as what is shown in the following example.

EXAMPLE 5-4 gssapi.ldif File Contents

```
dn: cn=GSSAPI,cn=identity mapping,cn=config
changetype: add
objectClass: top
objectClass: nsContainer
cn: GSSAPI
dn: cn=default,cn=GSSAPI,cn=identity mapping,cn=config
changetype: add
objectClass: top
objectClass: nsContainer
objectClass: dsIdentityMapping
objectClass: dsPatternMatching
cn: default
dsMatching-pattern: \${Principal}
dsMatching-regexp: (.*)@EXAMPLE.COM
dsMappedDN: uid=\$1,ou=People,dc=example,dc=com

dn: cn=SASL,cn=security,cn=config
changetype: modify
replace: dsSaslPluginsPath
dsSaslPluginsPath: /usr/lib/mps/sasl2/libsasl.so
```

Next, use the `ldapmodify` command to update the Directory Server to enable GSSAPI with the appropriate mappings, as shown in the following example:

```
$ ldapmodify -D cn=admin,cn=Administrators,cn=config -w - -a -f /data/ds/shared/bin/gssapi.ldif
adding new entry cn=GSSAPI,cn=identity mapping,cn=config
adding new entry cn=default,cn=GSSAPI,cn=identity mapping,cn=config
modifying entry cn=SASL,cn=security,cn=config
$
```

Directory Server Machine: Create a Directory Server Keytab

As mentioned previously, to authenticate Kerberos users through GSSAPI, the Directory Server must have its own Principal in the KDC. For authentication to work properly, the Principal information must reside in a Kerberos keytab on the Directory Server machine. This information must be in a file that is readable by the user account under which the Directory Server operates.

Create a keytab file with the correct properties by using the following command sequence:

```
$ /usr/sbin/kadmin -p kws/admin
Enter Password: secret
kadmin: ktadd -k //local/ds/config/ldap.keytab ldap/directory.example.com
Entry for principal ldap/directory.example.com with kvno 3, encryption type
  DES-CBC-CRC added to keytab
  WRFILE:/local/ds/config/ldap.keytab.
kadmin: quit
$
```

Change the permissions and ownership on this custom keytab. Make the keytab owned by the user account used to run Directory Server and readable only by that user:

```
$ chown unixuser:unixgroup /local/ds/config/ldap.keytab
$ chmod 600 /local/ds/config/ldap.keytab
$
```

By default, the Directory Server tries to use the standard Kerberos keytab in the file `/etc/kerb5/krb5.keytab`. However, making this file readable by the Directory Server user could constitute a security risk, which is why a custom keytab was created for the Directory Server.

Configure the Directory Server to use the new custom keytab. Do this by setting the `KRB5_KTNAME` environment variable.

Finally, restart the Directory Server to allow these changes to take effect:

```
$ KRB5_KTNAME=/etc/kerb5/ldap.keytab dsadm restart /local/ds
```


Directory Server Machine: Add a Test User to the Directory Server

To authenticate a Kerberos user to the Directory Server, there must be a directory entry for the user that corresponds to the Kerberos Principal for that user.

In a previous step, a test user was added to the Kerberos database with a Principal of `kerberos-test@EXAMPLE.COM`. Because of the identity mapping configuration added to the directory, the corresponding directory entry for that user must have a DN of `uid=kerberos-test,ou=People,dc=example,dc=com`.

Before you can add the user to the directory, you must create the file `testuser.ldif` with the following contents.

EXAMPLE 5-5 New `testuser.ldif` File

```
dn: uid=kerberos-test,ou=People,dc=example,dc=com
changetype: add
objectClass: top
objectClass: person
objectClass: organizationalPerson
objectClass: inetOrgPerson
uid: kerberos-test
givenName: Kerberos
sn: Test
cn: Kerberos Test
description: An account for testing Kerberos authentication through GSSAPI
```

Next, use `ldapmodify` to add this entry to the server:

```
$ ldapmodify -D cn=admin,cn=Administrators,cn=config -w - -f testuser.ldif
adding new entry uid=kerberos-test,ou=People,dc=example,dc=com
$
```

Directory Server Machine: Get a Kerberos Ticket as the Test User

The test user exists in the Kerberos database and Directory Server and the KDC. Therefore, it is now possible to authenticate as the test user to the Directory Server over Kerberos through GSSAPI.

First, use the `kinit` command to get a Kerberos ticket for the user, as shown in the following example:

```
$ kinit kerberos-test
Password for kerberos-test@EXAMPLE.COM: secret
$
```

Then, use the `klist` command to view information about this ticket:

```

$ klist
Ticket cache: /tmp/krb5cc_0
Default principal: kerberos-test@EXAMPLE.COM

Valid starting          Expires                Service principal
Sat Jul 24 00:24:15 2004  Sat Jul 24 08:24:15 2004  krbtgt/EXAMPLE.COM@EXAMPLE.COM
        renew until Sat Jul 31 00:24:15 2004

$

```

Client Machine: Authenticate to the Directory Server Through GSSAPI

The final step is to authenticate to the Directory Server by using GSSAPI. The `ldapsearch` utility provided with the Directory Server provides support for SASL authentication, including GSSAPI, DIGEST-MD5, and EXTERNAL mechanisms. However, to bind by using GSSAPI you must provide the client with the path to the SASL library. Provide the path by setting the `SASL_PATH` environment variable to the `lib/sasl` directory:

```

$ SASL_PATH=SASL-library
$ export SASL_PATH
$

```

To actually perform a Kerberos-based authentication to the Directory Server using `ldapsearch`, you must include the `-o mech=GSSAPI` and `-o authzid=principal` arguments.

You must also specify the fully qualified host name, shown here as `-h directory.example.com`, which must match the value of the `nslapd-localhost` attribute on `cn=config` for the server. This use of the `-h` option is needed because the GSSAPI authentication process requires the host name provided by the client to match the host name provided by the server.

The following example retrieves the `dc=example,dc=com` entry while authenticated as the Kerberos test user account created previously:

```

$ ldapsearch -h directory.example.com -p 389 -o mech=GSSAPI \
  -o authzid="kerberos-test@EXAMPLE.COM" -b "dc=example,dc=com" -s base "(objectClass=*)"
version: 1
dn: dc=example,dc=com
dc: example
objectClass: top
objectClass: domain
$

```

Check the Directory Server access log to confirm that the authentication was processed as expected:

```

$ tail -12 /local/ds/logs/access

[24/Jul/2004:00:30:47 -0500] conn=0 op=-1 msgId=-1 - fd=23 slot=23 LDAP

```

```

        connection from 1.1.1.8 to 1.1.1.8
[24/Jul/2004:00:30:47 -0500] conn=0 op=0 msgId=1 - BIND dn="" method=sasl
        version=3 mech=GSSAPI
[24/Jul/2004:00:30:47 -0500] conn=0 op=0 msgId=1 - RESULT err=14 tag=97
        nentries=0 etime=0, SASL bind in progress
[24/Jul/2004:00:30:47 -0500] conn=0 op=1 msgId=2 - BIND dn="" method=sasl
        version=3 mech=GSSAPI
[24/Jul/2004:00:30:47 -0500] conn=0 op=1 msgId=2 - RESULT err=14 tag=97
        nentries=0 etime=0, SASL bind in progress
[24/Jul/2004:00:30:47 -0500] conn=0 op=2 msgId=3 - BIND dn="" method=sasl
        version=3 mech=GSSAPI
[24/Jul/2004:00:30:47 -0500] conn=0 op=2 msgId=3 - RESULT err=0 tag=97
        nentries=0 etime=0 dn="uid=kerberos-test,ou=people,dc=example,dc=com"
[24/Jul/2004:00:30:47 -0500] conn=0 op=3 msgId=4 - SRCH base="dc=example,dc=com"
        scope=0 filter="(objectClass=*)" attrs=ALL
[24/Jul/2004:00:30:47 -0500] conn=0 op=3 msgId=4 - RESULT err=0 tag=101 nentries=1
        etime=0
[24/Jul/2004:00:30:47 -0500] conn=0 op=4 msgId=5 - UNBIND
[24/Jul/2004:00:30:47 -0500] conn=0 op=4 msgId=-1 - closing - U1
[24/Jul/2004:00:30:48 -0500] conn=0 op=-1 msgId=-1 - closed.
$

```

This example shows that the bind is a three-step process. The first two steps return LDAP result 14 (SASL bind in progress), and the third step shows that the bind was successful. The `method=sasl` and `mech=GSSAPI` tags show that the bind used the GSSAPI SASL mechanism. The `dn="uid=kerberos-test,ou=people,dc=example,dc=com"` at the end of the successful bind response shows that the bind was performed as the appropriate user.

Pass-Through Authentication

Pass-through authentication (PTA) is a mechanism by which bind requests are filtered by bind DN. One Directory Server (the delegator) receives the bind request and, based on the filter, can consult another Directory Server (the delegate) to authenticate bind requests. As part of this functionality, the PTA plug-in enables the delegator Directory Server to accept simple password-based bind operations for entries that are not necessarily stored in its local database.

The PTA plug-in is also used by DSCC for private communication with the server. When a server instance is registered in DSCC, the PTA plug-in is enabled and the DSCC URL is added as an argument.

```

$ dsconf get-plugin-prop -h host -p port "Pass Through Authentication" enabled argument
argument : ldap://DSCC_URL:DSCC_PORT/cn=dsc
enabled  : on

```

Note – If possible, avoid modifying the PTA plug-in for your own use. Modifications to the PTA plug-in can cause access problems for DSCC.

If you cannot avoid modifying the PTA plug-in, you must do the following:

- Keep the enabled property on.
- Keep the DSCC URL in the argument, although you can add other values to the argument property.

If the PTA plug-in is disabled or the DSCC URL is removed from the argument, the server instance will appear as inaccessible in DSCC. If this happens, DSCC will automatically give you the option of resetting the PTA plug-in.

Directory Server Access Control

The control of access to your directory is an integral part of creating a secure directory. This chapter describes access control instructions (ACIs) that determine which permissions are granted to users who access the directory.

While you are in the planning phase of your directory deployment, define an access control strategy that serves your overall security policy. See the *Sun Java System Directory Server Enterprise Edition 6.2 Deployment Planning Guide* for tips on planning an access control strategy.

For additional information about ACIs, including ACI syntax and bind rules, see *Sun Java System Directory Server Enterprise Edition 6.2 Reference*.

This chapter covers the following topics:

- “Creating, Viewing, and Modifying ACIs” on page 141
- “Access Control Usage Examples” on page 143
- “Viewing Effective Rights” on page 156
- “Advanced Access Control: Using Macro ACIs” on page 160
- “Logging Access Control Information” on page 166
- “Client-Host Access Control Through TCP Wrapping” on page 167

Creating, Viewing, and Modifying ACIs

You can create ACIs either by using Directory Service Control Center (DSCC) or by using the command line. Whichever method you choose, it is often easier to view and copy an existing ACI value, rather than to create a new ACI from scratch.

You can view and modify the `aci` attribute values in DSCC. For information about how to modify ACIs through DSCC, see the DSCC online help.

▼ To Create, Modify, and Delete ACIs

To create ACIs by using the command line, you first create the ACIs in a file using LDIF statements. Then you add the ACIs to your directory tree by using the `ldapmodify` command.

You can use DSCC to perform this task. For information, see [“Directory Service Control Center Interface” on page 43](#) and the DSCC online help.

1 Create the ACI in an LDIF file.

```
dn: dc=example,dc=com
changetype: modify
add: aci
aci: (target)(version 3.0; acl "name";permission bindrules;)
```

This example shows how to add an ACI. To modify or delete the ACI, replace `add` with `replace` or `delete`.

For more examples of ACIs that are commonly used, see [“Access Control Usage Examples” on page 143](#).

2 Make the change using the LDIF file.

```
$ ldapmodify -h host -p port -D cn=admin,cn=Administrators,cn=config -w - -f ldif-file
```

▼ To View ACI Attribute Values

ACIs are stored as one or more values of the `aci` attribute of an entry. The `aci` attribute is a multi-valued operational attribute that can be read and modified by directory users. Therefore, the ACI attribute itself should be protected by ACIs. Administration users are usually given full access to the `aci` attribute.

You can use DSCC to perform this task. For information, see [“Directory Service Control Center Interface” on page 43](#) and the DSCC online help.

● View the ACI attribute value of an entry by running the following `ldapsearch` command:

```
$ ldapsearch -h host -p port -D cn=admin,cn=Administrators,cn=config -w - \
  -b entryDN -s base "(objectclass=*)" aci
```

The result is LDIF text that you can copy to your new LDIF ACI definition for editing. Because the value of an ACI is a long string, the output from the `ldapsearch` operation is likely to be displayed over several lines. In addition, the first space is a continuation marker. If you want the LDIF output to not contain a continuation marker, use the `-T` option. Take the output format into account when copying and pasting the LDIF output.

Note – To view the permissions that an aci value grants and denies, see [“Viewing Effective Rights” on page 156](#).

▼ To View ACIs at the Root Level

When you create a suffix, some default ACIs are created at the top or root level. These ACIs allow the default administration user `cn=admin`, `cn=Administrators`, `cn=config` to have the same access rights to directory data as the Directory Manager.

You can use DSCC to perform this task. For information, see [“Directory Service Control Center Interface” on page 43](#) and the DSCC online help.

- **View the default root level ACIs.**

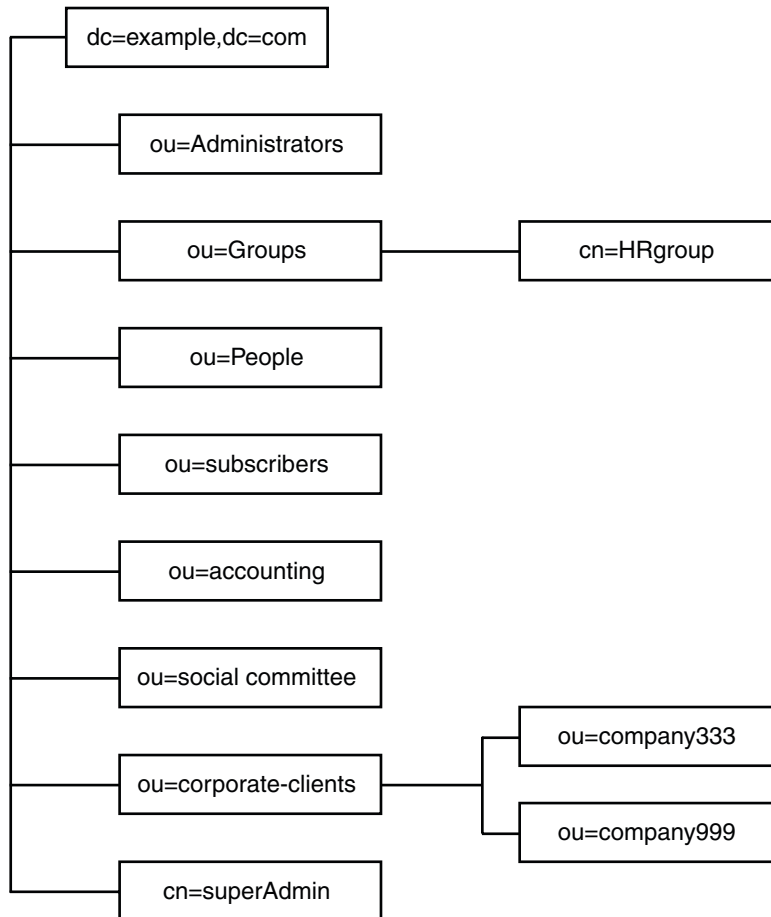
```
$ ldapsearch -h host -p port -D cn=admin,cn=Administrators,cn=config -w - \
-b "" -s base "(objectclass=*)" aci
```

Access Control Usage Examples

The examples in this section illustrate how an imaginary ISP company, Example.com, would implement its access control policy.

In addition, you can find ACI examples in the example LDIF file provided with your installation, `install_path/ds6/ldif/Example.ldif`.

All of the examples explain how to perform a given task by using an LDIF file. The following figure shows the example.com Directory Information Tree in graphical form.



Example.com offers a web hosting service and internet access. Part of Example.com's web-hosting service is to host the directories of client companies. Example.com actually hosts and partially manages the directories of two medium-sized companies, Company333 and Company999. Example.com also provides internet access to a number of individual subscribers.

Example.com wants to put the following access rules in place:

- Grant anonymous read, search, and compare access to the entire Example.com tree for Example.com employees. See [“Granting Anonymous Access” on page 145](#).
- Grant write access to Example.com employees for personal information, such as homeTelephoneNumber, and homeAddress. See [“Granting Write Access to Personal Entries” on page 146](#).

- Grant Example.com subscribers the right to read the entry `dc=example,dc=com` for company contact information, but not to read any entries below it. See [“Granting Access to a Certain Level”](#) on page 147.
- Grant Example.com employees the right to add any role to their entry, except certain critical roles. See [“Restricting Access to Key Roles”](#) on page 148.
- Grant certain administrators the same rights as the Directory Manager for a suffix. See [“Granting a Role Full Access to an Entire Suffix”](#) on page 149.
- Grant the Example.com Human Resources group all rights on the entries in the People branch. See [“Granting a Group Full Access to a Suffix”](#) on page 149.
- Grant all Example.com employees the right to create group entries under the Social Committee branch of the directory, and to delete group entries that an employee owns. See [“Granting Rights to Add and Delete Group Entries”](#) on page 150.
- Grant all Example.com employees the right to add themselves to group entries under the Social Committee branch of the directory. See [“Allowing Users to Add or Remove Themselves From a Group”](#) on page 151.
- Grant access to the directory administrator (role) of Company333 and Company999 on their respective branches of the directory tree, with certain conditions. These conditions include SSL authentication, time and date restrictions, and specified location. See [“Granting Conditional Access to a Group or Role”](#) on page 152.
- Grant individual subscribers access to their own entries. See [“Granting Write Access to Personal Entries”](#) on page 146.
- Deny individual subscribers access to the billing information in their own entries. See [“Denying Access”](#) on page 153.
- Grant anonymous access to the world to the individual subscribers subtree, except for subscribers who have specifically requested to be unlisted. If desired, this part of the directory could be a read-only server outside of the firewall, and be updated once a day. See [“Granting Anonymous Access”](#) on page 145 and [“Setting a Target Using Filtering”](#) on page 155.

Granting Anonymous Access

Most directories are configured to enable you to anonymously access at least one suffix for read, search, or compare. You might want to set these permissions if you are running a corporate personnel directory, such as a phone book that you want employees to be able to search. This is the case at Example.com internally, as shown in [“ACI “Anonymous Example.com””](#) on page 146.

As an ISP, Example.com also wants to advertise the contact information of all of its subscribers by creating a public phone book that is accessible to the world. This is depicted in [“ACI “Anonymous World””](#) on page 146.

ACI “Anonymous Example.com”

In LDIF, to grant read, search, and compare permissions to the entire Example.com tree to Example.com employees, you would write the following statement:

```
aci: (targetattr !="userPassword")(version 3.0; acl "Anonymous
example"; allow (read, search, compare)
userdn= "ldap:///anyone" );)
```

This example assumes that the aci is added to the dc=example,dc=com entry. Note that the userPassword attribute is excluded from the scope of the ACI.

Note – Protect attributes that are confidential and attributes that should not be visible using the same syntax used in the example to protect the password attribute, (targetattr !="attribute-name").

ACI “Anonymous World”

In LDIF, to grant read and search access of the individual subscribers subtree to the world, while denying access to information on subscribers who want to be unlisted, you could write the following statement:

```
aci: (targetfilter= "(!(unlistedSubscriber=yes))")
(targetattr="homePostalAddress || homePhone || mail")
(version 3.0; acl "Anonymous World"; allow (read, search)
userdn="ldap:///anyone";)
```

This example assumes that the ACI is added to the ou=subscribers,dc=example,dc=com entry. The example also assumes that every subscriber entry has an unlistedSubscriber attribute that is set to yes or no. The target definition filters out the unlisted subscribers based on the value of this attribute. For details on the filter definition, refer to [“Setting a Target Using Filtering” on page 155](#).

Granting Write Access to Personal Entries

Many directory administrators want to allow internal users to change some but not all of the attributes in their own entry. The directory administrators at Example.com want to allow users to change their own password, home telephone number, and home address, but nothing else. This is depicted in [“ACI “Write Example.com”” on page 147](#).

Example.com also has a policy to let their subscribers update their own personal information in the Example.com tree provided that the subscribers establish an SSL connection to the directory. This is depicted in [“ACI “Write Subscribers”” on page 147](#).

ACI "Write Example.com"

Note – By setting this permission, you are also granting users the right to delete attribute values.

In LDIF, to grant Example.com employees the right to update their home telephone number and home address, you would write the following statement:

```
aci: (targetattr="homePhone ||
homePostalAddress")(version 3.0; acl "Write Example.com";
allow (write) userdn="ldap:///self" ;)
```

This example assumes that the ACI is added to the `ou=People,dc=example,dc=com` entry.

ACI "Write Subscribers"

Note – By setting this permission, you are also granting users the right to delete attribute values.

In LDIF, to grant Example.com subscribers the right to update their home telephone number, you would write the following statement:

```
aci: (targetattr="homePhone")
(version 3.0; acl "Write Subscribers"; allow (write)
userdn= "ldap://self" and authmethod="ssl";)
```

This example assumes that the `aci` is added to the `ou=subscribers,dc=example,dc=com` entry, and that users must bind using SSL.

Note that Example.com subscribers do not have write access to their home address because they might delete that attribute. The home address is business-critical information that Example.com needs billing purposes.

Granting Access to a Certain Level

You can set the scope of an ACI to affect different levels within your directory tree, to fine-tune the level of access you want to allow. The target ACI scope can be set to one of the following:

- | | |
|-----------------------|--|
| <code>base</code> | The entry itself |
| <code>onelevel</code> | The entry itself and all entries one level below |
| <code>subtree</code> | The entry itself and all entries beneath that entry, to an unlimited depth |

ACI "Read Example.com only"

In LDIF, to grant Example.com subscribers the right to read the entry `dc=example,dc=com` for company contact information, but not allow access to any entries below it, you would write the following statement:

```
aci: (targetscope="base") (targetattr="*)(version 3.0;
acl "Read Example.com only"; allow (read,search,compare)
userdn="ldap:///cn=*,ou=subscribers,dc=example,dc=com");)
```

This example assumes that the ACI is added to the `dc=example, dc=com` entry.

Restricting Access to Key Roles

You can use role definitions in the directory to identify functions that are critical to your business, such as the administration of your network and directory.

For example, you might create a `superAdmin` role by identifying a subset of your system administrators who are available at a particular time of day and day of the week at corporate sites worldwide. Or you might want to create a `First Aid` role that includes all staff members who have first aid training at a particular site. For information about creating role definitions see ["Managing Roles" on page 214](#).

When a role gives any sort of privileged user rights over critical corporate or business functions, consider restricting access to that role. For example, at Example.com, employees can add any role to their own entry, except the `superAdmin` role, as shown in the following example.

ACI "Roles"

In LDIF, to grant Example.com employees the right to add any role to their own entry, except the `superAdmin` role, you would write the following statement:

```
aci: (targetattr="*") (targetfilters="add=nsRoleDN:
(nsRoleDN !="cn=superAdmin, dc=example, dc=com")")
(version 3.0; acl "Roles"; allow (write)
userdn= "ldap:///self" ;)
```

This example assumes that the ACI is added to the `ou=People,dc=example, dc=com` entry.

Granting a Role Full Access to an Entire Suffix

Sometimes it is useful to grant certain users the same rights as the Directory Manager for a suffix. At Example.com, Kirsten Vaughan is an administrator for Directory Server. She has a role of `superAdmin`. This role has the following advantages:

- Better security because administrators binding as themselves can be forced to use strong authentication such as SSL
- Better security because the Directory Manager password is known by fewer people
- More traceability through logging

Note – Adding Kirsten Vaughan to the `cn=Administrators, cn=config` group would also grant her the same rights as Directory Manager.

To give a user the same rights as the Directory Manager for the whole server, follow the procedure in [“To Create an Administration User with Root Access” on page 68](#).

ACI “Full Access”

In LDIF, to grant the administrator Kirsten Vaughan the same rights as a Directory Manager, use the following statement:

```
aci: (targetattr="*") (version 3.0; acl "Full Access";
  allow (all) groupdn= "ldap:///cn=SuperAdmin,dc=example,dc=com"
  and authmethod="ssl" ;)
```

This example assumes that the ACI is added to the root entry "" (no text).

Granting a Group Full Access to a Suffix

Most directories have groups that are used to identify certain corporate functions. A group can be given access to all or part of the directory. By applying access rights to a group, you can avoid setting access rights for each member individually. Instead, you grant users access rights by adding them to a group.

For example, when you create a Directory Server instance, an `Administrators, cn=config` group with full access to the directory is created by default.

At Example.com, the Human Resources group is allowed full access to the `ou=People` branch of the directory so that they can update the employee directory, as shown in [“ACI “HR”” on page 150](#).

ACI "HR"

In LDIF, to grant the HR group all rights to the employee branch of the directory, you would use the following statement:

```
aci: (targetattr="*") (version 3.0; acl "HR"; allow (all)
    groupdn= "ldap:///cn=HRgroup,ou=Groups,dc=example,dc=com");)
```

This example assumes that the ACI is added to the following entry:

```
ou=People,dc=example,dc=com
```

Granting Rights to Add and Delete Group Entries

Some organizations allow employees to create entries in the tree to increase employees' efficiency and to encourage employees to contribute to the corporate dynamics. At Example.com, for example, the social committee is organized into various clubs, such as tennis, swimming, skiing, and role-playing.

Any Example.com employee can create a group entry that represents a new club, as shown in ["ACI "Create Group" on page 150.](#)

Any Example.com employee can become a member of one of these groups, as shown in ["Allowing Users to Add or Remove Themselves From a Group" on page 151.](#)

Only the group owner can modify or delete a group entry, as shown in ["ACI "Delete Group" on page 151.](#)

ACI "Create Group"

In LDIF, to grant Example.com employees the right to create a group entry under the ou=Social Committee branch, you would write the following statement:

```
aci: (targetattr="*") (targetfilters="add=objectClass:
(|(objectClass=groupOfNames)(objectClass=top))")
(version 3.0; acl "Create Group"; allow (read,search,add)
userdn= "ldap:///uid=*,ou=People,dc=example,dc=com"
and dns="*.Example.com");)
```

This example assumes that the ACI is added to the ou=Social Committee,dc=example,dc=com entry.

Note –

- This ACI does not grant write permission, which means that the entry creator cannot modify the entry.
- Because the server adds the value `top` behind the scenes, you need to specify `objectClass=top` in the `targetfilters` keyword.
- This ACI restricts the client machine to be in the `example.com` domain.

ACI “Delete Group”

In LDIF, to grant Example.com employees the right to modify or delete a group entry of the group to which they belong under the `ou=Social Committee` branch, you would write the following statement:

```
aci: (targetattr = "*") (targetfilters="del=objectClass:
(objectClass=groupOfNames)")
(version 3.0; acl "Delete Group"; allow (write,delete)
userattr="owner#GROUPDN";)
```

This example assumes that the `aci` is added to the `ou=Social Committee,dc=example,dc=com` entry.

Note that to use DSCC to create this ACI is not very effective because you have to use manual editing mode to create the target filter and to check group ownership.

Allowing Users to Add or Remove Themselves From a Group

Many directories set ACIs that allow users to add or remove themselves from groups such as mailing lists.

At Example.com, employees can add themselves to any group entry under the `ou=Social Committee` subtree, as shown in [“ACI “Group Members”” on page 151](#).

ACI “Group Members”

In LDIF, to grant Example.com employees the right to add themselves to a group, you would write the following statement:

```
aci: (targetattr="member")(version 3.0; acl "Group Members";
allow (selfwrite)
(userdn= "ldap:///uid=*,ou=People,dc=example,dc=com") );)
```

This example assumes that the ACI is added to the `ou=Social Committee, dc=example, dc=com` entry.

Granting Conditional Access to a Group or Role

In many cases, when you grant a group or role privileged access to the directory, you must ensure that those privileges are protected from intruders trying to impersonate your privileged users. Therefore, in many cases, access control rules that grant critical access to a group or role are often associated with a number of conditions.

Example.com, for example, has created a Directory Administrator role for each of its hosted companies, Company333 and Company999. Example.com wants these companies to be able to manage their own data and implement their own access control rules while securing the data against intruders.

For this reason, Company333 and Company999 have full rights on their respective branches of the directory tree, provided that the following conditions are fulfilled:

- The connection is authenticated using a certificate over SSL.
- Access is requested between 8:00 and 18:00, Monday through Thursday.
- Access is requested from a specified IP address for each company.

These conditions are depicted in one ACI for each company, ACI “Company333” and ACI “Company999”. Because the content of both ACIs is the same, the following examples use the “Company333” ACI only.

ACI “Company333”

In LDIF, to grant Company333 full access to its own branch of the directory under the conditions stated previously, you would write the following statement:

```
aci: (targetattr = "*") (version 3.0; acl "Company333"; allow (all)
  (roledn="ldap:///cn=DirectoryAdmin,ou=Company333,
  ou=corporate clients,dc=example,dc=com") and (authmethod="ssl")
  and (dayofweek="Mon,Tues,Wed,Thu") and (timeofday >= "0800" and
  timeofday <= "1800") and (ip="255.255.123.234"); )
```

This example assumes that the ACI is added to the `ou=Company333, ou=corporate clients, dc=example, dc=com` entry.

Denying Access

If you have already allowed access to a large part of your suffix, you might want to deny access to a smaller part of the suffix beneath the existing ACI.

Note – Denying access should be avoided where possible, because it can lead to surprising or complicated access control behavior. Restrict access by using a combination of scoping, attribute lists, target filters and so on.

Also, deleting a deny access ACI does not remove rights, but instead expands the rights set by other ACIs.

When the Directory Server evaluates access rights, it reads deny rights first, then allow rights.

In the examples that follow, Example.com wants all subscribers to be able to read billing information, such as connection time or account balance, under their own entries.

Example.com also explicitly wants to deny write access to that information. The read access is depicted in “[ACI “Billing Info Read”](#)” on page 153. The deny access is depicted in “[ACI “Billing Info Deny”](#)” on page 153.

ACI “Billing Info Read”

In LDIF, to grant subscribers permission to read billing information in their own entry, you would write the following statement:

```
aci: (targetattr="connectionTime || accountBalance")
      (version 3.0; acl "Billing Info Read"; allow (search,read)
        userdn="ldap:///self");
```

This example assumes that the relevant attributes have been created in the schema and that the ACI is added to the `ou=subscribers,dc=example,dc=com` entry.

ACI “Billing Info Deny”

In LDIF, to deny subscribers permission to modify billing information in their own entry, you would write the following statement:

```
aci: (targetattr="connectionTime || accountBalance")
      (version 3.0; acl "Billing Info Deny";
        deny (write) userdn="ldap:///self");
```

This example assumes that the relevant attributes have been created in the schema and that the ACI is added to the `ou=subscribers,dc=example,dc=com` entry.

Proxy Authorization

The proxy authorization method is a special form of authentication. A user that binds to the directory by using his or her own identity is granted the rights of another user through proxy authorization.

To configure Directory Server to allow proxy requests you must do the following:

- Grant the administrators the right to proxy as other users.
- Grant your regular users normal access rights as defined in your access control policy.

Note – You can grant proxy rights to any users of the directory except the Directory Manager. In addition, you cannot use the Directory Manager's DN as a proxy DN. You need to exercise great care when granting proxy rights because you grant the right to specify any DN (except the Directory Manager DN) as the proxy DN. If Directory Server receives more than one proxied authentication control in the same operation, an error is returned to the client application and the operation attempt is unsuccessful.

Example Proxy Authorization

Example.com wants the client application that binds as MoneyWizAcctSoftware to have the same access rights to the LDAP data as an Accounting Administrator.

The following parameters apply:

- The client application's bind DN is `uid=MoneyWizAcctSoftware,ou=Applications,dc=example,dc=com`.
- The targeted subtree to which the client application is requesting access is `ou=Accounting,dc=example,dc=com`.
- An Accounting Administrator with access permissions to the `ou=Accounting,dc=example,dc=com` subtree exists in the directory.

For the client application to gain access to the Accounting subtree, by using the same access permissions as the Accounting Administrator, the following must be true:

- The Accounting Administrator must have access permissions to the `ou=Accounting,dc=example,dc=com` subtree. For example, the following ACI grants all rights to the Accounting Administrator entry:

```
aci: (targetattr="*") (version 3.0; acl "allowAll-AcctAdmin"; allow
  (all) userdn="ldap:///uid=AcctAdministrator,ou=Administrators,
  dc=example,dc=com");
```

- The following ACI that grants proxy rights to the client application must exist in the directory:

```
aci: (targetattr="*") (version 3.0; acl "allowproxy- accountingsoftware";
  allow (proxy) userdn= "ldap:///uid=MoneyWizAcctSoftware,ou=Applications,
  dc=example,dc=com");
```

With this ACI in place, the `MoneyWizAcctSoftware` client application can bind to the directory and then send an LDAP command, such as `ldapsearch` or `ldapmodify`, that requires the access rights of the proxy DN.

In this example, if the client wanted to perform an `ldapsearch` command, the command would include the following controls:

```
$ ldapsearch -D "uid=MoneyWizAcctSoftware,ou=Applications,dc=example,dc=com" -w - \
-y "uid=AcctAdministrator,ou=Administrators,dc=example,dc=com" ...
```

Note that the client binds as itself, but is granted the privileges of the proxy entry. The client does not need the password of the proxy entry.

Setting a Target Using Filtering

If you want to set access controls that allow access to a number of entries that are spread across the directory, you might want to use a filter to set the target.

In LDIF, to use a filter to allow all users in HR access to employee entries, you would write the following statement:

```
aci: (targetattr="*") (targetfilter=(objectClass=employee))
  (version 3.0; acl "HR access to employees";
  allow (all) groupdn= "ldap:///cn=HRgroup,ou=People,dc=example,dc=com");
```

This example assumes that the ACI is added to the `ou=People,dc=example,dc=com` entry.

Note – Because search filters do not directly name the object for which you are managing access, try not to allow or deny access to the wrong objects. Unintentionally allowing or denying access to the wrong objects becomes more of a risk as your directory becomes more complex. Additionally, filters can make it difficult for you to troubleshoot access control problems within your directory.

Defining Permissions for DNs That Contain a Comma

DNs that contain commas require special treatment within your LDIF ACI statements. In the target and bind rule portions of the ACI statement, commas must be escaped by a single backslash (\). The following example illustrates this syntax:

```
dn: o=Example.com Bolivia\, S.A.  
objectClass: top  
objectClass: organization  
aci: (target="ldap:///o=Example.com Bolivia\,S.A.") (targetattr="*")  
(version 3.0; acl "aci 2"; allow (all) groupdn =  
"ldap:///cn=Directory Administrators, o=Example.com Bolivia\, S.A.");)
```

Viewing Effective Rights

When maintaining the access policy on the entries of a directory, you need to know the effects on security of the ACIs that you define. Directory Server enables you to evaluate existing ACIs by viewing the effective rights that the ACIs grant for a given user on a given entry.

Directory Server responds to the “Get Effective Rights”, control which can be included in a search operation. The response to this control is to return the effective rights information about the entries and attributes in the search results. This extra information includes read and write permissions for each entry and for each attribute in each entry. The permissions can be requested for the bind DN that is used for the search or for an arbitrary DN. This choice allows administrators to test the permissions of directory users.

Effective rights functionality relies on an LDAP control. You must ensure that the proxy identity used to bind to the remote server is also allowed to access the effective rights attributes.

Restricting Access to the Get Effective Rights Control

The operation of viewing effective rights is a directory operation that needs to be protected and appropriately restricted.

To restrict access to effective rights information, modify the default ACI for `getEffectiveRights` attribute. Then create a new ACI for the `getEffectiveRightsInfo` attribute.

For example, the following ACI allows only members of the Directory Administrators Group to get effective rights:

```
aci: (targetattr != "aci")(version 3.0; acl
  "getEffectiveRights"; allow(all) groupdn =
  "ldap:///cn=Directory Administrators,ou=Groups,dc=example,dc=com");)
```

To obtain effective rights information, you need to have access control rights to use the Effective Rights control *and* read access to the `aclRights` attribute. This double layer of access control provides basic security that can be more finely tuned if necessary. By analogy with proxy, if you have read access to the `aclRights` attribute in an entry, you can request information about anyone's rights to that entry and its attributes. This implies that the user who manages the resource can determine who has rights to that resource, even if that user does not actually manage those with the rights.

If a user requesting rights information does not have the rights to use the Effective Rights control, the operation fails and an error message is returned. However, if the user requesting rights information does have the rights to use the control but lacks the rights to read the `aclRights` attribute, the `aclRights` attribute will not appear in the returned entry. This behavior reflects Directory Server's general search behavior.

Using the Get Effective Rights Control

Specify the "Get Effective Rights" control by using the `ldapsearch` command with the `-J "1.3.6.1.4.1.42.2.27.9.5.2"` option. By default, the control returns the effective rights of the bind DN entry on the entries and attributes in the search results.

Use the following options to change the default behavior:

- `-c "dn: bind DN"` — The search results show the effective rights of the user binding with the given DN. This option allows an administrator to check the effective rights of another user. The option `-c "dn:"` shows the effective rights for anonymous authentication.
- `-X "attributeName ..."` — The search results also include the effective rights on the named attributes. Use this option to specify attributes that do not appear in the search results. For example, use this option to determine if a user has permission to add an attribute that does not currently exist in an entry.

- When using either or both of the `-c` and `-X` options, the `-J` option with the OID of the “Get Effective Rights” control is implied and does not need to be specified. If you specify a NULL value for the Effective Rights control, the rights are retrieved for the current user. In addition, the rights are retrieved for the attributes and entries that are being returned with the current `ldapsearch` operation.

Then you must select the type of information you want to view. Choose either the simple rights or the more detailed logging information that explains how those rights are granted or denied. The type of information is determined by adding either `aclRights` or `aclRightsInfo`, respectively, as an attribute to return in the search results. You can request both attributes to receive all effective rights information, although the simple rights essentially repeat the information in the detailed logging information.

Note – The `aclRights` and `aclRightsInfo` attributes behave like virtual operational attributes. These attributes are not stored in the directory and are not returned unless explicitly requested. They are generated by Directory Server in response to the “Get Effective Rights” control.

Thus, these attributes cannot be used in filters or search operations of any kind.

The effective rights feature inherits other parameters that affect access control. These parameters include time of day, authentication method, machine address, and name.

The following example shows how the user Carla Fuente can view her rights in the directory. In the results, `1` means that permission is granted, and `0` means that permission is denied.

```
$ ldapsearch -J "1.3.6.1.4.1.42.2.27.9.5.2 -h host1.Example.com -p 389 \
-D "uid=cfuente,ou=People,dc=example,dc=com" -w - -b "dc=example,dc=com" \
"(objectclass=*)" aclRights
Enter bind password:
dn: dc=example,dc=com
aclRights;entryLevel: add:0,delete:0,read:1,write:0,proxy:0
dn: ou=Groups, dc=example,dc=com
aclRights;entryLevel: add:0,delete:0,read:1,write:0,proxy:0
dn: ou=People, dc=example,dc=com
aclRights;entryLevel: add:0,delete:0,read:1,write:0,proxy:0
dn: cn=Accounting Managers,ou=groups,dc=example,dc=com
aclRights;entryLevel: add:0,delete:0,read:1,write:0,proxy:0
dn: cn=HR Managers,ou=groups,dc=example,dc=com
aclRights;entryLevel: add:0,delete:0,read:1,write:0,proxy:0
dn: uid=bjensen,ou=People, dc=example,dc=com
aclRights;entryLevel: add:0,delete:0,read:1,write:0,proxy:0
dn: uid=cfuente, ou=People, dc=example,dc=com
aclRights;entryLevel: add:0,delete:0,read:1,write:1,proxy:0
```

This result shows Carla Fuente the entries in the directory where she has at least read permission and shows that she can modify her own entry. The Effective Rights control does not bypass normal access permissions, so a user does not see the entries for which they do not have read permission. In the following example, the Directory Manager can see the entries to which Carla Fuente does not have read permission:

```
$ ldapsearch -h host1.Example.com -p 389 -D cn=admin,cn=Administrators,cn=config -w - \
-c "dn: uid=cfuente,ou=People,dc=example,dc=com" -b "dc=example,dc=com" \
"(objectclass=*)" aclRights
Enter bind password:
dn: dc=example,dc=com
aclRights;entryLevel: add:0,delete:0,read:1,write:0,proxy:0
dn: ou=Groups, dc=example,dc=com
aclRights;entryLevel: add:0,delete:0,read:1,write:0,proxy:0
dn: cn=Directory Administrators, dc=example,dc=com
aclRights;entryLevel: add:0,delete:0,read:0,write:0,proxy:0
dn: ou=Special Users,dc=example,dc=com
aclRights;entryLevel: add:0,delete:0,read:0,write:0,proxy:0
dn: ou=People, dc=example,dc=com
aclRights;entryLevel: add:0,delete:0,read:1,write:0,proxy:0
dn: cn=Accounting Managers,ou=groups,dc=example,dc=com
aclRights;entryLevel: add:0,delete:0,read:1,write:0,proxy:0
dn: cn=HR Managers,ou=groups,dc=example,dc=com
aclRights;entryLevel: add:0,delete:0,read:1,write:0,proxy:0
dn: uid=bjensen,ou=People, dc=example,dc=com
aclRights;entryLevel: add:0,delete:0,read:1,write:0,proxy:0
dn: uid=cfuente, ou=People, dc=example,dc=com
aclRights;entryLevel: add:0,delete:0,read:1,write:1,proxy:0
```

In the preceding output, the Directory Manager can see that Carla Fuente cannot even view the Special Users or the Directory Administrators branches of the directory tree. In the following example, the Directory Manager can see that Carla Fuente cannot modify the mail and manager attributes in her own entry:

```
$ ldapsearch -h host1.Example.com -p 389 -D cn=admin,cn=Administrators,cn=config -w - \
-c "dn: uid=cfuente,ou=People,dc=example,dc=com" -b "dc=example,dc=com" \
"(uid=cfuente)" aclRights "*"
Enter bind password:
version: 1
dn: uid=cfuente, ou=People, dc=example,dc=com
aclRights;attributeLevel;mail: search:1,read:1,compare:1,
write:0,selfwrite_add:0,selfwrite_delete:0,proxy:0
mail: cfuente@Example.com
aclRights;attributeLevel;uid: search:1,read:1,compare:1,
write:1,selfwrite_add:1,selfwrite_delete:1,proxy:0
uid: cfuente
aclRights;attributeLevel;givenName: search:1,read:1,compare:1,
```

```
write:1,selfwrite_add:1,selfwrite_delete:1,proxy:0
givenName: Carla
aclRights;attributeLevel;sn: search:1,read:1,compare:1,
write:1,selfwrite_add:1,selfwrite_delete:1,proxy:0
sn: Fuente
aclRights;attributeLevel;cn: search:1,read:1,compare:1,
write:1,selfwrite_add:1,selfwrite_delete:1,proxy:0
cn: Carla Fuente
aclRights;attributeLevel;userPassword: search:0,read:0,
compare:0,write:1,selfwrite_add:1,selfwrite_delete:1,proxy:0
userPassword: {SSHA}wnbWHIq2HPiY/5ECwe6MWBGx2KMiZ8JmjF80Ow==
aclRights;attributeLevel;manager: search:1,read:1,compare:1,
write:0,selfwrite_add:0,selfwrite_delete:0,proxy:0
manager: uid=bjensen,ou=People,dc=example,dc=com
aclRights;attributeLevel;telephoneNumber: search:1,read:1,compare:1,
write:1,selfwrite_add:1,selfwrite_delete:1,proxy:0
telephoneNumber: (234) 555-7898
aclRights;attributeLevel;objectClass: search:1,read:1,compare:1,
write:1,selfwrite_add:1,selfwrite_delete:1,proxy:0
objectClass: top
objectClass: person
objectClass: organizationalPerson
objectClass: inetorgperson
aclRights;entryLevel: add:0,delete:0,read:1,write:0,proxy:0
```

Advanced Access Control: Using Macro ACIs

Organizations that use repeating directory tree structures can optimize the number of ACIs used in the directory by using macros. When you reduce the number of ACIs in your directory tree, it is easier to manage your access control policy. In addition, the efficiency of your ACI memory usage is improved.

Macros are placeholders that are used to represent a DN or a portion of a DN in an ACI. You can use a macro to represent a DN in the target portion of the ACI, in the bind rule portion, or in both. In practice, when Directory Server gets an incoming LDAP operation, the ACI macros are matched against the resource targeted by the LDAP operation. The matching occurs in order to determine a matching substring, if any matching substring exists. If a match exists, the bind rule-side macro is expanded using the matched substring, and access to the resource is determined by evaluating that expanded bind rule.

This section contains an example of a macro ACI and information about macro ACI syntax.

Macro ACI Example

The benefits of macro ACIs and how they work are best explained by using an example.

[Figure 6-1](#) shows a directory tree in which using macro ACIs is an effective way of reducing the overall number of ACIs.

In this illustration, note the repeating pattern of subdomains with the same tree structure (ou=groups, ou=people). This pattern is also repeated across the tree because the Example.com directory tree stores the two suffixes dc=hostedCompany2, dc=example, dc=com, and dc=hostedCompany3, dc=example, dc=com, which are not shown in the figure.

The ACIs in the directory tree also have a repeating pattern. For example, the following ACI is located on the dc=hostedCompany1, dc=example, dc=com node:

```
aci: (targetattr="*")
  (targetfilter=(objectClass=nsManagedDomain))(version 3.0;
  acl "Domain access"; allow (read,search) groupdn=
  "ldap:///cn=DomainAdmins,ou=Groups,dc=hostedCompany1,
  dc=example,dc=com");)
```

This ACI grants the domainAdmins group read and search rights to any entry in the dc=hostedCompany1, dc=example, dc=com tree.

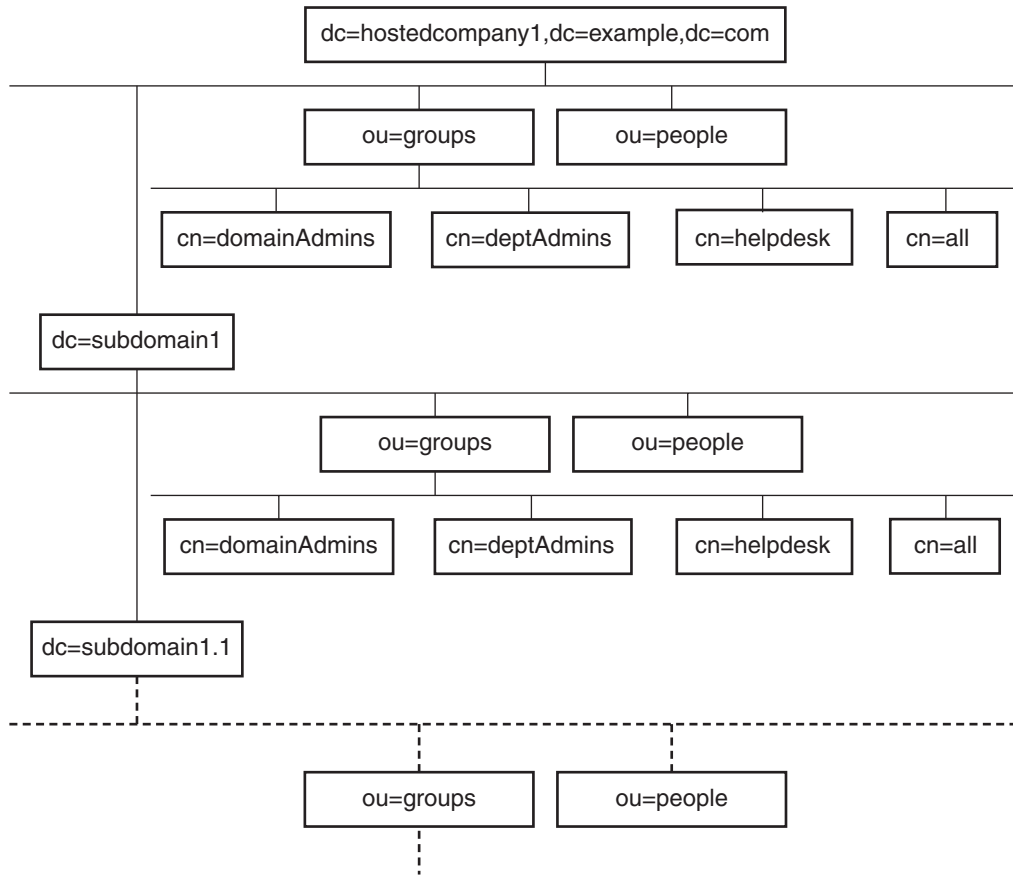


FIGURE 6-1 Example Directory Tree for Macro ACIs

The following ACI is located on the `dc=hostedCompany1,dc=example,dc=com` node:

```
aci: (targetattr="*")
  (targetfilter=(objectClass=nsManagedDomain))
  (version 3.0; acl "Domain access"; allow (read,search)
  groupdn="ldap:///cn=DomainAdmins,ou=Groups,dc=hostedCompany1,dc=example,dc=com");)
```

The following ACI is located on the `dc=subdomain1,dc=hostedCompany1,dc=example,dc=com` node:

```
aci: (targetattr="*")
  (targetfilter=(objectClass=nsManagedDomain))
  (version 3.0; acl "Domain access"; allow (read,search)
  groupdn="ldap:///cn=DomainAdmins,ou=Groups,dc=subdomain1,dc=hostedCompany1,
  dc=example,dc=com");)
```

The following ACI is located on the `dc=hostedCompany2,dc=example,dc=com` node:

```
aci: (targetattr="*")
  (targetfilter=(objectClass=nsManagedDomain))
  (version 3.0; acl "Domain access"; allow (read,search)
  groupdn="ldap:///cn=DomainAdmins,ou=Groups,dc=hostedCompany2, dc=example,dc=com");)
```

The following ACI is located on the `dc=subdomain1,dc=hostedCompany2,dc=example,dc=com` node:

```
aci: (targetattr="*")
  (targetfilter=(objectClass=nsManagedDomain))
  (version 3.0; acl "Domain access"; allow (read,search)
  groupdn="ldap:///cn=DomainAdmins,ou=Groups,dc=subdomain1,dc=hostedCompany2,
  dc=example,dc=com");)
```

In the preceding four ACIs, the only difference is the DN that is specified in the `groupdn` keyword. By using a macro for the DN, it is possible to replace these ACIs with a single ACI at the root of the tree, on the `dc=example,dc=com` node. This macro ACI reads as follows:

```
aci: (target="ldap:///ou=Groups,($dn),dc=example,dc=com")
  (targetattr="*")(targetfilter=(objectClass=nsManagedDomain))
  (version 3.0; acl "Domain access"; allow (read,search)
  groupdn="ldap:///cn=DomainAdmins,ou=Groups,[$dn],dc=example,dc=com");)
```

Note that the `target` keyword which was not previously used needs to be introduced.

In the preceding example, the number of ACIs is reduced from four to one. However, the real benefit is a factor of how many repeating patterns you have down and across your directory tree.

Macro ACI Syntax

To simplify the discussion in this section, the ACI keywords such as `userdn`, `roledn`, `groupdn`, and `userattr` that are used to provide bind credentials are collectively called the *subject* of the ACI. The subject determines to whom the ACI applies.

The following table shows which macros can be used to replace specific ACI keywords.

TABLE 6-1 Macro ACI Keywords

Macro	Description	ACI Keywords
<code>(\$dn)</code>	For matching in the target, and direct substitution in the subject.	<code>target</code> , <code>targetfilter</code> , <code>userdn</code> , <code>roledn</code> , <code>groupdn</code> , <code>userattr</code>

TABLE 6-1 Macro ACI Keywords (Continued)

Macro	Description	ACI Keywords
[\$dn]	For substituting multiple RDNs that work in subtrees of the subject.	targetfilter, userdn, roledn, groupdn, userattr
(\$attr.attrName)	For substituting the value of the <i>attributeName</i> attribute from the target entry into the subject.	userdn, roledn, groupdn, userattr

The following restrictions apply to macro ACI keywords:

- When using the (\$dn) and [\$dn] macros in a subject, you *must* define a target that contains the (\$dn) macro.
- You can combine the (\$dn) macro (but not the [\$dn] macro) with the (\$attr.attrName) macro in a subject.

Matching for (\$dn) in the Target

The (\$dn) macro in the target of an ACI determines the substitution value by comparing it to the entry targeted by the LDAP request. For example, you have an LDAP request targeted at this entry:

```
cn=all,ou=groups,dc=subdomain1, dc=hostedCompany1,dc=example,dc=com
```

In addition, you have an ACI that defines the target as follows:

```
(target="ldap:///ou=Groups, ($dn), dc=example, dc=com")
```

The (\$dn) macro matches with “dc=subdomain1, dc=hostedCompany1”. This substring is then used for substitutions in the subject of the ACI.

Substituting (\$dn) in the Subject

In the subject of the ACI, the (\$dn) macro is replaced by the entire substring that matches in the target. For example:

```
groupdn="ldap:///cn=DomainAdmins,ou=Groups, ($dn), dc=example, dc=com"
```

The subject becomes this:

```
groupdn="ldap:///cn=DomainAdmins,ou=Groups,  
dc=subdomain1,dc=hostedCompany1,dc=example,dc=com"
```

After the macro has been expanded, Directory Server evaluates the ACI following the normal process to determine whether access is granted.

Note – Unlike a standard ACI, an ACI that uses macro substitution does not necessarily grant access to the child of the targeted entry. This is because when the child DN is the target, the substitution might not create a valid DN in the subject string.

Substituting [\$dn] in the Subject

The substitution mechanism for [\$dn] is slightly different than for (\$dn). The DN of the targeted resource is examined several times, each time dropping the left-most RDN component, until a match is found.

For example, suppose that you have an LDAP request targeted at the `cn=all,ou=groups,dc=subdomain1,dc=hostedCompany1,dc=example,dc=com` subtree, and the following ACI:

```
aci: (targetattr="*")
      (target="ldap:///ou=Groups,($dn),dc=example,dc=com")
      (version 3.0; acl "Domain access"; allow (read,search)
        groupdn="ldap:///cn=DomainAdmins,ou=Groups,[$dn],
        dc=example,dc=com");)
```

The server proceeds as follows to expand this ACI:

1. The server verifies that the (\$dn) in target matches `dc=subdomain1,dc=hostedCompany1`.
2. The server replaces [\$dn] in the subject with `dc=subdomain1,dc=hostedCompany1`.

The resulting subject is `groupdn="ldap:///cn=DomainAdmins,ou=Groups,dc=subdomain1,dc=hostedCompany1,dc=example,dc=com"`. If access is granted because the bind DN is a member of that group, the macro expansion stops, and the ACI is evaluated. If the bind DN is not a member, the process continues.

3. The server replaces [\$dn] in the subject with `dc=hostedCompany1`.

The resulting subject is `groupdn="ldap:///cn=DomainAdmins,ou=Groups,dc=hostedCompany1,dc=example,dc=com"`. Again, the bind DN is tested as a member of this group and if it is, the ACI is evaluated fully. If the bind DN is not a member, macro expansion stops with the last RDN of the matched value, and ACI evaluation is finished for this ACI.

The advantage of the [\$dn] macro is that it provides a flexible way to grant domain-level administrators access to *all* the subdomains in the directory tree. Therefore, the [\$dn] macro is useful for expressing a hierarchical relationship between domains.

For example, consider the following ACI:

```
aci: (target="ldap:///ou=*,($dn),dc=example,dc=com") (targetattr="*")
      (targetfilter=(objectClass=nsManagedDomain))
      (version 3.0; acl "Domain access"; allow (read,search) groupdn=
        "ldap:///cn=DomainAdmins,ou=Groups,[$dn],dc=example,dc=com");)
```

The ACI grants access to the members of `cn=DomainAdmins,ou=Groups,dc=hostedCompany1,dc=example,dc=com` to all of the subdomains under `dc=hostedCompany1`. Thus, an administrator who belongs to that group could access, for example, the subtree `ou=people,dc=subdomain1.1,dc=subdomain1`.

However, at the same time, members of `cn=DomainAdmins,ou=Groups,dc=subdomain1.1` would be denied access to the `ou=people,dc=subdomain1,dc=hostedCompany1` and `ou=people,dc=hostedCompany1` nodes.

Macro Matching for (`$attr.attrName`)

The (`$attr.attrName`) macro is always used in the subject part of a DN. For example, you could define the following `roledn`:

```
roledn = "ldap:///cn=DomainAdmins,($attr.ou),dc=HostedCompany1,dc=example,dc=com"
```

Now, assume that the server receives an LDAP operation that is targeted at the following entry:

```
dn: cn=Babs Jensen,ou=People,dc=HostedCompany1,dc=example,dc=com
cn: Babs Jensen
sn: Jensen
ou: Sales
...
```

To evaluate the `roledn` part of the ACI, the server reads the value of the `ou` attribute stored in the targeted entry. The server then substitutes this value in the subject to expand the macro. In the example, the `roledn` is expanded as follows:

```
roledn = "ldap:///cn=DomainAdmins,ou=Sales,dc=HostedCompany1,dc=example,dc=com"
```

Directory Server then evaluates the ACI according to the normal ACI evaluation algorithm.

When the attribute that is named in the macro is multivalued, each value is used in turn to expand the macro. The first value that provides a successful match is used.

Logging Access Control Information

To obtain information about access control in the error logs, you must set the appropriate log level.

▼ To Set Logging for ACIs

You cannot use DSCC to perform this task. Use the command line, as described in this procedure.

- **Set the log level to take into account ACL processing.**

```
$ dsconf set-log-prop -h host -p port error level:err-acl
```

Client-Host Access Control Through TCP Wrapping

You can control the host or IP address from which connections are accepted or rejected at the TCP level using TCP wrappers. You can limit client-host access through TCP wrapping. This enables you to have non host-based protection for initial TCP connections to a Directory Server.

Although you can set TCP wrapping for Directory Server, TCP wrapping can result in significant performance degradation, especially during a Denial of Service attack. The best performance is achieved by using a host-based firewall that is maintained outside Directory Server, or IP port filtering.

▼ To Enable TCP Wrapping

You cannot use DSCC to perform this task. Use the command line, as described in this procedure.

- 1 **Create a `hosts.allow` file or a `hosts.deny` file, somewhere within the instance path.**

For example, create the file in *instance-path*/config. Ensure that the formatting of the files that you create comply with `hosts_access(4)`.

- 2 **Set the path to the access file.**

```
$ dsconf set-server-prop -h host -p port host-access-dir-path:path-to-file
```

For example:

```
$ dsconf set-server-prop -h host -p port host-access-dir-path:/local/ds1/config
"host-access-dir-path" property has been set to "/local/ds1/config".
The "/local/ds1/config" directory on host1 must contain valid hosts.allow
and/or hosts.deny files.
Directory Server must be restarted for changes to take effect.
```

▼ To Disable TCP Wrapping

You cannot use DSCC to perform this task. Use the command line, as described in this procedure.

- **Set the host access path to "".**

```
$ dsconf set-server-prop -h host -p port host-access-dir-path:""
```


Directory Server Password Policy

When a user connects to Directory Server, the user is authenticated. The directory can grant access rights and resource limits to the user depending on the identity established during authentication. An *account* in this chapter refers loosely to a user entry. The account also reflects the permissions for the user to perform operations on the directory. In this discussion of password policy, every account is associated with a user entry, and a password.

This chapter also addresses account activation, an aspect of password policy. The Directory Administrator can directly lock and unlock accounts, independently of password policy.

This chapter does not cover authentication methods. Some authentication methods, such as SASL GSSAPI and client SSL certificate-based authentication, do not involve the use of passwords. The information about password policy in this chapter does not apply to such authentication methods. See [Chapter 5, “Directory Server Security,”](#) for instructions on configuring authentication mechanisms.

This chapter also does not cover the compatibility of password policies between Directory Server 6.2 and previous Directory Server versions. When you create a Directory Server 6.2 instance, the password policy implementation defaults to a Directory Server 5 compatible mode to facilitate upgrading from earlier versions. To take full advantage of the password policy features described in this chapter, you will need to change the password policy compatibility mode. For more information about setting the password compatibility mode, see “Password Policy Compatibility” in *Sun Java System Directory Server Enterprise Edition 6.2 Migration Guide*.

This chapter covers the following topics:

- “Password Policies and Worksheet” on page 170
- “Managing the Default Password Policy” on page 175
- “Managing Specialized Password Policies” on page 178
- “Modifying Passwords From the Command Line When `pwdSafeModify` Is TRUE” on page 187
- “Resetting Expired Passwords” on page 187
- “Setting Account Properties” on page 190

- [“Manually Locking Accounts” on page 192](#)

Password Policies and Worksheet

This section explains password policy settings and provides a worksheet to help you define password policies that fit your requirements.

Note – To use the default password policy, see [“Managing the Default Password Policy” on page 175](#).

Password Policy Settings

When you specify a password policy in Directory Server, you either modify or create an entry that includes the object class `pwdPolicy(5dsoc)`.

When defining a password policy for a particular type of user, you need to consider the following:

- How accounts get locked out when an intruder appears to be trying to crack a password.
See [“Policy for Account Lockout” on page 170](#) for details.
- How password changes can be made.
See [“Policy for Password Changes” on page 171](#) for details.
- What password values are allowed.
See [“Policy for Password Content” on page 172](#) for details.
- How password expiration is handled.
See [“Policy for Password Expiration” on page 173](#) for details.
- If the server records the time of the last successful authentication.
See [“Policy for Tracking Last Authentication Time” on page 173](#).

Subsequent sections in this chapter explain how you handle these areas of password policy. Use the [“Worksheet for Defining Password Policy” on page 174](#) to clarify each password policy that you plan to implement.

Policy for Account Lockout

This section explains the policy attributes that govern account lockout.

A Directory Server account refers loosely to a user's entry and to the permissions that user has to perform operations on the directory. Each account is associated with a bind DN and a user password. When an intruder appears to be trying to crack a password, you want Directory

Server to lock the account. The lock prevents the intruder from using the account to bind. The lock also prevents the intruder from being able to continue the attack.

As administrator, you can also manually render inactive an account or the accounts of all users who share a role. See [“Manually Locking Accounts” on page 192](#) for instructions. Yet, a key part of your password policy is specifying under what circumstances Directory Server locks an account *without* your intervention.

First of all, you must specify that Directory Server can use `pwdLockout(5dsat)` to automatically lock accounts when too many failed binds occur. Directory Server keeps track of consecutive failed attempts to bind to an account. You use `pwdMaxFailure(5dsat)` to specify how many consecutive failures are allowed before Directory Server locks the account.

Directory Server locks accounts strictly according to password policy. The operation is purely mechanical. Accounts can lock not because an intruder is mounting an attack against the account, but because the user typed the password incorrectly. Thus, you can use `pwdFailureCountInterval(5dsat)` to specify how long Directory Server should wait between tries before cleaning out the records of failed attempts. You use `pwdLockoutDuration(5dsat)` to specify how long lockout should last before Directory Server automatically unlocks the account. The administrator does not have to intervene to unlock accounts of users who make legitimate mistakes with no malicious intent.

If your user data is replicated across a replication topology, lockout attributes are replicated along with other entry data. The `pwdIsLockoutPrioritized(5dsat)` attribute's default setting is TRUE, so updates for lockout attributes are replicated with a higher priority. A user is thus limited to making `pwdMaxFailure` consecutive failed attempts to bind to any single replica before being locked out, and probably fewer attempts at other replicas before being locked out. For details about how to make sure that a user gets exactly `pwdMaxFailure` attempts before being locked out across an entire replicated topology, see [“Preventing Authentication by Using Global Account Lockout” in *Sun Java System Directory Server Enterprise Edition 6.2 Deployment Planning Guide*](#).

Policy for Password Changes

This section explains the policy attributes that govern changes to passwords.

In many deployments, Directory Server is the repository for identity data. Users should be able to change their own passwords, as specified by `pwdAllowUserChange(5dsat)`, so you do not have to change the passwords.

After you allow users to change their own passwords, you might also want to control the circumstances under which users can change their passwords. You can use `pwdSafeModify(5dsat)` to specify that users who change a password must provide the correct existing password before they are allowed to replace the password. See [“Modifying Passwords From the Command Line When `pwdSafeModify` Is TRUE” on page 187](#) for an example of how to modify the password. You can prevent users from reusing passwords by using

`pwdInHistory(5dsat)` to specify how many passwords Directory Server remembers. You can also prevent users from changing their passwords too often by setting `pwdMinAge(5dsat)`.

In many cases either you as administrator or some application that you manage creates user entries in the directory. You can assign a user password value to change when the user first binds to the new account. You might also have to reset a user password, after which the user should change the password when next using the account. Directory Server has a specific attribute, `pwdMustChange(5dsat)`, that you can use to indicate whether a user must change passwords after the password value is reset by another user.

You can also specify that the Directory Administrator is not subject to policy when changing passwords by setting `passwordRootdnMayBypassModsChecks(5dsat)`.

Policy for Password Content

This section explains the policy attributes that govern password content.

Although password values are not generally returned in directory searches, an attacker could potentially gain access to the directory database. Therefore, password values are generally stored in one of the supported hashed formats that you specify using `passwordStorageScheme(5dsat)`.

You can also enforce a check that passwords meet your definition of minimum password quality, by setting `pwdCheckQuality(5dsat)`. The server then checks that the password does not match any of the values of the `cn`, `givenName`, `mail`, `ou`, `sn`, or `uid` attributes. The comparison of the password with any of these attributes is case-insensitive.

Additional checks are available with `pwdCheckQuality(5dsat)` set. You can enforce that passwords have at least a specified number of characters by setting `pwdMinLength(5dsat)`. Furthermore, when the Strong Password Check plug-in is enabled, Directory Server checks that the password does not contain strings from the dictionary file that the plug-in uses. The server also checks that the password contains an appropriate mix of different types of characters.

You can enable strong password checking with the `dsconf set -server -prop` command. Use the `pwd-strong-check-enabled` property to turn on the plug-in, and restart the server for the change to take effect. Use the `pwd-strong-check-require-charset` property to specify what character sets to require in passwords. The `pwd-strong-check-require-charset` property takes a mask of the following values:

<code>lower</code>	The new password must include a lower case character.
<code>upper</code>	The new password must include an upper case character.
<code>digit</code>	The new password must include a digit.
<code>special</code>	The new password must include a special character.
<code>any-two</code>	The new password must include at least one character from each of at least two of the above mentioned character sets.

any - three The new password must include at least one character from each of at least three of the above mentioned character sets.

The default setting for the `pwd-strong-check-require-charset` property is `lower && upper && digit && special`.

Policy for Password Expiration

This section explains the policy attributes that govern password expiration.

To ensure that users change their passwords regularly, you can configure Directory Server to have passwords expire after the passwords reach a certain age, by setting `pwdMaxAge(5dsat)`.

Users must be informed that their passwords are going to expire. You can configure Directory Server to return a warning that the password used to bind is going to expire. Use `pwdExpireWarning(5dsat)` to define how long before expiration that the warning should be returned when a client binds. *Notice that the client application gets the warning. The user does not get the warning directly.* Client applications must notify the end user when the applications receive the warning that the password is about to expire.

You can allow users one or more tries to bind with an expired password, by setting `pwdGraceAuthNLimit(5dsat)`. Users who failed to change their passwords in time can thus still bind to change their passwords. Be aware that, when a user binds with a grace login, the user can perform any operation. A grace login works as if the password had not expired.

Directory Server updates the operational attribute `pwdChangedTime(5dsat)` every time that the password on the entry is modified. As a result, if you wait to enable password expiration, user passwords that have already aged expire immediately when you enable password expiration. Use warnings and grace logins if this behavior is not what you intend.

Policy for Tracking Last Authentication Time

This section covers the use of the password policy attribute `pwdKeepLastAuthTime(5dsat)`.

When set, `pwdKeepLastAuthTime` causes Directory Server to track the time of the last successful bind every time that a user authenticates. The time is recorded on the `pwdLastAuthTime(5dsat)` operational attribute of the user's entry.

Because this behavior adds an update for each successful bind operation, the `pwdKeepLastAuthTime` feature is not activated by default. You must explicitly turn the feature on to use it in your deployment.

