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NetWorker® for IRIX™ Administrator's Guide
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About this Guide

The *NetWorker® for IRIX™ Administrator's Guide* documents the Silicon Graphics® implementation of Legato NetWorker from Legato Systems, Inc. NetWorker for IRIX is adapted from the Legato 4.0.2 release of NetWorker. This guide was prepared in conjunction with the Release 4.0.2 of NetWorker for IRIX and IRIX Release 5.2.

The *NetWorker for IRIX Administrator's Guide* contains information on how to install, configure, and manage NetWorker backup and recover software. This manual provides enough information for the basic use and administration of NetWorker installed in a typical networked environment.

Audience

This manual is intended for system administrators who are responsible for installing software and maintaining the servers and clients on a network. It may also be used by operators who monitor the daily backups of the systems on a network and maintain the backup media and devices.

The *NetWorker for IRIX Administrator's Guide* contains information on how to install NetWorker backup and recover software on Silicon Graphics servers and clients. If you have a heterogenous network and are backing up client systems of a platform different from the NetWorker server, you need to purchase a Legato ClientPak from Silicon Graphics, which includes documentation for other platforms.

Contents of this Guide

The *NetWorker for IRIX Administrator's Guide* contains information on day-to-day NetWorker tasks such as managing the backup volumes and monitoring the backups, and the less frequent system administration tasks involved in configuring the backup environment using NetWorker.

Chapter 1, "Introduction to NetWorker," provides a brief introduction to NetWorker features and terminology.

Chapter 2, "Installing NetWorker," explains the procedures for installing NetWorker software on NetWorker servers and clients and activating software licensing on NetWorker servers (client software is unlicensed).

Chapter 3, "NetWorker Test Drive," is a tutorial designed to familiarize you with NetWorker features and tasks.

Chapter 4, "NetWorker Configuration and Policy Issues," explains backup levels, backup schedules, browse policies, and retention policies.

Chapter 5, "Configuring a NetWorker Server," explains server configuration tasks such as adding backup devices, creating backup schedules for automatic backups, adding clients, and creating and using volume pools.

Chapter 6, "NetWorker Daily Operations," describes day-to-day administration tasks. These tasks include checking the server status, labeling and mounting backup volumes, monitoring indexes, and checking NetWorker notices.

Chapter 7, "Managing Indexes and Volumes Manually," explains index and volume management tasks that are performed when needed.

Chapter 8, "Using NetWorker with Jukeboxes," explains how to configure and administer jukeboxes.

Chapter 9, "NetWorker Performance," provides system, peripherals, and network performance information to help you choose a NetWorker server configuration, and explains how to measure server and client performance.

Appendix A, "Troubleshooting," explains troubleshooting procedures and discusses error messages and their causes.

Appendix B, “Recovering from a Disk Crash,” explains how to save important information about your system so that it will be available to you in the event of a disk crash, and how to recover after a disk crash.

Appendix C, “Theory of Operations,” provides reference information about how NetWorker works.

Appendix D, “Command Summary,” describes the command line interface to NetWorker: commonly used commands, commands available on clients, and commands available on servers.

Conventions

There are some conventions used in this manual to make information easy to access and understand. The conventions are:

- Command names are described in *italic* typeface. For example:

  To invoke NetWorker, enter the *networker* command at the prompt in a shell window.

- Examples, shell prompts, and information displayed on the screen are presented in fixed-width typeface. For example:

  ```
  NetWorker successfully installed on ‘mars’.
  ```

- Examples of what you type are displayed in bold fixed-width typeface. For example:

  ```
  mars% /usr/etc/networker &
  ```

- Names of buttons are displayed in *italics*. For example:

  Press the *Cancel* button.

- Important pieces of information and cautionary notes that prevent you from making a mistake are marked with the word “Note.” For example:

  Note: If you do not highlight any save sets in the Save sets scrolling list, then NetWorker removes all the oldest cycles of all the save sets displayed in the scrolling list for the client highlighted in the Clients scrolling list. ♦

- Tips or suggestions that you do not necessarily have to follow, but may give you hints as to how to set up NetWorker at your site are marked with the word “Tip.” For example:

  Tip: You may want to store a copy of the weekly or monthly full backup off-site. ♦

- Entries that you type and are substituted by a variable are displayed as italic. For example:

  `atlas% man` *name*

Other Documentation

To learn how to use the NetWorker Backup and Recover windows for manual backups, see the *NetWorker for IRIX User’s Guide*.

To get information about a specific release of NetWorker for IRIX, see the *NetWorker for IRIX Release Notes*.

If you would like more technical information about the NetWorker commands, see the online reference pages after you have installed NetWorker.

Both the *NetWorker for IRIX Administrator’s Guide* and *NetWorker for IRIX User’s Guide* are available online, as InSight manuals. To view the manuals, use *insight*(1) and install the subsystems *networker4.books.NetWorker_AG* and *networker4.books.NetWorker_UG*.

Product Support

Silicon Graphics offers a comprehensive product support and maintenance program for IRIS products. For information about using support services for this product, refer to the *Release Notes* that accompany it.

Chapter 1

Introduction to NetWorker

Everyone knows about the importance of backing up computer systems to protect from the loss of valuable data. In a networked environment, where the number of files grows as systems are added to the network, the need to protect against loss of data becomes crucial.

NetWorker for IRIX is a software product that reliably protects files against loss across an entire network of systems. NetWorker saves valuable administrator time by speeding and simplifying daily backup operations. An easy-to-use graphical user interface guides you through administering and configuring your network for scheduled backups. And NetWorker creates a database of your backups, making it easy to recover files. As the network and volume of files expands, NetWorker has the capacity and performance to handle the load.

Whether you need to recover an entire filesystem or a single file, NetWorker tracks the location of the files on the backup volumes and requests the ones you need by name. You do not have to think about which backups are on which backup volumes. All you need to do is mount the requested backup volume in a NetWorker server device to recover the desired files. Loading and mounting volumes is automatic if you are using a jukebox.

NetWorker Basics

A set of files backed up by a NetWorker client is called a *save set*. *Backup volumes* are the media to which NetWorker backs up data and are recognized and managed by NetWorker. *Volume pools* are used by NetWorker to sort specific data to pre-selected backup volumes.

The backup volume names and client save sets are maintained in two indexes on the server: the *file index* and the *media index*. NetWorker uses these two indexes to track file backups to specific backup volumes. The *media manager* works with the two indexes to track where the backups are located on the backup volumes, making it easy to recover lost files.

When backing up files, NetWorker may request that you mount a writable backup volume in the server device. When recovering files, NetWorker requests a specific backup volume by its name. All you need to do is mount the requested backup volume or volumes in the device(s) attached to the server. If you have a jukebox and a NetWorker Support for Jukebox option, NetWorker automatically loads the requested volume if it is stored in the jukebox.

The NetWorker Client/Server Model

A client / server architecture is the key to the ability to support network-wide, heterogeneous backup and recover. NetWorker *servers* provide a backup and recover service: they receive files from NetWorker *clients*, store the files on backup volumes, and retrieve the files on demand.

A NetWorker server is a system equipped with one or more backup devices. The server responsibilities are to

- write files from many client systems to media
- maintain an index of information about all the files backed up and where they are stored
- allow the clients to browse the file index
- fill requests from clients to back up or recover files
- initiate automatic network-wide backups according to a specific schedule
- give notices about NetWorker events

The NetWorker clients are all the other systems on the network that use the backup and recover service provided by the server. Clients may be desktop workstations, PCs with small disk drives, or large systems with gigabytes of data.

The clients on the network have software installed that

- gives the client access to the server for backing up and recovering files
- allows the client to browse the online index on the server to select files for recovery

A single NetWorker server can provide the backup and recover services to many client systems.

Backing Up Clients

NetWorker backs up the systems on a network-wide basis. Network-wide backups are more efficient and easier to maintain than local backup because of these NetWorker features:

- NetWorker has pre-configured backup schedule suitable for most small-to-medium sized networks. You can easily edit this schedule using the NetWorker X™ Window System interface. You may create multi-level backups spanning any time period: weekly, monthly, bi-monthly, or quarterly.
- A sophisticated media manager prompts you for all of its media requirements. When a volume is needed for backup or file recovery, NetWorker sends a message via its window-based status monitor or electronic mail.
- NetWorker enables you to back up to pre-mounted multiple devices or to a jukebox for unattended backups.
- The filesystems or individual files being backed up can span multiple backup volumes, or numerous filesystems and files can be saved to the same backup volume.
- The online backup feature allows you to perform backups while server and client systems remain in operation.

- The backups from many clients take place in parallel. This feature keeps a steady stream of data supplied to the backup device or devices so they can operate at full speed. The parallel backup option also ensures that no single client can monopolize the server and prevent other clients from accessing the server. With NetWorker for IRIX and the Concurrent Device Support for NetWorker option or with NetWorker Advanced for IRIX, NetWorker can back up to several backup devices at once, thus optimizing server performance.
- You can separate the media containing your full backups from media containing non-full backups.
- You can sort data during backup to pre-selected volume pools.

Recovering Lost Files

The NetWorker online index and media manager work together to expedite the recovery of lost files. The basic procedure for recovering files is as follows:

- Users browse the online index of previous file backups to identify the lost files and mark the files they want to recover, using the graphical user interface.
- The NetWorker media manager determines which backup volumes are needed to recover the files and requests only the ones it needs for the recovery.
- Once the volume is loaded in the server device, the files are recovered to the client.
- The NetWorker Support for Jukebox options automate the tape loading operation for fast recoveries.

Backup Devices and Media

NetWorker supports the following backup devices sold by Silicon Graphics and their corresponding backup media:

- Silicon Graphics 2 GB 4 mm (DAT) tape drives
- Silicon Graphics 2.3 GB 8 mm tape drives
- Silicon Graphics 5.0 GB 8 mm tape drives
- Silicon Graphics 50 GB 8 mm tape jukeboxes
- Silicon Graphics 10 GB Digital Linear Tape drives
- Silicon Graphics 70 GB Digital Linear Tape mini-libraries

The following unsupported backup devices may also work:

- EXABYTE™ 8200 (8 mm)
- EXABYTE 8500 (8 mm)
- EXABYTE EXB-10i stacker (8 mm)
- EXABYTE EXB-10e stacker (8 mm)

For a complete list of the backup devices currently supported by NetWorker for IRIX, see the *NetWorker for IRIX Release Notes*.

Chapter 2

Installing NetWorker

This chapter describes the procedure for installing and licensing NetWorker for IRIX on NetWorker servers and clients. The NetWorker software distribution CD contains all the software you need for Silicon Graphics servers and clients including the NetWorker Support for Jukebox options, the Concurrent Device Support for NetWorker option, and support for additional clients.

NetWorker server software is license-protected with NetLS™ node-locked licenses, so the NetWorker software distribution is shipped with a temporary license that enables you to use all NetWorker features to back up a maximum of 10 clients for a short period until you obtain permanent licenses from Silicon Graphics.

