



EMC[®] NetWorker[®]
Release 7.6 Service Pack 1

Disaster Recovery Guide

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As part of an effort to improve and enhance the performance and capabilities of its product lines, EMC periodically releases revisions of its hardware and software. Therefore, some functions described in this document may not be supported by all versions of the software or hardware currently in use. For the most up-to-date information on product features, refer to your product release notes.

If a product does not function properly or does not function as described in this document, please contact your EMC representative.

Audience

This document is part of the EMC NetWorker documentation set, and is intended for use by the following audiences:

- ◆ System administrators who perform backup and recovery procedures, and maintain the safety of the data located over a network.
- ◆ Managers who want to learn how to implement a disaster recovery program.
- ◆ Users responsible for implementing disaster recovery plans and procedures.

Organization

This guide is organized into these chapters:

- ◆ [Chapter 1, “Introduction to NetWorker Disaster Recovery”](#)
- ◆ [Chapter 2, “Planning and Preparing for a NetWorker Server Recovery”](#)
- ◆ [Chapter 3, “NetWorker Server Disaster Recovery Roadmaps”](#)
- ◆ [Chapter 4, “Recovering a NetWorker Server”](#)
- ◆ [Chapter 5, “Recovering a NetWorker Client and Storage Node”](#)
- ◆ [Chapter 6, “Special Microsoft Recovery Procedures”](#)
- ◆ [Chapter 7, “Recovering the NetWorker Management Console Server”](#)

NetWorker product documentation

This section describes the additional documentation and information products that are available with NetWorker.

NetWorker 7.6 Service Pack 1 Administration Guide

Describes how to configure and maintain the NetWorker software.

NetWorker Release 7.6 Service Pack 1 Installation Guide

Provides instructions for installing or updating the NetWorker software for clients, console, and server on all supported platforms.

NetWorker Release 7.6 Service Pack 1 Cluster Installation Guide

Contains information related to installation of the NetWorker software on cluster server and clients.

NetWorker Release 7.6 Service Pack 1 Release Notes

Contain information on new features and changes, fixed problems, known limitations, environment and system requirements for the latest NetWorker software release.

NetWorker Data Domain Deduplication Devices Integration Guide

Provides planning and configuration information on the use of Data Domain devices for data deduplication backup and storage in a NetWorker environment.

NetWorker License Manager 9th Edition Installation and Administration Guide

Provides installation, set up, and configuration information for the NetWorker License Manager product.

NetWorker Licensing Guide

Provides information about licensing NetWorker products and features.

NetWorker 7.6 Service Pack 1 Error Message Guide

Provides information on common NetWorker error messages.

NetWorker 7.6 Service Pack 1 Performance Optimization Planning Guide

Contains basic performance tuning information for NetWorker.

NetWorker 7.6 Service Pack 1 Command Reference Guide

Provides reference information for NetWorker commands and options.

NetWorker Management Console Online Help

Describes the day-to-day administration tasks performed in the NetWorker Management Console and the NetWorker Administration window. To view Help, click **Help** in the main menu.

NetWorker User Online Help

Describes how to use the NetWorker User program, which is the Windows client interface connect to a NetWorker server to back up, recover, archive, and retrieve files over a network.

NetWorker related documentation

For more information about NetWorker software, refer to this documentation:

EMC Information Protection Software Compatibility Guide

The EMC Information Protection Software Compatibility guide provides a list of supported clients, servers, and storage node operating systems for the following software products: AlphaStor, ArchiveXtender, DiskXtender for Unix/Linux, DiskXtender for Windows, Backup Advisor, AutoStart, AutoStart SE, RepliStor, NetWorker, and NetWorker Modules and Options.

E-lab Issue Tracker

Issue Tracker offers up-to-date status and information on NetWorker known limitations and fixed bugs that could impact your operations. E-Lab Issue Tracker Query allows you to find issues in the Issue Tracker database by matching issue number, product feature, host operating system, fixed version, or other fields.

NetWorker Procedure Generator

The NetWorker Procedure Generator (NPG) is a stand-alone Windows application used to generate precise user driven steps for high demand tasks carried out by customers, Support and the field. With the NPG, each procedure is tailored and

generated based on user-selectable prompts. This generated procedure gathers the most critical parts of NetWorker product guides and combines experts' advice into a single document with a standardized format.

Note: To access the E-lab Issue Tracker or the NetWorker Procedure Generator, go to <http://www.Powerlink.emc.com>. You must have a service agreement to use this site.

Technical Notes and White Papers

Provides an in-depth technical perspective of a product or products as applied to critical business issues or requirements. Technical Notes and White paper types include technology and business considerations, applied technologies, detailed reviews, and best practices planning.

Conventions used in this document

EMC uses the following conventions for special notices.

Note: A note presents information that is important, but not hazard-related.



CAUTION

A caution contains information essential to avoid data loss or damage to the system or equipment.



IMPORTANT

An important notice contains information essential to operation of the software.

Typographical conventions

EMC uses the following type style conventions in this document:

Normal	Used in running (nonprocedural) text for: <ul style="list-style-type: none"> Names of interface elements (such as names of windows, dialog boxes, buttons, fields, and menus) Names of resources, attributes, pools, Boolean expressions, buttons, DQL statements, keywords, clauses, environment variables, functions, and utilities URLs, pathnames, filenames, directory names, computer names, filenames, links, groups, service keys, file systems, and notifications
Bold	Used in running (nonprocedural) text for: <ul style="list-style-type: none"> Names of commands, daemons, options, programs, processes, services, applications, utilities, kernels, notifications, system calls, and man pages Used in procedures for: <ul style="list-style-type: none"> Names of interface elements (such as names of windows, dialog boxes, buttons, fields, and menus) What user specifically selects, clicks, presses, or types
<i>Italic</i>	Used in all text (including procedures) for: <ul style="list-style-type: none"> Full titles of publications referenced in text Emphasis (for example a new term) Variables
Courier	Used for: <ul style="list-style-type: none"> System output, such as an error message or script URLs, complete paths, filenames, prompts, and syntax when shown outside of running text
Courier bold	Used for: <ul style="list-style-type: none"> Specific user input (such as commands)

<i>Courier italic</i>	Used in procedures for: <ul style="list-style-type: none">• Variables on command line• User input variables
< >	Angle brackets enclose parameter or variable values supplied by the user
[]	Square brackets enclose optional values
	Vertical bar indicates alternate selections - the bar means “or”
{ }	Braces indicate content that you must specify (that is, x or y or z)
...	Ellipses indicate nonessential information omitted from the example

Where to get help

EMC support, product, and licensing information can be obtained as follows.

Product information — For documentation, release notes, software updates, or for information about EMC products, licensing, and service, go to the EMC Powerlink website (registration required) at:

<http://Powerlink.EMC.com>

Technical support — For technical support, go to EMC Customer Service on Powerlink. To open a service request through Powerlink, you must have a valid support agreement. Please contact your EMC sales representative for details about obtaining a valid support agreement or to answer any questions about your account.

Your comments

Your suggestions will help us continue to improve the accuracy, organization, and overall quality of the user publications. Please send your opinion of this document to:

BSGdocumentation@emc.com

If you have issues, comments, or questions about specific information or procedures, please include the title and, if available, the part number, the revision (for example, A01), the page numbers, and any other details that will help us locate the subject you are addressing.

The *EMC NetWorker Recovery Guide* provides step-by-step instructions for recovering from a disaster on supported NetWorker client, server, and storage node platforms.

This chapter includes these sections:

- ◆ Supported operating systems 10
- ◆ NetWorker server recovery defined 10

Supported operating systems

This guide provides disaster recovery information for EMC® NetWorker® software on these operating systems:

- ◆ Linux
- ◆ Mac OS X
- ◆ Microsoft Windows
- ◆ NetWare
- ◆ UNIX

NetWorker server recovery defined

For the purpose of this guide, a *disaster* is any situation in which the day-to-day access to data (for example, working files, software programs, or system files) is disrupted. A disaster also can damage network components, such as data, devices, hardware, media, and software.

A disaster can result from any of these situations:

- ◆ Computer viruses that can corrupt data
- ◆ Hardware and software failures
- ◆ Infrastructure interruptions, inconsistencies, or loss of services, such as communication or network connections

The degree of loss during a disaster can range from one or more files to an entire computer system. The severity of the disaster determines the procedures necessary to recover data.

This chapter includes these sections on planning and preparing to recover a NetWorker server:

- ◆ [Backing up data](#) 12
- ◆ [Preparing for NetWorker server recovery](#) 13
- ◆ [Troubleshooting a NetWorker server recovery](#) 14

Note: If you are viewing the online version of this guide, print a hard copy and store it in a safe location.

Backing up data

Back up important data on a scheduled basis. The more time and effort invested in incorporating, maintaining, and testing a backup solution, the better prepared you are in the event of a disaster.

Ensure that servers are backed up regularly as part of a backup group. Otherwise, a “bootstrap” is not saved (backups performed by using the command line or the NetWorker User program do not save the NetWorker server bootstrap). Use a local backup device on the server to back up the server’s bootstrap.

Always perform a scheduled backup of the NetWorker server after upgrading to a new release of NetWorker software. This ensures that an upgraded version of the bootstrap is saved. Bootstrap backups should also be performed before upgrading.

The bootstrap information can be printed from the savegrp.log file, which is located in the *nsr* directory. The *NetWorker Administration Guide* provides instructions on how to configure the NetWorker software to send bootstrap information directly to a printer or to a specified email address. If the bootstrap is backed up to a pool, other than the preconfigured pools, save the name of the pool along with the bootstrap.

Note: Index backups are not included in bootstrap backups.

Maintain a copy of this information in a safe location for easy access by those assigned to perform disaster recovery. Consider maintaining a copy of this information in both an onsite and offsite location.

Having the correct information handy in case a disaster occurs is a key element in recovering from a disaster as quickly as possible.

Gathering the key information

Maintain accurate records for each hardware, software, network, device, and media component.

Hardware information

Maintain this computer hardware information up-to-date:

- ◆ File-system configuration
- ◆ Fully qualified domain names, IP addresses, and hostnames
- ◆ For Domain Name System (DNS) clients, maintain the DNS host’s Internet address and hostname
- ◆ Hard drive configuration
- ◆ Media device names
- ◆ Hardware vendor contact information and contract number
- ◆ Configuration information for each piece of hardware, both active and inactive, within the organization or organizational site

Software information

Maintain this computer software information up-to-date:

- ◆ Copies of the original operating system media and patches (and where they are located)
- ◆ Software enabler and authorization codes
- ◆ Software vendor contact information and contract number
- ◆ The operating system version and patches installed
- ◆ Operating system configuration
- ◆ Emergency media that can be used to recover a computer if a disaster occurs
- ◆ NetWorker bootstrap information for each NetWorker server
- ◆ Kernel configuration and location
- ◆ Device drivers
- ◆ A list of any Windows volume mount points

Preparing for NetWorker server recovery

This section describes the steps required to prepare for the recovery of a NetWorker server. This is useful if you are making changes to the operating system, hardware, or are performing an upgrade. The steps include:

- ◆ [“Task 1: Perform a full backup of the backup server” on page 13](#)
- ◆ [“Task 2: Create a new group and place all clients in the new group” on page 13](#)
- ◆ [“Task 3: Replace hardware and reinstall/upgrade the operating system” on page 14](#)
- ◆ [“Task 4: Recover your NetWorker server implementation” on page 14](#)

Task 1: Perform a full backup of the backup server

Perform a full backup of the backup server (BK_SERV) to generate the bootstrap information. Run this command for the full backup:

```
savegrp -l full -c BK_SERV -G group_name
```

Where *group_name* identifies the group containing the server with the save set called ALL

Note: Print this information and keep it handy. It is needed during recovery operations.

Task 2: Create a new group and place all clients in the new group

Create a new group and place all the clients in that new group by performing the following steps:

1. Create the new group.
2. Once the new group is created, place all of your clients into that group, and then run this command:

```
savegrp -O -l full BK_SERV -G Group_name
```

Where *Group_name* identifies the group created in step 1.

This command performs a full backup of all client indexes, belonging to the new group, onto the same tape. It also creates bootstrap information which should be kept close at hand.

Task 3: Replace hardware and reinstall/upgrade the operating system

Identify the defective or suspect hardware and replace it as required.

Note: If you are performing a disaster recovery, install the same version of NetWorker with the same patch level and in the same location, where it was installed prior to the disaster. Configure the new server with the same name that was used for the configuration prior to the disaster. In other words, if the NetWorker server was defined with a fully qualified domain name (FQDN), then ensure that the new server is configured with the FQDN. The same conditions apply to the devices name.

Task 4: Recover your NetWorker server implementation

[Chapter 4, “Recovering a NetWorker Server,”](#) provides instructions on recovering the NetWorker server.

Troubleshooting a NetWorker server recovery

This section includes these tasks:

- ◆ [“Task 1: Obtaining the bootstrap SSID” on page 14](#)
- ◆ [“Task 2: Shutting down NetWorker and renaming the media database” on page 15](#)
- ◆ [“Task 3: Restarting NetWorker” on page 16](#)
- ◆ [“Task 4: Configuring the backup media” on page 16](#)

Note: Before starting the disaster recovery procedure, ensure that you are aware of the bootstrap SSID and the volume that contains the bootstrap.

Task 1: Obtaining the bootstrap SSID

To obtain the bootstrap SSID:

1. Verify that the bootstrap SSID was previously recorded. This information can be obtained from the Bootstrap notifications information, which is usually printed out or emailed to the administrator.
2. If the bootstrap information is unavailable, locate the bootstrap SSID and the volume containing that bootstrap SSID in:
 - - ..\nsr\logs\messages file
 - - ..\nsr\logs\savegrp.log

If the media database is not lost and the volumes list is there then run the command:

```
mminfo -av -B -s server_name
```

This lists all the bootstrap SSID available in the media database and the volume name containing the bootstrap SSID by tracing the daemon.log file line-by-line back to the last good bootstrap.

This allows you to locate the volume containing the required bootstrap.

3. Find the bootstrap SSID.

If you are aware of the volume that contains the bootstrap information, but unaware of the bootstrap SSID, run this command:

```
scanner -B device_name
```

Note: The *device_name* could be: \\.\Tape0, \\.\Tape1, /dev/rmt/0cbn, /dev/rmt/1cbn, depending on the operating system in use, the number of devices you have, and the device you configured within NetWorker. Ensure you use the correct letter case; these commands are case-sensitive.

This scanner command will locate the latest bootstrap SSID available on that volume.

Now start with a fresh database, especially if there is a database corruption. This is to avoid additional corruption or problems in the future.

Task 2: Shutting down NetWorker and renaming the media database

To rename the media database:

1. Shut down NetWorker services as indicated in [Table 1 on page 15](#).

Table 1 Shutting down NetWorker services

If you are using this operating system...	Use this procedure...
Windows	The NetWorker services are: NetWorker Backup and Recovery server (nsrd) and NetWorker Remote Exec Service (nsrexecd). To stop the services on Windows, run these commands: <ul style="list-style-type: none"> • net stop nsrexecd • net stop nsrd
UNIX	The NetWorker daemons are: nsrd, nsrmmdbd, nsrindexd, nsrjobjd, nsrlcpd (if jukebox is configured), nsrmmgd, nsrmmmd, and nsrexecd. To stop the NetWorker daemons, run the nsr_shutdown command.

2. Rename the mm directory to **mm.old**:
 - a. In UNIX it is located in */nsr/mm*.
 - b. In Windows it is located in *.\nsr\mm* (*.\program files\Legato\nsr\mm*).
3. Rename the index directory to *index.old*. On UNIX, it is located in */nsr/index* while it is located in *.\nsr\index* (*.\program files\Legato\nsr\index*) on Windows.

Task 3: Restarting NetWorker

Restart NetWorker services again as indicated in [Table 2 on page 16](#).

Table 2 Restarting NetWorker services

If you are using this operating system...	Use this procedure...
Windows	The NetWorker services are: NetWorker Backup and Recovery server (nsrd) and NetWorker Remote Exec Service (nsrexecd). To start the services on Windows run these commands: <ul style="list-style-type: none"> • net start nsrexecd • net start nsrd
UNIX	The NetWorker daemons are: nsrd, nsrmmdbd, nsrindexd, nsrmmdd, and nsrexecd. To start the NetWorker daemons, run these commands, at the UNIX prompt, in the order specified: <ul style="list-style-type: none"> • nsrexecd • nsrd

Task 4: Configuring the backup media

To configure the backup media:

1. Define a tape drive in NetWorker administrators interface. If you have a jukebox and if the jukebox configuration and the devices are still defined in NetWorker, then skip this step. Otherwise, configure one of the tape drives in the jukebox (if you have a jukebox) as a stand-alone device. Do not reconfigure the jukebox; manually, because after recovery, the configuration details of the jukebox are restored.
2. Load the appropriate volume (obtained in Task 1) in the drive just configured in NetWorker:
 - If the jukebox is configured, then load the volume by using the **nsrjb -ln -s server_name device** command.
 - If you only have a stand-alone device configured then you need to load the volume manually in the drive.
3. Run **mmrecov** command. You will be asked for the bootstrap ID (which was obtained above), the file and the record numbers. If you do not have the file or record numbers, skip them by hitting enter.
4. Now **mmrecov** utility will scan the volume and will start its recovery procedure. Watch the resulting output of this command. It may ask you for another volume (if the bootstrap used is not from a full backup.) If asked for another volume, load the volume manually in the drive just configured in NetWorker.

Note: If any errors are indicated contact EMC Technical Support. If no errors are displayed, the *mm* directory, the *index* directory and a *res.R* directory (if using NetWorker 5.x) are recovered. NetWorker 6.x only recovers the *mm* and the *res.R* directories.

5. Shut down NetWorker service .
6. Rename the res directory to **res.old**.
7. Rename res.R directory to **res**.
8. Start NetWorker services again.

- Run the appropriate command to rebuild the index as indicated in [Table 3 on page 17](#):

Table 3 NetWorker commands to rebuild the index

NetWorker version	Command name
6.x, 7.x	<code>nsrck -L7</code>
5.x	<code>nsrck -F</code>

- Run this command:

`nsrim -X`

If you start the NetWorker user interface, all clients, volumes, and indexes should be available.

This chapter explains the general procedures to follow should it become necessary to recover, or move, a NetWorker server, client, storage node, or NetWorker Management Console. It includes these sections:

- ◆ Before starting..... 20
- ◆ NetWorker server movement 20
- ◆ NetWorker client or storage node recovery 20
- ◆ NetWorker server recovery 21
- ◆ NetWorker Management Console server recovery 22

Before starting

This chapter provides general information on procedures to follow if a disaster occurs and references to the detailed recovery procedures that are required to correct disaster situations.

NetWorker server movement

Contact EMC Professional Services for assistance with moving a NetWorker server to a new operating system environment. Merging or consolidating several NetWorker servers onto a single NetWorker server is not supported.

NetWorker client or storage node recovery

This section identifies the steps required to recover a NetWorker client or storage node.

NetWorker client or storage node recovery in a UNIX environment

To recover a NetWorker client or storage node, see [“Recovering a UNIX NetWorker client and storage node” on page 48](#)

NetWorker client or storage node recovery in a Windows environment

[Table 4](#) lists the topics that explain the steps required to recover a Windows NetWorker client or storage node.

Table 4 Recovering a Windows NetWorker client or storage node

To do this...	On...
Recover a NetWorker client or storage node.	“Recovering a Windows NetWorker client or storage node” on page 54.
Recover a NetWorker client that is part of a MSCS cluster on Windows 2008.	“Recovering a MS Cluster on Windows Server 2008 / R2” on page 71.
Recover a NetWorker client using ASR.	“Performing a Windows ASR recovery” on page 72.
Recover an Active Directory NetWorker client.	“Recovering Active Directory” on page 76.
Recover DHCP and WINS databases for a NetWorker client.	“Recovery of DHCP and WINS databases” on page 80.
Recover Windows Server 2008 or 2008 R2 using WSB.	“Performing a Windows Server 2008 offline system recovery using Windows Server Backup (WSB) and NetWorker” on page 81.
Recover other Microsoft application databases.	“NetWorker Module for Microsoft Applications” on page 70.

NetWorker client or storage node recovery in other environments

[Table 5](#) lists the topics that explain the steps required to recover a NetWorker client in other supported environments.

Table 5 Recovering NetWorker clients in other environments

To do this...	On...
Recover a Mac OS X NetWorker client.	“Recovering a Mac OS X NetWorker client” on page 60.
Recover a NetWorker NetWare client.	“Recovering a NetWare NetWorker client containing an NDS partition” on page 63.
Recover a NetWorker Avamar client whose primary Avamar server has failed.	“De-duplication and Avamar server disaster recovery” on page 62.

NetWorker server recovery

This section identifies the various steps involved in recovering a NetWorker server within all supported operating system environments.

NetWorker server recovery in a UNIX environment

[Table 6](#) lists the activities that you must perform to recover a NetWorker server operating within a UNIX operating system environment.

Table 6 Recovering a UNIX NetWorker server

Step	To do this...	On...
1	Replace all hardware and operating systems as required.	applicable vendor and OEM documentation.
2	Recover the NetWorker server.	“Recovering a NetWorker server” on page 25.
3	Recover the NetWorker client as required.	“Recovering a NetWorker client” on page 49.
4	Recover the NetWorker storage node as required.	“Recovering a NetWorker storage node” on page 51.

NetWorker server recovery in a Windows environment

[Table 7](#) lists the activities to recover a NetWorker server operating within a Windows operating system environment.