Worksheet for Defining Password Policy

This worksheet is designed to help you define a password policy to implement either through the command-line interface or using Directory Service Control Center (DSCC). Use one worksheet for each password policy.

After you record the DN of the password policy entry, record your decisions about settings for attributes in each policy area. Also record your rationale for those settings.

Password Policy Worksheet

Password Policy Entry Distinguished Name

dn: cn=

Policy Area	Attribute	Write Your Settings Here	Write Your Rationale for Settings Here
Account Lockout	pwdFailureCountInterval(5dsat)		
	pwdIsLockoutPrioritized(5dsat)		
	pwdLockout(5dsat)		
	pwdLockoutDuration(5dsat)		
	pwdMaxFailure(5dsat)		
Password Changes	passwordRootdnMayBypassModsChecks(5dsat)		
	pwdAllowUserChange(5dsat)		
	pwdInHistory(5dsat)		
	pwdMinAge(5dsat)		
	pwdMustChange(5dsat)		
Password Content	passwordStorageScheme(5dsat)		
	pwdCheckQuality(5dsat)		
	pwdMinLength(5dsat)		
Password Expiration	pwdExpireWarning(5dsat)		
	pwdGraceAuthNLimit(5dsat)		
	pwdMaxAge(5dsat)		

Policy Area	Attribute	Write Your Settings Here	Write Your Rationale for Settings Here
Tracking Last Authentication Time	pwdKeepLastAuthTime(5dsat)		

Note – When the `pwdCheckQuality` attribute is set to 2, the server can perform additional checks. When the Password Check plug-in is also enabled, settings for the plug-in affect what checks are performed the on values of new passwords.

Managing the Default Password Policy

The default password policy applies to all users in the directory instance who do not have a specialized policy defined. However, the default password policy does not apply to the Directory Manager. See [“Which Password Policy Applies” on page 178](#) for details on policy scope.

The default password policy is the one policy that you can configure using the `dsconf` command. You can also view default password policy by reading `cn=Password Policy,cn=config`.

This section shows the policy attributes for each policy area and the related `dsconf` server properties. It also explains how to view and change default password policy settings.

Correlation Between Password Policy Attributes and `dsconf` Server Properties

The following table shows the password policy attributes and related `dsconf` server properties for each password policy area.

Policy Area	Policy Attribute	<code>dsconf</code> Server Property
Account Lockout	<code>pwdFailureCountInterval</code>	<code>pwd-failure-count-interval</code>
	<code>pwdLockout</code>	<code>pwd-lockout-enabled</code>
	<code>pwdLockoutDuration</code>	<code>pwd-lockout-duration</code>
	<code>pwdMaxFailure</code>	<code>pwd-max-failure-count</code>

Policy Area	Policy Attribute	dsconf Server Property
Password Changes	passwordRootdnMayBypassModsChecks	pwd-root-dn-bypass-enabled
	pwdAllowUserChange	pwd-user-change-enabled
	pwdInHistory	pwd-max-history-count
	pwdMinAge	pwd-min-age
	pwdMustChange	pwd-must-change-enabled
Password Content	pwdSafeModify	pwd-safe-modify-enabled
	pwdCheckQuality	pwd-check-enabled, pwd-accept-hashed-password-enabled, pwd-strong-check-dictionary-path, pwd-strong-check-enabled, pwd-strong-check-require-charset
	pwdMinLength	pwd-min-length
Password Expiration	passwordStorageScheme	pwd-storage-scheme
	pwdExpireWarning	pwd-expire-warning-delay
	pwdGraceAuthNLimit	pwd-grace-login-limit
Tracking Last Authentication Time	pwdMaxAge	pwd-max-age
	pwdKeepLastAuthTime	pwd-keep-last-auth-time-enabled

Note – The properties that correlate to `pwdCheckQuality` configure the Password Check plug-in. Therefore, the five properties apply to the entire server instance. The five properties thus also apply to other password policies where `pwdCheckQuality: 2`.

▼ To View Default Password Policy Settings

You can view default password policy settings with the `dsconf` command.

You can use DSCC to perform this task. For information, see [“Directory Service Control Center Interface” on page 43](#) and the DSCC online help.

- **Read the default password policy configuration.**

```
$ dsconf get-server-prop -h host -p port | grep ^pwd-
pwd-accept-hashed-pwd-enabled      : N/A
pwd-check-enabled                   : off
pwd-compat-mode                     : DS5-compatible-mode
```



```

pwd-expire-no-warning-enabled      : on
pwd-expire-warning-delay          : 1d
pwd-failure-count-interval        : 10m
pwd-grace-login-limit             : disabled
pwd-keep-last-auth-time-enabled   : off
pwd-lockout-duration              : 1h
pwd-lockout-enabled               : off
pwd-lockout-repl-priority-enabled : on
pwd-max-age                       : disabled
pwd-max-failure-count             : 3
pwd-max-history-count             : disabled
pwd-min-age                      : disabled
pwd-min-length                    : 6
pwd-mod-gen-length                : 6
pwd-must-change-enabled           : off
pwd-root-dn-bypass-enabled        : off
pwd-safe-modify-enabled           : off
pwd-storage-scheme                : SSHA
pwd-strong-check-dictionary-path  : /local/ds6/plugins/words-english-big.txt
pwd-strong-check-enabled          : off
pwd-strong-check-require-charset  : lower
pwd-strong-check-require-charset  : upper
pwd-strong-check-require-charset  : digit
pwd-strong-check-require-charset  : special
pwd-supported-storage-scheme      : CRYPT
pwd-supported-storage-scheme      : SHA
pwd-supported-storage-scheme      : SSHA
pwd-supported-storage-scheme      : NS-MTA-MD5
pwd-supported-storage-scheme      : CLEAR
pwd-user-change-enabled           : on

```

▼ To Change Default Password Policy Settings

You can change the default password policy by setting server properties with the `dsconf` command.

Note – Before completing this procedure, read and complete the [“Worksheet for Defining Password Policy” on page 174](#).

You can use DSCC to perform this task. For information, see [“Directory Service Control Center Interface” on page 43](#) and the DSCC online help.

- 1 **Translate the settings from your worksheet into `dsconf` command property settings.**

2 Use the `dsconf set-server-prop` command to change default password policy properties appropriately.

For example, the following command allows the Directory Manager to violate the default policy when modifying passwords:

```
$ dsconf set-server-prop -h host -p port pwd-root-dn-bypass-enabled:on
```

Managing Specialized Password Policies

Specialized password policies are defined in a `pwdPolicy(5dsoc)` entry. A policy can be defined anywhere in the directory tree, typically in a subtree that is replicated with the accounts that the policy governs. The policy has a DN of the form `cn=policy name, subtree`.

After defining the password policy, you assign the password policy by setting the `pwdPolicySubentry(5dsat)` attribute in the desired user entry.

This section covers these topics:

- [“Which Password Policy Applies” on page 178](#)
- [“To Create a Password Policy” on page 179](#)
- [“To Assign a Password Policy to an Individual Account” on page 181](#)
- [“To Assign a Password Policy Using Roles and CoS” on page 182](#)
- [“To Set Up a First Login Password Policy” on page 184](#)

Which Password Policy Applies

Directory Server allows you to configure multiple password policies. This section explains default password policies and specialized password policies. This section also explains which policy is enforced when multiple password policies could apply to a given account.

When you first create a Directory Server instance, that instance has a default password policy. That default password policy is expressed in the configuration entry `cn=PasswordPolicy, cn=config`. The default password policy applies to all accounts in the directory except for the Directory Manager.

As in all Directory Server password policies, `cn=PasswordPolicy, cn=config` has object class `pwdPolicy(5dsoc)` and object class `sunPwdPolicy(5dsoc)`.

Note – When you create a Directory Server instance, password policy attributes remain in Directory Server 5 compatible mode to facilitate upgrading from earlier versions. In Directory Server 5 compatible mode, Directory Server also handles password policy entries that have object class `passwordPolicy(5dsoc)`.

After your upgrade is complete, you use the new password policy in fully featured mode, as described in *Sun Java System Directory Server Enterprise Edition 6.2 Migration Guide*. The administrative move is transparent to directory applications.

This chapter covers password policy configuration using the new password policy features.

You can change the default password policy to override the default settings. You can use the `dsconf(1M)` command to set the server properties for default password policy. Such server property names typically start with the `pwd-` prefix. When changing settings for such properties, you override the default password policy for the instance. Replication does not, however, copy the changes to replicas. The changes that you make to the default password policy are part of the configuration for the instance, not part of the directory data.

In addition to configuring the default password policy, you can also configure *specialized password policies*. A specialized password policy is defined by an entry in the directory tree. The specialized password policy entry has the same object class, `pwdPolicy(5dsoc)`, as the default password policy, and therefore takes the same policy attributes. Because specialized password policies are regular directory entries, policy entries are replicated in the same manner as regular directory entries.

A user entry references a specialized password policy through the value of the operational attribute `pwdPolicySubentry(5dsat)`. When referenced by a user entry, a specialized password policy overrides the default password policy for the instance. In many deployments, you assign users roles. You can configure roles to work with class of service (CoS) to determine the password policies that apply to user accounts, by setting the `pwdPolicySubentry` value. To override the password policy set by a role, change the `pwdPolicySubentry` value on that user's entry directly.

To summarize this section, initially the default password policy applies. You can change the default password policy to override the defaults. You can then create specialized password policy entries to override the default password policy. When you assign password policy with roles and CoS, you can override the CoS-assigned policy by specifying a password policy for an individual entry.

▼ To Create a Password Policy

You create and modify specialized password policies in the same way that you create and modify any other directory entry. The following procedure demonstrates use of a text editor to

write the password policy entry in LDIF. Then you use the `ldapmodify` command with the `-a` option to add the password policy entry to the directory.

You can use DSCC to perform this task. For information, see [“Directory Service Control Center Interface” on page 43](#) and the DSCC online help.

Before You Begin Example data as shown here is from `Example.ldif` unless stated otherwise.

1 Complete a password policy worksheet for the policy you want to create.

See [“Worksheet for Defining Password Policy” on page 174](#) for a sample.

2 Write a password policy entry, in LDIF, that is based on the worksheet.

For example, the following policy entry specifies a password policy for temporary employees at `Example.com`, whose subtree root is `dc=example,dc=com`:

```
dn: cn=TempPolicy,dc=example,dc=com
objectClass: top
objectClass: pwdPolicy
objectClass: sunPwdPolicy
objectClass: LDAPsubentry
cn: TempPolicy
pwdAttribute: userPassword
pwdCheckQuality: 2
pwdLockout: TRUE
pwdLockoutDuration: 300
pwdMaxFailure: 3
pwdMustChange: TRUE
```

In addition to the default password policy settings, the policy as shown here specifies additional behaviors. Password quality checks are enforced. Accounts are locked for five minutes, 300 seconds, after three consecutive bind failures. Passwords must be changed after the passwords are reset. After the policy is assigned to user accounts, the settings *explicitly* specified here override the default password policy.

3 Add the password policy entry to the directory.

For example, the following command adds the password policy for temporary employees at `Example.com` under `dc=example,dc=com`. The password policy has been saved in a file named `pwp.ldif`.

```
$ ldapmodify -a -D uid=kvaughan,ou=people,dc=example,dc=com -w - -f pwp.ldif
Enter bind password:
adding new entry cn=TempPolicy,dc=example,dc=com
```

```
$ ldapsearch -D uid=kvaughan,ou=people,dc=example,dc=com -w --b dc=example,dc=com \
"(&(objectclass=ldapsubentry)(cn=temppolicy))"
Enter bind password:
version: 1
```

```
dn: cn=TempPolicy,dc=example,dc=com
objectClass: top
objectClass: pwdPolicy
objectClass: LDAPsubentry
cn: TempPolicy
pwdCheckQuality: 2
pwdLockout: TRUE
pwdLockoutDuration: 300
pwdMaxFailure: 3
pwdMustChange: TRUE
$
```

As shown in `Example.ldif`, `kvaughan` is an Human Resources manager who has access to modify `dc=example,dc=com` entries. `Vaughan's` bind password, as shown in `Example.ldif`, is `bribery`.

See Also To define which user accounts are governed by the policies you define, see [“To Assign a Password Policy to an Individual Account” on page 181](#) or [“To Assign a Password Policy Using Roles and CoS” on page 182](#).

▼ To Assign a Password Policy to an Individual Account

This procedure assigns an existing password policy to a single user account.

Note – To complete this procedure, you must have a specialized password policy to assign. See [“To Create a Password Policy” on page 179](#).

You can use DSCC to perform this task. For information, see [“Directory Service Control Center Interface” on page 43](#) and the DSCC online help.

Example data shown here is from `Example.ldif` unless stated otherwise.

- **Add the password policy DN to the values of the `pwdPolicySubentry` attribute of the user entry.**

For example, the following commands assign the password policy that is defined in [“To Create a Password Policy” on page 179](#) to David Miller's entry, whose DN is

```
uid=dmiller,ou=people,dc=example,dc=com:
```

```
$ cat pwp.ldif
```

```
dn: uid=dmiller,ou=people,dc=example,dc=com
```

```
changetype: modify
```

```
add: pwdPolicySubentry
```

```
pwdPolicySubentry: cn=TempPolicy,dc=example,dc=com
```

```
$ ldapmodify -D uid=kvaughan,ou=people,dc=example,dc=com -w - -f pwp.ldif
```

```

Enter bind password:
modifying entry uid=dmiller,ou=people,dc=example,dc=com

$ ldapsearch -D uid=kvaughan,ou=people,dc=example,dc=com -w - -b dc=example,dc=com \
"(uid=dmiller)" pwdPolicySubentry
Enter bind password:
version: 1
dn: uid=dmiller, ou=People, dc=example,dc=com
pwdPolicySubentry: cn=TempPolicy,dc=example,dc=com
$

```

As shown in Example. ldif, kvaughan is a Human Resources manager who has access to modify dc=example, dc=com entries. Vaughan's bind password, as shown in Example. ldif, is bribery.

▼ To Assign a Password Policy Using Roles and CoS

This procedure assigns an existing specialized password policy to a set of users by applying roles and class of service (CoS). See [Chapter 9, “Directory Server Groups, Roles, and CoS,”](#) for more information about roles and CoS.

Note – To complete this procedure, you must have a specialized password policy to assign. See [“To Create a Password Policy” on page 179.](#)

You can use DSCC to perform this task. For information, see [“Directory Service Control Center Interface” on page 43](#) and the DSCC online help.

Example data shown here is from Example. ldif unless stated otherwise.

1 Create a role for the entries to be governed by the password policy.

For example, the following commands create a filtered role for temporary employees at Example.com:

```

$ cat tmp.ldif
dn: cn=TempFilter,ou=people,dc=example,dc=com
objectclass: top
objectclass: LDAPsubentry
objectclass: nsRoleDefinition
objectclass: nsComplexRoleDefinition
objectclass: nsFilteredRoleDefinition
cn: TempFilter
nsRoleFilter: (&(objectclass=person)(status=contractor))
description: filtered role for temporary employees

$ ldapmodify -a -D uid=kvaughan,ou=people,dc=example,dc=com -w - -f tmp.ldif
Enter bind password:

```

```
modifying entry cn=TempFilter,ou=people,dc=example,dc=com
```

```
$
```

As shown in Example. ldif, kvaughan is a Human Resources manager who has access to modify dc=example, dc=com entries. Vaughan's bind password, as shown in Example. ldif, is bribery.

2 Create a class of service to generate the DN of the password policy entry.

The DN is the value of the pwdPolicySubentry attribute of users who have the role that you created.

For example, the following commands create a filtered role for temporary employees at Example.com. The commands assign cn=TempPolicy, dc=example, dc=com to users who have the role.

```
$ cat cos.ldif
dn: cn=PolTempl,dc=example,dc=com
objectclass: top
objectclass: nsContainer

dn: cn="cn=TempFilter,ou=people,dc=example,dc=com",
   cn=PolTempl,dc=example,dc=com
objectclass: top
objectclass: extensibleObject
objectclass: LDAPsubentry
objectclass: costemplate
cosPriority: 1
pwdPolicySubentry: cn=TempPolicy,dc=example,dc=com

dn: cn=PolCoS,dc=example,dc=com
objectclass: top
objectclass: LDAPsubentry
objectclass: cosSuperDefinition
objectclass: cosClassicDefinition
cosTemplateDN: cn=PolTempl,dc=example,dc=com
cosSpecifier: nsRole
cosAttribute: pwdPolicySubentry operational

$ ldapmodify -a -D uid=kvaughan,ou=people,dc=example,dc=com -w - -f cos.ldif
Enter bind password:
modifying entry cn=TempFilter,ou=people,dc=example,dc=com

$
```

Users whose status is contractor now become subject to the password policy cn=TempPolicy, dc=example, dc=com.

▼ To Set Up a First Login Password Policy

In many deployments, the password policy to apply for new accounts differs from the password policy to apply for established accounts. This section demonstrates a first login password policy. The policy gives users three days to use a newly created account, and set their new passwords before that account is locked. The policy is designed to work in the same way for users whose passwords have been reset.

You cannot use DSCC to perform this task. Use the command line, as described in this procedure.

1 Create a specialized password policy for newly created accounts.

For example, add a password policy entry that sets expiration time to three days, which is 259,200 seconds. This password policy also has `pwdMustChange(5dsat)` set to `TRUE`, meaning the users must change their passwords when they first bind.

```
$ cat firstLogin.ldif
dn: cn=First Login,dc=example,dc=com
objectClass: top
objectClass: LDAPsubentry
objectClass: pwdPolicy
objectClass: sunPwdPolicy
cn: First Login
passwordStorageScheme: SSHA
pwdAttribute: userPassword
pwdInHistory: 0
pwdExpireWarning: 86400
pwdLockout: TRUE
pwdMinLength: 6
pwdMaxFailure: 3
pwdMaxAge: 259200
pwdFailureCountInterval: 600
pwdAllowUserChange: TRUE
pwdLockoutDuration: 3600
pwdMinAge: 0
pwdCheckQuality: 2
pwdMustChange: TRUE

$ ldapmodify -a -D cn=admin,cn=Administrators,cn=config -w - -f firstLogin.ldif
Enter bind password:
adding new entry cn=First Login,dc=example,dc=com

$
```


2 Create a role that includes all newly created accounts.

In creating this role, set up some way to distinguish newly created accounts from established accounts.

a. Define new accounts as accounts that have a `pwdReset(5dsat)` attribute set to TRUE.

When a user's password is changed by another user, such as a password administrator, `pwdReset` is set to TRUE.

b. Create the role that identifies new accounts.

For example, the following commands create a role for accounts whose passwords have been reset.

```
$ cat newRole.ldif
dn: cn=First Login Role,ou=people,dc=example,dc=com
objectclass: top
objectclass: LDAPsubentry
objectclass: nsRoleDefinition
objectclass: nsComplexRoleDefinition
objectclass: nsFilteredRoleDefinition
cn: First Login Role
nsRoleFilter: (pwdReset=TRUE)
description: Role to assign password policy for new and reset accounts

$ ldapmodify -a -D uid=kvaughan,ou=people,dc=example,dc=com -w - -f newRole.ldif
Enter bind password:
adding new entry cn=First Login Role,ou=people,dc=example,dc=com

$
```

3 Assign the password policy for newly created accounts with class of service.

```
$ cat newCoS.ldif
dn: cn=First Login Template,dc=example,dc=com
objectClass: top
objectClass: nsContainer

dn: cn="cn=First Login Role,ou=people,dc=example,dc=com",
  cn=First Login Template,dc=example,dc=com
objectClass: top
objectClass: extensibleObject
objectClass: LDAPSubEntry
objectClass: CoSTemplate
cosPriority: 1
pwdPolicySubentry: cn=First Login,dc=example,dc=com

dn: cn=First Login CoS,dc=example,dc=com
objectClass: top
objectClass: LDAPSubEntry
```

```
objectClass: CoSSuperDefinition
objectClass: CoSClassicDefinition
cosTemplateDN: cn=First Login Template,dc=example,dc=com
cosSpecifier: nsRole
cosAttribute: pwdPolicySubentry operational

$ ldapmodify -a -D uid=kvaughan,ou=people,dc=example,dc=com -f newCoS.ldif
Enter bind password:
adding new entry cn=First Login Template,dc=example,dc=com

adding new entry cn="cn=First Login Role,ou=people,dc=example,dc=com",
cn=First Login Template,dc=example,dc=com

adding new entry cn=First Login CoS,dc=example,dc=com

$
```

Example 7-1 Checking Password Policy Assignment

Add a new user that fits the role that you have added. You add the user to verify that new users are subject to the new password policy, but existing users are not.

```
$ cat quentin.ldif
dn: uid=qcubbins,ou=People,dc=example,dc=com
objectclass: top
objectclass: person
objectclass: organizationalPerson
objectclass: inetOrgPerson
uid: qcubbins
givenName: Quentin
sn: Cubbins
cn: Quentin Cubbins
mail: quentin.cubbins@example.com
userPassword: ch4ngeM3!
description: New account

$ ldapmodify -a -D uid=kvaughan,ou=people,dc=example,dc=com -w - -f quentin.ldif
Enter bind password:
adding new entry uid=qcubbins,ou=People,dc=example,dc=com

$ ldapsearch -D uid=kvaughan,ou=people,dc=example,dc=com -w - \
-b dc=example,dc=com uid=qcubbins nsrole pwdPolicySubentry
Enter bind password:
version: 1
dn: uid=qcubbins,ou=People,dc=example,dc=com
nsrole: cn=first login role,ou=people,dc=example,dc=com
pwdPolicySubentry: cn=First Login,dc=example,dc=com
$ ldapsearch -b dc=example,dc=com uid=bjensen nsrole pwdPolicySubentry
```

```

version: 1
dn: uid=bjensen, ou=People, dc=example,dc=com
$

```

Notice that Barbara Jensen's existing account is governed by the default password policy. Quentin Cubbins's new account is governed, however, by the password policy that you defined.

Modifying Passwords From the Command Line When `pwdSafeModify` Is TRUE

When the password policy for a user has `pwdSafeModify` set to TRUE, the old password must be provided with the new password to change the password. The command `dsconf set-server-prop pwd-safe-modify-enabled:on` has the same effect for the default password policy.

You can use the `ldappasswd(1)` command to change the password. This command provides support for safe password modification. This command implements RFC 3062, *LDAP Password Modify Extended Operation* (<http://www.ietf.org/rfc/rfc3062.txt>)

You can use the `ldapmodify(1)` command to change the password. The LDIF that you pass to the `ldapmodify` command in that case should be as follows:

```

dn: DN of user whose password you are changing
changetype: modify
delete: userPassword
userPassword: old password
-
add: userPassword
userPassword: new password

```

You can also use the LDAP password modify extended operation. Setting up support for the extended operation is explained in “[To Reset a Password With the Password Modify Extended Operation](#)” on page 188.

Resetting Expired Passwords

When password policy enforces password expiration, some users will not change their passwords in time. This section shows how you can change passwords that have expired.

Note – Directory Server updates the operational attribute `pwdChangedTime(5dsat)` every time that the password on the entry is modified. As a result, if you wait to enable password expiration, user passwords that have already aged expire immediately when you enable password expiration. Use warnings and grace logins if this behavior is not what you intend.

This section includes procedures for resetting a password with the password modify extended operation and for allowing grace authentications when passwords expire.

The mechanisms described in this section are intended for use by administrators, or by applications that handle the actual user interaction with the directory. You typically rely on an application to ensure that the end user is in fact using the mechanisms in the way you intended.

▼ To Reset a Password With the Password Modify Extended Operation

User accounts are locked when passwords expire. When you reset the password, you unlock the account. The password can be reset by another user such as an administrator. After password reset, Directory Server unlocks the user account. Directory Server provides support for RFC 3062, *LDAP Password Modify Extended Operation* (<http://www.ietf.org/rfc/rfc3062.txt>). The extended operation enables you to allow a directory administrator or a directory application to unlock accounts through password reset.

Be cautious when allowing use of the password modify extended operation, as shown in this procedure. Limit access to administrators and applications that you trust. Do not allow passwords to travel over the network in clear text.

You cannot use DSCC to perform this task. Use the command line, as described in this procedure.

- 1 Give users access to a password administrator or to a password administration application.**
- 2 Allow the password administrator access to use the password modify extended operation.**

The following commands set an ACI to allow members of a Password Managers role to use the password modify extended operation when connected over SSL:

```
$ cat exop.ldif
dn: oid=1.3.6.1.4.1.4203.1.11.1,cn=features,cn=config
objectClass: top
objectClass: directoryServerFeature
oid: 1.3.6.1.4.1.4203.1.11.1
cn: Password Modify Extended Operation
aci: (targetattr != "aci")(version 3.0;
  acl "Password Modify Extended Operation
```

```
" ; allow( read, search, compare, proxy ) ( roledn = "
ldap:///cn=Password Managers,dc=example,dc=com" and authmethod = "SSL");)
```

```
$ ldapmodify -a -D cn=admin,cn=Administrators,cn=config -w - -f exop.ldif
Enter bind password:
adding new entry oid=1.3.6.1.4.1.4203.1.11.1,cn=features,cn=config
```

```
$
```

The entry under `cn=features,cn=config` allows you to manage access to operations that use the password modify extended operation.

3 Have the password administrator reset the user password.

This step unlocks the user account, and can be completed with the `ldappaswd(1)` command.

4 (Optional) If the user must change the password, have the password administrator notify the user.

Users must change their passwords after reset if the password policy that governs their entries includes `pwdMustChange: TRUE`.

▼ To Allow Grace Authentications When Passwords Expire

This procedure describes how to give users grace authentications, allowing users to change passwords that have expired.

The grace authentications are intended to be managed by an application that handles password policy request and response controls. The procedure shows a simple example of how to use the control in an application.

You cannot use DSCC to perform this task. Use the command line, as described in this procedure.

1 Make sure that users have access to an application that uses password policy request and response controls.

The application should ensure that users handle grace authentications properly.

2 Allow the application to use the password policy controls.

The following commands set an ACI to allow members of a Password Managers role to use the password policy controls:

```
$ cat ctrl.ldif
dn: oid=1.3.6.1.4.1.42.2.27.8.5.1,cn=features,cn=config
objectClass: top
```

```
objectClass: directoryServerFeature
oid: 1.3.6.1.4.1.42.2.27.8.5.1
cn: Password Policy Controls
aci: (targetattr != "aci")(version 3.0; acl "Password Policy Controls
"; allow( read, search, compare, proxy ) roledn = "
ldap:///cn=Password Managers,dc=example,dc=com");)

$ ldapmodify -a -D cn=admin,cn=Administrators,cn=config -w - -f ctrl.ldif
Enter bind password:
adding new entry oid=1.3.6.1.4.1.42.2.27.8.5.1,cn=features,cn=config

$
```

The entry under `cn=features, cn=config` has the sole purpose of allowing you to manage access to operations that use the password policy request and response controls.

- 3 **Set `pwdGraceAuthNLimit` in the password policy to the number of authentications to allow after the password has expired.**
- 4 **Make sure that the application guides the end user to change the expired password promptly before grace authentications are exhausted.**

Setting Account Properties

The following sections describe how to set the look-through limit, size limit, time limit and idle timeout of an account.

▼ To Set the Look-Through Limit for an Account

- **Use the `ldapmodify` command to set the value of `nsLookThroughLimit`.**

The following command removes the look-through limit for Barbara Jensen:

```
$ ldapmodify -D cn=admin,cn=Administrators,cn=config -w -
Enter bind password:
dn: uid=bjensen,ou=people,dc=example,dc=com
changetype: modify
add: nsLookThroughLimit
nsLookThroughLimit: -1
^D
modifying entry uid=bjensen,ou=people,dc=example,dc=com

^D
$
```

▼ To Set the Size Limit for an Account

- Use the `ldapmodify` command to set the value of `nsSizeLimit`.

The following command removes the size limit for Barbara Jensen:

```
$ ldapmodify -D cn=admin,cn=Administrators,cn=config -w -
Enter bind password:
dn: uid=bjensen,ou=people,dc=example,dc=com
changetype: modify
add: nsSizeLimit
nsSizeLimit: -1
^D
modifying entry uid=bjensen,ou=people,dc=example,dc=com

^D
$
```

▼ To Set the Time Limit for an Account

- Use the `ldapmodify` command to set the value of `nsTimeLimit`.

The following command removes the time limit for Barbara Jensen:

```
$ ldapmodify -D cn=admin,cn=Administrators,cn=config -w -
Enter bind password:
dn: uid=bjensen,ou=people,dc=example,dc=com
changetype: modify
add: nsTimeLimit
nsTimeLimit: -1
^D
modifying entry uid=bjensen,ou=people,dc=example,dc=com

^D
$
```

▼ To Set the Idle Timeout for an Account

- Use the `ldapmodify` command to set the value of `nsIdleTimeout`.

The following command sets the idle timeout for Barbara Jensen to five minutes (300 seconds):

```
$ ldapmodify -D cn=admin,cn=Administrators,cn=config -w -
Enter bind password:
dn: uid=bjensen,ou=people,dc=example,dc=com
changetype: modify
add: nsIdleTimeout
```

```
nsIdleTimeout: 300
^D
modifying entry uid=bjensen,ou=people,dc=example,dc=com

^D
$
```

Manually Locking Accounts

Directory Server allows you to configure password policy to force the lockout of accounts after a specified number of failed bind attempts. See [“Policy for Account Lockout” on page 170](#) for details. This section covers manual account locking and activation tools that the Directory Manager can use.

The Directory Manager can manage account lockout without using the lockout duration timer. The locked account remains locked until the password is manually reset. The Directory Manager can also render certain accounts inactive for an indefinite period of time.

This section shows how to check account status, render accounts inactive, and reactivate accounts.

▼ To Check Account Status

Check account status as shown here.

Note – You must bind as the Directory Manager.

You cannot use DSCC to perform this task. Use the command line, as described in this procedure.

- **Use the `ns-accountstatus` command to check the status the account or role.**

The following command checks Barbara Jensen's account status:

```
$ ns-accountstatus -D "cn=Directory Manager" -j pwd.txt \  
-I uid=bjensen,ou=people,dc=example,dc=com \  
uid=bjensen,ou=people,dc=example,dc=com activated.  
$
```

See the `ns-accountstatus(1M)` man page for details.

▼ To Render Accounts Inactive

Render an account or a role inactive as shown here.

Note – You must bind as the Directory Manager.

You cannot use DSCC to perform this task. Use the command line, as described in this procedure.

- **Use the `ns -inactivate` command to render the account or role inactive.**

The following command renders Barbara Jensen's account inactive:

```
$ ns-inactivate -D "cn=Directory Manager" -j pwd.txt \  
-I uid=bjensen,ou=people,dc=example,dc=com \  
uid=bjensen,ou=people,dc=example,dc=com inactivated.  
$
```

See the `ns -inactivate(1M)` man page for details.

▼ To Reactivate Accounts

Unlock an account or a role as shown here.

Note – You must bind as the Directory Manager.

You cannot use DSCC to perform this task. Use the command line, as described in this procedure.

- **Use the `ns -activate` command to reactivate the account or role.**

The following command renders Barbara Jensen's account active again:

```
$ ns-activate -D "cn=Directory Manager" -j pwd.txt \  
-I uid=bjensen,ou=people,dc=example,dc=com \  
uid=bjensen,ou=people,dc=example,dc=com activated.  
$
```

`ns -activate(1M)` man page for details.

Directory Server Backup and Restore

The data managed by your Directory Server is often imported in bulk. Directory Server Enterprise Edition provides tools for importing and exporting entire suffixes. It also provides tools for making backups of all suffixes at once and for restoring all data from a backup.

Before starting any backup or restore operation, ensure that you design a backup and restore strategy to suit your situation. For more information about the different backup options, considerations to take into account, and guidelines for planning a backup and restore strategy, see “Designing Backup and Restore Policies” in *Sun Java System Directory Server Enterprise Edition 6.2 Deployment Planning Guide*.

This chapter covers the following topics:

- “Binary Backup” on page 195
- “Backing Up to LDIF” on page 198
- “Binary Restore” on page 199
- “Importing Data From an LDIF File” on page 201
- “Restoring Replicated Suffixes” on page 204
- “Disaster Recovery” on page 208

Binary Backup

This section explains how to perform a binary backup of directory data. In addition to the binary backup procedures in this section, you can make a binary copy to use for initializing a suffix in a replication topology. See “[Initializing a Replicated Suffix by Using Binary Copy](#)” on page 249.

Backing Up Directory Data Only

A binary data backup saves a copy of your directory data that you can use if the database files later become corrupted or deleted. This operation does not back up configuration data. If you want to back up the whole Directory Server for disaster recovery, see [“Disaster Recovery” on page 208](#).



Caution – Never stop the server during a backup operation.

Your backup must be performed more frequently than the *purge delay*. The purge delay, specified by the `nsDS5ReplicaPurgeDelay` attribute, is the period of time, in seconds, after which internal purge operations are performed on the change log. The default purge delay is 604800 seconds (1 week). The change log maintains a record of updates, which might or might not have been replicated.

If your backup is performed less frequently than the purge delay, the change log might be cleared before it has been backed up. Changes will therefore be lost if you use the backup to restore data.

All backup procedures described in this section store a copy of the server files on the same host by default. You should then copy and store your backups on a different machine or file system for greater security.

▼ To Back Up Your Directory Data

Your Directory Server must be stopped to run the `dsadm backup` command.

You can use DSCC to perform this task. For information, see [“Directory Service Control Center Interface” on page 43](#) and the DSCC online help.

- **Back up your directory data.**

```
$ dsadm backup instance-path archive-dir
```

For example:

```
$ dsadm backup /local/ds /local/tmp/20051205
```

Note – You can back up directory data while the server is running by using the `dsconf backup` command. However, if changes are made to the directory data while the backup is running, proper recovery is more difficult. To avoid this problem when using `dsconf backup`, set replication referrals or make the server read-only.

For more information about the `dsadm` and `dsconf` commands, see the `dsadm(1M)` and `dsconf(1M)` man pages.

▼ To Back Up the `dse.ldif` File

When restoring a server, the `dse.ldif` configuration file must contain the same configuration information as when the server was backed up.

● Back up your `dse.ldif` configuration file.

```
$ cp instance-path/config/dse.ldif archive-dir
```

When you perform the following actions, Directory Server automatically backs up the `dse.ldif` configuration file in the directory `instance-path/config`.

- When you start Directory Server, a backup of the `dse.ldif` file is created in a file named `dse.ldif.startOK`.
- When you make modifications to the `cn=config` branch, the file is first backed up to a file named `dse.ldif.bak` in the `config` directory before the server writes the modifications to the `dse.ldif` file.

Backing Up a File System

This procedure uses the *frozen mode* feature. Frozen mode enables you to stop database updates on disk so that a file system snapshot can be taken safely. You can use frozen mode as an additional measure for ensuring a robust backup.

Your server must not write user data on the disk while the file system backup is in progress. If you are sure that no updates will occur during a certain time frame, make your backup during this time. If you cannot guarantee that there will be no updates, put your server into frozen mode before making a backup.

A server in frozen mode continues to write to the access and errors logs. In a single-server topology, operations received when frozen mode is on result in an LDAP error being returned. The error message logged is the standard error for the database being offline. In a replicated topology, a referral is returned. For frozen mode to work correctly, no other tasks should be running on the databases.

Note that the databases of a server in frozen mode are more stable than those in read-only mode. Unlike frozen mode, read-only mode permits tasks to be created and configuration entries to be modified. When frozen mode is on, all configured databases are taken offline. Any internal operations in progress are notified of the database going offline. LDAP operations in progress are completed, and the database environment is flushed. Subsequent incoming operations, including searches to user data, are refused until frozen mode is set to off. You can, however, search configuration parameters while frozen mode is on.

▼ To Back Up a File System

For parts of this procedure, you can use DSCC to perform this task. For information, see [“Directory Service Control Center Interface” on page 43](#) and the DSCC online help. Other parts of the procedure can only be done using the command line.

1 (Optional) Put your server into frozen mode.

```
$ dsconf set-server-prop -h host -p port read-write-mode:frozen
```

2 Back up your file system, using a tool appropriate to your file system type.

3 If your server is in frozen mode, make the server read-write again.

```
$ dsconf set-server-prop -h host -p port read-write-mode:read-write
```

If your server receives replication updates from another server, replication updates will start as soon as frozen mode is turned off.

Backing Up to LDIF

Backing up to LDIF allows you to back up directory data to a formatted LDIF file.

Exporting to LDIF

You can back up directory data by exporting the contents of a suffix using LDIF. Exporting data can be useful for doing the following:

- Backing up the data in your server
- Copying your data to another directory server
- Exporting your data to another application
- Repopulating suffixes after a change to your directory topology

The export operations do not export the configuration information (`cn=config`).



Caution – Do not stop the server while an export operation is in progress.

▼ To Export a Suffix to LDIF

You can use DSCC to perform this task. For information, see [“Directory Service Control Center Interface” on page 43](#) and the DSCC online help.

● Use one of the following commands to export a suffix to an LDIF file:

- If your server is local and stopped, type:

```
$ dsadm export instance-path suffix-DN LDIF-file
```

- If your server is remote and running, type:

```
$ dsconf export -h host -p port suffix-DN LDIF-file
```

The following example uses `dsconf export` to export two suffixes to a single LDIF file:

```
$ dsconf export -h host1 -p 1389 ou=people,dc=example,dc=com \
ou=contractors,dc=example,dc=com /local/ds/ldif/export123.ldif
```

The `dsadm export` and `dsconf export` commands can also be used with the `--no-repl` option to specify that no replication information is to be exported. The default is that the replicated suffix is exported to an LDIF file with replication information. The resulting LDIF file will contain attribute subtypes that are used by the replication mechanism. This LDIF file can then be imported on the consumer server to initialize the consumer replica, as described in [“Initializing Replicas” on page 245](#)

For more information about these commands, see the `dsadm(1M)` and `dsconf(1M)` man pages.

Binary Restore

The following procedures describe how to restore suffixes in your directory. Your server must have been backed up using the procedures described in [“Backing Up Directory Data Only” on page 196](#). Before restoring suffixes involved in replication agreements, read [“Restoring Replicated Suffixes” on page 204](#).



Caution – Do not stop the server during a restore operation. Because restoring your server overwrites any existing database files, any modifications that were made to the data since the backup are lost.

▼ To Restore Your Server

You can use DSCC to perform this task. For information, see [“Directory Service Control Center Interface” on page 43](#) and the DSCC online help.

- **Use one of the following commands to restore your server:**

- If your server is local and stopped, type:

```
$ dsadm restore instance-path archive-dir
```

For example, to restore a backup from a backup directory, type:

```
$ dsadm restore /local/ds/ local/ds/bak/2006_07_01_11_34_00
```

- If your server is remote and running, type:

```
$ dsconf restore -h host -p port archive-dir
```

For example, to restore a backup from a backup directory:

```
$ dsconf restore -h host1 -p 1389 /local/ds/bak/2006_07_01_11_34_00
```

For more information about these commands, see the `dsadm(1M)` and `dsconf(1M)` man pages.

Restoring the `dse.ldif` Configuration File

Directory Server creates two backup copies of the `dse.ldif` file in the following directory:

```
instance-path/config
```

The `dse.ldif.startOK` file records a copy of the `dse.ldif` file at server start up. The `dse.ldif.bak` file contains a backup of the most recent changes to the `dse.ldif` file. Copy the file that contains the most recent changes to your directory.

▼ To Restore the `dse.ldif` Configuration File

For parts of this procedure, you can use DSCC to perform this task. For information, see [“Directory Service Control Center Interface” on page 43](#) and the DSCC online help. Other parts of the procedure can only be done using the command line.

1 Stop the server.

```
$ dsadm stop instance-path
```

2 Change to the directory that contains the configuration files.

```
$ cd instance-path/config
```

3 Overwrite the `dse.ldif` file with a backup configuration file that is known to be valid, for example:

```
$ cp dse.ldif.startOK dse.ldif
```

4 Start the server with the following command:

```
$ dsadm start instance-path
```


Importing Data From an LDIF File

You can import data to a Directory Server suffix in the following ways:

- Initialize a suffix from an LDIF file. This operation deletes the current data in the suffix and replaces it with the contents of the LDIF file.
- Use an LDIF file to perform bulk `ldapadd`, `ldapmodify`, or `ldapdelete` operations. This allows you to add, modify, and delete entries in bulk in any suffix of the directory.

The following table shows the differences between initializing a suffix and adding, modifying, and deleting entries in bulk.

TABLE 8-1 Comparison of Initializing a Suffix and Importing Data in Bulk

Domain of Comparison	Initializing Suffixes	Adding, Modifying, and Deleting Entries in Bulk
Overwrites content	Overwrites content	Does not overwrite content
LDAP operations	Add only	Add, modify, delete
Performance	Fast	Slower
Response to server failure	Atomic (all changes are lost after a failure)	Best effort (all changes made up to the point of the failure remain)
LDIF file location	Local to client or local to server	On client machine
Imports configuration information (cn=config)	Imports configuration information	Does not import configuration information
Commands	If server is local and stopped: <code>dsadm import</code> If server is remote and running: <code>dsconf import</code>	<code>ldapmodify -B</code>

Initializing a Suffix

Initializing a suffix overwrites the existing data in a suffix with the contents of an LDIF file that contains only entries for addition.

You must be authenticated as the Directory Manager or an Administrator to initialize a suffix.

When the server is running, only the Directory Manager and Administrators can import an LDIF file that contains a root entry. For security reasons, only these users have access to the root entry of a suffix, for example, `dc=example,dc=com..`

Before restoring suffixes involved in replication agreements, read [“Restoring Replicated Suffixes” on page 204](#).

▼ To Initialize a Suffix

Note – All LDIF files that you import must use UTF-8 character-set encoding.

When initializing a suffix, the LDIF file must contain the root entry and all directory tree nodes of the corresponding suffix.

You can use DSCC to perform this task. For information, see [“Directory Service Control Center Interface” on page 43](#) and the DSCC online help.

- **Use one of the following commands to initialize the suffix from an LDIF file, that is, import the contents of a database to an LDIF file.**



Caution – These commands overwrite the data in your suffix.

- If your server is local and stopped, type:

```
$ dsadm import instance-path LDIF-file suffix-DN
```

The following example uses the `dsadm import` command to import two LDIF files into a single suffix:

```
$ dsadm import /local/ds /local/file/example/demo1.ldif \  
/local/file/example/demo2.ldif dc=example,dc=com
```

- If your server is remote and running, type:

```
$ dsconf import -h host -p port LDIF-file suffix-DN
```

The following example imports an LDIF file using `dsconf import`. You do not need root privileges to run the command, but you must authenticate as a user with root permissions, such as the Directory Manager.

```
$ dsconf import -h host1 -p 1389 /local/file/example/demo1.ldif \  
ou=People,dc=example,dc=com
```

Note – If you run either `dsconf import` or `dsconf reindex` or both commands on multiple suffixes in parallel, transaction logs will grow and might negatively affect performance.

For more information on these commands, see the `dsadm(1M)` and `dsconf(1M)` man pages.

Adding, Modifying, and Deleting Entries in Bulk

When you perform an `ldapmodify` operation, you are able to add, modify, or delete entries in bulk. Entries are specified in an LDIF file that contains update statements to modify or delete existing entries. This operation does not erase entries that already exist.

The changed entries may target any suffix that is managed by your Directory Server. As with any other operation that adds entries, the server will index all new entries as they are imported.

The `ldapmodify` command will import an LDIF file through LDAP and perform all operations that the file contains. Using this command you can modify data in all directory suffixes at the same time.

Before restoring suffixes involved in replication agreements, see [“Restoring Replicated Suffixes” on page 204](#).

▼ To Add, Modify and Delete Entries in Bulk

Note – All LDIF files that you import must use UTF-8 character-set encoding.

When importing an LDIF file, parent entries must either exist in the directory or be added first from the file.

You can use DSCC to perform this task. For information, see [“Directory Service Control Center Interface” on page 43](#) and the DSCC online help.

- **Add, modify, or delete from an LDIF file in bulk.**

```
$ ldapmodify -D cn=admin,cn=Administrators,cn=config -w - -B baseDN -f LDIF-file
```

The following example performs an import using the `ldapmodify` command. You do not need root privileges to run this command, but you must authenticate as a user with root permissions, such as `cn=Directory Manager` or `cn=admin,cn=Administrators,cn=config`. The last parameter specifies the name of the LDIF file to import.

```
$ ldapmodify -D cn=admin,cn=Administrators,cn=config -w - \
  -B dc=example,dc=com -f /local/ds/ldif/demo.ldif
```

Restoring Replicated Suffixes

Suffixes that are replicated between supplier servers and consumer servers require special consideration before being restored. If possible, update the suffix through the replication mechanism instead of restoring it from a backup.

When you restore a supplier or hub instance, the server configuration must be the same as it was when the backup was made. To ensure this, restore the `dse.ldif` file before restoring Directory Server data. See [“Restoring the `dse.ldif` Configuration File” on page 200](#).

This section explains how and when to restore a replica, and how to ensure that it is synchronized with other replicas after the operation. To initialize a replica, see [“Initializing Replicas” on page 245](#).

If you have a large replicated suffix and you want to add many entries and ensure that replication updates are added correctly, see [“Incrementally Adding Many Entries to Large Replicated Suffixes” on page 253](#).

This section contains information about the following:

- [“Restoring the Supplier in a Single-Master Scenario” on page 204](#)
- [“Restoring a Supplier in a Multi-Master Scenario” on page 205](#)
- [“Restoring a Hub” on page 206](#)
- [“Restoring a Dedicated Consumer” on page 206](#)
- [“Restoring a Master in a Multi-Master Scenario” on page 207](#)

Restoring the Supplier in a Single-Master Scenario

A suffix that is a single-master supplier contains the authoritative data for the entire replication topology. Therefore, restoring this suffix is equivalent to reinitializing all data in the entire topology. You should restore a single master only if you want to reinitialize all data from the contents of the backup to be restored.

If the single-master data is not recoverable due to an error, consider using the data on one of the consumers because it might contain updates that are more recent than a backup. In this case, you need to export the data from the consumer replica to an LDIF file, and reinitialize the master from the LDIF file.

Whether you restore a backup or import an LDIF file on a master replica, you must then reinitialize all of the hubs and consumer replicas that receive updates from this replica. A message is logged to the supplier servers’ log files to remind you that reinitialization of the consumers is required.

Restoring a Supplier in a Multi-Master Scenario

In multi-master replication, the other masters each contain an authoritative copy of the replicated data. You cannot restore an old backup because it might be out of date with the current replica contents. If possible, allow the replication mechanism to bring the master up to date from the contents of the other masters.

If that is not possible, restore a multi-master replica in one of the following ways:

- The simplest way is not to restore a backup, but to reinitialize the intended master from one of the other masters. This ensures that the latest data is sent to the intended master and that the data will be ready for replication. See [“Replica Initialization From LDIF” on page 246](#).
- For replicas with millions of entries, it can be faster to make a binary copy to restore a more recent backup of one of the other masters. See [“Initializing a Replicated Suffix by Using Binary Copy” on page 249](#).
- If you have a backup of your master that is not older than the maximum age of the change log contents on *any* of the other masters, the backup may be used to restore this master. See [“To Modify Change Log Settings on a Master Replica” on page 238](#) for a description of change log age. When the old backup is restored, the other masters will use their change logs to update this master with all modifications that have been processed since the backup was saved.

Regardless of how you restore or reinitialize, the master replica will remain in read-only mode after the initialization. This behavior allows the replica to synchronize with the other masters, after which time you may allow write operations, as described in [“Restoring a Master in a Multi-Master Scenario” on page 207](#).

The advantage of allowing all replicas to converge before allowing write operations on the restored or reinitialized master is that none of the hub or consumer servers will require reinitialization.

Restoring a Hub

This section applies only in situations where the replication mechanism cannot automatically bring a hub replica up to date. Such situations include if the database files become corrupted or if replication has been interrupted for too long. In these cases, you need to restore or reinitialize the hub replica in one of the following ways:

- The simplest way is not to restore a backup, but to reinitialize the hub from one of the master replicas. This ensures that the latest data is sent to the hub and that the data will be ready for replication. See [“Initializing a Suffix” on page 201](#).
- For replicas with millions of entries, it can be faster to make a binary copy to restore a more recent backup taken from another hub replicated suffix. See [“Initializing a Replicated Suffix by Using Binary Copy” on page 249](#). If there is no other hub replica to copy, reinitialize the hub as described in the previous item, or restore it as described in the next item, if possible.
- If you have a backup of your hub that is not older than the maximum age of the change log contents on *any* of its suppliers, either hub or master replicas, the backup may be used to restore this hub. When the hub is restored, its suppliers will use their change logs to update this hub with all modifications that have been processed since the backup was saved.

Note – Regardless of how you restore or reinitialize the hub replica, you *must* then reinitialize all consumers of this hub, including any other levels of hubs.

Restoring a Dedicated Consumer

This section applies only in situations where the replication mechanism cannot automatically bring a dedicated consumer replica up to date. Such situations include if the database files become corrupted or if replication has been interrupted for too long. In these cases, you need to restore or reinitialize the consumer in one of the following ways:

- The simplest way is not to restore a backup, but to reinitialize the consumer from one of its suppliers, either a master or a hub replica. This ensures that the latest data is sent to the consumer and that the data will be ready for replication. See [“Replica Initialization From LDIF” on page 246](#).
- For replicas with millions of entries, it can be faster to make a binary copy to restore a more recent backup taken from another consumer replicated suffix. See [“Initializing a Replicated Suffix by Using Binary Copy” on page 249](#). If there is no other consumer to copy, reinitialize the replica as described in the previous item or restore it as described in the next item, if possible.
- If the backup of your consumer is not older than the maximum age of change log contents on *any* of its suppliers, either hub or master replicas, the backup may be used to restore this consumer. When the consumer is restored, its suppliers will use their change logs to update the consumer with all modifications that have been processed since the backup was saved.

Restoring a Master in a Multi-Master Scenario

In the case of multi-master replication, other masters may process change operations while a given master is being restored. Therefore, when restoration is complete, the new master must also receive new updates that were not included in the restore data. Because restoring a master might take a significant amount of time, the number of pending updates might also be significant.

To allow convergence of these pending updates, newly restored masters are automatically set to read-only mode for client operations after restoration. This is true only when restoring a master by importing data from an LDIF file at the command line, or by using a backup to perform a binary copy.

Therefore, after restoration, a master in a multi-master configuration will process replication updates and allow read operations, but it will return referrals for all write operations from clients.

To verify that the new master is fully synchronized with the other masters before allowing updates, manually enable updates on an initialized master.

Note – With master replicas sending referrals because of this new behavior, clients wanting to perform write operations might reach their configured hop limit. You might need to increase the hop limit configuration for clients so they can reach an available master. If all master replicas are initialized or reinitialized, all write operations will fail because no replica will be accepting client updates.

In any case, monitor initialized masters closely, and set the referral attributes appropriately to maximize server response.

▼ To Begin Accepting Updates Through the Command Line

You can use DSCC to perform this task. For information, see [“Directory Service Control Center Interface” on page 43](#) and the DSCC online help.

The following commands can be used in scripts that automate the process of initializing a multi-master replica.

1 Use the `insync` tool to ensure that the replica has converged with all other masters.

Replicas are in sync if the delay between modifications on all servers is zero or if the replica has never had any changes to replicate (delay of -1). For more information, see the `insync(1)` man page.

2 Begin accepting updates.

```
$ dsconf set-suffix-prop -h host -p port suffix-DN repl-accept-client-update-enabled:on
```

This command automatically sets the server to read-write mode.

Disaster Recovery

If you want to back up or restore your Directory Server for disaster recovery purposes, use the following procedures.

▼ To Make a Backup for Disaster Recovery

For parts of this procedure, you can use DSCC to perform this task. For information, see [“Directory Service Control Center Interface” on page 43](#) and the DSCC online help. Other parts of the procedure can only be done using the command line.

- 1 **Make a backup of your database files by using the command `dsadn backup` or `dsconf backup`.**
Use the procedure in [“Binary Backup” on page 195](#), and store the backup files in a safe place.
- 2 **Copy the configuration directory `instance-path/config` to a safe place.**
- 3 **Copy the schema directory `instance-path/config/schema` to a safe place.**
- 4 **Copy the alias directory `instance-path/alias` to a safe place.**

▼ To Restore for Disaster Recovery

For parts of this procedure, you can use DSCC to perform this task. For information, see [“Directory Service Control Center Interface” on page 43](#) and the DSCC online help. Other parts of the procedure can only be done using the command line.

- 1 **Install the same version of Directory Server that you had previously on the host.**
- 2 **Create a server instance by using the `dsadm create` command.**
Use the same instance that was used at backup time. See [“Creating Suffixes” on page 58](#).
- 3 **Restore the configuration directory `instance-path/config`.**
- 4 **Restore the schema directory `instance-path/config/schema`.**
- 5 **Restore the alias directory `instance-path/alias`.**

6 Ensure that the configuration for the restored server is correct.

For example, the directory structure and plug-in configuration must be the same as on the backed up server.

7 Restore your database files by using the command `dsconf restore`.

Use the procedure in [“Binary Restore”](#) on page 199.

Directory Server Groups, Roles, and CoS

Beyond the hierarchical structure of data in a directory, managing entries that represent users often requires creating groups that share common attribute values. Directory Server provides advanced entry management functionality through groups, roles, and class of service (CoS).

This chapter covers the following topics:

- “About Groups, Roles, and Class of Service” on page 211
- “Managing Groups” on page 212
- “Managing Roles” on page 214
- “Class of Service” on page 218
- “Maintaining Referential Integrity” on page 229

About Groups, Roles, and Class of Service

Groups, roles, and CoS are defined as follows:

- Groups are entries that name other entries, either as a list of members or as a filter for members. For groups that consist of a list of members, Directory Server generates values for the `isMemberOf` attribute on each user entry. The `isMemberOf` attribute on a user entry thus shows all the groups to which that entry belongs.
- Roles provide the same functionality as groups, and more, through a mechanism that generates the `nsrole` attribute on each member of a role.
- CoS generates a computed attribute, which allows entries to share a common attribute value without having to store the attribute in each entry.

You cannot use the `isMemberOf` attribute to make all the members of static groups automatically inherit from a common computed attribute value.

Directory Server provides the ability to perform searches that are based on the values of the roles, and groups and the CoS computed attributes. Filter strings used in any operation can include the `nsRole` attribute or any attribute generated by a CoS definition. Filter strings can

also be used to perform any of the comparison operations on the value of this attribute. However, computed CoS attributes cannot be indexed. Therefore, any search that involves a CoS-generated attribute might consume a large amount of resources in terms of time and memory.

To take full advantage of the features offered by roles, groups, and class of service, determine your grouping strategy in the planning phase of your directory deployment. Refer to “Grouping Directory Data and Managing Attributes” in *Sun Java System Directory Server Enterprise Edition 6.2 Deployment Planning Guide* for a description of these features and how they can simplify your topology.

To gain a deeper understanding of how roles and groups work, see Chapter 8, “Directory Server Groups and Roles,” in *Sun Java System Directory Server Enterprise Edition 6.2 Reference*. For a detailed description of CoS, see Chapter 9, “Directory Server Class of Service,” in *Sun Java System Directory Server Enterprise Edition 6.2 Reference*.

Managing Groups

Groups enable you to associate entries for ease of administration. For example, using groups makes it easier to define access control instructions (ACIs). Group definitions are special entries that either name their members in a static list or provide a filter that defines a dynamic set of entries.

The scope of possible members of a group is the entire directory, regardless of where the group definition entries are located. To simplify administration, all group definition entries are usually stored in a single location, usually `ou=Groups` under the root suffix.

The two types of groups are static groups and dynamic groups.

- **Static groups.** The entry that defines a static group inherits from either the `groupOfNames` or `groupOfUniqueNames` object class. Group members are listed by their DN as multiple values of the `member` or `uniqueMember` attribute.

Alternatively, you can use the `isMemberOf` attribute for static groups. The `isMemberOf` attribute is calculated and added to the user entry at the start of the search. It is then removed again after the search has finished. This functionality provides easy management of groups, and fast read access.

- **Dynamic groups.** The entry that defines a dynamic group inherits from the `groupOfURLs` object class. Group membership is defined by one or more filters that are specified in the multivalued `memberURL` attribute. The members in a dynamic group are the entries that match any one of the filters whenever the filters are evaluated.

▼ To Create a New Static Group

You cannot use DSCC to perform this task. Use the command line, as described in this procedure.

1 Create a new static group using the `ldapmodify` command.

For example, to create a new static group called System Administrators and to add some members, you could use this command:

```
$ ldapmodify -a -h host1 -p 1389 -D cn=admin,cn=Administrators,cn=config -w -
dn: cn=System Administrators, ou=Groups, dc=example,dc=com
changetype: add
cn: System Administrators
objectclass: top
objectclass: groupOfNames
ou: Groups
member: uid=kvaughan, ou=People, dc=example,dc=com
member: uid=rdaugherty, ou=People, dc=example,dc=com
member: uid=hmilller, ou=People, dc=example,dc=com
```

2 Check to see that the new group has been created and that the members have been added.

For example, to check that Kirsten Vaughan is in the new System Administrators group, type:

```
$ ldapsearch -b "dc=example,dc=com" uid=kvaughan isMemberOf
uid=kvaughan,ou=People,dc=example,dc=com
isMemberOf: cn=System Administrators, ou=Groups, dc=example,dc=com
isMemberOf: cn=HR Managers,ou=groups,dc=example,dc=com
```

▼ To Create a New Dynamic Group

You cannot use DSCC to perform this task. Use the command line, as described in this procedure.

● Create a new dynamic group by using the `ldapmodify` command.

For example, to create a new dynamic group called “3rd Floor”, which includes all employees whose room numbers start with 3, you could use this command:

```
$ ldapmodify -a -h host1 -p 1389 -D cn=admin,cn=Administrators,cn=config -w -
dn: cn=3rd Floor, ou=Groups, dc=example,dc=com
changetype: add
cn: 3rd Floor
objectclass: top
objectclass: groupOfUrls
ou: Groups
memberURL: ldap:///dc=example,dc=com??sub?(roomnumber=3*)
```

Managing Roles

A role is an alternate grouping mechanism that is designed to be more efficient and easier for applications to use. While roles are defined and administered like groups, a generated role attribute in each member entry automatically indicates the roles of an entry. For example, an application can read the roles of an entry, rather than having to select a group and browse the members list.

By default, the scope of a role is limited to the subtree where the scope is defined. However, you can extend scoping of the nested role. You can allow the scope to nest roles located in other subtrees and to have members anywhere in the directory. For details see [“To Extend the Scope of a Role” on page 217](#) and [“Example of a Nested Role Definition” on page 216](#).

This section explains how to use roles securely, and how to manage roles from the command line.

Using Roles Securely

To use roles securely, you must set access control instructions (ACIs) to protect appropriate attributes. For example, user A possesses the managed role, MR. Managed roles are equivalent to static groups, and explicitly assign a role to each member entry by adding the `nsRoleDN` attribute to the entry. The MR role has been locked using account inactivation through the command line. This means that user A cannot bind to the server because the `nsAccountLock` attribute is computed as “true” for that user. However, suppose the user was already bound and noticed that he is now locked through the MR role. If no ACI exists to prevent the user from having write access to the `nsRoleDN` attribute, the user can remove the `nsRoleDN` attribute from his own entry and unlock himself.

To prevent users from removing the `nsRoleDN` attribute, you must apply ACIs. With filtered roles, you must protect the part of the filter that would prevent the user from being able to relinquish the filtered role by modifying an attribute. Users should not be allowed to add, delete, or modify the attribute used by the filtered role. In the same way, if the value of the filter attribute is computed, all the attributes that can modify the value of the filter attribute need to be protected. As nested roles can contain filtered and managed roles, the preceding points should be considered for each of the roles that are contained in the nested role.

For detailed instructions on setting ACIs for security, see [Chapter 6, “Directory Server Access Control.”](#)

Managing Roles From the Command Line

Roles are defined in entries that the Directory Administrator can access through command-line utilities. After you create a role, you assign members to the role as follows:

- Members of a managed role have the `nsRoleDN` attribute in their entry.
- Members of a filtered role are entries that match the filter specified in the `nsRoleFilter` attribute.
- Members of a nested role are members of the roles that are specified in the `nsRoleDN` attributes of the nested role definition entry.

All role definitions inherit from the `LDAPsubentry` and `nsRoleDefinition` object classes. The following example shows additional object classes and associated attributes specific to each type of role.

Example of a Managed Role Definition

To create a role for all marketing staff, use the following `ldapmodify` command:

```
$ ldapmodify -a -h host1 -p 1389 -D cn=admin,cn=Administrators,cn=config -w -
dn: cn=Marketing,ou=marketing,ou=People,dc=example,dc=com
objectclass: top
objectclass: LDAPsubentry
objectclass: nsRoleDefinition
objectclass: nsSimpleRoleDefinition
objectclass: nsManagedRoleDefinition
cn: Marketing
description: managed role for marketing staff
```

Notice that the `nsManagedRoleDefinition` object class inherits from the `LDAPsubentry`, `nsRoleDefinition`, and `nsSimpleRoleDefinition` object classes.

Assign the role to a marketing staff member who is named Bob by updating his entry as follows:

```
$ ldapmodify -h host1 -p 1389 -D cn=admin,cn=Administrators,cn=config -w -
dn: cn=Bob Arnold,ou=marketing,ou=People,dc=example,dc=com
changetype: modify
add: nsRoleDN
nsRoleDN: cn=Marketing,ou=marketing,ou=People,dc=example,dc=com
```

The `nsRoleDN` attribute indicates that the entry is a member of a managed role. The managed role is identified by the DN of its role definition. To allow users to modify their own `nsRoleDN` attribute, but to prevent users from adding or removing the `nsManagedDisabledRole`, add the following ACI:

```
aci: (targetattr="nsRoleDN")(targetattrfilters="add=nsRoleDN:
(!nsRoleDN=cn=AdministratorRole,dc=example,dc=com)),
```

```
del=nsRoleDN:(!(nsRoleDN=cn=nsManagedDisabledRole,dc=example, dc=com)")
(version3.0;aci "allow mod of nsRoleDN by self except for critical values";
allow(write) userdn="ldap:///self";)
```

Example of a Filtered Role Definition

To set up a filtered role for sales managers, assuming that they all have the `isManager` attribute, use the following `ldapmodify` command:

```
$ ldapmodify -a -h host1 -p 1389 -D cn=admin,cn=Administrators,cn=config -w -
dn: cn=ManagerFilter,ou=sales,ou=People,dc=example,dc=com
objectclass: top
objectclass: LDAPsubentry
objectclass: nsRoleDefinition
objectclass: nsComplexRoleDefinition
objectclass: nsFilteredRoleDefinition
cn: ManagerFilter
nsRoleFilter: (isManager=True)
Description: filtered role for sales managers
```

Notice that the `nsFilteredRoleDefinition` object class inherits from the `LDAPsubentry`, `nsRoleDefinition`, and `nsComplexRoleDefinition` object classes. The `nsRoleFilter` attribute specifies a filter that finds all employees in the `ou=sales` organization that have subordinates, for example:

```
$ ldapsearch -h host1 -p 1389 -D cn=admin,cn=Administrators,cn=config -w - \
-b "ou=People,dc=example,dc=com" -s sub "(cn=*Fuentes)"
dn: cn=Carla Fuentes,ou=sales,ou=People,dc=example,dc=com
cn: Carla Fuentes
isManager: TRUE...
nsRole: cn=ManagerFilter,ou=sales,ou=People,
dc=example,dc=com
```

Note – The filter string of a filtered role can be based on any attribute, except computed attributes that are generated by the CoS mechanism.

When filtered role members are user entries, you can choose to restrict their ability to add or remove themselves from the role. Protect the filtered attributes with ACIs.

Example of a Nested Role Definition

The roles that are nested within the nested role are specified by using the `nsRoleDN` attribute. Use the following command to create a role that contains both the marketing staff and sales manager members of the roles created in the previous examples:

```
$ ldapmodify -a -h host1 -p 1389 -D cn=admin,cn=Administrators,cn=config -w -
dn: cn=MarketingSales,ou=marketing,ou=People,dc=example,dc=com
```



```

objectclass: top
objectclass: LDAPsubentry
objectclass: nsRoleDefinition
objectclass: nsComplexRoleDefinition
objectclass: nsNestedRoleDefinition
cn: MarketingSales
nsRoleDN: cn=ManagerFilter,ou=sales,ou=People,dc=example,dc=com
nsRoleDN: cn=Marketing,ou=marketing,ou=People,dc=example,dc=com
nsRoleScopeDN: ou=sales,ou=People,dc=example,dc=com

```

Notice that the `nsNestedRoleDefinition` object class inherits from the `LDAPsubentry`, `nsRoleDefinition`, and `nsComplexRoleDefinition` object classes. The `nsRoleDN` attributes contain the DN of the marketing managed role and the sales managers filtered role. Both of the users in the previous examples, Bob and Carla, would be members of this new nested role.

The scope of this filter includes the default scope, which is the subtree where the filter is located, and the subtree below any values of the `nsRoleScopeDN` attribute. In this case, the `ManagerFilter` is in the `ou=sales,ou=People,dc=example,dc=com` subtree. This subtree must be added to the scope.

Extending the Scope of a Role

Directory Server provides an attribute that allows the scope of a role to be extended beyond the subtree of the role definition entry. This single-valued attribute, `nsRoleScopeDN`, contains the DN of the scope to be added to an existing role. The `nsRoleScopeDN` attribute can only be added to a nested role. See [“Example of a Nested Role Definition” on page 216](#).

▼ To Extend the Scope of a Role

You cannot use DSCC to perform this task. Use the command line, as described in this procedure.

The `nsRoleScopeDN` attribute enables you to extend the scope of a role in one subtree to include an entry in another subtree. For example, imagine two main subtrees in the `example.com` directory tree: `o=eng,dc=example,dc=com` (the engineering subtree) and `o=sales,dc=example,dc=com` (the sales subtree.) A user in the engineering subtree requires access to a sales application governed by a role in the sales subtree (`SalesAppManagedRole`). To extend the scope of the role, do the following:

1 Create a role for the user in the engineering subtree.

For example, create the role `EngineerManagedRole`. This example uses a managed role, but it could just as well have been a filtered or nested role.

2 Create a nested role, for example, `SalesAppPlusEngNestedRole`, in the sales subtree to house the newly created `EngineerManagedRole` and the initial `SalesAppManagedRole`.

- 3 Add the `nsRoleScopeDN` attribute to the `SalesAppPlusEngNestedRole`, with the DN of the engineering subtree scope that you want to add, in this case, `o=eng,dc=example,dc=com`.**

The necessary permissions must be granted to the engineering user so that he can access the `SalesAppPlusEngNestedRole` role and, in turn, the sales application. In addition, the entire scope of the role must be replicated.

Note – The restriction of extended scope to nested roles means that an administrator who previously managed roles in one domain only has rights to use the roles that already exist in the other domain. The administrator is not able to create an arbitrary role in the other domain.

Class of Service

The class of service (CoS) mechanism generates computed attributes as an entry is retrieved for a client application, which simplifies entry management and reduces storage requirements. The CoS mechanism allows attributes to be shared between entries, and as with groups and roles, CoS relies on helper entries.

For an explanation of how you can use CoS in your deployment, see “Managing Attributes With Class of Service” in *Sun Java System Directory Server Enterprise Edition 6.2 Deployment Planning Guide*.

For a description of how CoS is implemented in Directory Server, see Chapter 9, “Directory Server Class of Service,” in *Sun Java System Directory Server Enterprise Edition 6.2 Reference*.

Note – Any search operation can test the existence of a CoS-generated attribute or compare the value of the attribute. The names of the computed attributes may be used in any filter string from a client search operation, except in an internal filter used in a filtered role.

Using CoS Securely

The following sections describe the general principles for read and write protection of data in each of the CoS entries. The detailed procedure for defining individual access control instructions (ACIs) is described in [Chapter 6, “Directory Server Access Control.”](#)

Protecting the CoS Definition Entry

Although the CoS definition entry does not contain the value of the generated attribute, it does provide the information to find that value. Reading the CoS definition entry reveals how to find the template entry that contains the value. Writing to this entry modifies how the computed attribute is generated.

You should therefore define both read and write ACIs for the CoS definition entries.

Protecting the CoS Template Entries

The CoS template entry contains the value of the generated CoS attribute. Therefore, at a minimum, the CoS attribute in the template must be protected by an ACI for both reading and updating.