The remainder of this chapter explains how to install NetWorker software on Silicon Graphics servers and clients, and how to install and activate the licenses that enable the server software. The basic steps are:

- Use *inst*(1M) to install NetWorker software on servers. This procedure is described in the section “Installing Server Software.”
- Enable NetWorker server software by following the directions in the section “Enabling Server Software.”
- Configure clients to recognize its NetWorker server by following the directions in the section “Configuring Clients to Recognize the Server.”
- Use *inst*(1M) to install NetWorker software on clients. This procedure is described in the section “Installing NetWorker Software on Clients.”
- Follow the directions included with the NetWorker package to obtain permanent licenses from Silicon Graphics, if you did not install permanent licenses earlier.
- Install permanent licenses to replace temporary licenses on the appropriate servers by again using the procedure in the section “Enabling Server Software.”

A Silicon Graphics NetWorker server can back up other vendors' systems as well as Silicon Graphics clients. NetWorker software for those clients and installation information for those clients is included in Legato NetWorker ClientPak products, which are available from Silicon Graphics.

Note: Legato NetWorker ClientPak products may include client software for Silicon Graphics systems running IRIX 4.0.*x*. On systems running IRIX 4.0.*x*, you should install client software from the NetWorker for IRIX CD instead. ♦

Installing and Enabling NetWorker Software on Servers

To install and enable NetWorker software on servers, you must perform these three tasks:

- Install NetWorker software on servers, as described in the section "Installing Server Software."
- Install and activate licenses and perform other tasks to enable the NetWorker products, as described in the section "Enabling Server Software."
- Configure network information service (NIS) master hosts or other systems so that clients can recognize the NetWorker servers, as described in the section "Configuring Clients to Recognize the Server."

Installing Server Software

To install NetWorker on a server, you need:

- IRIX Release 5.2 or later running on the server.
- A filesystem on the server with enough free disk space to store the NetWorker indexes. For each client (including the server itself), the size of the indexes on the server is approximately 2% of the disk space in use on the client.

Follow this procedure to install Networker server software:

1. On the server, become root and give the *inst*(1M) command:

   ```
   % /bin/su -
   Password:
   # inst
   ```

2. Specify the location of the NetWorker software distribution and get a list of the subsystems, for example:

   ```
   Inst> from /CDROM/dist
   Inst> list
   ```

   For additional information on *inst*, see the *IRIS Software Installation Guide*.

3. Make subsystem selections in *inst*. Use Table 2-1 to guide you in selecting subsystems. Subsystems not listed in Table 2-1 should not be installed on servers. For example, to install the required software, the reference pages, the release notes, and the InSight versions of the NetWorker manuals give these commands:

   ```
   Inst> keep *
   Inst> install networker4.*.server networker4.*.client_5
   Inst> install networker4.man.relnotes
   ```

   For additional information on these subsystems, see the *NetWorker for IRIX Release Notes*.

Table 2-1 Subsystems for NetWorker Servers

Subsystem	Description	Required/Optional
networker4.sw.server	NetWorker server software	Required
networker4.sw.client_5	NetWorker client software	Required
networker4.man.server	Reference pages for NetWorker server software	Optional
networker4.man.client_5	Reference pages for NetWorker client software	Optional
networker4.books.NetWorker_UG	InSight version of the *NetWorker for IRIX User's Guide*, viewable with *insight*(1)	Optional
networker4.books.NetWorker_AG	InSight version of this guide	Optional

4. Perform the installation and exit *inst*:

   ```
   Inst> go
   Inst> quit
   ```

5. Choose a filesystem for the NetWorker index files. As a rule of thumb, the amount of disk space used by the index files is about 2% of the amount of disk space used by the backed up files. You can use part of filesystem, or dedicate a filesystem. Dedicated filesystems are typically called */nsr*.

6. If you've chosen a filesystem other than a dedicated filesystem named */nsr*, give this command to tell NetWorker where to put the index files:

   mars# **ln -s** *directory* **/nsr**

   directory is the name of a directory in the filesystem you've chosen for the index files, for example */bigfs/nsr*.

7. Start NetWorker daemons with this command:

   ```
   mars# /etc/init.d/networker start
   ```

   Because the licenses haven't been enabled yet with the *nsrcap* command (see the next section, "Enabling Server Software"), these messages, which can be ignored, appear in */var/adm/SYSLOG* and in mail sent to *root*:

   ```
   NetWorker Registration: (notice) server disabled; No
   valid Base or Advanced licenses found,
   nsrd: either install new licenses or recover a valid
   resource file. (15017)
   NetWorker registration: (info) Server is disabled
   (Install base enabler).
   ```

   If this is the first time that NetWorker has been installed on this system, you may also see this message, which you can also ignore:

   ```
   Verification could not mount '/nsr/mm/mmvolume'
   ```

After you install software on the server, you must enable it by following the instructions in the next section, and you must ensure that clients can recognize the hostname alias *nsrhost* by following the instructions in the following section, "Configuring Clients to Recognize the Server."

Enabling Server Software

When you purchase any of the NetWorker products, you must enable them on servers by installing NetLS licenses and activating the licenses with the *nsrcap*(1M) command.

All NetWorker products are included on the NetWorker software distribution CD. Table 2-2 lists the NetWorker products, their features, and licensing information.

Table 2-2 Licensed NetWorker Products

Product	Description	Licensing Information
NetWorker for IRIX	Supports 10 clients and one or two tape drives. May be used with the Concurrent Device Support for NetWorker option to enable simultaneous use of both tape drives.	NetWorker for IRIX or NetWorker Advanced for IRIX license is required on each NetWorker server.
NetWorker Advanced for IRIX	Supports 10 clients and up to 10 concurrently active tape drives.	NetWorker for IRIX or NetWorker Advanced for IRIX license is required on each NetWorker server.
Concurrent Device Support for NetWorker	Used with NetWorker for IRIX to make both tape drives active simultaneously.	
NetWorker Support for 10 Additional Clients	Supports 10 additional clients.	Clients licenses are additive up to a maximum of 210 clients per server.
NetWorker Support for 50 Additional Clients	Supports 50 additional clients.	Clients licenses are additive up to a maximum of 210 clients per server.
NetWorker Support for Jukebox w / <= 16 Slots	Enables the use of a jukebox of up to 16 slots. Cannot be used with NetWorker for IRIX.	One Jukebox license is required for each connected jukebox.
NetWorker Support for Jukebox w / <= 64 Slots	Enables the use of a jukebox of up to 64 slots. Cannot be used with NetWorker for IRIX.	One Jukebox license is required for each connected jukebox.
NetWorker Support for Jukebox w / > 16 Slots	Enables the use of a jukebox of up to 8192 slots. Cannot be used with NetWorker for IRIX.	One Jukebox license is required for each connected jukebox.

The software distribution CD is usually shipped with a temporary NetWorker Advanced for IRIX NetLS license and a temporary NetLS license for NetWorker Support for Jukebox w/ <= 16 Slots. This allows you to use these products on any Silicon Graphics system for a short period.

To continue to use NetWorker products after the temporary license expires, you must obtain a permanent, node-locked license for each NetWorker product you purchase. If you do not already have the appropriate licenses for your NetWorker product(s), see *Network License System Administration Guide* and the *NetWorker for IRIX Release Notes* for information on obtaining licenses. Additional information on installing NetLS licenses is available in the *Network License System Administration Guide.*

The next two sections describe how to enable NetWorker server software by installing and activating NetLS licenses. The section “Enabling Server Software Except Jukeboxes” explains how to enable all server software except NetWorker Support for Jukebox options. The section “Enabling Jukeboxes” explains how to enable NetWorker for IRIX Jukebox options.

Enabling Server Software Except Jukeboxes

Follow the steps below to enable all NetWorker server software except jukebox support. This procedure can be used when the software is initially installed and when upgrades are added, for example when a license for Networker Support for 50 Additional Clients is added to the system.

1. Find the NetWorker NetLS license information stickers or sheets in your package.
2. Become *root* on the NetWorker server.

   ```
   mars% /bin/su -
   Password:
   ```

3. If it is not already installed, use *inst* to install the subsystem *netls_eoe.sw.netls_eoe* from the IRIX CD that you used when installing the system software on the server.

4. To begin entering license information, bring up the *ls_nodelock*(1M) window with this command:

   ```
   mars# /usr/etc/ls_nodelock
   ```

5. Using the information from one license information sheet, fill in the Product Name, Version, Expiration Date, and License Password fields.

6. Press the *Add* button.

7. Repeat steps 5 and 6 for each license information sheet.

8. When you are finished adding NetLS licenses, press the *Quit* button.

9. Activate the licenses by running the *nsrcap* command as *root*:

   ```
   mars# /usr/etc/nsrcap -v
   Found a NetLS license for installation:
          name:         NetWorker Advanced/10
          enabler code: 2b2d6b-a3b02d-6a9c80
          license type: B10
          expires:      990 days (Nov 18, 1996)
   ```

   The output of *nsrcap* lists each license you installed. These licenses are now activated.

   Note: If you have the Registration window open at the time you activate NetWorker licenses with *nsrcap*, close it to refresh the window. ♦

Enabling Jukeboxes

The procedure for enabling a NetWorker Support for Jukebox option software differs from the procedure for enabling other NetWorker software. Use the procedure in this section to enable each Jukebox option you purchase. You can use this procedure to enable jukeboxes when you install NetWorker initially and to enable jukeboxes that you add later as upgrades.

Follow this procedure for each jukebox:

1. Create the tape devices inside the jukebox. You can use the Devices window of the *networker*(1M) command as described in the section “Adding and Deleting Backup Devices” in Chapter 5, or you can use the *nsradmin*(1M) command.

To use the *nsradmin* command, give the command and use its interactive commands to create each device, for example:

```
mars# /usr/etc/nsradmin
NetWorker administration program.
Use the "help" command for help, "visual" for full-screen
mode.
nsradmin> create type: NSR device; name:
/dev/rmt/tps1d6nrnsv; media type: 8mm
                        type: NSR device;
                        name: /dev/rmt/tps1d1nrnsv;
                  media type: 8mm;
Create? yes
created resource id
0.54.54.205.45.119.204.141.192.48.174.2(1)
nsradmin> create ...
...
nsradmin> <Ctrl-d>
```

Note: The create command may be shown wrapped in the example above. However, the command must be entered on a single line. ♦

In the first create command, substitute the pathname of one of your devices and the media type of your jukebox. The pathname is usually the “nrnsv” (no rewind, non-byte-swapped, variable block size) variant of the device. (See the *tps*(7M) reference page for more information on pathnames and specific devices.) The media type must be one of these, spelled exactly this way: 8mm, 8mm 5GB, DLT, 4mm, 3480, optical, qic, or himt.

For the second and remaining devices in the jukebox, give the create command again with the pathname for the device and media type.