Table 7 Recovering a Windows NetWorker server

Step	To do this...	On...
1	Replace hardware and the operating system as required.	applicable vendor and OEM documentation.
2	Recover the NetWorker server.	“Recovering a NetWorker server” on page 25.
3	Recover the NetWorker client as required.	“Recovering a Windows NetWorker client or storage node” on page 54
4	Recover the NetWorker storage Node as required.	“Recovering a Windows NetWorker client or storage node” on page 54

NetWorker Management Console server recovery

Table 8 identifies the various steps involved in recovering a NetWorker Management Console server (NMC) from within UNIX or Windows operating system environment.

Table 8 MNC server recovery

Step	Task	Where to find more information
1	Complete one of these actions as required:	
	a. Reinstall the NetWorker software.	The appropriate <i>NetWorker Installation Guide</i> for instructions on reinstalling NetWorker software.
	b. Recover the NetWorker software.	The recovery procedures provided in Chapter 4, "Recovering a NetWorker Server,"
2	Complete one of these actions as required:	
	a. Reinstall the NMC software.	The appropriate <i>NetWorker Installation Guide</i> for instructions on reinstalling the NetWorker Management Console software.
	b. Recover the NMC software.	The recovery procedures found in this guide.
3	Recover the NMC server database.	"Recovering the console server database" on page 84.

This chapter provides the instructions necessary to recover a NetWorker server from any supported operating system. The procedures describe, in general terms, what you should do and provides examples where appropriate. In some cases, specific operating systems require unique procedures and, wherever necessary the operating system is specified in the procedure heading.

This chapter includes these procedures:

◆ Prerequisites	24
◆ Recovering a NetWorker server	25
◆ Task 1: Reinstall the NetWorker server software	27
◆ Task 2: Configure NetWorker device and client resources	29
◆ Task 3: Locate the server's bootstrap save set ID	31
◆ Task 4: Recover the server bootstrap from Windows or UNIX systems	32
◆ Task 5: Rename the NetWorker server resource directory/files	35
◆ Task 6: Recover indexes and data	36
◆ Task 7: Recover the application and user data (UNIX only)	43
◆ Task 8: Complete Windows specific recovery procedures	45
◆ Task 9: Perform a test backup and recovery	46

Prerequisites

There is a significant amount of information that must be known before you attempt to recover a NetWorker server. [Table 10 on page 24](#) identifies the information, based on the operating system in use, that you will require during the recovery procedure.

Note: Future recoveries can be simplified if this information, including any changes made to it, is recorded and kept in a secure location.

Table 10 Information required to recover a NetWorker server

UNIX	Windows
NetWorker version and patch level.	NetWorker version and patch level.
NetWorker installation path.	NetWorker installation path.
NetWorker datazone ID (required for recoveries from cloud devices)	NetWorker datazone ID (required for recoveries from cloud devices)
TCP/IP properties: <ul style="list-style-type: none"> • Adapter type • IP address • Default gateway • Subnet mask • DNS server 	TCP/IP properties: <ul style="list-style-type: none"> • Adapter type • IP address • Default gateway • Subnet mask • DNS server • WINS server (if used)
Computer properties: <ul style="list-style-type: none"> • Hostname • DNS domain name • Superuser password 	Host properties: <ul style="list-style-type: none"> • Computer name • Fully-qualified domain name • Administrator account password
Backup or clone volumes that contain the NetWorker server's most recent: <ul style="list-style-type: none"> • bootstrap • client file indexes • volume names (required for cloud devices only) 	Backup or clone volumes that contain the NetWorker server's most recent: <ul style="list-style-type: none"> • bootstrap • client file indexes • file-system data including <i>all</i> Windows SYSTEM or VSS SYSTEM save sets. • volume names (required for cloud devices only)
Device and SCSI drivers.	If you routinely move NetWorker backup media off site for safekeeping, ensure that all necessary volumes are available so that you can avoid delays during a recovery.
Boot files required for booting the kernel. For example: <ul style="list-style-type: none"> /unix /boot /etc/default/boot /stand/vmunix 	Note: Before you begin a NetWorker server recovery in a Windows environment, you should understand the information about SYSTEM or VSS SYSTEM save sets in the <i>NetWorker Administration Guide</i> .

Note: If you routinely move NetWorker backup media to an off-site location for safekeeping, ensure that all necessary volumes are available so that you can avoid delays during a recovery. To list the media associated with the files to recover, run **mminfo -mv** from the command prompt. The *EMC NetWorker Command Reference Guide* contains more information about the **mminfo** command.

DNS server

If the host being recovered uses DNS for hostname resolution, the DNS server must be available or hostnames cannot be resolved. This could cause the NetWorker software to be unresponsive when attempting to resolve hostnames.

If the DNS server is not available, try the following:

1. Disable DNS lookup for the host being recovered and utilize the local hosts file on the NetWorker server for hostname resolution.
 - For Windows, the hosts file is located in *C:\Windows\System32\Drivers\etc*.
 - For UNIX, the file is located in */etc*.
UNIX systems must be modified to look up the hosts files, before DNS, as a hostname resolution method.
2. When the DNS server is available, re-enable DNS lookup.

Recovering a NetWorker server

This section describes how to install the NetWorker software. Unless specified, these instructions apply to any operating system supported for a NetWorker server.

For Windows OS: Reinstall the Windows operating system

If you want to update Windows during the recovery, first recover the Windows version that was installed immediately prior to the disaster, then upgrade after you have completed the recovery.

To reinstall the Windows operating system:

1. Reinstall the same version of Windows, including any patches, service packs, or option packs in use immediately prior to the disaster.

During the installation, be sure to set the following configuration options as they were prior to the disaster:

- Windows installation location
- Computer name
- Administrator account password
- Regional settings
- Date and time settings

Note: If the computer that is being recovered was a domain controller prior to the disaster, that configuration is recovered later in the process.

2. After the operating system is installed, configure the computer as follows:

Windows 2003 and Windows XP Professional:

- a. Start the **Control Panel System** tool.
- b. On the **System Properties** dialog box, click the **Computer Name** tab and click the **Change** button.
- c. In the **Computer Name Changes** dialog box, ensure that the computer name is correct and that the computer is installed into a workgroup, not a domain. If the computer being recovered was previously a domain controller or a member of a domain, it will be restored to the correct domain when the recovery is complete. Click **More**.
- d. In the **DNS Suffix and NetBIOS Computer Name** dialog box, ensure that the **Primary DNS Suffix Of This Computer** text box contains the correct domain name (the name that is appended to the hostname to form the fully-qualified domain name). For example, the fully-qualified domain name for a computer named *kingdome*, might be *kingdome.seattle.washington.com*.
- e. Start the **Control Panel Local Area Connection** tool.
- f. In the **Local Area Connection Status** dialog box, click **Properties**.
- g. In the **Local Area Connection Properties** dialog box, select **Internet Protocol (TCP/IP)** and click **Properties**.
- h. In the **Internet Protocol (TCP/IP) Properties** dialog box, set the TCP/IP properties as they were prior to the disaster, with the same IP address, subnet mask, default gateway, and DNS server.

Windows 2000:

- a. Start the **Control Panel System** tool.
- b. In the **System Properties** dialog box, click the **Network Identification** tab and click **Properties**.
- c. In the **Identification Changes** dialog box, ensure that the computer name is correct and that the computer is a member of the correct domain. Click **More**.
- d. In the **DNS Suffix and NetBIOS Computer Name** dialog box, ensure that the **Primary DNS Suffix Of This Computer** box contains the correct domain name (the name that is appended to the host name to form the fully-qualified domain name). For example, the fully-qualified domain name for a computer named *kingdome*, might be *kingdome.seattle.washington.com*.
- e. Start the **Control Panel NetWork and Dial-up Connections** tool.
- f. In the **Network and Dial-up Connections** window, right-click **Local Area Connection** and select **Properties**.
- g. In the **Local Area Connection Properties** dialog box, select **Internet Protocol (TCP/IP)** and click **Properties**.
- h. In the **Internet Protocol (TCP/IP) Properties** dialog box, set the TCP/IP properties as they were prior to the disaster, with the same IP address, subnet mask, default gateway, and DNS server.

Windows NT 4.0:

- a. Start the **Control Panel Network** tool.
- b. In the **Network** dialog box, click the **Identification** tab and ensure that the computer name and domain are correct.
- c. Click the **Protocols** tab, select **TCP/IP** and click **Properties**.

- d. In the **Microsoft TCP/IP Properties** dialog box, set the TCP/IP properties as they were prior to the disaster, with the same IP address, subnet mask, default gateway, and DNS server.
3. In the *hosts* file (`%SystemRoot%\system32\drivers\etc\hosts`) make an entry for the NetWorker server to be used in the recovery. NetWorker software requires this entry when:
 - DNS is not in use or no DNS server is available.
 - The NetWorker server host being recovered is also a DNS server.

The entry in the *hosts* file must include the IP address, the fully-qualified domain name, and the computer name, all on the same line. For example:

```
123.56.890.474 kingdome.seattle.washington.com kingdome
```

Note: If the machine being recovered is also a NetWorker server and no DNS server is available, each client must also be listed in this file.

4. Configure the virtual memory as it was prior to the system being brought down by a disaster. Instructions are provided in [Table 11](#).

Table 11 Virtual memory configuration

With this operating system	Complete these instructions
Windows 2003 and Windows XP Professional	<ol style="list-style-type: none"> 1. Start the Control Panel System tool. 2. In the System Properties dialog box, click the Advanced tab and click Settings in the Performance section. 3. In the Performance Options dialog box, click the Advanced tab and click Change in the Virtual Memory section. 4. In the Virtual Memory dialog box, set the virtual memory options. Click OK.
Windows 2000	<ol style="list-style-type: none"> 1. Start the Control Panel System tool. 2. In the System Properties dialog box, click the Advanced tab and click Performance Options. 3. In the Performance Options dialog box, click Change. 4. In the Virtual Memory dialog box, set the virtual memory options. Click OK.
Windows NT 4.0	<ol style="list-style-type: none"> 1. Start the Control Panel System tool. 2. In the System Properties dialog box, click the Performance Tab. 3. On the Performance tab, click Change. 4. In the Virtual Memory dialog box, set the virtual memory options. Click OK.

5. Reinstall any additional Windows components previously installed through Windows Setup, such as Gateway Services for NetWare.

Do not upgrade OEM drivers for network interface cards (NIC) with the OEM Service Pack version of the NIC drivers.

Task 1: Reinstall the NetWorker server software

To reinstall the NetWorker server software:

1. Reinstall the same version of the NetWorker server software into its original location. When you reinstall the NetWorker server software, the NetWorker client is also installed. Installation instructions are provided in the appropriate *NetWorker Installation Guide*.

Note: To upgrade the NetWorker server, first recover the server to its original state, then perform the upgrade. In a UNIX environment, you do not have to reload the license enablers if the NetWorker configuration files still exist. By default, the configuration files are located in the `SYS:NSR\RES` directory. In a windows environment, you can install NetWorker over a network from a shared drive and, because `mmrecov` is case-sensitive, the installation path must be the same as the original. For example, `C:\Program Files\legato\nsr` is not same as `C:\Program Files\legato\NSR`.

2. Reinstall any NetWorker patches that were installed prior to the disaster.
3. If the `/nsr` directory or any of its subdirectories except for `/nsr/res` were linked, re-create these links. Step 4 provides more information about the `/nsr/res` directory.

To re-create links to NetWorker directories:

- Stop the NetWorker daemons by entering the `nsr_shutdown` command at the command line:

nsr_shutdown

- Move the files to their original location.
- Create the links from the `/nsr` directory to the original location.
- Restart the NetWorker server by first entering the `nsrexecd` command and then entering the `nsrd` command, for example:

nsrexecd

nsrd

Note: You also can restart the NetWorker server by running the NetWorker startup script for the appropriate platform.

4. Determine `/nsr/res` directory linking issues as detailed in [Table 12](#).

Table 12 Directory linking issues while reinstall the NetWorker server software

Was <code>/nsr/res</code> linked to another directory?	Action
No	Skip this step.
Yes	Do <i>not</i> re-create the link; instead, create a <code>/nsr/res</code> directory. This directory is used temporarily in "Task 4: Recover the server bootstrap from Windows or UNIX systems" on page 32.

Note: The resource database will not be recovered to the `/nsr/res` directory created in this step. Instead, the resource directory will be recovered to the link's target directory. For example, if `/nsr/res` was linked to a directory named `/bigres`, then the resource database is recovered to `/bigres`. Ensure that there is enough space in the target directory for the recovered resource database.

Task 2: Configure NetWorker device and client resources

To configure NetWorker device and client resources:

1. Create and configure the NetWorker server's device resources.

To recover data by using a stand-alone device, ensure that a resource for the stand-alone device exists (this is defined in the `/nsr/res` directory). If a resource for the standalone device does not exist, create it using the NetWorker Administrator program.

2. In the Windows NetWorker Administrator program, open the NetWorker server's client resource and verify that the **Aliases** attribute (in the **Preferences** tab) contains the correct information. For example, aliases for a computer named *kingdome* might be:

kingdome

kingdome.seattle.washington.com

Set the NetWorker browse and retention policies to a decade. The browse policy is one quarter (three months) by default. This enables you to recover all of the server's records.



CAUTION

If you do not reset the NetWorker server's browse and retention policies, any of the server's records that are more than one quarter (three months) old will be discarded, because the browse policy is one quarter by default.

3. If you are using the Windows NetWorker Administrator program:
 - a. Configure the client resource for the NetWorker server. Set the browse and retention policies to a time value that covers the oldest save sets being used for the recovery. This allows you to recover all of the NetWorker server's records with the **mmrecov** command.

Note: If the browse and retention policies set for the client instance of the NetWorker server are long enough to cover all of the save sets you use, all of the NetWorker server's records are recovered. However, if the browse and retention policies set for the client are not changed and save sets exist for the NetWorker server that have browse and retention policies greater than one month, they are discarded because the default browse policy is one month.

- b. If the NetWorker server's client file index has not been relocated from its original path, or if you are going to recover a relocated client file index from a backup created with NetWorker release 7.x, skip this step and proceed to ["Task 3: Locate the server's bootstrap save set ID" on page 31](#).

If you are going to recover the client file index from a backup created with a NetWorker release earlier than 7.x, and you moved the NetWorker server's client file index path to a different location, you must:

- Edit the **Index Path** attribute of the NetWorker server's client resource to reflect the correct path.
- Stop and restart the NetWorker Backup and Recovery Service and the NetWorker Remote Exec Service.

4. If you are recovering data using an autochanger, you must complete the steps specific to your operating system. [Table 13](#) identifies the procedures for each support operating system.

Table 13 Recovering data using an autochanger from specific operating systems (1 of 2)

If your operating system is...	Then...
UNIX	<ol style="list-style-type: none"> 1. Ensure that an autochanger resource exists (this is defined in the <code>/nsr/res</code> directory). If the Autochanger resource does not exist, create it using the NetWorker Console Administration interface. The <i>EMC NetWorker Administration Guide</i> provides details about this interface. 2. Reset the autochanger by using the nsrjb -vHE command. This command resets the autochanger, ejects backup volumes, re-initializes the element status, and checks each slot for a volume. <ul style="list-style-type: none"> • If the autochanger does not support the -E option, initialize the element status by using sjielm (on Linux, use ielem). • Inventory the autochanger by using the nsrjb -I command. This helps to determine whether the volumes required to recover the bootstrap are located inside the autochanger. <p>Note: None of these volumes will be in the media database, so you cannot view the contents of the tape through NMC, and the volume name will come up as <code>-*</code>.</p>

Table 13 Recovering data using an autochanger from specific operating systems (2 of 2)

If your operating system is...	Then...
Windows	<ol style="list-style-type: none"> 1. Start a Windows command prompt and change to the <NetWorker_install_path>\bin directory. 2. Create and configure the Autochanger resource using the NetWorker Console Administration interface. The <i>EMC NetWorker Administration Guide</i> provides details about the NetWorker Console Administration interface. 3. Run the nsrjb -vHE command from the command prompt. This resets the autochanger, ejects backup volumes, re-initializes the element status, and checks each slot for a volume. If the autochanger does not support the -E option (to re-initialize the element status), use the sjielm command to initialize the element status. 4. To determine which volume contains the bootstrap, load the tape and run scanner -B. The media database will not contain any save set information for the tape. Inventory the autochanger by running the nsrjb -lv command from the command prompt. If you know the slot number where the bootstrap is located, use the nsrjb -inv -S # command to inventory that particular slot. 5. If you are using an autochanger with Removable Storage enabled: <ol style="list-style-type: none"> a. On the desktop, right-click My Computer and select Manage. b. In the left pane of the Computer Management window, expand <i>Storage\Removable Storage\Physical Locations</i>. c. Right-click the icon for the autochanger and select Inventory. d. Minimize (but do not close) the Computer Management window. e. After the Removable Storage inventory is complete, start the NetWorker Administrator program and select Devices on the Configure tab. f. In the Devices window, right-click the Devices icon and select Create. g. In the Create Devices dialog box, create a stand-alone NetWorker Device resource for each drive in the autochanger. h. In the Computer Management window, double-click the icon for the autochanger (under <i>Storage\Removable Storage\Physical Locations</i>). Icons for the autochanger's volumes appear in the right pane. i. Right-click the icon for the volume that contains the bootstrap and select Mount.

Task 3: Locate the server's bootstrap save set ID

If you already know the save set ID of the NetWorker server's most recent bootstrap, skip this task and go to ["Task 4: Recover the server bootstrap from Windows or UNIX systems"](#) on page 32.

The bootstrap contains the NetWorker server's media database and resource configuration files, which are required for a NetWorker server recovery. ["Backing up data"](#) on page 12 contains more information about the bootstrap.

If you routinely move NetWorker backup media to an off-site location for safekeeping, and a subsequent file recover operation generates a mount request, the recover operation waits until an operator mounts the request media. To avoid delays when recovering files, use the **mminfo -mv** command to list the media that is associated with the file to be recovered and to retrieve the media from the off site storage before starting the recover.

To locate the save set ID of the most recent bootstrap:

1. Insert the most recent media or clone volumes used for scheduled backups into the appropriate device.
2. At the console command line, switch to the directory where the NetWorker binary and executable files are located.
3. If you are using an autochanger, insert the first volume of the bootstrap save set into the first drive of the autochanger by using this command:

```
nsrjb -lnv -S slot -f device_name
```

where:

- *slot* is the slot where the first volume is located.
 - *device_name* is the pathname for the first drive. You can obtain the *device_name* by using the **inquire** command.
4. Use the **scanner -B** command to determine the save set ID of the most recent bootstrap on the media. For example:

```
scanner -B device_name
```

where *device_name* is the pathname for the drive where the appropriate volume is located (for example, \\.\Tape0 or /dev/rmt/0hbn).

If you do not locate the save set ID of the most recent bootstrap on the most recent media, run the **scanner -B** command on the preceding media to locate the save set ID of the most recent bootstrap.

If the bootstrap was backed up to a cloud device, use the following command:

```
scanner -B -V cloud_volume -Z datazone_id cloud_device
```

where:

- *cloud_volume* is the cloud volume label name.
 - *datazone_id* is the datazone ID that the NetWorker server belonged to before the disaster.
 - *cloud_device* is the name of the cloud device.
5. Record both the bootstrap save set ID, file number, record number, and the volume label from the output.

Task 4: Recover the server bootstrap from Windows or UNIX systems

This task describes how to recover the bootstrap save set from within either a Windows or UNIX system. Recovering the bootstrap overwrites the media database and recovers the resource files.

Note: The **mmrecov** command is used to recover only the media database and resource files. To recover the client file indexes (including the NetWorker server's own client file index), use the **nsrck** command. The *NetWorker Command Reference Guide* provides details about the **mmrecov** and **nsrck** commands.

To recover the bootstrap save set:

Note: Steps 1 and 2 are required when using the **-N** option with the **mmrecov** command.

1. Unmount all volumes including tape, file type, advanced file type devices, and cloud volumes.
 - a. In the NetWorker Administration interface, click **Devices**.
 - b. Select **Devices** in the navigation tree. The Devices detail table appears.
 - c. Right-click a device and select **Unmount**.
2. Enable the CDI (Common Device Interface) attribute on all tape devices.

Note: NDMP, AlphaStor, and optical devices do not support CDI.

- a. In the NetWorker Administration interface, click **Devices**.
 - b. From the View menu, select **Diagnostic Mode**.
 - c. Select **Devices** in the navigation tree. The Devices detail table appears.
 - d. Double-click a device in the Devices table (or right-click the device and select **Properties**).
 - e. Select the **Advanced** tab. In the Device Configuration area, locate the CDI settings and select **SCSI commands**.
 The *EMC NetWorker Administration Guide* provides more details about CDI considerations.
 - f. Stop and restart the NetWorker server services/daemons.
3. Run the **mmrecov -N** command.

Note: Using the **-N** option sets the Scan Needed flag on *ALL* volumes to protect against the possibility of overwriting data that was backed up after the last bootstrap was created. The **-F** flag can be used in conjunction with the **-N** flag to protect only advanced file type devices (AFTDs). When the **-N** flag is set and you attempt to recover data from a tape volume that has newer save sets than what is recorded in the bootstrap, a message displays explaining how to update the bootstrap, to avoid the possibility of overwriting the newer data. The message will identify the starting file and record number to scan into the media database (and client file index if desired).