- In the case of *pointer CoS*, the single template entry should not be allowed to be renamed. In most cases, it is simplest to protect the entire template entry.
- With *classic CoS*, all template entries have a common parent specified in the definition entry. If only templates are stored in this parent entry, access control to the parent entry protects the templates. However, if other entries beneath the parent require access, the template entries must be protected individually.
- In the case of *indirect CoS*, the template can be any entry in the directory, including user entries that might still need to be accessed. Depending on your needs, you can either control access to the CoS attribute throughout the directory or ensure that the CoS attribute is secure in each entry that is used as a template.

Protecting the Target Entries of a CoS

All entries in the scope of a CoS definition, for which the computed CoS attribute is generated, also contribute to computing its value.

When the CoS attribute already exists in a target entry, by default, the CoS mechanism does not override this value. If you do not want this behavior, define your CoS to override the target entry, or protect the CoS attribute in all potential target entries.

Both indirect and classic CoS also rely on a specifier attribute in the target entry. This attribute specifies the DN or RDN of the template entry to use. You should use an ACI to protect this attribute either globally throughout the scope of the CoS or individually on each target entry where it is needed.

Protecting Other Dependencies

Computed CoS attributes can be defined in terms of other generated CoS attributes and roles. You must understand and protect these dependencies to ensure that your computed CoS attribute is protected.

For example, the CoS specifier attribute in a target entry could be `nsRole`. Therefore the role definition must also be protected by an ACI.

In general, any attribute or entry that is involved in the computation of the computed attribute value should have an ACI for both read and write access control. For this reason, complex dependencies should be well planned or simplified to reduce subsequent complexity of access control implementation. Keeping dependencies on other computed attributes to a minimum improves directory performance and reduces maintenance.

Managing CoS From the Command Line

Because all configuration information and template data are stored as entries in the directory, you can use the LDAP command-line tools to configure and manage CoS definitions. This section shows how to create CoS definition entries and CoS template entries from the command line.

Creating the CoS Definition Entry From the Command Line

All CoS definition entries have the LDAPsubentry object class and inherit from the cosSuperDefinition object class. In addition, each type of CoS inherits from specific object classes and contains the corresponding attributes. The following table lists the object classes and attributes that are associated with each type of CoS definition entry.

TABLE 9-1 Object Classes and Attributes in CoS Definition Entries

CoS Type	CoS Definition Entry
Pointer CoS	objectclass: top objectclass: LDAPsubentry objectclass: cosSuperDefinition objectclass: cosPointerDefinition cosTemplateDN: <i>DN</i> cosAttribute: <i>attributeName override merge</i>
Indirect CoS	objectclass: top objectclass: LDAPsubentry objectclass: cosSuperDefinition objectclass: cosIndirectDefinition cosIndirectSpecifier: <i>attributeName</i> cosAttribute: <i>attributeName override merge</i>
Classic CoS	objectclass: top objectclass: LDAPsubentry objectclass: cosSuperDefinition objectclass: cosClassicDefinition cosTemplateDN: <i>DN</i> cosSpecifier: <i>attributeName</i> cosAttribute: <i>attributeName override merge</i>

In all cases, `cosAttribute` is multivalued. Each value defines an attribute that is generated by the CoS mechanism.

You can use the following attributes in CoS definition entries. For more information about each of these attributes, see the individual attributes in *Sun Java System Directory Server Enterprise Edition 6.2 Man Page Reference*.

TABLE 9-2 CoS Definition Entry Attributes

Attribute	Purpose Within the CoS Definition Entry
<code>cosAttribute</code> <i>attributeName override merge</i>	Defines the name of the computed attribute for which you want to generate a value. This attribute is multivalued, and each value represents the name of an attribute whose value is generated from the template. The <i>override</i> and <i>merge</i> qualifiers specify how the CoS attribute value is computed in special cases described following this table. The <i>attributeName</i> cannot contain any subtypes. Attribute names with subtypes are ignored, but other values of <code>cosAttribute</code> are processed.
<code>cosIndirectSpecifier</code> <i>attributeName</i>	Defines the name of the attribute in target entries whose value is used by indirect CoS to identify the template entry. The named attribute is called the specifier and must contain a full DN string in each target entry. This attribute is single-valued, but the <i>attributeName</i> can be multivalued to designate multiple templates.
<code>cosSpecifier</code> <i>attributeName</i>	Defines the name of the attribute in target entries whose value is used by classic CoS to identify the template entry. The named attribute is called the specifier and must contain a string that can be found in the RDN of template entries. This attribute is single-valued, but the <i>attributeName</i> can be multivalued to designate multiple templates.
<code>cosTemplatedDN</code> <i>DN</i>	Provides the full DN of the template entry for a pointer CoS definition or the base DN of the template entry for classic CoS. This attribute is single-valued.

Note – You cannot use the `isMemberOf` attribute as a `CosSpecifier` to make all the members of static groups automatically inherit from a common computed attribute value.

The `cosAttribute` attribute allows two qualifiers following the name of the CoS attribute, the *override* qualifier and the *merge* qualifier.

The *override* qualifier describes the behavior when an attribute that is dynamically generated by CoS already physically exists in the entry. The *override* qualifier can be one of the following:

- `default` (or no qualifier) - Indicates that the server does not override a real attribute value stored in the entry when the attribute is of the same type as the computed attribute.
- `override` - Indicates that the server always returns the value generated by the CoS, even when a value is stored with the entry.

- `operational` - Indicates that the attribute will only be returned if it is explicitly requested in the search. Operational attributes do not need to pass a schema check to be returned. The `operational` qualifier has the same behavior as the `override` qualifier.

You can only make an attribute operational if the attribute is also defined as operational in the schema. For example, if your CoS generates a value for the `description` attribute, you cannot use the `operational` qualifier because the `description` attribute is not marked operational in the schema.

The `merge` qualifier is either absent or `merge-schemes`. This qualifier allows the computed CoS attribute to be multivalued, either from multiple templates or multiple CoS definitions. For more information, see [“Multivalued CoS Attributes” on page 222](#).

Overriding Real Attribute Values

You might create a pointer CoS definition entry that contains an `override` qualifier as follows:

```
dn: cn=pointerCoS,dc=example,dc=com
objectclass: top
objectclass: LDAPsubentry
objectclass: cosSuperDefinition
objectclass: cosPointerDefinition
cosTemplateDn: cn=exampleUS,cn=data
cosAttribute: postalCode override
```

This pointer CoS definition entry indicates that the entry is associated with the template entry `cn=exampleUS, cn=data` that generates the value of the `postalCode` attribute. The `override` qualifier indicates that this value takes precedence over the value of the `postalCode` attribute if the attribute exists in a target entry.

Note – If the CoS attribute is defined with the `operational` or `override` qualifiers, you cannot perform write operations on the “real” value of that attribute in any entry in the CoS scope.

Multivalued CoS Attributes

When you specify the `merge-schemes` qualifier, the generated CoS attribute can be multivalued in two ways:

- With indirect or classic CoS, the specifier attributes in target entries can be multivalued. In this case, each value determines a template, and the value from each template is part of the generated value.
- Multiple CoS definition entries of any type can contain the same attribute name in their `cosAttribute`. In this case, if all definitions contain the `merge-schemes` qualifier, the generated attribute contains all values computed by each definition.

The two situations can occur together and define even more values. However, in all cases, duplicate values will only be returned one time in a generated attribute.

In the absence of the `merge-schemes` qualifier, the `cosPriority` attribute of the template entry is used to determine a single value among all templates for the generated attribute. This scenario is described in the next section.

The `merge-schemes` qualifier never merges a “real” value that is defined in the target with generated values from the templates. The `merge` qualifier is independent of the `override` qualifier. All pairings are possible, and the behaviors implied by each are complimentary. Also, the qualifiers can be specified in any order after the attribute name.

Note – When there are multiple CoS definitions for the same attribute, the definitions must all have the same `override` and `merge` qualifiers. When different pairs of qualifiers occur in CoS definitions, one of the combinations is selected arbitrarily among all definitions.

CoS Attribute Priority

If multiple CoS definitions or multivalued specifiers exist, but no `merge-schemes` qualifier, Directory Server uses a priority attribute to select a single template that defines the single value of the computed attribute.

The `cosPriority` attribute represents the global priority of a particular template among all those being considered. A priority of zero is the highest priority. Templates that contain no `cosPriority` attribute are considered the lowest priority. When two or more templates provide an attribute value but have the same or no priority, a value is chosen arbitrarily.

Template priorities are not taken into account when using the `merge-schemes` qualifier. When merging, all templates being considered define a value regardless of any priority that the templates define. The `cosPriority` attribute is defined on CoS template entries as described in the following section.

Note – The `cosPriority` attribute must not have a negative value. Also, attributes generated by indirect CoS do not support priority. Do not use `cosPriority` in template entries of an indirect CoS definition.

Creating the CoS Template Entry From the Command Line

When using pointer CoS or classic CoS, the template entry contains the `LDAPsubentry` and `cosTemplate` object classes. This entry must be created specifically for the CoS definition. Making the CoS template entry an instance of the `LDAPsubentry` object class allows ordinary searches to be performed unhindered by the configuration entries.

The template of the indirect CoS mechanism is an arbitrary, existing entry in the directory. The target does not need to be identified ahead of time or given the `LDAPsubentry` object class, but the target must have the auxiliary `cosTemplate` object class. The indirect CoS template is accessed only when the CoS is evaluated to generate a computed attribute and its value.

In all cases, the CoS template entry must contain the attribute and the value that is generated by the CoS on the target entries. The attribute name is specified in the `cosAttribute` attribute of the CoS definition entry.

The following example shows a template entry of the highest priority for a pointer CoS that generates the `postalCode` attribute:

```
dn: cn=ZipTemplate,ou=People,dc=example,dc=com
objectclass: top
objectclass: LDAPsubentry
objectclass: extensibleobject
objectclass: cosTemplate
postalCode: 95054
cosPriority: 0
```

The following sections provide examples of template entries along with examples of each type of CoS definition entry.

Example of a Pointer CoS

The following command creates a pointer CoS definition entry that has the `cosPointerDefinition` object class. This definition entry uses the CoS template entry that is stated in the example in the previous section to share a common postal code among all entries in the `ou=People,dc=example,dc=com` tree.

```
$ ldapmodify -a -h host1 -p 1389 -D cn=admin,cn=Administrators,cn=config -w -
dn: cn=pointerCoS,ou=People,dc=example,dc=com
objectclass: top
objectclass: LDAPsubentry
objectclass: cosSuperDefinition
objectclass: cosPointerDefinition
cosTemplateDn: cn=ZipTemplate,ou=People,dc=example,dc=com
cosAttribute: postalCode
```

The CoS template entry (`cn=ZipTemplate,ou=People,dc=example,dc=com`) supplies the value stored in its `postalCode` attribute to all entries located under the `ou=People,dc=example,dc=com` suffix. If you search for any entry that does not have a postal code in the same subtree, you will see the value of the generated attribute:

```
$ ldapsearch -h host1 -p 1389 -D cn=admin,cn=Administrators,cn=config -w - \
  -b "ou=People,dc=example,dc=com" -s sub "(cn=*Jensen)"
dn: cn=Babs Jensen,ou=People,dc=example,dc=com
cn: Babs Jensen
...
postalCode: 95054
```


Example of an Indirect CoS

Indirect CoS names an attribute in the `cosIndirectSpecifier` attribute to locate the template specific to each target. The template entry for indirect CoS may be any entry in the directory, including other user entries. This example indirect CoS uses the `manager` attribute of the target entry to identify the CoS template entry. The template entry is the manager's user entry. The manager's user entry contains the value of the attribute to generate. The value is that of `departmentNumber` in this case.

The following command creates the indirect CoS definition entry, which contains the `cosIndirectDefinition` object class:

```
$ ldapmodify -a -h host1 -p 1389 -D cn=admin,cn=Administrators,cn=config -w -
dn: cn=generateDeptNum,ou=People,dc=example,dc=com
objectclass: top
objectclass: LDAPsubentry
objectclass: cosSuperDefinition
objectclass: cosIndirectDefinition
cosIndirectSpecifier: manager
cosAttribute: departmentNumber
```

Next, add the `cosTemplate` object class to the template entries, and make sure that they define the attribute to be generated. In this example, all manager entries are templates:

```
$ ldapmodify -h host1 -p 1389 -D cn=admin,cn=Administrators,cn=config -w -
dn: cn=Carla Fuentes,ou=People,dc=example,dc=com
changetype: modify
add: objectclass
objectclass: cosTemplate
-
add: departmentNumber
departmentNumber: 318842
```

With this CoS, target entries (the entries under `ou=People,dc=example,dc=com`) that contain the `manager` attribute automatically have the department number of their manager. The `departmentNumber` attribute is computed on the target entries because it does not exist in the server. However, the `departmentNumber` attribute is returned as part of the target entry. For example, if Babs Jensen's manager is defined to be Carla Fuentes, her department number is the following:

```
$ ldapsearch -h host1 -p 1389 -D cn=admin,cn=Administrators,cn=config -w - \
-b "ou=People,dc=example,dc=com" -s sub "(cn=*Jensen)"
dn: cn=Babs Jensen,ou=People,dc=example,dc=com
cn: Babs Jensen
...
manager: cn=Carla Fuentes,ou=People,dc=example,dc=com
departmentNumber: 318842
```

Example of a Classic CoS

This example shows how to generate a postal address with a classic CoS. The generated value is specified in a template entry that is located by a combination of the `cosTemplateDn` in the CoS definition and the value of the `cosSpecifier` attribute in the target entry. The following command creates the definition entry by using the `cosClassicDefinition` object class:

```
$ ldapmodify -a -h host1 -p 1389 -D cn=admin,cn=Administrators,cn=config -w -  
dn: cn=classicCoS,dc=example,dc=com  
objectclass: top  
objectclass: LDAPsubentry  
objectclass: cosSuperDefinition  
objectclass: cosClassicDefinition  
cosTemplateDn: ou=People,dc=example,dc=com  
cosSpecifier: building  
cosAttribute: postalAddress
```

Using the same command, create the template entries that give the postal address for each building:

```
dn: cn=B07,ou=People,dc=example,dc=com  
objectclass: top  
objectclass: LDAPsubentry  
objectclass: extensibleobject  
objectclass: cosTemplate  
postalAddress: 7 Old Oak Street, Anytown, CA 95054
```

With this CoS, target entries (the entries under `ou=People,dc=example,dc=com`) that contain the `building` attribute will automatically have the corresponding postal address. The CoS mechanism searches for a template entry that has the specifier attribute value in its RDN. In this example, if Babs Jensen is assigned to building B07, her postal address is generated as follows:

```
$ ldapsearch -h host1 -p 1389 -D cn=admin,cn=Administrators,cn=config -w - \  
-b "ou=People,dc=example,dc=com" -s sub "(cn=*Jensen)"  
dn: cn=Babs Jensen,ou=People,dc=example,dc=com  
cn: Babs Jensen  
...  
building: B07  
postalAddress: 7 Old Oak Street, Anytown, CA 95054
```

Creating Role-Based Attributes

You can create classic CoS schemes that generate attribute values for an entry that is based on the role possessed by the entry. For example, you could use role-based attributes to set the server look-through limit on an entry-by-entry basis.

To create a role-based attribute, use the `nsRole` attribute as the `cosSpecifier` in the CoS definition entry of a classic CoS. Because the `nsRole` attribute can be multivalued, you can define CoS schemes that have more than one possible template entry. To resolve the ambiguity of which template entry to use, you can include the `cosPriority` attribute in your CoS template entry.

For example, you can create a CoS that allows members of the manager role to exceed the standard mailbox quota. The manager role is as follows:

```
dn: cn=ManagerRole,ou=People,dc=example,dc=com
objectclass: top
objectclass: LDAPsubentry
objectclass: nsRoleDefinition
objectclass: nsComplexRoleDefinition
objectclass: nsFilteredRoleDefinition
cn: ManagerRole
nsRoleFilter: (isManager=True)
Description: filtered role for managers
```

The classic CoS definition entry is created as follows:

```
dn: cn=generateManagerQuota,ou=People,dc=example,dc=com
objectclass: top
objectclass: LDAPsubentry
objectclass: cosSuperDefinition
objectclass: cosClassicDefinition
cosTemplateDn: cn=managerCOS,ou=People,dc=example,dc=com
cosSpecifier: nsRole
cosAttribute: mailboxquota override
```

The CoS template name must be a combination of the `cosTemplateDn` and the value of `nsRole`, which is the DN of the role. For example:

```
dn: cn="cn=ManagerRole,ou=People,dc=example,dc=com",\
  cn=managerCOS,ou=People,dc=example,dc=com
objectclass: top
objectclass: LDAPsubentry
objectclass: extensibleobject
objectclass: cosTemplate
mailboxquota: 1000000
```

The CoS template entry provides the value for the `mailboxquota` attribute. An additional qualifier of `override` tells the CoS to override any existing `mailboxquota` attributes values in the target entry. Target entries that are members of the role will have computed attributes generated by the role and by the CoS, for example:

```
$ ldapsearch -h host1 -p 1389 -D cn=admin,cn=Administrators,cn=config -w -\
  -b "ou=People,dc=example,dc=com" -s sub "(cn=*Fuentes)"
```

```
dn: cn=Carla Fuentes,ou=People,dc=example,dc=comcn: Carla Fuentes
isManager: TRUE...nsRole: cn=ManagerRole,ou=People,dc=example,dc=com
mailboxquota: 1000000
```

Note – The role entry and the CoS definition entry should be located in the same place in the directory tree so that they have the same target entries in their scope. The CoS target entry should also be located in the same place so that it is easy to find and maintain.

Monitoring the CoS Plug-In

Directory Server enables you to monitor certain aspects of the CoS plug-in. CoS monitoring attributes are stored in the `cn=monitor`, `cn=Class of Service`, `cn=plugins`, `cn=config` entry. For details of the each attribute under this entry and the information that they provide, see *Sun Java System Directory Server Enterprise Edition 6.2 Man Page Reference*.

Setting CoS Logging

Directory Server logs warning messages when it is forced to make an arbitrary distinction among multiple applicable definition entries. Such warning messages takes this form:

```
Definition /defDN1/ and definition /defDN2/ compete to provide attribute
'/type/' at priority /level/
```

You can also configure Directory Server to log informational messages when the server is forced to make an arbitrary distinction among multiple, potentially applicable definition entries. To do so, set the error log to include messages from plug-ins.

Note – Because setting additional log levels can result in a heavy logging load, you might not want to set logging on a production server.

The content of informational messages takes the following form:

```
Definition /defDN1/ and definition /defDN2/ potentially compete
to provide attribute '/type/' at priority /level/
```

You can then choose whether to resolve such cases of CoS ambiguity by setting CoS priorities appropriately on the definition entries.

Maintaining Referential Integrity

Referential integrity is a plug-in mechanism that ensures that relationships between entries are maintained. Several types of attributes, such as those for group membership, contain the DN of another entry. Referential integrity can be used to ensure that when an entry is removed, all attributes that contain its DN are also removed.

For example, if a user's entry is removed from the directory and referential integrity is enabled, the server also removes the user from any groups of which the user is a member. If referential integrity is not enabled, the user must be manually removed from the group by the administrator. This is an important feature if you are integrating Directory Server with other Sun Java System products that rely on the directory for user and group management.

How Referential Integrity Works

When the referential integrity plug-in is enabled it performs integrity updates on specified attributes immediately after a delete, rename, or move operation. By default, the referential integrity plug-in is disabled.

Whenever you delete, rename, or move a user or group entry in the directory, the operation is logged to the referential integrity log file:

```
instance-path/logs/referint
```

After a specified time, known as the *update interval*, the server performs a search on all attributes for which referential integrity is enabled, and matches the entries resulting from that search with the DNs of deleted or modified entries present in the log file. If the log file shows that the entry was deleted, the corresponding attribute is deleted. If the log file shows that the entry was changed, the corresponding attribute value is modified accordingly.

When the default configuration of the referential integrity plug-in is enabled, it performs integrity updates on the `member`, `uniquemember`, `owner`, `seeAlso`, and `nsroledn` attributes immediately after a delete, rename, or move operation. You can, however, configure the behavior of the referential integrity plug-in to suit your own requirements. The following behavior can be configured:

- Record referential integrity updates in a different file.
- Modify the update interval.

If you want to reduce the impact that referential integrity updates has on your system, you might want to increase the amount of time between updates.
- Select the attributes to which you apply referential integrity.

If you use or define attributes containing DN values, you might want the referential integrity plug-in to monitor them.

▼ To Configure the Referential Integrity Plug-In

Note – All attributes in all databases that are used by the referential integrity plug-in must be indexed. The indexes need to be created in the configuration of all the databases. When the retro changelog is enabled, the `cn=changeLog` suffix must be indexed. For information, see [Chapter 12, “Directory Server Indexing.”](#)

Certain limitations are associated with using the referential integrity plug-in in a replicated environment. For a list of these limitations, see [“Replication and Referential Integrity” on page 254.](#)

You can use DSCC to perform this task. For information, see [“Directory Service Control Center Interface” on page 43](#) and the DSCC online help.

- 1 Make sure that all replicas are configured and that all replication agreements are defined.**
- 2 Determine the set of attributes for which you will maintain referential integrity and the update interval that you want to use on your master servers.**
- 3 Enable the referential integrity plug-in on all master servers using the same set of attributes and the same update interval.**

- To define the attributes for referential integrity, use this command:

```
$ dsconf set-server-prop -h host -p port ref-integrity-attr:attribute-name \  
ref-integrity-attr:attribute-name
```

- To add a referential integrity attribute to an existing list of attributes, use this command:

```
$ dsconf set-server-prop -h host -p port ref-integrity-attr+:attribute-name
```

- To define the referential integrity update interval, use this command:

```
$ dsconf set-server-prop -h host -p port ref-integrity-check-delay:duration
```

- To enable referential integrity, use this command:

```
$ dsconf set-server-prop -h host -p port ref-integrity-enabled:on
```

- 4 Ensure that the referential integrity plug-in is disabled on all consumer servers.**

Directory Server Replication

Replication is the mechanism by which directory contents are automatically copied from a Directory Server to one or more other Directory Servers. All write operations are automatically mirrored to other Directory Servers. For a complete description of replication concepts, replication scenarios, and how to plan for replication in your directory deployment, see the *Sun Java System Directory Server Enterprise Edition 6.2 Deployment Planning Guide*.

In a replication topology, generally one suffix on a server is replicated to or from another suffix on a server. For this reason, the terms replica, replicated suffix and replicated server can be used interchangeably.

This chapter describes the tasks to be performed to set up the various replication scenarios by using the command line, and covers the following topics:

- “Planning Your Replication Deployment” on page 232
- “Recommended Interface for Configuring and Managing Replication” on page 232
- “Summary of Steps for Configuring Replication” on page 232
- “Enabling Replication on a Dedicated Consumer” on page 235
- “Enabling Replication on a Hub” on page 236
- “Enabling Replication on a Master Replica” on page 238
- “Configuring the Replication Manager” on page 239
- “Creating and Changing Replication Agreements” on page 241
- “Fractional Replication” on page 243
- “Replication Priority” on page 244
- “Initializing Replicas” on page 245
- “Indexing Replicated Suffixes” on page 253
- “Incrementally Adding Many Entries to Large Replicated Suffixes” on page 253
- “Maintaining Referential Integrity” on page 229
- “Replication Over SSL” on page 254
- “Replication Over a WAN” on page 256
- “Modifying the Replication Topology” on page 260
- “Replication With Releases Prior to Directory Server 6.2” on page 266
- “Using the Retro Change Log” on page 266

- [“Getting Replication Status” on page 270](#)
- [“Solving Common Replication Conflicts” on page 271](#)

Planning Your Replication Deployment

You can configure a replication deployment with an unlimited number of masters. You are not required to include hubs or consumers in your deployment. Procedures for configuring replication for hubs and consumers are included in this chapter, but they are optional.

Before you begin configuring replication, you need to have a clear understanding of the way that replication will be deployed in your organization. You must understand the replication concepts described in *Sun Java System Directory Server Enterprise Edition 6.2 Reference*. You must also have carefully planned your future replication configuration using the design guidelines provided in the *Sun Java System Directory Server Enterprise Edition 6.2 Deployment Planning Guide*.

Recommended Interface for Configuring and Managing Replication

The easiest way to configure and manage replication is by using Directory Service Control Center (DSCC). By using DSCC, you can configure replication automatically. You can choose the level of automation you require for setting up your replication topology, for example, whether you want to initialize the suffixes during replication configuration or not. DSCC also provides checks that can prevent errors. In addition, DSCC provides a graphical view of the replication topology.

The DSCC online help provides procedures for setting up replication by using DSCC.

Note – Only use the command-line procedures provided in this chapter if you are unable to use DSCC for configuring replication.

Summary of Steps for Configuring Replication

[“Summary of Steps for Configuring Replication” on page 233](#) assumes that you are replicating a single suffix. If you are replicating more than one suffix, you can configure the suffixes in parallel on each server. In other words, you can repeat each step to configure replication on multiple suffixes.

The rest of this chapter contains detailed instructions on how to configure replication.

▼ Summary of Steps for Configuring Replication

You can use DSCC to perform this task. For information, see [“Directory Service Control Center Interface” on page 43](#) and the DSCC online help.

To configure any replication topology, follow the general steps as outline in this procedure.

- 1 Do the following on all servers that contain a dedicated consumer replica:**
 - a. Create an empty suffix for the consumer replicated suffix.**
See [“To Create a Suffix for a Consumer Replica” on page 235](#).
 - b. Enable the consumer replicated suffix.**
See [“To Enable a Consumer Replica” on page 235](#).
 - c. (Optional) Configure the advanced consumer settings.**
See [“To Perform Advanced Consumer Configuration” on page 235](#).
- 2 If applicable, do the following on all servers that contain a hub replicated suffix:**
 - a. Create an empty suffix for the hub replicated suffix.**
See [“To Create a Suffix for a Hub Replica” on page 237](#).
 - b. Enable the hub replicated suffix.**
See [“To Enable a Hub Replica” on page 237](#).
 - c. (Optional) Configure the advanced hub settings.**
See [“To Modify Change Log Settings on a Hub Replica” on page 237](#).
- 3 Do the following on all servers that contain a master replicated suffix:**
 - a. Create a suffix for the master replicated suffix.**
See [“To Create a Suffix for a Master Replica” on page 238](#).
 - b. Enable the master replicated suffix.**
See [“To Enable a Master Replica” on page 238](#).
 - c. (Optional) Configure the advanced master settings.**
See [“To Modify Change Log Settings on a Master Replica” on page 238](#).

Note – Make sure that you enable all replicas before you create a replication agreement so that you can initialize consumer replicas immediately after you create the replication agreement. Consumer initialization is always the last stage in setting up replication.

- 4 Ensure your replication manager configuration is complete.**
 - If you plan to use the default manager, set the default replication manager password on all servers. See [“To Change the Default Replication Manager Password”](#) on page 241.
 - If you plan to use a non-default replication manager, define the alternative replication manager entry on all servers. See [“Using a Non-Default Replication Manager”](#) on page 239.
- 5 Create replication agreements on all master replicas as follows:**
 - a. Between masters in a multimaster topology**
 - b. Between masters and their dedicated consumers**
 - c. Between masters and hub replicas**See [“Creating and Changing Replication Agreements”](#) on page 241.
- 6 (Optional) If you want to use fractional replication, configure it now.** See [“Fractional Replication”](#) on page 243.
- 7 (Optional) If you want to use replication priority, configure it now.** See [“Replication Priority”](#) on page 244.
- 8 Configure replication agreements between the hub replicas and their consumers.** See [“Creating and Changing Replication Agreements”](#) on page 241.
- 9 For multimaster replication, initialize all masters from the same master replica that contains the original copy of the data.** See [“Initializing Replicas”](#) on page 245.
- 10 Initialize the hub and consumer replicas.** See [“Initializing Replicas”](#) on page 245.

Enabling Replication on a Dedicated Consumer

A dedicated consumer is a read-only copy of a replicated suffix. The dedicated consumer receives updates from servers that bind as the replication manager to make changes. Configuring the consumer server consists of preparing an empty suffix to hold the replicated suffix and enabling replication on that suffix. Optional advanced configuration can include setting referrals, changing the purge delay, and modifying properties.

The following sections explain how to configure one dedicated consumer replicated suffix on its server. Repeat all procedures on each server that will contain a dedicated consumer replicated suffix.

▼ To Create a Suffix for a Consumer Replica

- If an empty suffix does not already exist, create it on the consumer with the same DN as the intended master replica.

For instructions, see [“Creating Suffixes” on page 58](#).



Caution – If the suffix exists and is not empty, its contents will be lost when the replicated suffix is initialized from the master.

▼ To Enable a Consumer Replica

After you have created an empty suffix, you need to enable the consumer replicated suffix.

You can use DSCC to perform this task. For information, see [“Directory Service Control Center Interface” on page 43](#) and the DSCC online help.

- Enable the consumer replicated suffix.

```
$ dsconf enable-repl -h host -p port consumer suffix-DN
```

For example:

```
$ dsconf enable-repl -h host1 -p 1389 consumer dc=example,dc=com
```

▼ To Perform Advanced Consumer Configuration

If you want to configure your consumer replicated suffix for advanced features, do so now.

You can use DSCC to perform this task. For information, see [“Directory Service Control Center Interface” on page 43](#) and the DSCC online help.

1 If you want to use SSL for referrals, set secure referrals.

```
$ dsconf set-suffix-prop -h host -p port suffix-DN referral-url:ldaps://servername:port
```

For example:

```
$ dsconf set-suffix-prop -h host1 -p 1389 dc=example,dc=com \  
  referral-url:ldaps://server2:2389
```

The replication mechanism automatically configures consumers to return referrals for all known masters in the replication topology. These default referrals assume that clients will use simple authentication over a regular connection. If you want to give clients the option of binding to masters using SSL for a secure connection, add referrals of the form `ldaps://servername :port` that use a secure *port* number. Note that if the masters are configured for secure connections only, the URLs will point to the secure ports by default.

If you have added one or more LDAP URLs as referrals, you can force the consumer to send referrals exclusively for these LDAP URLs and not for the master replicas. For example, suppose that you want clients to always be referred to the secure port on the master servers and not to the default port. Create a list of LDAP URLs for these secure ports, and set the property for using these referrals. You can also use an exclusive referral if you want to designate a specific master or a Directory Server proxy to handle all updates.

2 If you want to change the replication purge delay for the consumer, use this command:

```
$ dsconf set-suffix-prop -h host -p port suffix-DN repl-purge-delay:time
```

For example, to set the purge delay to 2 days, type:

```
$ dsconf set-suffix-prop -h host1 -p 1389 dc=example,dc=com repl-purge-delay:2d
```

The consumer server stores internal information about updates to the replicated suffix contents, and the purge delay parameter specifies how long it must keep this information. The purge delay determines in part how long replication between the consumer and its master can be interrupted and still recover normally. It is related to the `MaxAge` parameter of the change log on its supplier server. The shorter of these two parameters determines the longest time that replication between the two servers can be disabled or down and still recover normally. The default value of 7 days is sufficient in most cases.

Enabling Replication on a Hub

Hub replicas act as both consumers and masters to further distribute replicated data to a larger number of consumers. Hub replicas receive replication updates from their suppliers and send replication updates to their consumers. They do not accept modifications, but instead return referrals to the masters.

Configuring a hub server consists of preparing an empty suffix to hold the replicated suffix and enabling replication on that suffix. Optional advanced configuration can include choosing a different replication manager, setting referrals, setting the purge delay, and modifying change log parameters.

The following sections explain how to configure one hub server. Repeat all procedures on each server that will contain a hub replicated suffix.

▼ To Create a Suffix for a Hub Replica

- **If an empty suffix does not already exist, create it on the hub server with the same DN as the intended master replica.**

For instructions, see [“Creating Suffixes” on page 58](#).

If the suffix exists and is not empty, its contents will be lost when the replicated suffix is initialized from the master.

▼ To Enable a Hub Replica

If you have hub replicas, enable them now.

You can use DSCC to perform this task. For information, see [“Directory Service Control Center Interface” on page 43](#) and the DSCC online help.

- **Enable the hub replicated suffix.**

```
$ dsconf enable-repl -h host -p port hub suffix-DN
```

For example:

```
$ dsconf enable-repl -h host1 -p 1389 hub dc=example,dc=com
```

▼ To Modify Change Log Settings on a Hub Replica

For advanced hub configuration, the only parameters that you might want to modify are related to the change log. As a supplier, a hub server requires a change log.

You can use DSCC to perform this task. For information, see [“Directory Service Control Center Interface” on page 43](#) and the DSCC online help.

- **To modify a change log setting on a hub, use one of the following commands:**

```
$ dsconf set-server-prop -h host -p port suffix-DN repl-cl-max-age:value
```

```
$ dsconf set-server-prop -h host -p port suffix-DN repl-cl-max-entry-count:value
```

Enabling Replication on a Master Replica

Master replicas contain the master copy of the data and centralize all modifications before propagating updates to all other replicas. A master records all changes, checks the status of its consumers, and sends updates to them when necessary. In multimaster replication, master replicas also receive updates from other masters.

Configuring a master server consists of defining the suffix that contains the master replica, enabling the master replica, and configuring it for advanced replication, if necessary.

The following sections explain how to configure one master server. Repeat all procedures on each server that will contain a master replicated suffix.

▼ To Create a Suffix for a Master Replica

- **Choose or create a suffix on the master server that will contain the entries that you want to replicate.**

For instructions, see to [“Creating Suffixes” on page 58](#).

To ensure correct multimaster configuration and initialization, only load one of the masters with the data. Any data on other replicated suffixes will be overwritten.

▼ To Enable a Master Replica

When you enable replication on a master, you must assign a replication ID. The replication ID is used to distinguish the owner of update statements and to resolve conflicts that might occur with multimaster replication. Therefore, the replication ID must be unique for all master replicas of this suffix. Once set, the replication ID must not be changed.

You can use DSCC to perform this task. For information, see [“Directory Service Control Center Interface” on page 43](#) and the DSCC online help.

- **Enable the master replicated suffix.**

```
$ dsconf enable-repl -h host -p port -d ReplicaID master suffix-DN
```

where *ReplicaID* is an integer between 1 and 65534.

For example, to create a master replicated suffix with replica ID 1, use this command:

```
$ dsconf enable-repl -h host1 -p 1389 -d 1 master dc=example,dc=com
```

▼ To Modify Change Log Settings on a Master Replica

For advanced master configuration, you might want to modify the change log settings.

You can use DSCC to perform this task. For information, see “[Directory Service Control Center Interface](#)” on page 43 and the DSCC online help.

- **If you want to modify a change log setting on a master, use one of the following commands:**

```
$ dsconf set-server-prop -h host -p port suffix-DN repl-cl-max-age:value
```

```
$ dsconf set-server-prop -h host -p port suffix-DN repl-cl-max-entry-count:value
```

Configuring the Replication Manager

This section describes how to configure a non-default replication manager and how to set the default replication manager password.

Using a Non-Default Replication Manager

The *replication manager* is the user that suppliers will use to bind to a consumer server when sending replication updates. All servers that contain suffixes receiving updates must have at least one replication manager entry.

Directory Server has a default replication manager entry that you can use on every server, especially for simple replication scenarios: `cn=replication manager, cn=replication, cn=config`. The replication mechanism automatically configures consumer replicas with this user, simplifying the deployment of replicas.

If you have a more complex replication scenario, you might want several replication managers with a different password for each replicated suffix. You can replace the existing default replication manager with one or more new replication managers.



Caution – Never bind or perform operations on the server using the DN and password of the replication manager. The replication manager is for use only by the replication mechanism. Any other use might require reinitializing the replicas.

Never use the Directory Manager as the replication manager. Because the `cn=admin, cn=Administrators, cn=config` entry is used for other administrative tasks, you must also not use this user or any other user in the administrator group as the replication manager.

After you have chosen the replication manager for each consumer, ensure that you remember the replication manager DN that you chose or created. You will need this DN and its password later when creating the replication agreement with this consumer on its supplier.

▼ To Set A Non-Default Replication Manager

You can use DSCC to perform this task. For information, see [“Directory Service Control Center Interface” on page 43](#) and the DSCC online help.

1 On all consumer (destination) replicated suffixes, create a new replication manager and password.

```
$ ldapmodify -a -h host -p port -D cn=admin,cn=Administrators,cn=config -w -
Enter bind password:
dn:"cn=new-replication-manager,cn=replication,cn=config"
objectclass: top
objectclass: person
userpassword:password
sn:new-replication-manager
```

For example:

```
$ ldapmodify -a -h host1 -p 1389 -D cn=admin,cn=Administrators,cn=config -w -
Enter bind password:
dn:"cn=ReplicationManager3,cn=replication,cn=config"
objectclass: top
objectclass: person
userpassword:secret
sn:ReplicationManager3
```

2 On all consumer (destination) replicated suffixes, set the replication manager bind DN.

```
$ dsconf set-suffix-prop -h host -p port suffix-DN \
  repl-manager-bind-dn:"cn=new-replication-manager,cn=replication,cn=config"
```

For example:

```
$ dsconf set-suffix-prop -h host1 -p 1389 dc=example,dc=com \
  repl-manager-bind-dn:"cn=ReplicationManager3,cn=replication,cn=config"
```

3 For all replication agreements that you have created on all supplier (source) replicated suffixes, set the replication manager bind DN.

a. Create a temporary file for setting the new replication manager password.

This file is read once, and the password is stored for future use.

```
$ echo password > password-file
```

b. Set the replication manager bind DN and password to be used by the replication mechanism when performing updates.

```
$ dsconf set-repl-agmt-prop -h host -p port suffix-DN host:port \
  auth-bind-dn:"cn=new-replication-manager,cn=replication,cn=config" \
  auth-pwd-file:password-file
```


For example:

```
$ dsconf set-repl-agmt-prop -h host2 -p 1389 dc=example,dc=com host1:1389 \
  auth-bind-dn:"cn=ReplicationManager3,cn=replication,cn=config" \
  auth-pwd-file:pwd.txt
```

c. Remove the temporary password file.

```
$ rm password-file
```

▼ To Change the Default Replication Manager Password

1 Create a temporary file for setting the replication manager password.

This file is read once, and the password is stored for future use.

```
$ echo password > password-file
```

2 On all consumer (destination) servers in the replication topology, set the replication manager bind password.

```
$ dsconf set-server-prop -h host -p port def-repl-manager-pwd-file:password-file
```

For example:

```
$ dsconf set-server-prop -h host1 -p 1389 def-repl-manager-pwd-file:pwd.txt
```

3 Remove the temporary password file.

```
$ rm password-file
```

Creating and Changing Replication Agreements

A *replication agreement* is a set of parameters on a supplier that configures and controls how updates are sent to a given consumer. The replication agreement must be created on the supplier replicated suffix that is sending updates to its consumer. You must create a replication agreement on the supplier for every consumer that you want updated.

▼ To Create a Replication Agreement

You can use DSCC to perform this task. For information, see [“Directory Service Control Center Interface” on page 43](#) and the DSCC online help.

If you use DSCC to create a new replication agreement, you can choose to copy some or all replication agreement configuration settings from an existing replication agreement.

1 From your master server, create a replication agreement for each consumer that you want to replicate to.

```
$ dsconf create-repl-agmt -h host -p port suffix-DN consumer-host:consumer-port [consumer-host:consumer-port]
```

For example:

```
$ dsconf create-repl-agmt -h host1 -p 1389 dc=example,dc=com host2:1389
```

To list existing replication agreements by using the command line, use the `dsconf list-repl-agmts` command.

Note – If you change the port number on a master when replication is running, you do not need to reinitialize the servers. However, the old replication agreement that pointed to the old address (*host:old-port*) is no longer useful. If you want replication to continue as it did before the port number was changed, you must create a new agreement with the new address (*host:new-port*).

2 Check that the replication agreement has been created correctly.

```
$ dsconf show-repl-agmt-status -h host -p port suffix-DN consumer-host:consumer-port
```

3 If the authentication status is not OK, run the `dsconf accord-repl-agmt` command.

Note – Only use the command `dsconf accord-repl-agmt` if you are using the default replication manager. If you have created a new replication manager, do not use this command because it overwrites some required settings.

The `dsconf accord-repl-agmt` command ensures that both the supplier and destination servers share the same replication authentication settings.

```
$ dsconf accord-repl-agmt -h host -p port suffix-DN consumer-host:consumer-port
```

For example:

```
$ dsconf accord-repl-agmt -h host2 -p 1389 dc=example,dc=com host1:1389
```

▼ To Change the Destination of a Replication Agreement

This procedure changes the remote replica pointed to by an existing replication agreement. The suffix DN and configuration of the existing agreement remain the same.

- **Change the host name and port number of the remote replica in the replication agreement.**

```
$ dsconf change-repl-dest -h host -p port suffix-DN host:port new-host:new-port
```

If this command is run with the *-A protocol* option, you can change the authentication protocol that is used by replication.

Fractional Replication

By default, the replication operation copies entire entries in the replicated suffix to consumer replicas. With the fractional replication feature, you can select the suffix that you want to use, and which attributes you want to include or exclude. Fractional replication is configured in the replication agreement, allowing you to define the attribute set for each consumer replicated suffix of a master. You can control which data is distributed and use replication bandwidth and consumer resources more efficiently.

For example, if you want to reduce replication bandwidth, you can choose not to replicate attributes with typically large values such as `photo`, `jpegPhoto`, and `audio`. As a result, these attributes will not be available on consumers. As another example, you can choose to replicate only the `uid` and `userpassword` attributes to a consumer server that is dedicated to performing authentication.

Considerations for Fractional Replication

Note – Fractional replication cannot be used in versions of the product prior to Directory Server 5.2. When configuring a fractional replication agreement, both the master and consumer replicas must use at least Directory Server 5.2.

Enabling or modifying a fractional set of attributes requires you to reinitialize the consumer replica. Therefore, you need to determine your fractional replication needs before deployment and define your attribute set before you initialize your replicated suffixes for the first time.

You need to proceed with caution when replicating a small set of attributes, given the dependency of complex features such as ACIs, roles, and CoS on certain attributes. In addition, not replicating other attributes that are mentioned in specifiers or filters of the ACI, roles, or CoS mechanisms might compromise the security of the data. Not replicating might also result in different sets of attributes being returned in searches. Managing a list of attributes to exclude is safer, and less prone to human error, than managing a list of attributes to include.

You need to turn off schema checking in the consumer server if the attribute set that you replicate does not allow all replicated entries to follow the schema. Replication of non-conforming entries does not cause errors because the replication mechanism bypasses schema checking on the consumer. However, the consumer will contain non-conforming entries and should have schema checking turned off to expose a coherent state to its clients.

Fractional replication is configured in the replication agreement of master replicas with hubs and dedicated consumers. Configuration of fractional replication between two master replicas in a multimaster replication environment is not supported. Also, if several masters have replication agreements with the same replica, all these agreements must replicate the same set of attributes.

▼ To Configure Fractional Replication

To configure fractional replication, you must specify the suffix, determine whether to include or exclude attributes on that suffix, then choose which attributes to include or exclude. If you choose to exclude attributes on a suffix, all other attributes are automatically included. Likewise, if you choose to include certain attributes on a suffix, all other attributes are automatically excluded.

You can use DSCC to perform this task. For information, see [“Directory Service Control Center Interface” on page 43](#) and the DSCC online help.

- **Configure fractional replication on a replication agreement located on the source server.**

```
$ dsconf set-repl-agmt-prop -h host -p port suffix-DN consumer-host:consumer-port property:value
```

where *property* is either `repl-fractional-exclude-attr` or `repl-fractional-include-attr`.

For example, if you want to configure a fractional agreement to exclude JPEG and TIFF photos from being replicated on the suffix `dc=example,dc=com`, use this command:

```
$ dsconf set-repl-agmt-prop -h host2 -p 1389 dc=example,dc=com host1:1389  
repl-fractional-exclude-attr:jpegPhoto repl-fractional-exclude-attr:tiffPhoto
```

To add an attribute to an existing list of attributes that should be excluded, use this command:

```
$ dsconf set-repl-agmt-prop -h host -p port suffix-DN consumer-host:consumer-port repl-fractional-exclude-attr+:attribute
```

Replication Priority

Specifying replication priority is optional. You can create replication rules to specify that certain changes, such as updating the user password, are replicated with high priority. Any changes specified in replication rules are replicated as high priority, and all other changes are replicated with normal priority.

Note – Replication priority rules only need to be created on the master server. No configuration is required for hubs and consumers.

▼ To Configure Replication Priority

You can use DSCC to perform this task. For information, see [“Directory Service Control Center Interface” on page 43](#) and the DSCC online help.

- **To create a new replication priority rule on a master, use this command:**

```
$ dsconf create-repl-priority -h host -p port suffix-DN priority-name property:value
```

You can set replication priority with one or more of the following properties:

- Operation type, `op-type`
- Bind DN, `bind-dn`
- Base DN, `base-dn`
- Attribute type, `attr`

The *priority-name* is user defined.

For example, to create a replication rule specifying that user password changes are replicated with high priority, use this command:

```
$ dsconf create-repl-priority -h host2 -p 1389 dc=example,dc=com pw-rule \
  attr:userPassword
```

To display current replication rules, use the `dsconf list-repl-priorities -v` command. When used with the `-v` option, this command displays additional information related to prioritized replication rules.

```
$ dsconf list-repl-priorities -h host2 -p 1389 -v
```

For more information, see the `dsconf(1M)` man page.

Initializing Replicas

After you have created a replication agreement and after both replicas have been configured, you must initialize the consumer replicated suffix before replication can begin. During initialization, you physically copy data from the supplier replicated suffix to the consumer replicated suffix.

In addition, certain error conditions or configuration changes require you to reinitialize replicas. For example, if the data in a single master replicated suffix is restored from a backup for any reason, you need to reinitialize all of the replicas that it updates.

When reinitializing, the contents of the replicated suffix are deleted on the consumer and replaced with the contents of the suffix on the master. This ensures that the replicas are synchronized and that replication updates can resume. All of the initialization methods described in this section automatically rebuild the indexes of the consumer replica so that the consumer is ready to respond optimally to client read requests.

With multimaster replication, consumers might not need to be reinitialized if they have been updated by the other masters in the topology.

▼ To Initialize a Replicated Suffix from a Remote (Supplier) Server

You can initialize a suffix from a remote server by using an existing replication agreement. Use this method of initializing if possible, because it is less complicated than the other methods. Use the other methods only for large quantities of data that make the import too time consuming.

You can use DSCC to perform this task. For information, see [“Directory Service Control Center Interface” on page 43](#) and the DSCC online help.

Online initialization of a replicated suffix by using DSCC is an easy way to initialize or reinitialize a consumer. However, if you are initializing a large number of entries, this process can be time consuming. In this case, you might find offline consumer initialization with the command line more efficient.

1 Initialize your replica.

```
$ dsconf init-repl-dest -h host -p port suffix-DN destination-host:destination-port [destination-host:destination-port]
```

where *destination-host:destination-port* is the host and port of the destination server that you are initializing from the remote server.

2 (Optional) For each agreement, check that the suffix appears as initialized.

```
$ dsconf show-repl-agmt-status -h host -p port suffix-DN destination-host:destination-port
```

Replica Initialization From LDIF

▼ To Initialize a Replicated Suffix From LDIF

This procedure outlines the general steps to use to initialize a replicated suffix from an LDIF file.

You can use DSCC to perform this task. For information, see [“Directory Service Control Center Interface” on page 43](#) and the DSCC online help.

Online initialization of a replicated suffix by using DSCC is an easy way to initialize or reinitialize a consumer. However, if you are initializing a large number of entries, this process can be time consuming. In this case, you might find offline consumer initialization with the command line more efficient.

1 Ensure that you have set up replication agreements.

You must do this *before* you initialize replicas.

2 Export the original copy of the suffix data from a master replicated suffix to an LDIF file.

See [“To Export a Replicated Suffix to LDIF” on page 247](#).

In a multimaster replication environment, you can use the LDIF file exported from the original master to initialize both the other masters and any consumers. In a cascading replication environment, you can use the same file to initialize both the hub replicas and their consumers.

In all cases, you must start with an LDIF file that has been exported from a configured master replica. You cannot use an arbitrary LDIF file to initialize all replicas because it does not contain replication meta-data.

3 If you are initializing a fractional replica, filter the file to keep only the replicated attributes, then transfer that file to all of the consumer servers.

See [“Filtering an LDIF File for Fractional Replication” on page 248](#).

4 Initialize your replica.

Do one of the following:

- For fast initialization on a server that is offline (stopped), use the `dsadm import` command.

```
$ dsadm import instance-path LDIF_file suffix-DN
```

- To initialize a replica online from an LDIF file, use the `dsconf import` command.

```
$ dsconf import -h host -p port LDIF_file suffix-DN
```

Using `dsconf import` is slower than using `dsadm import`, but you do not need to stop your server while performing the import operation.

For more detailed information about initializing suffixes, and for examples, see [“Initializing a Suffix” on page 201](#). For detailed command usage, see `dsadm(1M)` and `dsconf(1M)`.

5 (Optional) For each agreement, check that the suffix appears as initialized.

```
$ dsconf show-repl-agmt-status -h host -p port suffix-DN destination-host:destination-port
```

▼ To Export a Replicated Suffix to LDIF

You can use DSCC to perform this task. For information, see [“Directory Service Control Center Interface” on page 43](#) and the DSCC online help.

● Export the replicated suffix contents in an LDIF file by using one of the following commands:

- For an offline export, type:

```
$ dsadm export instance-path suffix-DN LDIF_file
```

- For an online export, type:

```
$ dsconf export -h host -p port suffix-DN LDIF_file
```

The following example will export the entire `dc=example,dc=com` replicated suffix and replication information to the file `example_replica_export.ldif`:

```
$ dsconf export -h host2 -p 1389 dc=example,dc=com \
/local/ds/ldif/example_export_replica.ldif
```

For more information, see [“Backing Up to LDIF” on page 198](#) and the `dsadm(1M)` and `dsconf(1M)` man pages.

Filtering an LDIF File for Fractional Replication

Initializing a replica with fractional replication configured is transparent when using DSCC. Only the selected attributes will be sent to the consumer during the initialization.

If you have configured fractional replication, you should filter out any unused attributes before copying the exported LDIF file to the consumer servers. Directory Server provides the `fildif` tool for this purpose. This tool filters the given LDIF file to keep only the attributes that are allowed by the attribute set defined in your replication agreement.

This tool reads the server’s configuration to determine the attribute set definition. To read the configuration file, the `fildif` tool must be run as root or as the user who owns the process and the files (specified by the `nsslapd-localuser` attribute). For example, the following command filters the file exported from the `dc=example,dc=com` suffix in the previous example:

```
$ fildif -i /local/ds1/ldif/example_master.ldif \
-o /local/ds1/ldif/filtered.ldif -b "cn=host2.example.com:1389, \
cn=replica,cn=\\\"dc=example,dc=com\\\",cn=mapping tree,cn=config" -p /local/ds1
```

For the location of the `fildif` command, see [“Command Locations” on page 34](#).

The `-i` and `-o` options are the input and output files, respectively. The `-b` option is the DN of the replication agreement where fractional replication is defined. You can find this DN by using this command:

```
$ ldapsearch -h host -p port -D cn=admin,cn=Administrators,cn=config -w - \
-b "cn=config" "(&(objectclass=nsds5replicationagreement) (nsDS5ReplicaPort=replica-port) \
(nsDS5ReplicaHost=replica-host))" dn
```

For example:

```
$ ldapsearch -h host2 -p 1389 -D cn=admin,cn=Administrators,cn=config -w - \
-b "cn=config" "(&(objectclass=nsds5replicationagreement) \
(nsDS5ReplicaPort=2090)(nsDS5ReplicaHost=host2))" dn
Enter bind password:
version: 1
dn: cn=host2:1389,cn=replica,cn=dc\=example\,dc\=com,cn=mapping tree,cn=config
```

For the full command-line syntax for the `fildif` tool, see the `fildif(1)` man page.

You can then use the `filtered.ldif` file produced by `fildif` to initialize the consumer in this replication agreement. Transfer the file to the consumer server and import it as described in [“Importing Data From an LDIF File” on page 201](#).

Initializing a Replicated Suffix by Using Binary Copy

A binary copy enables you to clone an entire server by using the binary backup files from one server to restore the identical directory contents onto another server. You can use a binary copy to initialize or reinitialize any server from the binary copy of a master or hub server, or a consumer from the binary copy of another consumer server.

Note – This advanced procedure interacts with the database files of Directory Server and should only be used by experienced administrators.

Certain restrictions on this feature make it practical and time efficient only for replicas with very large database files, for example, replicas containing millions of entries.

Restrictions for Using Binary Copy With Replication

Because a binary copy moves database files from one machine to another, the mechanism is subject to the following strict limitations:

- Both machines must run the same operating system, including any service packs or patches.
- Both machines must share the same processor architecture. For example, you can perform binary copy between two UltraSPARC® T1 processors but not between an UltraSPARC T1 and an AMD Opteron processor.
- Both machines must be either big endian or little endian.
- Both machines must map memory the same way. For example, you can perform binary copy between server instances on two 64-bit systems, but not between one server instance on a 32-bit system and another on a 64-bit system.
- Both machines must have the same version of Directory Server installed, including binary format (32 bits or 64 bits), service pack, and patch level.
- Both servers must have the same directory tree divided into the same suffixes. The database files for *all* suffixes *must* be copied together. Individual suffixes cannot be copied.
- Each suffix must have the same indexes configured on both servers, including VLV (virtual list view) indexes. The databases for the suffixes must have the same name.
- Each server must have the same suffixes configured as replicas.
- If fractional replication is configured, it must be configured identically on all servers.
- Attribute encryption must not be used on either server.

- The attribute value uniqueness plug-in must have the same configuration on both servers if enabled, and it must be re-configured on the new copy, as explained in the following procedures.

These procedures describe alternate ways of performing a binary copy: a binary copy that does not require stopping the server and a binary copy that uses the minimum amount of disk space.

Making a Binary Copy for Initializing a Server

This section describes how to make a binary copy for initializing a server, and how to make a binary copy that uses minimum disk space.

▼ To Make a Binary Copy For Initializing a Server

Use this procedure to perform a binary copy for initializing a replicated server because it uses the normal backup functionality to create a copy of the server's database files. Performing a normal backup ensures that all database files are in a coherent state without requiring you to stop the server.

This procedure has certain limitations. The backup and restore operations create copies of the database files on the same machine, thereby doubling the amount of disk space required by those files on each machine. Additionally, the actual copy operation on these files might take a significant amount time if your directory contains gigabytes of data.

For parts of this procedure, you can use DSCC to perform this task. For information, see [“Directory Service Control Center Interface” on page 43](#) and the DSCC online help. Other parts of the procedure can only be done using the command line.

- 1 Install Directory Server on the target machine for the new replicated suffix, create a new instance of the server if necessary, and configure the server according to [“Restrictions for Using Binary Copy With Replication” on page 249](#).**
- 2 Create all replication agreements in your replication topology that involve this replicated suffix.** Include agreements from suppliers to this replica. If this replica is not a dedicated consumer, include agreements from this replica to its consumers. See [“Creating and Changing Replication Agreements” on page 241](#).
- 3 Select a fully configured and initialized replica of the same type as you want to initialize, either master, hub, or consumer, and perform a normal backup on it according to [“Binary Backup” on page 195](#).**
- 4 Copy or transfer the files from the backup directory to a directory on the target machine by using the `ftp` command, for example.**

- 5 If you have initialized a new master in a multimaster replication scenario, follow the procedures in [“Restoring a Master in a Multi-Master Scenario” on page 207](#).

▼ To Use Binary Copy for Initializing a Server Using Minimum Disk Space

This procedure uses less disk space and takes less time because it does not make backup copies of the database files. However, it requires you to stop the server that is being cloned to order to ensure that the database files are in a coherent state.



Caution – This procedure *must not* be used to reinitialize a master that has already participated in a multimaster replication scenario. It can only be used to reinitialize a consumer server or to initialize a new master server. To reinitialize an existing master replica, use online initialization, import an LDIF file, or follow the procedure in [“Making a Binary Copy for Initializing a Server” on page 250](#).

For parts of this procedure, you can use DSCC to perform this task. For information, see [“Directory Service Control Center Interface” on page 43](#) and the DSCC online help. Other parts of the procedure can only be done using the command line.

- 1 **Install Directory Server on the target machine for the new replicated suffix, create a new instance of the server if necessary, and configure the server according to [“Restrictions for Using Binary Copy With Replication” on page 249](#).**
- 2 **Create all replication agreements in your replication topology that involve this replica.**
Include agreements from suppliers to this replica. If this replica is not a dedicated consumer, include agreements from this replica to its consumers. See [“Creating and Changing Replication Agreements” on page 241](#).
- 3 **Stop the target server that will be initialized or reinitialized, as described in [“Starting, Stopping, and Restarting a Directory Server Instance” on page 57](#).**
- 4 **Select a fully configured and initialized replica of the same type that you want to initialize, either master, hub, or consumer, and stop this server as well.**
If you are cloning a master replica in a multimaster configuration, ensure that it is fully up-to-date with all of the latest changes from the other masters before stopping it.
- 5 **Remove all database files from the target server, including transaction logs, change logs, and region files (`_db.xxx` files).**
Unless the files have been relocated, database files and transaction logs are located in the *instance-path/db* directory.

- 6 Copy or transfer all database files, including transaction logs and change logs, from the source replica machine to the target machine, by using the `ftp` command, for example.**

Unless the files have been relocated, database files and transaction logs are located in the *instance-path/db* directory.

If you are initializing a master or hub replica, you must also copy all files in the change log, which is located in *instance-path/changeLog* by default.

- 7 Restart both the source and the target servers.**

Initializing Replicas in Cascading Replication

In the case of cascading replication, always initialize replicas in the order shown in the following procedure.

▼ To Initialize Replicas in Cascading Replication

You can use DSCC to perform this task. For information, see [“Directory Service Control Center Interface” on page 43](#) and the DSCC online help.

- 1 If you also have multimaster replication, ensure that one master has the complete set of data to replicate, then use this master to initialize the replica on each of the other masters.**
- 2 Initialize the replicas on the first-level hub replicas from their master replicas.**
- 3 If you have several levels of hubs, initialize each level from the previously initialized level of hubs.**
- 4 From the last level of hub replicas, initialize the replicas on the dedicated consumers.**

Indexing Replicated Suffixes

Indexes are not replicated automatically from one server instance to another. To index an attribute for all server instances holding a replicated suffix, perform one of the following actions.

- Manage all server instances holding the replicated suffix as a server group in DSCC. Add the index to one server in the group, then use the Copy Server Configuration action to copy index settings to other servers in the group.

For more information about DSCC, see [“Directory Service Control Center Interface” on page 43](#).

- Manage the index on each server instance with the `dsconf` command, as described in [Chapter 12, “Directory Server Indexing.”](#)
- Use binary copy to initialize suffixes, as described in [“Initializing a Replicated Suffix by Using Binary Copy” on page 249](#).

Incrementally Adding Many Entries to Large Replicated Suffixes

If you have a directory with a very large number of entries and you want to add a large quantity of entries, do not use `ldapmodify -a` because it is too time consuming. Instead, add the new entries incrementally by using the `dsconf import` command with an option for adding entries in a replicated topology. When you import the entries, an LDIF file is generated that contains the additions as well as replication meta-data. You then import this generated LDIF file to the other replicas. The generated LDIF file ensures that replication synchronization is constant across the replicas to which you add data.

▼ To Add Many Entries to Large Replicated Suffixes

Before You Begin This procedure generates a large LDIF file. Before running the first `dsconf import` command, ensure that you have enough disk space available for the generated LDIF file.

You cannot use DSCC to perform this task. Use the command line, as described in this procedure.



Caution – This procedure can be used to initialize a server with a large number of entries in several passes. However, if one of the imports fails, the whole database can be lost. Be sure to backup data prior to each import.

1 On any master replica, import the entries.

```
$ dsconf import -h host -p port -K generated-LDIF-file suffix-DN
```

The `-K` option ensures that existing data is not removed. It also generates a file *generated-LDIF-file*, that contains the new entries and information required by the replication process.

2 On all other replicas, import the file generated in the previous step.

```
$ dsconf import -h host -p port \  
-K -f incremental-output=no generated-LDIF-file suffix-DN
```

The option `-f incremental-output=no` specifies that an additional LDIF file will not be generated. Only one generated LDIF file is needed for this procedure.

Replication and Referential Integrity

If you are using the referential integrity plug-in with replication, you must enable it on all master servers. You do not need to enable it on hub or consumer servers.

The following limitations are associated with the use of the referential integrity plug-in in a replication environment:

- The plug-in must be enabled on all servers containing master replicas.
- You must enable the plug-in with the same configuration on every master.
- It is not useful to enable the plug-in on servers containing only hub or consumer replicas.

For information about configuring the referential integrity plug-in, see [“To Configure the Referential Integrity Plug-In” on page 230](#).

Replication Over SSL

You can configure Directory Servers involved in replication so that all replication operations occur over an SSL connection.

▼ To Configure Replication Operations for SSL

This procedure shows example commands for setting up replication on a replication topology with two masters.

Note – This example shows a simple replication configuration, using a self-signed certificate. When setting up replication over SSL in a production environment, you will have better security if you use Certificate Authority trusted certificates instead.

Replication over SSL will fail if the supplier server certificate is an SSL server-only certificate that cannot act as a client during an SSL handshake.

While replication is secure by SSL, authentication of the replication manager is still done using a simple bind and password. You can use client-based authentication to fully secure replication, but this requires more complex settings.

You can use DSCC to perform this task. For information, see [“Directory Service Control Center Interface” on page 43](#) and the DSCC online help.

1 Create new servers and start them.

```
$ dsadm create -p 1389 -P 1636 /local/ds1
$ dsadm create -p 2389 -P 2636 /local/ds2

$ dsadm start /local/ds1
$ dsadm start /local/ds2
```

2 On all servers, create empty suffixes.

```
$ dsconf create-suffix -e -i -p 1389 dc=example,dc=com
$ dsconf create-suffix -e -i -p 2389 dc=example,dc=com
```

3 On all servers, set the multimaster password file.

```
$ dsconf set-server-prop -e -i -h example1.server -p 1389 \
  def-repl-manager-pwd-file:/local/ds1/replmanrpwd1.txt
$ dsconf set-server-prop -e -i -h example2.server -p 2389 \
  def-repl-manager-pwd-file:/local/ds1/replmanrpwd2.txt
```

4 On all servers, enable replication.

```
$ dsconf enable-repl -h example1.server -p 1389 -e -i -d 1 master dc=example,dc=com
$ dsconf enable-repl -h example2.server -p 2389 -e -i -d 2 master dc=example,dc=com
```

5 On all servers, view the existing default certificate.

```
$ dsadm show-cert -F der -o certfile1 /local/ds1 defaultCert
$ dsadm show-cert -F der -o certfile2 /local/ds2 defaultCert
```

6 On all servers, add the CA trusted certificate from all other servers.

```
$ dsadm add-cert --ca /local/ds1 "ds2 Repl Manager Cert" certfile2
$ dsadm add-cert --ca /local/ds2 "ds1 Repl Manager Cert" certfile1
```

7 On all master and hub (source) servers, create replication agreements with all consumer (destination) servers.

Note that secure LDAP ports are used for the replication agreements.

```
$ dsconf create-repl-agmt -h example1.server -p 1389 -e -i \  
  --auth-protocol "ssl-simple" dc=example,dc=com example2.server:2636  
$ dsconf create-repl-agmt -h example2.server -p 2389 -e -i \  
  --auth-protocol "ssl-simple" dc=example,dc=com example1.server:1636
```

8 For all replication agreements, configure the authentication password file to be the replication manager password file of the consumer (destination) server in the replication agreement.

```
$ dsconf set-repl-agmt-prop -h example1.server -p 1389 -e -i \  
  dc=example,dc=com example2.server:2636 auth-pwd-file:/local/ds1/replmanrpwd2.txt  
$ dsconf set-repl-agmt-prop -h example2.server -p 2389 -e -i \  
  dc=example,dc=com example1.server:1636 auth-pwd-file:/local/ds1/replmanrpwd1.txt
```

After you have initialized the suffixes, the supplier will send all replication update messages to the consumer over SSL and will use certificates if you chose that option. Customer initialization will also use a secure connection if performed through DSCC using an agreement configure for SSL.

9 On all servers, restart the server in order to take configuration changes into account.

```
$ dsadm restart /local/ds1  
$ dsadm restart /local/ds2
```

10 On one of the master servers, initialize the suffix.

```
$ dsconf import -h example1.server -p 1389 -e -i /tmp/Example.ldif dc=example,dc=com
```

11 On all servers not yet initialized, initialize the servers by using a replication agreement.

```
$ dsconf init-repl-dest -e -i -h example1.server -p 1389 \  
  dc=example,dc=com example1.server:2636
```

Replication Over a WAN

Directory Server enables you to perform all forms of replication including multimaster replication between machines connected through a wide area network (WAN). This replication allows supplier servers to initialize and update consumers by making optimal use of the bandwidth over networks with higher latency and lower bandwidth.

Note – When deploying or troubleshooting a replication topology that replicates over a WAN, you must check network speed, latency, and packet loss. Network problems in any of these areas might cause replication delay.

In addition, replication data transfer rates will always be less than what the available physical medium allows in terms of bandwidth. If the update volume between replicas cannot physically be made to fit into the available bandwidth, tuning will not prevent your replicas from diverging under heavy update load. Replication delay and update performance are dependent on many factors, including but not limited to: modification rate, entry size, server hardware, error rates, average latency, and average bandwidth.

If you have questions about replication in your environment, contact your Sun Service Provider.

Internal parameters of the replication mechanism are optimized by default for WANs. However, if you experience slow replication due to the factors mentioned previously, you might want to empirically adjust the window size and group size parameters. You might also be able to schedule your replication to avoid peak network times, thus improving your overall network usage. Finally, Directory Server supports the compression of replication data to optimize bandwidth usage.

Configuring Network Parameters

The window and group network parameters determine how the replication mechanism groups entries to send them more efficiently over the network. These parameters affect how suppliers and consumers exchange replication update messages and acknowledgments. The parameters are configurable in every replication agreement, which allows you to tailor the replication performance according to the specific network conditions of each consumer.

Monitor the effects of any modifications that you make and adjust the parameters accordingly. Refer to [“Getting Replication Status” on page 270](#) for instructions. You do not need to interrupt replication to modify the window size and group size parameters.

Configuring Window Size

The window size (default value 10) represents the maximum number of update messages that can be sent without immediate acknowledgment from the consumer.

It is more efficient to send many messages in quick succession instead of waiting for an acknowledgment after each message. Using the appropriate window size, you can eliminate the time replicas spend waiting for replication updates or acknowledgments to arrive.

If your consumer replica is lagging behind the supplier, increase the window size to a higher value than the default, such as 100, and check replication performance again before making further adjustments. When the replication update rate is high and the time between updates is therefore small, even replicas connected by a local area network (LAN) can benefit from a higher window size.

▼ To Configure Window Size

You can use DSCC to perform this task. For information, see [“Directory Service Control Center Interface” on page 43](#) and the DSCC online help.

● Modify the window size.

```
$ dsconf set-repl-agmt-prop -h host -p port suffix-DN consumer-host:consumer-port transport-window-size:value
```

For example:

```
$ dsconf set-repl-agmt-prop -h host2 -p 1389 dc=example,dc=com host1:1389 \  
transport-window-size:20
```

Configuring Group Size

The group size (default value 1) represents the maximum number of data modifications that can be bundled into a single update message. If the network connection appears to be impeding replication, increase the group size to a higher value than the default, such as 10, and recheck replication performance.

When increasing the group size, make sure that the following are true:

- The window size is set significantly higher than the group size.
- The window size divided by the group size is much greater than the value for `nsslapd-maxThreadsPerConn` under `cn=config` on the consumer (typically twice as large).

When the group size is set higher than 1, the supplier does not wait to fill a group before sending updates to the consumer.

▼ To Configure Group Size

You can use DSCC to perform this task. For information, see [“Directory Service Control Center Interface” on page 43](#) and the DSCC online help.

● Modify the group size.

```
$ dsconf set-repl-agmt-prop -h host -p port suffix-DN \  
consumer-host:consumer-port transport-group-size:value
```

For example:

```
$ dsconf set-repl-agmt-prop -h host2 -p 1389 dc=example,dc=com host1:1389 \  
transport-group-size:10
```

Scheduling Replication Activity

If immediate synchronization between your replicas is not critical, you can schedule replication during periods of low network usage. Replication of data should complete significantly faster when the network is more available.