2. Run the *jbm_enabler*(1M) command as *root* to tell NetWorker about the jukebox surrounding the tape device. For example:

```
mars# /usr/etc/jbm_enabler
Enter the letter corresponding to the type of jukebox
you are installing:
        a) DLT2700
        b) ADIC-1200c
        c) ATL
        d) EXB-10i
        e) EXB-10e
        f) EXB-60
        g) EXB-120
        h) HP-C1553A
        i) Lago Datawheel
        j) other
Choice? d
Installing a EXB-10i jukebox.
Name you would like to assign to the jukebox device? 10i
Pathname of the control port for the jukebox
device? [/dev/scsi/sc1d5l0] /dev/scsi/sc1d2l0
Enter pathname of media drive 1
(eg: /dev/rmt/tps1d6nrnsv): ? /dev/rmt/tps1d1nrnsv
Enter the slots you wish to use for backup? [1-10] 1-10

Jukebox has been added successfully
```

   Several supported jukeboxes don't appear in the list above. If you have a Silicon Graphics 50 GB 8 mm tape jukebox, choose item "e," EXB-10i. If you have a Silicon Graphics 70 GB Digital Linear Tape mini-library, choose item "a," DLT2700.

   The numbers that you enter for the slots represent a range of slots, not the total number of slots available. Usually, for a jukebox, you do not enter a single slot number. Entering a single slot number means that only a single slot would be used for backup and recovery with NetWorker.

3. To begin entering license information, bring up the *ls_nodelock*(1M) window with this command:

```
mars# /usr/etc/ls_nodelock
```

4. Using the information from the license information sheet, fill in the Product Name, Version, Expiration Date, and License Password fields.

5. Press the *Add* button.
6. Press the *Quit* button to exit *ls_nodelock*.
7. Activate the license by running the *nsrcap* command as *root*:

```
mars# /usr/etc/nsrcap -v
Found a NetLS license for installation:
        name:         JSM-10
        enabler code: 2b2d6b-a3b02d-6a9c80
        license type: J10
        expires:      990 days (Nov 18, 1996)
```

Note: If you have the Registration window open when you enable a NetWorker license with *nsrcap*, close it to refresh the window. ♦

Configuring Clients to Recognize the Server

The clients on the network can be configured so that when they use the networker command, it automatically points to their server. (If clients aren't configured this way, users must use the "Change Server" command on the File pull-down menu of *networker* to specify their server.) Configuring the clients by defining a hostname alias called *nsrhost* that can be resolved by each client to be the name of their NetWorker server.

Configuring clients to recognize the NetWorker server can be done in these ways:

- If your network uses the network information service NIS, use the section "Using NIS to Configure Clients."
- If your network uses the Domain Network Service (DNS), refer to the documentation on the BIND Name Server in the *IRIS Advanced Site and Server Administration Guide*.
- If your network does not use NIS and does not use DNS, use the section "Configuring Clients Without NIS or DNS."

For more information about how clients bind to NetWorker servers, see the *nsr*(1M) reference page.

Using NIS to Configure Clients

If you have NIS on the network, follow these steps to configure clients to recognize the NetWorker server:

1. Identify the NIS master for each client by using the *ypwhich*(1) command on each client:

   ```
   jupiter% ypwhich -m hosts
   venus
   ```

   In this example, venus is the master NIS host for the client jupiter.

2. As *root* on each of the master NIS hosts, edit the */etc/hosts* file, adding *nsrhost* as an alias next to the name of the NetWorker server. For example:

   ```
   137.69.1.3 mars nsrhost
   ```

   Note: Only one host in */etc/hosts* should have the *nsrhost* alias. If several NetWorker servers back up files on clients served by a single NIS master host, some users may have to specify their server using the "Change Server" command on the File pull-down menu of *networker*.

3. On each of the master NIS hosts, change directory to */usr/etc/yp* and use the *ypmake*(1) command:

   ```
   jupiter# cd /usr/etc/yp
   jupiter# /usr/etc/yp/ypmake
   ```

4. To verify that each client can recognize the NetWorker server, give this command on each client after waiting a suitable period for NIS databases to propagate:

   ```
   jupiter# ypmatch nsrhost hosts
   137.69.1.3 mars nsrhost
   ```

   The hostname listed in the output should be the name of the NetWorker server.

Configuring Clients Without NIS or DNS

This section describes the procedure for configuring a client to recognize the NetWorker server when NIS and DNS (BIND) are not used on the network. This procedure can also be used if NIS and / or DNS are in use on the network.

1. Log on to the client as *root*:

   ```
   jupiter#
   ```

2. Edit the file */etc/hosts*, adding *nsrhost* as an alias next to the NetWorker server name:

   ```
   137.69.1.3 mars nsrhost
   ```

   In this example, the client named jupiter will be backed up by the NetWorker server named mars.

   Note: If you have purchased NetWorker for more than one server, only one host should have the *nsrhost* alias in each client's */etc/hosts* file. ♦

3. If NIS and / or DNS are in use on the network, verify that *nsrhost* is correctly aliased:

   ```
   jupiter% /usr/etc/ping -c1 nsrhost
   PING mars.engr.xyz.com (192.48.155.20): 56 data bytes
   ...
   ```

   In the command, the **-c** is followed by a one. The first line of output should contain the name of the NetWorker server. If the output doesn't contain the name of the NetWorker server, modify the client's */usr/etc/resolv.conf* file so that the local */etc/hosts* file is checked before NIS or BIND. See the *resolver*(4) reference page for more information.

Installing NetWorker Software on Clients

Follow the procedure in this section to install Networker client software. Because licenses for NetWorker clients are not installed on the clients, no enabling of the client software is required.

1. On the client, become root and give the *inst*(1M) command:

   ```
   % /bin/su -
   Password:
   # inst
   ```

2. Specify the location of the NetWorker software distribution and get a list of the subsystems, for example:

   ```
   Inst> from /CDROM/dist
   Inst> list
   ```

   For additional information on *inst*, see the *IRIS Software Installation Guide*.

3. Make subsystem selections in *inst*. Use Table 2-3 to guide you in selecting subsystems. Subsystems not listed in Table 2-3 should not be installed on clients. For example, to install the required software, references pages, release notes, and the InSight versions of the NetWorker manuals on an IRIX 5.2 client, give these commands:

   ```
   Inst> keep *
   Inst> install networker4.*.client_5
   Inst> install networker4.man.relnotes
   Inst> install networker4.books.*
   ```

   For additional information on these subsystems, see the *NetWorker for IRIX Release Notes*.

Table 2-3 Subsystems for NetWorker Clients

Subsystem	Description	Required/Optional
networker4.sw.client_4	NetWorker client software	Required (install on systems running IRIX 4.0.*x* only)
networker4.sw.client_5	NetWorker client software	Required (install on systems running IRIX 5.*x* only)
networker4.man.client_4	Reference pages for NetWorker client software	Optional (install on systems running IRIX 4.0.*x* only)
networker4.man.client_5	Reference pages for NetWorker client software	Optional (install on systems running IRIX 5.*x* only)
networker4.books.NetWorker_UG	The InSight version of the *NetWorker for IRIX User's Guide*, viewable with *insight*(1)	Optional on systems running IRIX 5.*x*; cannot be installed on systems running IRIX 4.0.*x*
networker4.books.NetWorker_AG	The InSight version of this guide	Optional on systems running IRIX 5.*x*; cannot be installed on systems running IRIX 4.0.*x*

4. Perform the installation and exit *inst*:

```
Inst> go
Inst> quit
```

5. Check to see if the hostname alias *nsrhost* has been set to your NetWorker server:

```
jupiter% /usr/etc/ping -c1 nsrhost
PING mars.engr.xyz.com (192.48.155.20): 56 data bytes
...
```

In the command, the **-c** is followed by a one. The first line of output should contain the name of the NetWorker server.

If the output doesn't contain the name of the NetWorker server, the *networker* command won't automatically connect you to your server; you'll have to use the "Change Server" command on the File pull-down menu to specify your server.

To set the hostname alias *nsrhost* to your NetWorker server, follow the directions in the section "Configuring Clients to Recognize the Server" in this chapter or ask your system administrator to help you.

Removing NetWorker

If you need to remove the NetWorker software and data files on a server for any reason, follow these steps:

1. Shut down the NetWorker server using the *nsr_shutdown*(1M) command:

   ```
   mars# /usr/etc/nsr_shutdown
   ```

2. Use the *versions*(1M) command to remove any or all of the NetWorker software. For example to remove all of the software, give this command:

   ```
   mars# versions remove networker4
   ```

3. Remove the data files by giving these commands:

   ```
   mars# cd /nsr
   mars# rm -rf .
   mars# cd /
   mars# rm /nsr
   ```

You can remove NetWorker software on a client with the *versions* or *inst* commands.

NetWorker Test Drive

This chapter leads you through the process of “test driving” the NetWorker software. This chapter introduces you to the benefits of key NetWorker features.

In this test drive you will

- start NetWorker and learn about its main window and menus.
- learn about tabular views of NetWorker windows.
- label and mount a backup volume.
- perform an unscheduled backup and recover.
- view the Schedules window for information about scheduling backups.
- view the Clients window for information about your NetWorker clients.
- enable the backup in the Groups window.
- perform a scheduled backup immediately by pressing the *Start* button in the Group Control window.
- verify the backup in the Group Control window.
- be introduced to the NetWorker Support for Jukebox and Concurrent Device Support for NetWorker options.

Starting NetWorker

The NetWorker graphical user interface makes learning and using NetWorker straightforward. The intuitive windows, pull-down menus, and dialog boxes guide you through the backup and recover process. To use the NetWorker window interface you must have the X Window System running on your system.

To start NetWorker, enter the *networker*(1M) command at the prompt in a shell window:

```
# /usr/etc/networker &
```

The main window appears, as shown in Figure 3-1. If you have trouble starting NetWorker, the daemons may not be running properly. See Appendix A, “Troubleshooting,” for information on checking and starting the NetWorker daemons.

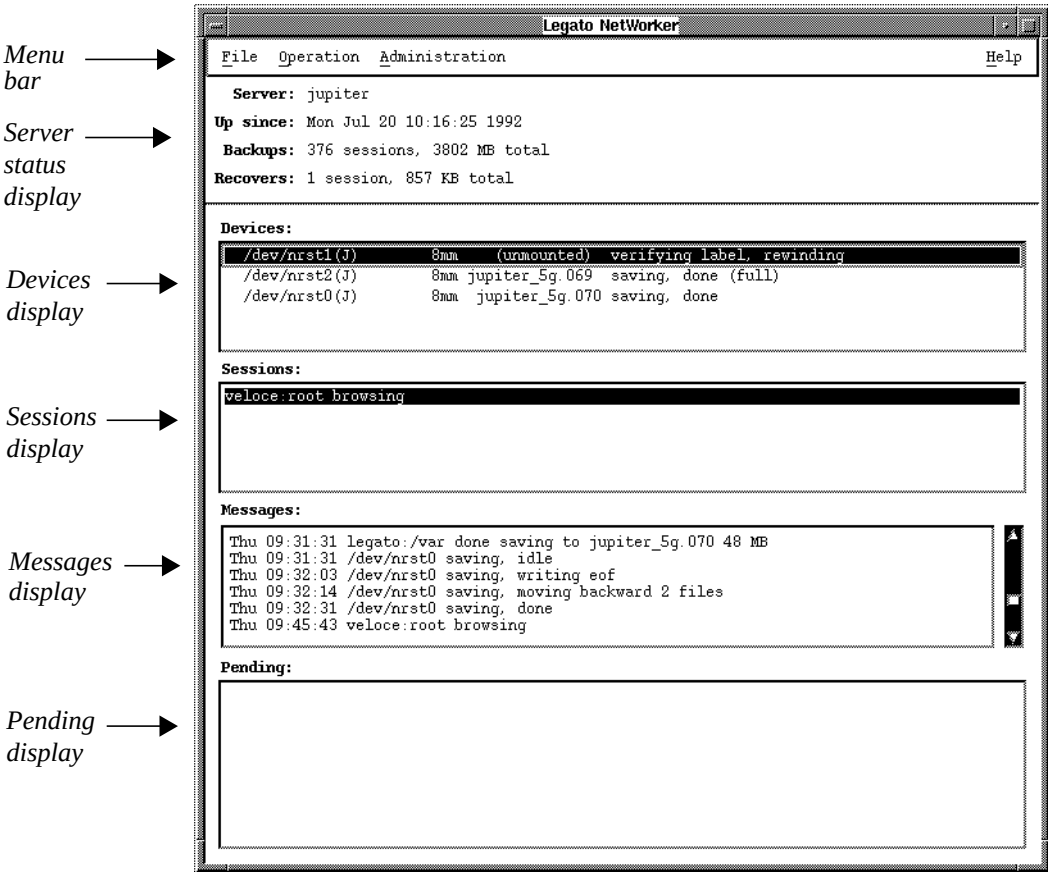

Figure 3-1 NetWorker Main Window

The NetWorker Main Window

The NetWorker main window is a dual purpose window: it serves as both a starting point for all NetWorker tasks and as a monitor for server activity.