In the case of an AFTD, the device will be marked read-only and the entire AFTD must be scanned in to avoid the possibility of overwriting newer data. Because the **-N** option works only with tape devices that support CDI on CDI-enabled devices, the Scan Needed flag is ignored on NDMP, AlphaStor, optical drives, or any tape device that has had CDI disabled. Although AFTDs do not use CDI, the Scan Needed flag will be set if the **-N** (and **-F**) option is used for these devices. For more information on CDI usage restrictions, refer to the *Configuring Tape Devices for EMC NetWorker* technical note on Powerlink.

If, within a Windows environment, you use clone volumes and have not loaded all of the necessary volumes, **mmrecov** prompts you for the original volume. In that case:

- a. Press **Ctrl - c** to exit **mmrecov**.
- b. Restart the NetWorker Backup and Recovery Service and the NetWorker Remote Exec Service.
- c. Run the **mmrecov -N** command to recover the bootstrap.

Note: The **mmrecov** command overwrites the server's media database. However, **mmrecov** does not overwrite the resource database. Instead, **mmrecov** recovers the resource database to an alternate location.

If, in a UNIX environment, the predisaster resource database was located in the default directory, which is `/nsr/res`, it is recovered to `/nsr/res.R`.

If the predisaster resource database was linked, then the resource database will be recovered to the link's target directory. For example, if `/nsr/res` was linked to a directory named `/bigres`, then the resource database will be recovered to a directory named `/bigres`.

4. If the server has devices configured and enabled, this message appears.

```
What is the name of the device you plan on using [xxxx]?
```

Where `xxxx` identifies the default device name. If you receive this message, enter the name of the device you are using for the recovery.

5. When this message appears, enter the save set ID for the latest bootstrap.

```
Enter the latest bootstrap save set ID []: 20076
```

If you are recovering a cloned version of the bootstrap, specify the save set ID associated with the clone.

6. When this message appears, enter the file number to begin the recovery.

```
Enter starting file number (if known) [0]: 130
```

If you do not know the correct file number, press **Return**. to accept the default of zero.

7. When this message appears, enter the first record number to begin the recovery.

```
Enter starting record number (if known) [0]: 0
```

If you do not know the correct record number, press **Return**. to accept the default of zero.

8. When prompted, insert the volume containing the appropriate save set ID, as entered **20076** in step 3.

Once you have loaded the appropriate volume, this message appears:

```
Scanning xxx for save set 20076; this might take a while...
```

Note: In both of these examples, `xxx` represents the device name previous entered in step 2.

NetWorker then scans the volume for the appropriate save set and recovers it. Use the NetWorker Management Console to monitor the recovery.

The NetWorker media database and resource database are recovered when this message appears:

```
If your resource files were lost, they are now recovered in the
'res.R'
directory. Copy or move them to the 'res' directory, after you have
shut
down the service. Then restart the service.
```

```
Otherwise, just restart the service.
If the on-line index for the server-name was lost, it can be
recovered
using the nsrck command.
```

Task 5: Rename the NetWorker server resource directory/files

The process of renaming server resource directories and files is dependent on the operating system in using. Perform the appropriate procedure:

- ◆ [“Task 5a: Rename the NetWorker server resource directory in a UNIX system” on page 35](#)
- ◆ [“Task 5b: Rename the NetWorker server resource directory in a Windows system” on page 36](#)

Task 5a: Rename the NetWorker server resource directory in a UNIX system

Because the resource files cannot be reliably overwritten while the NetWorker software is running, **mmrecov** recovered the *res* directory to an alternate location.

To rename the resource directory:

1. Stop the daemons by entering the **nsr_shutdown** command at the command line:

```
nsr_shutdown
```

2. Rename the existing */nsr/res* directory to */nsr/res.orig* using this command:

```
mv res res.orig
```

3. Access the recovered resource database.

If the resource database was recovered to */nsr/res.R*, rename */nsr/res.R* to */nsr/resn* using this command:

```
mv res.R res
```

If the */nsr/res* directory was linked before the disaster, then the resource database is recovered to the link's target directory. For example, if */nsr/res* was linked to a directory named */bigres*, then the resource database is now recovered to */bigres*. In this case, re-create the link from the */nsr/res* directory to the target directory. For example:

```
ln -s /bigres /nsr/res
```

4. Restart the NetWorker server by first entering the **nsrexecd** command, then entering the **nsrd** command, for example:

```
nsrexecd
```

```
nsrd
```

Note: You also can restart the NetWorker server by running the NetWorker startup script for the appropriate platform.

5. After verifying that the NetWorker resources are correct, remove the `/nsr/res.orig` directory.
6. Run the `nsrjb -HE` command to reset the autochanger.
7. If you are using an autochanger, run the `nsrjb -Iv` command to reinventory the autochanger; or run the `nsrjb -Iv -S` command to reinventory only the affected slots.
8. If the `-N` option was used with the `mmrecov` command in [“Task 4: Recover the server bootstrap from Windows or UNIX systems” on page 32](#), enable the CDI (Common Device Interface) attribute on all tape devices.

Note: NDMP, AlphaStor, and optical devices do not support CDI.

9. If the NetWorker Console server was installed on the same machine as the NetWorker server, re-install the console software. Installation instructions are provided in the appropriate *EMC NetWorker Installation Guide*. After reinstalling the NetWorker Console server, add the NetWorker server to list of hosts managed by the NetWorker Console server. The *EMC NetWorker Administration Guide* contains instructions on adding the server to the list of hosts.

Task 5b: Rename the NetWorker server resource directory in a Windows system

Because the NetWorker server’s resource files cannot reliably be overwritten while the NetWorker services are running, the `mmrecov` command recovers the `res` directory as `res.R`.

To put the recovered resource files into effect:

1. Stop these NetWorker services on the NetWorker server:
 - NetWorker Backup and Recovery Service
 - NetWorker Remote Exec Service
2. Copy the contents of the `<NetWorker_install_path>\res.R` directory to the `<NetWorker_install_path>\res` directory.
3. Restart the NetWorker services.

Task 6: Recover indexes and data

There are unique procedures, based on the operating system in use, concerning the recovery of indexes and data. These include:

- ◆ [“Task 6a: Reset and inventory the autochanger in a Windows environment” on page 37](#)
- ◆ [“Task 6b: Recover all client file indexes in a UNIX environment” on page 38](#)
- ◆ [“Task 6c: Recover the NetWorker server data in a Windows environment” on page 39](#)

Task 6a: Reset and inventory the autochanger in a Windows environment

When resetting an autochanger, in a Windows environment, it is necessary to know how to:

- ◆ [“Reset and inventory an autochanger with removable storage disabled” on page 37](#)
- ◆ [“Reset and inventory an autochanger with removable storage enabled” on page 37](#)

Note: If you are using a stand-alone storage device to perform the recovery, skip this task and proceed to [“Task 6c: Recover the NetWorker server data in a Windows environment” on page 39](#).

Reset and inventory an autochanger with removable storage disabled

To reset and inventory an autochanger with Removable Storage disabled:

1. Start a Windows command prompt and change to the directory that contains the NetWorker binary files. The default location is <NetWorker_install_path>\bin.
2. To reset the autochanger, eject volumes, re-initialize the element status, and check each slot for a volume, run this command:

```
nsrjb -vHE
```

3. If you know which slots have changed configuration since the disaster, inventory only those slots. For example, to inventory only slot 3, run this command:

```
nsrjb -Iv -S 3
```

If you do not know which slots have changed configuration since the disaster, inventory all slots by running this command:

```
nsrjb -Iv
```

Note: If the autochanger does not support the **-E** option of the **nsrjb** command (to re-initialize the element status) use the **sjielm** command to initialize the element status. More information about the **nsrjb** and **sjielm** commands is provided in the *NetWorker Command Reference Guide*.

4. If the **-N** option was used with the **mmrecov** command in [“Task 4: Recover the server bootstrap from Windows or UNIX systems” on page 32](#), enable the CDI (Common Device Interface) attribute on all tape devices.

Note: NDMP, AlphaStor, and optical devices do not support CDI.

Reset and inventory an autochanger with removable storage enabled

To reset and inventory an autochanger with Removable Storage enabled:

1. In **NetWorker Administrator** from the NetWorker Management Console, select **Autochanger** from the **Configure** tab.
2. In the **Autochanger** window, right-click the icon for the **Removable Storage** jukebox and select **Delete**.
3. Start a Windows command prompt and change to the directory that contains the NetWorker binary files. The default location is <NetWorker_install_path>\bin.
4. Create a new Autochanger resource using the **NetWorker Console Administration** interface. The *NetWorker Administration Guide* provides details about the **NetWorker Console Administration** interface.

5. In the **NetWorker Console Administration Libraries** screen, right-click the icon for the **Removable Storage** jukebox and select **Operations**.
6. Right-click **My Computer** and select **Manage**.
7. In the left pane of the **Computer Management** window, expand **Storage\Removable Storage\Media Pools\Import** and check the appropriate type-specific media pool for NetWorker volumes.
8. On the **Autochanger Operations** dialog box, click **Add Volume** to reallocate NetWorker volumes from the import pool to this jukebox. Continue allocating until all of the NetWorker volumes belonging to the library associated with this jukebox are moved from the Import pool to the appropriate type-specific pool under **Storage\Removable Storage\Media Pools\NetWorker**.
9. In the **Autochanger Operations** dialog box, click **Reset** to reset the removable storage jukebox.
10. In the **Autochanger Operations** dialog box, click **Inventory** to inventory the contents of the removable storage jukebox.
11. If the **-N** option was used with the **mmrecov** command in [“Task 4: Recover the server bootstrap from Windows or UNIX systems” on page 32](#), enable the CDI (Common Device Interface) attribute on all tape devices.

Note: NDMP, AlphaStor, and optical devices do not support CDI.

Task 6b: Recover all client file indexes in a UNIX environment

Once you recover the server’s media database and resource database, recover all client file indexes on the NetWorker server. You will recover one client file index for each NetWorker client that the NetWorker server backed up.

Because a NetWorker server always has the NetWorker client installed, this task includes recovering the client file index for the NetWorker server.

To recover all client file indexes:

1. Enter the **nsrck -L7** command:

```
nsrck -L7 client_name
```

Note: Specify *client_name* if you want to recover an index only for a specific client.

2. If you are using a cloned version of the client file index, the NetWorker server may prompt you to load an original volume (not the clone volume).

To use the clone:

1. Press **Ctrl - c** to exit out of **nsrck** and verify that the pending original volume message has terminated.
2. Enter the **nsrck -L7** command:

```
nsrck -L7 client_name
```

Note: Although you must recover a computer’s client file index before you can select individual files to recover, you can recover an entire save set on a computer by using a save set recover. You can also use save set recover to recover a portion of a save set.

3. If the **-N** option was used with the **mmrecov** command in “Task 4: Recover the server bootstrap from Windows or UNIX systems” on page 32 and you attempt to mount a tape volume that has savesets that are newer than what is recorded in the media database, you will get a message similar to the following:

```
nw_server nsrd media info: Volume volume_name has save sets
unknown to media database. Last known file number in media database
is ### and last known record number is ###. Volume volume_name
must be scanned; consider scanning from last known file and record
numbers.
```

- a. For the tape volume, make a note of the file number and record number that is displayed in the message and then enter the following command to update the media database and thus, avoid a potential loss of data:

```
scanner -f file -r record -i device
```

For cloud volumes, enter the following command:

```
scanner -m -S ssid -V cloud_volume -Z datazone_ID cloud_device
```

where *datazone_ID* is the NetWorker server datazone ID if it is in a different datazone than the cloud device.

- b. After the scanner operation completes, remove the Scan Needed flag from the tape volume by using the **nsrmm** command:

```
nsrmm -o notscan volume_name
```

- c. For AFTD devices, remove the read-only status so that they can be used for future backups:

- a. Unmount the AFTD device and its corresponding .RO device.

- b. Enter the following command:

```
nsrmm -o notreadonly AFTD_volume
```

where *AFTD_volume* is the name of the advanced file type device but not its corresponding .RO device.

- c. Mount the AFTD device and its corresponding .RO device.

Task 6c: Recover the NetWorker server data in a Windows environment

Recovering the client is a two step process. First, recover the SYSTEM or VSS SYSTEM save sets. Once these save sets have been recovered successfully, recover the System Drive and all other local drives.



IMPORTANT

Recovery of volume mount points and their data requires special handling. If you attempt to recover a mount point and the mounted volume's data in a single operation, the data will be recovered to the root of the host volume and recovery of the mount point will fail. To successfully recover the mounted volume's data, first manually re-create the mount point. Use the same path as the original. Then perform a separate NetWorker file recovery to recover just the mounted volume's data (without including any of the host volume's data in the recovery). The *EMC NetWorker Administration Guide* provides more information about backing up, recovering, and creating mount points.

To recover the NetWorker client or storage node data:

1. Log on to Windows with local administrator privileges.

Note: Directed recovery of SYSTEM or VSS SYSTEM save sets is not supported. To recover these save sets, log onto the computer being recovered with local administrator privileges. Additionally, recover the SYSTEM or VSS SYSTEM save sets to the location that they were in before the disaster.

2. If you are using an autochanger, make sure it has been inventoried. [“Task 6a: Reset and inventory the autochanger in a Windows environment” on page 37](#) provides more information. This ensures that the NetWorker server can recognize the location of each volume.
3. If you load a clone volume, the NetWorker software uses the clone volume for the remainder of the recovery process if either of these conditions exist:
 - The original volume was not added back into the media database.
 - The original volume was added back into the media database, but it was not placed in an autochanger and inventoried.

However, if the original volume was added back into the media database, placed in an autochanger, and inventoried, the NetWorker software prompts you to mount the original volume.
4. If the `-N` option was used with the `mmrecov` command in [“Task 4: Recover the server bootstrap from Windows or UNIX systems” on page 32](#) and you attempt to mount a tape volume that has savesets that are newer than what is recorded in the media database, you will get a message similar to the following:

```
nw_server nsrd media info: Volume volume_name has save sets
unknown to media database. Last known file number in media database
is ### and last known record number is ###. Volume volume_name
must be scanned; consider scanning from last known file and record
numbers.
```

- a. Make a note of the file number and record number that is displayed in the message and then enter the following command to update the media database and thus, avoid a potential loss of data:

```
scanner -f file -r record -i device
```

Where *file* is the last known file number in the media database, *record* is the last known record number in the media database, and *device* is the name of the device.

For cloud volumes, enter the following command:

```
scanner -m -S ssid -V cloud_volume -Z datazone_ID cloud_device
```

where *datazone_ID* is the NetWorker server datazone ID if it is in a different datazone than the cloud device.

- b. After the scanner operation completes, remove the Scan Needed flag from the tape volume by using the `nsrmm` command:

```
nsrmm -o notscan volume_name
```

- c. For AFTD devices, remove the read-only status so that they can be used for future backups:

- a. Unmount the AFTD device and its corresponding .RO device.
 - b. Enter the following command:


```
nsrmm -o notreadonly AFTD_volume
```

 where *AFTD_volume* is the name of the advanced file type device but not its corresponding .RO device.
 - c. Mount the AFTD device and its corresponding .RO device.
5. Ensure that all drives that contained system information prior to the disaster are accessible. The system information includes the boot partition, system partition, and the partition that contains the databases and database logs for the system state components.
 - a. Any Server Roles and Features that were installed before the disaster must be installed before performing the disaster recovery.
 - b. If the host was on a domain, do not join the domain at this time.
 - c. Use the Disk Management utility (diskmgmt.msc) to create volumes (other than C:) if they existed before. Ensure that these volumes are of the same size or larger than the original volumes.
 6. Start the **NetWorker User** program.
 7. Click the **Recover** button.
 8. In the **Source Client** dialog box, select the computer you are recovering and click **OK**.
 9. In the **Destination Client** dialog box, select the computer you are recovering and click **OK**.
 10. The computer's directory structure appears in the Recover window. Mark all SYSTEM or VSS SYSTEM save sets for recovery:



IMPORTANT

Do not select local drive data for recovery at this time.

- Windows 2003 and Windows XP Professional:
 - SYSTEM STATE:
 - SYSTEM FILES:
 - SYSTEM DB:

Alternatively, if you are using Windows 2003 and Volume Shadow Copy Service (VSS) is licensed and enabled, or for Windows Server 2008, Windows Vista or later, mark these save sets:

- VSS SYSTEM BOOT:
- VSS SYSTEM FILESET:
- VSS SYSTEM SERVICES:
- VSS USER DATA:
- VSS OTHER:
- VSS ASR DISK: (Windows 2003 only)

Note: When performing a disaster recovery in multiple Windows platforms and copying the registry, a failure may be reported during the recovery of **VSS SYSTEM BOOT**: due to the size of the **PendingRenameFileOperations** registry value, which is populated during the disaster recovery. The error message indicates a lack of system

resources. If this error appears, it is recommended to set the variable **NSR_RECOV_TEMP_CLEANUP** to an appropriate value (for example, 1) in the system space, and then restart the disaster recovery. Setting this variable ensures that the error does not appear, and that the recovery and subsequent cleanup of the temporary recover files after reboot occur without this interruption.

- Windows 2000:
 - SYSTEM STATE:
 - SYSTEM FILES:
 - SYSTEM DB:
 - SHAREPOINT: (for SharePoint Portal servers only)
- Windows NT 4.0:
 - SYSTEM STATE:
 - REPAIRDISK: (recover only if needed)

NetWorker software backs up user profiles in the save set that corresponds to the disk drive on which they are located (for example, the C: save set). To recover user profiles, recover the save set in which they were saved. User profile folders are located in:

- %SystemDrive%\Documents and Settings for Windows 2003, Windows 2000, and Windows XP Professional
- %SystemRoot%\profiles for Windows NT 4.0

11. From the **Option** menu, select **Recover Options**.

12. In the **Recover Options** dialog box, select **Overwrite Existing File**.

If you do not select **Overwrite Existing File**, the recovery process pauses before any existing files are overwritten. A **Naming Conflict** dialog box appears, prompting you to indicate how the NetWorker software should resolve filename conflicts.

13. Click **Start** to begin the recovery.

Note: Files in the Windows **Recycle Bin** are not password protected. If the **Password Protection** dialog box appears, select **Recover > OK** to recover them.

14. Check the log file to verify that no error messages were generated during the recovery sessions. The NetWorker software logs information about the recovery process to the <NetWorker_install_path>\logs file. This file is overwritten each time a recovery is performed. If there are error messages in the log file, you might need to run the recovery again after addressing the source of the errors.

15. After recovery, reboot the computer to completely recover the system-protected files and restart services that were automatically stopped prior to recovery.

If the host was a member of a Windows domain, it will rejoin the domain after the reboot operation.

16. Log on to the host and recover the system drive and all local drives.

- a. Start the NetWorker **User** program.
- b. Click the **Recover** button.
- c. In the **Source Client** dialog box, select the computer you are recovering and click **OK**.

- d. In the **Destination Client** dialog box, select the computer you are recovering and click **OK**.
- e. The host's directory structure appears in the Recover window. Mark all local directories and drives, *except* for the NetWorker installation directory, for recovery.
- f. From the **Option** menu, select **Recover Options**.
- g. In the **Recover Options** dialog box, select **Overwrite Existing File**.
- h. Click **Start** to begin the recovery

By default, the directed recover option is enabled when you install the NetWorker client. The bootstrap backup restores the res directory, which in turn contains the nsrla database directory. The nsrla database contains the setting for directed recoveries, so this setting should be preserved with the bootstrap restore. The *EMC NetWorker Administration Guide* provides more information about setting the directed recover option on the NetWorker client.

If you perform a complete reinstallation of the Windows operating system during a disaster recovery, the display resolution will be set to default values when the disaster recovery is complete. To reconfigure to the previous display settings, use the Control Panel Display tool. This problem does not occur if you perform an ASR recovery on a Windows 2003 or Windows XP Professional NetWorker client.

Bootmgr file deleted upon recovery of C:\directory with VSS System save set selected

If the **bootmgr** file is located under the C:\ directory, a backup of folders under "C:\\" with "VSS SYSTEM FILESET: \" also backs up the **bootmgr** file as part of the file system. During recovery, if you select the entire C:\ directory and select the **Overwrite** option, the original **bootmgr** file gets deleted and the following errors appear:

```
52973: Winworkr: Didn't recover requested file C:\bootmgr
52973: Winworkr: Didn't recover requested file C:\config.sys
```

This leads to corruption of the machine. Upon rebooting the machine, a message appears indicating "bootmgr file is missing, press Ctrl+Alt+Del to restart".

To avoid this problem, during recovery, mark the backed up folders present in the C:\ directory one-by-one; do not include the **bootmgr** and **Config.sys** files. If you select the entire C:\ directory and then try to unmark only bootmgr and config.sys, the recovery will not work.

Note: This issue is only seen when a backup is performed via NMC (scheduled backups) and the machine has its bootmgr file in C:\. This does not occur with client-initiated Winworkr backups. Note also that a machine running Windows 2008 R2 can be configured to hold the boot related files in a separate volume.

Task 7: Recover the application and user data (UNIX only)

To recover the application and user data that was on the NetWorker server:

1. Log in as root.
2. Load and inventory the devices. This ensures that the NetWorker server can recognize the location of each volume.

Note: If you load a clone volume, you must either delete the original volume from the media database or mark the desired save set as suspect in the media database. If you are using a clone volume, it will be used for the remainder of the recovery process.

3. Run the **nwrecover** program.
4. Mark all of the directories or files to be recovered, taking into consideration the outlined files and directories in [Example 1](#).



CAUTION

Overwriting operating system files may cause unpredictable results.