You can schedule replication to start and end at a certain time of day, on a daily or weekly basis. You can do this independently for every consumer through its replication agreement. The new schedule will take effect immediately, causing the next replication of data for the corresponding consumer to be delayed until first allowed by the schedule.

▼ To Schedule Replication Activity

You can use DSCC to perform this task. For information, see [“Directory Service Control Center Interface” on page 43](#) and the DSCC online help.

● Modify the replication schedule.

```
$ dsconf set-repl-agmt-prop -h host -p port suffix-DN \  
  host:port repl-schedule:value
```

For example, if you want to set replication to occur between 2:00 and 4:00 every night, type:

```
$ dsconf set-repl-agmt-prop -h host2 -p 1389 dc=example,dc=com host1:1389 \  
  repl-schedule:"0200-0400 0123456"
```

where 0123456 indicate the days of the week, with 0 representing Sunday, 1 representing Monday, and so on.

Configuring Replication Compression

To reduce the bandwidth used by replication, you may configure replication to compress the data that is sent when updating consumers. The replication mechanism uses the Zlib compression library. Both supplier and consumer must be running on a Solaris or Linux platform to enable compression.

You should empirically test and select the compression level that gives you best results for your expected replication usage in your WAN environment. Do not set this parameter in a LAN where there is wide network bandwidth because the compression and decompression computations will slow down replication.

▼ To Configure Replication Compression

You cannot use DSCC to perform this task. Use the command line, as described in this procedure.

- **Configure replication compression on the replication agreement entry in the master server.**

```
$ dsconf set-repl-agmt-prop -h host -p port suffix-DN \  
  consumer-host:consumer-port transport-compression:level
```

where *level* can be high, medium, low, or none.

For example, to use the fastest compression when sending replication updates to the consumer on host1:1389, type:

```
$ dsconf set-repl-agmt-prop -h host2 -p 1389 dc=example,dc=com host1:1389 \  
  transport-compression:high
```

For more information about setting the compression level, see *Sun Java System Directory Server Enterprise Edition 6.2 Reference*.

Modifying the Replication Topology

This section explains these aspects of managing an existing replication topology:

- [“Changing the Replication Manager” on page 260](#)
- [“Managing Replication Agreements” on page 260](#)
- [“Promoting or Demoting Replicas” on page 262](#)
- [“Disabling a Replicated Suffix” on page 263](#)
- [“Keeping Replicated Suffixes Synchronized” on page 263](#)

Changing the Replication Manager

You can edit a replication agreement to change the replication manager identity that is used to bind to the consumer server. To avoid any interruption of the replication, you should define the new replication manager entry or certificate entry on the consumer before modifying the replication agreement. However, if replication is interrupted due to a bind failure, the replication mechanism will automatically send all the necessary updates when you correct the error, within the limits of the replication recovery settings. For the procedure, see [“Using a Non-Default Replication Manager” on page 239](#).

Managing Replication Agreements

You can disable, enable, or delete a replication agreement.

Disabling a Replication Agreement

When a replication agreement is disabled, the master stops sending updates to the designated consumer. Replication to that server is stopped, but all settings in the agreement are preserved.

You may resume replication by re-enabling the agreement at a later time. See [“Enabling a Replication Agreement” on page 261](#) for information about resuming the replication mechanism after an interruption.

▼ To Disable a Replication Agreement

You can use DSCC to perform this task. For information, see [“Directory Service Control Center Interface” on page 43](#) and the DSCC online help.

● Disable a replication agreement.

```
$ dsconf disable-repl-agmt -h host -p port suffix-DN consumer-host:consumer-port
```

For example:

```
$ dsconf disable-repl-agmt -h host2 -p 1389 dc=example,dc=com host1:1389
```

Enabling a Replication Agreement

Enabling a replication agreement resumes replication with the designated consumer. However, if replication has been interrupted longer than the replication recovery settings allow and the consumer was not updated by another supplier, you must reinitialize the consumer. The replication recovery settings are the maximum size and age of this supplier’s change log and the purge delay of the consumer (see [“To Perform Advanced Consumer Configuration” on page 235](#)).

When the interruption is short and replication can recover, the master will update the consumer automatically when the agreement is re-enabled.

▼ To Enable a Replication Agreement

You can use DSCC to perform this task. For information, see [“Directory Service Control Center Interface” on page 43](#) and the DSCC online help.

● Enable a replication agreement.

```
$ dsconf -h host -p port enable-repl-agmt suffix-DN consumer-host:consumer-port
```

For example:

```
$ dsconf -h host2 -p 1389 enable-repl-agmt dc=example,dc=com host1:1389
```

Deleting a Replication Agreement

Deleting a replication agreement stops the replication to the corresponding consumer and removes all configuration information about the agreement. If you want to resume replication at a later date, disable the agreement instead, as described in [“Disabling a Replication Agreement” on page 260](#).

▼ To Delete a Replication Agreement

You can use DSCC to perform this task. For information, see [“Directory Service Control Center Interface” on page 43](#) and the DSCC online help.

● Delete a replication agreement.

```
$ dsconf delete-repl-agmt -h host -p port suffix-DN consumer-host:consumer-port
```

For example:

```
$ dsconf delete-repl-agmt -h host2 -p 1389 dc=example,dc=com host1:1389
```

Promoting or Demoting Replicas

Promoting or demoting a replica changes its role in the replication topology. Dedicated consumers can be promoted to hubs, and hubs can be promoted to masters. Masters can be demoted to hubs, and hubs can also be demoted to dedicated consumers. However, masters cannot be demoted directly to consumers, just as consumers cannot be promoted directly to masters.

The allowed promotions and demotions within the multimaster replication mechanism make the topology very flexible. A site that was formerly served by a consumer replica might grow and require a hub with several replicas to handle the load. If the load includes many modifications to the replica contents, the hub can become a master to allow faster local changes that can then be replicated to other masters at other sites.

When promoting or demoting replicas, be aware of the following:

- If you promote a consumer, it becomes a hub. If you promote a hub, it becomes a master. You cannot promote a server directly from consumer to master. You must first promote the consumer to a hub, then promote the hub to a master. Likewise, when demoting a master to a consumer, you must demote the master to a hub before demoting from a hub to a consumer.
- When demoting a master to a hub, the replica will become read-only and be configured for sending referrals to the remaining masters. The new hub will retain all of its consumers, whether hubs or dedicated consumers.
- Demoting a single master to a hub will create a topology without a master replica. Directory Server will allow you to do this under the assumption that you will define a new master. However, it is better to add a new master as a multimaster and allow it to be initialized before demoting the other master.
- Before demoting a hub to a consumer, you must disable or delete all replication agreements to and from the hub. If you do not do this, the demote operation will fail with this error:
LDAP_OPERATIONS_ERROR “Unable to demote a hub to a read-only replica if some agreements are enabled”.

If the hub's consumers were not updated by other hubs or masters, they will no longer be updated. You should create new agreements on the remaining hubs or masters to update these consumers.

- When promoting a consumer to a hub, its change log is enabled, and you may define new agreements with consumers.
- When promoting a hub to a master, the replica will accept modification requests, and you may define new agreements with other masters, hubs, or dedicated consumers.

▼ To Promote or Demote a Replica

You can use DSCC to perform this task. For information, see [“Directory Service Control Center Interface” on page 43](#) and the DSCC online help.

● Promote or demote a replica by using one of the commands:

```
$ dsconf promote-repl -h host -p port role suffix-DN
```

```
$ dsconf demote-repl -h host -p port role suffix-DN
```

where *role* is master, hub or consumer.

Disabling a Replicated Suffix

Disabling a replicated suffix removes it from the replication topology. It will no longer be updated or send updates, depending on its role as a master, hub, or consumer. Disabling a suffix on a supplier server deletes all replication agreements, and they will have to be re-created if the replica is enabled again.

▼ To Disable a Replicated Suffix

You can use DSCC to perform this task. For information, see [“Directory Service Control Center Interface” on page 43](#) and the DSCC online help.

● Disable a replicated suffix.

```
$ dsconf disable-repl -h host -p port suffix-DN
```

For example:

```
$ dsconf disable-repl -h host2 -p 1389 dc=example,dc=com
```

Keeping Replicated Suffixes Synchronized

After you stop a Directory Server involved in replication for regular maintenance, when it comes back online, you need to ensure that it gets updated through replication immediately. In

the case of a master in a multimaster environment, the directory information needs to be updated by another master in the multimaster set. In other cases, after a hub server or a dedicated consumer server is taken offline for maintenance, when they come back online, they need to be updated by the master server.

This section describes the replication retry algorithm and explains how to force replication updates to occur without waiting for the next retry.

Note – The procedures described in this section can be used only when replication is already set up *and* consumers have been initialized.

Replication Retry Algorithm

When a source replica is unsuccessful in replicating to a destination, it retries periodically in incremental time intervals. The retry intervals depend on the error type.

Note that even if you have configured replication agreements to always keep the source replica and the destination replica synchronized, this is not sufficient to immediately update a replica that has been offline for over five minutes.

▼ To Force Replication Updates

If replication has stopped, you can force replication updates to the destination suffixes.

You cannot use DSCC to perform this task. Use the command line, as described in this procedure.

- **On the source server, restart replication updates to the destination server.**

```
$ dsconf update-repl-dest-now -h host -p port suffix-DN destination-host:destination-port
```

For example:

```
$ dsconf update-repl-dest-now -h host2 -p 1389 dc=example,dc=com host1:1389
```

Moving a Master Replica to a New Machine

In some situations, it might be necessary to move a master replica to a different machine. If you do not need to use the same host name and port number, use `dsconf change-repl-dest` to change the host name and port number of the remote replica. For more information, see [“To Change the Destination of a Replication Agreement” on page 242](#).

If you need to retain the same host name and port number, you must remove the master from the existing topology, and then re-add the master to the topology.

It is much easier to use DSCC to perform these tasks, because DSCC takes care of any impacted replication agreements. If you use DSCC, however, you cannot specify the same replica ID that the master originally had in the topology. To use the same replica ID, you must use the command line to perform these tasks, as follows.

▼ **To Remove a Master From an Existing Replication Topology**

Before You Begin Make sure that all changes from the master have already been replicated.

- 1 If you can, back up the master using binary copy so that you do not lose any changes.**
- 2 Demote the master replica to a hub replica.**
See [“Promoting or Demoting Replicas” on page 262](#).
- 3 Wait for the hub to start replicating to other servers.**
When the hub opens a replication session to the other servers in the topology, it remains in the RUV but is no longer used in referrals.
- 4 Stop the hub.**
See [“Starting, Stopping, and Restarting a Directory Server Instance” on page 57](#).
- 5 Remove the hub from the topology.**
See [“Disabling a Replicated Suffix” on page 263](#).

▼ **To Add a Master to an Existing Replication Topology**

- 1 Add the master replica, using the same replica ID.**
See [“Enabling Replication on a Master Replica” on page 238](#).
- 2 Recreate the replication agreements from that master to the other replicas in the topology.**
- 3 Initialize the new master.**
 - a. If you were able to back up the master, initialize the master from this backup.**
 - b. If you were not able to back up the master (in the event of a machine crash), initialize the master from another master in the topology.**

Replication With Releases Prior to Directory Server 6.2

This section provides information about how to configure replication with releases of Directory Server prior to 6.2.

Replicating Between Directory Server 6.2 and Directory Server 5.1 or 5.2

Directory Server 5.1, 5.2 and 6.2 are compatible with regard to replication configuration, with the following exceptions:

- Replication priority is not supported in releases prior to Directory Server 6.2. If you configure replication priority on a 6.2 master replica, the replication priority will be transferred to consumers running Directory Server 6.2, but not to any consumers running a previous version of Directory Server.
- An unlimited number of masters is not supported on replication topologies that contain Directory Server 5.1 or 5.2 masters. Although Directory Server 6.2 supports an unlimited number of masters in a replication topology, this number is limited to four if your replication topology includes any Directory Server 5.2 master servers. Directory Server 5.1 does not support multimaster replication.

Using the Retro Change Log

The retro change log is used by LDAP clients to ascertain the history of changes made to the Directory Server data. The retro change log is stored in a separate database to the Directory Server change log, under the suffix `cn=changeLog`.

A retro change log can be enabled on a standalone server or on each server in a replication topology. When the retro change log is enabled on a server, by default updates to all suffixes on that server are logged. The retro change log can be configured to log updates to specified suffixes only.

For information about using the retro change log in a replicated topology and about restrictions on using the retro change log, see “Replication and the Retro Change Log Plug-In” in *Sun Java System Directory Server Enterprise Edition 6.2 Reference*.

For information about the attributes of an entry in the retro change log, see the `changeLogEntry(5dsoc)` man page.

For more information about modifying the retro change log, see the `dsconf(1M)` man page.

This section explains various ways that you can use the retro change log.

▼ To Enable the Retro Change Log

To use the retro change log, you must enable it.

You cannot use DSCC to perform this task. Use the command line, as described in this procedure.

1 Modify the retro change log configuration entry:

```
$ dsconf set-server-prop -h host -p port retro-cl-enabled:on
```

2 Restart the server.

For information, see [“Starting, Stopping, and Restarting a Directory Server Instance” on page 57](#).

▼ To Configure the Retro Change Log to Record Updates for Specified Suffixes

When the retro change log is enabled on a server, by default it records updates to all suffixes on the server. This procedure describes how to configure the retro change log to record updates to specified suffixes only.

You cannot use DSCC to perform this task. Use the command line, as described in this procedure.

1 Modify the retro change log configuration entry:

```
$ dsconf set-server-prop -h host -p port retro-cl-suffix-dn:suffix-DN
```

For example, to log changes only on the `cn=Contractors,dc=example,dc=com` suffix and the `ou=People,dc=example,dc=com` suffix, use this command:

```
$ dsconf set-server-prop -h host2 -p 1389 \  
  retro-cl-suffix-dn:"cn=Contractors,dc=example,dc=com" \  
  retro-cl-suffix-dn:"ou=People,dc=example,dc=com"
```

To add a suffix to an existing list of specified suffixes, use this command:

```
$ dsconf set-server-prop -h host -p port retro-cl-suffix-dn+:suffix-DN
```

2 Restart the server.

For information, see [“Starting, Stopping, and Restarting a Directory Server Instance” on page 57](#).

▼ To Configure the Retro Change Log to Record Attributes of a Deleted Entry

This procedure describes how to configure the retro change log to record specified attributes of an entry when that entry is deleted.

You cannot use DSCC to perform this task. Use the command line, as described in this procedure.

1 Specify the attributes that must be recorded:

```
$ dsconf set-server-prop -h host -p port retro-cl-deleted-entry-attr: \
  attribute1 attribute2
```

For example, to set the retro change log to record the UID attributes of deleted entries, use this command:

```
$ dsconf set-server-prop -h host -p port retro-cl-deleted-entry-attr:uid
```

To add an attribute to an existing list of specified attributes, use this command:

```
$ dsconf set-server-prop -h host -p port retro-cl-deleted-entry-attr+:attribute
```

2 Restart the server.

For information, see [“Starting, Stopping, and Restarting a Directory Server Instance” on page 57](#).

▼ To Trim the Retro Change Log

The entries in the retro change log can be removed automatically after a specified period of time. To configure the period of time after which entries are deleted automatically, make sure that the retro change log is enabled, then set the `nsslapd-changelogmaxage` configuration attribute in the `cn=Retro ChangeLog Plugin, cn=plugins, cn=config` entry.

You cannot use DSCC to perform this task. Use the command line, as described in this procedure.

1 Check that the retro change log is enabled.

```
$ dsconf get-server-prop -h host -p port retro-cl-enabled
```

2 If the retro change log is not enabled, enable it.

```
$ dsconf set-server-prop -h host -p port retro-cl-enabled:on
```

3 Set the maximum age for changes logged.

```
$ dsconf set-server-prop -h host -p port retro-cl-max-age:duration
```

where *duration* can be either undefined (no age limit) or one of the following:

- s for seconds
- m for minutes
- h for hours
- d for days
- w for weeks

For example, to set the retro change log maximum age to two days, type:

```
$ dsconf set-server-prop -h host 2 -p 1389 retro-cl-max-age:2d
```

The retro change log will be trimmed at the next operation on the change log.

Accessing Control and the Retro Change Log

The retro change log supports search operations. It is optimized for searches that include filters of this form:

```
(&(changeNumber>=X)(changeNumber<=Y))
```

As a general rule, do not perform add or modify operations on the retro change log entries. You can delete entries to trim the size of the log. The only time that you need to perform a modify operation on the retro change log is to modify the default access control policy.

When the retro change log is created, by default, the following access control rules apply:

- Read, search, and compare rights are granted to all authenticated users (`userdn=anyone`, not to be confused with anonymous access where `userdn=all`) to the retro change log top entry `cn=changeLog`.
- Write and delete access are not granted, except implicitly to the Directory Manager.

Do not grant read access to anonymous users because the retro change log entries can contain modifications to sensitive information such as passwords. You may want to further restrict access to the retro change log contents if authenticated users should not be allowed to view its contents.

To modify the default access control policy that applies to the retro change log, modify the `aci` attribute of the `cn=changeLog` entry. Refer to [Chapter 6, “Directory Server Access Control.”](#)

Getting Replication Status

You can get replication status by using DSCC or by using command-line tools.

Getting Replication Status in DSCC

You can graphically view replication, including replication agreements and replication delay, by using the Suffix tab. For more information, see the DSCC online help.

In addition, you can use DSCC to view your replication topology, as shown in following figure.

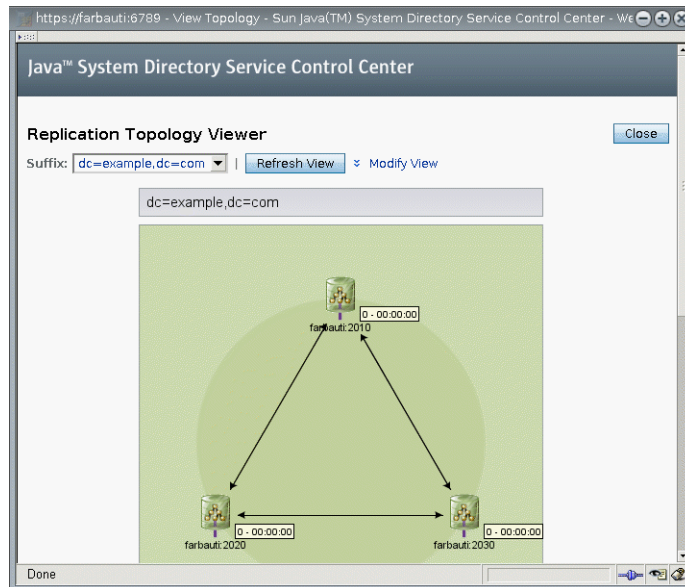


FIGURE 10-1 Sample Replication Topology

Getting Replication Status by Using the Command Line

If you are unable to use DSCC, use command-line tools to obtain information about your replication deployment.

The man pages provide full command-line syntax and usage examples for these tools.

- `repldisc` - “Discovers” and constructs a table of all known servers in a replication deployment. See the `repldisc(1)` man page.
- `insync` - Indicates the synchronization state between a supplier and one or more consumer replicas. See the `insync(1)` man page.

- `entrycmp` - Compares the same entry in two or more replicas. See the `entrycmp(1)` man page.

To find the directories where these commands are located, see [“Command Locations” on page 34](#).

Solving Common Replication Conflicts

Multimaster replication uses a loose consistency replication model. This means that the same entries may be modified simultaneously on different servers. When updates are sent between the two servers, any conflicting changes must be resolved. Most resolution occurs automatically. For example, the timestamp associated with the change on each server is resolved by the most recent change taking precedence. However, some change conflicts require manual intervention to reach a resolution.

This section covers the following topics:

- [“Solving Replication Conflicts by Using DSCC” on page 271](#)
- [“Solving Replication Conflicts by Using the Command Line” on page 271](#)
- [“Solving Naming Conflicts” on page 272](#)
- [“Solving Orphan Entry Conflicts” on page 274](#)
- [“Solving Potential Interoperability Problems” on page 274](#)

Solving Replication Conflicts by Using DSCC

The easiest way to resolve a replication conflict is by using DSCC. See the DSCC online help for information.

Solving Replication Conflicts by Using the Command Line

You can solve replication conflicts by using the command line. Entries that have a change conflict that cannot be resolved automatically by the replication process contain the operational attribute `nsds5ReplConflict` as a conflict marker.

To find entries with conflicts, periodically search for entries that contain this attribute. For example, you could use the following `ldapsearch` command to find entries with conflicts:

```
$ ldapsearch -h host2 -p 1389 -D cn=admin,cn=Administrators,cn=config \
-w - -b "dc=example,dc=com" "(nsds5ReplConflict=*)"
```

Note that the `nsds5ReplConflict` attribute is indexed by default.

Solving Naming Conflicts

Entries with identical DNs may be created on separate masters if they are created before the servers replicate the changes to each other. Upon replication, the conflict resolution mechanism will automatically rename the second entry created.

An entry with a DN naming conflict is renamed by including its unique identifier, provided by the operational attribute `nsuniqueid`, in its DN.

For example, if the entry `uid=bjensen,ou=People,dc=example,dc=com` is created simultaneously on two masters, both will have the following two entries after replication:

- `uid=bjensen,ou=People,dc=example,dc=com`
- `nsuniqueid=66446001-1dd211b2-66225011-2ee211db+uid=bjensen,dc=example,dc=com`

The second entry must be given a useful DN. You can delete the conflicting entry and add it again with a non-conflicting name. However, renaming the entry ensures that its contents have not changed. The renaming procedure depends on whether the naming attribute is single-valued or multivalued. See the following procedures.

▼ To Rename a Conflicting Entry That has a Multivalued Naming Attribute

You can use DSCC to perform this task. For information, see [“Directory Service Control Center Interface” on page 43](#) and the DSCC online help.

1 Rename the entry while keeping the old RDN value, for example:

```
$ ldapmodify -h host2 -p 1389 -D cn=admin,cn=Administrators,cn=config -w -
Enter bind password:
dn: nsuniqueid=66446001-1dd211b2-66225011-2ee211db+uid=bjensen,dc=example,dc=com
changetype: modrdn
newrdn: uid=bj66446001
deleteoldrdn: 0
^D
```

You cannot delete the old RDN value in this step because it also contains the `nsuniqueid` operational attribute, which cannot be deleted.

2 Remove the old RDN value of the naming attribute and the conflict marker attribute, for example:

```
$ ldapmodify -h host2 -p 1389 -D cn=admin,cn=Administrators,cn=config -w -
Enter bind password:
dn: uid=bj66446001,dc=example,dc=com
changetype: modify
delete: uid
uid: bjensen
-
delete: nsds5ReplConflict
^D
```


▼ To Rename a Conflicting Entry With a Single-Valued Naming Attribute

When the naming attribute in a duplicate entry is single-valued, for example `dc` (domain component), you cannot simply rename the entry to another value of the same attribute. Instead, you must give the entry a temporary name.

You can use DSCC to perform this task. For information, see [“Directory Service Control Center Interface” on page 43](#) and the DSCC online help.

1 Rename the entry by using a different naming attribute, and keep the old RDN, for example:

```
$ ldapmodify -h host2 -p 1389 -D cn=admin,cn=Administrators,cn=config -w -
Enter bind password:
dn: nsuniqueid=66446001-1dd211b2-66225011-2ee211db+dc=HR,dc=example,dc=com
changetype: modrdn
newrdn: o=TempHREntry
deleteoldrdn: 0
^D
```

You cannot delete the old RDN value in this step because it also contains the `nsuniqueid` operational attribute, which cannot be deleted.

2 Change the desired naming attribute to a unique value and remove the conflict marker attribute, for example:

```
$ ldapmodify -h host2 -p 1389 -D cn=admin,cn=Administrators,cn=config -w -
Enter bind password:
dn: o=TempHREntry,dc=example,dc=com
changetype: modify
replace: dc
dc: NewHR
delete: nsds5ReplConflict
^D
```

3 Rename the entry back to the intended naming attribute, for example:

```
$ ldapmodify -h host2 -p 1389 -D cn=admin,cn=Administrators,cn=config -w -
Enter bind password:
dn: dc=NewHR,dc=example,dc=com
changetype: modrdn
newrdn: dc=HR
deleteoldrdn: 1
^D
```

By setting the value of the `deleteoldrdn` attribute to 1, you delete the temporary attribute-value pair `o=TempHREntry`. If you want to keep this attribute, set the value of the `deleteoldrdn` attribute to 0.

Solving Orphan Entry Conflicts

When a delete operation is replicated, and the consumer server finds that the entry to be deleted has child entries, the conflict resolution procedure creates a *glue* entry to avoid having orphaned entries in the directory.

In the same way, when an add operation is replicated, and the consumer server cannot find the parent entry, the conflict resolution procedure creates a glue entry representing the parent so that the new entry is not an orphan entry.

Glue entries are temporary entries that include the object classes `glue` and `extensibleObject`. Glue entries can be created in various ways:

- If the conflict resolution procedure finds a deleted entry with a matching unique identifier, the glue entry is a resurrection of that entry. It also includes the `glue` object class and the `nsds5ReplConflict` attribute.

In such cases, you can either modify the glue entry to remove the `glue` object class and the `nsds5ReplConflict` attribute to keep the entry as a normal entry, or delete the glue entry and its child entries.

- The server creates a minimal entry with the `glue` and `extensibleObject` object classes.

In such cases, you must either modify the entry to turn it into a meaningful entry or delete the entry and all of its child entries.

Solving Potential Interoperability Problems

For interoperability with applications that rely on attribute uniqueness, such as a mail server, you might need to restrict access to the entries that contain the `nsds5ReplConflict` attribute. If you do not restrict access to these entries, the applications that require only one attribute will pick up both the original entry and the conflict resolution entry that contains the `nsds5ReplConflict` and operations will fail.

To restrict access, you need to modify the default ACI that grants anonymous read access using the following command:

```
$ ldapmodify -h host2 -p 1389 -D cn=admin,cn=Administrators,cn=config -w -
Enter bind password:
dn: dc=example,dc=com
changetype: modify
delete: aci
aci: (target ="ldap:///dc=example,dc=com")
      (targetattr !="userPassword"
      (version 3.0;acl "Anonymous read-search access";
      allow (read, search, compare)(userdn = "ldap:///anyone");)
-
-
```

```
add: aci
aci: (target="ldap:///dc=example,dc=com")
(targetattr!="userPassword")
(targetfilter="!(nsds5ReplConflict=*)")(version 3.0;acl
"Anonymous read-search access";allow (read, search, compare)
(userdn="ldap:///anyone");)
^D
```

The new ACI will keep entries that contain the `nsds5ReplConflict` attribute from being returned in search results.

Directory Server Schema

Directory Server comes with a standard schema that includes hundreds of object classes and attributes. While the standard object classes and attributes should meet most of your requirements, you might need to extend the schema by creating new object classes and attributes. For an overview of the standard schema and for instructions on designing schema to suit your deployment, see the *Sun Java System Directory Server Enterprise Edition 6.2 Deployment Planning Guide*.

This chapter describes how to manage your schema and covers the following topics:

- [“Managing Schema Checking” on page 277](#)
- [“About Custom Schema” on page 279](#)
- [“Managing Attribute Types Over LDAP” on page 284](#)
- [“Managing Object Classes Over LDAP” on page 287](#)
- [“Extending Directory Server Schema” on page 290](#)
- [“Replicating Directory Schema” on page 294](#)

Managing Schema Checking

When schema checking is on, Directory Server ensures that all import, add, and modify operations conform to the currently defined directory schema.

- The object classes and attributes of each entry conform to the schema.
- The entry contains all required attributes for all of its defined object classes.
- The entry contains only attributes that are allowed by its object classes.

Note – When modifying an entry, Directory Server performs schema checking on the entire entry, not just on the attributes that are being modified. Therefore, the operation might fail if any object class or attribute in the entry does not conform to the schema.

However, schema checking does not verify the validity of attribute values with regard to their syntax.

Schema checking is turned on by default. In general, run Directory Server with schema checking turned on. Many client applications assume that having schema checking turned on is an indication that all entries conform to the schema. However, turning on schema checking does not cause Directory Server to verify the existing contents in the directory. The only way to guarantee that all directory contents conform to the schema is to turn on schema checking before adding any entries or reinitializing all entries.

One case where you might want to turn schema checking off is to accelerate import operations of LDIF files known to conform to the schema. However, there is a risk of importing entries that do not conform to the schema. If schema checking is off, imported entries that do not conform to the schema are not detected.

See [“Replicating Directory Schema” on page 294](#) for details on using schema checking in replicated environments.

▼ To Fix Schema Compliance Problems

When an entry does not conform to the schema, it might not be possible to search for this entry, and modification operations on the entry might fail. Follow the steps in this procedure to correct the problem.

You can use DSCC to perform this task. For information, see [“Directory Service Control Center Interface” on page 43](#) and the DSCC online help.

Before You Begin To avoid having to fix schema compliance issues, plan your schema ahead of your deployment to minimize schema changes. For more information, see the *Sun Java System Directory Server Enterprise Edition 6.2 Deployment Planning Guide*.

- 1 To determine why the entry does not comply, retrieve the entry and manually compare it with the currently defined schema.**

See [“To View Attribute Types” on page 285](#) and [“To View an Object Class” on page 289](#) for details.

- 2 Modify the entry so that it complies with the schema, or modify the schema so that it complies with the entry.**

About Custom Schema

You can extend the standard schema if it is too limited for your directory needs. Follow these guidelines when customizing schema:

- Reuse existing schema elements whenever possible.
- Minimize the number of mandatory attributes that you define for each object class.
- Do not define more than one object class or attribute for the same purpose.
- Keep the schema as simple as possible.

When customizing the schema, do not modify, delete, or replace any existing definitions of attributes or object classes in the standard schema. Doing so can lead to compatibility problems with other directories and with LDAP client applications.

Do not modify any Directory Server internal operational attributes. You can, however, create your own operational variables for external applications.

Always define object classes instead of using `objectClass: extensibleObject`. Directory Server does not perform schema checking for entries that have the object class `extensibleObject`, so it does not constrain or check what attributes are present on the entry. Typos in applications, for example, `giveName` for the `givenName` attribute type, go unnoticed by Directory Server. Also, Directory Server must assume that all otherwise undefined attributes of `extensibleObject` entries are multivalued and have case-insensitive string syntax. Furthermore, some applications rely on entries having a particular object class. In general, if you have an application that requires an extension to an object class, do not relinquish schema management. Instead, create an auxiliary object class that contains the attributes that are required for the application.

This section contains information about the default directory schema, and about creating customized attributes and object classes.

Default Directory Server Schema

The schema provided with Directory Server is described in a set of files that are stored in the *instance-path/config/schema/directory*.

This directory contains all of the common schema for Directory Server and related products. The LDAP v3 standard user and organization schema is located in the `00core.ldif` file. The configuration schema used by earlier versions of the directory is located in the `50ns-directory.ldif` file.

Note – Do not modify files in this directory while the server is running.

Object Identifiers

Each LDAP object class or attribute must be assigned a unique name and object identifier (OID). When you define a schema, you need an OID that is unique to your organization. One OID is enough to meet all of your schema needs. You then add new branches on that OID for your attributes and object classes.

Obtaining and assigning OIDs in your schema involves doing the following:

- Obtaining an OID for your organization from the Internet Assigned Numbers Authority (IANA) or a national organization.

In some countries, corporations already have OIDs assigned to them. If your organization does not already have an OID, you can obtain an OID from IANA.

- Creating an OID registry so you can track OID assignments.

An OID registry is a list that you maintain, which gives the OIDs and OID descriptions that are used in your directory schema. An OID registry ensures that no OID is ever used for more than one purpose.

- Creating branches in the OID tree to accommodate schema elements.

Create at least two branches under the OID branch of your directory schema, using *OID . 1* for attributes and *OID . 2* for object classes. If you want to define your own matching rules or controls, you can add new branches as needed, such as *OID . 3*.

Naming Attributes and Object Classes

When creating names for new attributes and object classes, make the name meaningful so your schema is easier to use.

Avoid naming collisions between custom schema elements and existing schema elements by including a unique prefix on custom elements. For example, Example.com Corporation might add the prefix `Example` before each of its custom schema elements. It might also add a special object class called `ExamplePerson` to identify Example.com employees in its directory.

Note that in LDAP, attribute type names and object class names are *case insensitive*. Applications should treat them as case insensitive strings.

When Defining New Object Classes

Add new object classes when the existing object classes do not support all of the information you need to store in a directory entry.

There are two approaches to creating new object classes:

- Create many new object classes, one for each object class structure to which you want to add an attribute.
- Create a single object class that supports all of the attributes that you create for your directory. You create this kind of an object class by defining it to be an AUXILIARY object class.

Suppose your site wants to create the attributes `ExampleDepartmentNumber` and `ExampleEmergencyPhoneNumber`. You can create several object classes that allow some subset of these attributes. You can create an object class called `ExamplePerson` and have it allow the `ExampleDepartmentNumber` and `ExampleEmergencyPhoneNumber` attributes. The parent of `ExamplePerson` would be `inetOrgPerson`. You can then create an object class called `ExampleOrganization` and have it also allow the `ExampleDepartmentNumber` and `ExampleEmergencyPhoneNumber` attributes. The parent of `ExampleOrganization` would be the `organization` object class.

Your new object classes would appear in LDAP v3 schema format as follows:

```
objectclasses: (1.3.6.1.4.1.42.2.27.999.1.2.3 NAME 'ExamplePerson'
DESC 'Example Person Object Class' SUP inetorgPerson STRUCTURAL MAY
(ExampleDepartmentNumber $ ExampleEmergencyPhoneNumber) )
objectclasses: (1.3.6.1.4.1.42.2.27.999.1.2.4 NAME
'ExampleOrganization' DESC 'Example Organization Object Class' SUP
organization STRUCTURAL MAY (ExampleDepartmentNumber
$ ExampleEmergencyPhoneNumber) )
```

Alternatively, you can create a single object class that allows all of these attributes. Then you can use the object class with any entry on which you want to use the attributes. The single object class would appear as follows:

```
objectclasses: (1.3.6.1.4.1.42.2.27.999.1.2.5 NAME 'ExampleEntry'
DESC 'Example Auxiliary Object Class' SUP top AUXILIARY MAY
(ExampleDepartmentNumber $ ExampleEmergencyPhoneNumber) )
```

The new `ExampleEntry` object class is marked AUXILIARY, meaning that it can be used with any entry regardless of its structural object class.

Consider the following when deciding how to implement new object classes.

- Multiple STRUCTURAL object classes result in more schema elements to create and maintain. Generally, the number of elements remains small and needs little maintenance. However, if you plan to add more than two or three object classes to your schema, you might find it easier to use a single object class.
- Multiple STRUCTURAL object classes require more careful and more rigid data design. Rigid data design forces you to consider the object class structure on which every piece of data is placed. You might find this restriction to be either helpful or cumbersome.

- Single AUXILIARY object classes simplify data design when you have data that you want to put on more than one type of object class structure.
For example, suppose that you want preferredOS on both a person and a group entry. You might want to create only a single object class to allow this attribute.
- Design object classes that relate to real objects and group elements that constitute sensible groupings.
- Avoid required attributes for new object classes.
Requiring attributes can make your schema inflexible. When you create a new object class, allow rather than require attributes.
After defining a new object class, you need to decide which attributes the object class allows and requires, and from which object class or classes it inherits.

When Defining New Attributes

Add new attributes when the existing attributes do not support all of the information you need to store in a directory entry. Try to use standard attributes whenever possible. Search the attributes that already exist in the default directory schema and use those attributes in association with a new object class.

For example, you might find that you want to store more information on a person entry than the person, organizationalPerson, or inetOrgPerson object classes support. If you want to store birth dates in your directory, no attribute exists within the standard Directory Server schema. You can create a new attribute called dateOfBirth. Allow this attribute to be used on entries that represent people by defining a new auxiliary class that allows this attribute.

When Creating Custom Schema Files

Keep the following in mind when creating custom schema files, especially when you are using replication:

- When adding new schema elements, all attributes must be defined before they can be used in an object class. You can define attributes and object classes in the same schema file.
- Each custom attribute or object class that you create should be defined in only one schema file. This practice prevents the server from overriding any previous definitions when the server loads the most recently created schema. Directory Server loads the schema files in numerical order first, then in alphabetical order.
- When defining new schema definitions manually, best practice is generally to add these definitions to the 99user.ldif file.

When you update schema elements using LDAP, the new elements are written automatically to the `99user.ldif` file. As a result, any other schema definition changes that you made in custom schema files might be overwritten. Using only the `99user.ldif` file prevents possible duplications of schema elements and the danger of schema changes being overwritten.

- As Directory Server loads schema files in alphanumeric order with numbers loaded first, you should name custom schema files as follows:

```
[00-99] filename.ldif
```

The number is higher than any directory standard schema already defined.

If you name your schema file with a number that is lower than the standard schema files, the server might encounter errors when loading the schema. In addition, all standard attributes and object classes are loaded only after your custom schema elements have been loaded.

- Make sure that custom schema file names are not numerically or alphabetically higher than `99user.ldif` because Directory Server uses the highest sequenced file for its internal schema management.

For example, if you created a schema file and named it `99zzz.ldif`, the next time you update the schema, all of the attributes with an X-ORIGIN value of 'user defined' would be written to `99zzz.ldif`. The result would be two LDIF files that contain duplicate information, and some information in the `99zzz.ldif` file might be erased.

- As a general rule, identify the custom schema elements that you are adding with the following two items:
 - 'user defined' in the X-ORIGIN field of custom schema files,
 - A more descriptive label such as 'Example.com Corporation defined' in the X-ORIGIN field, so that the custom schema element is easy for other administrators to understand. For example X-ORIGIN ('user defined' 'Example.com Corporation defined').

If you are adding schema elements manually and do not use 'user defined' in the X-ORIGIN field, the schema elements appear read-only in DSCC.

The 'user defined' value is added automatically by the server if you add custom schema definitions by using LDAP or DSCC. However, if you do not add a more descriptive value in the X-ORIGIN field, you might later have difficulty understanding what the schema relates to.

Propagate any custom schema files manually to all of your servers because these changes are not replicated automatically.

When you change the directory schema, the server keeps a timestamp of when the schema was changed. At the beginning of each replication session the server compares its timestamp with its consumer's timestamp and, if necessary, pushes any schema changes. For custom schema files, the server maintains only one timestamp, which is associated with the `99user.ldif` file. This means that any custom schema file changes or additions that you

make to files other than `99user.ldif` will not be replicated. Therefore, you must propagate custom schema files to all other servers to ensure that all schema information is present throughout the topology.

Managing Attribute Types Over LDAP

This section explains how to create, view, and delete attribute types over LDAP.

Creating Attribute Types

The `cn=schema` entry has a multivalued attribute, `attributeTypes`, that contains definitions of each attribute type in the directory schema. You can add to those definitions by using the `ldapmodify(1)` command.

New attribute type definitions, and changes that you make to user-defined attribute types, are saved in the file `99user.ldif`.

For each attribute type definition, you must provide at least an OID to define your new attribute type. Consider using at least the following elements for new attribute types:

- **Attribute OID.** Corresponds to the object identifier for your attribute. An OID is a string, usually of dotted decimal numbers, that uniquely identifies the schema object.

For strict LDAP v3 compliance, you must provide a valid numeric OID. To learn more about OIDs or to request a prefix for your enterprise, send email to the IANA (Internet Assigned Number Authority) at iana@iana.org, or see the [IANA web site](http://www.iana.org) (<http://www.iana.org>).

- **Attribute name.** Corresponds to a unique name for the attribute. Also called its attribute type. Attribute names must begin with a letter and contain only ASCII letters, digits, and hyphens.

An attribute name can contain uppercase letters, but no LDAP client should rely on case to differentiate attributes. Attribute names must be handled in a case-insensitive manner according to section 2.5 of [RFC 4512](http://www.ietf.org/rfc/rfc4512.txt) (<http://www.ietf.org/rfc/rfc4512.txt>).

You can optionally include alternate attribute names, also referred to as aliases, for your attribute type.

- **Attribute description.** Is short descriptive text that explains the attribute's purpose.
- **Syntax.** Is referenced by the OID and describes the data to be held by the attribute.

Attribute syntaxes with their OIDs are listed in [RFC 4517](http://www.ietf.org/rfc/rfc4517.txt) (<http://www.ietf.org/rfc/rfc4517.txt>).

- **Number of values allowed.** By default, attributes are multivalued, but you might want to restrict an attribute to a single value.

▼ To Create an Attribute Type

You can use DSCC to perform this task. For information, see “[Directory Service Control Center Interface](#)” on page 43 and the DSCC online help.

- 1 **Prepare your attribute type definition according to the syntax specified in RFC 4517** (<http://www.ietf.org/rfc/rfc4517.txt>).

- 2 **Use the `ldapmodify(1)` command to add your attribute type definition.**

Notice that Directory Server adds X-ORIGIN 'user defined' to the definition that you provide.

Example 11-1 Creating an Attribute Type

The following example adds a new attribute type with Directory String syntax using the `ldapmodify` command:

```
$ cat blogURL.ldif
dn: cn=schema
changetype: modify
add: attributeTypes
attributeTypes: ( 1.2.3.4.5.6.7
  NAME ( 'blog' 'blogURL' )
  DESC 'URL to a personal weblog'
  SYNTAX 1.3.6.1.4.1.1466.115.121.1.15
  SINGLE-VALUE )

$ ldapmodify -D cn=admin,cn=Administrators,cn=config -w - -f blogURL.ldif
Enter bind password:
modifying entry cn=schema

$
```

In a production environment, you would provide a valid, unique OID, not 1.2.3.4.5.6.7.

Viewing Attribute Types

The `cn=schema` entry has a multivalued attribute, `attributeTypes`, that contains definitions of each attribute type in the directory schema. You can read those definitions by using the `ldapsearch(1)` command.

▼ To View Attribute Types

You can use DSCC to perform this task. For information, see “[Directory Service Control Center Interface](#)” on page 43 and the DSCC online help.

- **Use the `ldapsearch` command to view all the attribute type definitions that currently exist in your directory schema.**

Example 11-2 Viewing Attribute Types

The following command displays definitions for all attribute types:

```
$ ldapsearch -T -b cn=schema "(objectclass=*)" attributeTypes
```

The `-T` option prevents the `ldapsearch` command from folding LDIF lines, so you can more easily work with the output using commands such as `grep` or `sed`. If you then pipe the output of this command through the `grep` command, you can view only the user-defined extensions to directory schema. For example:

```
$ ldapsearch -T -b cn=schema "(objectclass=*)" attributeTypes | grep "user defined"
attributeTypes: ( 1.2.3.4.5.6.7 NAME ( 'blog' 'blogURL' )
DESC 'URL to a personal weblog'
SYNTAX 1.3.6.1.4.1.1466.115.121.1.15 SINGLE-VALUE
X-ORIGIN 'user defined' )
```

Deleting Attribute Types

The `cn=schema` entry has a multivalued attribute, `attributeTypes`, that contains definitions of each attribute type in the directory schema. You can delete definitions with `X-ORIGIN 'user defined'` by using the `ldapmodify(1)` command.

Because the schema is defined by the LDAP view in `cn=schema`, you can view and modify the schema online using the `ldapsearch` and `ldapmodify` utilities. However, you can delete only schema elements that have the value `'user defined'` for the `X-ORIGIN` field. The server will not delete other definitions.

Changes that you make to user-defined attributes are saved in the file `99user.ldif`.

▼ To Delete Attribute Types

You can use DSCC to perform this task. For information, see [“Directory Service Control Center Interface” on page 43](#) and the DSCC online help.

- 1 View the definition of the attribute type to delete.**
See [“To View Attribute Types” on page 285](#) for details.
- 2 Use the `ldapmodify(1)` command to delete the attribute type definition as it appears in the schema.**

Example 11-3 Deleting an Attribute Type

The following command deletes the attribute type that is created in [Example 11-1](#):

```
$ ldapmodify -D cn=admin,cn=Administrators,cn=config -w -
Enter bind password:
dn: cn=schema
changetype: delete
delete: attributeTypes
attributeTypes: ( 1.2.3.4.5.6.7 NAME ( 'blog' 'blogURL' )
DESC 'URL to a personal weblog'
SYNTAX 1.3.6.1.4.1.1466.115.121.1.15 SINGLE-VALUE
X-ORIGIN 'user defined' )
^D
```

Notice that you must include the X-ORIGIN 'user defined', which was added by Directory Server to classify this schema definition as an extension.

Managing Object Classes Over LDAP

This section explains how to create, view, and delete object classes over LDAP.

Creating Object Classes

The cn=schema entry has a multivalued attribute, objectClasses, that contains definitions of each object class in the directory schema. You can add to those definitions by using the ldapmodify(1) command.

New object class definitions, and changes that you make to user-defined object classes, are saved in the file 99user.ldif.

If you are creating several object classes that inherit from other object classes, you must create the parent object classes first. If your new object class uses custom attributes, you must also define those first.

For each object class definition, you must provide at least an OID. Consider using at least the following elements for new object classes:

- **Object Class OID.** Corresponds to the object identifier for your object class. An OID is a string, usually of dotted decimal numbers, that uniquely identifies the schema object.

For strict LDAP v3 compliance, you must provide a valid numeric OID. To learn more about OIDs or to request a prefix for your enterprise, send email to the IANA (Internet Assigned Number Authority) at iana@iana.org, or see the [IANA web site](http://www.iana.org) (<http://www.iana.org>).

- **Object class name.** Corresponds to a unique name for the object class.
- **Parent object class.** Is an existing object class from which this object class inherits attributes.

If you do not intend to have this object class inherit from another specific object class, use `top`.

Typically, if you want to add new attributes for user entries, the parent would be the `inetOrgPerson` object class. If you want to add new attributes for corporate entries, the parent is usually `organization` or `organizationalUnit`. If you want to add new attributes for group entries, the parent is usually `groupOfNames` or `groupOfUniqueNames`.

- **Required attributes.** Lists and defines attributes that *must* be present for this object class.
- **Allowed attributes.** Lists and defines additional attributes that can be present for this object class.

▼ To Create an Object Class

You can use DSCC to perform this task. For information, see “[Directory Service Control Center Interface](#)” on page 43 and the DSCC online help.

- 1 **Prepare your object class definition according to the syntax specified in RFC 4517** (<http://www.ietf.org/rfc/rfc4517.txt>).
- 2 **Use the `ldapmodify(1)` command to add your object class definition.**

Notice that Directory Server adds X-ORIGIN 'user defined' to the definition that you provide.

Example 11-4 Creating an Object Class

The following example adds a new object class using the `ldapmodify` command:

```
$ cat blogger.ldif
dn: cn=schema
changetype: modify
add: objectClasses
objectClasses: ( 1.2.3.4.5.6.8
  NAME 'blogger'
  DESC 'Someone who has a blog'
  SUP inetOrgPerson
  STRUCTURAL
  MAY blog )

$ ldapmodify -D cn=admin,cn=Administrators,cn=config -w - -f blogger.ldif
Enter bind password:
modifying entry cn=schema

$
```


In a production environment, you would provide a valid, unique OID, not 1.2.3.4.5.6.8.

Viewing Object Classes

The `cn=schema` entry has a multivalued attribute, `objectClasses`, that contains definitions of each object class in the directory schema. You can read those definitions by using the `ldapsearch(1)` command.

▼ To View an Object Class

You can use DSCC to perform this task. For information, see [“Directory Service Control Center Interface” on page 43](#) and the DSCC online help.

- **Use the `ldapsearch` command to view all the object class definitions that currently exist in your directory schema.**

Example 11-5 Viewing Object Classes

The following command displays definitions for all object classes:

```
$ ldapsearch -T -b cn=schema "(objectclass=*)" objectClasses
```

The `-T` option prevents the `ldapsearch` command from folding LDIF lines, so you can more easily work with the output using commands such as `grep` or `sed`. If you then pipe the output of this command through the `grep` command, you can view only the user-defined extensions to directory schema. For example:

```
$ ldapsearch -T -b cn=schema "(objectclass=*)" objectClasses | grep "user defined"
objectClasses: ( 1.2.3.4.5.6.8 NAME 'blogger'
  DESC 'Someone who has a blog' STRUCTURAL MAY blog
  X-ORIGIN 'user defined' )
$
```

Deleting Object Classes

The `cn=schema` entry has a multivalued attribute, `objectClasses`, that contains definitions of each object class in the directory schema. You can delete definitions with `X-ORIGIN 'user defined'` by using the `ldapmodify(1)` command.

Because the schema is defined by the LDAP view in `cn=schema`, you can view and modify the schema online using the `ldapsearch` and `ldapmodify` utilities. However, you can delete only schema elements that have the value `'user defined'` for the `X-ORIGIN` field. The server will not delete other definitions.

Changes that you make to user-defined elements are saved in the file `99user.ldif`.

▼ To Delete an Object Class

You can use DSCC to perform this task. For information, see “[Directory Service Control Center Interface](#)” on page 43 and the DSCC online help.

- 1 **View the definition of the object class to delete.**
See “[To View an Object Class](#)” on page 289 for details.
- 2 **Use the `ldapmodify(1)` command to delete the object class definition as it appears in the schema.**

Example 11–6 Deleting an Object Class

The following command deletes the object class that was created in [Example 11–4](#):

```
$ ldapmodify -D cn=admin,cn=Administrators,cn=config -w -
Enter bind password:
dn: cn=schema
changetype: delete
delete: objectClasses
objectClasses: ( 1.2.3.4.5.6.8 NAME 'blogger' DESC 'Someone who has a blog'
STRUCTURAL MAY blog X-ORIGIN 'user defined' )
^D
```

Notice that you must include `X-ORIGIN 'user defined'`, which was added by Directory Server to classify this schema definition as an extension.

Extending Directory Server Schema

When you add new attributes to your schema, you must create a new object class to contain the new attributes. Although it might seem convenient to just add the attributes to an existing object class that already contains most of the attributes you require, doing so compromises interoperability with LDAP clients.

Interoperability of Directory Server with existing LDAP clients relies on the standard LDAP schema. If you change the standard schema, you will also have difficulties when upgrading your server. For the same reasons, you cannot delete standard schema elements.

Directory Server schema are stored in attributes of the `cn=schema` entry. Like the configuration entry, this is an LDAP view of the schema that is read from files during server startup.

The method that you use to extend Directory Server schema depends on whether you want control over the file name where schema extensions are stored. It also depends whether you want to push changes to consumers through replication. See the following table to determine which procedure to follow in your specific case.

TABLE 11-1 Ways to Extend Schema

Task	Instructions
You do not use replication. You intend to extend the schema by adding a custom schema file.	“To Extend Schema With a Custom Schema File” on page 292
You intend to extend the schema through LDAP.	“To Extend Schema Through LDAP” on page 293
You use replication. You intend to preserve the file name of your custom schema file on all servers.	“To Extend Schema With a Custom Schema File” on page 292
You use replication. You intend to extend the schema by adding a custom schema file on a master replica. You then let the replication mechanism copy the schema extensions to consumer servers.	“To Extend Schema Using a Schema File and Replication” on page 293

For more information about object classes, attributes, and the directory schema as well as guidelines for extending your schema, see “Designing a Directory Schema” in *Sun Java System Directory Server Enterprise Edition 6.2 Deployment Planning Guide*. For information about standard attributes and object classes, see *Sun Java System Directory Server Enterprise Edition 6.2 Man Page Reference*.

This section provides information about the various methods to extend the directory schema.

Extending Schema With a Custom Schema File

Schema files are LDIF files that are located in `instance-path/config/schema/`. The `instance-path` corresponds to the file system directory where the Directory Server instance resides. For example, the instance might be located in `/local/ds/`. The files define standard schema that are used by Directory Server and all servers that rely on Directory Server. The files and the standard schema are described in *Sun Java System Directory Server Enterprise Edition 6.2 Reference* and *Sun Java System Directory Server Enterprise Edition 6.2 Man Page Reference*.

Schema files are read once only at startup by the server. The LDIF contents of the files are added to the in-memory LDAP view of the schema in `cn=schema`. Because the order of schema definitions is important, schema file names are prepended with a number and loaded in alphanumerical order. Schema files in this directory are writable only by the system user who is defined during installation.

When defining the schema directly in an LDIF file, do not use the value 'user defined' for the X-ORIGIN field. This value is reserved for schema elements that are defined through the LDAP view of cn=schema and that appear in the file 99user.ldif.

The 99user.ldif file contains additional ACIs for the cn=schema entry and all schema definitions that have been added from the command-line or using DSCC. The 99user.ldif file is overwritten when new schema definitions are added. If you want to modify this file, you must restart the server immediately to ensure that your changes are current.

Do not modify the standard schema that is defined in the other schema files. You can, however, add new files to define new attributes and object classes. For example, to define new schema elements in many servers, you could define the elements in a file named 98mySchema.ldif and copy this file to the schema directory on all servers. You would then restart all servers to load your new schema file.

▼ To Extend Schema With a Custom Schema File

You can use DSCC to perform this task. For information, see “[Directory Service Control Center Interface](#)” on [page 43](#) and the DSCC online help.

1 Create your own schema definition file, such as 98mySchema.ldif.

The syntax of definitions in the schema files is described in [RFC 4517](#) (<http://www.ietf.org/rfc/rfc4517.txt>).

2 (Optional) If this server is a master replica that sends updates to other servers, copy your schema definition file to each server instance in the replication topology.

The replication mechanism cannot detect any changes that you make directly to the LDIF files that contain the schema. Therefore, your changes are not replicated to consumers even after restarting the master.

3 Restart each Directory Server instance to which you copied your schema definition file.

Your changes take effect when the servers restart and thus reload schema definitions.

Extending Schema Through LDAP

Because the schema is defined by the LDAP view in cn=schema, you can view and modify the schema online using the ldapsearch and ldapmodify utilities. However, you can modify only schema elements that have the value 'user defined' for the X-ORIGIN field. The server refuses any modification to the other definitions.

New element definitions, and changes that you make to user-defined elements, are saved in the file 99user.ldif.

▼ To Extend Schema Through LDAP

You can use DSCC to perform this task. For information, see [“Directory Service Control Center Interface” on page 43](#) and the DSCC online help.

Before You Begin Modifying schema definitions from the command line is prone to error because of the long values that you must type exactly. However, you can use this functionality in scripts that need to update your directory schema.

- 1 **Use the `ldapmodify(1)` command to add or delete individual `attributeTypes` attribute values.** See [“To Create an Attribute Type” on page 285](#) or [“To Delete Attribute Types” on page 286](#) for details.
- 2 **Use the `ldapmodify(1)` command to add or delete individual `objectClasses` attribute values.** See [“To Create an Object Class” on page 288](#) or [“To Delete an Object Class” on page 290](#) for details.

See Also To modify one of the values, you must delete the specific value and then add the value as a new value. This process is required because the attributes are multivalued. For details, see [“Modifying One Value of a Multi Valued Attribute” on page 92](#).

Extending Schema Using a Schema File and Replication

For information about custom schema files, see [“Extending Schema With a Custom Schema File” on page 291](#). The following procedure explains how to use the replication mechanism to propagate schema extensions to all the servers in a topology.

▼ To Extend Schema Using a Schema File and Replication

For parts of this procedure, you can use DSCC to perform this task. For information, see [“Directory Service Control Center Interface” on page 43](#) and the DSCC online help. Other parts of the procedure can only be done using the command line.

- 1 **Prepare your schema extensions in one of the following ways:**
 - **Create your own schema definition file, such as `98mySchema.ldif`.**
 - **Add your schema extensions to `99user.ldif`.**

The syntax of definitions in the schema files is described in [RFC 4517](#) (<http://www.ietf.org/rfc/rfc4517.txt>).

2 Run the `schema_push` command on the master server where you put the schema definition file.

This script does not actually push the schema to replicas. Instead the script writes a special attribute into the schema files so that the schema files are replicated as soon as they are loaded. For more information, see the `schema_push(1M)` man page.

3 Restart the master server where you put the schema definition file.

The replication mechanism cannot detect any changes that you make directly to the LDIF files that contain the schema. When you restart the server after running `schema_push`, however, the server loads all schema files and then the replication mechanism replicates the new schema to consumers.

Replicating Directory Schema

Whenever you configure the replication of one or more suffixes between two servers, schema definitions are automatically replicated as well. The automatic replication of schema definitions ensures that all replicas have a complete, identical schema that defines all object classes and attributes that can be replicated to the consumers. Master servers therefore also contain the master schema.

However, schema replication is not instantaneous, even when you modify schema over LDAP. Schema replication is triggered either by updates to directory data or at the start of the first replication session after the schema is modified.

To enforce the schema on all replicas, you must at least enable schema checking on all masters. As the schema is checked on the master where the LDAP operation is performed, the schema does not need to be checked when updating the consumer. To improve performance, the replication mechanism bypasses schema checking on consumer replicas.

Note – Do not turn off schema checking on hubs and dedicated consumers. Schema checking has no performance impact on a consumer. Keep schema checking on to indicate that the replica contents conform to its schema.

Master servers replicate the schema automatically to their consumers during consumer initialization. Master servers also replicate the schema automatically any time the schema is modified through DSCC or through the command-line tools. By default, the entire schema is replicated. Any additional schema elements that do not yet exist on the consumer are created on the consumer and stored in the `99user.ldif` file.

For example, assume that a master server contains schema definitions in the `98mySchema.ldif` file when the server is started. Also assume that you then define replication agreements to other servers, either masters, hubs, or dedicated consumers. When you subsequently initialize the replicas from this master, the replicated schema contains the definitions from `98mySchema.ldif`, but the definitions are stored in `99user.ldif` on the replica servers.

After the schema has been replicated during consumer initialization, modifying the schema in `cn=schema` on the master also replicates the entire schema to the consumer. Therefore, any modifications to the master schema through the command-line utilities or through DSCC are replicated to the consumers. These modifications are stored in `99user.ldif` on the master, and by the same mechanism as described previously, the modifications are also stored in `99user.ldif` on the consumers.

Consider the following guidelines for maintaining consistent schema in a replicated environment:

- Do not modify the schema on a consumer server.
Modifications to the schema on the consumer server can cause replication errors. This is because differences in the schema on the consumer can result in updates from the supplier not conforming to schema on the consumer.
- In a multimaster replication environment, modify schema on a single master server.
When you modify the schema on two master servers, the master most recently updated propagates its version of the schema to the consumer. The schema on the consumer might then become inconsistent with the schema on the other master.

When configuring *fractional replication*, also consider the following guidelines:

- As schema is pushed by suppliers in fractional replication configurations, schema on a fractional consumer replica are a copy of the master replica's schema. Therefore, schema might not correspond to the fractional replication configuration being applied.
- In general, Directory Server replicates all required attributes for each entry as defined in the schema to avoid schema violations. When you configure fractional replication to filter out required attributes, you must disable schema checking.
- If schema checking is enabled with fractional replication, you might not be able to initialize the replica offline. Directory Server does not allow you to load data from LDIF if required attributes are filtered out.
- If you have disabled schema checking on a fractional consumer replica, schema checking is not enforced on the whole server instance on which that fractional consumer replica resides. As a result, avoid configuring supplier replicas on the same server instance as a fractional consumer.

Limiting Schema Replication

By default, whenever the replication mechanism replicates the schema, it sends the entire schema to its consumers. There are two situations where it is not desirable to send the entire schema to consumers:

- Modifications to `cn=schema` using DSCC or from the command-line are limited to the user-defined schema elements, and all of the standard schema are unchanged. If you modify the schema often, sending the large set of unchanged schema elements every time has a performance impact. You might be able to improve replication and server performance by replicating only the user-defined schema elements.
- When a master on Directory Server replicates to a consumer on Directory Server 5.1, the schema for the configuration attributes of these versions differ and create conflicts. In this case, you *must* replicate only the user-defined schema elements.

Note – Directory Server uses the `11rfc2307.ldif` schema file. The schema file conforms to [RFC 2307](http://www.ietf.org/rfc/rfc2307.txt) (<http://www.ietf.org/rfc/rfc2307.txt>).

Versions of Directory Server prior to Directory Server 5.2 use the `10rfc2307.ldif` schema file.

▼ To Limit Schema Replication

You cannot use DSCC to perform this task. Use the command line, as described in this procedure.

- **Limit schema replication so that only the user-defined schema is replicated.**

```
$ dsconf set-server-prop -h host -p port repl-user-schema-enabled:on
```

The default value, `off`, causes the entire schema to be replicated when necessary.

Directory Server Indexing

Like a book index, Directory Server indexes speed up searches by associating search strings with references to the directory contents.

For information about the types of indexes and index tuning, see Chapter 6, “Directory Server Indexing” in *Sun Java System Directory Server Enterprise Edition 6.2 Reference*.

This chapter covers the following topics:

- “Managing Indexes” on page 297
- “Managing Browsing Indexes” on page 303

Managing Indexes

This section describes how to manage indexes for specific attributes. The section includes information about creating, modifying, and deleting indexes. See “[Managing Browsing Indexes](#)” on page 303 for procedures specific to virtual list view (VLV) operations.

▼ To List Indexes

You can use DSCC to perform this task. For information, see “[Directory Service Control Center Interface](#)” on page 43 and the DSCC online help.

- **To list your existing indexes and their properties, use this command:**

```
$ dsconf list-indexes -h host -p port -v suffix-DN
```

▼ To Create Indexes

Note – You cannot create a new system index. Only the existing system indexes defined internally by Directory Server are maintained.

You can use DSCC to perform this task. For information, see [“Directory Service Control Center Interface” on page 43](#) and the DSCC online help.

1 Create the new index configuration.

Use the `dsconf create-index` command-line utility to configure the new index information by specifying the attribute that you want to index.

For example, to create an index entry for the `preferredLanguage` attribute, use this command:

```
$ dsconf create-index -h host -p port dc=example,dc=com preferredLanguage
```

Note – The command `dsconf create-index` sets the index configuration, but does not actually create the index files necessary for searches. Generating the index files can affect performance. To give you more control over the indexing procedure, generating the index files is done manually after the new index configuration has been created.

Always use the attribute’s primary name when creating indexes. Do not use the attribute’s alias. The primary name of the attribute is the first name listed for the attribute in the schema, for example, `uid` for the `userId` attribute.

2 (Optional) Set the index properties by using the `dsconf set-index-prop` command.

The `dsconf create-index` command creates an index with default properties. If you want to modify these properties, use the `dsconf set-index-prop` command. For more information about modifying index properties, see [“To Modify Indexes” on page 298](#).

3 Generate the index files.

See [“To Generate Indexes” on page 299](#).

4 Repeat the previous steps for all servers that you want to be indexed.

▼ To Modify Indexes

You can use DSCC to perform this task. For information, see [“Directory Service Control Center Interface” on page 43](#) and the DSCC online help.

1 Modify the index properties.

```
$ dsconf set-index-prop -h host -p port suffix-DN attr-name property:value
```

For example, to enable the approximate index approx-enabled for the preferredLanguage index, use the command:

```
$ dsconf set-index-prop -h host -p port dc=example,dc=com preferredLanguage approx-enabled:on
```

You can modify the following properties for each index:

- eq-enabled equality
- pres-enabled presence
- sub-enabled substring

One of the properties that you might want to modify is the optional nsMatchingRule attribute. This attribute contains the OID for any matching rule known by the server. It enables the OID of a language collation order for internationalized indexes, and other matching rules such as CaseExactMatch. For a list of supported locales and the OID of their associated collation order, see *Sun Java System Directory Server Enterprise Edition 6.2 Reference*.

For more information about index configuration attributes, see *Sun Java System Directory Server Enterprise Edition 6.2 Reference*.

2 Regenerate your new indexes.

See [“To Generate Indexes” on page 299](#).

3 Repeat the previous steps for all servers that include the modified attribute index.

▼ To Generate Indexes

This procedure generates index files so that new or modified indexes can be searchable.

You can use DSCC to perform this task. For information, see [“Directory Service Control Center Interface” on page 43](#) and the DSCC online help.

● Generate your index files in one of the following ways:

- Generate your new index files online.

```
$ dsconf reindex -h host -p port [-t attr] suffix-DN
```

where -t specifies that only the specified attribute or attributes are to be reindexed, not all attributes.

For example, to regenerate the preferredLanguage index, type:

```
$ dsconf reindex -h host -p port -t preferredLanguage dc=example,dc=com
```

While the `dsconf reindex` command is running, the contents of the suffix remain available through the server. However, searches are not indexed until the command has completed. Reindexing is a resource-intensive task that can impact the performance of other operations on the server.

- Generate your new index files offline.

```
$ dsadm reindex -t attr instance-path suffix-DN
```

For example, to regenerate the `preferredLanguage` index, type:

```
$ dsadm reindex -t preferredLanguage /local/ds dc=example,dc=com
```

- Regenerate all of your indexes quickly offline by reinitializing your suffix.

When you reinitialize a suffix, all index files are automatically regenerated. Depending on the size of the directory, reinitializing the suffix is usually faster than reindexing two or more attributes. However, the suffix is unavailable during the initialization. For more information, see [“Reindexing a Suffix by Reinitialization” on page 302](#).

Note – If you run either `dsconf import` or `dsconf reindex` or both commands on multiple suffixes in parallel, transaction logs will grow and might negatively affect performance.

▼ To Delete Indexes

You can use DSCC to perform this task. For information, see [“Directory Service Control Center Interface” on page 43](#) and the DSCC online help.

- **Remove all indexes that are configured for an attribute.**

```
$ dsconf delete-index -h host -p port suffix-DN attr-name
```

For example, the following command deletes all indexes for the `preferredLanguage` attribute:

```
$ dsconf delete-index -h host -p port dc=example,dc=com preferredLanguage
```

Take great care when deleting default indexes because it can affect Directory Server functioning.

Changing the Index List Threshold

Slow searches might be a result of your system index list size exceeding the index list threshold. The index list threshold is the maximum number of values for each index key. To determine whether the index list threshold size has been exceeded, examine the access log. The `notes=U` flag at the end of an access log `RESULT` message indicates that an unindexed search was performed. A previous `SRCH` message for the same connection and operation specifies the search

filter that was used. The following two-line example traces an unindexed search for `cn=Smith` that returns 10,000 entries. Timestamps have been removed from the messages.

```
conn=2 op=1 SRCH base="o=example.com" scope=0 filter="(cn=Smith)"
conn=2 op=1 RESULT err=0 tag=101 nentries=10000 notes=U
```

If your system often exceeds the index list threshold, consider increasing the threshold to improve performance. The following procedure uses the `dsconf set-server-prop` command to modify the `all-ids-threshold` property. For more information about tuning indexes and the `all-ids-threshold` property, see “Tuning Indexes for Performance” in *Sun Java System Directory Server Enterprise Edition 6.2 Reference*.

▼ To Change the Index List Threshold

You can use DSCC to perform this task. For information, see “[Directory Service Control Center Interface](#)” on page 43 and the DSCC online help.

1 Adjust the index list threshold.

You can adjust your index list threshold at any of the following levels:

- At the instance level:

```
dsconf set-server-prop -h host -p port all-ids-threshold:value
```

- At the suffix level:

```
dsconf set-suffix-prop -h host -p port suffix-DN all-ids-threshold:value
```

- At the entry level:

```
dsconf set-index-prop -h host -p port suffix-DN all-ids-threshold:value
```

- At the index level, by search type:

```
dsconf set-index-prop -h host -p port suffix-DN all-ids-threshold search-type:value
```

where *search-type* is one of the following:

- eq-enabled equality
- pres-enabled presence
- sub-enabled substring

The `all-ids-threshold` property cannot be configured for the approximate index.

You can use DSCC to set the threshold at the index level, by search type. For more information, see the Directory Server online help.

2 Regenerate the suffix indexes.

See “[To Generate Indexes](#)” on page 299.

- 3 If the database cache size was tuned for the old `all IDs` threshold value and the server has adequate physical memory, consider increasing the database cache size.**

Increase the database cache size by 25 percent of the magnitude of the increase to the `all IDs` threshold.

In other words, if you increase the `all IDs` threshold from 4000 to 6000, you can increase the database cache size by about 12 ½ percent to account for the increase in index list size.

Database cache size is set using the attribute `dbcachesize`. Find the optimum size empirically before applying changes to production servers.

Reindexing a Suffix

If your index files become corrupt, you must reindex the suffix to recreate the index files in the corresponding database directory. You can reindex a suffix either by reindexing the suffix while the directory server is running or by reinitializing the suffix.