The main window contains the pull-down menus for all operation and administration tasks. The operation and administration tasks described in this manual are easily accessible through the X Window System graphical user interface.

The main window has a menu bar and five displays (see Figure 3-1):

Menu bar
: Contains the File, Operation, Administration, and Help pull-down menus. These are explained in the section "Using NetWorker Menus" in this chapter.

Server status display
: Tells how long the current server has been online, the number of backups and recovers the server has completed since it has been online, and the amount of data contained in the backups and recovers. The upper right corner of this display shows the version of NetWorker running on the server.

Devices display
: Shows the devices known to the server and which backup volume, if any, is mounted on the device.

Sessions display
: Provides current information on which clients are backing up, browsing, or recovering files.

Messages display
: Provides a history of the NetWorker server activity.

Pending display
: Shows messages that may require operator attention.

Using NetWorker Menus

This section includes information about the pull-down menus in the main NetWorker window and how to use them.

The File Pull-Down Menu

The File pull-down menu, shown in Figure 3-2, has selections for changing the current NetWorker server or polling interval, and for exiting NetWorker.

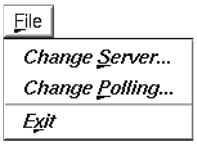

Figure 3-2 File Pull-Down Menu

Changing the NetWorker Server

Select “Change Server” to choose another NetWorker server to monitor or configure. Most networks need only one NetWorker server to back up all the systems on the network. If you have more than one NetWorker server, however, choose the one you want to monitor or configure by selecting its hostname in the Change Server window, shown in Figure 3-3.

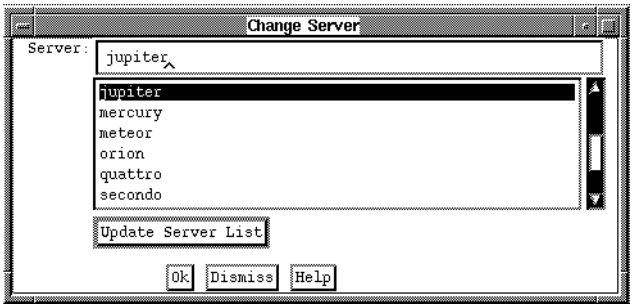

Figure 3-3 Change Server Window

To change NetWorker servers:

1. Select “Change Server” from the File menu in the main window. The Change Server window appears.
2. Press the *Update Server List* button to display all of the NetWorker servers on your network. NetWorker broadcasts to find NetWorker servers, however the broadcast may not reach all servers on your network, so the list may be incomplete.

3. Highlight the hostname of the desired server in the Server scrolling list, or enter a valid hostname in the Server field.
4. Press *Ok* to monitor and configure the new server in all the NetWorker windows.

   Note: All operation and administration tasks apply to the server selected in the main window. ♦

Changing the Polling Interval

"Change Polling" allows you to change the polling interval. Polling controls how often, in seconds, the data in the main window is updated. When the system is heavily loaded, you might want the main window updated less frequently.

To change the polling interval:

1. Select "Change Polling" from the File menu in the main window.
2. Use the mouse to slide the bar to the right or left to select the desired polling interval.
3. Press *Ok* to apply the change.

Exiting NetWorker

To exit NetWorker, select "Exit" from the File menu. Or, press both the **<Alt>** key and the **F** key at the same time, release them, and then press the **X** key. If the Backup or Recover windows are open, they must closed, too, by selecting "Exit" from their File menus.

The Operation Pull-Down Menu

The Operation pull-down menu lists the commands for operating NetWorker daily. It contains the volume mounting and labeling commands (described in the section "Labeling and Mounting Backup Volumes" in Chapter 5), the manual backup and recover commands (described in the *NetWorker for IRIX User's Guide*), and the commands for managing the indexes and volumes (described in Chapter 7, "Managing Indexes and Volumes Manually"). The Operation pull-down menu is shown in Figure 3-4.

Figure 3-4 Operation Pull-Down Menu

All of the commands on the Operation pull-down menu have a speed key sequence that is represented by a line underneath a letter in each command. To use keyboard shortcuts for the commands in the Operation pull-down menu, hold down the **<Alt>** key and the **O** key at the same time, release them, then press the key that corresponds to the underlined letter in the command name.

The Administration Pull-Down Menu

The Administration pull-down menu, shown in Figure 3-5, contains the commands for administering and configuring the NetWorker server and clients (explained in Chapter 5, “Configuring a NetWorker Server”). The “Jukeboxes” command is explained in Chapter 8, “Using NetWorker with Jukeboxes.”

Figure 3-5 Administration Pull-Down Menu

The Help Pull-Down Menu

The Help pull-down menu is shown in Figure 3-6.

Figure 3-6 Help Pull-Down Menu

All NetWorker windows contain a Help pull-down menu or *Help* button. The Help pull-down menu offers you online help about the window as well as a menu for selecting other types of help.

The Help pull-down menu has four commands:

“On Window”	Displays a help screen with information about the currently selected window.
“Topics”	Lists help topics.
“On Help”	Gives you information on how to use the Help facility.
“On Version”	Displays the NetWorker software release version for the server.

Using Tabular Views of Administration Windows

NetWorker has the ability to display information in a tabular view for all of the administrative commands in the Administration pull-down menu (except “Schedules”). This feature is useful in administering NetWorker because it enables you to view information or data in a more compact format. The tabular view is especially helpful for large sites that have a lot of information to display.

For example, in the Clients window there are two ways to view client information:

- configuration information for one client at a time
- configuration information for all of the clients at the same time, in the tabular view

To display the tabular view for the Client window, follow these steps:

1. Select the “Clients” command from the Administration pull-down menu. The Clients window appears as shown in Figure 3-7.

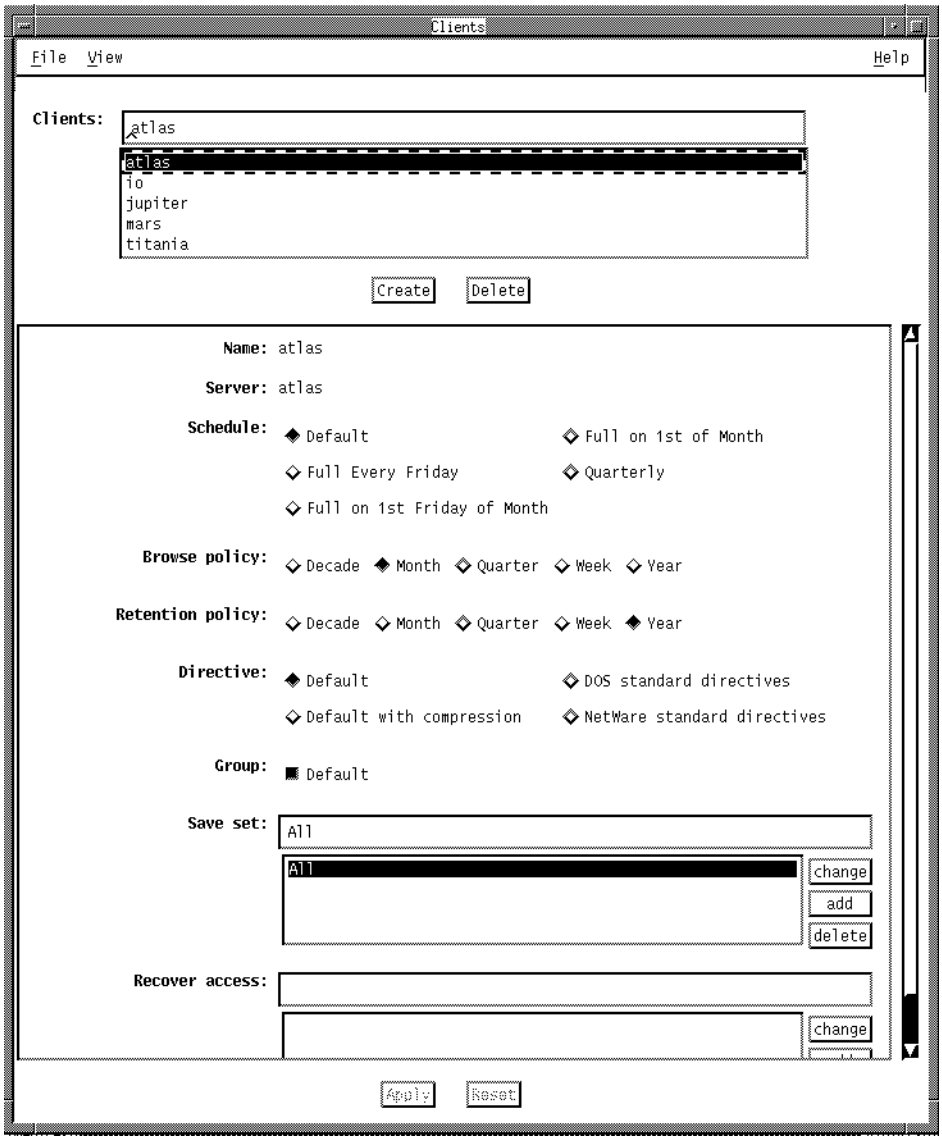

Figure 3-7 Clients Window

2. Select the “Tabular” command from the View pull-down menu, shown in Figure 3-7. The Clients window changes to a tabular view, as shown in Figure 3-8.