Example 1 Operating system files to not overwrite

This list contains examples of operating system files that you should consider not overwriting. To determine all of the operating system files that should not be overwritten during a recovery, refer to the operating system documentation:

- Operating system boot files, such as:
 - /unix
 - /boot
 - /etc/default/boot
 - /stand/vmunix
- Other operating system files. For example, some of the files not to overwrite on the Solaris platform include:
 - /dev directory
 - /etc/path_to_inst
 - /etc/name_to_major
 - /etc/mnttab
 - /etc/dfs/sharetab
 - /etc/rmtab
 - /kernel
 - /usr/kernel
 - /etc/saf/zsmon/_pmpipe
 - /etc/sysevent/piclevent_door

Instead of overwriting these files, unmark the directory and when the restore has completed, if required, run another restore and mark only these files/directories, then choose to relocate or rename them. The *EMC NetWorker Administration Guide* provides more information about renaming files during recovery.

5. Click **Start** to begin the recovery.

Note: The bootstrap backup restores the res directory, which in turn contains the nsrla database directory. The nsrla database contains the setting for directed recoveries, so this setting should be preserved with the bootstrap restore. More information about setting the **directed recover** option on a NetWorker client is provided in the *NetWorker Administration Guide*.

Task 8: Complete Windows specific recovery procedures

This section describes the recovery procedures that you must perform when working within a Windows environment. These procedures include:

- ◆ [“Task 8a: Recover the NetWorker server’s client file indexes” on page 45](#)
- ◆ [“Task 8b: Recover the removable storage jukebox configuration” on page 45](#)
- ◆ [“Task 8c: Verify the NetWorker server recovery” on page 46](#)

Task 8a: Recover the NetWorker server’s client file indexes

After the NetWorker server’s bootstrap save set is recovered, you can recover the client file indexes in any order; it is not necessary to recover the server’s own client file index before recovering the index of any other client.

If the clients have the NetWorker client software installed, you can run manual and scheduled backups as soon as the NetWorker server bootstrap is recovered. You also can recover complete save sets. You cannot, however, browse a client’s save sets until you recover the client file index.

To recover the client file indexes:

1. To recover the client file indexes, run one of these commands from the NetWorker server:
 - For *all* clients enter `nsrck -L7`
 - For a *specific* client enter `nsrck -L7 client_name`
2. If you are recovering the client file indexes from a clone volume, you may be prompted to load the original volume. In that case:
 - a. Press **Ctrl - c** to exit `nsrck`.
 - b. Restart these NetWorker services:
 - NetWorker Backup and Recovery Service
 - NetWorker Remote Exec Service
 - c. Recover the client file indexes by running one of these commands:
 - For *all* clients enter `nsrck -L7`
 - For a *specific* client enter `nsrck -L7 client_name`

Task 8b: Recover the removable storage jukebox configuration

If you are using a stand-alone storage device or an autochanger with Removable Storage disabled, skip this task and go to [“Task 8c: Verify the NetWorker server recovery” on page 46](#).

To recover an autochanger with Removable Storage enabled:

1. Right-click **My Computer** and select **Manage**.
2. In the left pane of the **Computer Management** window, expand Storage\Removable Storage\Physical Locations.
3. Double-click the icon for your autochanger. Icons for the autochanger’s volumes appear in the right pane.
4. Right-click the icon for the volume that contains the bootstrap and select **Mount**.
5. Start a Windows command prompt and change to the `<NetWorker_install_path>\bin` directory.

6. From the command prompt, run this command to recover the NetWorker server's bootstrap:


```
mmrecov
```
7. Stop these NetWorker services:
 - NetWorker Backup and Recovery Service
 - NetWorker Remote Exec Service
8. Rename the <NetWorker_install_path>\res.R directory to <NetWorker_install_path>\res.
9. Restart the NetWorker services.
10. On the **Autochanger Operations** dialog box, click **Reset**.

Task 8c: Verify the NetWorker server recovery

To verify the NetWorker server recovery:

1. Reboot the NetWorker server host computer and verify that the NetWorker Backup and Recover server, NetWorker Power Monitor, and NetWorker Remote Exec services are started.
2. Use the Windows Event Viewer to examine the event logs for errors. In particular, check for:
 - Service startup errors related to the Windows system state
 - Errors regarding the recovery of Windows system-protected files

The *NetWorker Administration Guide* provides information about how the NetWorker software handles the Windows system state and system-protected files.

3. Verify that the NetWorker server and its associated clients are included in a scheduled NetWorker backup.
4. Perform a test backup and recover.
5. Verify that any applications that were running prior to the disaster, such as Microsoft Office, have been properly recovered. To check this, you can start each application and open a file.
6. If the NetWorker server was previously configured as a domain controller, verify that the drives configured to store the Active Directory database and log files have been recovered.

The appendix titled "Additional Features of the Microsoft Windows Server" in the *EMC NetWorker Administration Guide* provides more information on the recovery of domain controllers.

Task 9: Perform a test backup and recovery

To test the NetWorker client backup and recovery process:

1. Perform a test manual backup by using the appropriate backup commands.
2. Perform a test recovery by using the appropriate recovery commands.

The *EMC NetWorker Administration Guide* provides additional information on testing backup and recovery configurations.

This chapter provides the instructions necessary to recover NetWorker clients and storage nodes, from any supported operating system. The procedures describe, in general terms, what you should do and provides examples where appropriate. In some cases, specific operating systems require unique procedures and, wherever necessary the operating system is specified in the procedure heading.

This chapter includes these procedures:

- ◆ [Recovering a UNIX NetWorker client and storage node](#) 48
- ◆ [Recovering a Windows NetWorker client or storage node](#) 54
- ◆ [Recovering a Mac OSX NetWorker client](#) 60
- ◆ [De-duplication and Avamar server disaster recovery](#) 62
- ◆ [Recovering a NetWare NetWorker client containing an NDS partition](#) 63

Recovering a UNIX NetWorker client and storage node

The storage node allows you to access the volumes on which the backups for all of the network computers reside. If the storage node experiences a disaster, it must be recovered before you can recover application and user data to other computers on the network.

These sections provide information on recovering a NetWorker client:

- ◆ [“NetWorker bare metal recovery \(BMR\) recovery” on page 48](#)
- ◆ [“Prerequisites” on page 48](#)
- ◆ [“Recovering a NetWorker client” on page 49](#)
- ◆ [“Recovering a NetWorker storage node” on page 51](#)

NetWorker bare metal recovery (BMR) recovery

A BMR recovery enables the restoration or migration of a server from one hardware type to another. This type of recovery begins with the HomeBase Server and the profile data that is gathered and includes the filesystem and application data restore from the NetWorker server through the Console server.

HomeBase Server installation is separate from NetWorker server installation. The HomeBase Server must be configured and available when:

- ◆ A BMR client resource is created.
- ◆ BMR backup data (profiles) are generated from NetWorker clients.

See the EMC HomeBase product documentation for details about HomeBase Server installation, profile management, and recovery specifics. Enabling the back up and restore of profiles for BMR recovery is described in the *EMC NetWorker Administration Guide*.

Prerequisites

Before recovering either a NetWorker client or storage node, ensure that the UNIX operating system is installed on the computer and that the NetWorker server is functioning and available on the network.

Note: [Chapter 4, “Recovering a NetWorker Server.”](#) provides instructions to recover the NetWorker server.

Additionally, ensure that you have the:

- ◆ Hostname of the NetWorker server.
- ◆ Version and patch level of the NetWorker client or storage node software that was on the computer before the disaster occurred.
- ◆ Name of any links to NetWorker directories. An example of a typical link from a NetWorker directory to a user directory is `/nsr` to `/var/nsr`.

Recovering a NetWorker client

This section describes how to recover a NetWorker client computer back to the original computer or to a different computer.

To recover a NetWorker client, complete the following tasks:

- ◆ “Task 1: Reinstall NetWorker client” on page 49
- ◆ “Task 2: Recover the application and user data” on page 49
- ◆ “Testing the backup and recovery” on page 53

Task 1: Reinstall NetWorker client

To reinstall the NetWorker client software:

1. Install the latest version of the NetWorker client or the same version as the one running on the NetWorker server.

Note: If you need to update the client software, first recover the client to its original state, and then perform the update.

2. Reinstall any NetWorker backup utility patches that were installed prior to the disaster.
3. Re-create any links to NetWorker directories.
4. (Optional) Use the **nwrecover** program to perform a test recovery to ensure that the recovery process is functioning properly.

Task 2: Recover the application and user data

To recover the application and user data:

1. To determine which volumes contain the application and user data backups for this computer, you can either mark the files you want to recover in **nwrecover** and then go to the required volumes option, or use the **mminfo -avot** command on the NetWorker server, for example:

```
mminfo -avot -c client_name
```

where *client_name* is the hostname of the computer whose application and user data is to be recovered.

2. Start the **nwrecover** program on the client computer whose application and user data you are recovering.
3. Mark all of the directories and files to be recovered:

Note: Overwriting operating system files may cause unpredictable results. The following list contains examples of operating system files that you should consider not overwriting. To determine all of the operating system files that should not be overwritten during a recovery, refer to the operating system documentation.

- Operating system boot files, such as:
 - /unix
 - /boot
 - /etc/default/boot
 - /stand/vmunix
- Other operating system files. For example, some of the files not to overwrite on the Solaris platform include:

- /dev directory
- /etc/path_to_inst
- /etc/name_to_major
- /etc/mnttab
- /etc/dfs/sharetab
- /etc/rmtab
- /kernel
- /usr/kernel
- /etc/saf/zsmon/_pmpipe
- /etc/sysevent/piclevent_door

Instead of overwriting these files, unmark the directory and when the restore has completed, if required, run another restore and mark only these files/directories, then choose to relocate or rename them. The *EMC NetWorker Administration Guide* provides more information about renaming files during recovery:

1. From the **Options** menu, select **Recover Options** to set the recover options.
2. In the **Recover Options** dialog box, select **Overwrite Existing File**.

Note: If you did not set the recover options, select the **Overwrite Existing File** option when the **Naming Conflict** dialog box appears. To enable automatic overwriting of files with the same name, select the **Suppress Further Prompting** option in the **Naming Conflict** dialog box.

3. Select **Start**.

Note: If the scan needed flag is set on a volume, and the volume has savesets that are newer than what is recorded in the media database, you will get a message similar to the following:

```
nw_server nsrd media info: Volume volume_name has save sets unknown
to media database. Last known file number in media database is ###
and last known record number is ###. Volume volume_name must be
scanned; consider scanning from last known file and record numbers.
```

Make a note of the file number and record number that is displayed in the message and then enter the following command to update the media database and thus, avoid a potential loss of data:

```
scanner -f file -r record -i device
```

Where *file* is the last known file number in the media database, *record* is the last known record number in the media database, and *device* is the name of the device. After the scanner command completes, you can proceed with your recovery operation.

4. When the recovery is complete, reboot the computer.

The computer should now be recovered.

Note: By default, the directed recover option is enabled when you install the NetWorker client. If the directed recover option was disabled on the client before the disaster, set this option to disable directed recoveries to this client. This option is set through the `nsradmin` command. The *EMC NetWorker Administration Guide* provides more information about setting the disable directed recover option on a NetWorker client.

5. Perform a test of the NetWorker client backup and recovery. [“Testing the backup and recovery” on page 53](#) provides instructions.

Recovering a NetWorker storage node

This section describes how to recover a NetWorker storage node computer back to the original computer or to a different computer.

To recover a NetWorker storage node, complete the following tasks:

- ◆ [“Task 1: Reinstall the NetWorker storage node” on page 51](#)
- ◆ [“Task 2: Recover the application and user data” on page 52](#)
- ◆ [“Testing the backup and recovery” on page 53](#)

Task 1: Reinstall the NetWorker storage node

To reinstall the NetWorker storage node software:

1. Reinstall the same version of the NetWorker storage node software into its original location.

Note: To upgrade the storage node software, first recover the storage node to its original state, and then perform the upgrade.

2. Reinstall any NetWorker backup utility patches that were installed prior to the disaster.
3. Re-create any links to NetWorker directories.
4. Optionally, use the `nwrecover` program to perform a test recovery to ensure that the recovery process is functioning properly.

Note: The NetWorker client software is also installed when you install the storage node software.

The storage node can now access volumes that contain backups for other computers on the network. These volumes contain the application and user data that are required to fully recover computers that were protected with the NetWorker client software.

[“Recovering a NetWorker client” on page 49](#) provides instructions to recover the application and user data for other NetWorker clients.

[“Task 2: Recover the application and user data” on page 52](#) provides instructions to recover application and user data that was on the storage node computer.

Task 2: Recover the application and user data

To recover the application and user data that was on the NetWorker storage node computer:

1. To determine which volumes contain the application and user data backups for this computer, use the **mminfo -avot** command on the NetWorker server, for example:

```
mminfo -avot -c storage_node_name
```

where *storage_node_name* is the hostname of the computer whose application and user data you are recovering.

Note: This information can also be obtained in **nwrecover** through required volumes after the data to be recovered is marked. This method may give you a more accurate report of the needed volumes, since **mminfo** outputs can show multiple tapes for a backup that are not necessarily needed to restore what has been marked.

2. Start the **nwrecover** program on the storage node computer.
3. Mark all of the directories and files to be recovered:

Note: Overwriting operating system files may cause unpredictable results. The following list contains examples of operating system files that you should consider not overwriting. To determine all of the operating system files that should not be overwritten during a recovery, refer to the operating system documentation.

- Operating system boot files, such as:
 - /unix
 - /boot
 - /etc/default/boot
 - /stand/vmunix
- Other operating system files. For example, some of the files not to overwrite on the Solaris platform include:
 - /dev directory
 - /etc/path_to_inst
 - /etc/name_to_major
 - /etc/mnttab
 - /etc/dfs/sharetab
 - /etc/rmtab
 - /kernel
 - /usr/kernel
 - /etc/saf/zsmon/_pmpipe
 - /etc/sysevent/piclevent_door

Instead of overwriting these files, unmark the directory and when the restore has completed, if required, run another restore and mark only these files/directories, then choose to relocate or rename them. The *EMC NetWorker Administration Guide* provides more information about renaming files during recovery:

1. From the **Options** menu, select **Recover Options** to set the recover options.
2. In the **Recover Options** dialog, select **Overwrite Existing File**.

Note: If you did not set the recover options, you must select the **Overwrite Existing File** option when the **Naming Conflict** dialog appears. To enable automatic overwriting of files with the same name, select the **Suppress Further Prompting** option in the **Naming Conflict** dialog.

3. Select **Start**.

Note: If the scan needed flag is set on a volume, and the volume has savesets that are newer than what is recorded in the media database, you will get a message similar to the following:

```
nw_server nsrd media info: Volume volume_name has save sets unknown
to media database. Last known file number in media database is ###
and last known record number is ###. Volume volume_name must be
scanned; consider scanning from last known file and record numbers.
```

Make a note of the file number and record number that is displayed in the message and then enter the following command to update the media database and thus, avoid a potential loss of data:

```
scanner -f file -r record -i device
```

Where *file* is the last known file number in the media database, *record* is the last known record number in the media database, and *device* is the name of the device. After the scanner command completes, you can proceed with your recovery operation.

4. Reboot the computer when the recovery is complete. The computer should now be recovered.

Note: By default, the **directed recover** option is enabled when you reinstall the NetWorker client. The bootstrap backup restores the res directory, which in turn contains the nsrla database directory. The nsrla database contains the setting for directed recoveries, so this setting should be preserved with the bootstrap restore. The *EMC NetWorker Administration Guide* provides more information about setting the **directed recover** option on the NetWorker client.

5. Perform a test of the NetWorker storage node backup and recovery. [“Testing the backup and recovery” on page 53](#) provides instructions.

Testing the backup and recovery

To test the NetWorker client and storage node backup and recovery process:

1. Perform a test backup by using each of the EMC backup utilities incorporated into the backup solution.
2. Perform a test recovery by using the EMC utility used to back up the data. The *NetWorker Administration Guide* provides details.

Recovering a Windows NetWorker client or storage node

This section explains how to recover a Windows 2008 / 2008 R2 / 2008 Server Core / 2003 / XP / 2000 NetWorker client or storage node host computer.

Note: For Windows 2003 and Windows XP Professional systems, perform tasks 1 through 5 that appear on the following pages — but do so only as a last resort for recovering a NetWorker client. For a NetWorker client, use the ASR recovery method if possible. [“Performing a Windows ASR recovery” on page 72](#) contains more information. You cannot use the ASR recovery method for a NetWorker storage node.

Before you begin the recovery procedures, identify all EMC products (such as SmartMedia® and NetWorker Modules) and any associated patches that were installed prior to the disaster. You *must* reinstall any EMC backup software and patches that are unusable or appear to be damaged. For more information, refer to the appropriate product installation guide.

You can recover a NetWorker client or storage node to the original computer, or to a different computer.

To recover the client or storage node, perform the following tasks in the specified order:

- ◆ [“Task 1: Satisfy Windows hardware and operating system requirements” on page 55](#)
- ◆ [“Task 2: Satisfy the NetWorker client or storage node recovery requirements” on page 55.](#)
- ◆ [“Task 3: Reinstall the NetWorker client or storage node software” on page 56.](#)
- ◆ [“Task 4: Recover the NetWorker client or storage node data” on page 56](#)
- ◆ [“Task 5: Verify the NetWorker client or storage node recovery” on page 59](#)

Note: Before you begin recovery of a NetWorker client or storage node, you should understand the information about SYSTEM or VSS SYSTEM save sets in the *EMC NetWorker Administration Guide*.

Partial recovery of a NetWorker storage node

In most cases, the NetWorker server should be fully functional before you begin recovery of its associated clients or storage nodes. However, if the storage device required for a NetWorker server recovery is connected to a remote storage node, you might have to partially recover the storage node *before* you can recover the NetWorker server. In that case:

- ◆ Reinstall the NetWorker client or storage node software to provide a storage device for the NetWorker server to use.
- ◆ Recover the NetWorker server. [Chapter 4, “Recovering a NetWorker Server.”](#) provides more information.
- ◆ Perform the remaining tasks to recover the client or storage node. [“Task 4: Recover the NetWorker client or storage node data” on page 56](#) and [“Task 5: Verify the NetWorker client or storage node recovery” on page 59](#) provide more information.

Task 1: Satisfy Windows hardware and operating system requirements

If you are recovering to a new or rebuilt host, ensure that the following requirements are met:

- ◆ The hardware configuration is the same as the original host configuration.
- ◆ The same Operating System version and Service Packs are installed.
- ◆ The same Server Roles and Features are installed. These server roles and features must be installed before starting the NetWorker disaster recovery tasks. These roles include but are not limited to:
 - IIS (Internet Information Services)
 - Terminal Services
 - FSRM (File System Resource Manager)
 - DFS (Distributed File System)
 - Network Policy and Access Services
 - Active Directory Lightweight Directory Services (ADAM)

Note: If you are recovering a domain controller configuration that has Active Directory with Integrated DNS, you only need to install the Active Directory Domain Services role. You do not need to install DNS role.

Task 2: Satisfy the NetWorker client or storage node recovery requirements

To recover a NetWorker client or storage node requires:

- ◆ A reinstallation of the same Windows operating system including any patches.
- ◆ The hostname is the same as the original host.
- ◆ The hosts file is updated to have entries for the backup server and domain controller (if applicable).
- ◆ The same release and patch level of the NetWorker software that was in use prior to the disaster.
- ◆ The installation path of the NetWorker software prior to the disaster.
- ◆ Backup or clone volumes that contain the NetWorker client or storage node data.

Note: If you routinely move NetWorker backup media to an offsite location for safekeeping, ensure that you have all necessary volumes available to avoid delays during a recovery. You can run the `mminfo -s server -mv` command from the command prompt to list the media associated with the files you intend to recover. The *NetWorker Command Reference Guide* provides details about the `mminfo` command.

Task 3: Reinstall the NetWorker client or storage node software

If the NetWorker client or storage node software is not properly installed and running on the host computer, you must reinstall it according to these instructions:

1. To reinstall the NetWorker client or storage node software, refer to the appropriate *EMC NetWorker Installation Guide*:
 - If the NetWorker installation kit is available on a shared drive, reinstall it over the network.
 - Reinstall the NetWorker software to the same path location it occupied prior to the disaster.
 - To update the NetWorker software, first recover the NetWorker client or storage node to its predisaster state, then perform the update.
2. Reinstall any NetWorker patches that were installed prior to the disaster.
3. Reinstall the temporary enabler code for each EMC backup product. For temporary enabler codes, refer to the product Installation Guide.
4. If you are recovering a NetWorker storage node, ensure that the storage devices the NetWorker server will use are correctly configured. Details are provided in the appropriate *EMC NetWorker Administration Guide*.

Task 4: Recover the NetWorker client or storage node data

Recovering the client is a two step process. First, recover the SYSTEM or VSS SYSTEM save sets. Once these save sets have been recovered successfully, recover the System Drive and all other local drives.

To recover the NetWorker client or storage node data:

1. Log on to Windows with local administrator privileges.

Note: Directed recovery of SYSTEM or VSS SYSTEM save sets is not supported. To recover these save sets, log onto the computer being recovered with local administrator privileges. Additionally, recover the SYSTEM or VSS SYSTEM save sets to the location that they were in before the disaster.

2. Ensure that all drives that contained system information prior to the disaster are accessible. The system information includes the boot partition, system partition, and the partition that contains the databases and database logs for the system state components.
 - a. Any Server Roles and Features that were installed before the disaster must be installed before performing the disaster recovery.
 - b. If the host was on a domain, do not join the domain at this time.
 - c. Use the Disk Management utility (diskmgmt.msc) to create volumes (other than C:) if they existed before. Ensure that these volumes are the same size or larger than the original volumes.
3. Start the **NetWorker User** program.
4. Click the **Recover** button.
5. In the **Source Client** dialog box, select the computer you are recovering and click **OK**.