Reindexing a Suffix While the Directory Server Is Running

When you reindex a suffix, the server examines all of the entries the suffix contains and rebuilds the index files. During reindexing, the contents of the suffix are read-only. Because the server must scan the entire suffix for every attribute that is reindexed, this process might take up to several hours for suffixes with millions of entries. The length of time also depends on the indexes you configure. In addition, while the suffix is being reindexed, indexes are not available and server performance is impacted.

▼ To Reindex All Indexes on A Suffix

You can use DSCC to perform this task. For information, see [“Directory Service Control Center Interface” on page 43](#) and the DSCC online help.

- **Reindex all indexes on a suffix.**

```
$ dsconf reindex -h host -p port suffix-DN
```

For example, to initialize all indexes on the `dc=example,dc=com` suffix, use this command:

```
$ dsconf reindex -h host -p port dc=example,dc=com
```

Reindexing a Suffix by Reinitialization

When you reinitialize a suffix, the new contents are imported, which means that the suffix contents are replaced and new index files are created. Reinitializing a suffix can be faster than reindexing more than one attribute because all attributes are indexed in parallel as the entries are loaded. However, be aware that the suffix is unavailable while it is being reinitialized.

▼ To Reindex a Suffix Through Reinitialization

You can use DSCC to perform this task. For information, see “[Directory Service Control Center Interface](#)” on page 43 and the DSCC online help.

- 1 Set the suffix to read-only, as described in “[Setting Referrals and Making a Suffix Read-Only](#)” on page 61.
- 2 Export the entire suffix to an LDIF file, as described in “[Backing Up to LDIF](#)” on page 198.
- 3 Import the same LDIF file to reinitialize the suffix, as described in “[Importing Data From an LDIF File](#)” on page 201.
During the initialization, the suffix is unavailable. When the initialization is complete, all configured indexes are ready to be used.
- 4 Make the suffix writable again, as described in “[Setting Referrals and Making a Suffix Read-Only](#)” on page 61.

Managing Browsing Indexes

Browsing indexes are special indexes used only for search operations that request server-side sorting of results. *Sun Java System Directory Server Enterprise Edition 6.2 Reference* explains how browsing indexes work in Directory Server.

Browsing Indexes for Client Searches

Customized browsing indexes for sorting client search results must be defined manually. To create a browsing index, or virtual list view (VLV) index, use the following procedure. This section also includes procedures for adding or modifying browsing index entries and for regenerating browsing indexes.

▼ To Create a Browsing Index

For parts of this procedure, you can use DSCC to perform this task. For information, see “[Directory Service Control Center Interface](#)” on page 43 and the DSCC online help. Other parts of the procedure can only be done using the command line.

- 1 Add new browsing index entries or edit existing browsing index entries by using the `ldapmodify` command.
For instructions, see “[To Add or Modify Browsing Index Entries](#)” on page 304.

- 2 **Run the `dsconf reindex` command to generate the new set of browsing indexes to be maintained by the server.**

For instructions, see [“To Regenerate Browsing Indexes” on page 305](#).

▼ To Add or Modify Browsing Index Entries

A browsing index is specific to a given search on a given base entry and its subtree. The browsing index configuration is defined in the database configuration of the suffix that contains the entry.

- 1 **Configure the `vlvBase`, `vlvScope`, and `vlvFilter` attributes for each browsing index on a directory server.**

These attributes configure the base of the search, the scope of the search, and a filter for the search. These attributes use the `vlvSearch` object class.

- 2 **Configure the `vlvSort` attribute for each browsing index.**

This attribute specifies the name of the attribute or attributes that sort the index. This entry is a child of the first entry and uses the `vlvIndex` object class to specify which attributes to sort and in what order.

The following example uses the `ldapmodify` command to create the browsing index configuration entries:

```
$ ldapmodify -a -h host -p port -D cn=admin,cn=Administrators,cn=config -w -
Enter bind password:
dn: cn=people_browsing_index, cn=database-name,
cn=ldbm database,cn=plugins,cn=config
objectClass: top
objectClass: vlvSearch
cn: Browsing ou=People
vlvBase: ou=People,dc=example,dc=com
vlvScope: 1
vlvFilter: (objectclass=inetOrgPerson)

dn: cn=Sort rev employeenumbr, cn=people_browsing_index,
cn=database-name,cn=ldbm database,cn=plugins,cn=config
objectClass: top
objectClass: vlvIndex
cn: Sort rev employeenumbr
vlvSort: -employeenumbr
^D
```

The `vlvScope` is one of the following:

- `0` for the base entry alone
- `1` for the immediate children of the base
- `2` for the entire subtree rooted at the base

The `vlvFilter` is the same LDAP filter that is used in the client search operations. Because all browsing index entries are located in the same place, you should use descriptive `cn` values to name your browsing indexes.

Each `vlvSearch` entry must have at least one `vlvIndex` entry. The `vlvSort` attribute is a list of attribute names that defines the attribute to sort on and the sorting order. The dash (-) in front of an attribute name indicates reverse ordering. You can define more than one index for a search by defining several `vlvIndex` entries. With the previous example, you could add the following entry:

```
$ ldapmodify -a -h host -p port
-D cn=admin,cn=Administrators,cn=config -w -
dn: cn=Sort sn givenname uid, cn=people_browsing_index,
   cn=database-name,cn=ldb database,cn=plugins,cn=config
objectClass: top
objectClass: vlvIndex
cn: Sort sn givenname uid
vlvSort: sn givenname uid
^D
```

- 3 **To modify a browsing index configuration, edit the corresponding `vlvSearch` entry or the corresponding `vlvIndex` entry.**
- 4 **To remove a browsing index so that the browsing index is no longer maintained by the server, remove the individual `vlvIndex` entries.**

Alternatively, if only one `vlvIndex` entry exists, remove both the `vlvSearch` entry and the `vlvIndex` entry.

▼ To Regenerate Browsing Indexes

- **After you have created the browsing index entries, generate the new browsing indexes for the attributes specified.**

```
$ dsadm reindex -l -t attr-index instance-path suffix-DN
```

The command scans the directory contents and creates a database file for the browsing index.

The following example generates the browsing index that you defined in the previous section:

```
$ dsadm reindex -l -b database-name -t Browsing /local/ds \
  ou=People,dc=example,dc=com
```

For more information about the `dsadm reindex` command, see the `dsadm(1M)` man page.

Directory Server Attribute Value Uniqueness

The UID uniqueness plug-in ensures that the value of a given attribute is unique among all entries of the directory or of a subtree. The plug-in stops any operation that tries to add an entry that contains an existing value for the given attribute. The plug-in also stops any operation that adds or modifies the attribute to a value that already exists in the directory.

The UID uniqueness plug-in is disabled by default. When the plug-in is enabled, it ensures the uniqueness of the `uid` attribute by default. You can create new instances of the plug-in to enforce unique values on other attributes. The UID uniqueness plug-in ensures attribute value uniqueness on a single server.

This chapter covers the following topics:

- [“Overview of Attribute Value Uniqueness” on page 307](#)
- [“Enforcing Uniqueness of the `uid` and Other Attributes” on page 308](#)
- [“Using the Uniqueness Plug-In With Replication” on page 310](#)

Overview of Attribute Value Uniqueness

The UID uniqueness plug-in is a pre-operation plug-in. It checks LDAP add, modify, and modify DN operations before the server performs an update of the directory. The plug-in determines whether the operation will cause two entries to have the same attribute value. If so, the server terminates the operation and returns error 19 LDAP_CONSTRAINT_VIOLATION to the client.

You can configure the plug-in to enforce uniqueness in one or more subtrees in the directory or among entries of a specific object class. This configuration determines the set of entries for which unique attribute values is enforced.

You can define several instances of the UID uniqueness plug-in if you want to enforce the uniqueness of other attributes. Define one plug-in instance for each attribute whose value must

be unique. You can also have several plug-in instances for the same attribute to enforce “separate” uniqueness in several sets of entries. A given attribute value is allowed only once in each set of subtrees.

When you enable attribute uniqueness on an existing directory, the server does not check for uniqueness among existing entries. Uniqueness is only enforced when an entry is added or when the attribute is added or modified.

By default, the UID uniqueness plug-in is disabled because the plug-in affects multimaster replication. You can enable the UID uniqueness plug-in when using replication, but you should be aware of the behavior described in [“Using the Uniqueness Plug-In With Replication” on page 310](#).

Enforcing Uniqueness of the `uid` and Other Attributes

This section explains how to enable and configure the default uniqueness plug-in for the `uid` attribute and how to enforce uniqueness of any other attribute.

▼ To Enforce Uniqueness of the `uid` Attribute

This procedure describes how to enable and configure the UID uniqueness plug-in by using the `dsconf` command. The DN of the plug-in configuration entry is `cn=uid uniqueness,cn=plugins,cn=config`.

You can use DSCC to perform this task. For information, see [“Directory Service Control Center Interface” on page 43](#) and the DSCC online help.

When using DSCC, you must not modify the default UID uniqueness plug-in to enforce uniqueness of another attribute. If you do not want to have a UID uniqueness plug-in, leave the plug-in disabled and create a new plug-in instance for another attribute, as described in [“To Enforce Uniqueness of Another Attribute” on page 309](#).

1 Enable the plug-in.

```
$ dsconf enable-plugin -h host -p port "uid uniqueness"
```

2 Modify the plug-in arguments according to how you want to specify the subtrees where uniqueness is enforced.

- To specify the base DN of a single subtree, type:

```
$ dsconf set-plugin-prop -h host -p port "uid uniqueness" argument:uid argument:subtreeBaseDN
```

For example:

```
$ dsconf set-plugin-prop -h host1 -p 1389 "uid uniqueness" argument:uid \
argument:dc=People,dc=example,dc=com
```

- To specify more than one subtree, add more arguments with the full base DN of a subtree as the value of each argument.

```
$ dsconf set-plugin-prop -h host -p port "uid uniqueness" argument:uid \
argument:subtreeBaseDN argument:subtreeBaseDN
```

- To specify subtrees according to the object class of their base entries, set the arguments to the following values. Uniqueness of the uid attribute is enforced in the subtree below every entry with the *baseObjectClass*. Optionally, you can specify the *entryObjectClass* in the third argument so that the plug-in only enforces uniqueness in operations that target entries with this object class.

```
$ dsconf set-plugin-prop -h host -p port "uid uniqueness" argument:attribute=uid \
argument:markerObjectClass=baseObjectClass argument:entryObjectClass=baseObjectClass
```

- To add an argument to an existing list of arguments, use the following command:

```
$ dsconf set-plugin-prop -h host -p port "uid uniqueness" argument+:argument-value
```

3 Restart the server for your changes to take effect.

▼ To Enforce Uniqueness of Another Attribute

The UID uniqueness plug-in can be used to enforce the uniqueness of any attribute. You must create a new instance of the plug-in by creating a new entry under `cn=plugins,cn=config` in the directory.

You cannot use DSCC to perform this task. Use the command line, as described in this procedure.

1 Create a new plug-in.

```
$ dsconf create-plugin -h host -p port -H lib-path -F init-func \
-Y type plugin-name
```

plugin-name should be a short and descriptive name that includes the name of the attribute. For example, to create a plug-in for the uniqueness of the mail ID attribute, use this command:

```
$ dsconf create-plugin -h host1 -p 1389 -H /opt/SUNWdsee/ds6/lib/uid-plugin.so \
-F NSUniqueAttr_Init -Y preoperation "mail uniqueness"
```

2 Set the plug-in properties.

```
$ dsconf set-plugin-prop -h host -p port plugin-name property:value
```

For example, to set the properties for the mail uniqueness plug-in, :

```
$ dsconf set-plugin-prop -h host1 -p 1389 "mail uniqueness" \
  desc:"Enforce unique attribute values..." version:6.0 \
  vendor:"Sun Microsystems, Inc." depends-on-type:database
```

3 Enable the plug-in.

```
$ dsconf enable-plugin -h host -p port plugin-name
```

4 Specify the plug-in arguments.

These arguments depend on how you want to determine the subtrees where uniqueness is enforced.

- To define one or more subtrees according to their base DN, the first argument must be the name of the attribute that should have unique values. Subsequent arguments are the full DNs of the base entries of the subtrees.

```
$ dsconf set-plugin-prop -h host -p port plugin-name argument:attribute-name \
  argument:subtreeBaseDN argument:subtreeBaseDN...
```

- To add an argument to an existing list of arguments, use the following command:

```
$ dsconf set-plugin-prop -h host -p port plugin-name argument+:argument-value
```

- To define subtrees according to the object class of their base entries, the first argument must contain `attribute=attribute-name` which specifies the name of the attribute that should have unique values. The second argument must be the `baseObjectClass` that determines the base entry of subtrees where uniqueness is enforced. Optionally, you can specify an `entryObjectClass` in the third argument so that the plug-in enforces uniqueness only in operations that target entries with this object class.

```
$ dsconf set-plugin-prop -h host -p port plugin-name argument:attribute=attribute-name \
  argument:markerObjectClass=baseObjectClass argument:requiredObjectClass=entryObjectClass
```

In all plug-in arguments, no space can appear before or after the = sign.

5 Restart the server for your changes to take effect.

Using the Uniqueness Plug-In With Replication

The UID uniqueness plug-in does not perform any checking on attribute values when an update is performed as part of a replication operation. This does not affect single-master replication, but the plug-in cannot automatically enforce attribute uniqueness for multimaster replication.

Single-Master Replication Scenario

Because all modifications by client applications are performed on the master replica, the UID uniqueness plug-in should be enabled on the master server. The plug-in should be configured to enforce uniqueness in the replicated suffix. Because the master ensures that the values of the desired attribute are unique, you do not need to enable the plug-in on the consumer server.

Enabling the UID uniqueness plug-in on the consumer of a single master does not interfere with replication or normal server operations. However, it might cause slight performance degradation.

Multimaster Replication Scenario

The UID uniqueness plug-in was not designed for use in a multimaster replication scenario. Because multimaster replication uses a loosely consistent replication model, simultaneously adding the same attribute value on both servers will not be detected, even if the plug-in is enabled on both servers.

However, you can use the UID uniqueness plug-in if the attribute on which you are performing the uniqueness check is a naming attribute, and the uniqueness plug-in is enabled for the same attribute in the same subtrees on all masters.

When these conditions are met, uniqueness conflicts are reported as naming conflicts at replication time. Naming conflicts must be resolved manually. For more information, refer to [“Solving Common Replication Conflicts”](#) on page 271.

Directory Server Logging

This chapter describes how to manage Directory Server logs.

If you want information to assist you in defining a logging strategy, use the logging policy information in “Designing a Logging Strategy” in *Sun Java System Directory Server Enterprise Edition 6.2 Deployment Planning Guide*.

For a description of the log files and their contents, see Chapter 7, “Directory Server Logging,” in *Sun Java System Directory Server Enterprise Edition 6.2 Reference*.

This chapter covers the following topics:

- “Log Analysis Tool” on page 313
- “Viewing Directory Server Logs” on page 314
- “Configuring Logs for Directory Server” on page 315
- “Rotating Directory Server Logs Manually” on page 317

Log Analysis Tool

The Directory Server Resource Kit provides a log analysis tool, `logconv`, that enables you to analyze Directory Server access logs. The log analysis tool extracts usage statistics. It also counts the occurrences of significant events. For more information about this tool, see the `logconv(1)` man page.

Viewing Directory Server Logs

You can view the logs directly on the server in the default *instance-path/logs* file. If you have modified the default path, you can find the log file location using the `dsconf` command as follows:

```
$ dsconf get-log-prop -h host -p port log-type path
```

Alternatively, you can view the log files through Directory Service Control Center (DSCC). DSCC enables you to view and sort the log entries.

The following figure shows a sample of a Directory Server access log in DSCC.

The screenshot shows the DSCC web interface for the instance `condyle:1389`. The 'Access Logs' tab is active, showing a table of log entries. The table has the following data:

Timestamp	Message	Connection	Operation	ID
Jul 7, 2006 3:09:12 PM MEST	BIND dn="cn=admin,cn=Administrators,cn=dc" method=128 version=3	26	1	2
Jul 7, 2006 3:09:12 PM MEST	RESULT err=0 tag=97 nentries=0 etime=0 dn="cn=admin,cn=administrators,cn=dc"	26	1	2
Jul 7, 2006 3:09:12 PM MEST	SRCH base="cn=config" scope=0 filter="(objectClass=*)" attrs=ALL	26	2	3
Jul 7, 2006 3:09:12 PM MEST	RESULT err=0 tag=101 nentries=1 etime=0	26	2	3
Jul 7, 2006 3:09:12	UNBIND	26	3	4

FIGURE 14-1 DSCC Access Log

▼ To Tail Directory Server Logs

You can use the `dsadm` command to display a specified number of lines of the Directory Server logs, or to display log entries younger than a specified age. This example tails the error log. To tail the access log, use `show - access - log` instead of `show - error - log`.

1 Display error log entries younger than a certain age.

```
$ dsadm show-error-log -A duration instance-path
```

You must specify a unit for the duration. For example, to display error log entries younger than 24 hours, type:

```
$ dsadm show-error-log -A 24h /local/ds
```

2 Display a specified number of lines from the error log (starting from the end).

```
$ dsadm show-error-log -L last-lines instance-path
```

The number of lines is expressed as an integer. For example, to display the last 100 lines, type:

```
$ dsadm show-error-log -L 100 /local/ds
```

If you do not specify a value, the default number of lines displayed is 20.

Configuring Logs for Directory Server

Many aspects of the log files can be modified. Some examples include the following:

- Enabling the audit log
 - Unlike the access log and the errors log, the audit log is not enabled by default. For information, see [“To Enable the Audit Log” on page 316](#).
- General settings
 - Enabling or disabling logging
 - Enabling or disabling log buffering
 - Log file location
 - Verbose logging
 - Log level
- Log rotation settings.
 - Creation of new logs at regular time intervals
 - Maximum log file size before a new log file is created
- Log deletion settings
 - Maximum file age before deletion
 - Maximum file size before deletion
 - Minimum free disk space before deletion

The following procedures describe how to modify log configuration and how to enable the audit log.

▼ To Modify Log Configuration

You can use DSCC to perform this task. For information, see [“Directory Service Control Center Interface” on page 43](#) and the DSCC online help.

1 View the settings for the log that you want to modify.

```
$ dsconf get-log-prop -h host -p port log-type
```

For example, to list the existing error log settings, type:

```
$ dsconf get-log-prop -h host1 -p 1389 error
Enter "cn=Directory Manager" password:
buffering-enabled      : off
enabled                : on
level                  : default
max-age                : 1M
max-disk-space-size   : 100M
max-file-count        : 2
max-size               : 100M
min-free-disk-space-size : 5M
path                   : /tmp/ds1/logs/errors
perm                   : 600
rotation-interval     : 1w
rotation-min-file-size : unlimited
rotation-time         : undefined
verbose-enabled       : off
```

2 Set the new value.

Set the value that you want for the property.

```
$ dsconf set-log-prop -h host -p port log-type property:value
```

For example, to set the rotation interval for the error log to two days, use this command:

```
$ dsconf set-log-prop -h host1 -p 1389 error rotation-interval:2d
```

▼ To Enable the Audit Log

Unlike the access log and errors log, the audit log is not enabled by default. Before viewing the audit log, you must enable it.

You can use DSCC to perform this task. For information, see [“Directory Service Control Center Interface” on page 43](#) and the DSCC online help.

● Enable the audit log.

```
$ dsconf set-log-prop -h host -p port audit enabled:on
```

Rotating Directory Server Logs Manually

If you have a log that is getting very large, you can manually rotate the log at any time. Rotation backs up the existing log file and creates a fresh log file.

▼ To Rotate Log Files Manually

You can use DSCC to perform this task. For information, see [“Directory Service Control Center Interface” on page 43](#) and the DSCC online help.

- **Rotate the log file.**

```
$ dsconf rotate-log-now -h host -p port log-type
```

For example, to rotate the access log:

```
$ dsconf rotate-log-now -h host1 -p 1389 access
```


Directory Server Monitoring

Directory Server can be monitored using a variety of methods. These methods are described in Chapter 3, “Directory Server Monitoring” in *Sun Java System Directory Server Enterprise Edition 6.2 Reference*.

This chapter describes how to set up and administer monitoring in Directory Server.

This chapter covers the following topics:

- “Setting Up SNMP for Directory Server” on page 319
- “Enabling Java ES MF Monitoring” on page 320
- “Troubleshooting Java ES MF Monitoring” on page 321
- “Monitoring a Server Using `cn=monitor`” on page 321

Setting Up SNMP for Directory Server

This section describes how to set up your server to be monitored through SNMP.

For a description of SNMP implementation in Directory Server, see “Directory Server and SNMP” in *Sun Java System Directory Server Enterprise Edition 6.2 Reference*.

▼ To Set Up SNMP

For parts of this procedure, you can use DSCC to perform this task. For information, see “[Directory Service Control Center Interface](#)” on page 43 and the DSCC online help. Other parts of the procedure can only be done using the command line.

1 Enable the Java ES Management Framework plug-in.

Use the procedure “[Enabling Java ES MF Monitoring](#)” on page 320. This procedure also enables the Common Agent Container, which is part of the Java ES MF.

2 Access the SNMP-managed objects defined by the MIB and exposed through the agents.

The tasks required for this step are entirely dependent on your SNMP management system. See your SNMP management system documentation for instructions.

When exposing the MIB, you might want to use the RFC text files for this MIB. These files are available at <http://www.ietf.org/rfc/rfc2605.txt> and <http://www.ietf.org/rfc/rfc2788.txt>.

Enabling Java ES MF Monitoring

If you want to use the Sun Java ES Management Framework (Java ES MF) for monitoring, you must enable the Java ES MF plug-in.

For more information about administering the Java ES MF, see the *Sun Java Enterprise System 5 Monitoring Guide*.

▼ To Enable Java ES MF Monitoring

You can use DSCC to perform this task. For information, see “[Directory Service Control Center Interface](#)” on page 43 and the DSCC online help.

1 Initialize and register the Java ES Monitoring Framework.

```
$ dscscsetup mfwk-reg
```

For the location of this command, see “[Command Locations](#)” on page 34.

2 Enable the Java ES Management Framework plug-in.

```
$ dsconf enable-plugin -h host -p port "Monitoring Plugin"
Enter "cn=Directory Manager" password:
Directory Server must be restarted for changes to take effect.
```

3 Restart the Directory Server instance.

```
$ dsadm restart instance-path
```

4 Verify that the Java ES Management Framework plug-in is enabled.

```
$ dsconf get-plugin-prop -h host -p port -v "Monitoring Plugin"
Enter "cn=Directory Manager" password:
Reading property values of the plugin "Monitoring Plugin"...
argument          :
depends-on-named   :
depends-on-type    : database
desc              : Monitoring plugin
enabled           : on
```



```

feature          : Monitoring
init-func       : mf_init
lib-path        : /opt/SUNWdsee/ds6/lib/mf-plugin.so
type            : object
vendor          : Sun Microsystems, Inc.
version         : 6.0

```

Troubleshooting Java ES MF Monitoring

If Java ES MF monitoring does not work, ensure that you have correctly installed the Common Agent Container, as described in Chapter 2, “Installing Directory Server Enterprise Edition 6.2,” in *Sun Java System Directory Server Enterprise Edition 6.2 Installation Guide*.

If you are still experiencing problems, see the *Sun Java Enterprise System 5 Monitoring Guide*.

Monitoring a Server Using cn=monitor

Server status, replication status, resource usage, and other monitoring information is available through DSCC.

Alternatively, you can monitor the Directory Server’s current activities from any LDAP client by performing a search operation on the following entries:

- cn=monitor
- cn=monitor, cn=ldb database, cn=plugins, cn=config
- cn=monitor, cn=dbName, cn=ldb database, cn=plugins, cn=config

dbName is the database name of the suffix that you want to monitor. Note that except for information about each connection, by default, the cn=monitor entry is readable by anyone, including clients bound anonymously.

The following example shows how to view the general server statistics:

```

$ ldapsearch -h host -p port -D cn=admin,cn=Administrators,cn=config -w - \
-s base -b "cn=monitor" "(objectclass=*)"

```

For a description of all monitoring attributes that are available in these entries, see “Directory ServerMonitoring Attributes” in *Sun Java System Directory Server Enterprise Edition 6.2 Reference*.

Many of the parameters that can be monitored reflect Directory Server performance, and are influenced by configuration and tuning. For more information about each of the configurable attributes, see the attribute man pages in *Sun Java System Directory Server Enterprise Edition 6.2 Man Page Reference*.

PART II

Directory Proxy Server Administration

Directory Proxy Server Tools

Sun Java™ System Directory Proxy Server provides a browser interface and command-line tools to register and manage instances of Directory Proxy Server. The browser interface is called Directory Service Control Center (DSCC). This chapter describes basic tasks that are required to administer Directory Proxy Server by using DSCC or the command line.

To decide whether to use DSCC or the command line to perform a specific task, see [“Deciding When to Use DSCC and When to Use the Command Line”](#) on page 42.

For more information about the administration framework, see “Directory Server Enterprise Edition Administration Model” in *Sun Java System Directory Server Enterprise Edition 6.2 Deployment Planning Guide*.

This chapter covers the following topics:

- [“Using DSCC for Directory Proxy Server”](#) on page 325
- [“Command-Line Tools for Directory Proxy Server”](#) on page 326

Using DSCC for Directory Proxy Server

This section describes how to access DSCC for Directory Proxy Server.

▼ To Access DSCC for Directory Proxy Server

- 1 **Access DSCC in the same way as you would for Directory Server.**

See [“To Access DSCC”](#) on page 44.

- 2 **Click on the Proxy Server tab to view and manage Directory Proxy Server.**

The following figure shows the initial window for Directory Proxy Server.

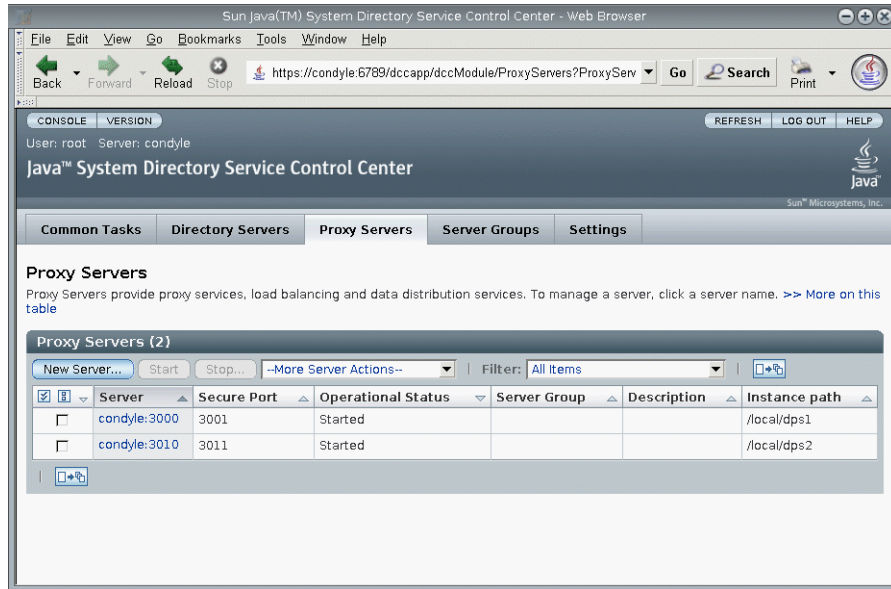


FIGURE 16-1 Initial DSCC Window for Directory Proxy Server

- 3 Click a Directory Proxy Server instance to view or to manage that server.

Note – For more information about using DSCC, see the online help.

Command-Line Tools for Directory Proxy Server

The commands-line tools that you use to work with Directory Proxy Server are called `dpadm` and `dpconf`. For information about how to use these commands, see the `dpadm(1M)` and `dpconf(1M)` man pages.

This section describes the location of the `dpadm` and `dpconf` commands. It also provides information on environment variables, comparisons between the commands, and where to find help for using the commands.

Location of Directory Proxy Server Commands

The Directory Proxy Server command-line tools are located in the following directory by default:

`install-path/dps6/bin`

Your installation path depends on your operating system. Installation paths for all operating systems are listed in “[Default Paths and Command Locations](#)” on page 33.

Setting Environment Variables for `dpconf`

The `dpconf` command requires some options that you can preset by using environment variables. If you do not specify an option when using the command, or do not set the environment variable, the default setting will be used. You can configure environment variables for the following options:

- D *userDN* User bind DN. Environment variable: `LDAP_ADMIN_USER`. Default: `cn=Proxy Manager`.
- w *password-file* Password file for the user bind DN. Environment variable: `LDAP_ADMIN_PWF`. Default: Prompt for password.
- h *host* Host name or IP address. Environment variable: `DIR_PROXY_HOST`. Default: `localhost`.
- p *LDAP-port* LDAP port number. Environment variable: `DIR_PROXY_PORT`. Default: 389 if the server instance is running as root, and 1389 if the server instance is running as a regular user.
- e, --unsecured Specifies that `dpconf` should open a clear connection by default. Environment variable: `DIR_PROXY_UNSECURED`. If this variable is not set, `dpconf` opens a secure connection by default.

For more details, see the `dpconf(1M)` man page.

Comparison of `dpadm` and `dpconf`

The following table shows a comparison of the `dpadm` and `dpconf` commands.

TABLE 16-1 Comparison of the `dpadm` and `dpconf` Commands

	<code>dpadm</code> Command	<code>dpconf</code> Command
Purpose	To manage the process or the files on a local instance of Directory Proxy Server	To configure a local or remote instance of Directory Proxy Server
User	Operating system user	LDAP user

TABLE 16-1 Comparison of the `dpadm` and `dpconf` Commands (Continued)

	<code>dpadm</code> Command	<code>dpconf</code> Command
Local or remote	The command <i>must</i> be local to the instance, that is, the command must be run on the host on which the server is running.	The command <i>can</i> be local to the instance but can also be run from anywhere on the network.
Example uses of the command	Create an instance of Directory Proxy Server. Start and stop an instance of Directory Proxy Server. Manage the certificate database.	Modify the configuration of an instance of Directory Proxy Server. Create a data view. Configure load balancing in a data source pool.
Server state	The server can be running or stopped.	The server <i>must</i> be running.
How the command identifies the server instance	By specifying the instance path. The instance path can be relative or absolute.	By specifying the host name or IP address and the port number. The command uses the LDAP port (-p) or the LDAPS secure port (-P). If a port number is not specified on the command line, the environment variable <code>PROXY_PORT</code> is used. If the environment variable is not set, the default ports are used.

Setting Multi-Valued Properties With `dpconf`

Certain Directory Proxy Server properties can take multiple values. Use the following syntax to specify the following values:

```
$ dpconf set-container-prop -h host -p port \
  property:value [property:value]
```

For example, to set multiple writable attributes for an LDAP data view named `my-view`, type the following command:

```
$ dpconf set-ldap-data-view-prop -h host1 -p 1389 \
  writable-attr:uid writable-attr:cn writable-attr:userPassword
```

To add a value to a multi-valued property that already contains values, type the following command:

```
$ dpconf set-container-prop -h host -p port \
  property+:value
```


To remove a value from a multi-valued property that already contains values, type the following command:

```
$ dpconf set-container-prop -h host -p port\  
property-:value
```

For example, in the scenario described previously, to add `sn` to the list of writable attributes, type the following command:

```
$ dpconf set-ldap-data-view-prop -h host1 -p 1389 \  
writable-attr+:sn
```

To remove `cn` from the list of writable attributes, type the following command:

```
$ dpconf set-ldap-data-view-prop -h host1 -p 1389 \  
writable-attr-:cn
```

Obtaining Help for Using `dpadm` and `dpconf`

For information about how to use the `dpadm` and `dpconf` commands, see the `dpadm(1M)` and `dpconf(1M)` man pages.

- To obtain a list of subcommands, type the appropriate command:

```
$ dpadm --help
```

```
$ dpconf --help
```

- To obtain information about how to use a subcommand, type the appropriate command:

```
$ dpadm subcommand --help
```

```
$ dpconf subcommand --help
```

- To obtain information about the configuration properties used in the `dpconf` command, type:

```
$ dpconf help-properties
```

- To obtain information about the configuration properties for a subcommand, use this command:

```
$ dpconf help-properties subcommand-entity
```

For example, to find information about the access log properties, type:

```
$ dpconf help-properties access-log
```

- To obtain information about a property used in a subcommand, use this command:

```
$ dpconf help-properties subcommand-entity property
```

For example, to find information about the `log-search-filters` property of the `set-access-log-prop` subcommand, type:

```
$ dpconf help-properties access-log log-search-filters
```

- To list the key properties of a group of entities, such as data views or connection handlers, use the verbose option `-v` with the `list` subcommand.

For example, to view the key properties and relative priorities of all of the connection handlers, use this command:

```
$ dpconf -h host -p port list-connection-handlers -v
```

Name	is-enabled	priority	description
anonymous	false	99	unauthenticated connections
default connection handler	true	100	default connection handler
dsc administrators	true	1	Administrators connection handler

For more information about an individual property, see the man page corresponding to that property.

Directory Proxy Server Instances

This chapter describes how to administer an instance of Directory Proxy Server. This chapter covers the following topics:

- “Creating and Deleting a Directory Proxy Server Instance” on page 331
- “Finding the Status of a Directory Proxy Server Instance” on page 333
- “Starting, Stopping, and Restarting a Directory Proxy Server Instance” on page 333
- Performing Load Balancing, Distribution, and Virtualization using Directory Proxy Server Instance

Creating and Deleting a Directory Proxy Server Instance

When you create an instance of Directory Proxy Server, the files and directories required for the instance are created in the path that you specify.

▼ To Create a Directory Proxy Server Instance

You can use DSCC to perform this task. For information, see “[Directory Service Control Center Interface](#)” on page 43 and the DSCC online help.

If you use DSCC to create a new server instance, you can choose to copy some or all of the server configuration settings from an existing server.

1 Create the instance of Directory Proxy Server.

```
$ dpadm create -p port instance-path
```

For example, to create a new instance in the directory `/local/dps`, use this command:

```
$ dpadm create -p 2389 /local/dps
```

To specify any other parameter of the instance, see the `dpadm(1M)` man page.

- 2 **Type a password if required.**
- 3 **Confirm that the instance has been created by verifying the status of the instance.**
`$ dpadm info instance-path`
- 4 **(Optional) If you installed Directory Proxy Server using the Sun Java™ Enterprise System installer or a native package installation, and your OS provides a service management solution, you can enable the server to be managed as a service, as shown in this table.**

Operating System	Command
Solaris 10	<code>dpadm enable-service --type SMF <i>instance-path</i></code>
Solaris 9	<code>dpadm autostart <i>instance-path</i></code>
Linux, HP-UX	<code>dpadm autostart <i>instance-path</i></code>
Windows	<code>dpadm enable-service --type WIN_SERVICE <i>instance-path</i></code>

- 5 **(Optional) Register the server instance, using one of these methods:**
 - Access DSCC through the URL `https://localhost:6789` and log in to the browser interface.
 - Use the command `dsccreg add-server`.
For details, see the `dsccreg(1M)` man page.

▼ To Delete a Directory Proxy Server Instance

You can use DSCC to perform this task. For information, see [“Directory Service Control Center Interface” on page 43](#) and the DSCC online help.

- 1 **(Optional) Stop the Directory Proxy Server instance.**
`$ dpadm stop instance-path`
 If you do not stop the instance, the delete command will stop it automatically. However, if you have enabled the instance in a service management solution, you must stop it manually.
- 2 **(Optional) If you have previously used DSCC to manage the server, use the command line to unregister the server.**
`$ dsccreg remove-server /local/dps`
 Enter DSCC administrator's password:
 /local/dps is an instance of DPS
 Enter password of "cn=Proxy Manager" for /local/dps:
 Unregistering /local/dps from DSCC on localhost.

Connecting to `/local/dps`
 Disabling DSCC access to `/local/dps`

For details, see the `dsccreg(1M)` man page.

- 3 (Optional) If you previously enabled the server instance in a service management solution, then disable the server from being managed as a service.

Operating System	Command
Solaris 10	<code>dpadm disable-service --type SMF instance-path</code>
Solaris 9	<code>dpadm autostart --off instance-path</code>
Linux, HP-UX	<code>dpadm autostart --off instance-path</code>
Windows	<code>dpadm disable-service --type WIN_SERVICE instance-path</code>

- 4 Delete the instance.

```
$ dpadm delete instance-path
```

Finding the Status of a Directory Proxy Server Instance

This procedure describes how to find the status of an instance of Directory Proxy Server.

▼ To Find the Status of a Directory Proxy Server Instance

You can use DSCC to perform this task. For information, see [“Directory Service Control Center Interface” on page 43](#) and the DSCC online help.

- Find the status of an instance of Directory Proxy Server.

```
$ dpadm info instance-path
```

Starting, Stopping, and Restarting a Directory Proxy Server Instance

This section provides information about starting, stopping, and restarting Directory Proxy Server from the command line.

▼ To Start and Stop Directory Proxy Server

You can use DSCC to perform this task. For information, see [“Directory Service Control Center Interface” on page 43](#) and the DSCC online help.

- **To start or stop Directory Proxy Server, do one of the following.**

- To start Directory Proxy Server, type:

```
$ dpadm start instance-path
```

For example, to start an instance at `/local/dps`, use this command:

```
$ dpadm start /local/dps
```

- To stop Directory Proxy Server, type:

```
$ dpadm stop instance-path
```

For example:

```
$ dpadm stop /local/dps
```

▼ To View Whether It Is Necessary to Restart a Directory Proxy Server Instance

Sometimes, a configuration change requires the server to be restarted before the change takes effect. Use this procedure to check whether it is necessary to restart a Directory Proxy Server instance after a configuration change.

- **View whether it is necessary to restart the server.**

```
$ dpconf get-server-prop -h host -p port is-restart-required
```

- If the command returns `true`, you must restart the instance of Directory Proxy Server.
- If the command returns `false`, it is not necessary to restart the instance of Directory Proxy Server.

▼ To Restart Directory Proxy Server

You can use DSCC to perform this task. For information, see [“Directory Service Control Center Interface” on page 43](#) and the DSCC online help.

- **Restart Directory Proxy Server.**

```
$ dpadm restart instance-path
```

For example, to restart an instance at `/local/dps`, use this command:

```
$ dpadm restart /local/dps
```


Directory Proxy Server Configuration

This chapter describes how to configure an instance of Directory Proxy Server. The procedures in this chapter use the `dpadm` and `dpconf` commands. For information about these commands, see the `dpadm(1M)` and `dpconf(1M)` man pages.

The chapter covers the following topics:

- “Configuration Examples” on page 337
- “Modifying the Configuration of Directory Proxy Server” on page 343
- “Backing Up and Restoring a Directory Proxy Server Instance” on page 344
- “Configuring the Proxy Manager” on page 345
- “Configuration Changes Requiring Server Restart” on page 346
- “Accessing Configuration Entries for a Directory Server by Using Directory Proxy Server” on page 347

Configuration Examples

This section demonstrates two example Directory Proxy Server configurations, one for load balancing, another for data distribution. For more on virtual directory, see “[Sample Virtual Configurations](#)” on page 413.

Configuring Directory Proxy Server To Perform Load Balancing

A simple case of load balancing consists of sending search and compare operations to one set of directories, and sending other operations to another set. Directory Proxy Server receives all client operations. The server must determine which set gets the reads, and which set gets the other operations.

The key stages in configuring Directory Proxy Server to handle this load balancing scenario are as follows.

1. Add directories as data sources for Directory Proxy Server.
2. Add the data sources to a data source pool.
3. Configure some of the data sources to accept search and compare, other data sources to accept add, bind, delete, modify, and modify DN operations.
4. Add the data source pool to a data view.

The following example involves Directory Proxy Server, listening on port 9389. The proxy is configured here to balance the load as described across one Directory Server instance, `ds1:1389`, handling search and compare operations, and another Directory Server instance, `ds2:2389`, handling other operations.

The first step creates the data sources, and enables the data sources. This step requires a proxy server restart.

```
$ dpconf create-ldap-data-source -p 9389 ds1 localhost:1389
$ dpconf create-ldap-data-source -p 9389 ds2 localhost:2389
$ dpconf set-ldap-data-source-prop -p 9389 ds1 is-enabled:true
$ dpconf set-ldap-data-source-prop -p 9389 ds2 is-enabled:true
$ dpadm restart /local/dps
```

The second step adds the data sources to a data source pool.

```
$ dpconf create-ldap-data-source-pool -p 9389 "Directory Pool"
$ dpconf attach-ldap-data-source -p 9389 "Directory Pool" ds1 ds2
```

The third step configures `ds1` to accept search and compare operations, `ds2` to accept other operations.

```
$ dpconf set-attached-ldap-data-source-prop -p 9389 "Directory Pool" ds1 \
add-weight:disabled bind-weight:disabled compare-weight:1 delete-weight:disabled \
modify-dn-weight:disabled modify-weight:disabled search-weight:1
$ dpconf set-attached-ldap-data-source-prop -p 9389 "Directory Pool" ds2 \
add-weight:1 bind-weight:1 compare-weight:disabled delete-weight:1 \
modify-dn-weight:1 modify-weight:1 search-weight:disabled
```

The fourth step adds the data source pool to a data view, so that client application requests are routed to the pool.

```
$ dpconf create-ldap-data-view -p 9389 "Balanced View" "Directory Pool" \
dc=example,dc=com
```

Configuring Directory Proxy Server for Distribution of Suffix Data

A simple case of data distribution consists of storing entries having UIDs beginning with A through M in one set of directories, and storing entries having UIDs beginning with N through Z in another set of directories. Directory Proxy Server receives all client operations. The server must determine which set of directories handles A through M, and which set handles N through Z.

The key stages in configuring Directory Proxy Server to handle this data distributions scenario are as follows.

1. Add directories as data sources for Directory Proxy Server.
2. Add the data sources to data source pools to handle the different data distributions.
3. Create data views designed to distribute client requests to the appropriate data pools.
4. Split the LDIF to be loaded into the appropriate data sources.
5. Import the split LDIF into the appropriate data sources.
6. Adjust the operation based weights for the data sources attached to the appropriate data pools.

The following example involves Directory Proxy Server, listening on port 9389. To keep the example simple, the proxy is configured here to distribute as described across only three Directory Server instances. For availability and read scalability, use replicated directory topologies to store LDAP data. One Directory Server instance, `dsA-M:1389` handles the user entries having UIDs beginning with A through M. Another Directory Server instance, `dsN-Z:2389`, handles the user entries having UIDs beginning with N through Z. A final directory instance handles the base entries of the suffix, `dsBase:3389`.

The first step creates and enables the data sources. The base data source holds entries near the root of the suffix that do not have UIDs. In a typical deployment, these entries would be much fewer in number than distributed entries.

```
$ dpconf create-ldap-data-source -p 9389 dsA-M localhost:1389
$ dpconf set-ldap-data-source-prop -p 9389 dsA-M is-enabled:true

$ dpconf create-ldap-data-source -p 9389 dsN-Z localhost:2389
$ dpconf set-ldap-data-source-prop -p 9389 dsN-Z is-enabled:true

$ dpconf create-ldap-data-source -p 9389 dsBase localhost:3389
$ dpconf set-ldap-data-source-prop -p 9389 dsBase is-enabled:true
```

The second step adds the data sources to a data source pool.

```

$ dpconf create-ldap-data-source-pool -p 9389 "Base Pool"
$ dpconf attach-ldap-data-source -p 9389 "Base Pool" dsBase

$ dpconf create-ldap-data-source-pool -p 9389 "A-M Pool"
$ dpconf attach-ldap-data-source -p 9389 "A-M Pool" dsA-M

$ dpconf create-ldap-data-source-pool -p 9389 "N-Z Pool"
$ dpconf attach-ldap-data-source -p 9389 "N-Z Pool" dsN-Z

```

The third step creates data views designed to distribute client requests to the appropriate data pools. Notice how the base pool handles `dc=example,dc=com`, whereas the pools holding data distributed according to UID values handle `ou=people,dc=example,dc=com`. This step requires a server restart.

```

$ dpconf create-ldap-data-view -p 9389 "Base View" "Base Pool" \
dc=example,dc=com

$ dpconf create-ldap-data-view -p 9389 "A-M View" "A-M Pool" \
ou=people,dc=example,dc=com
$ dpconf set-ldap-data-view-prop -p 9389 "A-M View" \
distribution-algorithm:lexicographic lexicographic-attrs:uid \
lexicographic-lower-bound:a lexicographic-upper-bound:m
The proxy server will need to be restarted in order for the changes to take effect

$ dpconf create-ldap-data-view -p 9389 "N-Z View" "N-Z Pool" \
ou=people,dc=example,dc=com
$ dpconf set-ldap-data-view-prop -p 9389 "N-Z View" \
distribution-algorithm:lexicographic lexicographic-attrs:uid \
lexicographic-lower-bound:n lexicographic-upper-bound:z
The proxy server will need to be restarted in order for the changes to take effect
$ dpadm restart /local/dps

```

The fourth step splits the LDIF to be loaded into the appropriate data sources. This example uses both the `dsadm split-ldif` command to perform the initial split, and also some file editing to retain the top entry in all the data sources. This makes it possible both to retain the top entry that specifies access control instructions, and to use a single import command for each data source.

```

$ dpadm split-ldif /local/dps /local/ds6/ldif/Example.ldif /tmp/
[14/May/2007:21:14:13 +0200] - STARTUP      - INFO - Java Version: 1.5.0_09
      (Java Home: /local/jre)
[14/May/2007:21:14:13 +0200] - STARTUP      - INFO - Java Heap Space: Total Memory
      (-Xms) = 3MB,
      Max Memory (-Xmx) = 63MB
[14/May/2007:21:14:13 +0200] - STARTUP      - INFO - Operating System: SunOS/sparc 5.10
[14/May/2007:21:14:15 +0200] - INTERNAL    - ERROR - Entry starting at line 0 does not
      start with a DN
[14/May/2007:21:14:15 +0200] - INTERNAL    - ERROR - Unable to parse line "# Kirsten is

```

```

a Directory Administrator and therefore should not" of entry "uid=kvaughan, ou=People,
dc=example,dc=com" starting at line 112 as an attribute/value pair -- no colon found.
[14/May/2007:21:14:15 +0200] - INTERNAL - ERROR - Unable to parse line "# Robert is
a Directory Administrator and therefore should not" of entry "uid=rdaugherty,
ou=People, dc=example,dc=com" starting at line 298 as an attribute/value pair --
no colon found.
[14/May/2007:21:14:16 +0200] - INTERNAL - ERROR - Unable to parse line "# Harry is
a Directory Administrator and therefore should not" of entry "uid=hmiller, ou=People,
dc=example,dc=com" starting at line 556 as an attribute/value pair -- no colon found.
[14/May/2007:21:14:16 +0200] - INTERNAL - INFO - SplitLDIF processing complete.
Processed 156 entries.
$ ls /tmp/*ldif
/tmp/a-m view.ldif /tmp/base view.ldif /tmp/n-z view.ldif

```

This step also requires a top entry that is added to the LDIF before import.

```

$ cp /local/ds6/ldif/Example.ldif /tmp/top.ldif
$ vi /tmp/top.ldif
$ cat /tmp/top.ldif
dn: dc=example,dc=com
objectclass: top
objectclass: domain
dc: example
aci: (target="ldap:///dc=example,dc=com")(targetattr !=
"userPassword")(version 3.0;acl "Anonymous read-search access";
allow (read, search, compare)(userdn = "ldap:///anyone");)
aci: (target="ldap:///dc=example,dc=com") (targetattr =
"*)"(version 3.0; acl "allow all Admin group"; allow(all) groupdn =
"ldap:///cn=Directory Administrators,ou=Groups,dc=example,dc=com");)

$ cat /tmp/top.ldif /tmp/base\ view.ldif > /tmp/top\ and\ base\ view.ldif
$ cat /tmp/top.ldif /tmp/a-m\ view.ldif > /tmp/top\ and\ a-m\ view.ldif
$ cat /tmp/top.ldif /tmp/n-z\ view.ldif > /tmp/top\ and\ n-z\ view.ldif

```

The fifth step imports the split LDIF into the appropriate data sources. Here, the directory handling the base entries is on port 3389. The directory handling A-M is listening on port 1389. The directory handling N-Z is listening on port 2389.

```

$ dsconf import -p 1389 /tmp/top\ and\ a-m\ view.ldif dc=example,dc=com
...
Task completed (slapd exit code: 0).

$ dsconf import -p 2389 /tmp/top\ and\ n-z\ view.ldif dc=example,dc=com
...
Task completed (slapd exit code: 0).
$ dsconf import -p 3389 /tmp/top\ and\ base\ view.ldif dc=example,dc=com
...
Task completed (slapd exit code: 0).

```

The sixth step adjusts the operation based weights for the data sources attached to the appropriate data pools. If client applications perform operations other than searches, then weights must be set for those operations as well.

```
$ dpconf set-attached-ldap-data-source-prop -p 9389 "Base Pool" dsBase search-weight:1
$ dpconf set-attached-ldap-data-source-prop -p 9389 "A-M Pool" dsA-M search-weight:1
$ dpconf set-attached-ldap-data-source-prop -p 9389 "N-Z Pool" dsN-Z search-weight:1
```

After the operations based weights are set, client applications can search through Directory Proxy Server as if the data were not physically distributed.

The following search looks for a user whose UID begins with R.

```
$ ldapsearch -p 9389 -b dc=example,dc=com uid=rfisher
version: 1
dn: uid=rfisher, ou=People, dc=example,dc=com
cn: Randy Fisher
sn: Fisher
givenName: Randy
objectClass: top
objectClass: person
objectClass: organizationalPerson
objectClass: inetOrgPerson
ou: Human Resources
ou: People
l: Cupertino
uid: rfisher
mail: rfisher@example.com
telephoneNumber: +1 408 555 1506
facsimileTelephoneNumber: +1 408 555 1992
roomNumber: 1579
```

The next search looks for one of the base entries.

```
$ ldapsearch -p 9389 -b ou=groups,dc=example,dc=com cn=hr\ managers
version: 1
dn: cn=HR Managers,ou=groups,dc=example,dc=com
objectClass: top
objectClass: groupOfUniqueNames
cn: HR Managers
ou: groups
uniqueMember: uid=kvaughan, ou=People, dc=example,dc=com
uniqueMember: uid=cschmith, ou=People, dc=example,dc=com
description: People who can manage HR entries
```

Modifying the Configuration of Directory Proxy Server

This section describes how to modify the configuration of Directory Proxy Server.

▼ To Modify the Configuration of Directory Proxy Server

You can use DSCC to perform this task. For information, see [“Directory Service Control Center Interface” on page 43](#) and the DSCC online help.

1 Find the current configuration of Directory Proxy Server.

```
$ dpconf get-server-prop -h host -p port
```

Alternatively, view the current setting of one or more configuration properties.

```
$ dpconf get-server-prop -h host -p port property-name ...
```

For example, find whether unauthenticated operations are allowed by running this command:

```
$ dpconf get-server-prop -h host -p port allow-unauthenticated-operations
allow-unauthenticated-operations : true
```

2 Change one or more of the configuration parameters.

```
$ dpconf set-server-prop -h host -p port property:value ...
```

For example, disallow unauthenticated operations by running this command:

```
$ dpconf set-server-prop -h host -p port allow-unauthenticated-operations:false
```

If you attempt to perform an illegal change, the change is not made. For example, if you set the `allow-unauthenticated-operations` parameter to `f` instead of `false`, the following error is produced:

```
$ dpconf set-server-prop -h host -p port allow-unauthenticated-operations:f
The value "f" is not a valid value for the property "allow-unauthenticated-operations".
Allowed property values: BOOLEAN
The "set-server-prop" operation failed.
```

3 If necessary, restart the instance of Directory Proxy Server for the changes to take effect.

For information about restarting Directory Proxy Server, see [“To Restart Directory Proxy Server” on page 334](#).

Displaying Directory Proxy Server Instance Configuration Information

To display the Directory Proxy Server instance configurations, type `dpconf info`.

```
$ dpconf info
Instance Path      : instance path
Host Name          : host
Secure listen address : IP address
Port               : port
Secure port        : secure port
SSL server certificate : defaultServerCert
```

Directory Proxy Server needs to be restarted.

`dpconf info` displays `Secure listen address` and `Non-secure listen address` only if these properties are set to non-default values. The above output does not display `Non-secure listen address`, as this property is not set to a non-default value.

`dpconf info` also reminds the user to restart the instance if it needs to be restarted.

You can also use `dpadm info` to display Directory Proxy Server instance configuration information.

Backing Up and Restoring a Directory Proxy Server Instance

When you use `dpadm` to back up Directory Proxy Server, the configuration files and server certificates are backed up. If you have implemented Directory Proxy Server virtual ACIs, the ACIs are also backed up.

Directory Proxy Server automatically backs up the `conf.ldif` file whenever the server starts successfully.

▼ To Back Up a Directory Proxy Server Instance

You can use DSCC to perform this task. For information, see [“Directory Service Control Center Interface” on page 43](#) and the DSCC online help.

1 Stop the instance of Directory Proxy Server.

```
$ dpadm stop instance-path
```

2 Back up the instance of Directory Proxy Server.

```
$ dpadm backup instance-path archive-dir
```


The *archive-dir* directory is created by the backup command and must not exist before you run the command. This directory contains a backup of each of the configuration files and the certificates.

▼ To Restore a Directory Proxy Server Instance

You can use DSCC to perform this task. For information, see [“Directory Service Control Center Interface” on page 43](#) and the DSCC online help.

You must create a Directory Proxy Server instance before starting the restore operation.

1 Stop the instance of Directory Proxy Server.

```
$ dpadm stop instance-path
```

2 Restore the instance of Directory Proxy Server.

```
$ dpadm restore instance-path archive-dir
```

- If the instance path exists, the restore operation is performed silently. The configuration files and the certificates in the *archive-dir* directory replace those in the *instance-path* directory.
- If the instance path does not exist, the restore operation fails.

Configuring the Proxy Manager

The Proxy Manager is the privileged administrator, comparable to the root user on UNIX® systems. The Proxy Manager entry is defined when an instance of Directory Proxy Server is created. The default DN of the Proxy Manager is `cn=Proxy Manager`.

You can view and change the Proxy Manager DN and password, as shown in the following procedure.

▼ To Configure the Proxy Manager

You can use DSCC to perform this task. For information, see [“Directory Service Control Center Interface” on page 43](#) and the DSCC online help.

1 Find the configuration of the Proxy Manager.

```
$ dpconf get-server-prop -h host -p port configuration-manager-bind-dn configuration-manager-bind-pwd
configuration-manager-bind-dn : cn=proxy manager
configuration-manager-bind-pwd : {3DES}U77v39WX8MDpcWVrueetB0lfJlBc6/5n
```

The default value for the Proxy Manager is `cn=proxy manager`. A hashed value is returned for the configuration manager password.

2 Change the DN of the Proxy Manager.

```
$ dpconf set-server-prop -h host -p port configuration-manager-bind-dn:bindDN
```

3 Create a file that contains the password for the Proxy Manager and set the property that points to that file.

```
$ dpconf set-server-prop -h host -p port configuration-manager-bind-pwd-file:filename
```

Configuration Changes Requiring Server Restart

Most configuration changes to Directory Proxy Server and its entities can be made online. Certain changes require that the server be restarted before the changes take effect. If you make configuration changes to any properties in the following list, the server must be restarted:

```
aci-data-view  
bind-dn  
client-cred-mode  
custom-distribution-algorithm  
db-name  
db-pwd  
db-url  
db-user  
distribution-algorithm  
ldap-address  
ldap-port  
ldaps-port  
listen-address  
listen-port  
load-balancing-algorithm  
num-bind-init  
num-read-init  
num-write-init  
number-of-search-threads  
number-of-threads  
number-of-worker-threads  
ssl-policy  
use-external-schema
```

The `rws` and `rwd` keywords of a property indicate whether changes to the property require the server to be restarted.

- If a property has an `rws` (read, write, static) keyword, the server must be restarted when the property is changed.
- If a property has an `rwd` (read, write, dynamic) keyword, modifications to the property are implemented dynamically (without restarting the server).

To determine whether a change to a property requires the server to be restarted, run the following command:

```
$ dpconf help-properties | grep property-name
```

For example, to determine whether changing the bind DN of an LDAP data source requires the server to be restarted, run the following command:

```
$ dpconf help-properties | grep bind-dn
connection-handler      bind-dn-filters        rwd STRING | any
This property specifies a set of regular expressions. The bind DN
of a client must match at least one regular expression in order for
the connection to be accepted by the connection handler. (Default: any)
ldap-data-source        bind-dn                 rws DN | ""
This property specifies the DN to use when binding to the LDAP data
source. (Default: undefined)
```

To determine whether the server must be restarted following a configuration change, run the following command:

```
$ dpconf get-server-prop -h host -p port is-restart-required
```

Accessing Configuration Entries for a Directory Server by Using Directory Proxy Server

The configuration entries for Directory Proxy Server are in `cn=config`. When you use Directory Proxy Server to access configuration entries, by default, you access the configuration entries of Directory Proxy Server.

To access the configuration entries of a directory server, it is better to connect directly to Directory Server, not to Directory Proxy Server. For information about how to configure Directory Server, see [Chapter 3, “Directory Server Configuration.”](#)



Caution – If you reconfigure Directory Proxy Server to access the configuration entries of a directory server, you are likely to break the administration framework of Directory Proxy Server.

If you really need to access the configuration entries of a directory server through Directory Proxy Server, take special steps to ensure that you do not break the administration framework of Directory Proxy Server. This section describes how to access the configuration entries of a directory server by using Directory Proxy Server.

▼ To Access the Configuration Entries of a Directory Server by Using Directory Proxy Server

- 1 Create one or more data sources as described in [“Creating and Configuring LDAP Data Sources” on page 359](#).
- 2 Create an LDAP data source pool as described in [“Creating and Configuring LDAP Data Source Pools” on page 362](#).
- 3 Attach one or more data sources to the data source pool as described in [“Attaching LDAP Data Sources to a Data Source Pool” on page 363](#).

- To expose the configuration entries of one specific data source, attach only one LDAP data source to the LDAP data source pool.

```
$ dpconf attach-ldap-data-source -h host -p port pool-name data-source-name
```

After performing this step, a client can access the configuration entries of the data source that is connected to Directory Proxy Server.

- To expose the configuration entries of any data source, attach more than one LDAP data source to the LDAP data source pool.

```
$ dpconf attach-ldap-data-source -h host -p port pool-name data-source-name \  
data-source-name ...
```

After performing this step, a client can access the configuration entries of one of the data sources connected to Directory Proxy Server. However, the client cannot know which data source the configuration entries belong to.

- 4 Create an LDAP data view to expose `cn=config`.

```
$ dpconf create-ldap-data-view -h host -p port view-name pool-name cn=config
```

Directory Proxy Server Certificates

This chapter describes how to configure certificates on Directory Proxy Server. For information about configuring certificates on *Directory Server*, see [“Managing Certificates” on page 107](#).

The procedures in this chapter use the `dpadm` and `dpconf` commands. For information about these commands, see the `dpadm(1M)` and `dpconf(1M)` man pages.

This chapter covers the following topics:

- [“Default Self-Signed Certificate” on page 349](#)
- [“Creating, Requesting and Installing Certificates for Directory Proxy Server” on page 350](#)
- [“Renewing an Expired CA-Signed Certificate for Directory Proxy Server” on page 353](#)
- [“Listing Certificates” on page 353](#)
- [“Adding a Certificate From a Back-End LDAP Server to the Certificate Database on Directory Proxy Server” on page 354](#)
- [“Exporting a Certificate to a Back-End LDAP Server” on page 355](#)
- [“Backing Up and Restoring a Certificate Database for Directory Proxy Server” on page 356](#)
- [“Prompting for a Password to Access the Certificate Database” on page 356](#)

Default Self-Signed Certificate

When you create a Directory Proxy Server instance, it has a default self-signed certificate. A self-signed certificate is a public and private key pair, where the public key is self-signed by Directory Proxy Server.

▼ Viewing the Default Self-Signed Certificate

You can use DSCC to perform this task. For information, see [“Directory Service Control Center Interface” on page 43](#) and the DSCC online help.

- **View the default self-signed certificate.**

```
$ dpadm show-cert instance-path defaultservercert
```

Creating, Requesting and Installing Certificates for Directory Proxy Server

To run the Secure Sockets Layer (SSL) on Directory Proxy Server, you must either use a self-signed certificate or a Public Key Infrastructure (PKI) solution.

The PKI solution involves an external Certificate Authority (CA). For a PKI solution you need a CA-signed server certificate, which contains both a public key and a private key. This certificate is specific to one Directory Proxy Server instance. You also need a *trusted CA certificate*, which contains a public key. The trusted CA certificate ensures that all server certificates from your CA are trusted. This certificate is sometimes called a CA root key or root certificate.

For information about how to create a non-default self-signed certificate and to request and install a CA-signed certificate, see the following procedures.

▼ **To Create a Non-default Self-Signed Certificate for Directory Proxy Server**

When you create a Directory Proxy Server instance, a default self-signed certificate is automatically provided. If you want to create a self-signed certificate with non-default settings, use this procedure.

The procedure creates the public and private key pair for a server certificate, where the public key is signed by Directory Proxy Server. A self-signed certificate is valid for three months.

You can use DSCC to perform this task. For information, see [“Directory Service Control Center Interface” on page 43](#) and the DSCC online help.

- **To create a non-default self-signed certificate for Directory Proxy Server, type:**

```
$ dpadm add-selfsign-cert instance-path cert-alias
```

where *cert-alias* is the name of the self-signed certificate.

For example, you could create a certificate called `my-self-signed-cert` as follows:

```
$ dpadm add-selfsign-cert /local/dps my-self-signed-cert
```

For a description of all command options, see the `dpadm(1M)` man page or type `dpadm add-selfsign-cert --help` at the command line.

▼ To Request a CA-Signed Certificate for Directory Proxy Server

Self-signed certificates are useful for test purposes. However, in a production environment, using trusted Certificate Authority (CA) certificates is more secure.

You can use DSCC to perform this task. For information, see “[Directory Service Control Center Interface](#)” on page 43 and the DSCC online help.

1 Request a CA-signed server certificate.

```
$ dpadm request-cert instance-path cert-alias
```

where *cert-alias* is the name of the certificate that you are requesting. Certificate Authorities might require all of the options of the command to identify the server. For a description of all command options, see the `dpadm(1M)` man page.

The process for obtaining a CA certificate depends on the CA that you use. Some commercial CAs provide a web site that allows you to download the certificate. Other CAs will send the certificate to you in email.

For example, you could request a certificate called `my-CA-signed-cert` as follows:

```
$ dpadm request-cert -S cn=my-request,o=test /local/dps my-CA-signed-cert
-----BEGIN NEW CERTIFICATE REQUEST-----
MIIBYDCBygIBADAhMQ0wCwYDVQQDEwRnZXJpMRAwDgYDVQQDEwdteWwlnQ0MIGfMA0GCSqGSIb3
DQEBAQUAA4GNADCBiQKBgQC3v9ubG468wnjBDAMbRrEkmFDTQzT+LO30D/ALLX0iELVsHrtRyWhJ
PG9cURI9uwqs15crxCpJvho1kt3SB9+yMB8QL+CKnCDHLNAfn30MjFHShv/sAuEygFsN+Ekci5
W1jySYE2rzE0qKVxWLSILFo1UFRVRsUnORTX/Nas7QIDAQABoAAwDQYJKoZIhvcNAQEEBQADgYEA
fcQMnZNLpPobiX1xy1ROefPOhksVz8didY8Q2fjjaHG51ajMsqOROzubsuQ9Xh4ohT8KIA6xcBNZ
g8FRNIRAHctDXK0dOm3CpJ8da+YGI/ttSawIeNAKU1DApF9zMb7c21S4yEfWmreoQdXIC9YeKtF6
zwnb2EmIpjHzETtS5Nk=
-----END NEW CERTIFICATE REQUEST-----
```

When you request a certificate by using the `dpadm request-cert` command, the certificate request is a PKCS #10 certificate request in Privacy Enhanced Mail (PEM) format. PEM is the format specified by RFCs 1421 through 1424. For more information, see <http://www.ietf.org/rfc/rfc1421.txt>. The PEM format represents a base64-encoded certificate request in ASCII format.

When you request a CA-signed certificate, a temporary self-signed certificate is created. When you receive and install the CA-signed certificate from the CA, the new certificate replaces the temporary self-signed certificate.

2 Send the certificate request to the CA, according to its procedures.

After you have sent your request, you must wait for the CA to respond with your certificate. Response time for your request varies. For example, if your CA is internal to your company, the response time can be short. However, if the CA is external to your company, the CA can take several weeks to respond to your request.

3 Save the certificate that you receive from the CA.

Save your certificate in a text file, and back up the certificate in a safe location.

▼ To Install a CA-Signed Server Certificate for Directory Proxy Server

To trust the CA-signed server certificate, you must install the certificate on a Directory Proxy Server instance. This procedure installs the public key of a CA certificate to the certificate database on Directory Proxy Server.

You can use DSCC to perform this task. For information, see [“Directory Service Control Center Interface” on page 43](#) and the DSCC online help.

1 See if the trusted CA certificate for this CA is already installed.

To do this, list all installed CA certificates, as described in [“To List CA Certificates” on page 354](#).

2 If the trusted CA certificate is not installed, add it to the certificate database on the Directory Proxy Server instance.

```
$ dpadm add-cert instance-path cert-alias cert-file
```

where *cert-alias* is the name of the trusted CA certificate and *cert-file* is the name of the file containing the trusted CA certificate.

3 Install the CA-signed server certificate to the certificate database.

```
$ dpadm add-cert instance-path cert-alias cert-file
```

Where *cert-alias* is the name of the CA-signed server certificate and *cert-file* is the name of the file containing the CA-signed server certificate. Note that this *cert-alias* must be the same as the *cert-alias* used in the certificate request

For example, you can add a CA-signed server certificate named CA-cert to the certificate database on /local/dps as follows:

```
$ dpadm add-cert /local/dps CA-cert /local/safepace/ca-cert-file.ascii
```


Renewing an Expired CA-Signed Certificate for Directory Proxy Server

This section describes how to renew an expired CA-signed server certificate.

▼ To Renew an Expired CA-Signed Server Certificate for Directory Proxy Server

You can use DSCC to perform this task. For information, see [“Directory Service Control Center Interface” on page 43](#) and the DSCC online help.

- 1 Obtain an updated certificate from your CA.
- 2 Install the certificate on your instance of Directory Proxy Server.

```
$ dpadm renew-cert instance-path cert-alias cert-file
```

where *cert-alias* is the name of the new certificate and *cert-file* is the name of the file containing the certificate. For a description of all command options, see the `dpadm(1M)` man page.

Listing Certificates

For information about how to list server and CA certificates, see the following procedures.

▼ To List Server Certificates

This procedure lists all certificates that are installed on an instance of Directory Proxy Server.

You can use DSCC to perform this task. For information, see [“Directory Service Control Center Interface” on page 43](#) and the DSCC online help.

- List the server certificates in the certificate database on the Directory Proxy Server instance.

```
$ dpadm list-certs instance-path
```

By default, an instance of Directory Proxy Server contains a server certificate named `defaultservercert`. The text `Same as issuer` indicates that the default certificate is a self-signed server certificate.

For example:

```
$ dpadm list-certs /local/dps
Alias          Valid from      Expires on      Self-signed? Issued by      Issued to
```

```
-----
defaultservercert 2006/06/01 04:15 2008/05/31 04:15 y          CN=myserver:myport Same as issuer
1 certificate found.
```

▼ To List CA Certificates

This procedure lists CA certificates that are installed on an instance of Directory Proxy Server.

You can use DSCC to perform this task. For information, see [“Directory Service Control Center Interface” on page 43](#) and the DSCC online help.

- **List the CA certificates in the certificate database on the Directory Proxy Server instance.**

```
$ dpadm list-certs -C instance-path
```

For example:

```
$ dpadm list-certs -C /local/dps
Alias   Valid from      Expires on      Built-in Issued by      Issued to
-----
CAcert1 1999/06/21 06:00 2020/06/21 06:00 y          CN=company1, O=company2
...
```

Adding a Certificate From a Back-End LDAP Server to the Certificate Database on Directory Proxy Server

This section describes how to add a certificate from a back-end LDAP server to the certificate database on Directory Proxy Server.