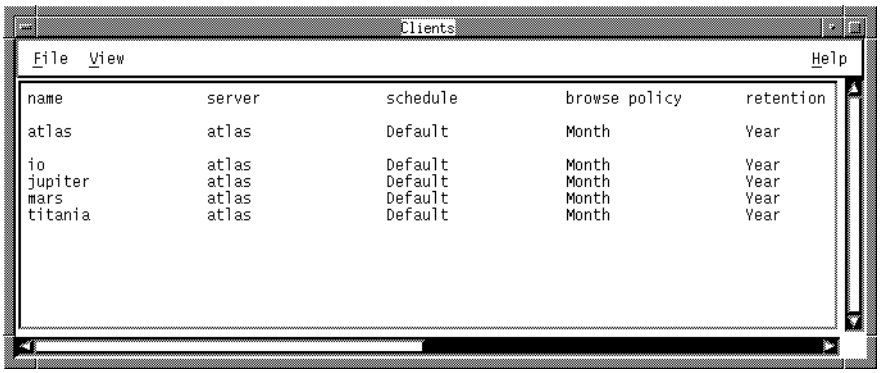

Figure 3-8 Tabular View of the Clients Window

3. Use the scroll bars in the Clients tabular view window to see all of the client configuration information.
4. To return to the normal Clients window, select the “Normal” command from the View pull-down menu.

Labeling and Mounting the Backup Volumes

NetWorker requires that all volumes have a label before they are used to back up files. NetWorker uses these labels to track and identify the contents of the backup volumes. When you start a recover, NetWorker automatically determines the volume(s) that are needed and asks for them by the label name. This powerful feature of NetWorker means that you can quickly locate the backup volumes required to recover files.

The mounting operation is automatic when using NetWorker with a jukebox.

Label and mount backup volumes through the Operation pull-down menu (shown in Figure 3-4). Follow these steps to label and mount a backup volume:

1. Find a blank piece of media that you can use for a backup.
2. Load it into the NetWorker server backup device.
3. Select “Label and Mount” from the Operation pull-down menu. NetWorker checks to see if you are over-writing an existing label, then displays the Label and Mount window, shown in Figure 3-9, where you enter the name of the volume:

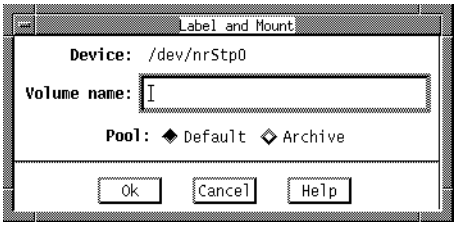

Figure 3-9 Label and Mount Window

4. Enter a name, such as “demo,” into the Volume name field.
5. Press the *Ok* button. The backup volume *demo* is automatically mounted in the backup device when you apply the label. The Devices display of the NetWorker main window indicates the name of the mounted volume.

   Now that the volume is labeled and mounted, you are ready to back up some files.

See the section “Labeling and Mounting Backup Volumes” in Chapter 5 for more information on NetWorker labeling and mounting features.

Trying a Backup and Recover

Typical day-to-day operation of NetWorker includes scheduled, unattended backups. NetWorker also supports unscheduled backups of selected files which are initiated by a user from a client system. Recovers can also be initiated by a user.

Tip: You should now read the section "Quick Tour" in Chapter 2 of the *NetWorker for IRIX User's Guide* to become familiar with unscheduled backups and recovers. ♦

After completing the "Quick Tour" in the *User's Guide*, you should be familiar with the NetWorker recover features. Thanks to the online index, users can browse their backed-up files and quickly identify files to be recovered. No longer does a system administrator have to worry about locating an important file when the user cannot remember the filename. NetWorker also automatically identifies the volumes where the files are stored. Adding a jukebox to your backups automates the recover process—recovering a file is effortless!

NetWorker offers many features to help you recover files in addition to those introduced in the "Quick Tour." An important feature is the ability to see the many different versions of a file that have been backed up over time with the "Versions" command. Another powerful feature is the ability to view the filesystem as it existed at any time in the past with the "Change browse time" command.

Viewing the Backup Schedule

Most of your backup activity occurs unattended through NetWorker‘s scheduling features. This section describes the Schedules window.

Open the Schedules window by selecting “Schedules” from the Administration pull-down menu. The Schedules window is shown in Figure 3-10.

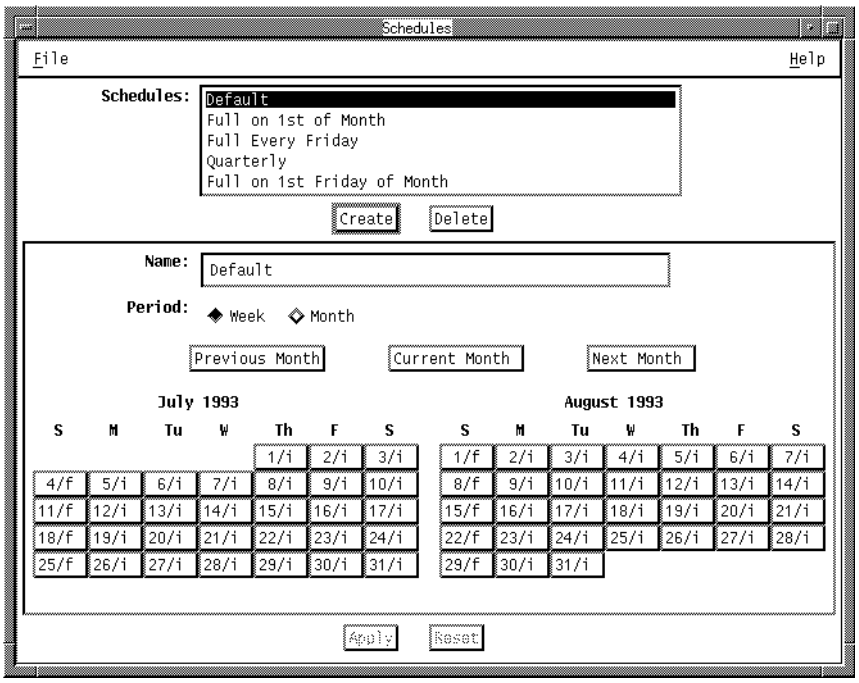

Figure 3-10 Schedules Window

The Schedules window provides an on-screen calendar that you use to set up a backup schedule. Or you can simply select from one of the NetWorker pre-configured schedules. These schedules are based on feedback we have obtained from NetWorker customers about the most popular ways to perform network-wide backups.

Notice each calendar day displays an “f” or an “i” next to the day. The “f” represents a full backup, and the “i” represents an incremental backup.

Your backup server is also treated as a NetWorker client. Your server is automatically backed up using the Default schedule, which has pre-configured selections. It completes a full backup every Sunday, followed by incremental backups on the other days of the week.

Note: Regardless of the selections in the pre-configured schedules, NetWorker always performs a full backup the first time it backs up your files. ♦

For more information about schedules, see the section "Setting Up the Backup Schedules" in Chapter 5.

Viewing the Clients Window

After installing NetWorker on your server, the server is backed up as a client of itself using the pre-configured selections in the Clients window, shown in Figure 3-7.

In the Clients window you see the name of your backup server in the Clients field and the pre-configured selections represented by the highlighted buttons. All of the configurations you select for your NetWorker client are created in the Clients window.

If you are backing up other client systems to your server, all you have to do (after installing NetWorker on the clients) is configure your clients using the Clients window. NetWorker can then back up your clients using the selected configurations.

You do not need to make any changes in this window for now. You may wish to make changes after you have created more groups and clients and are setting up different backup schedules.

The client configuration features are discussed in detail in the section "Configuring a Server's Clients" in Chapter 5.

Enabling the Scheduled Backup

Now that you have viewed the Schedule and Clients windows, enable the Default group to which your backup server belongs by choosing Enabled in the Groups window.

By enabling the group Default, you are telling NetWorker to back up all the clients in that group according to their pre-configured selections. Because your NetWorker server is pre-configured to belong to the group Default and the Default backup schedule, it is backed up based on those selections.

Open the Groups window, shown in Figure 3-11, by selecting “Groups” from the Administration pull-down menu. Notice that the Start time is 3:33 a.m. Also notice that the Autostart feature is Disabled as the pre-selected choice.

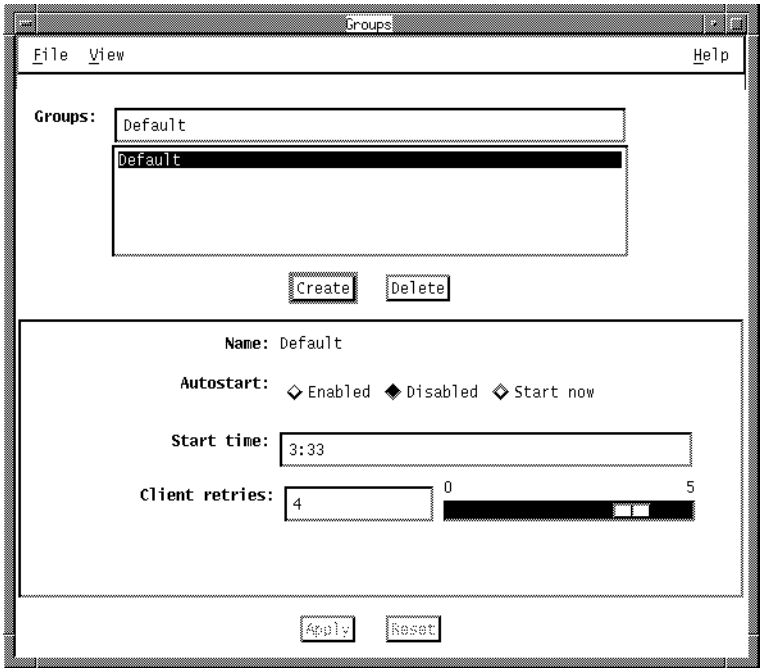

Figure 3-11 Groups Window

To enable the Default group, follow these steps:

1. Select the Enabled button in the Autostart choices.
2. Press the *Apply* button to apply the change.
3. Select “Exit” from the File menu to close the Groups window.

The Start time field is where you determine what time you want NetWorker to back up a group of clients. To change the time, simply enter the new start time.

Your NetWorker server is automatically included in the group Default. By enabling the Default group, your server and any other clients you add to the Default group in the future are backed up at 3:33 a.m. every morning, starting tomorrow.

The Groups window is described in detail in the section “Configuring Backup Groups” in Chapter 5.

Starting a Backup Now

You have looked at several different windows which have shown you that your NetWorker server is backed up according to pre-configured selections. However, you should start a backup now to see how NetWorker backs up a client.

You can start a scheduled backup immediately by pressing the *Start* button in the Group Control window or by pressing the *Start now* button in the Groups window. A backup begins right away for the group selected in the Groups scrolling list—the Default group, in this example. By starting a backup now, you are essentially overriding the pre-defined backup time for the Default group (3:33 a.m.). However, the Default group still backs up at 3:33 a.m. as scheduled.

To start a scheduled backup immediately from the Group Control window, follow these steps:

1. Select the “Group Control” command from the Operation pull-down menu (shown in Figure 3-4). The Group Control window appears, as shown in Figure 3-12.

Figure 3-12 Group Control Window

2. Select the Default group in the Group scrolling list.
3. Press the *Start* button. NetWorker begins a backup of the clients in the Default group according to the Default backup schedule, and displays `running` in the Status column of the Group Control window.