6. In the **Destination Client** dialog box, select the computer you are recovering and click **OK**.
7. The computer's directory structure appears in the Recover window. Mark all **SYSTEM** or **VSS SYSTEM** save sets for recovery:



IMPORTANT

Do not select local drive data for recovery at this time.

- Windows 2003 and Windows XP Professional:

- SYSTEM STATE:
- SYSTEM FILES:
- SYSTEM DB:

Alternatively, if you are using Windows 2003 and Volume Shadow Copy Service (VSS) is licensed and enabled, or for Windows Server 2008, Windows Vista or later, mark these save sets:

- VSS SYSTEM BOOT:
- VSS SYSTEM FILESET:
- VSS SYSTEM SERVICES:
- VSS USER DATA:
- VSS OTHER:
- VSS ASR DISK: (Windows 2003 only)

- Windows 2000:

- SYSTEM STATE:
- SYSTEM FILES:
- SYSTEM DB:
- SHAREPOINT: (for SharePoint Portal servers only)

- Windows NT 4.0:

- SYSTEM STATE:
- REPAIRDISK: (recover only if needed)

NetWorker software backs up user profiles in the save set that corresponds to the disk drive on which they are located (for example, the C: save set). To recover user profiles, recover the save set in which they were saved. User profile folders are located in:

- %SystemDrive%\Documents and Settings for Windows 2003, Windows 2000, and Windows XP Professional
- %SystemRoot%\profiles for Windows NT 4.0

8. From the **Option** menu, select **Recover Options**.
9. In the **Recover Options** dialog box, select **Overwrite Existing File**.

If you do not select **Overwrite Existing File**, the recovery process pauses before any existing files are overwritten. A **Naming Conflict** dialog box appears, prompting you to indicate how the NetWorker software should resolve filename conflicts.

10. Click **Start** to begin the recovery.

Note: Files in the Windows **Recycle Bin** are not password protected. If the **Password Protection** dialog box appears, select **Recover** > **OK** to recover them.

11. Check the log file to verify that no error messages were generated during the recovery sessions. The NetWorker software logs information about the recovery process to the <NetWorker_install_path>\logs file. This file is overwritten each time a recovery is performed. If there are error messages in the log file, you might need to run the recovery again after addressing the source of the errors.

Note: If the scan needed flag is set on a volume, and the volume has savesets that are newer than what is recorded in the media database, you will get a message similar to the following:

```
nw_server nsrd media info: Volume volume_name has save sets unknown to media database. Last known file number in media database is ### and last known record number is ###. Volume volume_name must be scanned; consider scanning from last known file and record numbers.
```

Make a note of the file number and record number that is displayed in the message and then enter the following command to update the media database and thus, avoid a potential loss of data:

```
scanner -f file -r record -i device
```

Where *file* is the last known file number in the media database, *record* is the last known record number in the media database, and *device* is the name of the device. After the scanner command completes, you can proceed with your recovery operation.

12. After recovery, reboot the computer to completely recover the system-protected files and restart services that were automatically stopped prior to recovery.

If the host was a member of a Windows domain, it will rejoin the domain after the reboot operation.
13. Log on to the host and recover the system drive and all local drives.
 - a. Start the NetWorker **User** program.
 - b. Click the **Recover** button.
 - c. In the **Source Client** dialog box, select the computer you are recovering and click **OK**.
 - d. In the **Destination Client** dialog box, select the computer you are recovering and click **OK**.
 - e. The host's directory structure appears in the Recover window. Mark all local directories and drives, *except* for the NetWorker installation directory, for recovery.
 - f. From the **Option** menu, select **Recover Options**.
 - g. In the **Recover Options** dialog box, select **Overwrite Existing File**.
 - h. Click **Start** to begin the recovery

Note: Recovery of volume mount points and their data requires special handling. If you attempt to recover a mount point and the mounted volume's data in a single operation, the data will be recovered to the root of the host volume and recovery of the mount point will fail. To successfully recover the mounted volume's data, first manually re-create the mount point. Use the same path as the original. Then perform a separate NetWorker file recovery to recover just the mounted volume's data (without including any of the host volume's data in the recovery). The *EMC NetWorker Administration Guide* provides more information about backing up, recovering, and creating mount points.

If you perform a complete reinstallation of the Windows operating system during a disaster recovery, the display resolution will be set to default values when the disaster recovery is complete. To reconfigure to the previous display settings, use the Control Panel Display tool. This problem does not occur if you perform an ASR recovery on a Windows 2003 or Windows XP Professional NetWorker client.

By default, the directed recover option is enabled when you install the NetWorker client. The bootstrap backup restores the res directory, which in turn contains the nsrla database directory. The nsrla database contains the setting for directed recoveries, so this setting should be preserved with the bootstrap restore. The *EMC NetWorker Administration Guide* provides more information about setting the directed recover option on the NetWorker client.

Note: The procedure in this note is optional. In Windows 7 and Windows 2008 R2, the BCD store contains the boot configuration parameters and controls the computer's boot environment. For more information about BCDEdit, refer to the BCDEdit reference document in the Microsoft documentation. During recovery, the BCD file is recovered to the folder `c:\boot_restored-{timestamp}`. Restoring this file is optional. To restore the recovered file, import the file using the following command: `bcdedit /import c:\boot_restored-{timestamp}\BCD`.

Task 5: Verify the NetWorker client or storage node recovery

To verify the NetWorker client or storage node recovery:

1. Reboot the NetWorker client or storage node host computer and verify that the NetWorker Remote Exec service has started.
2. Use the Windows Event Viewer to examine the event logs for errors. In particular, check for:
 - Service startup errors related to the Windows system state
 - Errors regarding the recovery of Windows system-protected files

Information about how the NetWorker software handles the Windows system state and system-protected files is provided in the *EMC NetWorker Administration Guide*.
3. Ensure that the storage node and the NetWorker server can detect the storage devices the NetWorker server is to use.
4. Perform a test recovery by using each of the EMC backup products you have reinstalled. Recover data with the EMC product used to back it up. Refer to the product documentation as necessary.
5. Perform a test backup to the NetWorker server to ensure that the connection between the NetWorker client or storage node and the NetWorker server is working properly.
6. Verify that any applications (such as Microsoft Office) that were running prior to the disaster have been properly recovered. To verify this, run each application and open a previously saved document.
7. To use **Active Desktop**, install it after you have recovered all of the computer's data.
8. If the NetWorker client or storage node computer was previously configured as a domain controller:

- **Windows 2000 or later**— Verify that the drives configured to store the Active Directory database and log files have been recovered.
- **Windows NT 4.0** — If the host is a Primary Domain Controller, synchronize it with the domain. If the computer is a Backup Domain Controller, synchronize it with the Primary Domain Controller.

“[Recovering Active Directory](#)” on page 76 provides more information about domain controller recovery.

Recovering a Mac OSX NetWorker client

These sections provide information on recovering a NetWorker client:

- ◆ “[Prerequisites](#)” on page 60
- ◆ “[Recover a NetWorker client](#)” on page 60

Prerequisites

Before recovering the NetWorker client, ensure that the Mac OS X operating system is installed on the computer and that the NetWorker server is functional and available on the network.

Additionally, ensure that you have the:

- ◆ Hostname of the NetWorker server.
- ◆ Version and patch level of the NetWorker client or storage node software that was on the computer before the disaster occurred.
- ◆ A successful backup of the Open Directory databases. The *EMC NetWorker Administration Guide* provides more information about backing up the Open Directory databases.

Recover a NetWorker client

This section describes how to recover a NetWorker client to the original computer or to a different computer of the same operating system.

To recover a NetWorker client, complete these tasks:

- ◆ “[Task 1: Reinstall the NetWorker client software](#)” on page 60
- ◆ “[Task 2: Recover the application and user data](#)” on page 61
- ◆ “[Task 3: Restore Open Directory Database files \(Mac OS X Server\)](#)” on page 61
- ◆ “[Task 4: Perform a test backup and recovery](#)” on page 62

Task 1: Reinstall the NetWorker client software

To reinstall the NetWorker client software:

1. Reinstall the same version of the NetWorker client.

Note: To upgrade the client software, first recover the client to its original state, and then perform the upgrade.

2. Reinstall any NetWorker client patches that were installed before the disaster.
3. (Optional) Use the **recover** program to perform a test recovery to ensure that the recovery process is functioning properly.

Task 2: Recover the application and user data

To recover the application and user data:

1. To determine which volumes contain the application and user data backups for this computer, use the **mminfo -avot** command on the NetWorker server, for example:

```
$ mminfo -avot -c client_name
```

where *client_name* is the hostname of the computer whose application and user data are being recovered.

2. Open a **recover** prompt on the NetWorker client with this command:

```
$ recover
```

3. At the **recover** prompt, browse backed-up Mac OS X data by using traditional UNIX file-system navigation commands.
4. Add all the directories and files to be recovered, by entering the **add** command, for example:

```
recover> add directory_name
```

To automatically overwrite existing files, enter the **force** option with the **add** command.

5. Start the recovery by entering this command at the **recover** prompt:

```
recover> recover
```

Note: When recovering application and user data, do not recover any Mac OS X operating system boot files that should not be overwritten. For example, do not recover the Mac OS X operating system kernel, `/mach_kernel`.

Task 3: Restore Open Directory Database files (Mac OS X Server)

This procedure assumes the NetWorker client was configured to backup Open Directory files using a **savepnp** script as described in *NetWorker Administration Guide*. You must be a NetWorker administrator to perform this procedure.

To restore Open Directory database files after a catastrophic failure requiring reinstallation of Mac OS X server software:

1. Ensure the host is configured as a standalone server:
 - a. Open **Server Admin**.
 - b. Select **Open Directory** and click **Settings**.
 - c. Click **General**, and change **Role** to **Standalone Server**.
2. Open a Terminal session as root.
3. Using the **recover** program, restore Open Directory's exported databases and configuration files:

```
# recover -af /etc/openldap /var/backups/networker.odpdb
/etc/hostconfig
/var/backups/networker.ldif /var/backups/networker.nidump
```

4. Restore Open Directory's LDAP database using this command:

```
# slapadd -c -l /var/backups/networker.ldif
```

1. If your LDAP server uses SSL, restore the Open Directory Password server database using this command:

- ```
mkpassdb -mergedb /var/backups/networker.odpdb
```
2. Restore the local NetInfo domain using this command:

```
niload -r / . < /var/backups/networker.nidump
```
  3. Use the recover program to restore the Open Directory preferences:

```
recover -af /Library/Preferences/DirectoryService
```
  4. Start the LDAP server:

```
/sbin/SystemStarter start LDAP
```

#### Task 4: Perform a test backup and recovery

To test the NetWorker client backup and recovery process:

1. Perform a test manual backup by using the EMC backup commands.
2. Perform a test recovery by using the EMC recover commands.

The *EMC NetWorker Administration Guide* provides additional information on testing backup and recovery configurations.

## De-duplication and Avamar server disaster recovery

When the NetWorker software is used in conjunction with EMC Avamar® de-duplication technology, the failure of the primary Avamar server and failover to the replication node requires immediate action. This is to ensure that the de-duplication backups of clients configured to use the failed primary Avamar server continue unabated.

**Note:** For instructions about recovering data from the replication node after failure of the primary server, see the *EMC NetWorker Administration Guide*.

In the event of the failure of your primary Avamar server, you should contact EMC professional services as quickly as possible to bring the server back online. After the server is brought back online, de-duplication backups invoked via the NetWorker software will proceed normally. However, if you need to perform de-duplication backups during the time that the primary server is off line, you must reconfigure your NetWorker de-duplication clients to use the replication node, rather than the primary Avamar server, for backup.

You must have the replication node configured as a NetWorker de-duplication node prior to reconfiguring your NetWorker de-duplication clients to use the replication node for backups. Furthermore, in order to guarantee that backups from the replication node can be recovered via the NetWorker software, you must configure the replication node on the NetWorker server prior to performing the backup. The *EMC NetWorker Administration Guide* contains further information about configuring replication nodes.

### Reconfiguring NetWorker de-duplication clients to use the replication node for backups

To reconfigure NetWorker de-duplication clients to use the replication node for backups:

1. Log in as root or as Windows administrator on the NetWorker server.
2. Type this at the command prompt:

```
nsradmin
```

The **nsradmin** prompt appears.

3. Limit the query to clients configured to use the primary Avamar server that has failed as their de-duplication node by typing this at the **nsradmin** prompt:

**. type: NSR client; De-duplication node: *de-duplication\_node\_name***

Where *de-duplication\_node\_name* is the name of the primary Avamar server that has failed.

4. Change the De-duplication attribute for the clients included in the query at [Step 3](#) to the replication node by typing this at the **nsradmin** prompt:

**update De-duplication node: *replication\_node\_name***

Where *replication\_node\_name* is the name of the Avamar replication node.

After your primary Avamar server has been brought back online, repeat this procedure to change the De-duplication node attribute to point to the primary Avamar server again.

## Recovering a NetWare NetWorker client containing an NDS partition

If the NetWare server did not contain an NDS partition (replicated or not), do not complete this section. Instead, recover the NetWare operating system, in accordance with the vendor instructions and documentation.

This section contains the following information on recovering a replicated NDS partition over the network:

- ◆ [“Recover a NetWare 4.10 SYS volume” on page 63](#)
- ◆ [“Recover a NetWare 4.11, 5.0, or IntraNetWare server SYS volume” on page 65](#)

For NetWare 4.11/IntraNetWare servers, do not delete the server or volume objects for the failed volume from the NDS tree; otherwise, you could eliminate references that other objects have to the volume. If you must delete objects on a NetWare 4.11/IntraNetWare server, use the NetWare 4.10 procedure for recovering from a disaster.

### Recover a NetWare 4.10 SYS volume

To recover a SYS volume on a NetWare 4.10 server, complete these tasks:

- ◆ [“Task 1: Recover the NetWare 4.10 SYS volume” on page 63](#)
- ◆ [“Task 2: Recover the SMS remote file system” on page 64](#)
- ◆ [“Task 3: Complete the recovery of the NetWare 4.10 SYS volume” on page 65](#)

#### Task 1: Recover the NetWare 4.10 SYS volume

To recover a SYS volume on a NetWare 4.10 server:

1. Use the NetWorker Administrator program or **netadmin** to delete the volume objects associated with the failed server.
2. Use **NDS Manager** or **partmgr** to delete the server object for the failed server. You cannot use **netadmin** to delete a server object.

The Partition Manager displays a warning message; select **Yes** to confirm the deletion.

3. Use **NDS Manager** or **dsrepair** to check the replica synchronization.

If you see error messages, wait a few minutes and try again.

4. From the NetWorker server, perform a directed recover to recover the failed server's Server Specific Info (SSI) files from a tape backup to a functioning NetWorker for NetWare client.

The server-specific information files (SERVDATA.NDS, VOLSINFO.TXT, STARTUP.NCF, and AUTOEXEC.NCF) are recovered to a subdirectory under SYS:\SYSTEM on the server you selected. This subdirectory is given a DOS 8.3 name derived from the source server name.

5. If the failed server held a master replica, use NDS Manager or **dsrepair** to designate a new master replica on a different server in the replica ring.
6. Use NDS Manager or **dsrepair** to perform an unattended full repair to check replica synchronization. If necessary, use NDS Manager or **dsrepair** on the servers containing master replicas to remove the failed server from the replica ring.
7. Shut down the failed server and replace any damaged server hardware. If you replace a hard drive, be sure that it is the same size or larger.
8. Format the DOS partitions and reinstall DOS.

---

**Note:** Use the DOS Time command to ensure that the computer is set to the correct time to avoid time synchronization errors.

---

9. Reinstall NetWare 4.10 and NDS on the repaired or replaced server. Run **install** or **nwconfig**, select Custom Install, and follow the directions on the screen. Use the *STARTUP.NCF* and *AUTOEXEC.NCF* files recovered with SSI to answer the questions displayed on the screen:
  - Enter the same server name and internal IPX number that the server had prior to the disaster.
  - When prompted, insert the NetWare License diskette for the server into the disk drive.
  - When prompted for the name of the NDS tree, select the name of the tree that the server resided in before the disaster.
  - Select the time zone and configure the time.
  - Log in and specify the context for the server and its objects. Use the same context that was used before the disaster.
  - Edit the **STARTUP.NCF** and **AUTOEXEC.NCF** files to match the versions recovered with SSI.

When the installation is complete, the server will contain all the files necessary to perform an SMS remote file-system recover. "[Task 2: Recover the SMS remote file system](#)" on page 64 provides more information.

## Task 2: Recover the SMS remote file system

To recover the SMS remote file system to a SYS volume on a NetWare 4.10 server:

1. Load the required namespace modules for each recovered volume. Use the *VOLSINFO.TXT* file to determine which namespaces need to be loaded (*MAC.NAM*, *LONG.NAM*, etc.).
2. Load the file-system TSA specific to your version of the NetWare operating system, by entering one of these commands:

```
LOAD TSA410
LOAD TSA312
LOAD TSA500
```

3. Recover the file system for each volume affected by the failure. Do not recover the Schema and Root; they are recovered from a replica. You also do not need to recover Server Specific Info again. When prompted, suppress further prompting and overwrite files.
4. When you are prompted, log in by using the full name of the backup user.
5. If the failed server had non-SYS volumes that were not affected by the failure, from the **File** menu in the Browser window, select Recover to display the NetWorker Recover **Options** dialog. Select the **Don't Overwrite Data; restore trustees, etc.** command, and then recover the volumes that were not affected by the failure.
6. Shut down and restart the repaired or replaced server.

### Task 3: Complete the recovery of the NetWare 4.10 SYS volume

To complete the recovery of a NetWare 4.10 SYS volume:

1. If necessary, use NDS Manager or **dsrepair** to reestablish replicas on the repaired or replaced server.
2. Enter these commands at the command prompt:

```
LOAD TSA410
LOAD TSANDS
LOAD TSA500
```

3. From the **Recover Browser** window, recover the server object, volume objects, and any objects that formerly referenced the recovered volume or server objects. Expand the **Root** resource, mark the required objects, and then select **Recover**. When prompted, suppress further prompting and overwrite files.
4. Use **NDS Manager** or the **Schedule immediate synchronization** function of **dsrepair** to synchronize the replica on all servers.
5. Verify the recovered data. From a workstation, use either the **nwadmin** server utility or the **ndir** workstation utility to check the data, trustee assignments, file ownership, and other related information.
6. The SYS volume should now be recovered.

### Recover a NetWare 4.11, 5.0, or IntraNetWare server SYS volume

To recover a SYS volume on a NetWare 4.11, NetWare 5.0, or IntraNetWare server, complete these tasks:

- ◆ [“Task 1: Recover the NetWare SYS volume” on page 66](#)
- ◆ [“Task 2: Reinstall the operating systems” on page 66](#)
- ◆ [“Task 3: Complete the NetWare SYS volume recovery” on page 67](#)

**Note:** For NetWare 4.11/IntraNetWare servers, do not delete the server or volume objects for the failed volume from the NDS tree; you do not want to eliminate any references other objects might have to the volume. If you must delete objects on a NetWare 4.11/IntraNetWare server, use the NetWare 4.10 procedure for recovering from a disaster.

**Task 1: Recover the NetWare SYS volume**

To recover a NetWare 4.11 or IntraNetWare SYS volume:

1. From the NetWorker server, perform a directed recover to recover the failed server's Server Specific Info (SSI) files from a tape backup to a functioning NetWorker for NetWare client.

The server-specific information files (SERVDATA.NDS, DSMISC.LOG, VOLSINFO.TXT, STARTUP.NCF, and AUTOEXEC.NCF) are recovered to a subdirectory under SYS:\SYSTEM on the client you have selected. This subdirectory is given a DOS 8.3 name derived from the source server name.

---

**Note:** For NetWare 4.11/IntraNetWare servers, do not delete the server or volume objects for the failed server from the NDS tree. You do not want to eliminate any references other objects might have to the server. If objects were deleted from the NDS tree, use the NetWare 4.10 procedure for recovering from a disaster.

---

2. If the failed server held a master replica, use NDS Manager or **dsrepair** to designate a new master replica on a different server in the replica ring. To determine which replicas were stored on the failed server, refer to DSMISC.LOG.
3. If the failed server also contained any nonmaster replicas, use NDS Manager or **dsrepair** on the servers containing master replicas to remove the failed server from the replica ring.
4. Use **dsrepair** to perform an unattended full repair to ensure the ring is functioning properly.

Refer to DSMISC.LOG to determine which replicas were stored on the failed server. If DSMISC.LOG shows that no other server has exactly the same replicas as the failed server, run **dsrepair** on any servers containing replicas of partitions on the failed server.

5. Shut down the failed server and replace any damaged hardware. To replace a hard drive, install a drive that is the same size or larger.

**Task 2: Reinstall the operating systems**

To reinstall the operating systems:

1. Format the DOS partitions and reinstall DOS.

---

**Note:** Use the DOS Time command to ensure that the computer is set to the correct time to avoid time synchronization errors.

---

2. Reinstall NetWare 4.11, NetWare 5.0, or IntraNetWare and NDS on the repaired or replaced server. Run **install** or **nwconfig**, select Custom Install, and follow the directions on the screen:
  - a. When prompted, enter the same server name and internal IPX number that the server had prior to the failure. Use the *STARTUP.NCF* and *AUTOEXEC.NCF* files included with the server-specific information for needed information.
  - b. After the preliminary files are copied, the Choose a Directory Tree dialog box appears. Press **F5** to recover NDS (option listed at the bottom right of the screen).
  - c. A new window displays two options:
    - A: (the default)
    - Press **F3** to specify a different path

If the Server Specific Info files are contained on diskette, insert the diskette into drive A: and press **Enter**. Otherwise, press **F3** and enter the path to the **Server Specific Info** files recovered in "Task 1: Recover the NetWare SYS volume".