▼ To Add a Certificate From a Back-End Directory Server to the Certificate Database on Directory Proxy Server

You can use DSCC to perform this task. For information, see [“Directory Service Control Center Interface” on page 43](#) and the DSCC online help.

- 1 **Display the certificate from the back-end Directory Server in PEM format by using this command syntax:**

```
dsadm show-cert -F ascii instance-path [cert-alias]
```

If you do not specify a *cert-alias*, the default server certificate is displayed. For a description of all command options, see the dsadm(1M) man page.

Where *cert-alias* is the name of the certificate. For a description of all command options, see the `dpconf(1M)` man page.

2 Copy the contents of the certificate to a file.

```
$ dpadm show-cert -F ascii -o filename instance-path cert-alias
```

3 Add the certificate to the certificate database for the back-end LDAP server as described in “[To Add the CA-Signed Server Certificate and the Trusted CA Certificate](#)” on page 110.

Next Steps Configure the back-end LDAP server for client authentication. For information about how to do this for Directory Server, see “[Configuring Credential Levels and Authentication Methods](#)” on page 117.

See Also For information about configuring certificate-based authentication between clients and Directory Proxy Server, see “[To Configure Certificate-based Authentication](#)” on page 457.

Backing Up and Restoring a Certificate Database for Directory Proxy Server

Server certificates are backed up when you use `dpadm` to back up Directory Proxy Server. The backed up certificates are stored in the *archive-path/alias* directory.

For information about how to back up and restore Directory Proxy Server, see “[Backing Up and Restoring a Directory Proxy Server Instance](#)” on page 344.

Prompting for a Password to Access the Certificate Database

By default, the password for the certificate database is managed internally. Therefore, you do not need to type a certificate password or specify the password file. When the certificate database is managed internally through a stored password, the password is stored in a secure environment.

For more security and more control over certificates, configure Directory Proxy Server to prompt for a password on the command line. You are then prompted to enter the password for all `dpadm` subcommands except `autostart`, `backup`, `disable-service`, `enable-service`, `info`, `restore`, and `stop`.

For information about configuring Directory Proxy Server to prompt or not to prompt for passwords, see the following procedures.

▼ To Prompt for a Password to Access the Certificate Database

You can use DSCC to perform this task. For information, see [“Directory Service Control Center Interface” on page 43](#) and the DSCC online help.

1 Stop the server.

```
$ dpadm stop instance-path  
Directory Proxy Server instance 'instance-path' stopped
```

2 Set the password prompt flag to on, then type and confirm the certificate database password.

```
$ dpadm set-flags instance-path cert-pwd-prompt=on  
Choose the certificate database password:  
Confirm the certificate database password:
```

3 Start the server, then type the certificate database password.

```
$ dpadm start instance-path  
Enter the certificate database password:
```

▼ To Disable the Password Prompt to Access the Certificate Database

You can use DSCC to perform this task. For information, see [“Directory Service Control Center Interface” on page 43](#) and the DSCC online help.

1 Stop the server.

```
$ dpadm stop instance-path  
Directory Proxy Server instance 'instance-path' stopped
```

2 Set the password prompt flag to off, then type the existing password.

```
$ dpadm set-flags instance-path cert-pwd-prompt=off  
Enter the old password:
```

3 Start the server.

```
$ dpadm start instance-path
```


LDAP Data Sources and Data Source Pools

This chapter describes how to use the `dpconf` command to create and configure LDAP data sources and data source pools. For reference information about these topics, see “LDAP Data Sources” in *Sun Java System Directory Server Enterprise Edition 6.2 Reference*.

This chapter covers the following topics:

- “Creating and Configuring LDAP Data Sources” on page 359
- “Creating and Configuring LDAP Data Source Pools” on page 362
- “Attaching LDAP Data Sources to a Data Source Pool” on page 363

Creating and Configuring LDAP Data Sources

For information about how to create and configure LDAP data sources, see the following procedures.

▼ To Create an LDAP Data Source

You can use DSCC to perform this task. For information, see “[Directory Service Control Center Interface](#)” on page 43 and the DSCC online help.

1 Create the data source.

```
$ dpconf create-ldap-data-source -h host -p port source-name host:port
```

In this command, *source-name* is a name that you assign to the new data source. *host* and *port* refer to the host and port on which the LDAP server is running. Note that the data source does not use SSL by default.

If the host is specified by an IP V6 address, you need to use the IP V6 reference when you create the data source. For example, if Directory Proxy Server will bind to a host with the IP V6 address `fe80::209:3dff:fe00:8c93` on port 2389, use the following command to create the data source:

```
$ dpconf create-ldap-data-source -h host1 -p 1389 ipv6-host \
  [fe80::209:3dff:fe00:8c93]:2389
```

If you use the console to create the data source, you must specify the actual IP V6 address (without the square brackets).

For information about how to modify the properties of an LDAP data source, see [“To Configure an LDAP Data Source” on page 360](#).

2 (Optional) View the list of data sources.

```
$ dpconf list-ldap-data-sources -h host -p port
```

▼ To Configure an LDAP Data Source

This procedure configures authorization between Directory Proxy Server and an LDAP data source. The procedure also configures how Directory Proxy Server monitors an LDAP data source.

You can use DSCC to perform this task. For information, see [“Directory Service Control Center Interface” on page 43](#) and the DSCC online help.

1 View the properties of the data source by using this command syntax:

```
dpconf get-ldap-data-source-prop -h host -p port [-M unit] [-Z unit] source-name [property...]
```

In this command, `-M` and `-Z` refer to the units in which you want data to be displayed. The `M` option specifies the unit of time. The value for `-M` can be `M`, `w`, `d`, `h`, `m`, `s`, or `ms`, to represent months, weeks, days, hours, minutes, seconds, or miliseconds. The `-Z` option specifies the data size unit. The value for `-Z` can be `T`, `G`, `M`, `k`, or `b`, to represent Terabytes, Gigabytes, Megabytes, kilobytes, or bytes.

If you do not specify a property, all properties are displayed. The default properties of an LDAP data source are as follows:

```
bind-dn                : -
bind-pwd               : -
client-cred-mode       : use-client-identity
connect-timeout        : 10s
description            : -
is-enabled              : false
is-read-only           : true
ldap-address           : host
```



```

ldap-port           : port
ldaps-port         : ldaps
monitoring-bind-timeout : 5s
monitoring-entry-dn   : ""
monitoring-entry-timeout : 5s
monitoring-inactivity-timeout : 2m
monitoring-interval   : 30s
monitoring-mode       : proactive
monitoring-search-filter : (|(objectClass=*)(objectClass=ldapSubEntry))
num-bind-incr        : 10
num-bind-init        : 10
num-bind-limit       : 1024
num-read-incr        : 10
num-read-init        : 10
num-read-limit       : 1024
num-write-incr       : 10
num-write-init       : 10
num-write-limit      : 1024
proxied-auth-check-timeout : 1.8s
proxied-auth-use-v1   : false
ssl-policy           : never
use-tcp-no-delay     : true

```

2 Enable the data source.

```
$ dpconf set-ldap-data-source-prop -h host -p port source-name is-enabled:true
```

3 Configure all the properties that are listed in [Step 1](#), if you want to change the default settings.

```
$ dpconf set-ldap-data-source-prop -h host -p port source-name property:value
```

For example, if you want to modify entries on a data source, configure the data source to allow write operations.

```
$ dpconf set-ldap-data-source-prop -h host -p port source-name is-read-only:false
```

To find information about a property used in a subcommand, run this command:

```
$ dpconf help-properties ldap-data-source property
```

To list the key properties for data sources, use the verbose option `-v` with the `list` subcommand.

```

$ dpconf list-ldap-data-sources -v
Name          is-enabled  ldap-address  ldap-port  ldaps-port  description
-----
datasource0  true       myHost       myPort     ldaps       -
datasource1  true       myHost       myPort     ldaps       -

```

- 4 **If necessary, restart the instance of Directory Proxy Server for the changes to take effect.**
For information about restarting Directory Proxy Server, see [“To Restart Directory Proxy Server” on page 334](#). For a list of configuration changes that require a server restart, see [“Configuration Changes Requiring Server Restart” on page 346](#).

Creating and Configuring LDAP Data Source Pools

For information about how to create and configure data source pools, see the following procedures:

▼ To Create an LDAP Data Source Pool

You can use DSCC to perform this task. For information, see [“Directory Service Control Center Interface” on page 43](#) and the DSCC online help.

- 1 **Create one or more data source pools.**

```
$ dpconf create-ldap-data-source-pool -h host -p port pool-name
```

Additional data source pools can be specified after the first *pool-name*. For information about how to modify the properties of a data source pool, see [“To Configure an LDAP Data Source Pool” on page 362](#).

- 2 **(Optional) View the list of data source pools.**

```
$ dpconf list-ldap-data-source-pools -h host -p port
```

▼ To Configure an LDAP Data Source Pool

You can use DSCC to perform this task. For information, see [“Directory Service Control Center Interface” on page 43](#) and the DSCC online help.

- 1 **View the properties of the data source pool by using this command syntax:**

```
dpconf get-ldap-data-source-pool-prop -h host -p port [-M unit] [-Z unit] \  
pool-name [property...]
```

In this command, *-M* and *-Z* refer to the units in which you want data to be displayed. The *M* option specifies the unit of time. The value for *-M* can be *M*, *w*, *d*, *h*, *m*, *s*, or *ms*, to represent months, weeks, days, hours, minutes, seconds, or miliseconds. The *-Z* option specifies the data size unit. The value for *-Z* can be *T*, *G*, *M*, *k*, or *b*, to represent Terabytes, Gigabytes, Megabytes, kilobytes, or bytes.

If you do not specify a property, all properties are displayed. The default properties of an LDAP data source pool are as follows:

```
client-affinity-policy      : write-affinity-after-write
client-affinity-timeout    : 20s
description                 : -
enable-client-affinity     : false
load-balancing-algorithm   : proportional
```

2 Configure the properties that are listed in [Step 1](#).

```
$ dpconf set-ldap-data-source-pool-prop -h host -p port pool-name \
  property: value
```

For information about how to configure the properties of a data source pool for load balancing and client affinity, see [Chapter 21, “Directory Proxy Server Load Balancing and Client Affinity.”](#)

Attaching LDAP Data Sources to a Data Source Pool

A data source that is attached to a data source pool is called an *attached data source*. The properties of an attached data source determine the load balancing configuration of the data source pool. When you configure the weights of an attached data source, consider the weights of all of the attached data sources in a data source pool. Ensure that the weights work together as required. For information about how to configure weights for load balancing, see [“To Configure Weights for Load Balancing” on page 366](#).

▼ To Attach an LDAP Data Source to a Data Source Pool

You can use DSCC to perform this task. For information, see [“Directory Service Control Center Interface” on page 43](#) and the DSCC online help.

1 Attach one or more data sources to a data source pool.

```
$ dpconf attach-ldap-data-source -h host -p port pool-name \
  source-name [source-name ...]
```

2 (Optional) View the list of attached data sources for a given data source pool.

```
$ dpconf list-attached-ldap-data-sources -h host -p port -E pool-name
```

In this command, `-E` is optional, and modifies the display output to show one property value per line.

3 (Optional) View the key properties of the attached data sources for a given data source pool.

```
$ dpconf list-attached-ldap-data-sources -h host -p port -v pool-name
```

In this command, `-v` specifies verbose output. For example, view the properties of an example data source pool.

```
$ dpconf list-attached-ldap-data-sources -h host1 -p 1389 -v My-pool
Name          add-weight  bind-weight  compare-weight
-----
datasource0   disabled   disabled     disabled
datasource1   disabled   disabled     disabled

delete-weight  modify-dn-weight  modify-weight  search-weight
-----
disabled       disabled          disabled       disabled
disabled       disabled          disabled       disabled
```

4 (Optional) View the properties of an attached data source by using the following command syntax:

```
$ dpconf get-attached-ldap-data-source-prop -h host -p port [-M unit] [-Z unit] \
  pool-name source-name [property...]
```

In this command, `-M` and `-Z` refer to the units in which you want data to be displayed. The `M` option specifies the unit of time. The value for `-M` can be `M`, `w`, `d`, `h`, `m`, `s`, or `ms`, to represent months, weeks, days, hours, minutes, seconds, or milliseconds. The `-Z` option specifies the data size unit. The value for `-Z` can be `T`, `G`, `M`, `k`, or `b`, to represent Terabytes, Gigabytes, Megabytes, kilobytes, or bytes.

If you do not specify a property, all properties are displayed.

The properties of an attached data source define the weight for each type of operation in load balancing. The default weights of an attached data source are as follows:

```
add-weight      : disabled
bind-weight     : disabled
compare-weight  : disabled
delete-weight   : disabled
modify-dn-weight : disabled
modify-weight   : disabled
search-weight   : disabled
```

For information about how to configure weights of an attached data source for load balancing, see [“To Configure Weights for Load Balancing” on page 366](#).

Directory Proxy Server Load Balancing and Client Affinity

For a description of load balancing and client affinity, see Chapter 16, “Directory Proxy Server Load Balancing and Client Affinity,” in *Sun Java System Directory Server Enterprise Edition 6.2 Reference*. This chapter covers the following topics:

- “Configuring Load Balancing” on page 365
- “Configuring Client Affinity” on page 372

Configuring Load Balancing

For information about load balancing, see “Load Balancing” in *Sun Java System Directory Server Enterprise Edition 6.2 Reference*. This section explains how to configure load balancing and provides sample configurations.

▼ To Select a Load Balancing Algorithm

You can use DSCC to perform this task. For information, see “[Directory Service Control Center Interface](#)” on page 43 and the DSCC online help.

- 1 **Obtain the current load balancing algorithm by viewing the properties of the LDAP data source pool.**

```
$ dpconf get-ldap-data-source-pool-prop -h host -p port pool-name
```

The default properties of an LDAP data source pool are as follows:

```
client-affinity-policy      : write-affinity-after-write
client-affinity-timeout    : 20s
description                 : -
enable-client-affinity     : false
load-balancing-algorithm   : proportional
```

By default, the load balancing algorithm is proportional.

2 Configure the LDAP data source pool to use an algorithm.

```
$ dpconf set-ldap-data-source-pool-prop -h host -p port pool-name \
  load-balancing-algorithm:selected-algorithm
```

where *selected-algorithm* is one of the following:

- failover
- operational-affinity
- proportional
- saturation

For more information about the algorithms, see “Introduction to Load Balancing” in *Sun Java System Directory Server Enterprise Edition 6.2 Reference*.

3 Restart the instance of Directory Proxy Server.

```
$ dpadm restart instance-path
```

▼ To Configure Weights for Load Balancing

You need to configure the weights of an attached data source in relation to the weights of any other attached data sources in the data source pool. Consider the weights of all of your attached data sources. If a data source has a weight of `disabled` for a type of operation, requests of that type are never sent to that data source. If a data source has a weight of `0` (zero), no requests are distributed to that data source unless all other data sources are unavailable. Therefore, data sources configured with a weight of `0` are used only when all other data sources are down.

You can use DSCC to perform this task. For information, see “[Directory Service Control Center Interface](#)” on page 43 and the DSCC online help.

1 View the list of data sources that are attached to the data source pool.

```
$ dpconf list-attached-ldap-data-sources -h host -p port pool-name
```

2 View the properties of one of the attached data sources.

```
$ dpconf get-attached-ldap-data-source-prop pool-name \
  attached-data-source-name
```

The properties of an attached data source define the weight for each type of operation. The default weights of an attached data source are as follows:

```
add-weight          : disabled
bind-weight         : disabled
compare-weight      : disabled
delete-weight       : disabled
modify-dn-weight    : disabled
modify-weight       : disabled
search-weight       : disabled
```

3 Configure the weights of one of the attached data sources.

```
$ dpconf set-attached-ldap-data-source-prop -h host -p port pool-name \
  attached-data-source-name add-weight:value \
  bind-weight:value compare-weight:value delete-weight:value \
  modify-dn-weight:value modify-weight:value search-weight:value
```

4 Repeat Step 2 and Step 3 for the other attached data sources.**5 Compare the key parameters of the attached data sources.**

```
$ dpconf list-attached-ldap-data-sources -h host -p port -v pool-name
```

For example, a data source pool can contain data sources with the following weights:

```
$ dpconf list-attached-ldap-data-sources -h host1 -p 1389 -v myPool
Name add-weight bind-weight compare-weight delete-weight modify-dn-weight modify-weight search-weight
-----
DS-1 disabled 3 disabled disabled disabled disabled disabled
DS-2 2 2 2 2 2 2 2
DS-3 1 1 1 1 1 1 1
```

Example Configurations for Load Balancing

This section contains sample procedures for configuring each of the load balancing algorithms.

▼ To Configure the Proportional Algorithm for Load Balancing

For a description of the proportional algorithm, see “Proportional Algorithm for Load Balancing” in *Sun Java System Directory Server Enterprise Edition 6.2 Reference*.

In this example, the data source *ds-1* is configured with twice the weight of the other two data sources.

You can use DSCC to perform this task. For information, see “[Directory Service Control Center Interface](#)” on page 43 and the DSCC online help.

Before You Begin Ensure that you have a data source pool with at least three attached data sources. For information about how to create data sources and data source pools, see [Chapter 20, “LDAP Data Sources and Data Source Pools.”](#)

1 Configure the data source pool to use the proportional algorithm for load balancing.

```
$ dpconf set-ldap-data-source-pool-prop -h host -p port pool-name \
  load-balancing-algorithm:proportional
```

2 Configure the properties of the first data source.

```
$ dpconf set-attached-ldap-data-source-prop -h host -p port pool-name ds-1 \
  add-weight:2 bind-weight:2 compare-weight:2 delete-weight:2 modify-dn-weight:2 \
  modify-weight:2 search-weight:2
```

3 Configure the properties of the second data source.

```
$ dpconf set-attached-ldap-data-source-prop -h host -p port pool-name ds-2 \
  add-weight:1 bind-weight:1 compare-weight:1 delete-weight:1 modify-dn-weight:1 \
  modify-weight:1 search-weight:1
```

4 Configure the properties of the third data source.

```
$ dpconf set-attached-ldap-data-source-prop -h host -p port pool-name ds-3 \
  add-weight:1 bind-weight:1 compare-weight:1 delete-weight:1 modify-dn-weight:1 \
  modify-weight:1 search-weight:1
```

5 Compare the key parameters of the attached data sources.

```
$ dpconf list-attached-ldap-data-sources -h host -p port -v pool-name
```

Name	add-weight	bind-weight	compare-weight	delete-weight	modify-dn-weight	modify-weight	search-weight
ds-1	2	2	2	2	2	2	2
ds-2	1	1	1	1	1	1	1
ds-3	1	1	1	1	1	1	1

6 Restart the instance of Directory Proxy Server.

```
$ dpadm restart instance-path
```

▼ To Configure the Saturation Algorithm for Load Balancing

For a description of the saturation algorithm, see “Saturation Algorithm for Load Balancing” in *Sun Java System Directory Server Enterprise Edition 6.2 Reference*.

In this example, the data source *ds-1* performs the majority of bind operations but does not perform any other types of operations. The three data sources are configured with the following weights:

- *ds-1* is configured with weight 3 for bind operations and is disabled for all other types of operations.
- *ds-2* is configured with weight 2 for all operations.
- *ds-3* is configured with weight 1 for all operations.

You can use DSCC to perform this task. For information, see “[Directory Service Control Center Interface](#)” on page 43 and the DSCC online help.

Before You Begin Ensure that you have a data source pool with at least three attached data sources. For information about how to create data sources and data source pools, see [Chapter 20, “LDAP Data Sources and Data Source Pools.”](#)

1 Configure the data source pool to use the saturation algorithm for load balancing.

```
$ dpconf set-ldap-data-source-pool-prop -h host -p port pool-name \
  load-balancing-algorithm:saturation
```

2 Configure the properties of the first data source.

```
$ dpconf set-attached-ldap-data-source-prop -h host -p port pool-name ds-1 \
  add-weight:disabled bind-weight:3 compare-weight:disabled delete-weight:disabled \
  modify-dn-weight:disabled modify-weight:disabled search-weight:disabled
```

3 Configure the properties of the second data source.

```
$ dpconf set-attached-ldap-data-source-prop -h host -p port pool-name ds-2 \
  add-weight:2 bind-weight:2 compare-weight:2 delete-weight:2 modify-dn-weight:2 \
  modify-weight:2 search-weight:2
```

4 Configure the properties of the third data source.

```
$ dpconf set-attached-ldap-data-source-prop -h host -p port pool-name ds-3 \
  add-weight:1 bind-weight:1 compare-weight:1 delete-weight:1 modify-dn-weight:1 \
  modify-weight:1 search-weight:1
```

5 Compare the key parameters of the attached data sources.

```
$ dpconf list-attached-ldap-data-sources -h host -p port -v pool-name
Name add-weight bind-weight compare-weight delete-weight modify-dn-weight modify-weight search-weight
-----
ds-1 disabled 3 disabled disabled disabled disabled disabled
ds-2 2 2 2 2 2 2 2
ds-3 1 1 1 1 1 1 1
```

6 Restart the instance of Directory Proxy Server.

```
$ dpadm restart instance-path
```

▼ To Configure the Operational Affinity Algorithm for Global Account Lockout

For a description of this algorithm, “Operational Affinity Algorithm for Global Account Lockout” in *Sun Java System Directory Server Enterprise Edition 6.2 Reference*.

This example has three data sources. The data source *ds-1* is configured to receive all bind requests.

You can use DSCC to perform this task. For information, see [“Directory Service Control Center Interface” on page 43](#) and the DSCC online help.

Before You Begin Ensure that you have a data source pool with at least three attached data sources. For information about how to create data sources and data source pools, see [Chapter 20, “LDAP Data Sources and Data Source Pools.”](#)

1 Configure the data source pool to use the operational affinity algorithm.

```
$ dpconf set-ldap-data-source-pool-prop -h host -p port pool-name \
  load-balancing-algorithm:operational-affinity
```

2 Configure the properties of the first data source.

```
$ dpconf set-attached-ldap-data-source-prop -h host -p port pool-name ds-1 \
  add-weight:1 bind-weight:100 compare-weight:1 delete-weight:1 modify-dn-weight:1 \
  modify-weight:1 search-weight:1
```

3 Configure the properties of the second data source.

```
$ dpconf set-attached-ldap-data-source-prop -h host -p port pool-name ds-2 \
  add-weight:1 bind-weight:1 compare-weight:1 delete-weight:1 modify-dn-weight:1 \
  modify-weight:1 search-weight:1
```

4 Configure the properties of the third data source.

```
$ dpconf set-attached-ldap-data-source-prop -h host -p port pool-name ds-3 \
  add-weight:1 bind-weight:1 compare-weight:1 delete-weight:1 modify-dn-weight:1 \
  modify-weight:1 search-weight:1
```

5 Compare the key parameters of the attached data sources.

```
$ dpconf list-attached-ldap-data-sources -h host -p port -v pool-name
```

Name	add-weight	bind-weight	compare-weight	delete-weight	modify-dn-weight	modify-weight	search-weight
ds-1	1	1	1	1	1	1	1
ds-2	100	1	1	1	1	1	1
ds-3	1	1	1	1	1	1	1

6 Restart the instance of Directory Proxy Server.

```
$ dpadm restart instance-path
```

▼ To Configure Operational Affinity Algorithm for Cache Optimization

For a description of this algorithm, see “Operational Affinity Algorithm for Cache Optimization” in *Sun Java System Directory Server Enterprise Edition 6.2 Reference*.

This example has three data sources. All search and compare operations are treated by the data source *ds-1*. When *ds-1* responds to a request, the targeted entry is stored in the cache. If *ds-1* responds repeatedly to the same request, the data source can use cached data.

You can use DSCC to perform this task. For information, see “[Directory Service Control Center Interface](#)” on page 43 and the DSCC online help.

Before You Begin Ensure that you have a data source pool with at least three attached data sources. For information about how to create data sources and data source pools, see [Chapter 20, “LDAP Data Sources and Data Source Pools.”](#)

1 Configure the data source pool to use the operational affinity algorithm.

```
$ dpconf set-ldap-data-source-pool-prop -h host -p port pool-name \
  load-balancing-algorithm:operational-affinity
```

2 Configure the properties of the first data source.

```
$ dpconf set-attached-ldap-data-source-prop -h host -p port pool-name ds-1 \
  add-weight:1 bind-weight:1 compare-weight:100 delete-weight:1 modify-dn-weight:1 \
  modify-weight:1 search-weight:100
```

3 Configure the properties of the second data source.

```
$ dpconf set-attached-ldap-data-source-prop -h host -p port pool-name ds-2 \
  add-weight:1 bind-weight:1 compare-weight:1 delete-weight:1 modify-dn-weight:1 \
  modify-weight:1 search-weight:1
```

4 Configure the properties of the third data source.

```
$ dpconf set-attached-ldap-data-source-prop -h host -p port pool-name ds-3 \
  add-weight:1 bind-weight:1 compare-weight:1 delete-weight:1 modify-dn-weight:1 \
  modify-weight:1 search-weight:1
```

5 Compare the key parameters of the attached data sources.

```
$ dpconf list-attached-ldap-data-sources -h host -p port -v pool-name
```

Name	add-weight	bind-weight	compare-weight	delete-weight	modify-dn-weight	modify-weight	search-weight
ds-1	1	1	100	1	1	1	100
ds-2	1	1	1	1	1	1	1
ds-3	1	1	1	1	1	1	1

6 Restart the instance of Directory Proxy Server.

```
$ dpadm restart instance-path
```

▼ To Configure the Failover Algorithm for Load Balancing

For a description of the failover algorithm, see “Failover Algorithm for Load Balancing” in *Sun Java System Directory Server Enterprise Edition 6.2 Reference*.

This example has three data sources. The data source *ds-1* receives all requests. If *ds-1* fails, *ds-2* receives all requests until *ds-1* recovers. If *ds-2* fails before *ds-1* recovers, *ds-3* receives all requests.

You can use DSCC to perform this task. For information, see “[Directory Service Control Center Interface](#)” on page 43 and the DSCC online help.

Before You Begin Ensure that you have a data source pool with at least three attached data sources. For information about how to create data sources and data source pools, see [Chapter 20, “LDAP Data Sources and Data Source Pools.”](#)

1 Configure the data source pool to use the failover algorithm for load balancing.

```
$ dpconf set-ldap-data-source-pool-prop -h host -p port pool-name \
  load-balancing-algorithm:failover
```

2 Configure the properties of the first data source.

```
$ dpconf set-attached-ldap-data-source-prop -h host -p port pool-name ds-1 \
  add-weight:3 bind-weight:3 compare-weight:3 delete-weight:3 modify-dn-weight:3 \
  modify-weight:3 search-weight:3
```

3 Configure the properties of the second data source.

```
$ dpconf set-attached-ldap-data-source-prop -h host -p port pool-name ds-2 \
  add-weight:2 bind-weight:2 compare-weight:2 delete-weight:2 modify-dn-weight:2 \
  modify-weight:2 search-weight:2
```

4 Configure the properties of the third data source.

```
$ dpconf set-attached-ldap-data-source-prop -h host -p port pool-name ds-3 \
  add-weight:1 bind-weight:1 compare-weight:1 delete-weight:1 modify-dn-weight:1 \
  modify-weight:1 search-weight:1
```

5 Compare the key parameters of the attached data sources.

```
$ dpconf list-attached-ldap-data-sources -h host -p port -v pool-name
```

Name	add-weight	bind-weight	compare-weight	delete-weight	modify-dn-weight	modify-weight	search-weight
ds-1	3	3	3	3	3	3	3
ds-2	2	2	2	2	2	2	2
ds-3	1	1	1	1	1	1	1

6 Restart the instance of Directory Proxy Server.

```
$ dpadm restart instance-path
```

Configuring Client Affinity

Client affinity reduces the risk of propagation delay in load-balanced deployments. For information about client affinity, see “Client Affinity” in *Sun Java System Directory Server Enterprise Edition 6.2 Reference*. This section explains how to configure affinity between a client connection and a data source, and provides sample configurations.

▼ To Configure Client Affinity

This procedure describes how to configure affinity between a client connection and a data source.

You can use DSCC to perform this task. For information, see [“Directory Service Control Center Interface” on page 43](#) and the DSCC online help.

1 View the current load balancing algorithm by viewing the properties of the data source pool.

```
$ dpconf get-ldap-data-source-pool-prop -h host -p port pool-name
```

The default properties of a data source pool are as follows:

```
client-affinity-policy      : write-affinity-after-write
client-affinity-timeout     : 20s
description                 : -
enable-client-affinity      : false
load-balancing-algorithm    : proportional
```

These parameters configure client affinity: `client-affinity-policy`, `client-affinity-timeout`, and `enable-client-affinity`. For a description of the properties and a list of their valid values, type:

```
dpconf help-properties ldap-data-source-pool client-affinity-policy \
  client-affinity-timeout enable-client-affinity
```

For more information about the properties, see these man pages: `client-affinity-policy(5dpconf)`, `client-affinity-timeout(5dpconf)`, and `enable-client-affinity(5dpconf)`.

2 Enable client affinity.

```
$ dpconf set-ldap-data-source-pool-prop -h host -p port pool-name \
  enable-client-affinity:true
```

3 Select a policy for client affinity.

```
$ dpconf set-ldap-data-source-pool-prop -h host -p port pool-name \
  client-affinity-policy:selected-policy
```

where *selected-policy* is one of the following:

`write-affinity-after-write`

Affinity for write requests after the first write request

`read-write-affinity-after-write`

Affinity for all requests after the first write request

`read-write-affinity-after-any`

Affinity for all requests after the first read request or write request

read-affinity-after-write

Affinity for the first read request after a write request

4 Configure the duration of the client affinity.

```
$ dpconf set-ldap-data-source-pool-prop -h host -p port pool-name \  
  client-affinity-timeout:time-out[unit]
```

The default *unit* for timeout is milliseconds.

Example Configurations for Client Affinity

This section contains example configurations related to client affinity, and includes examples for replication delay, verifying write operations, and connection-based routing.

▼ To Configure Client Affinity for Replication Delay When a Data Source Pool Contains Masters and Consumers

This procedure configures client affinity for all read and write operations that occur up to three seconds after the first write operation.

You can use DSCC to perform this task. For information, see [“Directory Service Control Center Interface” on page 43](#) and the DSCC online help.

● Configure the affinity parameters for the data source pool.

```
$ dpconf set-ldap-data-source-pool-prop -h host -p port pool-name \  
  client-affinity-policy:read-write-affinity-after-write client-affinity-timeout:3000 \  
  enable-client-affinity:true
```

▼ To Configure Client Affinity to Verify Each Write Operation With a Read Operation

This procedure configures client affinity for the first read operation after each write operation. The example could be for an application where a specified bind DN validates each write operation by performing a read operation.

You can use DSCC to perform this task. For information, see [“Directory Service Control Center Interface” on page 43](#) and the DSCC online help.

● Configure the affinity parameters for the data source pool.

```
$ dpconf set-ldap-data-source-pool-prop -h host -p port pool-name \  
  client-affinity-policy:read-affinity-after-write enable-client-affinity:true
```

▼ To Configure Client Affinity for Connection-Based Routing

In versions prior to Directory Proxy Server 6.0, one connection was opened between a client and an LDAP server. The same connection was used for all requests from the client until the connection was closed. This type of routing is called *connection-based routing*. This procedure describes how to configure client affinity for connection-based routing.

You can use DSCC to perform this task. For information, see “[Directory Service Control Center Interface](#)” on [page 43](#) and the DSCC online help.

Before You Begin Ensure that all data sources are attached to the data source pool and that `clientCredentialsForwarding` is set to `useBind`.

- **Configure the affinity parameters for the data source pool.**

```
$ dpconf set-ldap-data-source-pool-prop -h host -p port pool-name \  
  client-affinity-policy:read-write-affinity-after-any enable-client-affinity:true
```


Directory Proxy Server Distribution

For an overview of Directory Proxy Server distribution and a description of example use cases, see Chapter 17, “Directory Proxy Server Distribution,” in *Sun Java System Directory Server Enterprise Edition 6.2 Reference*.

This chapter covers the following topics:

- “Creating and Configuring LDAP Data Views” on page 377
- “Renaming Attributes and DNs” on page 380
- “Configuring excluded-subtrees and alternate-search-base-dn” on page 382
- “Creating and Configuring Data Views for Example Use Cases” on page 383

Creating and Configuring LDAP Data Views

For information about how to create and configure LDAP data views, see the following procedures:

▼ To Create an LDAP Data View

You can use DSCC to perform this task. For information, see “[Directory Service Control Center Interface](#)” on page 43 and the DSCC online help.

1 Create an LDAP data view.

```
$ dpconf create-ldap-data-view -h host -p port view-name pool-name suffix-DN
```

For information about how to modify the properties of an LDAP data view, see “[To Configure an LDAP Data View](#)” on page 378.

2 View the list of LDAP data views.

```
$ dpconf list-ldap-data-views -h host -p port
```

▼ To Configure an LDAP Data View

You can use DSCC to perform this task. For information, see [“Directory Service Control Center Interface” on page 43](#) and the DSCC online help.

1 View the properties of an LDAP data view.

```
$ dpconf get-ldap-data-view-prop -h host -p port view-name
```

If you create a data view without configuring any of the properties, your data view has the following configuration:

```
alternate-search-base-dn      : ""
attr-name-mappings           : none
base-dn                      : suffix-DN
contains-shared-entries      : false
custom-distribution-algorithm-class : none
description                  : -
distribution-algorithm       : none
dn-join-rule                 : none
dn-mapping-attrs            : none
dn-mapping-source-base-dn   : none
excluded-subtrees           : -
filter-join-rule            : none
is-enabled                   : true
is-read-only                 : false
is-routable                  : true
ldap-data-source-pool       : pool-name
lexicographic-attrs         : all
lexicographic-lower-bound   : none
lexicographic-upper-bound   : none
non-viewable-attr           : none
non-writable-attr           : none
numeric-attrs               : all
numeric-default-data-view   : false
numeric-lower-bound        : none
numeric-upper-bound        : none
pattern-matching-base-object-search-filter : all
pattern-matching-dn-regular-expression : all
pattern-matching-one-level-search-filter : all
pattern-matching-subtree-search-filter : all
process-bind                : -
replication-role            : master
viewable-attr               : all except non-viewable-attr
writable-attr               : all except non-writable-attr
```

Note – All users except the Proxy Manager see the `cn=config` and `cn=monitor` suffixes from the back-end server. By default, data from the back-end servers is not available to the Proxy Manager. The `cn=config` and `cn=monitor` subtrees that are available to the Proxy Manager are those of the proxy itself.

When you create a Directory Proxy Server instance, a connection handler for the Proxy Manager is created with an empty data view policy. If the Proxy Manager requires access to back-end data, you must add a data view to the data view policy of the Proxy Manager connection handler. On such a data view, the `cn=config` and `cn=monitor` subtrees are excluded by default.

2 Change one or more of the properties that are listed in [Step 1](#).

```
$ dpconf set-ldap-data-view-prop -h host -p port view-name \
  property:value [property:value ... ]
```

For example, to access the `dc=example,dc=com` subtree on a data source, specify `base-dn` in the data view.

```
$ dpconf set-ldap-data-view-prop -h host1 -p 1389 myDataView base-dn:dc=example,dc=com
```

To add a value to a multi-valued property, use this command:

```
$ dpconf set-ldap-data-view-prop -h host -p port view-name property+:value
```

To remove a value from a multi-valued property, use this command:

```
$ dpconf set-ldap-data-view-prop -h host -p port view-name property-:value
```

3 If necessary, restart the instance of Directory Proxy Server for the changes to take effect.

For information about restarting Directory Proxy Server, see [“To Restart Directory Proxy Server” on page 334](#).

▼ To Configure Custom Distribution Algorithm

Custom distribution algorithm can be configured for all types of data views, that is, `ldap-data-view`, `jdbm-data-view`, `ldif-data-view`, and `join-data-view`. In the following procedure the algorithm is set only for `ldap-data-view`.

1 Set the `extension-jar-file-url` property to contain the path of the Java Archive (JAR) file containing your distribution algorithm class.

```
$ dpconf set-server-prop -h host -p port extension-jar-file-url:jar file path
```

The *jar file path* can be replaced with a valid JAR file path such as `file:/expt/dps/custom_plugin/myjar.jar`.

- 2 **Before you configure** `custom-distribution-algorithm`, **set** `distribution-algorithm` to `none`.

```
$ dpconf set-ldap-data-view-prop view name distribution-algorithm:none
```

- 3 **Set the** `custom-distribution-algorithm` **property to your custom distribution algorithm class**.

```
$ dpconf set-ldap-data-view-prop view name custom-distribution-algorithm:PackageName.AlgoClassName
```

Renaming Attributes and DNs

Each entry in a directory is identified by a DN and a set of attributes and their values. Often, the DNs and the attributes defined on the client side do not map to the DNs and the attributes defined on the server side. Data views can be defined to rename DNs and attributes. When a client makes a request, the DNs and attributes are renamed to match the server side. When the result is returned to a client, the DNs and attributes are changed back to match the client side.

For information about attribute renaming and DN renaming, see “Attribute Renaming and DN Renaming” in *Sun Java System Directory Server Enterprise Edition 6.2 Reference*. For information about how to rename attributes and DNs, see the following procedures:

▼ To Configure Attribute Renaming

You can use DSCC to perform this task. For information, see “[Directory Service Control Center Interface](#)” on [page 43](#) and the DSCC online help.

- **Set one or more** `attr-name-mappings` **properties on the data view for which you want to configure attribute mapping**.

```
$ dpconf set-ldap-data-view-prop -h host -p port view-name \
  attr-name-mappings:client-side-attribute-name#server-side-attribute-name
  [attr-name-mappings:client-side-attribute-name#server-side-attribute-name ...]
```

For example, rename `surname` on the client side to `sn` on the server side.

```
$ dpconf set-ldap-data-view-prop -h host1 -p 1389 myDataView \
  attr-name-mappings:surname#sn
```

To add an attribute mapping to an existing list of mappings, use this command:

```
$ dpconf set-ldap-data-view-prop -h host -p port view-name \
  attr-name-mappings+:client-side-attribute-name#server-side-attribute-name
```

To remove an attribute mapping from an existing list of mappings, use this command:

```
$ dpconf set-ldap-data-view-prop -h host -p port view-name \
  attr-name-mappings-:client-side-attribute-name#server-side-attribute-name
```

▼ To Configure DN Renaming

You can use DSCC to perform this task. For information, see “[Directory Service Control Center Interface](#)” on [page 43](#) and the DSCC online help.

1 View the `base-dn` property and the DN mapping properties of the data view for which you want to rename DNS.

```
$ dpconf get-ldap-data-view-prop -h host -p port view-name base-dn \
  dn-mapping-source-base-dn dn-mapping-attrs
```

The properties have the following meanings:

- `base-dn` is the DN of the subtree on the client side, which is equivalent to the base DN of the data view.
- `dn-mapping-source-base-dn` is the DN of the subtree on the server side.
- `dn-mapping-attrs` defines a list of attributes that contain DNS of entries.

For example, the data view for the `dc=example,dc=com` database on the client side has the following values when DN renaming is not defined:

```
$ dpconf get-ldap-data-view-prop myDataView base-dn \
  dn-mapping-source-base-dn dn-mapping-attrs
base-dn                : dc=example,dc=com
dn-mapping-attrs       : none
dn-mapping-source-base-dn : none
```

2 Map a DN on the client side to a DN on the server side.

```
$ dpconf set-ldap-data-view-prop -h host -p port view-name \
  dn-mapping-source-base-dn:server-side-dn
```

For example, map the `dc=example,dc=com` database on the client side to `dc=example,dc=org` on the server side.

```
$ dpconf set-ldap-data-view-prop -h host1 -p 1389 myDataView \
  dn-mapping-source-base-dn:dc=example,dc=org
```

3 Rename attributes in the portion of the DIT that is affected by [Step 2](#), if those attributes contain DNS.

```
$ dpconf set-ldap-data-view-prop -h host -p port view-name \
  dn-mapping-attrs:attribute-name [dn-mapping-attrs:attribute-name ...]
```

For example, if the group attribute contains DNS in the namespace affected by the rename operation in [Step 2](#), rename the attribute as follows:

```
$ dpconf set-ldap-data-view-prop -h host1 -p 1389 myDataView dn-mapping-attrs:group
```

To add a DN mapping to an existing list of mappings, use this command:

```
$ dpconf set-ldap-data-view-prop -h host -p port view-name dn-mapping-attrs+:attribute-name
```

To remove a DN mapping from an existing list of mappings, use this command:

```
$ dpconf set-ldap-data-view-prop -h host -p port view-name dn-mapping-attrs-:attribute-name
```

4 View the base-dn property and the DN mapping properties of the data view for which you have renamed DNs.

```
$ dpconf get-ldap-data-view-prop -h host -p port view-name base-dn \
  dn-mapping-source-base-dn dn-mapping-attrs
```

For example, the data view for the dc=example,dc=com database on the client side has the following values after DN renaming:

```
$ dpconf get-ldap-data-view-prop -h host1 -p 1389 myDataView base-dn \
  dn-mapping-source-base-dn dn-mapping-attrs
base-dn                : dc=example,dc=com
dn-mapping-attrs       : group
dn-mapping-source-base-dn : dc=example,dc=org
```

Configuring excluded-subtrees and alternate-search-base-dn

When a subordinate data view is created, Directory Proxy Server automatically excludes the subordinate data view from the superior data view. When a request targets the subordinate data view, the request is sent to the subordinate data view, not to the superior data view.

When an alternate search base is specified in a subordinate data view, search operations targeted at the superior data view are also performed in the subordinate data view.

By default, Directory Proxy Server automatically configures the excluded-subtrees and alternate-search-base-dn properties. The following procedure describes how to configure these properties manually.

▼ To Manually Configure the excluded-subtrees and alternate-search-base-dn Properties

You can use DSCC to perform this task. For information, see [“Directory Service Control Center Interface” on page 43](#) and the DSCC online help.

1 Configure Directory Proxy Server to manually route requests.

```
$ dpconf set-server-prop -h host -p port data-view-automatic-routing-mode:manual
```

When `data-view-automatic-routing-mode` is `manual`, Directory Proxy Server does not generate the `excluded-subtrees` and `alternate-search-base-dn` properties. You must set the values of these properties manually. The values that you set here are not checked by Directory Proxy Server. Be aware that setting these values incorrectly can break the administration path.

Alternatively, configure Directory Proxy Server to partially route requests manually.

```
$ dpconf set-server-prop -h host -p port data-view-automatic-routing-mode:limited
```

When `data-view-automatic-routing-mode` is `limited`, Directory Proxy Server does not generate the `excluded-subtrees` and `alternate-search-base-dn` properties. However, Directory Proxy Server does check that the values set here do not conflict with the administration path.

2 Configure the view exclusion base.

```
$ dpconf set-ldap-data-view-prop -h host -p port view-name excluded-subtrees:suffix-DN
```

The view exclusion base determines branches of the DIT whose entries are not exposed by the data view.

3 Configure the alternate search base.

```
$ dpconf set-ldap-data-view-prop -h host -p port view-name \
  alternate-search-base-dn:search-base-DN
```

The alternate search base determines other branches of the DIT in which entries belonging to this data view may be located. The base DN is defined by default as an alternate search base in all data views.

Creating and Configuring Data Views for Example Use Cases

This section contains the following information about data views and how to create and configure them:

- “Default Data View” on page 384
- “Data Views That Route All Requests, Irrespective of the Target DN of the Request” on page 385
- “Data Views That Route Requests When a List of Subtrees Is Stored on Multiple, Data-Equivalent Data Sources” on page 386
- “Data Views That Provide a Single Point of Access When Different Subtrees Are Stored in Different Data Sources” on page 387
- “Data Views That Provide a Single Point of Access When Different Parts of a Subtree Are Stored in Different Data Sources” on page 389
- “Data Views That Provide a Single Point of Access When Superior and Subordinate Subtrees Are Stored in Different Data Sources” on page 391

- “Data Views With Hierarchy and a Distribution Algorithm” on page 393

The examples in this section assume that the connection handler allows all client connections to be processed by Directory Proxy Server.

Default Data View

If you create a data view without configuring any of the properties, your data view has the following configuration:

```

alternate-search-base-dn      : ""
alternate-search-base-dn     : base-DN
attr-name-mappings           : none
base-dn                      : suffix-DN
contains-shared-entries      : -
description                  : -
distribution-algorithm        : -
dn-join-rule                 : -
dn-mapping-attrs            : none
dn-mapping-source-base-dn    : none
excluded-subtrees           : -
filter-join-rule            : -
is-enabled                   : true
is-read-only                 : false
is-routable                  : true
ldap-data-source-pool        : pool-name
lexicographic-attrs         : all
lexicographic-lower-bound    : none
lexicographic-upper-bound    : none
non-viewable-attr           : -
non-writable-attr            : -
numeric-attrs                : all
numeric-default-data-view    : false
numeric-lower-bound          : none
numeric-upper-bound          : none
pattern-matching-base-object-search-filter : all
pattern-matching-dn-regular-expression : all
pattern-matching-one-level-search-filter : all
pattern-matching-subtree-search-filter : all
process-bind                 : -
replication-role             : master
viewable-attr                : all except non-viewable-attr
writable-attr                 : all except non-writable-attr

```


Data Views That Route All Requests, Irrespective of the Target DN of the Request

This section shows the configuration of a data view that routes all requests to a data source pool, irrespective of the target DN of the request. This data view is called the *root data view*. The root data view is created by default when an instance of Directory Proxy Server is created. For information about the root data view, see “Data Views to Route All Requests, Irrespective of the Target DN of the Request” in *Sun Java System Directory Server Enterprise Edition 6.2 Reference*.

The root data view has the following configuration:

```

alternate-search-base-dn          : -
attr-name-mappings                : none
base-dn                           : ""
contains-shared-entries           : -
description                        : Automatically-generated data view
                                   able to route client operations
                                   independently of the operation base dn

distribution-algorithm             : -
dn-join-rule                       : -
dn-mapping-attrs                  : none
dn-mapping-source-base-dn         : none
excluded-subtrees                  : ""
excluded-subtrees                  : cn=config
excluded-subtrees                  : cn=monitor
excluded-subtrees                  : cn=proxy manager
excluded-subtrees                  : cn=virtual access controls
excluded-subtrees                  : dc=example,dc=com
filter-join-rule                   : -
is-enabled                         : true
is-read-only                       : false
is-routable                        : true
ldap-data-source-pool              : defaultDataSourcePool
lexicographic-attrs                : all
lexicographic-lower-bound          : none
lexicographic-upper-bound          : none
non-viewable-attr                  : -
non-writable-attr                   : -
numeric-attrs                      : all
numeric-default-data-view          : false
numeric-lower-bound                : none
numeric-upper-bound                : none
pattern-matching-base-object-search-filter : all
pattern-matching-dn-regular-expression : all
pattern-matching-one-level-search-filter : all
pattern-matching-subtree-search-filter  : all
process-bind                        : -

```

```

replication-role           : master
viewable-attr              : all except non-viewable-attr
writable-attr               : all except non-writable-attr
    
```

Data Views That Route Requests When a List of Subtrees Is Stored on Multiple, Data-Equivalent Data Sources

This section describes how to configure a data view that routes requests targeted at a list of subtrees to a set of data-equivalent data sources. For information about this type of deployment, see “Data Views to Route Requests When a List of Subtrees Are Stored on Multiple, Data-Equivalent Data Sources” in *Sun Java System Directory Server Enterprise Edition 6.2 Reference*.

The example in this section has multiple data sources that contain the same set of subtrees. The data sources are data-equivalent and are pooled into one data source pool for load balancing. A data view is configured for each subtree to expose that subtree to client requests. The following figure shows the sample deployment.

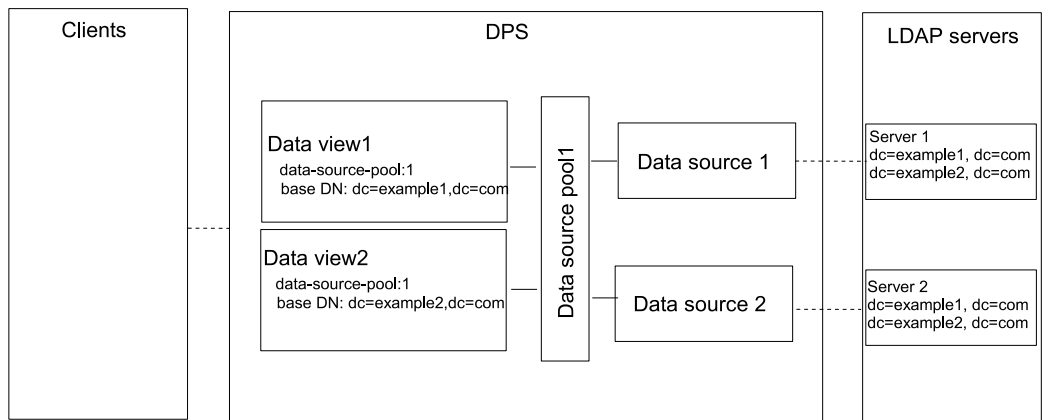


FIGURE 22-1 Sample Deployment That Routes Requests When a List of Subtrees Is Stored on Multiple, Data-Equivalent Data Sources

▼ To Configure Data Views That Route Requests When a List of Subtrees Is Stored on Multiple, Data-Equivalent Data Sources

You can use DSCC to perform this task. For information, see “[Directory Service Control Center Interface](#)” on page 43 and the DSCC online help.

- 1 **Create a data source for each LDAP server as described in “[Creating and Configuring LDAP Data Sources](#)” on page 359.**
- 2 **Create a data source pool as described in “[Creating and Configuring LDAP Data Source Pools](#)” on page 362.**
- 3 **Attach the data sources to the data source pool as described in “[Attaching LDAP Data Sources to a Data Source Pool](#)” on page 363.**
- 4 **(Optional) Configure load balancing.**
For information, see “[Configuring Load Balancing](#)” on page 365.
- 5 **Create a data view with a base DN at `dc=example1,dc=com` that refers to the data source pool.**

```
$ dpconf set-ldap-data-view-prop -h host1 -p 1389 dataview-1 \
  base-dn:dc=example1,dc=com ldap-data-source-pool:data-source-pool-1
```
- 6 **Create another data view with a base DN at `dc=example2,dc=com` that refers to the data source pool.**

```
$ dpconf set-ldap-data-view-prop -h host1 -p 1389 dataview-2 \
  base-dn:dc=example2,dc=com ldap-data-source-pool:data-source-pool-1
```

The other properties of the data views are the same as the default data view in “[Default Data View](#)” on page 384.
- 7 **If necessary, restart the instance of Directory Proxy Server for the changes to take effect.**
For information about restarting Directory Proxy Server, see “[To Restart Directory Proxy Server](#)” on page 334.

Data Views That Provide a Single Point of Access When Different Subtrees Are Stored in Different Data Sources

This section describes how to configure a data view that provides a single point of access to different subtrees stored in multiple data sources. For information about this type of deployment, see “Data Views to Provide a Single Point of Access When Different Subtrees Are Stored on Different Data Sources” in *Sun Java System Directory Server Enterprise Edition 6.2 Reference*.

The example in this section contains a data view for each subtree. A data source pool is configured for each set of data-equivalent data sources. The following figure shows the example deployment.

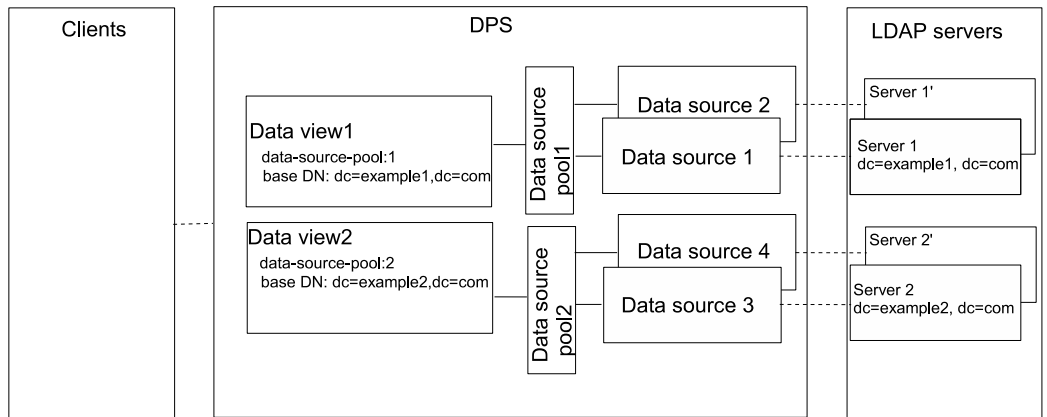


FIGURE 22-2 Sample Deployment That Provides a Single Point of Access When Different Subtrees Are Stored on Different Data Sources

▼ To Configure Data Views That Provide a Single Point of Access When Different Subtrees Are Stored on Different Data Sources

You can use DSCC to perform this task. For information, see [“Directory Service Control Center Interface” on page 43](#) and the DSCC online help.

- 1 **Create a data source for each LDAP server as described in [“Creating and Configuring LDAP Data Sources” on page 359](#).**
- 2 **Create two data source pools as described in [“Creating and Configuring LDAP Data Source Pools” on page 362](#).**
- 3 **Attach the data sources that contain `dc=example1,dc=com` to `data-source-pool-1`, and the data sources that contain `dc=example2,dc=com` to `data-source-pool-2`, as described in [“Attaching LDAP Data Sources to a Data Source Pool” on page 363](#).**
- 4 **(Optional) Configure load balancing.**
For information, see [“Configuring Load Balancing” on page 365](#).
- 5 **Create a data view with a base DN at `dc=example1,dc=com` that refers to `data-source-pool-1`.**

```
$ dpconf set-ldap-data-view-prop -h host1 -p 1389 dataview-1 \
  base-dn:dc=example1,dc=com ldap-data-source-pool:data-source-pool-1
```

- 6 Create another data view with a base DN at `dc=example2,dc=com` that refers to `data-source-pool-2`.**

```
$ dpconf set-ldap-data-view-prop -h host1 -p 1389 dataview-2 \
  base-dn:dc=example2,dc=com ldap-data-source-pool:data-source-pool-2
```

The other properties of the data views are the same as the default data view in [“Default Data View” on page 384](#).

- 7 If necessary, restart the instance of Directory Proxy Server for the changes to take effect.**

For information about restarting Directory Proxy Server, see [“To Restart Directory Proxy Server” on page 334](#).

Data Views That Provide a Single Point of Access When Different Parts of a Subtree Are Stored in Different Data Sources

This section describes how to configure a data view that provides a single point of access to different parts of a subtree. This example contains two data views with the same base DN. A numeric distribution algorithm is used to separate entries into different data views. A data source pool is configured for each set of data-equivalent data sources. The following figure shows the example deployment.

For information about this type of deployment, see [“Data Views to Route Requests When Different Parts of a Subtree Are Stored in Different Data Sources” in *Sun Java System Directory Server Enterprise Edition 6.2 Reference*](#).

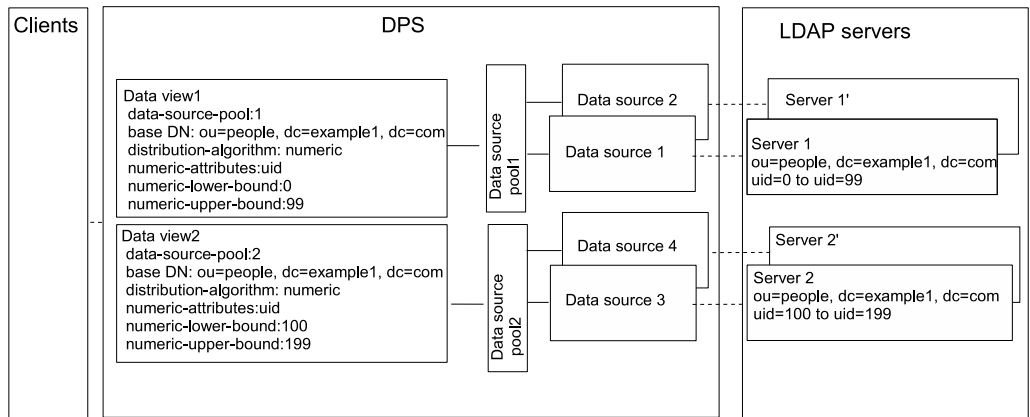


FIGURE 22-3 Sample Deployment That Provides a Single Point of Access When Different Parts of a Subtree Are Stored in Different Data Sources

▼ To Configure Data Views That Provide a Single Point of Access When Different Parts of a Subtree Are Stored in Different Data Sources

You can use DSCC to perform this task. For information, see [“Directory Service Control Center Interface” on page 43](#) and the DSCC online help.

- 1 Create a data source for each LDAP server as described in [“Creating and Configuring LDAP Data Sources” on page 359](#).
- 2 Create two data source pools as described in [“Creating and Configuring LDAP Data Source Pools” on page 362](#).
- 3 Attach the data sources that contain one part of the subtree to `data-source-pool-1`, and the data sources that contain the other part of the subtree to `data-source-pool-2`, as described in [“Attaching LDAP Data Sources to a Data Source Pool” on page 363](#).
- 4 (Optional) Configure load balancing.
For information, see [“Configuring Load Balancing” on page 365](#).
- 5 Create a data view with a distribution algorithm to select entries in `ou=people,dc=example,dc=com` with `uid` between 0 and 99, and configure the data view to direct requests to `data-source-pool-1`.

```
$ dpconf set-ldap-data-view-prop -h host1 -p 1389 dataview-1 \
  ldap-data-source-pool:data-source-pool-1 base-dn:ou=people,dc=example,dc=com \
  distribution-algorithm :numeric numeric-attrs:uid numeric-lower-bound :0 \
  numeric-upper-bound :99
```

- 6 Create another data view with a distribution algorithm to select entries in `ou=people,dc=example,dc=com` with `uid` between 100 and 199, and configure the data view to direct requests to `data-source-pool-2`.**

```
$ dpconf set-ldap-data-view-prop -h host1 -p 1389 dataview-2 \
  ldap-data-source-pool:data-source-pool-2 base-dn:ou=people,dc=example,dc=com \
  distribution-algorithm:numeric numeric-attrs:uid numeric-lower-bound:100
  numeric-upper-bound      :199
```

The other properties of the data views are the same as the default data view in [“Default Data View” on page 384](#).

- 7 If necessary, restart the instance of Directory Proxy Server for the changes to take effect.**

For information about restarting Directory Proxy Server, see [“To Restart Directory Proxy Server” on page 334](#).

Data Views That Provide a Single Point of Access When Superior and Subordinate Subtrees Are Stored in Different Data Sources

This section describes how to configure a data view for a single point of access when a superior branch of a subtree is stored in a different data source to a subordinate branch. For information about this type of deployment, see [“Data Views to Route Requests When Superior and Subordinate Subtrees Are Stored in Different Data Sources” in *Sun Java System Directory Server Enterprise Edition 6.2 Reference*](#).

The example in this section contains three data views. The base DN of data view 1 is superior to the base DN of data view 2 and the base DN of data view 3. Or, in other words, data source 2 and data source 3 contain subtrees that are subordinate to the subtree on data source 1. The following figure shows the example deployment.

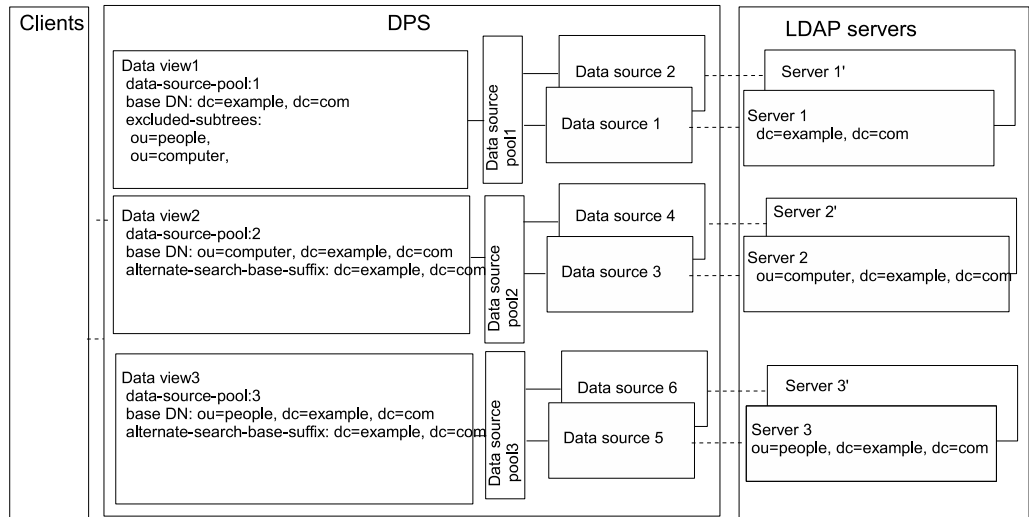


FIGURE 22-4 Sample Deployment to Routes Requests When Superior and Subordinate Subtrees Are Stored in Different Data Sources

Directory Proxy Server automatically excludes a subordinate branch of a subtree from a data view when the subordinate branch is configured as the base DN of a separate data view.

▼ To Configure Data Views That Provide a Single Point of Access When Superior and Subordinate Subtrees Are Stored in Different Data Sources

You can use DSCC to perform this task. For information, see [“Directory Service Control Center Interface” on page 43](#) and the DSCC online help.

- 1 Create a data source for each LDAP server as described in [“Creating and Configuring LDAP Data Sources” on page 359](#).
- 2 Create three data source pools as described in [“Creating and Configuring LDAP Data Source Pools” on page 362](#).
- 3 Attach the data sources to the data source pools by following the instructions in [“Attaching LDAP Data Sources to a Data Source Pool” on page 363](#).
 - Attach the data sources that contain dc=example, dc=com to data-source-pool-1.
 - Attach the data sources that contain ou=computer, dc=example, dc=com to data-source-pool-2.

- Attach the data sources that contain `ou=people,dc=example,dc=com` to `data-source-pool-3`.
- 4 (Optional) Configure load balancing.**
For information, see [“Configuring Load Balancing”](#) on page 365.
- 5 Create a data view with a base DN at `dc=example,dc=com` and a data source pool `data-source-pool-1`.**

```
$ dpconf create-ldap-data-view -h host1 -p 1389 dataview-1 \
  data-source-pool-1 dc=example,dc=com
```
- 6 Create a data view with a base DN at `ou=computer,dc=example,dc=com` and a data source pool `data-source-pool-2`.**

```
$ dpconf create-ldap-data-view -h host1 -p 1389 dataview-2 \
  data-source-pool-2 ou=computer,dc=example,dc=com
```
- 7 Create a data view with a base DN at `ou=people,dc=example,dc=com` and a data source pool `data-source-pool-3`.**

```
$ dpconf create-ldap-data-view -h host1 -p 1389 dataview-3 \
  data-source-pool-3 ou=people,dc=example,dc=com
```
- 8 Verify that the subtrees `ou=computer,dc=example,dc=com` and `ou=people,dc=example,dc=com` have been excluded from `dataview-1` by looking at the `excluded-subtrees` parameter.**

```
$ dpconf get-ldap-data-view-prop -h host1 -p 1389 dataview-1 excluded-subtrees
```

The list of excluded subtrees is returned.
- 9 If necessary, restart the instance of Directory Proxy Server for the changes to take effect.**
For information about restarting Directory Proxy Server, see [“To Restart Directory Proxy Server”](#) on page 334.

Data Views With Hierarchy and a Distribution Algorithm

This section describes how to configure a data view to combine hierarchy with distribution algorithms. For information about this type of deployment, see “Data Views With Hierarchy and a Distribution Algorithm” in *Sun Java System Directory Server Enterprise Edition 6.2 Reference*.

The example in this section contains four data views. The base DN of data view 1 is superior to the base DNs of the other data views. Data view 3 and data view 4 have the same base DN, but a numeric distribution algorithm separates the entries into different data views.

Directory Proxy Server automatically excludes a subordinate branch of a subtree from a data view when the subordinate branch is configured as the base DN of a separate data view. A numeric distribution algorithm separates entries from the same subtree into different data views. A data source pool is configured for each set of data-equivalent data sources.

The following figure shows the example deployment.

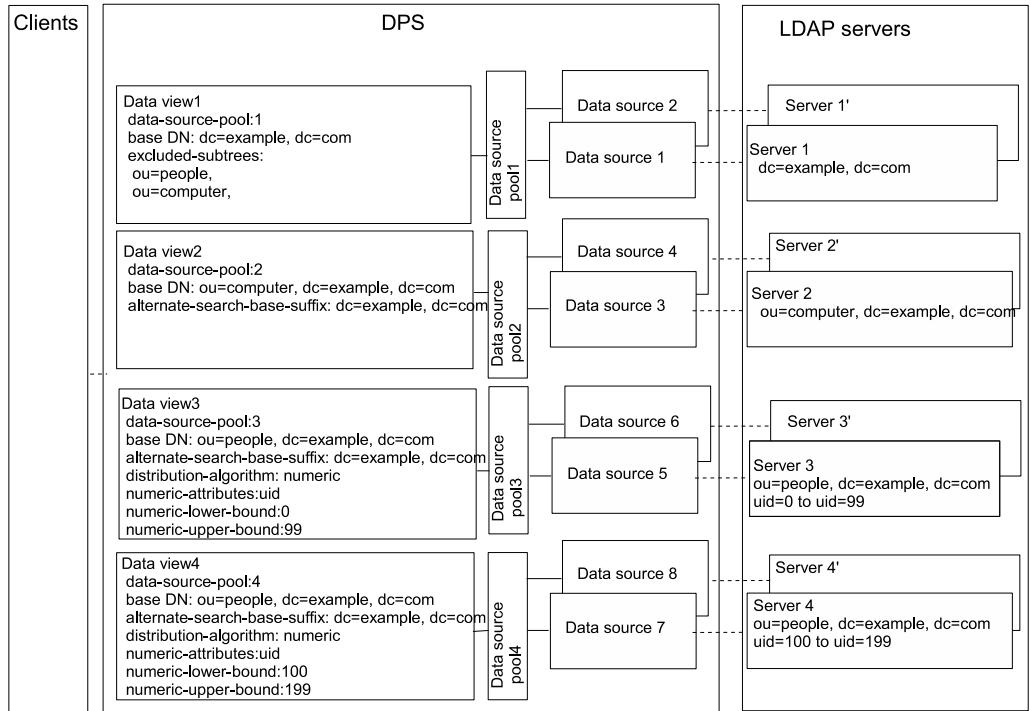


FIGURE 22-5 Sample Data View With Hierarchy and a Distribution Algorithm

▼ To Configure Data Views With Hierarchy and a Distribution Algorithm

You cannot use DSCC to perform this task. Use the command line, as described in this procedure.

- 1 Create a data source for each LDAP server as described in [“Creating and Configuring LDAP Data Sources” on page 359](#).
- 2 Create four data source pools as described in [“Creating and Configuring LDAP Data Source Pools” on page 362](#).

3 Attach the data sources to the data source pools by following the instructions in “Attaching LDAP Data Sources to a Data Source Pool” on page 363.

- Attach the data sources that contain `dc=example,dc=com` to `data-source-pool-1`.
- Attach the data sources that contain `ou=computer,dc=example,dc=com` to `data-source-pool-2`.
- Attach the data sources that contain entries in `ou=people,dc=example,dc=com` with `uid` between `0` and `99` to `data-source-pool-3`.
- Attach the data sources that contain entries in `ou=people,dc=example,dc=com` with `uid` between `100` and `199` to `data-source-pool-4`.

4 (Optional) Configure load balancing.

For information, see “Configuring Load Balancing” on page 365.