   After pressing the *Start* button, keep the Group Control window open so you can monitor the progress of your backup.
4. If you want more detailed information about the files being backed up, press the *Details* button. The Group Control Details window, shown in Figure 3-13, appears. After NetWorker has successfully backed up your files, the `Finished` message appears in the Status field.

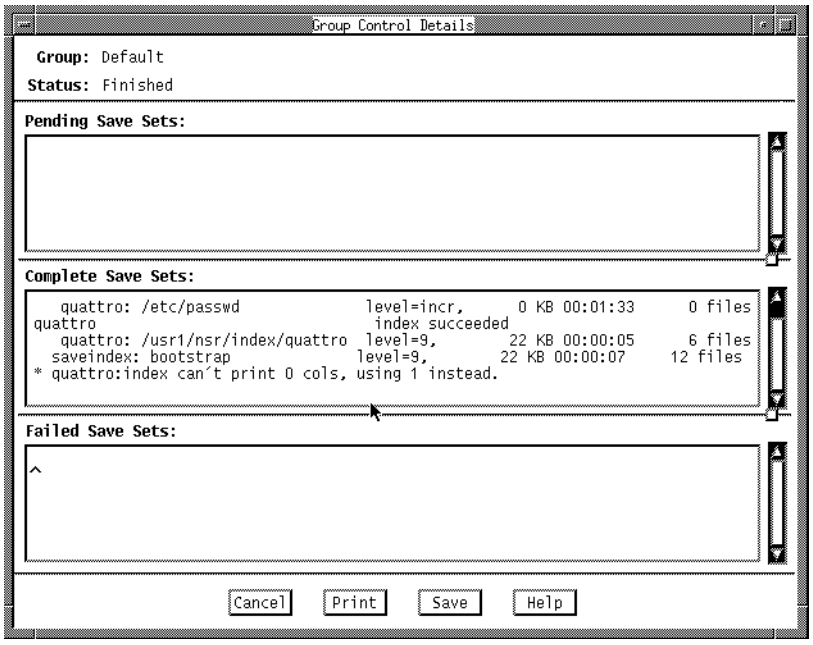

Figure 3-13 Group Control Details Window

If you want more information about the Group Control window, see the section “Monitoring a Scheduled Backup” in Chapter 6. For more information about the Group Control Details window, see the section “Displaying the Backup Details” in Chapter 6.

Using a Jukebox

If you use a jukebox as your backup device, most of your media handling operations are automatic. Mounting volumes is automatic, and media requests are also filled automatically.

You need to purchase a NetWorker Support for Jukebox option in order to use your jukebox with NetWorker.

See Chapter 8, “Using NetWorker with Jukeboxes,” for instructions on configuring and operating jukeboxes.

Using Concurrent Devices

A powerful feature that enhances server efficiency during backups is concurrent devices support. Concurrent devices support is used when you have more than one device attached to the NetWorker server and want to use all of the devices for backups simultaneously. Concurrent devices support spreads the backups evenly across the devices.

See the section “Using Concurrent Devices” in Chapter 5 for instructions on how to configure your server to operate devices concurrently.

Displaying NetWorker Licenses

To display installed, enabled NetWorker licenses, open the Registration window by selecting the “Registration” choice on the Administration menu. The Registration window appears, similar to the one shown in Figure 3-14.

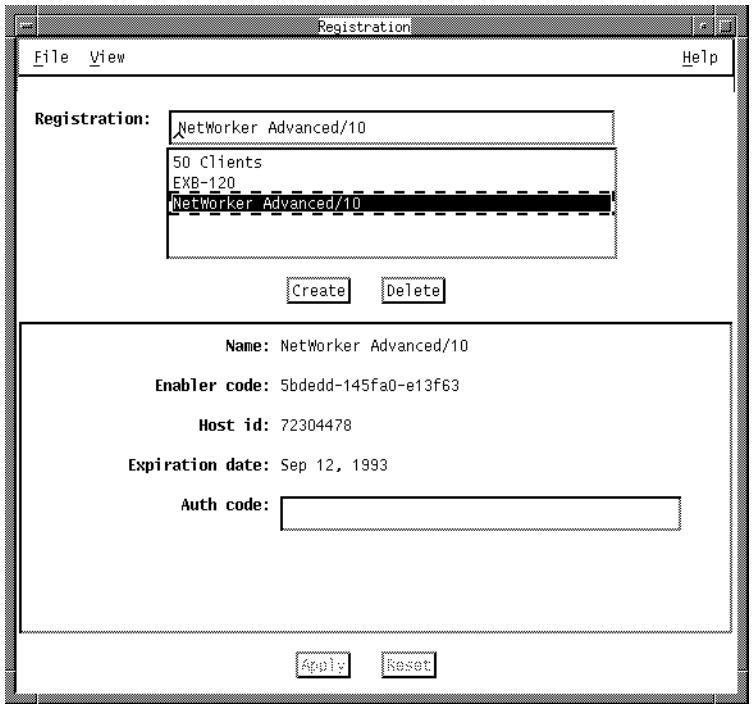

Figure 3-14 Registration Window

The Registration window shows each of the NetWorker licenses that have been installed on the server (using *ls_nodelock*(1M) or a text editor) and enabled (using *nsrcap*(1M)). For information on installing and enabling licenses, see the sections “Enabling Server Software” and “Enabling Jukeboxes” in Chapter 2. This version of NetWorker doesn’t use the Registration window to install and activate licenses.

The Next Step

Here are some suggestions for further configuration tasks you might want to try:

- Add additional clients to your Default backup group and enable the group for an overnight backup. In the morning, check the results of the scheduled backup in your mail.
- Create new groups to conform to your organizational structure and define schedules for each group. For example, create an Administration group with a Monday Full schedule; a Marketing group with a Tuesday Full schedule; an Engineering group with a Wednesday Full schedule; and a Sales group with a Thursday Full schedule.
- Run some recovery tests. After completing one or more backups, delete a file from your system. Using the Recover window and the “Versions” command, recover the correct version of the file.
- Simulate a hard disk crash and then recover your files using the disaster recovery procedures described in Appendix B, “Recovering from a Disk Crash.”

You have now taken a quick “test drive” of NetWorker for IRIX. You have seen that NetWorker is a powerful tool for protecting files across entire networks. More importantly, NetWorker is able to recover your files in a quickly and efficiently in the event of loss.

You have also seen that NetWorker is easy to administer and configure using the X Window system graphical user interface. The user interface allows you to monitor and configure NetWorker from any node on the network.

NetWorker Configuration and Policy Issues

This chapter provides examples and suggestions for you to consider while you are thinking about setting up your NetWorker environment. It also offers background information to help you understand the logic behind the NetWorker backup schedule and index policy features.

Pre-Configured Settings

NetWorker is shipped with easy-to-use pre-configured settings. Pre-configured settings are existing choices NetWorker has established for backing up the clients on your network. You are free to use these pre-configured selections, change them, or create your own configurations. By using these pre-configured settings, you can start backing up your data as soon as you install NetWorker.

After installation on a server, NetWorker backs up the NetWorker server as a client of itself using these pre-configured settings. If you are backing up other client systems to your server, all you have to do (after installing NetWorker on the clients) is add the clients by using the Clients window. (Open the Clients window by selecting the “Clients” command from the Administration pull-down menu.) NetWorker may then back up your clients using the pre-configured settings.

Your NetWorker server and newly created clients have these pre-configured settings, unless you select otherwise:

Schedule	The client uses the Default schedule of a full backup every Sunday and an incremental backup on the other days of the week. The Default schedule is described in detail in the section "Pre-Configured Schedules" in Chapter 4.
Browse policy	The browse policy for entries in the client's online file index is one month. This means that entries for the client's files remain in the file index and can be browsed and recovered in the Recover window for one month before being automatically removed. For information about the browse policy, see "NetWorker Browse and Retention Policies" in Chapter 4.
Retention policy	The retention policy for the client's media index is one year. This means that information concerning the names of the backup volumes containing save sets generated by clients is retained for one year. Files can be recovered for up to one year, providing the backup volumes are not overwritten with new backups.
Directive	The client uses the Default directive which skips *core* and *.o* files and backs up only the relevant information in the NFS®-based swap files. It also backs up your mail files without ever making any changes to them.
Group	The client is in the Default backup group which has a start time of 3:33 a.m. To enable the scheduled backup to take place at 3:33 a.m. every day, change the Autostart feature to Enabled in the Groups window.
Save set	The pre-configured selection is All. All of the local client filesystems are backed up.
Recover access	This field is blank, meaning that only the client itself can recover its backed-up files.

Note: The NetWorker server is listed in the Clients scrolling list prior to creating any clients because the server is automatically created as a client of itself when NetWorker is installed. To back up the NetWorker server as a client of itself using the pre-configured settings, all you have to do is enable the Autostart feature of the Default group in the Groups window. ♦

NetWorker Backup Schedules

The NetWorker server backs up each client system across your network according to a backup schedule. Schedules are created in the Schedules window and assigned to individual clients in the Clients window. Schedules can be very simple or very sophisticated, depending on the needs of your environment. All clients can share the same schedule, or each client can have its own unique schedule. This section discusses some of the considerations you should keep in mind while determining which schedule best fits your situation and explains the default schedules provided with NetWorker.

When creating backup schedules, you need to consider these questions:

- How long do you want to keep the backed-up data?
- How many versions of the data do you want to maintain?
- How much data do you have to back up?
- How many backup volumes do you want to use?
- How much time do you have to complete the network-wide backups?
- Do you want to be able to use just a few backup volumes to recover from an entire disk crash?

The typical capacity of an 8 mm tape cartridge is about 5 GB, and the maximum transfer rate is around 400 KB per second. Systems generally cannot sustain that transfer rate, but if they could, it would take more than 6 hours, for example, to back up 10 GB of data. To back up a network with a lot of data, you may use more than one schedule to stagger the full backups over several days.

Think about how many backup volumes you want to keep—this number depends on how often the data changes, and how long you want to keep the online backups.

If you run only incremental backups every night, you need more backup volumes to fully recover from a disk crash. If a site has 10 GB of data, and 5% of all the data is modified each day, that means 500 MB of data need to be backed up every day. At 400 KB per second, 500 MB takes about 25 minutes to back up, and fill up about one tenth of an 8 mm cartridge tape. If you are maintaining the backups for three months, you will have about 12 tapes of backups to keep on your shelves.

You also need to decide on a policy for recovering files. For example, if the users expect to be able to recover any version of a lost file for at least three months, you have to maintain all the backup volumes for the three-month period. On the other hand, if the users only expect to be able to recover the latest version of a lost file, you can use level 1–9 backups to decrease the quantity of backup volumes you need to maintain.

The following sections explains NetWorker backup levels, backup schedule issues, and the NetWorker pre-configured backup schedules.