- d. A **Remote Server Authentication** login dialog box is displayed. Log in. When prompted, enter the Directory tree name.
- e. Press **Enter**, and both the files and NDS are copied to the new server. DSMISC.LOG, VOLSINFO.TXT, and AUTOEXEC.NCF are copied to the SYS:SYSTEM directory. STARTUP.NCF is copied to the C:\NWSERVER directory.

The NDS recovery uses the information from SERVDATA.NDS (TSANDS.NLM is not needed). NDS is now fully functional on the server, but the partitions and replicas must still be reestablished.

- f. When prompted, insert the **NetWare License** diskette for the server into the diskette drive.
- g. Edit the STARTUP.NCF and AUTOEXEC.NCF files.
- h. If either the STARTUP.NCF or the AUTOEXEC.NCF files have changed because they were backed up with the server-specific information, both the original and the new files are displayed for you to compare and make edits as necessary. If the current files are the same as the original files, only the current files are displayed.

The server now contains all the files necessary to perform an SMS remote file system recover.

3. To finish the installation, complete either:
  - a. Press **Enter** to exit the utility.
 

NetWare will not copy the remaining system and public files but will exit the utility. These files should be recovered from a backup.
  - b. Press **F3** to continue installation.
 

Wait while the utility copies the remaining system and public files, and then exit.

### Task 3: Complete the NetWare SYS volume recovery

This section describes how to complete the recovery of the 4.11 SYS volume.

To complete the recovery of the 4.11 SYS volume:

1. Load the required namespace modules for each recovered volume. Use the VOLSINFO.TXT file to determine which namespaces need to be loaded (MAC.NAM, OS2.NAM, and so on).
2. Load the file-system TSA specific to your version of NetWare by entering one of these commands on the repaired or replaced server:
 

```
LOAD TSA410
LOAD TSA500
```
3. Recover the file system for each volume affected by the failure. Do not recover the Schema and Root; they will be recovered from a replica. You also do not need to recover Server Specific Info again. When prompted, suppress further prompting and overwrite files.

If the failed server had non-SYS volumes that were not affected by the failure, no further action is needed because the SERVDATA.NDS file preserves the trustee assignments on these other volumes.

4. Shut down and restart the server.
5. Use NDS Manager or **dsrepair** to re-establish replicas on the failed server. Use DSMISC.LOG to view a copy of the replica list that resided on the server at the time of backup.
6. Verify the recovered data. From a workstation, use the Novell **NWAdmin32** or the **rights /T /S** and **ndir** commands to check the data, trustee assignments, file ownership, and other related information.

---

This chapter includes the following special Microsoft recovery procedures and considerations:

- ◆ NetWorker Module for Microsoft Applications ..... 70
- ◆ Prerequisites before recovering a Windows system..... 70
- ◆ Recovering a MS Cluster on Windows Server 2008 / R2 ..... 71
- ◆ Performing a Windows ASR recovery ..... 72
- ◆ Recovering Active Directory ..... 76
- ◆ Recovery of DHCP and WINS databases ..... 80
- ◆ Performing a Windows Server 2008 offline system recovery using Windows Server Backup (WSB) and NetWorker ..... 81

---

## NetWorker Module for Microsoft Applications

NetWorker Module for Microsoft Applications (NMM) provides VSS-based backup and recovery of Windows, as well as Microsoft server applications such as Microsoft Exchange Server, Microsoft SQL Server, Microsoft Data Protection Manager (DPM), and Microsoft Office SharePoint Services.

If NMM is installed on the client computer, refer to the *NetWorker Module for Microsoft Applications Administration Guide* for documentation about that product.

There are also separate modules available for Microsoft Exchange Server and Microsoft SQL Server:

- ◆ EMC NetWorker Module for Microsoft Exchange to back up and recover Microsoft Exchange Server.
- ◆ EMC NetWorker Module for Microsoft SQL Server to back up and recover Microsoft SQL Server.

---

## Prerequisites before recovering a Windows system

The following prerequisites apply to all recovery tasks in this chapter.

---

### Satisfy Windows hardware and operating system requirements

Ensure that the following hardware and operating system requirements are met on the host:

- ◆ The hardware configuration is the same as the original host configuration.
- ◆ The same Operating System version and Service Packs are installed.
- ◆ The following additional requirements:
  - [“Task 1: Satisfy Windows hardware and operating system requirements” on page 55.](#)
  - [“Task 2: Satisfy the NetWorker client or storage node recovery requirements” on page 55.](#)
  - [“Task 3: Reinstall the NetWorker client or storage node software” on page 56.](#)

---

### Satisfy NetWorker and Avamar deduplication (if applicable) software requirements

Edit the following files to include the name and IP address of the NetWorker server (the backup server for the computer) and the primary Avamar deduplication node, if applicable, where the system save sets were previously saved to:

- %SystemRoot%\system32\drivers\etc\hosts
- %SystemRoot%\system32\drivers\etc\lmhosts
- Include the name and IP address of the Avamar replication node, if applicable.

## Recovering a MS Cluster on Windows Server 2008 / R2

This section contains procedures for recovering a cluster writer on Windows Server 2008 and Windows Server 2008 R2.

### Task 1: Recover the cluster node

To recover the cluster node:

1. Start the **NetWorker User** program.
2. Click the **Recover** button.
3. In the **Source Client** dialog box, select the computer you are recovering and click **OK**.
4. In the **Destination Client** dialog box, select the computer you are recovering and click **OK**.
5. The computer's directory structure appears in the Recover window. Mark the **VSS SYSTEM FILESET** saveset only.
6. From the **Option** menu, select **Recover Options**.
7. In the **Recover Options** dialog box, select **Overwrite Existing File**.

If you do not select **Overwrite Existing File**, the recovery process pauses before any existing files are overwritten. A **Naming Conflict** dialog box appears, and it prompts you to indicate how the NetWorker software should resolve filename conflicts.

8. Click **Start** to begin the recovery.



#### **IMPORTANT**

**Do not reboot at this time.**

### Task 2: Perform a nonauthoritative or authoritative cluster writer recovery operation

Choose a nonauthoritative or authoritative cluster recovery method based on the following criteria:

- ◆ Perform a nonauthoritative cluster recovery if the cluster is completely lost. The cluster is considered to be completely lost if the cluster service does not run on either node, and the cluster database is missing or corrupted.

Nonauthoritative cluster recoveries can be performed from the command line or from the NetWorker user interface.

- ◆ Perform an authoritative cluster recovery if the cluster configuration is lost, but the cluster is otherwise functioning normally on all nodes.

Authoritative cluster recoveries can only be performed from the command line.

#### **Nonauthoritative recovery (default)**

Use this mode if the cluster is completely lost. In such cases, the cluster service does not run on either node, and the cluster database is missing or corrupted.

Nonauthoritative recoveries restore the cluster but do not restore a particular version of the database. After the nonauthoritative restore is complete, you must follow up with an authoritative restore to recover a specific version of the database.

To perform a nonauthoritative recovery:

1. In the **NetWorker User** program, select the following save sets:
  - a. The entire **VSS SYSTEM BOOT** save set.
  - b. In the **VSS SYSTEM SERVICES** system save set, select **Cluster Database**.
2. Start the recovery.
3. Reboot the system when prompted.
4. Repeat [Step 1](#) and [Step 2](#) on the other nodes as needed.

### Authoritative restore

Use this mode when the cluster configuration is lost, but the cluster is otherwise functioning normally. For example, when a cluster resource was accidentally deleted or you want to revert to a previous cluster configuration. The cluster must be functioning normally on all nodes.

To perform an authoritative recovery, you must use a command line. You cannot perform this authoritative recovery from the NetWorker User program.

To perform an authoritative recovery:

1. Ensure that the cluster service is running in the local system.
2. Ensure that the cluster service is running on all nodes.
3. Type the following string on the command line:

```
recover -s NWServername -U -N "VSS SYSTEM SERVICES:\Cluster Database"
```

Where *NWServername* is the name of the NetWorker Server.

**Note:** Authoritative restores of the Windows 2008 cluster writer will restart the cluster service on all nodes in the cluster

4. Once done, use the NetWorker User program to recover any remaining client data on the cluster.

## Performing a Windows ASR recovery

Microsoft ASR (Automatic System Recovery) is a feature of the Windows 2003 and Windows XP Professional operating systems. More information about NetWorker software support for ASR, including procedures for performing ASR backups and creating an ASR disk is provided in the *EMC NetWorker Administration Guide*.

To use the ASR recovery method, perform these tasks in the specified order:

- ◆ [“Task 1: Perform an ASR recovery of the NetWorker client computer” on page 73](#)
- ◆ [“Task 2: Recover components that require special handling” on page 74](#)
- ◆ [“Task 3: Verify the NetWorker client recovery” on page 75](#)

ASR recovery is *not* supported for the following:

- ◆ NetWorker servers  
To recover a NetWorker server, see [Chapter 4, “Recovering a NetWorker Server,”](#)
- ◆ NetWorker storage nodes  
To recover a NetWorker storage node, see [Chapter 5, “Recovering a NetWorker Client and Storage Node,”](#)

- ◆ Windows Vista or Microsoft Windows Server 2008  
To recover NetWorker clients that are running Vista or 2008, see [Chapter 5, “Recovering a NetWorker Client and Storage Node.”](#)
- ◆ NetWorker clients operating in a Windows 2003 Microsoft Cluster Server (MSCS) environment.

---

## Limitations of the operating system’s recovery CD-ROM

Many computer manufacturers, such as Dell, Hewlett-Packard, Compaq, and IBM, provide a recovery CD-ROM or DVD with each system, which typically includes the Windows operating system installation files and any additional software that was included with the system. These recovery disks cannot be used to perform an ASR recovery. To perform an ASR recovery, you must have an official Microsoft Windows installation CD-ROM or DVD for the same version and Service Pack level of Windows that you are recovering. If you do not have the required installation software, contact your OEM immediately.

---

## ASR recovery requirements

To perform an ASR recovery of a NetWorker client host computer:

- ◆ The ASR disk for the computer you are recovering. If a current ASR disk or ASR save set is not available for the failed NetWorker client host computer, you must use the legacy NetWorker disaster recovery method described in [Chapter 5, “Recovering a NetWorker Client and Storage Node.”](#)
- ◆ The official Microsoft Windows 2003 or Windows XP Professional installation CD-ROM for the computer you are recovering.
- ◆ The latest NetWorker backup for the computer you are recovering.

**Note:** To avoid delays during a recovery, if you routinely move NetWorker backup media to an offsite location for safekeeping, ensure that all necessary volumes are available. To list the media associated with the files to be recovered, run **mminfo -mv** from the command prompt. The *EMC NetWorker Command Reference Guide* provides more information about the **mminfo** command.

---

## Task 1: Perform an ASR recovery of the NetWorker client computer

To perform an ASR recovery of the NetWorker client computer:

1. On the NetWorker client computer you are recovering, boot from the Windows 2003 or Windows XP Professional installation CD-ROM.

**Note:** You may need to run the BIOS setup program to configure the computer to boot from the CD-ROM drive. For the procedure, refer to the computer manufacturer’s documentation.

2. Watch closely at the beginning of the boot process. If prompted, press a key to boot from the CD-ROM drive.
3. During the text-mode phase of Windows setup, watch the lower portion of the screen. When prompted, press [F2] to display the ASR Recovery menu. Follow the instructions on the screen.

4. When prompted, insert the ASR disk into drive *A:* and press a key to continue. ASR formats the system partition, copies files, and begins the Windows installation.

---

**Note:** Due to a problem with Microsoft Windows XP Professional, when you are prompted to insert the ASR disk and press a key to continue, you may need to press a key several times before the system recognizes the disk and proceeds with the recovery. This problem does not occur on Windows 2003 systems.

---

5. If you did not select the **Pause During Recovery** option while creating the ASR disk, a fully automated recovery will be performed; there will be no pause and you will not be prompted to select which save sets to recover.

If you selected the **Pause During Recovery** option while creating the ASR disk, during the graphical phase of Windows setup, the **NetWorker ASR Client** dialog box appears. Expand **My Computer** and mark the save sets to be recovered. For example, mark these save sets:

```
C:\
D:\
SYSTEM STATE:\
SYSTEM DB:\
SYSTEM FILES:\
```

If Volume Shadow Copy Service (VSS) is licensed and enabled, mark the following VSS save sets:

```
VSS SYSTEM BOOT:\
VSS SYSTEM FILESET:\
```

---

**Note:** VSS USER DATA, VSS OTHER, and VSS SYSTEM SERVICES do not appear because they are not required to boot from ASR mode.

---

By default, the displayed save sets represent the most recent backup. You can view and select previous backups by entering a new browse time in the Browse Time field. The browse time must be entered in time and date the `nsr_getdate` format; for example, a date can be specified using the format `mm/dd/yy` or `monthname dd, yy`. More information about `nsr_getdate` is provided in the *EMC Command Reference Guide*.

6. Select **Continue** to complete the recovery. ASR finishes installing Windows, and then automatically runs a NetWorker recovery of the save sets selected in the previous step.

---

**Note:** The VSS components and certain legacy components cannot be correctly recovered during an ASR recovery. [“Task 2: Recover components that require special handling” on page 74](#) provides instructions to ensure that all necessary components are properly recovered.

---

## Task 2: Recover components that require special handling

Due to limitations in Microsoft ASR functionality, the following system state components cannot be correctly recovered during an ASR recovery:

- ◆ COM+ Registration Database
- ◆ Disk Quota Database
- ◆ Windows Management Instrumentation Database

◆ VSS writers

If the NetWorker client being recovered uses any of these components, the following procedures must be performed after an ASR recovery.

If the NetWorker client being recovered does *not* use any of these components, skip this task and proceed to “[Task 3: Verify the NetWorker client recovery](#)” on page 75.

For NetWorker clients with components that require special handling, do the following after an ASR recovery:

1. Log in with administrator privileges to the target computer.
2. Start the NetWorker **User** program.
3. Click the **Recover** toolbar button.
4. In the **Source Client** dialog, click **OK** to select the local client.
5. In the **Destination Client** dialog, click **OK** to select the local client.
6. In the **Recover** window, select the SYSTEM STATE save set and check for the presence of the COM+ Registration Database component. If it is present, mark the SYSTEM STATE save set for recovery.

Alternatively, if VSS is licensed and enabled, mark all VSS save sets for recovery, except VSS ASR DISK.

7. In the **Recover** window, select the SYSTEM DB save set and check for the presence of the Disk Quota Database and the Windows Management Instrumentation Database. If they are present, mark the SYSTEM DB save set for recovery.

---

**Note:** If VSS is licensed and enabled, skip this step.

8. If you marked any save sets for recovery, click **Start** to begin the recovery.

---

### Task 3: Verify the NetWorker client recovery

To verify the NetWorker client recovery:

1. Reboot the NetWorker client host computer and verify that the NetWorker Remote Exec and NetWorker Power Monitor services have started.

---

**Note:** You can disable the NetWorker Power Monitor service if it is not needed. The *EMC NetWorker Administration Guide* provides more information.

2. Use the **Windows Event Viewer** to examine the event logs for errors. In particular, check for the following:

- Service startup errors related to the Windows system state
- Errors regarding the recovery of Windows system-protected files

Information about how the NetWorker software handles the Windows system state and system-protected files is provided in the *EMC NetWorker Administration Guide*.

---

**Note:** VSS is unavailable during an ASR recovery. Once an ASR recovery is complete and the system is rebooted, VSS is available for proper recovery of the writers.

3. Verify that any applications (such as Microsoft Office) that were running prior to the disaster have been properly recovered. To verify this, start each application and open a previously saved document.

---

## Recovering Active Directory

Active Directory (AD) is the Windows directory service and the foundation for the Windows Distributed File System. AD is a component of the Windows system state on Windows Server 2008, 2003, and Windows 2000 domain controllers. A domain controller is a computer that stores directory data and manages user interactions with a domain, including login, authentication, directory searches, and access to other shared resources.

---

### Back up and recovery overview

The NetWorker software automatically backs up AD as a component of the SYSTEM STATE or VSS SYSTEM BOOT save set. An AD backup or restore includes the AD log files, database, patch files, and expiry token.

To recover AD, Windows requires that the system state be recovered. Each backup of the system state includes an expiry token for the AD backup. During recovery, the operating system compares the expiry token to the tombstone lifetime of the domain. An AD recovery fails if the expiry token is older than the tombstone lifetime. (This is a Microsoft restriction. To recover AD data that is past the tombstone lifetime, reinstall the operating system on the domain controller before recovering.) The tombstone lifetime is a configurable attribute of a Windows domain. By default, the tombstone lifetime is 60 days. The Microsoft Windows Server Resource Kit documentation on AD provides more information.

---

### Preparing to recover the system state on a domain controller

To prepare to recover the system state on a domain controller:

1. Before you start a recovery of the SYSTEM STATE or VSS SYSTEM BOOT save set on a Windows Server 2003 or Windows 2000 domain controller, boot the system in Directory Services Restore Mode.

---

**Note:** If you recover the SYSTEM STATE or VSS SYSTEM BOOT save set on a functioning Windows Server 2003 or Windows 2000 domain controller without first booting the system in Directory Services Restore Mode, recovery of the AD files will fail.

---

To boot the domain controller in Directory Services Restore Mode, do one of the following:

- Select the operating system to boot, but press **F8** before the system begins booting.
  - Select **Directory Services Restore Mode** as the boot option. Microsoft Windows documentation provides information about modifying the *boot.ini* file for multiple-boot configurations.
2. Perform either a nonauthoritative restore or an authoritative restore. The next section, [“Choosing a recovery method: nonauthoritative or authoritative restore”](#) provides more information.

## Choosing a recovery method: nonauthoritative or authoritative restore

A nonauthoritative restore returns a domain controller to its state at the time of the last backup. If there are additional domain controllers in the environment, they will overwrite the restored domain controller with any changes that have occurred since the last backup.

An authoritative restore enables you to overwrite all domain controllers with data from a restored domain controller. You can replicate an object, subtree, or the entire database from a restored domain controller to all domain controllers in the environment.

Choose a recovery method based on the following criteria:

- ◆ If your environment consists of a single domain controller, perform a nonauthoritative recovery.
- ◆ If you have multiple domain controllers:
  - If only a single domain controller is corrupt, perform a nonauthoritative restore on that domain controller. The restored domain controller will then be updated by the other domain controllers through the regular replication process.
  - If all domain controllers are corrupt, perform an authoritative restore.

## Performing a non-authoritative restore

To perform a nonauthoritative restore:

1. On the domain controller, close all programs.
2. From the Windows **Start** menu, click **Shut Down**.
3. Select **Restart** and then click **OK**. When the computer restarts, a list of startup choices appears. The startup choices and duration of the startup display are based on the settings in the operating systems section and the boot loader section of the boot.ini file. [“Preparing to recover the system state on a domain controller” on page 76](#) provides more information.
4. Choose the Windows boot option for the domain controller.
5. Press **F8** to display a list of special boot options.
6. Select **Directory Services Restore Mode** (Windows Domain Controllers Only) from the list of special boot options. When you reboot in this mode, AD is taken offline.
7. Log in as administrator by using the password specified when you created the domain controller. Windows starts in **Safe Mode**.
8. Recover the save sets.
  - To initiate the operation from the command-prompt, recover the save sets in the order listed:
    - SYSTEM FILES or VSS SYSTEM FILESET
    - SYSTEM STATE or VSS SYSTEM BOOT

The command used to recover each save set should look similar to the following:

```
NetWorker_install_path\bin\recover.exe -iY [-s
NetWorker_server_name] -N "saveset_name"
```

**Note:** To avoid using the Windows version of **recover.exe**, either include `<NetWorker_install_path>\bin\recover.exe` at the command-prompt, or ensure that `<NetWorker_install_path>\bin` is listed before `%SystemRoot%\System32` in the `$PATH` environment variable.

- To initiate the operation from the NetWorker User program's Recover window, mark both the SYSTEM STATE and SYSTEM FILES (or VSS SYSTEM BOOT and VSS SYSTEM FILESET) save sets in the **Recover** window, and click **Start**.
9. When the restore is finished, verify that the operation was successful.
  10. Restart the domain controller computer in normal mode (not in Directory Services Restore Mode). The AD recovery is now complete.

## Performing an authoritative restore

To perform an authoritative restore:

1. Follow [Step 1](#) through [Step 9](#) in "Performing a non-authoritative restore" on [page 77](#).
2. Run the Windows **ntdsutil** command-line utility.

The **ntdsutil** prompt appears. The **ntdsutil** utility is a command interface similar to the NetWorker **recover** interface. For help in the **ntdsutil** utility, type `?` at the **ntdsutil** prompt.

3. At the **ntdsutil** prompt, type:

```
NTDSUTIL: activate instance ntds (On Windows 2008 systems only)
```

```
NTDSUTIL: authoritative restore
```

4. To perform an authoritative restore:

- Of the entire database, type:

```
NTDSUTIL: restore database (On Windows 2003 systems only)
```

- Of a subtree or individual object, type:

```
NTDSUTIL: restore subtree "distinguished_name"
```

For example,

```
NTDSUTIL: restore subtree
"OU=engineering,DC=Seattle,DC=jupiter,DC=com"
NTDSUTIL: restore subtree
"CN=mars,CN=users,DC=Seattle,DC=jupiter,DC=com"
```

The Microsoft Windows Server Resource Kit documentation on AD provides information.