5 Create a data view with a base DN at `dc=example,dc=com`, that refers to `data-source-pool-1`.

```
$ dpconf create-ldap-data-view -h host1 -p 1389 dataview-1 \
  data-source-pool-1 dc=example,dc=com
```

6 Create a data view with a base DN at `ou=computer,dc=example,dc=com` that refers to `data-source-pool-2`.

```
$ dpconf create-ldap-data-view -h host1 -p 1389 dataview-2 \
  data-source-pool-2 ou=computer,dc=example,dc=com
```

7 Create a data view with a base DN at `ou=people,dc=example,dc=com` that refers to `data-source-pool-3`. Configure a distribution algorithm on the data view to select entries with `uid` between `0` and `99`.

```
$ dpconf create-ldap-data-view -h host1 -p 1389 dataview-3 \
  data-source-pool-3 ou=people,dc=example,dc=com
$ dpconf set-ldap-data-view-prop dataview-3 distribution-algorithm:numeric \
  numeric-attrs:uid numeric-lower-bound:0 numeric-upper-bound:99
```

8 Create a data view with a base DN at `ou=people,dc=example,dc=com` that refers to `data-source-pool-4`, and configure a distribution algorithm on the data view to select entries with `uid` between `100` and `199`.

```
$ dpconf create-ldap-data-view -h host1 -p 1389 dataview-4 \
  data-source-pool-4 ou=people,dc=example,dc=com
$ dpconf set-ldap-data-view-prop dataview-4 distribution-algorithm:numeric \
  numeric-attrs:uid numeric-lower-bound:100 numeric-upper-bound:199
```

9 Verify that the subtrees `ou=computer,dc=example,dc=com` and `ou=people,dc=example,dc=com` have been excluded from `dataview-1` by looking at the `excluded-subtrees` parameter.

```
$ dpconf get-ldap-data-view-prop -h host1 -p 1389 dataview-1 excluded-subtrees
```

The list of excluded subtrees is returned.

10 Restart the instance of Directory Proxy Server for the changes to take effect.

For information about restarting Directory Proxy Server, see [“To Restart Directory Proxy Server” on page 334](#).

Directory Proxy Server Virtualization

This chapter describes how to create virtual data views. *Virtual data views* transform the source data and present a different view of that data to client applications. Virtual data views include transformed LDAP data views, LDIF data views, join data views, and JDBC™ data views. For an overview of the features of virtual data views and a description of example use cases, see Chapter 18, “Directory Proxy Server Virtualization,” in *Sun Java System Directory Server Enterprise Edition 6.2 Reference*.

You cannot use Directory Service Control Center (DSCC) to perform the procedures in this chapter. You must use the command line.

This chapter covers the following topics:

- “Creating and Configuring LDIF Data Views” on page 397
- “Configuring Virtual Data Transformations” on page 399
- “Creating and Configuring Join Data Views” on page 400
- “Creating and Configuring JDBC Data Views” on page 404
- “Defining Access Control on Virtual Data Views” on page 411
- “Defining Schema Checking on Virtual Data Views” on page 413
- “Sample Virtual Configurations” on page 413

Creating and Configuring LDIF Data Views

An LDIF data view is a simple virtual data view in which an LDIF file is made to look like an LDAP data source. Unlike for LDAP data views, you do not create data sources or data source pools when you set up LDIF data views. Instead, you specify an LDIF file when you create the data view. By default, you cannot write to an LDIF data view. For more information, see “[Defining Access Control on Virtual Data Views](#)” on page 411.

For information about creating and configuring LDIF data views, see the following procedures.

▼ To Create an LDIF Data View

You cannot use DSCC to perform this task. Use the command line, as described in this procedure.

1 Create an LDIF data view.

```
$ dpconf create-ldif-data-view -h host -p port view-name path-to-ldif-file suffix-dn
```

2 (Optional) View the list of LDIF data views.

```
$ dpconf list-ldif-data-views -h host -p port
```

The virtual access controls data view is the only default LDIF data view. This data view is generated by the server and enables requests to be routed to virtual access control instructions (ACIs).

▼ To Configure an LDIF Data View

You cannot use DSCC to perform this task. Use the command line, as described in this procedure.

1 View the properties of an LDIF data view.

```
$ dpconf get-ldif-data-view-prop -h host -p port view-name
```

An LDIF data view has the following default properties:

```
alternate-search-base-dn           : ""
alternate-search-base-dn           : dc=com
attr-name-mappings                  : none
base-dn                             : suffixDN
bind-pwd-attr                       : userPassword
contains-shared-entries              : -
db-pwd-encryption                   : clear-text
description                          : -
distribution-algorithm               : -
dn-join-rule                         : -
dn-mapping-attrs                    : none
dn-mapping-source-base-dn           : none
excluded-subtrees                    : -
filter-join-rule                     : -
is-enabled                           : true
is-read-only                         : false
is-routable                          : true
ldif-data-source                     : /path/to/filename.ldif
lexicographic-attrs                 : all
lexicographic-lower-bound           : none
```

```

lexicographic-upper-bound      : none
non-viewable-attr              : -
non-writable-attr               : -
numeric-attrs                  : all
numeric-default-data-view      : false
numeric-lower-bound            : none
numeric-upper-bound            : none
pattern-matching-base-object-search-filter : all
pattern-matching-dn-regular-expression : all
pattern-matching-one-level-search-filter : all
pattern-matching-subtree-search-filter : all
process-bind                   : -
replication-role               : master
viewable-attr                  : all except non-viewable-attr
writable-attr                   : all except non-writable-attr

```

2 Change one or more of the properties that are listed in [Step 1](#).

```
$ dpconf set-ldif-data-view-prop -h host -p port view-name property:value \
[property:value ... ]
```

For example, to change the source LDIF file for the data view, set the `ldif-data-source` property.

```
$ dpconf set-ldif-data-view-prop -h host1 -p 1389 -D cn="Proxy Manager" \
myLDIFDataView ldif-data-source:/local/files/example.ldif
```

Configuring Virtual Data Transformations

Virtual data transformations are defined on existing data views, and create a virtual data view from a physical data view. For information about how they work, see “Virtual Data Transformations” in *Sun Java System Directory Server Enterprise Edition 6.2 Reference*.

You can add a virtual data transformation to any type of data view: an LDAP data view, an LDIF data view, a join data view, or a JDBC data view.

▼ To Add a Virtual Transformation

You cannot use DSCC to perform this task. Use the command line, as described in this procedure.

1 Add the transformation to a data view.

```
$ dpconf add-virtual-transformation -h host -p port view-name \
transformation-model transformation-action attribute-name [parameters...]
```

Note that *parameters* might be mandatory, depending on the *transformation-model* and the *transformation-action*. For information about transformation models, transformation actions, and transformation parameters, see “Virtual Data Transformations” in *Sun Java System Directory Server Enterprise Edition 6.2 Reference*.

- 2 (Optional) View the list of virtual transformations that are defined on a data view.

```
$ dpconf list-virtual-transformations -h host -p port view-name
```

Creating and Configuring Join Data Views

A join data view is an aggregation of multiple data views. For information about how a join data view works, see “Join Data Views” in *Sun Java System Directory Server Enterprise Edition 6.2 Reference*.

For information about how to create and configure join data views, see the following procedures.

▼ To Create a Join Data View

You cannot use DSCC to perform this task. Use the command line, as described in this procedure.

- 1 Identify the primary and secondary data views that will be aggregated to form the join view.

The primary and secondary data views must exist before the join view can be created. The primary and secondary views can be any type of data view, including an LDAP data view, LDIF data view, JDBC data view, or another join data view. Specific properties must be configured on the secondary view to allow it to function as the source for a join view. For more information, see “[To Configure the Secondary View of a Join View](#)” on page 403.

- 2 Create the join data view.

```
$ dpconf create-join-data-view -h host -p port view-name primary-view secondary-view \
  suffix-dn
```

- 3 (Optional) View the list of join views to check that your data view has been created successfully.

```
$ dpconf list-join-data-views -h host -p port
```

▼ To Configure a Join Data View

You cannot use DSCC to perform this task. Use the command line, as described in this procedure.

1 View the properties of a join data view.

```
$ dpconf get-join-data-view-prop -h host -p port view-name
```

The default properties of a join data view are as follows:

```
alternate-search-base-dn      : ""
alternate-search-base-dn     : dc=com
attr-name-mappings           : none
base-dn                      : suffixDN
contains-shared-entries      : -
description                  : -
distribution-algorithm       : -
dn-join-rule                 : -
dn-mapping-attrs             : none
dn-mapping-source-base-dn   : none
excluded-subtrees           : -
filter-join-rule            : -
is-enabled                   : true
is-read-only                 : false
is-routable                  : true
join-rule-control-enabled    : false
lexicographic-attrs         : all
lexicographic-lower-bound   : none
lexicographic-upper-bound   : none
non-viewable-attr           : -
non-writable-attr            : -
numeric-attrs                : all
numeric-default-data-view    : false
numeric-lower-bound         : none
numeric-upper-bound         : none
pattern-matching-base-object-search-filter : all
pattern-matching-dn-regular-expression : all
pattern-matching-one-level-search-filter : all
pattern-matching-subtree-search-filter : all
primary-view                 : primary-view
process-bind                 : -
replication-role             : master
secondary-view               : secondary-view
viewable-attr                : all except non-viewable-attr
writable-attr                 : all except non-writable-attr
```

2 Change one or more of the properties that are listed in [Step 1](#).

```
$ dpconf set-join-data-view-prop -h host -p port view-name property:value \
  [property:value ... ]
```

For example, to change the primary data view of a data source to `myLDAPDataView`, use the following command:

```
$ dpconf set-join-data-view-prop -h host1 -p 1389 -D cn="Proxy Manager" \
  myJoinDataView primary-view:myLDAPDataView
```

3 When a join data view is configured, set `viewable-attr` and `writable-attr` properties on primary data view and secondary data view.

Setting of these properties helps in splitting the search filters appropriately on primary and secondary data views. Otherwise, there might be discrepancies in search results when search filter contains attributes from secondary data view.

4 If necessary, restart the instance of Directory Proxy Server for the changes to take effect.

For information about restarting Directory Proxy Server, see [“To Restart Directory Proxy Server” on page 334](#).

▼ To Configure a Join Data View to Enable Referencing of a Data View by Multiple Join Data Views

Setting join rule configuration information in the join data view makes the data view to be referenced by multiple join data views. To do so, perform the following:

1 Set `join-rule-control-enabled` to `true` on the join data view.

```
$ dpconf set-join-data-view-prop view-name join-rule-control-enabled:true
```

After setting `join-rule-control-enabled` to `true`, join rule configuration information stored in the join data view is used by the server. If you have a join data view with the join rule configuration information stored in the secondary data view then this information is not used by the server. To have this information used by the server, you will have to manually add the configuration information at the join data view level.

2 Define a join rule that determines how the secondary view is related to the primary view.

The join rule can be one of the following:

- DN join rule

```
$ dpconf set-join-data-view-prop view-name \
  dn-join-rule:uid=\${primary-view-name.uid},ou=People,dc=example
```

- Filter join rule

```
$ dpconf set-join-data-view-prop view-name \
  filter-join-rule:uid=\${primary-view-name.uid}
```

▼ To Configure the Secondary View of a Join View

Specific properties must be configured on the secondary data view to allow it to function as the source for a join view. Because the secondary view can be any type of data view, the command you use will depend on the data view type. The following sample commands assume that the secondary view is an LDAP data view. For more information about the properties described here, see “Additional Secondary Data View Properties” in *Sun Java System Directory Server Enterprise Edition 6.2 Reference*.

You cannot use DSCC to perform this task. Use the command line, as described in this procedure.

1 Define a join rule that determines how the secondary view is related to the primary view.

The join rule can be one of the following:

- DN join rule

```
$ dpconf set-ldap-data-view-prop -h host -p port secondary-view-name \
dn-join-rule:uid=\${primary-view-name.uid},ou=People,dc=example
```

- Filter join rule

```
$ dpconf set-ldap-data-view-prop -h host -p port secondary-view-name \
filter-join-rule:uid=\${primary-view-name.uid}
```

The configuration for the `dn-join-rule` and `filter-join-rule` properties is used by the server only if the `join-rule-control-enabled` property on the join data view is set to `false`. Otherwise, if the `join-rule-control-enabled` property is set to `true` on the join data view, then the information set on the secondary view will be ignored.

2 If the filter join rule is set on the join data view, you need to set a virtual transformation rule on the secondary data view to be able to add an entry on the join data view.

```
dpconf add-virtual-transformation secondary-view-name \
write add-attr-value dn uid=\${uid}
```

Note – Without setting this rule, addition of entries to join data view would not be possible.

3 (Optional) Specify whether binds are allowed on the secondary view.

By default, binds are permitted on all data views. If you want to prohibit binds to the secondary data view, run the following command:

```
$ dpconf set-ldap-data-view-prop -h host -p port secondary-view-name process-bind:false
```

For more information about this property, see “Handling of Binds” in *Sun Java System Directory Server Enterprise Edition 6.2 Reference*.

4 (Optional) Specify whether the secondary view contains shared entries.

```
$ dpconf set-ldap-data-view-prop -h host -p port secondary-view-name \
contains-shared-entries:true
```

For more information about this property, see “Handling of Shared Entries” in *Sun Java System Directory Server Enterprise Edition 6.2 Reference*.

Creating and Configuring JDBC Data Views

A JDBC data view enables you to make a relational database accessible to LDAP client applications. For information about how JDBC data views work, see “JDBC Data Views” in *Sun Java System Directory Server Enterprise Edition 6.2 Reference*.

For information about how to create and configure JDBC data views, see the following procedures.

▼ To Create a JDBC Data View

You cannot use DSCC to perform this task. Use the command line, as described in this procedure.

1 Create a JDBC data source for the relational database.

```
$ dpconf create-jdbc-data-source -h host -p port -b db-name -B db-url -J driver-url \
[-J driver-url]... -S driver-class source-name
```

Currently, only one JDBC data source is supported for each JDBC data view. In other words, you cannot load balance across JDBC data sources. To access multiple JDBC data sources, you can create a data view for each data source, and join them together with a join data view.

The following properties must be set when you create a JDBC data source:

db-name	The name of the relational database, for example, payrolldb.
db-url	The URL to the database, in the form <code>jdbc:vendor:driver://dbhost:dbport</code> . The db-url is <i>not</i> a complete JDBC database URL, because it does not contain the database name. (The database name is specified by the db-name property.) You must finish db-url with a / for MySQL, DB2, and Derby databases and with a : for Oracle database.
driver-class	The JDBC driver class, for example <code>org.hsqldb.jdbcDriver</code> .
driver-url	The path to the JDBC driver, for example <code>file:///path/to/hsqldb/lib/hsqldb.jar</code> .

The `driver-url` property is multi-valued. Hence, `driver-url` can support multiple JAR files for the JDBC driver to ensure connectivity to the JDBC source on different platforms.

2 Create a JDBC data source pool.

```
$ dpconf create-jdbc-data-source-pool -h host -p port pool-name
```

3 Attach the JDBC data source to the JDBC data source pool.

```
$ dpconf attach-jdbc-data-source -h host -p port pool-name source-name
```

4 Create a JDBC data view.

```
$ dpconf create-jdbc-data-view -h host -p port view-name pool-name suffix-DN
```

5 (Optional) View the list of JDBC data views to check that your data view has been created successfully.

```
$ dpconf list-jdbc-data-views -h host -p port
```

▼ To Configure a JDBC Data View

You cannot use DSCC to perform this task. Use the command line, as described in this procedure.

1 View the properties of a JDBC data view.

```
$ dpconf get-jdbc-data-view-prop -h host -p port view-name
```

The default properties of a JDBC data view are as follows:

```
alternate-search-base-dn      : -
attr-name-mappings           : none
base-dn                      : o=sql
contains-shared-entries      : -
description                  : -
distribution-algorithm       : -
dn-join-rule                 : -
dn-mapping-attrs            : none
dn-mapping-source-base-dn   : none
excluded-subtrees           : -
filter-join-rule            : -
is-enabled                   : true
is-read-only                 : false
is-routable                  : true
jdbc-data-source-pool       : pool-name
lexicographic-attrs         : all
```

```

lexicographic-lower-bound      : none
lexicographic-upper-bound     : none
non-viewable-attr              : -
non-writable-attr               : -
numeric-attrs                  : all
numeric-default-data-view      : false
numeric-lower-bound            : none
numeric-upper-bound            : none
pattern-matching-base-object-search-filter : all
pattern-matching-dn-regular-expression : all
pattern-matching-one-level-search-filter : all
pattern-matching-subtree-search-filter : all
process-bind                    : -
replication-role                : master
viewable-attr                   : all except non-viewable-attr
writable-attr                    : all except non-writable-attr

```

2 Change one or more of the properties that are listed in [Step 1](#).

```

$ dpconf set-jdbc-data-view-prop -h host -p port view-name property:value \
  [property:value ... ]

```

▼ To Configure JDBC Tables, Attributes, and Object Classes

When you configure a JDBC data view, you must also configure the following objects:

- **JDBC object class.** Maps one or more JDBC tables to an LDAP object class.
- **JDBC table.** Defined for each relational database table.
- **JDBC attribute.** Defines an LDAP attribute from a specified column in a JDBC table.

1 Create a JDBC table for each table in the relational database.

```
% dpconf create-jdbc-table jdbc-table-name db-table
```

The name of the *db-table* is case sensitive. Make sure that you use the identical case that is used in the relational database, otherwise operations that target that table might fail.

2 Create a JDBC attribute for each column in each relational database table.

```
% dpconf add-jdbc-attr table-name attr-name sql-column
```

Creating a JDBC attribute maps the table column to an LDAP attribute.

3 (Optional) If the column in the relational database is case sensitive, change the LDAP syntax of the JDBC attribute.

```
% dpconf set-jdbc-attr-prop table-name attr-name ldap-syntax:ces
```

The value of `ldap-syntax` is `cis` by default. This implies that the `jdbc-attr` is case insensitive. Change the value to `ces` if your relational database is case sensitive.

Certain relational databases, such as Oracle and DB2, are case sensitive by default. LDAP is case insensitive by default. When Directory Proxy Server detects that a column of the relational database table is case sensitive, an `ldapsearch` query with the corresponding attribute in the filter is translated into a SQL query using the function `UPPER`.

For example, the query `ldapsearch -b "dc=mysuffix" "(attr=abc)"` is translated into the following SQL query:

```
SELECT * FROM mytable WHERE (UPPER(attr)='ABC')
```

By default, this type of query is not indexed. Queries of this nature can therefore have a substantial performance impact.

You can alleviate the performance impact in two ways:

- By setting the `ldap-syntax` property of the `jdbc-attr` to `ces`.
- By creating an index with the function `UPPER` for each `jdbc-attr` that might be used in an LDAP filter.

Note – If your relational database is not case sensitive, use `ldap-syntax` with the default value, that is, `cis`. `ldap-syntax:ces` is not supported with the case insensitive databases.

4 Create a JDBC object class for the LDAP relational database table.

```
% dpconf create-jdbc-object-class view-name objectclass primary-table \  

   [secondary-table... ] DN-pattern
```

Creating a JDBC object class essentially specifies an LDAP object class with which these tables will be associated. The JDBC object class also specifies the primary table and the secondary tables, if they exist.

When you create a JDBC object class, you specify a DN pattern. The DN pattern shows how the DN of the entry will be constructed.

All the subtree components defined in the DN pattern of JDBC object class should have a JDBC object class defined for them. For example, if there is a DN pattern `uid,ou` in a JDBC object class, there should be a JDBC object class definition with a DN pattern `ou`. This is necessary for Directory Proxy Server to construct a properly structured DIT. Otherwise, the subtree with values like `ou=xxx,base-DN` would not be returned in the search results.

5 If a secondary table exists, define the join rule between the primary table and the secondary table.

```
% dpconf set-jdbc-table-prop secondary-table-name filter-join-rule:join-rule
```

A join rule is defined on the secondary table and determines how data from that table is linked to data from the primary table. How you define the relationships between the primary and secondary tables of an object class is important. For more information, see [“Defining Relationships Between JDBC Tables” on page 408](#).

6 Specify the super class for the JDBC object class.

```
% dpconf set-jdbc-object-class-prop view-name objectclass super-class:value
```

The super class indicates the LDAP object class from which the JDBC object class inherits.

Defining Relationships Between JDBC Tables

In the simplest case, a JDBC object class contains only a single (primary) table. There is no secondary table, and thus no need to define relationships between tables.

If the object class contains more than one table, the relationships between these tables must be clearly defined. The relationships between tables are always defined on the secondary table. The following properties of a secondary table enable you to define these relationships:

- `is-single-row-table` specifies that an LDAP entry has only one matching row in the table.
- `contains-shared-entries` specifies that a row in the secondary table is used by more than one row in the primary table.
- `filter-join-rule` indicates how an entry should be retrieved from the secondary table based on something in the primary table.

The following examples illustrate how the filter join rule is defined, based on the values of the first two properties. These examples assume that the object class has one primary table and one secondary table.

EXAMPLE 23-1 `is-single-row-table:true` and `contains-shared-entries:true`

These are the default values of these properties. In this case, the relationship between the primary and secondary tables is $n \rightarrow 1$, that is, n rows in the primary table reference one shared row in the secondary table.

In the relational database, a foreign key (FK) is defined in the primary table, and points to a column in the secondary table.

Take, for example, an organization in which several employees can share the same manager. Two relational database tables are defined, with the following structure:

EXAMPLE 23-1 `is-single-row-table:true` and `contains-shared-entries:true` (Continued)

```
primary table : EMPLOYEE [ID, NAME, FK_MANAGER_ID]
secondary table : MANAGER [ID, NAME]
```

The following object class and attributes are defined:

```
object-class : employee
attr : name (from primary EMPLOYEE.NAME)
attr : manager (from secondary MANAGER.NAME)
```

The following filter join rule is defined in the secondary table:

```
"${ID}=${EMPLOYEE.FK_MANAGER_ID}"
```

With this configuration, the following behavior occurs for LDAP operations:

- **Adding an employee entry.** If the manager in the employee entry does not exist in the table, a new row is created. If the manager does exist, an existing row is used.
- **Replacing the value of the “manager” attribute in an entry.** The value of the row `MANAGER.NAME` is changed.
- **Deleting an employee entry.** The row in the secondary table is not deleted because the manager entries are shared.
- **Deleting the “manager” attribute from an entry.** The row in the secondary table is deleted and the foreign key (`EMPLOYEE.FK_MANAGER_ID`) is set to `NULL`.

EXAMPLE 23-2 `is-single-row-table:true` and `contains-shared-entries:false`

In this case, the relationship between the primary and secondary tables is $1 \rightarrow 1$ or $1 < -1$, that is, one row in the primary table is referenced by one row in the secondary table.

In the relational database, the foreign key (FK) might be defined in the primary table, or in the secondary table.

Take, for example, an organization in which the UID of employees is stored in one table, and the surname of employees is stored in a second table. Two relational database tables are defined, with the following structure:

```
primary table : UID [ID, VALUE, FK_SN_ID]
secondary table : SN [ID, VALUE]
```

The following object class and attributes are defined:

EXAMPLE 23-2 `is-single-row-table:true` and `contains-shared-entries:false` (Continued)

```
object-class : employee
attr : uid (from primary UID.VALUE)
attr : sn (from secondary ID.VALUE)
```

The following filter join rule is defined in the secondary table:

```
"${ID}=${UID.FK_SN_ID}"
```

This configuration could be the other way around, with the foreign key `FK_UID_ID` stored in the secondary table, and pointing to `UID.ID`.

EXAMPLE 23-3 `is-single-row-table:false` and `contains-shared-entries:false`

In this case, the relationship between the primary and secondary tables is $1 \rightarrow n$, that is, one row in the primary table is referenced by n rows in the secondary table. This example illustrates the case of multi-valued attributes. A multi-valued attribute is represented as a set of rows in the secondary table, with one row per attribute value.

In the relational database, the foreign key is defined in the secondary table, and points to a column in the primary table.

Take, for example, an organization in which an employee can have several telephone numbers. Two relational database tables are defined, with the following structure:

```
primary table : EMPLOYEE [ID, NAME]
secondary table : PHONE [ID, VALUE, USER_ID]
```

The following object class and attributes are defined:

```
object-class : employee
attr : cn (from primary EMPLOYEE.NAME)
attr : telephoneNumber (from secondary PHONE.VALUE)
```

The following filter join rule is defined in the secondary table:

```
"${USER_ID}=${EMPLOYEE.ID}"
```

EXAMPLE 23-4 `is-single-row-table:false` and `contains-shared-entries:true`

This case is currently unsupported in Directory Proxy Server.

Defining Access Control on Virtual Data Views

ACIs on virtual data views can be stored in an LDAP directory or in an LDIF file. For information about how virtual ACIs work, see “Access Control On Virtual Data Views” in *Sun Java System Directory Server Enterprise Edition 6.2 Reference*.

When you create a Directory Proxy Server instance, the following default configuration for virtual access controls is defined:

- An LDIF file in which ACIs are stored by default (*instance-path/config/access_controls.ldif*)
- An LDIF data view named `virtual access controls`
This data view enables Directory Proxy Server to access the ACIs stored in the LDIF file.

▼ To Define a New ACI Storage Repository

If you do not want to use the default ACI configuration described previously, you can define a different storage repository.

You cannot use DSCC to perform this task. Use the command line, as described in this procedure.

- 1 **Create a data view for the repository in which the virtual ACIs will be stored.**
 - If the ACIs will be stored in an LDAP directory, create an LDAP data source and an LDAP data view, as described in “[Creating and Configuring LDAP Data Views](#)” on page 377.
 - If the ACIs will be stored in an LDIF file, create an LDIF data view, as described in “[Creating and Configuring LDIF Data Views](#)” on page 397.
- 2 **Specify the name of the data view created in the previous step as the ACI data view.**

```
$ dpconf set-virtual-aci-prop -h host -p port aci-data-view:data-view-name
```
- 3 **If the ACI repository is an LDAP directory, define the credentials required to access the ACI data view.**

```
$ dpconf set-virtual-aci-prop -h host -p port aci-manager-bind-dn:bind-dn
$ dpconf set-virtual-aci-prop -h host -p port aci-manager-bind-pwd-file:filename
```

▼ To Configure Virtual Access Controls

Regardless of the ACI repository that you use, you must configure the virtual access controls.

Note – Only the Proxy Manager can create a pool of ACIs and manage ACIs directly through the ACI data view. If the ACI repository is an LDAP directory, you must modify the schema of that directory to include the `aciSource` object class and the `dpsaci` attribute. For more information about customizing the schema, see [“Extending Directory Server Schema” on page 290](#).

You cannot use DSCC to perform this task. Use the command line, as described in this procedure.

1 Create a pool of ACIs in the ACI repository, and set up global ACIs.

For information about global ACIs, see “Global ACIs” in *Sun Java System Directory Server Enterprise Edition 6.2 Reference*. To set up global ACIs, add an `aciSource` entry under the view base of the ACI data view. For example:

```
% ldapmodify -p port -D "cn=proxy manager" -w -
dn: cn=data-source-name,cn=virtual access controls
changetype: add
objectclass: aciSource
dpsaci: (targetattr="*") (target = "ldap:///ou=people,o=virtual") (version 3.0; \
  acl "perm1"; allow(all) groupdn="ldap:///cn=virtualGroup1,o=groups,o=virtual";)
cn: data-source-name
```

2 Configure one or more connection handlers to use this pool of ACIs.

```
% dpconf set-connection-handler-prop -h host -p port connection-handler \
aci-source:data-source-name
```

3 Add the required ACIs to the data.

To do this, create a virtual entry that contains the ACIs. For example:

```
% ldapmodify -p port -D "cn=virtual application,ou=application users,dc=com" -w -
dn: ou=people,o=virtual
changetype: modify
add: dpsaci
dpsaci: (targetattr="*")(version 3.0; acl "perm1"; allow(all) userdn ="ldap:///self";)
dpsaci: (targetattr="*")(version 3.0; acl "perm1"; allow(search, read, compare) \
  userdn ="ldap:///anyone";)
```

Note – Any user with the appropriate access rights can add and retrieve virtual ACIs through the data view.

Defining Schema Checking on Virtual Data Views

Generally, for LDAP data views, schema checking is performed by the backend directory, using the backend directory's schema. Use the following procedure if you want schema checking to be performed by Directory Proxy Server.

You cannot use DSCC to perform this task. Use the command line, as described in this procedure.

To normalize requests, particularly the DN, set the `use-external-schema` property of the server, as follows:

▼ To Define Schema Checking

- 1 **Indicate that the server instance should use an external schema.**

```
$ dpconf set-server-prop -h host -p port use-external-schema:true
```

- 2 **Enable schema checking on the connection handler.**

```
$ dpconf set-connection-handler-prop -h host -p port connection-handler \
  schema-check-enabled:true
```

- 3 **Create a data view that exposes `cn=schema`.**

If the external schema is defined in an LDAP directory, create an LDAP data view, as described in [“Creating and Configuring LDAP Data Views” on page 377](#), with a view base of `cn=schema`.

If the external schema is defined in an LDIF file, create an LDIF data view, as described in [“Creating and Configuring LDIF Data Views” on page 397](#) with a view base of `cn=schema`.

- 4 **Add this data view to the list of data views exposed by the connection handler.**

By default, all data views are exposed by the connection handler. If you have a defined a custom list of data views that are exposed by the connection handler, add this data view to the list.

```
$ dpconf set-connection-handler-prop -h host -p port connection-handler \
  data-view-routing-custom-list+:data-view-name
```

Sample Virtual Configurations

The following section provides two sample configurations. These configurations illustrate the main features of a virtual directory, and indicate how these features are configured.

Joining an LDAP Directory and a MySQL Database

The procedures in this section describe a sample virtual configuration that joins an LDAP directory and a MySQL database. The LDAP directory is the primary data source, that contains most of the user information. The MySQL database contains additional information about the users. The resulting configuration is illustrated in the following figure.

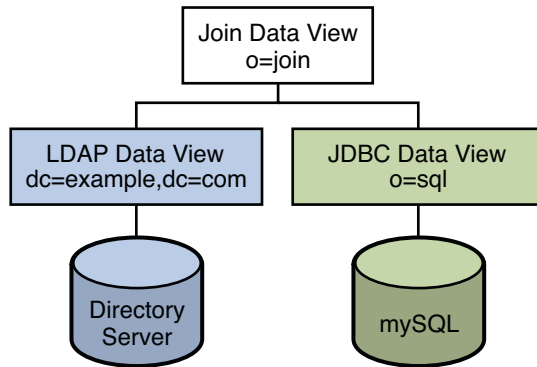


FIGURE 23-1 Sample Virtual Configuration

You can use the sample data provided in *install-path/ds6/ldif/Example.ldif* to duplicate this example, or you can substitute the sample data with your own data.

This configuration can be broken into three sections:

- Configuring and testing the LDAP data view
- Configuring and testing the JDBC data view
- Configuring and testing the join data view

For simplicity, all the commands in this section assume that the Directory Proxy Server is running on the local host in */local/dps*. The commands also assume that the following environment variables have been set:

```

DIR_PROXY_PORT      1389

LDAP_ADMIN_PWF      pwd.txt, a file containing the administrator password.

DIRSERV_PORT        4389

LDAP_ADMIN_USER     cn=Directory Manager
  
```

Configuring and Testing the LDAP Data View

▼ To Configure the LDAP Data View

Before You Begin The tasks in this section assume the following information:

- A Directory Server instance is running on `host1`, on port 4389.
- Data in the Directory Server is stored under the suffix `dc=example,dc=com`. To duplicate this example, create a Directory Server instance, create the suffix `dc=example,dc=com`, and import the sample data in `install-path/ds6/ldif/Example.ldif`.

1 Create an LDAP data source named `myds1` for the Directory Server instance.

```
% dpconf create-ldap-data-source myds1 host1:4389
```

2 Enable the data source, and allow write operations to the data source.

```
% dpconf set-ldap-data-source-prop myds1 is-enabled:true is-read-only:false
```

3 Create an LDAP data source pool named `myds1-pool`.

```
% dpconf create-ldap-data-source-pool myds1-pool
```

4 Attach the LDAP data source to the LDAP data source pool.

```
% dpconf attach-ldap-data-source myds1-pool myds1
```

5 Specify that the data source should receive 100% of the bind, add, search, and modify operations from that data source pool.

```
% dpconf set-attached-ldap-data-source-prop myds1-pool myds1 add-weight:100 \
bind-weight:100 modify-weight:100 search-weight:100
```

6 Create an LDAP data view for the data source pool, named `myds1-view`, with a base DN of `dc=example,dc=com`.

```
% dpconf create-ldap-data-view myds1-view myds1-pool dc=example,dc=com
```

▼ To Test the LDAP Data View

1 As a user under `dc=example,dc=com`, search all entries in the LDAP data source to verify that you can read from the data view.

```
% ldapsearch -p 1389 -D "uid=kvaughan,ou=people,dc=example,dc=com" -w bribery \
-b dc=example,dc=com "objectclass=*"
```

Note – You must use the credentials of a user under `dc=example,dc=com`. If you want to use `cn=Directory Manager`, you must define a data view to handle that DN.

- 2 **As a user under `dc=example,dc=com`, modify the `userPassword` attribute to verify that you can write to the data view.**

```
% ldapmodify -p 1389 -D "uid=kvaughan,ou=people,dc=example,dc=com" -w bribery
dn: uid=kvaughan,ou=people,dc=example,dc=com
changetype: modify
replace: userPassword
userPassword: myNewPassword
```

Note – A default ACI in Directory Server allows users to modify their own passwords.

Configuring and Testing the JDBC Data View

The following tasks assume that a MySQL database is installed, running and populated with data, and that the MySQL database has the following characteristics:

- Database name: `sample_sql`
- Database URL: `host2.example.com:3306/`
- JDBC driver URL: `file:/net/host2.example/local/mysql/lib/jdbc.jar`
- Driver class: `com.mysql.jdbc.Driver`
- Database user: `root`
- Database password file: `mysqlpwd.txt`

The following table describes the tables in the database, and their composite fields. You need this information to set up the JDBC data view.

mySQL Table	Fields
EMPLOYEE	ID, SURNAME,PASSWORD, TITLE, COUNTRY_ID
COUNTRY	ID, NAME
PHONE	USER_ID, NUMBER

▼ To Configure the JDBC Data View

- 1 **Create a JDBC data source named `mysql1` for the SQL database.**

```
% dpconf create-jdbc-data-source -b sample_sql -B jdbc:mysql://host2.example.com:3306 \
-J file:/net/host2.example/local/mysql/lib/jdbc.jar -S com.mysql.jdbc.Driver mysql1
```

- 2 **Specify the user name and password file for the SQL database.**

```
% dpconf set-jdbc-data-source-prop mysql1 db-pwd-file:sqlpwd.txt db-user:root
```

- 3 **Restart the proxy server.**

```
% dpadm restart /local/dps
```


4 Enable the data source, and allow write operations to the data source.

```
% dpconf set-jdbc-data-source-prop mysql1 is-enabled:true is-read-only:false
```

5 Create a JDBC data source pool named `mysql1-pool`.

```
% dpconf create-jdbc-data-source-pool mysql1-pool
```

6 Attach the JDBC data source to the data source pool.

```
% dpconf attach-jdbc-data-source mysql1-pool mysql1
```

7 Create a JDBC data view for the data source pool, named `myjdbc1-view`, with a base DN of `o=sql`.

```
% dpconf create-jdbc-data-view mysql1-view mysql1-pool o=sql
```

8 Create a JDBC table for each table in the MySQL database.

```
% dpconf create-jdbc-table employee1 EMPLOYEE
% dpconf create-jdbc-table country1 COUNTRY
% dpconf create-jdbc-table phone1 PHONE
```

The name of the table in the SQL database is case sensitive. Make sure that you use the same case that is used in the SQL database.

9 Create a JDBC attribute for each column in each table.

Creating a JDBC attribute maps the MySQL column to an LDAP attribute.

```
% dpconf add-jdbc-attr employee1 uid ID
% dpconf add-jdbc-attr employee1 sn SURNAME
% dpconf add-jdbc-attr employee1 userPassword PASSWORD
% dpconf add-jdbc-attr employee1 room ROOM
% dpconf add-jdbc-attr phone1 tel NUMBER
% dpconf add-jdbc-attr country1 country NAME
```

It is not necessary to create JDBC attributes for the `phone1 user_id` and `country1 id` columns, because these columns are used only in the context of the MySQL database. They will not have a corresponding LDAP attribute.

10 Create a JDBC object class for the LDAP `person` object class.

In this step, the `employee1` table is identified as the primary table, and the `country1` and `phone1` tables are identified as secondary tables. The creation of a JDBC object class also requires a DN. In this example, the DN is constructed from the `uid` attribute and the base DN of the data view.

```
% dpconf create-jdbc-object-class mysql1-view person employee1 country1 phone1 uid
```

11 Define the join rules between the primary table and the secondary tables.

A join rule is defined on the secondary table and determines how data from that table is linked to data from the primary table.

```
% dpconf set-jdbc-table-prop country1 filter-join-rule:'ID=${EMPLOYEE.COUNTRY_ID}'
% dpconf set-jdbc-table-prop phone1 filter-join-rule:'USER_ID=${EMPLOYEE.ID}'
```

12 Specify the super class for the JDBC object class.

The super class indicates the LDAP object class from which the JDBC object class inherits attributes.

```
% dpconf set-jdbc-object-class-prop mysql1-view person super-class:top
```

▼ To Create the Required ACIs

Before you can test the JDBC data view, you must enable write access to the data view by configuring ACIs. By default, write access to non-LDAP data views is denied. For the purposes of this example, it is sufficient to add one global ACI that allows users to modify their own passwords.

1 As the Proxy Manager, add a pool of ACIs to the JDBC data source and add a global ACI that allows users to modify their own entries.

```
% ldapmodify -p 1389 -D "cn=proxy manager" -w password
dn: cn=mysql1,cn=virtual access controls
changetype: add
objectclass: acisource
dpsaci: (targetattr="*") (target = "ldap:///o=sql") \
  (version 3.0; acl "enable all access for all users "; allow(all) \
  userdn="ldap:///uid=kvaughan,o=sql";)
cn: mysql1
```

2 Create a connection handler to handle connections to the o=sql domain.

```
% dpconf create-connection-handler mysql1-handler
```

3 Enable the connection handler and configure it to handle all binds from users in the o=sql domain.

```
% dpconf set-connection-handler-prop mysql1-handler is-enabled:true \
  bind-dn-filters:"uid=.*,o=sql"
```

4 Configure the connection handler to use the pool of ACIs added previously.

```
% dpconf set-connection-handler-prop mysql1-handler aci-source:mysql1
```

▼ To Test the JDBC Data View

- 1 As a user under `o=sql`, search the JDBC data source to verify that you can read from the data view.

```
% ldapsearch -p 1389 -D "uid=kvaughan,o=sql" -w mypwd -b o=sql "objectclass=*"

```

Note – You must use the credentials of a user under `o=sql`, or an anonymous bind.

- 2 As a user under `o=sql`, modify the `userPassword` attribute to verify that you can write to the data view.

```
% ldapmodify -p 1389 -D "uid=kvaughan,o=sql" -w mypwd
dn: uid=kvaughan,o=sql
changetype: modify
replace: userPassword
userPassword: myNewpwd

```

Creating and Testing the Join Data View

▼ To Create the Join Data View

- 1 Create a join data view named `myjoin1-view`.

Specifying the LDAP data view as the primary data view, and the JDBC data view as the secondary data view.

```
% dpconf create-join-data-view myjoin1-view myds1-view mysql1-view o=join

```

- 2 Define a join rule on the secondary data view.

The following join rule specifies that the `uid` attribute of entries from the secondary data view should match the `uid` attribute of entries from the primary data view.

```
% dpconf set-jdbc-data-view-prop mysql1-view filter-join-rule:uid='${myds1-view.uid}'

```

- 3 If the filter join rule is set on the join data view, you need to set a virtual transformation rule on the secondary data view to be able to add an entry on the join data view.

```
dpconf add-virtual-transformation secondary-view-name \
write add-attr-value dn uid=\${uid}

```

Note – Without setting this rule, addition of entries to join data view would not be possible.

4 Define the set of attributes that can be read from and written to the primary data view through a join data view.

```
% dpconf set-ldap-data-view-prop mydsl-view viewable-attr:dn viewable-attr:cn \
viewable-attr:sn viewable-attr:givenName viewable-attr:objectClass viewable-attr:ou \
viewable-attr:l viewable-attr:uid viewable-attr:mail viewable-attr:telephoneNumber \
viewable-attr:facsimileTelephoneNumber viewable-attr:roomNumber viewable-attr:userPassword
% dpconf set-ldap-data-view-prop mydsl-view writable-attr:dn writable-attr:cn \
writable-attr:sn writable-attr:givenName writable-attr:objectClass writable-attr:ou \
writable-attr:l writable-attr:uid writable-attr:mail writable-attr:telephoneNumber \
writable-attr:facsimileTelephoneNumber writable-attr:roomNumber writable-attr:userPassword
```

These definitions apply only in the context of the *join* view. By default all attributes can be read and written if you access the LDAP data view directly.

5 Define the set of attributes that can be read from and written to the secondary data view through a join data view.

```
% dpconf set-jdbc-data-view-prop mysql1-view viewable-attr:dn viewable-attr:objectclass \
viewable-attr:sn viewable-attr:room viewable-attr:userpassword viewable-attr:jobtitle \
viewable-attr:country viewable-attr:tel
% dpconf set-jdbc-data-view-prop mysql1-view writable-attr:dn writable-attr:objectclass \
writable-attr:sn writable-attr:room writable-attr:userpassword writable-attr:jobtitle \
writable-attr:country writable-attr:tel
```

These definitions apply only in the context of the *join* view. By default all attributes can be read and written if you access the JDBC data view directly.

▼ To Create the Required ACIs

1 As the proxy manager, add a global ACI that allows anonymous access to the join data view.

```
% ldapmodify -p 1389 -D "cn=proxy manager" -w password
dn: cn=myjoin1,cn=virtual access controls
changetype: add
objectclass: acisource
dpsaci: (targetattr="*") (target = "ldap:///o=join") \
(version 3.0; acl "anonymous_access"; allow(all) userdn="ldap:///anyone");
cn: myjoin1
```

2 Create a connection handler to handle connections to the o=join domain.

```
% dpconf create-connection-handler myjoin1-handler
```

3 Enable the connection handler and configure it to handle all binds from users under o=join.

```
% dpconf set-connection-handler-prop myjoin1-handler is-enabled:true \
bind-dn-filters:"uid=.*,ou=people,o=join"
```

4 Configure the connection handler to use the pool of ACIs added previously.

```
% dpconf set-connection-handler-prop myjoin1-handler aci-source:myjoin1
```

▼ To Test the Join Data View

1 As an anonymous user, search the join data view.

In this step, we search Kirsten Vaughan's entry to see whether data from both join views is retrieved.

```
% ldapsearch -p 1389 -b o=join "uid=kvaughan"
```

Note that the returned entry includes the attributes from both the LDAP data view and the JDBC data view.

2 As a user under o=join, modify the userPassword attribute to verify that you can write to the join data view.

```
% ldapmodify -p 1389 -D "uid=kvaughan,ou=people,o=join" -w myNewPassword
dn: uid=kvaughan,ou=people,o=join
changetype: modify
replace: userPassword
userPassword: myPassword
```

Joining Multiple Disparate Data Sources

This configuration describes an organization, Example.com, whose specific directory service requirements are met by some of the features of a virtual directory.

Data Storage Scenario

Example.com stores organizational data in multiple disparate data sources. For legacy reasons, user data is spread across an LDAP directory, a flat LDIF file, and an SQL database. The HR department stores user data in an LDAP directory, with a base DN of o=example.com. The Payroll department stores data in an SQL database. Administrative data such as departments and building numbers is stored by the administration department in an LDIF file, with a base DN of dc=example,dc=com.

In addition, Example.com has acquired a company named Company22. Company 22 also stores its user data in an LDAP directory, with a base DN of dc=company22,dc=com.

The following diagram provides a high level view of how Example.com's user data is stored.

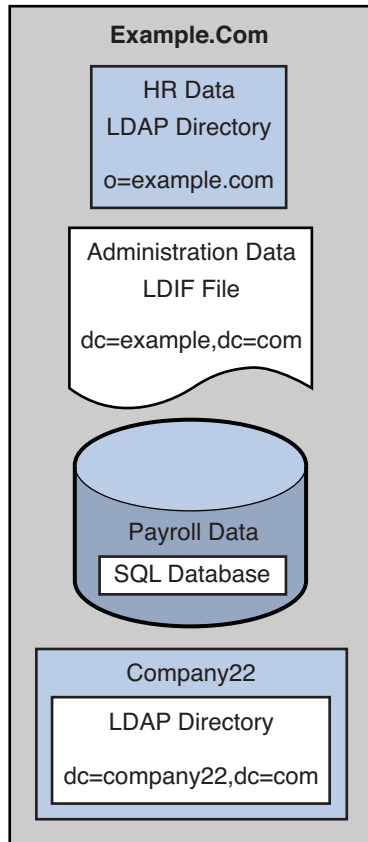


FIGURE 23-2 Data Storage In Disparate Sources

Client Application Requirements

Example.com has several LDAP client applications that require access to the data stored in the disparate data sources. The requirements of the client applications are not all the same. Different views of the data are required. In some cases, the clients require the data to be aggregated. In addition, some client applications require access to Company22's user data so that these new employees of Example.com can be administered along with the old employees.

The following diagram provides a high level view of Example.com's client application requirements.

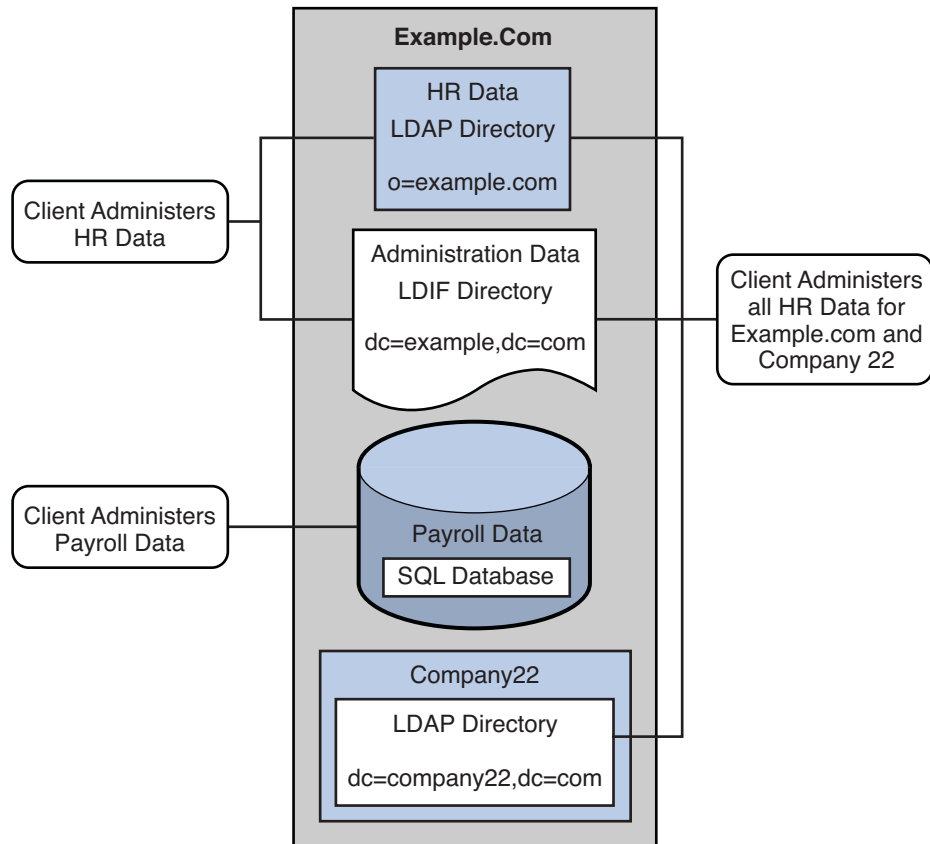


FIGURE 23-3 Client Application Requirements

The following sections walk you through sufficient configuration Directory Proxy Server data views to meet the client application requirements described in this sample scenario. For information about how data views work, see Chapter 17, “Directory Proxy Server Distribution,” in *Sun Java System Directory Server Enterprise Edition 6.2 Reference* and Chapter 18, “Directory Proxy Server Virtualization,” in *Sun Java System Directory Server Enterprise Edition 6.2 Reference*.

The configuration of the sample scenario is divided into the following sections:

- “Aggregate Data From the HR LDAP Directory and the Administration LDIF File” on page 424
- “Add Data From Company 22 to Example.Com's DIT by Renaming the DN” on page 426
- “Add Company 22's Data to the HR Data” on page 428
- “Enable LDAP Clients to Access the Payroll Data in an SQL Database” on page 429
- “Add Virtual Access Control” on page 431

Aggregate Data From the HR LDAP Directory and the Administration LDIF File

The HR department stores information such as employee names, job start data, and job level. The administration department stores additional data such as building codes and office numbers. The client application that handles the HR data requires access to the combined data from both sources. Both data sources have a common attribute, the `employeeNumber` that exists in each entry.

The following diagram illustrates the requirements of the client application.

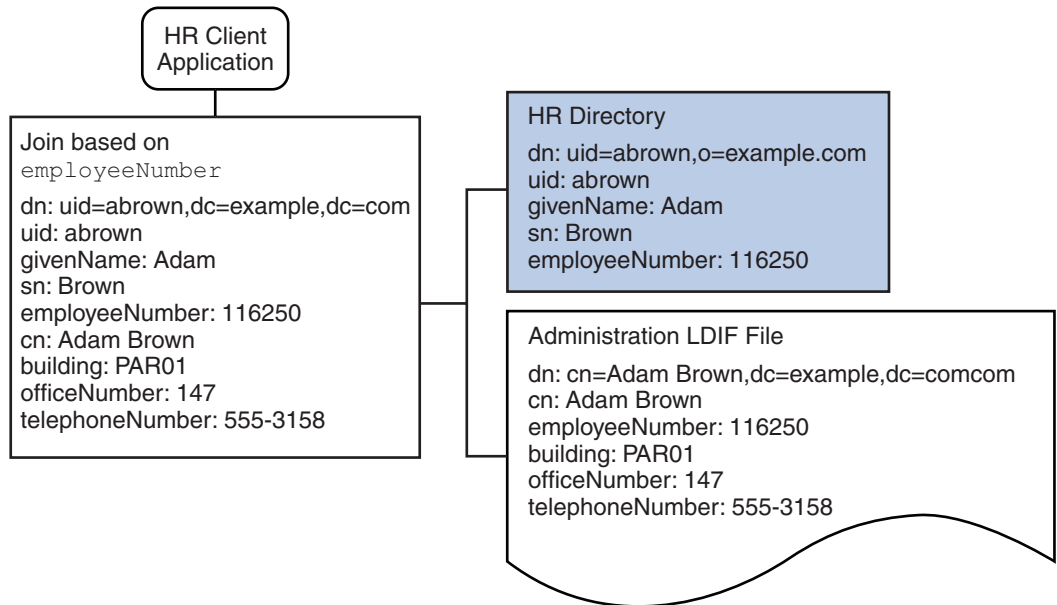


FIGURE 23-4 Aggregation of Data From LDAP Directory and LDIF File

To fulfill this application requirement, a data view is created for the payroll directory and for the administration LDIF file. These two data views are then joined to provide access to the aggregated data. This common attribute enables Directory Proxy Server to aggregate the data for each user.

For simplicity, the commands used in this section assume the following information:

- A Directory Proxy Server instance runs on the local host, with the default LDAP port (389).
- The Directory Proxy Server instance is located at `/local/myDPS`.
- The path to the file containing the Proxy Manager password has been set as a variable, `LDAP_ADMIN_PWF`. For more information about setting Directory Proxy Server environment variables, see “Environment Variables” in *Sun Java System Directory Server Enterprise Edition 6.2 Installation Guide*.

- The payroll LDAP directory runs on a host named `payrollHost`, on port 2389.
- The LDIF file used to store the administration data is named `example.ldif`.

To obtain the complete syntax of each command, run the command without any options. For example:

```
$ dpconf create-ldap-data-view
Operands are missing
Usage: dpcfg create-ldap-data-view VIEW_NAME POOL_NAME SUFFIX_DN
```

▼ Create and Enable an LDAP Data View for the Payroll Directory

1 Create an LDAP data source for the payroll directory.

```
$ dpconf create-ldap-data-source payroll-directory payrollHost:2389
```

2 Create an LDAP data source pool for the payroll directory.

```
$ dpconf create-ldap-data-source-pool payroll-pool
```

3 Attach the payroll data source to the data source pool.

```
$ dpconf attach-ldap-data-source payroll-pool payroll-directory
```

4 Configure the weights of the attached data source.

```
$ dpconf set-attached-ldap-data-source-prop -h payrollHost -p 2389 \
payroll-pool payroll-directory add-weight:2 \
bind-weight:2 compare-weight:2 delete-weight:2 \
modify-dn-weight:2 modify-weight:2 search-weight:2
```

5 Create an LDAP data view for the payroll directory.

```
$ dpconf create-ldap-data-view payroll-view payroll-pool o=example.com
```

6 Enable the LDAP data view so that client requests can be routed to this data view.

```
$ dpconf set-ldap-data-view-prop payroll-view is-enabled:true
```

7 Restart Directory Proxy Server for the changes to take effect.

```
$ dpadm restart /local/myDPS
```

▼ Create and Enable an LDIF Data View for the Administration Data

1 Create an LDIF data view for the administration data.

```
$ dpconf create-ldif-data-view admin-view example.ldif dc=example,dc=com
```

2 Enable the LDIF data view for the administration data.

```
$ dpconf set-ldif-data-view-prop admin-view is-enabled:true
```

3 Specify that the admin view contains entries that are used by more than one entry in the payroll view.

```
$ dpconf set-ldif-data-view-prop admin-view contains-shared-entries:true
```

When this property is set to TRUE, deleting an entry in the payroll data view will not result in the deletion of the shared entry in the admin data view. Adding an entry to the payroll data view will only add the entry to the secondary data view if it does not already exist.

4 Restart Directory Proxy Server for the changes to take effect.

```
$ dpadm restart /local/myDPS
```

▼ Join the Payroll Data View and the Admin Data View**1 Create a filter join rule on the admin data view that specifies how the data should be aggregated.**

The following join rule specifies that data should be joined based on the `employeeNumber` attribute of the user entry.

```
$ dpconf set-ldif-data-view-prop admin-view \  
filter-join-rule:'employeeNumber=\${payroll-view.employeeNumber}'
```

2 Create a join data view that aggregates the two data views.

For the join data view, the organization uses the suffix DN `dc=example,dc=com`.

```
$ dpconf create-join-data-view example-join-view payroll-view admin-view \  
dc=example,dc=com
```

Add Data From Company 22 to Example.Com's DIT by Renaming the DN

The user data for Company 22 is stored under the DN `dc=company22,dc=com`. While Example.com wants to keep this user data separate in most cases, one client application needs to administer Company 22 employees along with the rest of the Example.com employees. This client application requires Company 22's user data to *look like* Example.com data.

The following diagram illustrates the requirements of the client application.

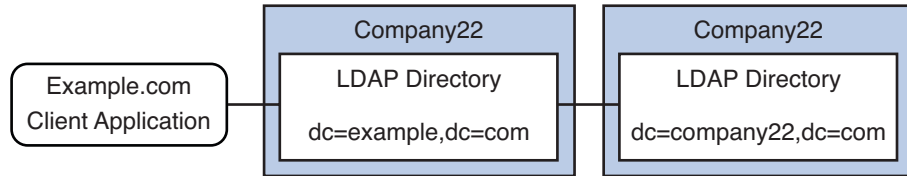


FIGURE 23-5 DN Renaming

To fulfill this application requirement, a data view with a virtual DN of `dc=example,dc=com` is created for the Company 22's directory.

For simplicity, the commands used in this section assume the following information:

- A Directory Proxy Server instance runs on the local host, with the default LDAP port (389).
- The Directory Proxy Server instance is located at `/local/myDPS`.
- The path to the file containing the Proxy Manager password has been set as a variable, `LDAP_ADMIN_PWF`. For more information about setting Directory Proxy Server environment variables, see “Environment Variables” in *Sun Java System Directory Server Enterprise Edition 6.2 Installation Guide*.
- The Company 22 LDAP directory runs on a host named `company22Host`, on port 2389.

▼ Create a Data View For Company 22's Directory With a Virtual DN

1 Create an LDAP data source for Company 22's directory.

```
$ dpconf create-ldap-data-source company22-directory company22Host:2389
```

2 Create an LDAP data source pool for Company 22's directory.

```
$ dpconf create-ldap-data-source-pool company22-pool
```

3 Attach Company 22's data source to the data source pool.

```
$ dpconf attach-ldap-data-source company22-pool company22-directory
```

4 Configure the weights of the attached data source.

```
$ dpconf set-attached-ldap-data-source-prop -h company22Host -p 2389 \
company22-pool company22-directory add-weight:2 \
bind-weight:2 compare-weight:2 delete-weight:2 \
modify-dn-weight:2 modify-weight:2 search-weight:2
```

5 Create an LDAP data view for Company 22's directory with a virtual DN of `dc=example,dc=com`.

```
$ dpconf create-ldap-data-view company22-view company22-pool dc=example,dc=com
```

- 6 **Instruct Directory Proxy Server to map this virtual DN to the real DN that is in Company 22's directory.**

```
$ dpconf set-ldap-data-view-prop company22-view \  
dn-mapping-source-base-dn:dc=company22,dc=com
```

- 7 **Enable the LDAP data view for Company 22's directory so that client requests can be routed to this data view.**

```
$ dpconf set-ldap-data-view-prop company22-view is-enabled:true
```

- 8 **Restart Directory Proxy Server for the changes to take effect.**

```
$ dpadm restart /local/myDPS
```

Add Company 22's Data to the HR Data

The HR department requires an aggregated view of the HR data for Example.com and the newly acquired Company 22. The following diagram illustrates the requirements of the global HR application.

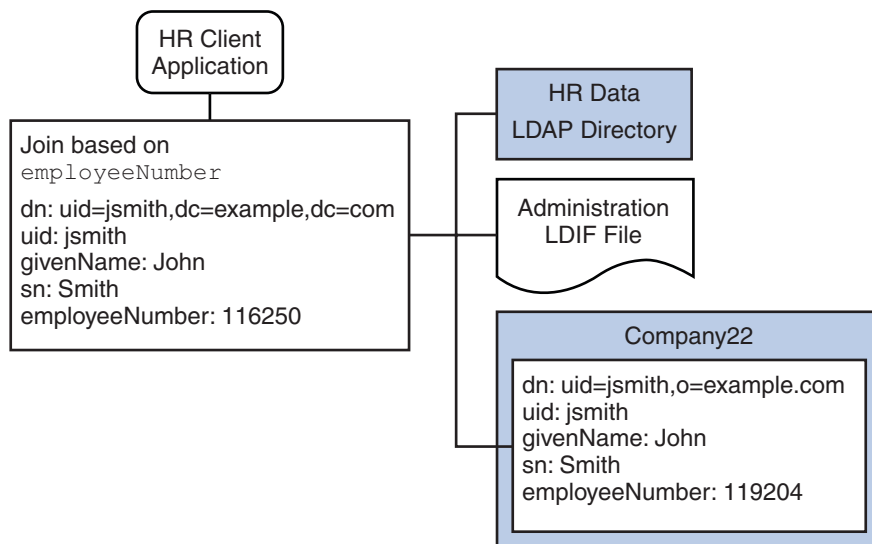


FIGURE 23-6 Aggregation of Data From Join Data View and LDAP Data View

▼ Join the Example Join Data View and the Company 22 Data View

- 1 **Create a filter join rule on the Company 22 data view that specifies how the data should be aggregated.**

The following join rule specifies that data should be joined based on the `employeeNumber` attribute of the user entry.

```
$ dpconf set-ldif-data-view-prop company22-view \
filter-join-rule:'employeeNumber=\${example-join-view.employeeNumber}'
```

- 2 **Create a join data view that aggregates Company 22's data view and Example.com's join data view.**

```
$ dpconf create-join-data-view global-join-view example-join-view \
company22-view dc=example,dc=com
```

Enable LDAP Clients to Access the Payroll Data in an SQL Database

Example.com's payroll department stores salary data in an SQL database. The database has two tables, an `employee` table and a `salary` table. Example.com has an LDAP client application that requires access to that data. The client application requires the SQL data to *look like* LDAP data.

The following diagram illustrates the requirements of the client application.

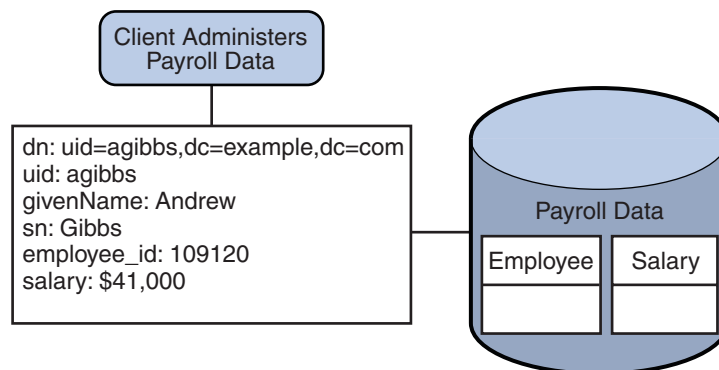


FIGURE 23-7 JDBC Dataview Providing Access to an SQL Database

To fulfill this application requirement, a JDBC data view is created that maps columns in the SQL tables to LDAP attributes.

For simplicity, the commands used in this section assume the following information:

- A Directory Proxy Server instance runs on the local host, with the default LDAP port (389).
- The Directory Proxy Server instance is located at `/local/myDPS`.

- The path to the file containing the Proxy Manager password has been set as a variable, LDAP_ADMIN_PWF. For more information about setting Directory Proxy Server environment variables, see “Environment Variables” in *Sun Java System Directory Server Enterprise Edition 6.2 Installation Guide*.
- The SQL database is up and running.
- The JAVA_HOME variable has been set to the correct Java path.
- The password to the SQL database is myPassword stored in the myPasswordField file.

▼ Create a JDBC Data View For Example.com's Payroll Database

1 Create a JDBC data source for the payroll database.

```
$ dpconf create-jdbc-data-source -b payrollsqldb \
  -B jdbc:payrollsqldb:payrollsql://localhost/ \
  -J file://payrollsqldb.jar \
  -S org.payrollsqldb.jdbcDriver payroll-src
```

2 Configure the JDBC data source with the properties of the SQL database.

```
$ dpconf set-jdbc-data-source-prop payroll-src \
  db-user:proxy
  db-pwd-file:password-file-location/myPasswordField
```

3 Enable the JDBC data source.

```
$ dpconf set-jdbc-data-source-prop payroll-src is-enabled:true
```

4 Create a JDBC data source pool for the payroll database.

```
$ dpconf create-jdbc-data-source-pool payroll-pool
```

5 Attach the payroll data source to the data source pool.

```
$ dpconf attach-jdbc-data-source payroll-pool payroll-src
```

6 Create a JDBC data view for the payroll database, with a virtual DN of o=payroll.

```
$ dpconf create-jdbc-data-view payroll-view payroll-pool o=payroll
```

7 Create a JDBC table for each table in the SQL database.

```
$ dpconf create-jdbc-table jdbc-employee employee
$ dpconf create-jdbc-table jdbc-salary salary
```

8 Add a JDBC attribute for each column in the SQL tables.

```
$ dpconf add-jdbc-attr jdbc-employee eid employee_id
$ dpconf add-jdbc-attr jdbc-employee first firstname
$ dpconf add-jdbc-attr jdbc-employee last lastname
$ dpconf add-jdbc-attr jdbc-employee description description
```

```
$ dpconf add-jdbc-attr jdbc-employee spouse spousesname
$ dpconf add-jdbc-attr jdbc-salary salary salary
$ dpconf add-jdbc-attr jdbc-salary social ssn
```

9 Specify which attributes can be viewed and which can be written, through the JDBC data view.

```
$ dpconf set-jdbc-data-view-prop payroll-view \
viewable-attr:eid \
viewable-attr:first \
viewable-attr:last \
viewable-attr:desc \
viewable-attr:spouse \
viewable-attr:salary \
viewable-attr:social
$ dpconf set-jdbc-data-view-prop payroll-view \
writable-attr:eid \
writable-attr:first \
writable-attr:last \
writable-attr:description \
writable-attr:spouse \
writable-attr:salary \
writable-attr:social
```

10 Create a JDBC object class that maps to an LDAP object class.

The following command creates an object class that maps to the LDAP person object class. The object class specifies that the employee table should be used as the primary table, and that the salary table should be used as the secondary table. The `eid` attribute should be used to construct the DN.

```
$ dpcfg create-jdbc-object-class payroll-view \
person jdbc-employee jdbc-salary eid
```

11 Create a filter join rule on the secondary table that specifies how data from the secondary table should be linked to data from the primary table.

The following join rule specifies that data should be joined based on the `employee_id` attribute.

```
$ dpconf set-jdbc-table-prop jdbc-salary \
filter-join-rule:'employee_id=\${employee.employee_id}'
```

12 Create a super class on the JDBC object class.

```
$ set-jdbc-object-class-prop payroll-view person super-class:extensibleObject
```

Add Virtual Access Control

Access control on LDAP directories is handled by defining ACIs in the directories themselves. When data sources are accessed through virtual data views, ACIs must be defined that apply only to the data viewed through these data views.

Any access that goes through Directory Proxy Server is controlled by a *connection handler*. For information about connection handlers, see [Chapter 25, “Connections Between Clients and Directory Proxy Server.”](#)

▼ Add an ACI That Allows Anonymous Access

1 Add the ACI.

```
$ ldapadd -v -D "cn=proxy manager" -w password -p 389
dn: cn=ldifonly-acis,cn=virtual access controls
objectclass: top
objectclass: aciSource
cn: ldifonly-acis
dpsaci: (targetattr="*)(version 3.0; acl "anonymous_access"; allow(all) \
(userdn="ldap:///anyone");)
```

2 Point the connection handler to the virtual ACI.

```
$ dpconf set-connection-handler-prop anonymous aci-source:ldifonly-acis
```

3 Enable the connection handler.

```
$ dpconf set-connection-handler-prop anonymous is-enabled:true
```


Connections Between Directory Proxy Server and Back-End LDAP Servers

This chapter describes how to configure connections between Directory Proxy Server and back-end LDAP servers. The chapter covers the following topics:

- “Configuring Connections Between Directory Proxy Server and Back-End LDAP Servers” on page 433
- “Configuring SSL Between Directory Proxy Server and Back-End LDAP Servers” on page 435
- “Choosing SSL Ciphers and SSL Protocols for Directory Proxy Server” on page 436
- “Forwarding Requests to Back-End LDAP Servers” on page 437

Configuring Connections Between Directory Proxy Server and Back-End LDAP Servers

When an LDAP data source is created, the number of default connections opened for the LDAP data source are six, that is, two for each read, bind, and write operations respectively. To verify the default connections, type the following command:

```
dpconf get-ldap-data-source-prop src-name num-read-init num-write-init num-bind-init
num-bind-init   : 2
num-read-init   : 2
num-write-init  : 2
```

The number of connections increases automatically when the traffic increases.

For information about how to configure connections between Directory Proxy Server and back-end LDAP servers, see the following procedures:

▼ To Configure the Number of Connections Between Directory Proxy Server and Back-End LDAP Servers

Note – This procedure configures the number of connections for bind operations. To configure the number of connections for read or write operations, perform the same procedure but replace `bind` with `read` or `write`.

You can use DSCC to perform this task. For information, see “[Directory Service Control Center Interface](#)” on page 43 and the DSCC online help.

1 Configure the initial number of connections between Directory Proxy Server and a back-end LDAP server for bind operations.

```
$ dpconf set-ldap-data-source-prop -h host -p port data-source-name \  
  num-bind-init:new-value
```

2 Configure the increment of connections for bind operations.

The increment is the number of connections that are added each time more than the current number of connections are requested.

```
$ dpconf set-ldap-data-source-prop -h host -p port data-source-name \  
  num-bind-incr:new-value
```

3 Configure the maximum number of connections for bind operations.

When this maximum number of connections is reached, no more connections can be added.

```
$ dpconf set-ldap-data-source-prop -h host -p port data-source-name \  
  num-bind-limit:new-value
```

▼ To Configure Connection Timeout

You can use DSCC to perform this task. For information, see “[Directory Service Control Center Interface](#)” on page 43 and the DSCC online help.

● Configure the maximum length of time that Directory Proxy Server can attempt to connect to a data source.

```
$ dpconf set-ldap-data-source-prop -h host -p port data-source-name \  
  connect-timeout:new-value
```

For example, configure the connection timeout to 10 milliseconds.

```
$ dpconf set-ldap-data-source-prop -h host1 -p 1389 data-source-name connect-timeout:10
```

▼ To Configure Connection Pool Wait Timeout

You can use DSCC to perform this task. For information, see [“Directory Service Control Center Interface” on page 43](#) and the DSCC online help.