Backup Levels

A backup schedule specifies what level of backup NetWorker performs for a client on each day of a weekly or monthly period. NetWorker supports four kinds of backup levels:

full	Every file is backed up, no matter when it last changed.
level 1–9	Files are backed up that have changed relative to the most recent lower backup level. Each backup level is represented by a number, 1 through 9, where 1 represents the fullest backup, and 9 represents the most minimal backup.
incremental	Files are backed up that have changed since the last backup, regardless of the level.
skip	No files are backed up; skip the backup. You may want to skip a backup on a holiday if you know that no one will be around to change backup volumes on the server.

If you do not need to maintain every version of a backed-up file online, you may use a backup scheme that includes occasional full backups followed by level 1–9 and incremental backups during the cycle. Different backup levels allow you to trade off the number of backup volumes and amount of time required to complete a backup versus the number of backup volumes and amount of time it takes to recover from a disk crash.

The diagram in Figure 4-1 illustrates how backup levels work.

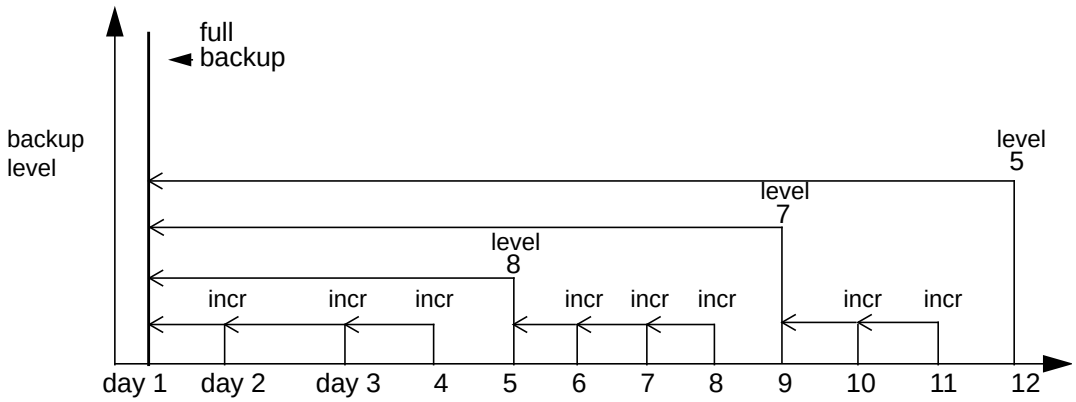

Figure 4-1 Backup Levels

Assume you use a new backup volume for each day's backup. On day 1, a full backup is run. On day 2, the incremental backs up everything that has changed since the full backup. On day 3, the incremental backs up everything that has changed since day 2. On day 4, the incremental backs up everything that has changed since day 3. At this point, you have 4 backup volumes. To recover from a disk crash, you need all four of them: the one with the full backup (day 1), and all the volumes with incremental backups.

On day 5, the level 8 backs up everything that has changed since the full backup. You no longer need the data on the backup volumes from day 2, 3, or 4. To do a full recovery, all you need is the full backup volume and the level 8 backup volume. If you had to recover from a complete loss of a disk, you have reduced the number of backup volumes you need to only two.

On day 9, the level 7 backs up everything that has changed since the full backup. You still need only two backup volumes to recover a disk: the full backup, and the level 7.

Level 1–9 backups help you maintain control of your pool of backup volumes. Planning your backup strategy carefully should allow you to recover everything on a disk with a maximum of four backup volumes.

Full Backups Versus Incremental Backups

If your site has a small number of files, you may choose to perform a full backup every day, or perhaps once a week. This is a simple schedule to set up and execute, and it makes recovering from a disk crash easy—you simply need the last full backup volume.

The issues you should consider are listed below:

- Full backups take more time to execute than do incremental backups.
- If the full backup does not fit on a single piece of media, someone has to monitor the backup and change the media (unless you have a jukebox).
- Full backups cause the online indexes to grow more rapidly than do incremental or level backups.

You may decide to schedule a full backup at the beginning of the period and then schedule incremental backups the rest of the period. This schedule minimizes the amount of time that the backups take, minimizes the size of the backups, and causes the NetWorker indexes to grow at a slower rate. However, if you need to recover from a disk crash, you may need all the tapes used during the schedule, because the most current version of your files may be scattered across several different tapes. Although NetWorker asks for each tape that it needs for the recovery by name, loading and unloading them can be time-consuming (unless you have a jukebox, or all the incremental backups fit on one tape).

Using Level Backups

You can use level 1 through level 9 backups to moderate between the two extremes described above. Level 1 through level 9 backups allow you to set up a schedule for each client that balances your need for small, fast backups that do not take up too much index space and your need to recover quickly and easily from a disk crash.

A level backup serves as a checkpoint in your schedule since it collects into a single backup session all the files that have changed over many days or even weeks. Without a level backup, these files would be spread across tapes from many different backup sessions. As a result, a level backup can simplify and speed file recovery.

To illustrate the effect of level 1 to level 9 backups, consider two examples. In the first example, a full backup takes place on the first day, followed by a level 9, level 8, level 7, and so on down to a level 1 backup over time.

A full backup followed by level 9 to level 1 is illustrated in Figure 4-2.

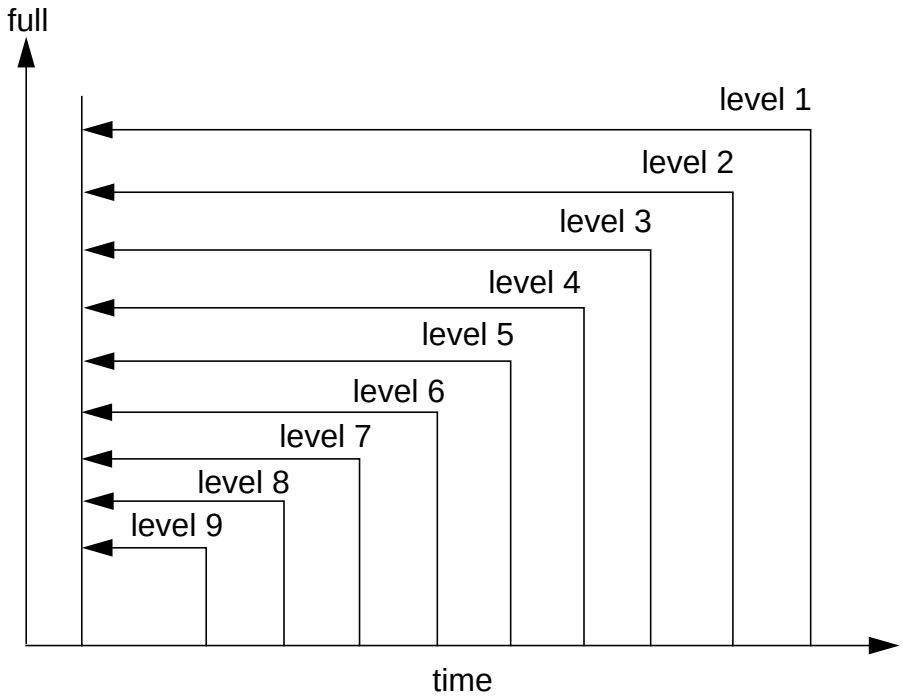

Figure 4-2 Full Back Followed by Level 9 to Level 1

The advantage of this schedule is that to recover from a disk crash, you only need two tapes: the one with the full backup, and the one with the last level backup. The disadvantage is that with each day, there are more changed files to back up, so the backups take longer to complete.

The figure below illustrates a backup schedule that also starts out with a full backup, but the level backups that follow are in reverse order: starting with a level 1 on the first day following the full backup, on down to a level 9 backup. Each day, the backup backs up only the files that have changed on that day.

A full backup followed by level 1 to level 9 is illustrated in Figure 4-3.

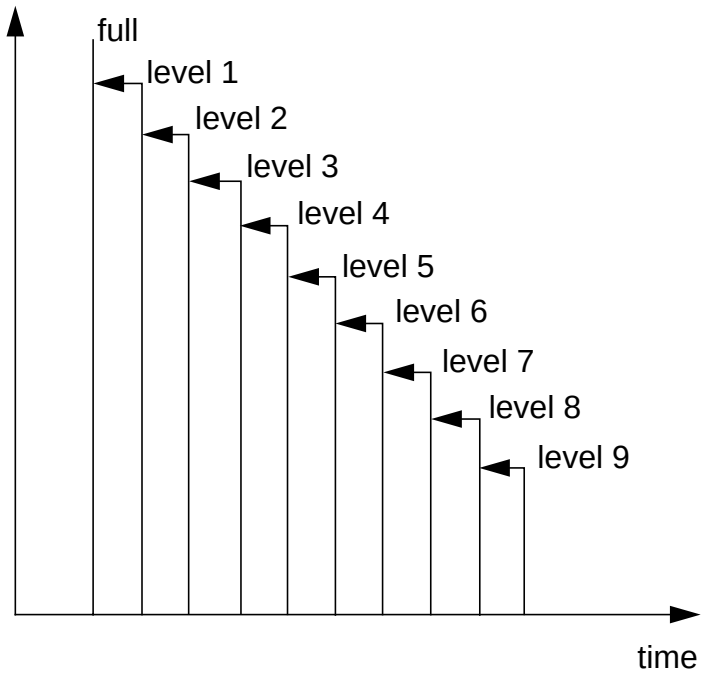

Figure 4-3 Full Back Followed by Level 1 to Level 9

The advantage of this schedule is that each day's backup is small and completes in a short period of time. The disadvantage is that recovering from a disk crash requires the full backup tape and all of the level backup tapes up until the day of the disk crash.

Neither of these backup schedules is practical. They simply illustrate how level backups work. The real power of level backups comes into play when you combine multiple levels along with fulls and incrementals.

Combining Full, Incremental, and Level Backups

Sites with even a few gigabytes of files to back up often choose a monthly schedule based on full, incremental, and level backups. The example described in this section performs a full backup on the first day of each month, a level 5 backup on the 10th and 20th of the month, and incremental backups on all other days.

This monthly backup schedule minimizes the size of daily backups while also making it relatively easy to recover in the event of a disk crash. This schedule offers several advantages. First, the level 5 backups simplify recovery. Assume that a disaster strikes on the 24th of the month. All the files that you need to recover an entire client system are located on tapes from just five backup sessions:

- The incrementals from the 21st, 22nd, and 23rd
- The level 5 backup from the 20th
- The full backup at the beginning of the month.

Second, the incremental backups are relatively small and quick to execute, even for large network environments, and several days of incrementals can fit onto a single tape. This further simplifies recovery and also avoids the need to have someone change tapes each day.

Illustrated in Figure 4-4 are level 5 and incremental backups after a full backup.