5. Exit the **ntdsutil** utility by typing **quit** at each successive **ntdsutil** prompt until the command-prompt appears.
6. Restart the domain controller in normal mode and log in.

## Checking authoritative restore results

To ensure that authoritative restore is working properly, perform the procedures in this section with Windows domain administrator privileges.

### Preparing to check the authoritative restore results

To check authoritative restore results:

1. Select two networked computers, for example, *node\_a* and *node\_b*.
2. On each computer, perform a fresh installation of the operating system. When you perform the installation, ensure that the hard disk on each computer is reformatted.
3. Set up a Windows domain with two domain controllers.
  - a. Use the Windows **dcpromo** command to configure *node\_a* as a domain controller.
  - b. Add *node\_b* to the domain.
  - c. Use the **dcpromo** command to configure *node\_b* as another domain controller for that domain.
4. Install the NetWorker client software on both nodes. If either node is to function as a NetWorker server, install the server software as well.
5. Back up either one of the domain controllers. For this example, back up *node\_a*.
6. After the backup completes, test the authoritative restore that is about to be performed, as follows:
  - a. Enter some changes (from the Active Directory Users and Computers snap-in) on *node\_a*, the backed-up domain controller. For example, delete an existing user, add one or more new users, and modify an existing user's **Description** field. Record the settings before and after the change.
  - b. Wait for the changes to be replicated to *node\_b*. The changes are replicated when the settings on *node\_a* appear on *node\_b*.
7. For an authoritative restore, complete the steps in [“Performing an authoritative restore” on page 78](#).
8. Ensure that the authoritative restore worked correctly, as described in the next section, [“How to check the authoritative restore results.”](#)

### How to check the authoritative restore results

To check the authoritative restore results:

1. Open the **Active Directory Users and Computers** MMC snap-in.
2. If the authoritative restore was successful, these settings appear on both *node\_a* and *node\_b* after the reboot and a complete replication cycle:
  - The modified user description now has its original description.
  - The deleted user is present again.
  - The users that were added after the backup are still present.

---

## Group policy recovery

To recover group policy objects:

1. Follow the steps in [“Performing a non-authoritative restore” on page 77](#) for more information.
2. Run the Windows **ntdsutil** command-line utility.

The **ntdsutil** prompt appears. The **ntdsutil** utility is a command interface similar to the NetWorker recover interface. For help in the **ntdsutil** utility, type **?** at the **ntdsutil** prompt.

3. At the **ntdsutil** prompt, type:

```
NTDSUTIL: activate instance ntds (On Windows 2008 systems only)
NTDSUTIL: authoritative restore
```

◆ To restore GPO on Windows Server 2003:

```
restore object "Distinguished Name of the Object"
```

For example:

```
restore object
"CN={760CC138-AF70-4E99-8DC6-457E49CBE154},CN=Policies,
CN=System,DC=w2k3,DC=com"
```

◆ To restore GPO on Windows Server 2008:

```
restore object "Distinguished Name of the Object"
```

For example:

```
restore object
"CN={760CC138-AF70-4E99-8DC6-457E49CBE154},CN=Policies,CN=System,DC=w2k8,DC=com"
```

and restore OUs (linked with the GPO in this example):

```
restore object "OU=OU1,DC=w2k8,DC=com)
```

4. Exit the **ntdsutil** utility by typing **quit** at each successive **ntdsutil** prompt until the command-prompt appears.

5. Restart the domain controller in normal mode and log in.

## Recovery of DHCP and WINS databases

If you are using Windows 2003 and are using ASR backup and recovery or have VSS licensed and enabled, no special handling is required to back up and recover DHCP and WINS databases. However, if you are not using ASR backup and recovery or do not have VSS licensed and enabled, use this section to learn how to back up and recover the DHCP and WINS databases.

**Note:** To recover the DHCP database, you must have a NetWorker backup that includes the `%SystemRoot%\System32\dhcp` directory. To recover the WINS database, you must have a NetWorker backup that includes a local disk backup of the WINS database. Instructions on configuring DHCP and WINS servers to include these databases in scheduled NetWorker backups is provided in the *NetWorker Administration Guide*.

### Recover a DHCP database

To recover a DHCP database:

1. Use the NetWorker User program to recover the backup of the `%SystemRoot%\System32\dhcp` directory on the DHCP server.
2. Use the Microsoft DHCP administrative tools to recover the DHCP database. For detailed instructions, refer the DHCP database recover procedures in the Microsoft documentation.

---

## Recover a WINS database

To recover a WINS database:

1. Use the NetWorker User program to recover the backup of the WINS database to a drive on the WINS server.
2. Use the Microsoft WINS administrative tools to recover the WINS database. For detailed instructions on using Microsoft WINS administrative tools, refer to the Microsoft documentation.

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## Performing a Windows Server 2008 offline system recovery using Windows Server Backup (WSB) and NetWorker

Complete instructions for backing up and recovering NetWorker clients that are using Windows Server 2008 and 2008 R2 are provided in the technical note titled, *Windows Server 2008 Offline System Recovery using Windows Server Backup with NetWorker*, which is available on Powerlink.



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This chapter describes how to recover the NetWorker Management Console (NMC) server. It includes this section:

- ◆ [Recovering the NMC server .....](#) 84

## Recovering the NMC server

This section describes how to recover from the NMC server from either a UNIX or Windows operating system environment. Regardless of the operating system in use, you perform the steps identified in [Table 14 on page 84](#) to recover the NMC server.

**Table 14** MNC server recovery

| Step | Activity                                             | On...                                                                                                                                                                                                                                                                     |
|------|------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1    | Reinstall or recover the NetWorker software.         | <ol style="list-style-type: none"> <li>1. The appropriate <i>NetWorker Installation Guide</i> for instructions on reinstalling NetWorker software.</li> <li>2. The recovery procedures provided in <a href="#">Chapter 4, "Recovering a NetWorker Server,"</a></li> </ol> |
| 2    | Reinstall the NetWorker Management Console software. | The appropriate <i>NetWorker Installation Guide</i> for instructions on reinstalling the NetWorker Management Console software.                                                                                                                                           |
| 3    | Recover the NMC server database.                     | <a href="#">"Recovering the console server database" on page 84.</a>                                                                                                                                                                                                      |

**Note:** During recovery of the NMC server database, no console graphical interface is available and, consequently, messages such as mount requests can not be addressed from the console.

For UNIX, you must use the `nsrwatch` command to view messages, and the use commands such as `nsrjb`, to address those issues. For Windows, monitor the daemon log file for messages. More information about `nsrwatch`, `nsrjb`, and other NetWorker commands, is provided in the *Command Reference Guide*.

## Recovering the console server database

This section describes how to recover lost data whenever the NMC server database becomes corrupted or if the NMC server is damaged. You must reinstall or recover the NetWorker client software before you attempt to recover the console database.

The *NetWorker Administration Guide* contains more information about backing up the console database.

To recover the console server database:

1. Stop the console server if it is currently running.
2. If you are operating in:
  - a. A Windows environment goto step 3.
  - b. A UNIX environment, set the appropriate library path environment variable to the following:

```
Console_install_dir/sybasa/lib64
Console_install_dir/sybasa/lib (Linux)
```

The environment variable to set varies by platform:

- Solaris/Linux: LD\_LIBRARY\_PATH
- AIX: LIBPATH
- HP-UX: SHLIB\_PATH

**Note:** If the Console is not installed in the default /opt/LGTONmc directory on Solaris, add *Console\_install\_dir/bin* to the LD\_LIBRARY\_PATH environment variable.

3. At the command prompt, enter the **recoverpsm** command:

```
recoverpsm recover options
```

where *recover options* can be:

- **-s** — Specifies the name of the NetWorker server.
- **-c** — Specifies the name of the NetWorker client.
- **-f** — Overwrites the existing database file, if one is present.
- **-t** — Specifies the point in time of the backup that will be recovered. If this is not specified, the most recent backup is used.
- **-d** — Specifies the destination directory where the database files will be recovered. If this is not specified, the database is restored to the current console server database directory.
- **-S** — Use this option to specify the name of the previous console server host if the console server has been moved to a different machine after the last backup. The format of the database server name is **gst\_on\_<NMC server host name>**. <NMC server host name> should be the computers "short name;" for example, if the computer name is *wolf.emc.com*, the proper format for this option would be **-S gst\_on\_wolf**.
- **-O** — Use this option to omit the recovery of the database credential file if, after the last backup, the console server has been moved to a different machine or is being recovered to a different location. If you are using the **-O** option, skip [Step 4](#) and continue with [Step 5](#).

The *EMC NetWorker Command Reference Guide* contains more information about the **recoverpsm** command.

4. If the operating system has not been reinstalled and you did not use the **-O** option with the **recoverpsm** command:
  - If you were using LDAP authentication, you can use the **recover** command to recover the *cst* directory, which is backed up under the saveset named *CONSOLE\_BACKUP\_FILES*.
5. If the operating system has been reinstalled or if you are recovering the Console server to a different host:
  - a. Use the **recover** command or the **NetWorker User** or **nwrecover** command to recover the *gstd\_db.conf* configuration file. This will maintain your existing database login credentials. For NetWorker 7.5 and greater, the *gstd\_db.conf* file is located in the saveset named *CONSOLE\_BACKUP\_FILES*.
  - b. If you were using LDAP authentication, you must configure your LDAP authorities again on the recovered Console server using the Configure Login Authentication wizard.
6. Restart the console server.



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This glossary contains terms related to disk storage subsystems. Many of these terms are used in this manual.

## A

- ACL** Access Control List. This is a list that specifies the permissions assigned to a specific file or directory.  
To recover a file that has an associated ACL, you must either be logged in to the system as root, as Administrator, or as the file's owner.
- active group** A NetWorker backup group that has its Autostart attribute enabled.
- administrator** The person normally responsible for installing, configuring, and maintaining NetWorker software.
- Administrators group** A Windows NT and Windows 2000 user group whose members have all the rights and abilities of users in other groups, plus the ability to create and manage all the users and groups in the domain. Only members of the Administrators group can modify Windows NT and Windows 2000 operating system files, maintain the built-in groups, and grant additional rights to groups.
- agent** The term used by Solaris to denote a cluster server. Also known as a logical server (HP TruCluster), a package (HP-UX), and a virtual server (Microsoft).
- annotation** A comment that you associate with an archive save set to help identify that data later. Annotations are stored in the media index for ease of searching and are limited to 1,024 characters.
- archive** The process by which NetWorker software backs up directories or files to an archive volume and then grooms them to free disk space. When data is archived, it is written to one or more storage volumes and then marked so that it is never subject to automatic recycling. You can delete the archived files from the client, thus freeing disk space. *See also* "grooming".
- archive clone pool** A pool comprised exclusively of archive clone save sets.
- archive pool** A volume "pool" comprised exclusively of archive save sets. Archived save sets are in a different format than regular backup save sets, and must be maintained on separate media.
- archive volume** A tape or other storage medium used to store NetWorker archive data.

|                               |                                                                                                                                                                                                                                                                                                                                                                                                                         |
|-------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>ASM</b>                    | Application-specific module. An ASM is a program that, when used in a directive, specifies the way that a set of files or directories is to be backed up and recovered. For example, <b>compressasm</b> is a NetWorker directive used to compress and decompress files.                                                                                                                                                 |
| <b>ASM specification</b>      | A directive that specifies how files or directories with a matching pattern are backed up. This specification appears in the format:<br><br>[+] <i>asm: argument</i><br><br>For more information, refer to the <b>nsr_5</b> man page or the <i>NetWorker Command Reference Guide</i> .                                                                                                                                  |
| <b>attribute</b>              | A feature of a resource. It is a service or information that the “ <b>resource</b> ” provides.                                                                                                                                                                                                                                                                                                                          |
| <b>authorization code</b>     | A code that is unique to your network that unlocks the software for permanent use.                                                                                                                                                                                                                                                                                                                                      |
| <b>autochanger</b>            | A mechanism that uses a robotic arm to move media among various components located in a device, including slots, media drives, media access ports, and transports. Autochangers automate media loading and mounting functions during backup and recovery. The term autochanger refers to a variety of robotic libraries, including autoloader, “ <b>carousel</b> ”, datawheel, jukebox, library, and near-line storage. |
| <b>auto media management</b>  | A feature that enables the storage device controlled by the NetWorker server to automatically label, mount, and overwrite a volume it considers unlabeled. Volumes that are eligible for reuse are also automatically recycled.                                                                                                                                                                                         |
| <b>alternate track</b>        | A track designated to contain data in place of a defective primary track. See also <i>primary track</i>                                                                                                                                                                                                                                                                                                                 |
| <b>actuator</b>               | A set of access arms and their attached read/write heads, which move as an independent component within a head and disk assembly (HDA).                                                                                                                                                                                                                                                                                 |
| <b>adapter</b>                | Card that provides the physical interface between the director and disk devices (SCSI adapter), director and parallel channels (Bus & Tag adapter), director and serial channels (Serial adapter).                                                                                                                                                                                                                      |
| <b>B</b>                      |                                                                                                                                                                                                                                                                                                                                                                                                                         |
| <b>backup</b>                 | The writing of saved data to a volume.                                                                                                                                                                                                                                                                                                                                                                                  |
| <b>backup cycle</b>           | The period of time from one level full backup to the next level full backup.                                                                                                                                                                                                                                                                                                                                            |
| <b>backup group</b>           | See “ <b>group</b> ”.                                                                                                                                                                                                                                                                                                                                                                                                   |
| <b>backup level</b>           | See “ <b>level</b> ”.                                                                                                                                                                                                                                                                                                                                                                                                   |
| <b>Backup Operators group</b> | A group of Microsoft Windows users who can log in to a domain from a computer or a server, back it up, and recover the data. Backup operators also can shut down servers or computers.                                                                                                                                                                                                                                  |
| <b>backup volume</b>          | A tape or other storage medium used to store NetWorker backup data, as opposed to an archive volume.                                                                                                                                                                                                                                                                                                                    |
| <b>base enabler code</b>      | See “ <b>enabler code</b> ”.                                                                                                                                                                                                                                                                                                                                                                                            |

|                                |                                                                                                                                                                                                                                                                                                                                                                                                               |
|--------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>bootstrap</b>               | A save set that is essential for the NetWorker disaster recovery procedures. The bootstrap is comprised of three components that reside on the NetWorker server: the “ <a href="#">media database</a> ”, the “ <a href="#">resource database</a> ”, and a “ <a href="#">server index</a> ”.                                                                                                                   |
| <b>browse policy</b>           | A policy that determines how long entries for backup data remain in the client file index.                                                                                                                                                                                                                                                                                                                    |
| <b>C</b>                       |                                                                                                                                                                                                                                                                                                                                                                                                               |
| <b>cache</b>                   | Random access electronic storage used to retain frequently used data for faster access by the channel.                                                                                                                                                                                                                                                                                                        |
| <b>carousel</b>                | A tray or tape cartridge that holds multiple backup volumes.                                                                                                                                                                                                                                                                                                                                                  |
| <b>client</b>                  | A computer that accesses the NetWorker server to back up or recover files. Clients may be workstations, computers, or file servers.                                                                                                                                                                                                                                                                           |
| <b>client file index</b>       | A database of information maintained by the NetWorker server that tracks every database object, file, or “ <a href="#">file system</a> ” backed up. The NetWorker server maintains a single client index file for each client computer.                                                                                                                                                                       |
| <b>client-initiated backup</b> | See “ <a href="#">manual backup</a> ”.                                                                                                                                                                                                                                                                                                                                                                        |
| <b>clone</b>                   | The NetWorker process used to make an exact copy of saved data (save sets). You can clone individual save sets or the entire contents of a backup volume. Cloning is different from a simple copy operation carried out on an operating system or hardware device. It is indexed and tracked by NetWorker software in both the “ <a href="#">client file index</a> ” and the <a href="#">media database</a> . |
| <b>clone pool</b>              | A pool of volumes comprised exclusively of cloned data. Save sets of different types (for example, archive) cannot be intermixed on the same clone volume.                                                                                                                                                                                                                                                    |
| <b>clone volume</b>            | A volume belonging to a clone pool.                                                                                                                                                                                                                                                                                                                                                                           |
| <b>cluster</b>                 | Two or more nodes that are connected and appear to network users as a single, highly available system. A highly available system allows the application services to continue despite most hardware or software failures.                                                                                                                                                                                      |
| <b>connection port</b>         | The port NetWorker processes use to perform backup and recovery sessions through a firewall.                                                                                                                                                                                                                                                                                                                  |
| <b>consolidate</b>             | The process of creating a complete backup of a save set by merging the most recent level 1 save set with its corresponding full level save set. For more information, refer to the <a href="#">nsrssc</a> man page or the <i>NetWorker Command Reference Guide</i> .                                                                                                                                          |
| <b>continued save set</b>      | Data associated with a save set that is continued from a previous volume. Continued save sets are created by the backup server when large save sets are being backed up, cloned, or archived to multiple volumes.                                                                                                                                                                                             |
| <b>cache slot</b>              | Unit of cache equivalent to one track.                                                                                                                                                                                                                                                                                                                                                                        |
| <b>channel director</b>        | The component in the Symmetrix subsystem that interfaces between the host channels and data storage. It transfers data between the channel and cache.                                                                                                                                                                                                                                                         |

**controller ID** Controller identification number of the director the disks are channeled to for EREP usage. There is only one controller ID for Symmetrix.

**count-key-data (CKD)** A data recording format employing self-defining record formats in which each record is represented by a count area that identifies the record and specifies its format, an optional key area that may be used to identify the data area contents, and a data area that contains the user data for the record. CKD also can refer to a set of channel commands that are accepted by a device that employs the CKD recording format.

## D

**DASD** Direct access storage device.

**data availability** Access to any and all user data by the application.

**delayed fast write** There is no room in cache for the data presented by the write operation.

**device address** The hexadecimal value that uniquely defines a physical I/O device on a channel path in an MVS environment. See also *unit address*

**device number** The value that logically identifies a disk device in a string.

**device support facilities program (ICKDSF)** A program used to initialize Symmetrix at installation and provide media maintenance.

**Diagnostics** System level tests or firmware designed to inspect, detect, and correct failing components. These tests are comprehensive and self-invoking.

**director** The component in the Symmetrix subsystem that allows Symmetrix to transfer data between the host channels and disk devices. See also *channel director*

**disk director** The component in the Symmetrix subsystem that interfaces between cache and the disk devices.

**dual-initiator** A Symmetrix feature that automatically creates a backup data path to the disk devices serviced directly by a disk director, if that disk director or the disk management hardware for those devices fails.

**dynamic path reconnect (dpr)** A function that allows disconnected I/O operations with Symmetrix to reconnect over any available channel path rather than be limited to the one on which the I/O operation was started. This function is available only on System 370/XA, System 370/ESA, and System 390/ESA systems.

**dynamic sparing** A Symmetrix feature that automatically transfers data from a failing disk device to an available spare disk device without affecting data availability. This feature supports all non-mirrored devices in the Symmetrix subsystem.