- **Configure the maximum length of time that Directory Proxy Server can wait for an established connection in a connection pool to become available.**

```
$ dpconf set-server-prop -h host -p port data-source-name \
  connection-pool-wait-timeout:value
```

For example, configure the timeout to 20 seconds.

```
$ dpconf set-ldap-data-source-prop -h host1 -p 1389 data-source-name \
  connection-pool-wait-timeout:20000
```

Configuring SSL Between Directory Proxy Server and Back-End LDAP Servers

The following procedure describes how to configure SSL between Directory Proxy Server and back-end LDAP servers.

▼ To Configure SSL Between Directory Proxy Server and a Back-End LDAP Server

You can use DSCC to perform this task. For information, see [“Directory Service Control Center Interface” on page 43](#) and the DSCC online help.

- 1 **Configure a secure port between Directory Proxy Server and the back-end LDAP server.**

```
$ dpconf set-ldap-data-source-prop -h host -p port data-source-name \
  ldaps-port:port-number
```

- 2 **Configure when SSL is used for connections between Directory Proxy Server and the back-end LDAP server.**

```
$ dpconf set-ldap-data-source-prop -h host -p port data-source-name ssl-policy:value
```

- If *value* is `always`, SSL is always used for connections.
- If *value* is `client`, SSL is used if the client is using SSL.

If the connection is not using SSL, you can promote the connection to SSL by using the `startTLS` command.

- 3 **Choose the protocols and ciphers for SSL as described in [“Choosing SSL Ciphers and SSL Protocols for Directory Proxy Server” on page 436](#).**

- 4 **Configure Directory Proxy Server to validate an SSL server certificate from the back-end LDAP server.**

For information, see [“To Add a Certificate From a Back-End Directory Server to the Certificate Database on Directory Proxy Server”](#) on page 354.

- 5 **If the back-end LDAP server requests a certificate from Directory Proxy Server, configure Directory Proxy Server to send an SSL client certificate.**

For information, see [“Exporting a Certificate to a Back-End LDAP Server”](#) on page 355.

- 6 **Restart the instance of Directory Proxy Server for the changes to take effect.**

For information about restarting Directory Proxy Server, see [“To Restart Directory Proxy Server”](#) on page 334.

Choosing SSL Ciphers and SSL Protocols for Directory Proxy Server

The ciphers and protocols that can be used by Directory Proxy Server depend on the Java™ Virtual Machine (JVM™) that is being used. By default, Directory Proxy Server uses the default ciphers and protocols that are enabled for the JVM machine.

▼ To Choose the List of Ciphers and Protocols

Use this procedure to retrieve the supported ciphers and protocols, and the enabled ciphers and protocols. If a cipher or protocol is supported, you can enable or disable it.

You can use DSCC to perform this task. For information, see [“Directory Service Control Center Interface”](#) on page 43 and the DSCC online help.

- 1 **View the list of supported ciphers and protocols.**

```
$ dpconf get-server-prop -h host -p port supported-ssl-cipher-suites \
supported-ssl-protocols
```

- 2 **View the list of enabled ciphers and protocols.**

```
$ dpconf get-server-prop -h host -p port enabled-ssl-cipher-suites \
enabled-ssl-protocols
```

- 3 **Enable one or more supported ciphers or protocols.**

- a. **Enable one or more supported ciphers.**

```
$ dpconf set-server-prop -h host -p port \
enabled-ssl-cipher-suites:supported-ssl-cipher-suite \
```

```
[enabled-ssl-cipher-suites:supported-ssl-cipher-suite ...]
```

To add a cipher to an existing list of supported ciphers, use this command:

```
$ dpconf set-server-prop -h host -p port \
  enabled-ssl-cipher-suites+:supported-ssl-cipher-suite
```

b. Enable one or more supported protocols.

```
$ dpconf set-server-prop -h host -p port \
  enabled-ssl-cipher-protocols:supported-ssl-cipher-protocol \
  [enabled-ssl-cipher-protocols:supported-ssl-cipher-protocol ...]
```

To add a protocol to an existing list of supported protocols, use this command:

```
$ dpconf set-server-prop -h host -p port \
  enabled-ssl-cipher-protocols+:supported-ssl-cipher-protocol
```

4 (Optional) Disable a supported cipher or protocol.

```
$ dpconf set-server-prop -h host -p port \
  enabled-ssl-cipher-protocols-:supported-ssl-cipher-protocol
```

Forwarding Requests to Back-End LDAP Servers

This section contains information about the various methods you can use to forward requests from Directory Proxy Server to back-end LDAP servers.

Forwarding Requests With Bind Replay

For information about bind replay for client credentials in Directory Proxy Server, see “Directory Proxy Server Configured for BIND Replay” in *Sun Java System Directory Server Enterprise Edition 6.2 Reference*. The following procedure describes how to forward requests from Directory Proxy Server to a back-end LDAP server by using bind replay.

▼ To Forward Requests With Bind Replay

You can use DSCC to perform this task. For information, see “[Directory Service Control Center Interface](#)” on [page 43](#) and the DSCC online help.

- **Configure the data source client credentials to authenticate to a back-end LDAP server by using the credentials provided by a client.**

```
$ dpconf set-ldap-data-source-prop -h host -p port data-source-name \
  client-cred-mode:use-client-identity
```

Forwarding Requests With Proxy Authorization

For information about proxy authorization in Directory Proxy Server, see “Directory Proxy Server Configured for Proxy Authorization” in *Sun Java System Directory Server Enterprise Edition 6.2 Reference*.

This section contains procedures for forwarding requests by using proxy authorization and by using a proxy authorization control.

▼ To Forward Requests by Using Proxy Authorization

1 Configure the data source to expect proxy authorization controls of either version 1 or version 2.

For example, configure the data source to expect proxy authorization controls of version 1.

```
$ dpconf set-ldap-data-source-prop -h host -p port data-source-name \  
  proxied-auth-use-v1:true
```

Alternatively, configure the data source to expect proxy authorization controls of version 2.

```
$ dpconf set-ldap-data-source-prop -h host -p port data-source-name \  
  proxied-auth-use-v1:false
```

2 Configure the data source to authenticate to a back-end LDAP server by using proxy authorization.

```
$ dpconf set-ldap-data-source-prop -h host -p port data-source-name \  
  client-cred-mode:use-proxy-auth
```

To configure a data source to authenticate to a back-end LDAP server by using proxy authorization for write operations only, run this command:

```
$ dpconf set-ldap-data-source-prop -h host -p port data-source-name \  
  client-cred-mode:use-proxy-auth-for-write
```

When write operations only are performed with a proxy authorization control, the client identity is not forwarded to the LDAP server for read requests. For more information about forwarding requests without the client identity, see [“Forwarding Requests Without the Client Identity” on page 439](#).

3 Configure the data source with the bind credentials of Directory Proxy Server.

```
$ dpconf set-ldap-data-source-prop -h host -p port data-source-name \  
  bind-dn:DPS-bind-dn bind-pwd-file:filename
```

4 Configure the data source with the timeout.

```
$ dpconf set-ldap-data-source-prop -h host -p port data-source-name \  
  proxied-auth-check-timeout:value
```

Directory Proxy Server verifies that the client DN has the relevant ACIs for proxy authorization by using the `getEffectiveRights` command. The result is cached in Directory Proxy Server and renewed when the `proxied-auth-check-timeout` expires.

- 5 **If necessary, restart the instance of Directory Proxy Server for the changes to take effect.**

For information about restarting Directory Proxy Server, see [“To Restart Directory Proxy Server” on page 334](#).

▼ **To Forward Requests by Using Proxy Authorization When the Request Contains a Proxy Authorization Control**

You can use DSCC to perform this task. For information, see [“Directory Service Control Center Interface” on page 43](#) and the DSCC online help.

- **Configure Directory Proxy Server to accept proxy authorization controls of version 1, version 2, or both.**

```
$ dpconf set-server-prop -h host -p port allowed-ldap-controls:proxy-auth-v1 \
  allowed-ldap-controls:proxy-auth-v2
```

Forwarding Requests Without the Client Identity

The following procedure describes how to forward requests from Directory Proxy Server to a back-end LDAP server without forwarding the client identity.

▼ **To Forward Requests Without the Client Identity**

You can use DSCC to perform this task. For information, see [“Directory Service Control Center Interface” on page 43](#) and the DSCC online help.

- 1 **Configure the data source to authenticate to a back-end LDAP server by using the credentials of Directory Proxy Server.**

```
$ dpconf set-ldap-data-source-prop -h host -p port data-source-name \
  client-cred-mode:use-specific-identity
```

- 2 **Configure the data source with the bind credentials of Directory Proxy Server.**

```
$ dpconf set-ldap-data-source-prop -h host -p port data-source-name \
  bind-dn:bind-dn-of-DPS bind-pwd-file:filename
```

- 3 **If necessary, restart the instance of Directory Proxy Server for the changes to take effect.**

For information about restarting Directory Proxy Server, see [“To Restart Directory Proxy Server” on page 334](#).

Forwarding Requests as an Alternate User

This section contains information about how to forward requests as an alternate user.

▼ To Configure Remote User Mapping

You can use DSCC to perform this task. For information, see [“Directory Service Control Center Interface” on page 43](#) and the DSCC online help.

1 Enable operations to be forwarded with an alternate user.

```
$ dpconf set-server-prop -h host -p port enable-user-mapping:true
```

2 Specify the name of the attribute that contains the ID for remote mapping.

```
$ dpconf set-server-prop -h host -p port \  
  remote-user-mapping-bind-dn-attr:attribute-name
```

3 Enable Directory Proxy Server to map the client ID remotely.

```
$ dpconf set-server-prop -h host -p port enable-remote-user-mapping:true
```

4 Configure the default mapping.

```
$ dpconf set-server-prop -h host -p port \  
  user-mapping-default-bind-dn:default-mapping-bind-dn \  
  user-mapping-default-bind-pwd-file:filename
```

If the mapped identity is not found on the remote LDAP server, the client identity is mapped to the default identity.

5 Configure the user mapping in the entry for the client on the remote LDAP server.

For information about configuring user mapping in Directory Server, see [“Proxy Authorization” on page 154](#).

▼ To Configure Local User Mapping

You can use DSCC to perform this task. For information, see [“Directory Service Control Center Interface” on page 43](#) and the DSCC online help.

1 Enable operations to be forwarded with an alternate user.

```
$ dpconf set-server-prop -h host -p port enable-user-mapping:true
```

2 Ensure that Directory Proxy Server is not configured to map the client ID remotely.

```
$ dpconf set-server-prop -h host -p port enable-remote-user-mapping:false
```


3 Configure the default mapping.

```
$ dpconf set-server-prop -h host -p port \
  user-mapping-default-bind-dn:default-mapping-bind-dn \
  user-mapping-default-bind-pwd-file:filename
```

The client ID is mapped to this DN if the mapping on the remote LDAP server fails.

4 If you permit unauthenticated users to perform operations, configure the mapping for unauthenticated clients.

```
$ dpconf set-server-prop -h host -p port \
  user-mapping-anonymous-bind-dn:anonymous-mapping-bind-dn \
  user-mapping-anonymous-bind-pwd-file:filename
```

For information about how to permit unauthenticated users to perform operations, see [“To Configure Anonymous Access” on page 457](#).

5 Configure the ID of the client.

```
$ dpconf set-user-mapping-prop -h host -p port \
  user-bind-dn:client-bind-dn user-bind-pwd-file:filename
```

6 Configure the ID of the alternate user.

```
$ dpconf set-user-mapping-prop -h host -p port \
  mapped-bind-dn:alt-user-bind-dn mapped-bind-pwd-file:filename
```

▼ To Configure User Mapping for Anonymous Clients

You can use DSCC to perform this task. For information, see [“Directory Service Control Center Interface” on page 43](#) and the DSCC online help.

● Configure the mapping for unauthenticated clients.

```
$ dpconf set-server-prop -h host -p port \
  user-mapping-anonymous-bind-dn:anonymous-mapping-bind-dn \
  user-mapping-anonymous-bind-pwd-file:filename
```

The mapping for anonymous clients is configured in Directory Proxy Server because the remote LDAP server does not contain an entry for an anonymous client.

For information about permitting unauthenticated users to perform operations, see [“To Configure Anonymous Access” on page 457](#).

Connections Between Clients and Directory Proxy Server

For an overview of the connections between clients and Directory Proxy Server, connection handlers, and a description of the criteria and policies used in connection handlers, see Chapter 20, “Connections Between Clients and Directory Proxy Server,” in *Sun Java System Directory Server Enterprise Edition 6.2 Reference*.

This chapter covers the following topics:

- “Creating, Configuring, and Deleting Connection Handlers” on page 443
- “Creating and Configuring Request Filtering Policies and Search Data Hiding Rules” on page 447
- “Creating and Configuring a Resource Limits Policy” on page 450
- “Configuring Directory Proxy Server as a Connection Based Router” on page 452

Creating, Configuring, and Deleting Connection Handlers

For information about how to create, configure, and delete connection handlers, and to configure affinity for data views, see the following procedures.

▼ To Create a Connection Handler

You can use DSCC to perform this task. For information, see “[Directory Service Control Center Interface](#)” on page 43 and the DSCC online help.

1 Create a connection handler.

```
$ dpconf create-connection-handler -h host -p port connection-handler-name
```

2 (Optional) View the list of connection handlers.

```
$ dpconf list-connection-handlers -h host -p port
```

▼ To Configure a Connection Handler

Before You Begin The properties of a connection handler must be defined in relation to the properties of the other connection handlers that are defined for the Directory Proxy Server instance. Consider the properties of all of your connection handlers to ensure that they specify different sets of criteria and are prioritized correctly.

You can use DSCC to perform this task. For information, see [“Directory Service Control Center Interface” on page 43](#) and the DSCC online help.

1 View a verbose list of connection handlers to see their key properties and relative priorities.

```
$ dpconf list-connection-handlers -h host -p port -v
Name                               is-enabled priority description
-----
anonymous                          false      99      unauthenticated connections
default connection handler         true       100     default connection handler
```

The connection handlers `anonymous` and `default connection handler` are created when you create an instance of Directory Proxy Server.

2 View all of the properties of one connection handler.

```
$ dpconf get-connection-handler-prop -h host -p port connection-handler-name
```

The default properties of a new connection handler are as follows:

```
aci-source                : -
allowed-auth-methods     : anonymous
allowed-auth-methods     : sasl
allowed-auth-methods     : simple
allowed-ldap-ports       : ldap
allowed-ldap-ports       : ldaps
bind-dn-filters           : any
data-view-routing-custom-list : -
data-view-routing-policy : all-routable
description               : -
domain-name-filters      : any
enable-data-view-affinity : false
ip-address-filters       : any
is-enabled                : false
is-ssl-mandatory         : false
priority                 : 99
request-filtering-policy  : no-filtering
resource-limits-policy    : no-limits
schema-check-enabled     : false
user-filter               : any
```

3 Configure the priority of the connection handler.

```
$ dpconf set-connection-handler-prop -h host -p port connection-handler-name priority:value
```

The priority can be any number from 1 to 100, where 1 is the highest priority. For an instance of Directory Proxy Server, the connection handlers are evaluated in order of priority.

4 (Optional) Specify the DN filtering property of the connection handler.

This property enables you to control access based on part or all of the bind DN. The value of the property is a regular expression.

```
$ dpconf set-connection-handler-prop -h host -p port connection-handler-name \
  bind-dn-filters:regular-expression
```

The bind DN filter takes the form of a Java™ regular expression. For information about creating Java regular expressions, see

<http://java.sun.com/j2se/1.4.2/docs/api/java/util/regex/Pattern.html>.

For example, to send all binds from users under `ou=people,dc=example,dc=com` to a connection handler named `secure-handler`, set the `bind-dn-filters` property as follows:

```
$ dpconf set-connection-handler-prop -h host1 -p 1389 secure-handler \
  bind-dn-filters:"uid=.*,ou=people,dc=example,dc=com"
```

5 (Optional) Specify the name of a request filtering policy to use with this connection handler.

```
$ dpconf set-connection-handler-prop -h host -p port connection-handler-name \
  request-filtering-policy:policy-name
```

where *policy-name* is the name of an existing request filtering policy. For information about how to create and configure a request filtering policy, see “[Creating and Configuring Request Filtering Policies and Search Data Hiding Rules](#)” on page 447.

6 (Optional) Specify the name of a resource limits policy to use with this connection handler.

```
$ dpconf set-connection-handler-prop -h host -p port connection-handler-name \
  resource-limits-policy:policy-name
```

where *policy-name* is the name of an existing resource limits policy. For information about how to create and configure a resource limits policy, see “[Creating and Configuring a Resource Limits Policy](#)” on page 450.

7 Configure any other properties that are listed in Step 2.

```
$ dpconf set-connection-handler-prop -h host -p port connection-handler-name \
  property:value [property:value ...]
```

For example, configure the connection handler to accept SSL connections only.

```
$ dpconf set-connection-handler-prop -h host -p port connection-handler-name \
  is-ssl-mandatory:true
```

For a description of a property and a list of its valid values, run this command:

```
$ dpconf help-properties connection-handler
```

8 Enable the connection handler.

```
$ dpconf set-connection-handler-prop -h host -p port connection-handler-name is-enabled:true
```

9 If necessary, restart the instance of Directory Proxy Server for the changes to take effect.

For information about restarting Directory Proxy Server, see [“To Restart Directory Proxy Server” on page 334](#).

▼ To Delete a Connection Handler

You can use DSCC to perform this task. For information, see [“Directory Service Control Center Interface” on page 43](#) and the DSCC online help.

1 (Optional) View the list of connection handlers.

```
$ dpconf list-connection-handlers -h host -p port
```

2 Delete one or more connection handlers.

```
$ dpconf delete-connection-handler -h host -p port connection-handler-name [connection-handler-name ... ]
```

▼ To Configure Affinity for Data Views

When a connection is allocated to a connection handler, requests on that connection are exposed to the list of data views that are configured for that connection handler, or to all of the configured data views. Successive requests on that connection are exposed exclusively to the data view that is used for the first request.

You can use DSCC to perform this task. For information, see [“Directory Service Control Center Interface” on page 43](#) and the DSCC online help.

1 Enable affinity for data views.

```
$ dpconf set-connection-handler-prop -h host -p port connection-handler-name \
  enable-data-view-affinity:true
```

2 (Optional) Configure the connection handler to route requests to a custom list of data views.

```
$ dpconf set-connection-handler-prop -h host -p port connection-handler-name data-view-routing-policy:custom
```

3 (Optional) Configure the list of data views.

```
$ dpconf set-connection-handler-prop -h host -p port connection-handler-name \
  data-view-routing-custom-list:view-name [data-view-routing-custom-list:view-name ... ]
```

To add a data view to an existing list of data views, use this command:

```
$ dpconf set-connection-handler-prop -h host -p port connection-handler-name \
  data-view-routing-custom-list+:view-name
```

To remove a data view from an existing list of data views, use this command:

```
$ dpconf set-connection-handler-prop -h host -p port connection-handler-name \
  data-view-routing-custom-list-:view-name
```

Creating and Configuring Request Filtering Policies and Search Data Hiding Rules

For an overview of request filtering policies, see “Request Filtering Policies for Connection Handlers” in *Sun Java System Directory Server Enterprise Edition 6.2 Reference*. For an overview of search data hiding rules, see “Search Data Hiding Rules in the Request Filtering Policy” in *Sun Java System Directory Server Enterprise Edition 6.2 Reference*.

For information about how to create and configure request filtering policies and search data hiding rules, see the following procedures.

▼ To Create a Request Filtering Policy

You can use DSCC to perform this task. For information, see “[Directory Service Control Center Interface](#)” on [page 43](#) and the DSCC online help.

1 Create a request filtering policy.

```
$ dpconf create-request-filtering-policy policy-name
```

2 Associate the request filtering policy with a connection handler.

```
$ dpconf set-connection-handler-prop -h host -p port connection-handler-name \
  request-filtering-policy:policy-name
```

▼ To Configure a Request Filtering Policy

You can use DSCC to perform this task. For information, see “[Directory Service Control Center Interface](#)” on [page 43](#) and the DSCC online help.

1 View the properties of a request filtering policy.

```
$ dpconf get-request-filtering-policy-prop -h host -p port policy-name
```

The default properties of a request filtering policy are as follows:

```
allow-add-operations           : true
allow-bind-operations          : true
allow-compare-operations       : true
allow-delete-operations        : true
allow-extended-operations      : true
allow-inequality-search-operations : true
allow-modify-operations        : true
allow-rename-operations        : true
allow-search-operations        : true
allowed-comparable-attrs      : all
allowed-search-scopes         : base
allowed-search-scopes         : one-level
allowed-search-scopes         : subtree
allowed-subtrees              : ""
description                    : -
prohibited-comparable-attrs   : none
prohibited-subtrees           : none
```

2 Configure the request filtering policy by setting one or more of the properties listed in [Step 1](#).

```
$ dpconf set-request-filtering-policy-prop -h host -p port policy-name \
  property:value [property:value ...]
```

By setting the properties listed in [Step 1](#), you configure the following features of the request filtering policy:

- The types of operations that clients are allowed to perform
- The subtrees that are exposed to a client or hidden from a client
- The scope for search operations
- The types of search filters
- The attribute types that can or cannot be compared in search and compare operations

▼ To Create Search Data Hiding Rules

You can use DSCC to perform this task. For information, see [“Directory Service Control Center Interface” on page 43](#) and the DSCC online help.

1 Create one or more search data hiding rules for a request filtering policy.

```
$ dpconf create-search-data-hiding-rule -h host -p port policy-name rule-name \
  [rule-name ...]
```

2 View the properties of a search data hiding rule.

```
$ dpconf get-search-data-hiding-rule-prop policy-name rule-name
```


The default properties of a search data hiding rule are as follows:

```
attrs                : -
rule-action          : hide-entry
target-attr-value-assertions : -
target-dn-regular-expressions : -
target-dns           : -
```

3 Configure a search data hiding rule by setting one or more of the properties listed in [Step 2](#).

```
$ dpconf set-search-data-hiding-rule-prop -h host -p port policy-name rule-name \
  property:value [property:value ...]
```

One of the following rule actions can be used:

hide-entry	The target entry is not returned.
hide-attributes	The target entry is returned but the specified attributes are filtered out.
show-attributes	The target entry is returned but the unspecified attributes are filtered out.

The rule can be applied to the following entries:

target-dns	Entries with the specified DN
target-dn-regular-expressions	Entries with the specified DN pattern
target-attr-value-assertions	Entries with a specified attribute name and attribute value pair (<i>attrName#attrValue</i>)

The following configuration defines a search data hiding rule that hides entries of type `inetorgperson`.

```
$ dpconf set-search-data-hiding-rule-prop -h host1 -p port my-policy my-rule \
  target-attr-value-assertions:objectclass#inetorgperson
```

Example Request Filtering Policy and Search Data Hiding Rule

The following examples contain a request filtering policy and a search data hiding rule. When the request filtering policy is combined with the search data hiding rule, access to data is limited as follows:

- The following types of operations are disallowed: add, delete, extended, modify, and rename.
- Only the `ou=people,dc=sun,dc=com` subtree can be accessed.
- Entries other than `inetorgperson` type are returned by search operations.

EXAMPLE 25-1 Sample Request Filtering Policy

```

allow-add-operations           : false
allow-bind-operations          : true
allow-compare-operations       : true
allow-delete-operations        : false
allow-extended-operations      : false
allow-inequality-search-operations : true
allow-modify-operations         : false
allow-rename-operations         : false
allow-search-operations         : true
allowed-comparable-attrs       : all
allowed-search-scopes          : base
allowed-search-scopes          : one-level
allowed-search-scopes          : subtree
allowed-subtrees               : ou=people,dc=sun,dc=com
description                    : myRequestFilteringPolicy
prohibited-comparable-attrs    : none
prohibited-subtrees            : none

```

EXAMPLE 25-2 Sample Search Data Hiding Rule

```

attrs                          : -
rule-action                     : hide-entry
target-attr-value-assertions    : objectclass:inetorgperson
target-dn-regular-expressions   : -
target-dns                      : -

```

Creating and Configuring a Resource Limits Policy

For an overview of resource limits policies, see “Resource Limits Policies for Connection Handlers” in *Sun Java System Directory Server Enterprise Edition 6.2 Reference*. For information about how to create and configure resource limits policies and to customize search limits, see the following procedures.

▼ To Create a Resource Limits Policy

You can use DSCC to perform this task. For information, see “[Directory Service Control Center Interface](#)” on [page 43](#) and the DSCC online help.

1 Create a resource limits policy.

```
$ dpconf create-resource-limits-policy -h host -p port policy-name
```

For information about how to modify the properties of a resource limits policy, see [“To Configure a Resource Limits Policy” on page 451](#).

2 Associate the resource limits policy to a connection handler.

```
$ dpconf set-connection-handler-prop -h host -p port connection-handler-name \
  resource-limits-policy:policy-name
```

▼ To Configure a Resource Limits Policy

You can use DSCC to perform this task. For information, see [“Directory Service Control Center Interface” on page 43](#) and the DSCC online help.

1 View the properties of a resource limits policy.

```
$ dpconf get-resource-limits-policy-prop -h host -p port policy-name
```

The default properties of a resource limits policy are as follows:

```
description                : -
max-client-connections     : unlimited
max-connections           : unlimited
max-simultaneous-operations-per-connection : unlimited
max-total-operations-per-connection : unlimited
minimum-search-filter-substring-length : unlimited
referral-bind-policy       : default
referral-hop-limit        : default
referral-policy            : default
search-size-limit         : unlimited
search-time-limit         : unlimited
```

2 Configure the resource limits policy by setting one or more of the properties that are listed in [Step 1](#):

```
$ dpconf set-resource-limits-policy-prop -h host -p port policy-name \
  property:value [property:value ...]
```

▼ To Customize Search Limits

Customized limits can be defined for search operations according to the search base and search scope. If the target DN and scope of a search operation matches the specified criteria, the maximum size of the search result is limited.

You can use DSCC to perform this task. For information, see [“Directory Service Control Center Interface” on page 43](#) and the DSCC online help.

1 Create one or more custom search limits.

```
$ dpconf create-custom-search-size-limit -h host -p port policy-name \
  custom-search-limit-name [custom-search-limit-name ...]
```

2 Set the criteria for the custom search limit.

```
$ dpconf set-custom-search-size-limit-prop -h host -p port policy-name \
  custom-search-limit-name one-level-search-base-dn:value subtree-search-base-dn:value
```

3 Set the limit for the number of results that are returned when a search meets one of the criteria in Step 2.

```
$ dpconf set-custom-search-size-limit-prop -h host -p port policy-name \
  custom-search-limit-name search-size-limit:value
```

4 View the properties of a custom search limit.

```
$ dpconf get-custom-search-size-limit-prop -h host -p port policy-name \
  custom-search-limit-name
```

The default properties of a custom search limit are as follows:

```
one-level-search-base-dn : -
search-size-limit       : unlimited
subtree-search-base-dn  : -
```

Configuring Directory Proxy Server as a Connection Based Router

Directory Proxy Server 5.2 is a connection based router. In Directory Proxy Server 5.2, a client connection is routed to a specific directory server. All requests on that client connection are sent to the same directory server until the connection is broken or until the client unbinds.

Directory Proxy Server 6.2 is an operation based router. However, for compatibility, this version of Directory Proxy Server can be configured as a connection based router, as described in the following procedure.

▼ To Configure Directory Proxy Server as a Connection Based Router

1 Create and configure one or more connection handlers as described in “[Creating, Configuring, and Deleting Connection Handlers](#)” on page 443.

You can also use the default connection handler.

2 Configure all connection handlers to route requests to the root data view only.

For example:

```
$ dpconf set-connection-handler-prop -h host1 -p 1389 myConnectionHandler \  
data-view-routing-policy:custom data-view-routing-custom-list:"root data view"
```

3 Create and configure a data source for each backend LDAP server as described in “Creating and Configuring LDAP Data Sources” on page 359.

For example:

```
$ dpconf create-ldap-data-source -h host1 -p 1389 myDataSource host2:2389
```

4 Create and configure a data source pool as described in “Creating and Configuring LDAP Data Source Pools” on page 362.

For example:

```
$ dpconf create-ldap-data-source-pool -h host1 -p 1389 myDataSourcePool
```

5 Attach all of the data sources to the data source pool as described in “Attaching LDAP Data Sources to a Data Source Pool” on page 363.

For example,

```
$ dpconf attach-ldap-data-source -h host1 -p 1389 myDataSourcePool myDataSource
```

6 Configure each data source to authenticate clients by using BIND replay as described in “Forwarding Requests With Bind Replay” on page 437.

For example:

```
$ dpconf set-ldap-data-source-prop -h host1 -p 1389 myDataSource \  
client-cred-mode:use-client-identity
```

7 Configure affinity between the client connection and the data source pool as described in “Configuring Client Affinity” on page 372.

For example:

```
$ dpconf set-ldap-data-source-pool-prop -h host1 -p 1389 myDataSourcePool \  
enable-client-affinity:true client-affinity-policy:read-write-affinity-after-write
```


Directory Proxy Server Client Authentication

For an overview of client authentication in Directory Proxy Server, see Chapter 21, “Directory Proxy Server Client Authentication,” in *Sun Java System Directory Server Enterprise Edition 6.2 Reference*.

This chapter covers the following topics:

- “Configuring Listeners Between Clients and Directory Proxy Server” on page 455
- “Authenticating Clients to Directory Proxy Server” on page 456

Configuring Listeners Between Clients and Directory Proxy Server

Directory Proxy Server provides a secure listener and a nonsecure listener for communication with clients. For information about listeners for Directory Proxy Server, see “Directory Proxy Server Client Listeners” in *Sun Java System Directory Server Enterprise Edition 6.2 Reference*. This section describes how to configure the listeners.

▼ To Configure the Listeners Between a Client and Directory Proxy Server

Note – This procedure configures the nonsecure listener between a client and Directory Proxy Server. To configure the secure listener, perform the same procedure but replace `ldap` with `ldaps`.

You can use DSCC to perform this task. For information, see “[Directory Service Control Center Interface](#)” on page 43 and the DSCC online help. In DSCC, you can configure this property on the Performance tab.

1 View the properties of the nonsecure listener.

```
$ dpconf get-ldap-listener-prop -h host -p port
```

The default properties of the nonsecure listener are as follows:

```
connection-idle-timeout      : 1h
connection-read-data-timeout : 2s
connection-write-data-timeout : 1h
is-enabled                   : true
listen-address               : 0.0.0.0
listen-port                  : port-number
max-connection-queue-size   : 128
max-ldap-message-size       : unlimited
number-of-threads           : 2
use-tcp-no-delay            : true
```

2 Change one or more of properties that are listed in [Step 1](#) according to your requirements.

```
$ dpconf set-ldap-listener-prop -h host -p port property:new-value
```

For example, to disable the nonsecure port for an instance of Directory Proxy Server running on host1, run the following command:

```
$ dpconf set-ldap-listener-prop -h host1 -p 1389 is-enabled:false
```



Caution – If you plan to use a non-privileged port number, you must run Directory Proxy Server as root.

To change the nonsecure port number, run the following command:

```
$ dpconf set-ldap-listener-prop -h host -p port listen-port:new-port-number
```

3 If necessary, restart the instance of Directory Proxy Server for the changes to take effect.

Changes to certain listener properties require a server restart. `dpconf` alerts you if the server must be restarted. For information about restarting Directory Proxy Server, see [“To Restart Directory Proxy Server” on page 334](#).

Authenticating Clients to Directory Proxy Server

By default, Directory Proxy Server is configured for simple bind authentication. No additional configuration is required for simple bind authentication.

For information about authentication between clients and Directory Proxy Server, see “Client Authentication Overview” in *Sun Java System Directory Server Enterprise Edition 6.2 Reference*. For information about how to configure authentication, see the following procedures.

▼ To Configure Certificate-based Authentication

For information about certificate-based authentication of clients, see “Configuring Certificates in Directory Proxy Server” in *Sun Java System Directory Server Enterprise Edition 6.2 Reference*. This section describes how to configure certificate-based authentication.

You can use DSCC to perform this task. For information, see “[Directory Service Control Center Interface](#)” on page 43 and the DSCC online help.

Note – Certificate-based authentication can only be performed over an SSL connection.

- **Configure Directory Proxy Server to require a client to present a certificate when the client establishes an SSL connection.**

```
$ dpconf set-server-prop -h host -p port allow-cert-based-auth:require
```

▼ To Configure Anonymous Access

For information about anonymous access, see “Anonymous Access” in *Sun Java System Directory Server Enterprise Edition 6.2 Reference*. For information about how to map the identity of an anonymous client to another identity, see “[Forwarding Requests as an Alternate User](#)” on page 440.

You can use DSCC to perform this task. For information, see “[Directory Service Control Center Interface](#)” on page 43 and the DSCC online help.

- **Permit unauthenticated users to perform operations.**

```
$ dpconf set-server-prop -h host -p port allow-unauthenticated-operations:true
```

▼ To Configure Directory Proxy Server for SASL External Bind

For information about SASL external bind, see “Using SASL External Bind” in *Sun Java System Directory Server Enterprise Edition 6.2 Reference*.

You can use DSCC to perform this task. For information, see “[Directory Service Control Center Interface](#)” on page 43 and the DSCC online help.

- 1 Disallow unauthenticated operations.**

```
$ dpconf set-server-prop -h host -p port allow-unauthenticated-operations:false
```

- 2 Require clients to present a certificate when establishing a connection.**

```
$ dpconf set-server-prop -h host -p port allow-cert-based-auth:require
```

The client provides a certificate that contains a DN.

3 Enable the authentication of clients by SASL external bind.

```
$ dpconf set-server-prop -h host -p port allow-sasl-external-authentication:true
```

4 Configure the identity used by Directory Proxy Server to map a client certificate on a back-end LDAP server.

```
$ dpconf set-server-prop -h host -p port cert-search-bind-dn:bind-DN \  
cert-search-bind-pwd-file:filename
```

5 Configure the base DN of the subtree that Directory Proxy Server searches.

Directory Proxy Server searches the subtree to find a user entry that is mapped to a client certificate.

```
$ dpconf set-server-prop -h host -p port cert-search-base-dn:base-DN
```

6 Map information in the client certificate to certificates on the LDAP server.

a. Name the attribute on the LDAP server that contains certificates.

```
$ dpconf set-server-prop cert-search-user-attribute:attribute
```

b. Map an attribute on the client certificate to the DN of the entry on the LDAP server that contains certificates.

```
$ dpconf set-server-prop -h host -p port \  
cert-search-attr-mappings:client-side-attribute-name:server-side-attribute-name
```

For example, to map a client certificate with the DN `cn=user1,o=sun,c=us` to an LDAP entry with the DN `uid=user1,o=sun`, run the following command:

```
$ dpconf set-server-prop -h host1 -p 1389 cert-search-attr-mappings:cn:uid \  
cert-search-attr-mappings:o:o
```

7 (Optional) Route requests for SASL external bind operations to all data views or to a custom list of data views.

- To route requests to all data views, run this command:

```
$ dpconf set-server-prop -h host -p port cert-data-view-routing-policy:all-routable
```

- To route requests to a list of data views, run this command:

```
$ dpconf set-server-prop -h host -p port cert-data-view-routing-policy:custom \  
cert-data-view-routing-custom-list:view-name [view-name...]
```

Directory Proxy Server Logging

Directory Proxy Server logs information in access logs and error logs. Unlike Directory Server, Directory Proxy Server does not have an audit log. For a description of the logs in Directory Proxy Server, see Chapter 23, “Directory Proxy Server Logging,” in *Sun Java System Directory Server Enterprise Edition 6.2 Reference*.

This chapter covers the following topics:

- “Viewing Directory Proxy Server Logs” on page 459
- “Configuring Directory Proxy Server Logs” on page 460
- “Configuring Directory Proxy Server Log Rotation” on page 462
- “Deleting Directory Proxy Server Logs” on page 465
- “Logging Alerts to the `syslogd` Daemon” on page 466
- “Tracking Client Requests Through Directory Proxy Server and Directory Server Access Logs” on page 469

Viewing Directory Proxy Server Logs

You can view Directory Proxy Server logs directly through the log files or by using Directory Service Control Center (DSCC).

By default, the logs are stored in this directory:

instance-path/logs

The following figure shows a screen capture of the error log for Directory Proxy Server on DSCC.

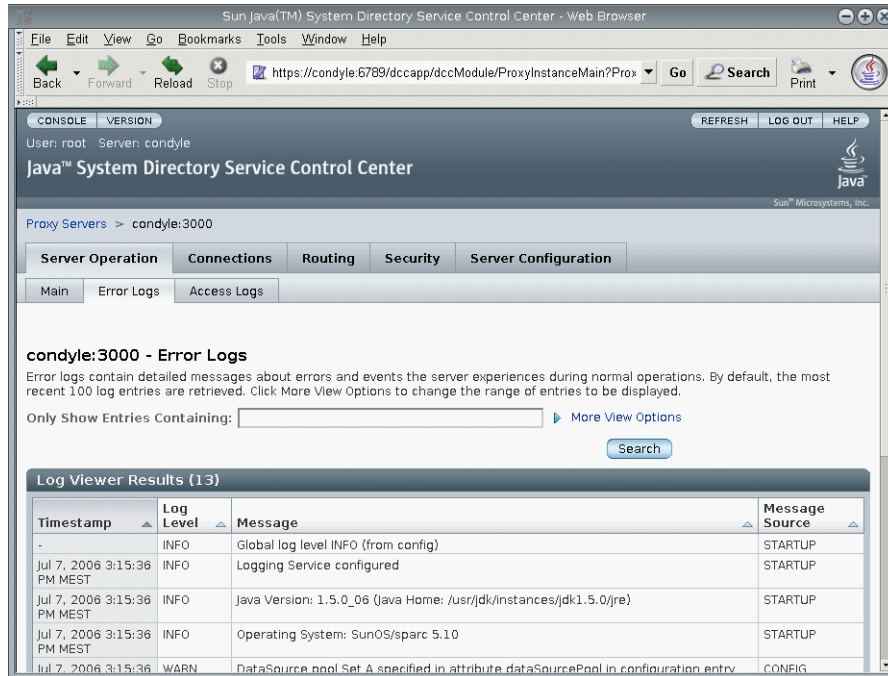


FIGURE 27-1 Error Log Window for Directory Proxy Server

Configuring Directory Proxy Server Logs

Directory Proxy Server error logs and access logs can be configured by using the `dpconf` command or DSCC. For information about how to configure the logs by using DSCC, see the Directory Proxy Server online help. This section describes how to configure Directory Proxy Server logs by using the `dpconf` command.

You can retrieve a complete list of the configuration options along with the allowed values and default values by running these commands:

```
$ dpconf help-properties error-log
```

```
$ dpconf help-properties access-log
```

▼ To Configure Directory Proxy Server Access and Error Logs

This procedure configures the Directory Proxy Server access log. To configure the Directory Proxy Server error log, perform the same procedure but replace `access` with `error`.

You can use DSCC to perform this task. For information, see “[Directory Service Control Center Interface](#)” on page 43 and the DSCC online help.

1 View the properties of the access log.

```
$ dpconf get-access-log-prop -h host -p port
```

The default properties of an access log are as follows:

```
default-log-level           : info
enable-log-rotation         : true
log-buffer-size             : 9.8k
log-file-name               : logs/access
log-file-perm               : 600
log-level-client-connections : -
log-level-client-disconnections : -
log-level-client-operations  : -
log-level-connection-handlers : -
log-level-data-sources       : -
log-level-data-sources-detailed : -
log-min-size                 : 100M
log-rotation-frequency      : 1h
log-rotation-policy         : size
log-rotation-size           : 100M
log-rotation-start-day      : 1
log-rotation-start-time     : 0000
log-search-filters          : false
max-age                     : unlimited
max-log-files                : 10
max-size                     : unlimited
min-free-disk-space-size    : 1M
```

2 Change one or more of the properties that are listed in [Step 1](#).

```
$ dpconf set-access-log-prop -h host -p port property:value \
  [property:value ...]
```

For example, to set the default log level for all message categories to warning, set the value of the `default-log-level` property to warning.

```
$ dpconf set-access-log-prop -h host1 -p 1389 default-log-level:warning
```

To disable all logs, irrespective of the log level for each message category, set the value of the `default-log-level` property to none.

```
$ dpconf set-access-log-prop -h host1 -p 1389 default-log-level:none
```

To reset a specific log level to the default log level, set that log level property to `inherited`. For example, to reset the log level for client connections, run the following command:

```
$ dpconf set-access-log-prop -h host1 -p 1389 log-level-client-connections:inherited
```

For information about properties that can be set by the `set-access-log-prop` subcommand, type:

```
$ dpconf help-properties access-log
```

Configuring Directory Proxy Server Log Rotation

By default, log files are rotated when the log file size reaches 100 Mbytes. Ten log files are retained by default, after which the rotation procedure begins to overwrite the oldest log file. This section describes how to configure Directory Proxy Server logs for scheduled rotation, how to rotate logs manually, and how to disable log rotation. For example configurations, see [“Example Configurations for Log Rotation” on page 464](#).

▼ To Configure Periodic Rotation of Access and Error Logs

This procedure configures the Directory Proxy Server access log. To configure the Directory Proxy Server error log, perform the same procedure but replace `access` with `error`.

You can use DSCC to perform this task. For information, see [“Directory Service Control Center Interface” on page 43](#) and the DSCC online help.

1 (Optional) View the properties of the access log.

```
$ dpconf get-access-log-prop -h host -p port
```

2 (Optional) View valid values for the properties of the access log.

```
$ dpconf help-properties access-log
```

3 To rotate logs when they reach a certain size, set the following properties:

```
$ dpconf set-access-log-prop -h host -p port \  
  log-rotation-policy:size log-rotation-size:maximum file size
```

If the unit of the maximum file size is not specified, the default unit of *bytes* is used. When the log file reaches the defined size, the log is rotated. The file size must be at least 1 Mbyte and no more than 2 Gbytes.

For an example of how to rotate logs by size, see [“Rotating the Log Based on Log Size” on page 464](#).

4 To rotate logs periodically, irrespective of the log size, set the following properties:

```
$ dpconf set-access-log-prop -h host -p port \
  log-rotation-frequency:interval in months, weeks, hours, or minutes \
  log-rotation-policy:periodic \
  log-rotation-start-day:day in week (1-7) or day in the month (1-31) \
  log-rotation-start-time:time of day (hhmm)
```

If the log is configured for rotation on the 31st of the month but the month has fewer than 31 days, the log is rotated on the first day of the following month.

For examples of how to rotate logs periodically, see [“Rotating the Log Based on Time” on page 464](#).

5 To rotate logs periodically if the log file is big enough, set the log-rotation-frequency and log-min-size properties.

```
$ dpconf set-access-log-prop -h host -p port \
  log-rotation-frequency:interval in months, weeks, hours, or minutes \
  log-rotation-policy:periodic log-min-size:minimum file size \
  log-rotation-start-day:day in week (1-7) or day in the month (1-31) \
  log-rotation-start-time:time of day (hhmm)
```

The log-min-size property represents the minimum size of the log. The rotation takes place at the scheduled time only if the log file is bigger than the specified size.

If the log is configured for rotation on the 31st of the month but the month has fewer than 31 days, the log is rotated on the first day of the following month.

For an example of how to rotate logs periodically if the file size is big enough, see [“Rotating the Log Based on Time and Log Size” on page 465](#).

▼ To Rotate Access and Error Logs Files Manually

This procedure rotates the Directory Proxy Server access log. To rotate the Directory Proxy Server error log, perform the same procedure but replace access with error.

You can use DSCC to perform this task. For information, see [“Directory Service Control Center Interface” on page 43](#) and the DSCC online help.

● Rotate the access log.

```
$ dpconf rotate-log-now -h host -p port access
```

▼ To Disable Access and Error Log Rotation

This procedure disables rotation of the Directory Proxy Server access log. To disable rotation of the Directory Proxy Server error log, perform the same procedure but replace access with error.

- **Disable log file rotation.**

```
$ dpconf set-access-log-prop -h host -p port enable-log-rotation:false
```

Example Configurations for Log Rotation

Examples of how to configure log rotation by log size, time, or both follow.

Rotating the Log Based on Log Size

This section example shows how to configure a log rotation according to log size only. This configuration rotates the log when it reaches 10 Mbytes, irrespective of the time since the log was last rotated.

```
$ dpconf set-access-log-prop -h host1 -p 1389 log-rotation-policy:size \  
  log-rotation-size:10M
```

Rotating the Log Based on Time

The examples in this section show how to configure log rotation according to the time since the last rotation, irrespective of log size.

- This configuration rotates the log at 3:00 today and then every 8 hours, irrespective of the size of the log file.

```
$ dpconf set-access-log-prop -h host1 -p 1389 log-rotation-frequency:8h \  
  log-rotation-policy:periodic log-rotation-start-time:0300
```

- This configuration rotates the log at 3:00, 13:00 and 23:00 every day, irrespective of the size of the log file. Because the `log-rotation-start-time` parameter takes precedence over the `log-rotation-frequency` parameter, the log is rotated at 23:00 and then 4 hours later. The log is not rotated at 23:00 and then 10 hours later.

```
$ dpconf set-access-log-prop -h host1 -p 1389 log-rotation-frequency:10h \  
  log-rotation-policy:periodic log-rotation-start-time:0300
```

- This configuration rotates the log at noon on Monday, and then at the same time every week, irrespective of the size of the log file.

```
$ dpconf set-access-log-prop -h host1 -p 1389 log-rotation-frequency:1w \  
  log-rotation-policy:periodic log-rotation-start-day:2 log-rotation-start-time:1200
```

- This configuration rotates the log at noon on Monday, and then every 3 days, irrespective of the size of the log file.

```
$ dpconf set-access-log-prop -h host1 -p 1389 log-rotation-frequency:3d \  
  log-rotation-policy:periodic log-rotation-start-day:2 log-rotation-start-time:1200
```


The log is rotated on the following days: Monday, Thursday, Sunday, Wednesday, and so on. Notice that the `log-rotation-start-day` parameter applies to the first week only. The log is not rotated on the Monday of the second week.

- This configuration rotates the log at noon on the 22nd day of the month, and then at the same time every month, irrespective of log size.

```
$ dpconf set-access-log-prop -h host1 -p 1389 log-rotation-frequency:1m \
  log-rotation-policy:periodic log-rotation-start-day:22 \
  log-rotation-start-time:1200
```

If the `log-rotation-start-day` is set to 31 and the month has only 30 days, the log is rotated on the first day of the following month. If the `log-rotation-start-day` is set to 31 and the month has only 28 days (February), the log is rotated on the 3rd.

Rotating the Log Based on Time and Log Size

This example shows how to configure a log rotation for a specified interval if the file size is big enough.

This configuration rotates the log at 3:00, 11:00, and 19:00 every day, if the size of the log file exceeds 1 Mbyte. If the size of the log file does not exceed 1 Mbyte, the log file is not rotated.

```
$ dpconf set-access-log-prop -h host1 -p 1389 log-rotation-frequency:8h \
  log-rotation-policy:periodic log-min-size:1M log-rotation-start-time:0300
```

Deleting Directory Proxy Server Logs

Directory Proxy Server enables you to configure log deletion based on time, size, or free disk space (the default). For more information about these deletion policies, see “Log File Deletion” in *Sun Java System Directory Server Enterprise Edition 6.2 Reference*.

The following procedures configure log deletion for the access log. To configure log deletion for the error log, use the same commands, but replace `access` with `error`.

▼ To Configure Access and Error Log Deletion Based on Time

You can use DSCC to perform this task. For information, see “[Directory Service Control Center Interface](#)” on [page 43](#) and the DSCC online help.

- **Specify the maximum age for log files.**

```
$ dpconf set-access-log-prop -h host -p port max-age:duration
```

where *duration* includes a unit of days (d), weeks (w), or months (M). For example, to delete backup log files older than five days, use this command:

```
$ dpconf set-access-log-prop -h host1 -p 1389 max-age:5d
```

▼ To Configure Access and Error Log Deletion Based on File Size

You can use DSCC to perform this task. For information, see [“Directory Service Control Center Interface” on page 43](#) and the DSCC online help.

- Specify the maximum size for log files.

```
$ dpconf set-access-log-prop -h host -p port max-size:memory-size
```

For example, to delete backup log files greater than 1 Mbyte, use this command:

```
$ dpconf set-access-log-prop -h host1 -p 1389 max-size:1M
```

▼ To Configure Access and Error Log Deletion Based on Free Disk Space

You can use DSCC to perform this task. For information, see [“Directory Service Control Center Interface” on page 43](#) and the DSCC online help.

- Specify the minimum available disk space.

```
$ dpconf set-access-log-prop -h host -p port min-free-disk-space-size:memory-size
```

For example, to delete backup log files when the available disk space is less than 2 Mbytes, use this command:

```
$ dpconf set-access-log-prop -h host1 -p 1389 min-free-disk-space-size:2M
```

Logging Alerts to the syslogd Daemon

This section describes how to configure the logging of alert messages to the syslogd daemon and how to configure the operating system to accept syslog alerts.

▼ To Configure Directory Proxy Server to Log Alerts to the syslogd Daemon

You can use DSCC to perform this task. For information, see [“Directory Service Control Center Interface” on page 43](#) and the DSCC online help.

1 (Optional) View the current values of the properties for the system log alerts.

```
$ dpconf get-server-prop -h host -p port syslog-alerts-enabled \
  syslog-alerts-facility syslog-alerts-host
```

The default properties for the system log alerts are as follows:

```
syslog-alerts-enabled   : false
syslog-alerts-facility  : USER
syslog-alerts-host     : localhost
```

The `syslog-alerts-host` property defines the host name of the `syslogd` daemon to which the messages are sent. The `syslog-alerts-facility` property is read-only and causes messages to be sent to the user category in the system log.

2 Enable alert messages to be logged to the syslogd daemon.

```
$ dpconf set-server-prop -h host -p port syslog-alerts-enabled:true
```

3 (Optional) Send alert messages to the syslogd daemon on a different host.

```
$ dpconf set-server-prop -h host -p port syslog-alerts-host:hostname
```

Configuring the Operating System to Accept syslog Alerts

This section provides instructions on configuring the Solaris™, Linux, and HP-UX operating systems to accept syslog alerts.

▼ To Configure the Solaris OS to Accept syslog alerts

1 Add the appropriate facility to the syslog configuration file.

For example, to store all alerts using the USER facility, add the following line to `/etc/syslog.conf`:

```
user.info      /var/adm/info
```

Here `/var/adm/info` is an example local directory in which messages will be stored. Ensure that `/var/adm/info` exists before continuing.

2 Restart the syslogd daemon.**a. On Solaris 8 and 9, restart syslogd by typing this:**

```
$ /etc/init.d/syslog stop | start
```

b. On Solaris 10, restart syslogd by typing this:

```
$ svcadm restart system/system-log
```

3 Verify that messages are logged in syslog.

```
$ logger -p user.info "Test message"
$ cat /var/adm/info
Jun 19 17:18:38 host user: [ID 12345 user.info] Test message
```

▼ To Configure Linux to Accept syslog Alerts**1 Add the appropriate facility to the syslog configuration file.**

For example, to store all alerts using the USER facility, add the following line to `/etc/syslog.conf`:

```
user.info      /var/adm/info
```

Here `/var/adm/info` is an example local directory in which messages will be stored. Ensure that `/var/adm/info` exists before continuing.

2 Configure the syslogd daemon to run with the -r option.

This option allows `syslogd` to accept connections from the network. By default, the `-r` option is not set.

To set the `-r` option, add the following line to `/etc/sysconfig/syslog`:

```
SYSLOGD_OPTIONS="-m 0 -r"
```

If `/etc/sysconfig/syslog` does not exist, add the same line to `/etc/init.d/syslog`.

3 Restart the syslogd daemon.

```
$ /etc/init.d/syslog stop | start
```

4 Verify that messages are logged in syslog.

```
$ logger -p user.info "Test message"
$ cat /var/adm/info
Jun 19 17:18:38 host user: [ID 12345 user.info] Test message
```

▼ To Configure HP-UX to Accept syslog alerts

1 Add the appropriate facility to the syslog configuration file.

For example, to store all alerts using the USER facility, add the following line to `/etc/syslog.conf`:

```
user.info      /var/adm/info
```

Here `/var/adm/info` is an example local directory in which messages will be stored. Ensure that `/var/adm/info` exists before continuing.

2 Restart the syslogd daemon.

```
$ /sbin/init.d/syslogd stop | start
```

3 Verify that messages are logged in syslog.

```
$ logger -p user.info "Test message"
$ cat /var/adm/info
Jun 19 17:18:38 host user: [ID 12345 user.info] Test message
```

Tracking Client Requests Through Directory Proxy Server and Directory Server Access Logs

To track the path of a client request, you must understand how requests are logged in the Directory Proxy Server access log and in the Directory Server access log. To understand this section, first read “Tracking Client Requests Through Directory Proxy Server and Directory Server Access Logs” in *Sun Java System Directory Server Enterprise Edition 6.2 Reference*.

▼ To Track Operations From Directory Server Through Directory Proxy Server to the Client Application

You cannot use DSCC to perform this task. Use the command line, as described in this procedure.

1 Locate the connection number for the operation that you want to track in the Directory Server access log.

For example, the following line in the access log shows an operation, `op=2` with connection number `conn=12839`.

```
[20/Jul/2006:18:01:49 -0500] conn=12839 op=2 msgId=4 - SRCH base="dc=example,dc=com"
scope=2 filter="(objectClass=organizationalunit)" attrs=ALL
```

2 Obtain the Directory Proxy Server connection information for that connection.

To obtain this information, search the Directory Server access log to locate all operations with the corresponding connection number. For example, on UNIX systems, run the following `grep` command to locate all lines in the Directory Server access log that correspond to connection `conn=12839`:

```
$ grep conn=12839 access
```

The line showing the initial LDAP connection is what you are looking for and will be similar to this:

```
[19/Jul/2006:16:32:51 -0500] conn=12839 op=-1 msgId=-1 - fd=27 slot=27  
LDAP connection from 129.153.160.175:57153 to 129.153.160.175
```

The previous line shows that there is an LDAP connection from `129.153.160.175:57153` to Directory Server. The port number (`57153`) is the information that is required to link the connection back to the Directory Proxy Server access log. The port number enables you to find the corresponding connection in the Directory Proxy Server log, and to locate the client information from this connection.

If the log files have been rotated since the connection was first established, you need to search the archived log files as well as the current access log file.

3 Locate the corresponding connection in the Directory Proxy Server access log.

To obtain this information, search the Directory Proxy Server access log to locate all operations with the corresponding port number.

You might find multiple entries in the log file with the same port number. To ensure that you locate the correct entry, include the timestamp from the Directory Server log entry in your search.

For example, on UNIX systems, run the following `grep` command to locate the connection entry that corresponds to the timestamp and port number found in the Directory Server log:

```
$ grep 19/Jul/2006:16:32 access | grep 57153
```

Note that the *seconds* value is excluded from the timestamp to take into account slight differences in server times.

The corresponding line in the Directory Proxy Server log will be similar to this:

```
[19/Jul/2006:16:32:51 -0500] - SERVER_OP - INFO - Created BIND LDAP connection  
s_conn=sunds-d1m1-9389:34 client=0.0.0.0:57153  
server=idm160.central.sun.com:9389 main
```

This line shows that Directory Proxy Server created a BIND connection to `s_conn=sunds-d1m1-9389:34`. Directory Proxy Server identifies itself as the client `client=0.0.0.0` on TCP port `57153`.

The important information to extract from this line of the log is the server ID and port number (`s_conn=sunds-d1m1-9389:34`).

4 Locate all operations that correspond to the server ID and port number identified in the previous step.

To obtain this information, search the Directory Proxy Server access log for all operations with the corresponding server ID and port number.

For example, on UNIX systems, run the following `grep` command to locate the operation that corresponds to the server ID found in the previous step:

```
$ grep s_conn=sunds-d1m1-9389:34 access
```

In this case, it is not useful to search for the timestamp because these operations might span several days. However, you must determine that the operations returned by the search are the correct ones. If there are multiple Create connection statements, ensure that you locate the one that corresponds to the original search statement. To do this, match the timestamp to the timestamp found in [Step 1](#).

The following extract of the Directory Proxy Server access log shows all operations returned for `s_conn=sunds-d1m1-9389:34`.

```
[19/Jul/2006:16:32:51 -0500] - SERVER_OP - INFO - Created BIND LDAP connection
s_conn=sunds-d1m1-9389:34 client=0.0.0.0:57153 server=idm160.central.sun.com:9389 main
[20/Jul/2006:18:01:49 -0500] - SERVER_OP - INFO - conn=31 op=0 BIND dn="cn=directory manager"
method="SIMPLE" s_msgid=3 s_conn=sunds-d1m1-9389:34
[20/Jul/2006:18:01:49 -0500] - SERVER_OP - INFO - conn=31 op=0 BIND RESPONSE err=0 msg=""
s_conn=sunds-d1m1-9389:34
[20/Jul/2006:18:01:49 -0500] - SERVER_OP - INFO - conn=31 op=1 SEARCH base="dc=example,dc=com"
scope=2 s_msgid=4 s_conn=sunds-d1m1-9389:34
[20/Jul/2006:18:01:49 -0500] - SERVER_OP - INFO - conn=31 op=1 SEARCH RESPONSE err=0 msg=""
nentries=1 s_conn=sunds-d1m1-9389:34
```

With this information, you can see that the connection ID for this search operation on Directory Proxy Server is 31 (`conn=31`).

5 Locate the client connection IP address that corresponds to the connection ID found in the previous step.

To obtain this information, search the Directory Proxy Server access log for all operations with the correct connection ID and timestamp. The timestamp to use is the one in the original search statement in [Step 1](#).

For example, on UNIX systems, run the following `grep` command to locate the client connection IP address:

```
$ grep "20/Jul/2006:18:01" access | grep conn=31
```

The line you are interested in is similar to this:

```
[20/Jul/2006:18:01:49 -0500] - CONNECT - INFO - conn=31 client=129.150.64.156:2031
server=0.0.0.0:11389 protocol=LDAP
```

6 Determine who owns the IP address found in the previous step.

With this information, you can establish precisely who was responsible for the operation performed on Directory Server.

Directory Proxy Server Monitoring and Alerts

Monitoring detects failure of Directory Proxy Server and of data sources.

For a description of the monitoring framework for Directory Proxy Server, and for a detailed layout of the `cn=monitor` entry, see “Monitoring Directory Proxy Server” in *Sun Java System Directory Server Enterprise Edition 6.2 Reference*. This chapter covers the following topics:

- “Retrieving Monitored Data About Directory Proxy Server” on page 473
- “Retrieving Monitored Data About Data Sources” on page 473
- “Configuring Administrative Alerts for Directory Proxy Server” on page 476
- “Retrieving Monitored Data About Directory Proxy Server by Using the JVM” on page 478

Retrieving Monitored Data About Directory Proxy Server

To retrieve monitored data about Directory Proxy Server, use the `cn=monitor` entry. This entry is managed by Directory Proxy Server in a local, in-memory database. You can retrieve attributes under `cn=monitor` by performing an LDAP search on the `cn=monitor` entry. You must bind as the Proxy Manager to search this entry.

For information about using the JVM to retrieve monitored data, see “Retrieving Monitored Data About Directory Proxy Server by Using the JVM” on page 478.

Retrieving Monitored Data About Data Sources

For a description of how Directory Proxy Server monitors the health of data sources, see “Monitoring Data Sources” in *Sun Java System Directory Server Enterprise Edition 6.2 Reference*. This section describes how to configure the monitoring of data sources.

▼ To Monitor a Data Source by Listening for Errors

In this type of monitoring, Directory Proxy Server listens for errors on the traffic between Directory Proxy Server and the data sources. This type of monitoring is called reactive monitoring because Directory Proxy Server reacts if an error is detected, but does not actively test data sources.

You can use DSCC to perform this task. For information, see [“Directory Service Control Center Interface” on page 43](#) and the DSCC online help.

- 1 **Set the monitoring mode for the data source to reactive.**

```
$ dpconf set-ldap-data-source-prop -h host -p port datasource monitoring-mode:reactive
```

- 2 **Configure an alert to be sent when an error is detected or when a data source goes offline or online, as described in [“Configuring Administrative Alerts for Directory Proxy Server” on page 476](#).**

▼ To Monitor a Data Source by Periodically Establishing Dedicated Connections

Directory Proxy Server creates a dedicated connection to a data source if there have been no requests to or responses from the data source for a specified interval.

You can use DSCC to perform this task. For information, see [“Directory Service Control Center Interface” on page 43](#) and the DSCC online help.

- 1 **Set the monitoring mode for the data source to proactive.**

```
$ dpconf set-ldap-data-source-prop -h host -p port datasource monitoring-mode:proactive
```

- 2 **Set the maximum time for which Directory Proxy Server detects no activity from a data source before establishing a dedicated connection.**

```
$ dpconf set-ldap-data-source-prop -h host -p port datasource \
  monitoring-inactivity-timeout:time
```

By default, the inactivity timeout is 120 seconds.

- 3 **Configure an alert to be sent when a data source is detected as offline or online, as described in [“Configuring Administrative Alerts for Directory Proxy Server” on page 476](#).**

▼ To Monitor a Data Source by Testing Established Connections

In this type of monitoring, Directory Proxy Server performs a search on each connection to each data source at a regular interval. In this way, Directory Proxy Server detects closed connections and prevents connections from being dropped because of inactivity.

You can use DSCC to perform this task. For information, see [“Directory Service Control Center Interface” on page 43](#) and the DSCC online help.

- 1 **Set the monitoring mode for the data source to proactive.**

```
$ dpconf set-ldap-data-source-prop -h host -p port datasource monitoring-mode:proactive
```

- 2 **Configure the monitoring search request that is performed by Directory Proxy Server.**

```
$ dpconf set-ldap-data-source-prop -h host -p port datasource \
  monitoring-bind-timeout:timeout monitoring-entry-dn:dn \
  monitoring-search-filter:filter monitoring-entry-timeout:timeout
```

The following properties are used in the search request:

monitoring-bind-timeout	The length of time that Directory Proxy Server waits to establish a connection to the data source. By default, the value of this property is 5 seconds.
monitoring-entry-dn	The DN of the target entry in the search request. By default, this property is the root DSE entry ("").
monitoring-search-filter	The search filter.
monitoring-entry-timeout	The length of time that Directory Proxy Server waits for the search response. By default, the value of this property is 5 seconds.

- 3 **Set the polling interval.**

```
$ dpconf set-ldap-data-source-prop -h host -p port datasource monitoring-interval:interval
```

If a connection is down, Directory Proxy Server polls the connection at this interval to detect its recovery. By default, the monitoring interval is 30 seconds.

- 4 **Configure an alert to be sent when a data source is detected as offline or online, as described in [“Configuring Administrative Alerts for Directory Proxy Server” on page 476](#).**

Configuring Administrative Alerts for Directory Proxy Server

For information about how to configure administrative alerts, see the following procedures.

▼ To Enable Administrative Alerts

You can use DSCC to perform this task. For information, see [“Directory Service Control Center Interface” on page 43](#) and the DSCC online help.

1 View the enabled alerts.

```
% dpconf get-server-prop -h host -p port enabled-admin-alerts
```

2 Enable one or more administrative alerts.

```
% dpconf set-server-prop -h host -p port enabled-admin-alerts:alert1 \  
[enabled-admin-alerts:alert2 ...]
```

For example, to enable all available alerts, run this command:

```
% dpconf set-server-prop -h host -p port \  
enabled-admin-alerts:error-configuration-reload-failure-with-impact \  
enabled-admin-alerts:error-server-shutdown-abrupt \  
enabled-admin-alerts:info-configuration-reload \  
enabled-admin-alerts:info-data-source-available \  
enabled-admin-alerts:info-server-shutdown-clean \  
enabled-admin-alerts:info-server-startup \  
enabled-admin-alerts:warning-configuration-reload-failure-no-impact \  
enabled-admin-alerts:warning-data-source-unavailable \  
enabled-admin-alerts:warning-data-sources-inconsistent \  
enabled-admin-alerts:warning-listener-unavailable
```

To disable all alerts, run this command:

```
% dpconf set-server-prop -h host -p port enabled-admin-alerts:none
```

To add an alert to an existing list of enabled alerts, run this command:

```
% dpconf set-server-prop -h host -p port enabled-admin-alerts+:alert-name
```

To remove an alert from an existing list of enabled alerts, run this command:

```
% dpconf set-server-prop -h host -p port enabled-admin-alerts-:alert-name
```

By default, no alerts are enabled.

See Also For more information, see `enabled-admin-alerts(5dpconf)`.

▼ To Configure Administrative Alerts to Be Sent to Syslog

You can use DSCC to perform this task. For information, see [“Directory Service Control Center Interface” on page 43](#) and the DSCC online help.

- 1 **Select the alerts that will be sent to the `syslog` daemon, as described in [“To Enable Administrative Alerts” on page 476](#).**

- 2 **Enable alerts to be sent to the `syslog` daemon.**

```
$ dpconf set-server-prop -h host -p port syslog-alerts-enabled:true
```

All alerts are sent to the `syslog` with the facility of `USER`.

- 3 **Set the host name of the `syslog` daemon to which alerts are to be sent.**

```
$ dpconf set-server-prop -h host -p port syslog_hostname:hostname
```

▼ To Configure Administrative Alerts to Be Sent to Email

You can use DSCC to perform this task. For information, see [“Directory Service Control Center Interface” on page 43](#) and the DSCC online help.

- 1 **Select the alerts that will be sent to the `syslog`, as described in [“To Enable Administrative Alerts” on page 476](#).**

- 2 **Configure the address and characteristics of the email.**

```
$ dpconf set-server-prop -h host -p port email-alerts-smtp-host:host-name \  
  email-alerts-smtp-port:port-number \  
  email-alerts-message-from-address:sender-email-address \  
  email-alerts-message-to-address:receiver-email-address \  
  [email-alerts-message-to-address:receiver-email-address ...] \  
  email-alerts-message-subject:email-subject
```

- 3 **Enable alerts to be sent to email.**

```
$ dpconf set-server-prop -h host -p port email-alerts-enabled:true
```

- 4 **(Optional) Set a flag to include the alert code in the email**

```
$ dpconf set-server-prop -h host -p port \  
  email-alerts-message-subject-includes-alert-code:true
```

▼ To Configure Administrative Alerts to Run a Script

You can use DSCC to perform this task. For information, see [“Directory Service Control Center Interface” on page 43](#) and the DSCC online help.

- 1 **Select the alerts that will be sent to the syslog, as described in “To Enable Administrative Alerts” on page 476.**

- 2 **Enable alerts to run a script.**

```
$ dpconf set-server-prop -h host -p port scriptable-alerts-enabled:true
```

- 3 **Set the name of the script that will be run.**

```
$ dpconf set-server-prop -h host -p port scriptable-alerts-command:script-name
```

Retrieving Monitored Data About Directory Proxy Server by Using the JVM

Directory Proxy Server runs inside a Java Virtual Machine (JVM) and depends on the memory of the JVM machine. To ensure that Directory Proxy Server is running correctly, you must monitor the memory consumption of the JVM machine.

For information about how to tune parameters for the JVM machine, see “Hardware Sizing For Directory Proxy Server” in *Sun Java System Directory Server Enterprise Edition 6.2 Deployment Planning Guide*.

By default, the heap size of the JVM machine is 250 Mbytes. If Directory Proxy Server does not have enough physical memory, the heap size might be less than 250 Mbytes.

When Directory Proxy Server is running, you can monitor the heap size of the JVM machine to ensure that it is not running out of memory. To do this, use the standard tools delivered with the Java Development Kit (JDK). These tools are located in these directories:

```
$JAVA_HOME/bin/jps and $JAVA_HOME/bin/jstat.
```

▼ To View the Heap Size of the JVM

You cannot use DSCC to perform this task. Use the command line, as described in this procedure.

- **View the heap size of JVM.**

```
$ dpadm get-flags instance-path jvm-args
jvm-args: -Xms250M -Xmx250M
```

▼ To Monitor the Heap Size of JVM When Directory Proxy Server is Running

You cannot use DSCC to perform this task. Use the command line, as described in this procedure.

1 View the PID of your instance of Directory Proxy Server.

```
$ jps
```

2 View the memory used by the JVM machine.

```
$ jstat -gcutil PID
```

- If the zero column is near to 100%, the JVM machine does not have enough memory.
- FGC is the number of full garbage collection (GC) events. Garbage collection is expensive.
- GCT (garbage collection time) is the amount of time spent by the GC.

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