**daemon** A program that lies dormant waiting for a specified condition to occur.

**datawheel** See "*autochanger*".

**DDS** Dynamic drive sharing, which allows NetWorker software to recognize shared drives.

|                          |                                                                                                                                                                                                                                                                                                                                                                                                  |
|--------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>device</b>            | <ol style="list-style-type: none"> <li>1. A storage unit that reads from and writes to storage volumes (<i>see</i> volume). A storage unit can be a tape device, optical drive, “<a href="#">autochanger</a>”, or file connected to the “<a href="#">server</a>” or “<a href="#">storage node</a>”.</li> <li>2. When DDS is enabled, refers to the access path to the physical drive.</li> </ol> |
| <b>DFS</b>               | Distributed File System root or child node. DFS is a Microsoft add-on for Windows NT 4.0 server (Alpha or Intel) or Windows 2000 that allows you to create a logical directory of shared directories that span multiple machines across a network.                                                                                                                                               |
| <b>DFS component</b>     | <ol style="list-style-type: none"> <li>1. A namespace for files and DFS links, called a DFS root.</li> <li>2. A connection to a shared file or folder, called a DFS child node.</li> </ol>                                                                                                                                                                                                       |
| <b>directed recovery</b> | A recovery method used to recover data that originated on one computer and re-create it on another computer.                                                                                                                                                                                                                                                                                     |
| <b>directive</b>         | An instruction that directs the NetWorker software to take special actions on a given set of files for a specified client during a backup.                                                                                                                                                                                                                                                       |
| <b>domain controller</b> | A Microsoft Windows computer that stores directory data and manages user interactions with a domain, including logon, authentication, directory searches, and access to other shared resources.                                                                                                                                                                                                  |
| <b>drive</b>             | When DDS is enabled, refers to the physical backup object, such as a tape drive, disk, or file. <i>See also</i> “ <a href="#">device</a> ”.                                                                                                                                                                                                                                                      |
| <b>E</b>                 |                                                                                                                                                                                                                                                                                                                                                                                                  |
| <b>enabler code</b>      | A special code provided by EMC that activates the software. The enabler code that unlocks the base features for software you purchase is referred to as a base enabler. Enabler codes for additional features or products (for example, autochanger support) are referred to as add-on enablers.                                                                                                 |
| <b>exit code</b>         | An indicator that specifies whether a backup or recovery session succeeded. An exit code of zero (0) indicates the session completed successfully. A nonzero exit code indicates the session did not complete successfully.                                                                                                                                                                      |
| <b>expiration date</b>   | The date when the volume changes from read/write to read-only.                                                                                                                                                                                                                                                                                                                                   |
| <b>expired save set</b>  | A save set whose browse time has been reached; therefore, it can no longer be browsed. In addition, the save set has been removed from the client file index.                                                                                                                                                                                                                                    |
| <b>EREP program</b>      | The program that formats and prepares reports from the data contained in the Error Recording Data Set (ERDS).                                                                                                                                                                                                                                                                                    |
| <b>ESCON</b>             | Enterprise Systems Connection.                                                                                                                                                                                                                                                                                                                                                                   |
| <b>ESCON director</b>    | Device that provides a dynamic switching function and extended link path lengths (with XDF capability) when attaching an ESCON channel to a Symmetrix serial channel interface.                                                                                                                                                                                                                  |
| <b>F</b>                 |                                                                                                                                                                                                                                                                                                                                                                                                  |
| <b>file index</b>        | <i>See</i> “ <a href="#">client file index</a> ”.                                                                                                                                                                                                                                                                                                                                                |
| <b>file system</b>       | <ol style="list-style-type: none"> <li>1. A file tree that is on a specific disk partition or other mount point.</li> </ol>                                                                                                                                                                                                                                                                      |

2. The entire set of all files.
3. A method of storing files.

|                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|-------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>firewall</b>                     | A system designed to prevent unauthorized access to or from a private network. All messages entering or leaving the intranet pass through the firewall, which examines each message and blocks those that do not meet the specified security criteria. There are several types of firewall techniques. The NetWorker software supports client backups from computers that are protected by “ <a href="#">packet filtering</a> ”. |
| <b>fork</b>                         | A subprocess the NetWorker software creates to perform a requested operation. In instances where a command uses a parallelism value, NetWorker software creates multiple instances of that command. Each instance of the command is identical to the original command and is referred to as a subprocess. Once each subprocess is created, they are run simultaneously.                                                          |
| <b>full backup</b>                  | See “ <a href="#">level</a> ”.                                                                                                                                                                                                                                                                                                                                                                                                   |
| <b>fast write</b>                   | In Symmetrix, a write operation at cache speed that does not require immediate transfer of data to disk. The data is written directly to cache and is available for later destaging.                                                                                                                                                                                                                                             |
| <b>field replaceable unit (FRU)</b> | A component that is replaced or added by service personnel as a single entity.                                                                                                                                                                                                                                                                                                                                                   |
| <b>frame</b>                        | Data packet format in an ESCON environment.                                                                                                                                                                                                                                                                                                                                                                                      |
| <b>G</b>                            |                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| <b>grooming</b>                     | The NetWorker process of removing the original files from a local disk after a successful archive operation.                                                                                                                                                                                                                                                                                                                     |
| <b>group</b>                        | A client or group of clients configured to start backing up files to the NetWorker server at a designated time of day.                                                                                                                                                                                                                                                                                                           |
| <b>gigabyte (GB)</b>                | 10 <sup>9</sup> bytes.                                                                                                                                                                                                                                                                                                                                                                                                           |
| <b>H</b>                            |                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| <b>head and disk assembly (HDA)</b> | A field replaceable unit in the Symmetrix subsystem containing the disk and actuator.                                                                                                                                                                                                                                                                                                                                            |
| <b>highly available system</b>      | A system that allows the application services to continue despite a hardware or software failure. Each cluster node has its own IP address. Each cluster node also has private (local) resources or disks that are available only to that machine.                                                                                                                                                                               |
| <b>home address (HA)</b>            | The first field on a CKD track that identifies the track and defines its operational status. The home address is written after the index point on each track.                                                                                                                                                                                                                                                                    |
| <b>hyper-volume extension</b>       | The ability to define more than one logical volume on a single physical disk device making use of its full formatted capacity. These logical volumes are user-selectable in size. The minimum volume size is one cylinder and the maximum size depends on the disk device capacity and the emulation mode selected.                                                                                                              |

**I**

**identifier (ID)** A sequence of bits or characters that identifies a program, device, controller, or system.

**IML** Initial microcode program loading.

**inactivity timeout** An attribute that indicates the number of minutes NetWorker software waits before determining that a client is unavailable for backup.

**incremental** See [“level”](#).

**index marker** Indicates the physical beginning and end of a track.

**index point** The reference point on a disk surface that determines the start of a track.

**INLINES** An EMC-provided host-based Cache Reporter utility for viewing short and long term cache statistics at the system console.

**I/O device** An addressable input/output unit, such as a disk device.

**J**

**jukebox** See [“autochanger”](#).

**K**

**kilobyte (K)** 1024 bytes.

**L**

**level** A measurement that determines how much data NetWorker software saves during a scheduled or manual backup.

A full (f) backup backs up all files, regardless of whether they have changed. Levels one through nine [1-9] back up files that have changed since the last lower numbered backup level. An incremental (incr) backup backs up only files that have changed since the last backup.

**library** See [“autochanger”](#).

**license enabler** The enabler code that enables you to run a feature or product.

**EMC License Manager** An application that manages the licenses for all EMC products and features.

**local cluster client** A NetWorker client that is not permanently bound to a physical machine, but is instead managed by a cluster manager. It can be bound to more than one physical machine in the cluster and can own its own data disks. It is also referred to as a logical or virtual client.

**local host** The node on which the client or server program is running.

**logical server** The term used in conjunction with HP TruCluster to denote a cluster server. Also known as an agent (Sun), a package (HP-UX), and a virtual server (Microsoft).

|                                            |                                                                                                                                                     |
|--------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>LUS</b>                                 | EMC User SCSI. The LUS driver is used by EMC software products as a proprietary device driver that sends arbitrary SCSI commands to an autochanger. |
| <b>least recently used algorithm (LRU)</b> | The algorithm used to identify and make available the cache space by removing the least recently used data.                                         |
| <b>logical volume</b>                      | A user-defined storage device. In the Model 5200, the user can define a physical disk device as one or two logical volumes.                         |
| <b>long miss</b>                           | Requested data is not in cache and is not in the process of being fetched.                                                                          |
| <b>longitude redundancy code (LRC)</b>     | Exclusive OR (XOR) of the accumulated bytes in the data record.                                                                                     |

## M

|                       |                                                                                                                                                                                                                                  |
|-----------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>megabyte (MB)</b>  | 10 <sup>6</sup> bytes.                                                                                                                                                                                                           |
| <b>mirroring</b>      | The Symmetrix maintains two identical copies of a designated volume on separate disks. Each volume automatically updates during a write operation. If one disk device fails, Symmetrix automatically uses the other disk device. |
| <b>mirrored pair</b>  | A logical volume with all data recorded twice, once on each of two different physical devices.                                                                                                                                   |
| <b>manual backup</b>  | A backup that a user requests from the client's <b>save</b> program. The user specifies participating files, file systems, and directories. A manual backup does not generate a "bootstrap" save set.                            |
| <b>media</b>          | The physical storage medium to which backup data is written. NetWorker software supports tape, magnetic or optical disk, and file systems as backup media. <i>See also "volume".</i>                                             |
| <b>media database</b> | A database that contains indexed entries about the storage volume location and the life cycle status of all data and volumes the NetWorker server manages. <i>See also "volume".</i>                                             |
| <b>multiplexing</b>   | A NetWorker feature that permits data from more than one save set to be simultaneously written to the same storage device.                                                                                                       |

## N

|                          |                                                                                                                                                                                                                                                                                                                                                                                                      |
|--------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>NDMP</b>              | Network Data Management Protocol. A storage management client/server protocol for enterprise-wide backup of network-attached storage. NetWorker software uses NDMP to provide connections to computers with NDMP data modules for tape operations, allowing a significant reduction in network traffic.                                                                                              |
| <b>NDS partition</b>     | An NDS partition defines the logical structure of directory data. NDS partitions allow distribution, where necessary, of the NDS database. They also improve network performance with multiple sites are connected by WAN links. Usually, a partition (or a physical copy of the partition known as a replica) is placed on a server that is physically close to the users of that partition's data. |
| <b>near-line storage</b> | <i>See "autochanger".</i>                                                                                                                                                                                                                                                                                                                                                                            |

|                                            |                                                                                                                                                                                                                                                                                 |
|--------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>NetWorker client</b>                    | See <a href="#">“client”</a> .                                                                                                                                                                                                                                                  |
| <b>NetWorker server</b>                    | See <a href="#">“server”</a> .                                                                                                                                                                                                                                                  |
| <b>NetWorker storage node</b>              | See <a href="#">“storage node”</a> .                                                                                                                                                                                                                                            |
| <b>NFS client</b>                          | A computer that can access files on a network file system (NFS) server.                                                                                                                                                                                                         |
| <b>NFS server</b>                          | A computer that contains exported file systems that NFS clients can access.                                                                                                                                                                                                     |
| <b>nonclone pool</b>                       | Pools that contain data that has not been cloned.                                                                                                                                                                                                                               |
| <b>notification</b>                        | A message generated and sent to the NetWorker administrator about important NetWorker events.                                                                                                                                                                                   |
| <b>Novell Directory Services partition</b> | See <a href="#">“NDS partition”</a> .                                                                                                                                                                                                                                           |
| <b>O</b>                                   |                                                                                                                                                                                                                                                                                 |
| <b>online indexes</b>                      | The databases located on the NetWorker server that contain all the information pertaining to the client backups ( <a href="#">“client file index”</a> ) and backup volumes ( <a href="#">“media database”</a> ).                                                                |
| <b>operator</b>                            | The person who monitors the server status, loads backup volumes into the server devices, and otherwise executes the day-to-day NetWorker tasks.                                                                                                                                 |
| <b>override</b>                            | A NetWorker feature that allows you to configure a different backup level for a specific date listed in a Schedule resource.                                                                                                                                                    |
| <b>P</b>                                   |                                                                                                                                                                                                                                                                                 |
| <b>package</b>                             | The term used by HP-UX to denote a cluster server. Also known as an agent (Sun), logical server (HP TruCluster), and virtual server (Microsoft).                                                                                                                                |
| <b>packet filtering</b>                    | A method of firewall protection that looks at each packet entering or leaving the network and accepts or rejects it based on user-defined rules. See also <a href="#">“firewall”</a> .                                                                                          |
| <b>parallelism</b>                         | A NetWorker feature that enables the NetWorker server to either back up save sets from several clients or many save sets from one client at the same time. Parallelism is also available during recovers.                                                                       |
| <b>pathname</b>                            | A set of instructions to the operating system for accessing a file. An <i>absolute pathname</i> tells how to find a file beginning at the root directory and working down the directory tree. A <i>relative pathname</i> tells how to find the file starting where you are now. |
| <b>physical cluster client</b>             | A NetWorker client that is bound to a physical machine in the cluster and can represent its own resources (private or local). It also can be called the physical client.                                                                                                        |
| <b>physical host</b>                       | Any one of the nodes (or machines) that forms the cluster.                                                                                                                                                                                                                      |
| <b>policy</b>                              | A set of constraints that specify how long an entry can remain in a client’s online file index. When a policy expires, the save sets associated with that policy are marked recyclable. Each client resource uses two policies: a browse policy and a retention policy.         |

|                                          |                                                                                                                                                                                                                                                                                                      |
|------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>pool</b>                              | A feature that enables you to sort backup data to selected volumes. A pool contains a collection of backup volumes to which specific data has been backed up.                                                                                                                                        |
| <b>probe</b>                             | The process NetWorker software uses to determine the directories or files to back up on each client.                                                                                                                                                                                                 |
| <b>purging</b>                           | The process of deleting all entries for files on the volume from the client file index, but allowing entries for the save sets to remain in the media database.                                                                                                                                      |
| <b>partitioned data set (PDS) assist</b> | An IBM feature for 3990 Model 6 and 3990 Model 3 with Extended Platform units. PDS Assist improves performance on large, heavily-used partitioned data sets by modifying the directory search process.                                                                                               |
| <b>physical ID</b>                       | Physical identification number of the Symmetrix director for EREP usage. This value automatically increments by one for each director installed in Symmetrix. This number must be unique in the mainframe system. It should be an even number. This number is referred to as the SCU_ID.             |
| <b>primary track</b>                     | The original track on which data is stored. See also <i>alternate track</i>                                                                                                                                                                                                                          |
| <b>promotion</b>                         | The process of moving data from a track on the disk device to cache slot.                                                                                                                                                                                                                            |
| <b>R</b>                                 |                                                                                                                                                                                                                                                                                                      |
| <b>recover</b>                           | A recovery method that re-creates an image of the client file systems and database on the NetWorker server.                                                                                                                                                                                          |
| <b>recyclable save set</b>               | A save set whose browse and retention policies have been reached; therefore, the save set has been removed from the media database.                                                                                                                                                                  |
| <b>recyclable volume</b>                 | A volume whose data has passed both its browse and retention policies and is now available for relabeling and use by a NetWorker server or storage node.                                                                                                                                             |
| <b>Registry</b>                          | A database of configuration information central to Windows NT and Windows 2000 operations. It centralizes all Windows settings and provides security and control over system, security, and user account settings.                                                                                   |
| <b>remote device</b>                     | A storage device that is attached to a NetWorker storage node.                                                                                                                                                                                                                                       |
| <b>RPC</b>                               | Remote Procedure Call. The protocol the NetWorker server uses to perform client requests over a network.                                                                                                                                                                                             |
| <b>resource</b>                          | A component of the NetWorker software that describes the NetWorker server and its clients. Devices, schedules, clients, groups, and policies are examples of NetWorker resources. Each resource contains a list of attributes that define the parameters to use for the specific NetWorker resource. |
| <b>resource database</b>                 | A database that contains information about each of the configured backup server's resources.                                                                                                                                                                                                         |
| <b>resource owner</b>                    | The cluster (logical, not physical) host that owns the resource. If a resource (for example, a shared disk) is not owned by any virtual host, it is assumed to be owned by the local host (physical node) that hosts the resource.                                                                   |
| <b>retention policy</b>                  | A policy that determines how long save set entries are retained in the NetWorker server's media database.                                                                                                                                                                                            |

|                               |                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|-------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>retrieve</b>               | The process of locating and copying back files and directories that NetWorker software has archived.                                                                                                                                                                                                                                                                                                                                    |
| <b>retry mechanism</b>        | The action NetWorker software performs when client operations fail. This situation might occur when the rate of transmission is either low or nonexistent. By using this mechanism, a previously failed operation might be more successful. Another common situation whereby a retry mechanism might succeed is when the client is in a reboot cycle.                                                                                   |
| <b>root</b>                   | <ol style="list-style-type: none"> <li>1. (UNIX only) The UNIX superuser account (with user name "root" and user ID). By extension, the privileged system-maintenance login on any operating system.</li> <li>2. (Windows NT/Windows 2000 and UNIX) The top node of the system directory structure; the home directory of the root user.</li> </ol>                                                                                     |
| <b>read hit</b>               | Data requested by the read operation is in cache.                                                                                                                                                                                                                                                                                                                                                                                       |
| <b>read miss</b>              | Data requested by the read operation is not in cache.                                                                                                                                                                                                                                                                                                                                                                                   |
| <b>record zero</b>            | The first record after the home address.                                                                                                                                                                                                                                                                                                                                                                                                |
| <b>S</b>                      |                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| <b>scrubbing</b>              | The process of reading, checking the error correction bits, and writing corrected data back to the source.                                                                                                                                                                                                                                                                                                                              |
| <b>SCSI adapter</b>           | Card in the Symmetrix subsystem that provides the physical interface between the disk director and the disk devices.                                                                                                                                                                                                                                                                                                                    |
| <b>SCU_ID</b>                 | For 3880 storage control emulations, this value uniquely identifies the storage director without respect to its selection address. It identifies to the host system, through the EREP, the director detecting the failing subsystem component. This value automatically increments by one for each director installed. The SCU_ID must be a unique number in the host system. It should be an even number and start on a zero boundary. |
| <b>short miss</b>             | Requested data is not in cache, but is in the process of being fetched.                                                                                                                                                                                                                                                                                                                                                                 |
| <b>SSID</b>                   | For 3990 storage control emulations, this value identifies the physical components of a logical DASD subsystem. The SSID must be a unique number in the host system. It should be an even number and start on a zero boundary.                                                                                                                                                                                                          |
| <b>stage</b>                  | The process of writing data from a disk device to cache.                                                                                                                                                                                                                                                                                                                                                                                |
| <b>storage control unit</b>   | The component in the Symmetrix subsystem that connects Symmetrix to the host channels. It performs channel commands and communicates with the disk directors and cache. See also <i>channel director</i>                                                                                                                                                                                                                                |
| <b>string</b>                 | A series of connected disk devices sharing the same disk director.                                                                                                                                                                                                                                                                                                                                                                      |
| <b>save set</b>               | A group of files or a file system from a single client computer backed up onto storage media.                                                                                                                                                                                                                                                                                                                                           |
| <b>save set consolidation</b> | The process that merges a level 1 backup with the last full backup of a save set to create a new full backup. See also "level".                                                                                                                                                                                                                                                                                                         |
| <b>save set ID</b>            | An internal identification number that NetWorker software assigns to a save set.                                                                                                                                                                                                                                                                                                                                                        |

|                           |                                                                                                                                                                                                                                                                                                |
|---------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>save set recover</b>   | The NetWorker attribute that indicates whether a given save set is browsable, recoverable, or recyclable. The save set status also indicates whether the save set has been successfully backed up.                                                                                             |
| <b>save set status</b>    | The NetWorker attribute that indicates whether a given save set is browsable, recoverable, or recyclable. The save set status also indicates whether the save set has been successfully backed up.                                                                                             |
| <b>save stream</b>        | The data and save set information being written to a storage volume during a backup. A save stream originates from a single save set.                                                                                                                                                          |
| <b>server</b>             | The computer on a network that runs the NetWorker server software, contains the online indexes, and provides backup and recovery services to the clients and storage nodes on the same network.                                                                                                |
| <b>server index</b>       | A database containing information about the server's files that have been backed up during scheduled backups. Also known as the server's " <a href="#">client file index</a> ".                                                                                                                |
| <b>service port</b>       | The port used by a server or storage node to listen for backup and recovery requests from clients through a firewall.                                                                                                                                                                          |
| <b>shared disk</b>        | The storage disk that is connected between multiple nodes in the cluster.                                                                                                                                                                                                                      |
| <b>shell prompt</b>       | A cue for input in a shell window where you enter a command.                                                                                                                                                                                                                                   |
| <b>silos</b>              | A repository for holding hundreds or thousands of volumes. Silo volumes are identified by barcodes, not by slot numbers.                                                                                                                                                                       |
| <b>skip</b>               | A backup level in which designated files are not backed up. <i>See also</i> " <a href="#">level</a> ".                                                                                                                                                                                         |
| <b>SMIT</b>               | System Management Interface Utility, which is a utility for managing and maintaining the AIX operating system configuration. The SMIT utility can be run in either a graphical or ASCII text mode. For disaster recoveries, SMIT is typically run in ASCII text mode.                          |
| <b>SMS</b>                | System management software, which is a Microsoft-based software installation system that allows the wide-scale, automatic installation of software products on clients from a single remote server.                                                                                            |
| <b>SNMP</b>               | Simple Network Management Protocol, which is a protocol that defines the communication between a manager (sometimes called a monitor or management station) and an object (the item being managed). NetWorker software uses SNMP to send messages to the administrator about NetWorker events. |
| <b>ssid</b>               | <i>See</i> " <a href="#">save set ID</a> ".                                                                                                                                                                                                                                                    |
| <b>staging</b>            | The process of moving data from one storage medium to another, less costly medium, and later removing the data from its original location.                                                                                                                                                     |
| <b>stand-alone</b>        | In a cluster environment, if the <i>NetWorker.clustersvr</i> file is missing at the binary location, the NetWorker server will start in noncluster mode, also called stand-alone mode. The stand-alone mode is sometimes referred to as the server backing up itself.                          |
| <b>stand-alone device</b> | A " <a href="#">storage device</a> " that contains a single drive for backing up data.                                                                                                                                                                                                         |
| <b>storage device</b>     | The hardware that reads and writes data during backup, recovery, or other NetWorker operations.                                                                                                                                                                                                |

**storage node** A storage device physically attached to another computer whose backup operations are administered from the controlling NetWorker server.

**System Reference Manual (SRM) console** The HP TruCluster utility used to manage cluster nodes.

## U

**unit address** The hexadecimal value that uniquely defines a physical I/O device on a channel path in an MVS environment. See also *device address*

**user groups** In the NetWorker software, refers to configuration resources that are used to assign users to access control groups and to configure the privileges associated with those groups.

## V

**versions** The date-stamped collection of available backups for any single file.

**virtual cluster client** A NetWorker client that is not permanently bound to a physical machine, but is instead managed by a cluster manager. It can be bound to more than one physical machine in the cluster and can own its own data disks. It is also referred to as a logical cluster client or a virtual client.

**virtual server** The term used by Microsoft to denote a cluster server. Also known as an agent (Sun), a logical server (HP TruCluster), and a package (HP-UX).

**volume** A unit of storage media, such as a magnetic tape, an optical disk, or a file. A storage device reads from and writes to volumes, which can be physical units (for example, a labeled tape cartridge) or logical units (for example, optical media can store multiple volumes on a single physical platter).

**volume ID** The internal identification assigned to a backup volume by NetWorker software.

**volume name** The name you assign to a backup volume when it is labeled.

**volume pool** See [“pool”](#).

**volume** A general term referring to a storage device. In the Symmetrix subsystem, a volume corresponds to single disk device.

## W

**write hit** There is room in cache for the data presented by the write operation.

**write miss** There is no room in cache for the data presented by the write operation.



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