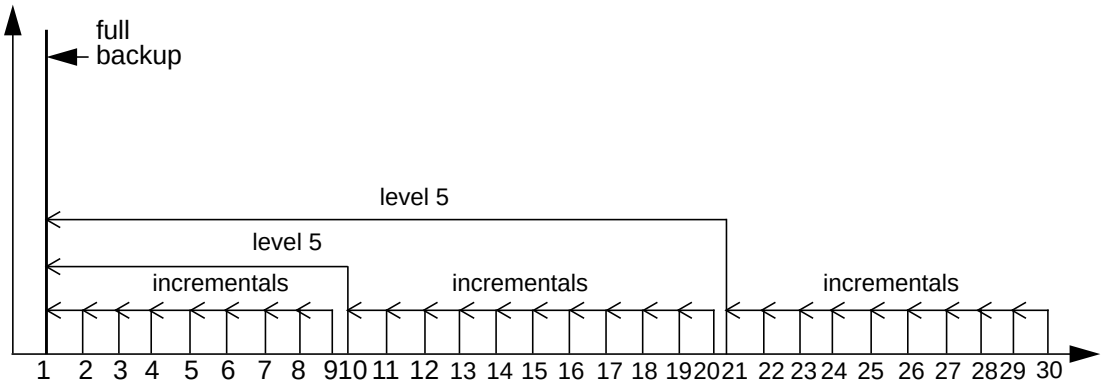

Figure 4-4 Full Backup Followed by Level 5 and Incremental Backups

Time to Complete Backups

The amount of time you have to complete a backup on any given day also influences the schedule that you decide to use. Thanks to flextime and around-the-world operations, many networks must be up and running for users from early in the morning until very late in the evening. And while NetWorker is able to back up live filesystems, most administrators want 100% of their network and systems capacity ready for users during work hours.

How many files can NetWorker back up in, for example, a four-hour backup window? If your backup server is able to drive a single 8 mm tape drive at an average of 400 KB/second (its maximum speed is 500 KB/second and some time is invariably lost loading the tape or rewinding), you can back up a maximum of 5.76 GB in four hours. If you have more than this amount of data to back up, then full backups must be limited to weekends and holidays when users are not affected.

A Silicon Graphics system with a 2 GB system disk and an 8 GB logical volume requires up to eight hours for a full backup on an EXABYTE 8500 tape drive.

To reduce the amount of time that backups take, follow these recommendations:

- Select a backup server with enough CPU power, memory, and bus bandwidth so that the backup server is not the bottleneck. See the section “Guidelines for Choosing a Configuration” in Chapter 9 for more information on choosing a hardware configuration.
- Leave the NetWorker parallelism feature turned on. This feature causes multiple client systems to send their files to the backup server in parallel. This keeps a stream of files ready for the tape drive, so that it does not start and stop.

- Experiment with compressing files on the client systems to reduce the size of the data that has to be written to tape. Using the *compressasm* directive can reduce the space consumed on a backup volume by as much as 50% (actual savings may vary). If you use *compressasm* on all the files that are being backed up, a full backup of 8 GB may fit onto a single backup volume. Compression may speed your backup as long as the client systems are still able to supply files to the backup server fast enough to keep the tape drive streaming.
- Take advantage of the ability to skip over specified files during the backup. For example, you could choose to skip over *core* files and *.o* files. The NetWorker *skip* directive provides an easy way to specify that such files be skipped. (See the section “Using Directives” in Chapter 5 for more information.)
- Make liberal use of incremental save levels. These are very efficient, since they take minimal backup media space and run very quickly.
- Add a second backup device to your backup server. For unattended backups, a NetWorker server with two backup devices is worth more than twice as much as a NetWorker server with only one backup device. Often the NetWorker server with two backup devices is more productive than two NetWorker servers with only one device each. With NetWorker Advanced for IRIX or with NetWorker for IRIX plus the Concurrent Device Support for NetWorker option, NetWorker can simultaneously back up to more than one device.
- Using a jukebox and NetWorker Support for Jukebox option software is the most efficient way to complete unattended backups.

Unless you have a jukebox and a NetWorker Support for Jukebox option, you also have to schedule backups based on someone being available to load and unload tapes. Many administrators find that an incremental backup of their network fits onto a single 4 mm or 8 mm tape, but they must schedule multi-tape full and level backups for specific nights or weekends when an operator is on duty to load additional tapes. If an operator is not available over a holiday weekend, then you can set an override in the schedule to skip the backup on that day. You may also want to override the schedule just before a holiday with a full backup for added peace of mind.

Staggering the Backup Schedules

Networks with a large number of files can take a very long time to back up completely, and require a lot of loading and unloading of tapes. There may not even be time in a night or an entire weekend to complete a full backup of all the systems across a very large network. An easy way to handle this problem is to stagger the clients' backup schedules. Rather than have every client system perform a full backup on Monday and incrementals the rest of the week, for example, you can schedule some clients to perform a full backup on Tuesday and others on Wednesday.

NetWorker goes one step further to smooth the backup load for very large client systems. With NetWorker you can assign a separate backup schedule to each filesystem. Each filesystem, in essence, is treated as if it is a completely separate client.

Convenience versus Security

You may leave the same backup volume mounted in the server's backup device throughout a week or month, and when it becomes full, replace it with a new labeled backup volume. NetWorker tracks all the backups, no matter what day of the week or month, or what part of the backup schedule cycle is in effect. The same backup volume may contain full, level 1–9, or incremental backups, and to NetWorker, it makes no difference. For you, the benefits are fewer backup volumes to manage and the ability to recover from a disk crash with a minimum number of backup volumes.

Some sites prefer to segregate the full backups from the level 1–9 and incremental ones. The full backups protect the network from a catastrophic disk loss, and you want to guarantee their integrity. There is always a very small risk that if you leave the backup volume with the full backup sitting in the backup device, something could happen to it.

If a backup volume with incremental backups is ruined, users may lose a day of work. In the worst possible case, if the backup volume with the full backup is destroyed, users may lose all the work done since the last full backup. Therefore, some administrators prefer to remove the backup volume used for a full backup and put it in a safe place, and mount another backup volume for the following level 1–9 and incremental backups. The trade-off is that you may need a few more backup volumes to recover from

a disk crash: the one with the last full, and the other volumes that contain the most recent level 1–9 and incremental
backups.

Pre-Configured Schedules

For your convenience, NetWorker is shipped with five pre-configured backup schedules. If these schedules fit your backup requirements, you can use them "out of the box." Or, you may delete them and create new ones to accommodate your site-specific needs.

This section explains the logic behind each schedule. After understanding how they work, you may want to use them as examples to set up your own schedules.

Note: You are not allowed to change the name of an existing schedule. For example, if you want to change the schedule "Full Every Friday" to "Full Every Monday," you must delete the "Full Every Friday" schedule and create a "Full Every Monday" schedule. You cannot change the existing schedule to complete full backups on Mondays instead of Fridays, and then edit its name. ♦

The most efficient way to best protect the systems from file loss and maintain control over the number of backup volumes is to follow full backups with level 1–9 and incremental backups.

Default

NetWorker provides a pre-configured backup schedule named "Default" which you are not allowed to delete. It is a weekly schedule, and completes a full backup every Sunday, followed by incremental backups all other days of the week. It is useful for a small-to-medium sized network where the scheduled backups fit onto one backup volume.

This schedule is convenient if you want to pre-mount the backup volume Friday night before you go home for the weekend. On Monday mornings, check your messages from NetWorker to make sure the backup completed. If you want to separate the full backups from the incrementals, remove the backup volume with the full backup and mount another one for the incremental backups.

The Default schedule is shown in Figure 3-10.

Each time you use the Schedules window to create a new weekly backup schedule, this pre-configured schedule appears in the calendar as your starting point.

Full Every Friday

This weekly schedule completes a full backup every Friday, followed by incremental backups the other days of the week.

This schedule is identical to the Default schedule, except that instead of completing a full backup on Sundays, the full backup takes place on Fridays. Depending upon how much data changes on the network, the daily incremental backups might all fit onto one backup volume. In that case, if you had to recover from a disk crash, you would need only two backup volumes: the one with the last full backup, and the one with the incremental backups.

Full on First Friday of Month

This monthly schedule completes a full backup on the first Friday of the month (not the first calendar day of the month). Incremental backups take place on all the other days.

The advantage of this schedule is that you complete a full backup only once a month. If you use this schedule, it would be a good idea to store the backup volume with the full backup in a safe place, and use other backup volumes for the incremental backups. It would also be a good idea to change backup volumes every few days for the incremental backups. If you allow all the incremental backups to be stored on one backup volume, and it is destroyed near the end of the month, you are at risk of not being able to fully recover from a disk crash.

Whenever you create a monthly schedule for a full backup on a weekday instead of a calendar day (like Friday, in this example), you must set the overrides in each month. (Notice the “f*” in the first Friday of each month.) This is because the first weekday (Monday through Friday) in a month may fall on any calendar day from 1 to 7.

Note: After the current year, you need to add the overrides for the next year. In other words, the overrides do not carry over from one year to the next. ♦

Full on First of Month

This monthly schedule completes a full backup on the first calendar day of the month. Many sites prefer to begin each month with a full backup on the first day of the month. On the other days of the month, an incremental backup takes place. This schedule has the same advantages and disadvantages as the "Full on 1st Friday of Month" schedule. This schedule is easier to create because you do not have to manually set any overrides.

Whenever you create a monthly schedule, this schedule is your starting point.

Quarterly

The quarterly schedule completes a full backup on the first day of the quarter. A level 5 backup takes place on the first day of the other months in the quarter. Every seven days, a level 7 backup takes place. The other days of the month, an incremental backup takes place.

This schedule is convenient because a full backup takes place only once a quarter. On the first day of the month, a level 5 backs up everything that has changed since the first day of the quarter. Every seven days, the level 7 backup protects all the data that has changed since the first day of the month. The daily changes are protected by incremental backups.

If you use this schedule, it is a good idea to segregate the backup volume with the full backup and store it in a safe place. The monthly level 5 backups should also be segregated onto their own backup volumes. The other days of the week, leave one backup volume in the server, so that the level 7 and incremental backups are stored on it. However, if a week's worth of backups is on one backup volume, and it is destroyed the same day the disk crashed, you could not recover the changes that took place that week. Therefore, it would be better to change backup volumes every day, putting each day's backup on its own volume. If a daily incremental backup is destroyed and you need to recover from a disk crash, you can recover all but one day's work.

When you create a quarterly schedule like this one, use the Month period to set the level backups, then set each quarterly full backup on the calendar with an override.

To recover from a disk crash, you would need the backup volume with the full backup, the latest level 5, the latest level 7, and the incremental backups for the week.

NetWorker Browse and Retention Policies

NetWorker maintains online indexes of all the files backed up for each client and an index of the files stored on each piece of media. NetWorker lets you set policies that automatically control how long the information is retained in these online indexes. This section explains NetWorker browse and retention policies and the trade-off between providing faster, easier recovery for your users versus conserving disk space.

Browse Policy

One popular NetWorker feature is the ability of a user to browse the many versions of a file that have been backed up over time and to choose which one to recover. However, each version of a file that NetWorker tracks takes up space in the client's online index (about 200 bytes each). Since disk space is limited, you need to establish a policy of how far back in time you keep information about backed up files in the indexes.

The browse policy that you select specifies how long the entries for your files remain in the file indexes. A browse policy can be any number of days, weeks, months, or years. NetWorker automatically deletes entries older than the browse policy time and frees up disk space. The browse policy you select, like the backup schedule, can be different for each client.

How Browse Policies Work

To recover a complete directory or file system you often need to recover some files from incremental and level backups as well as from a full. The incremental backup is dependent on the level backups and, in turn, on the full. NetWorker does not delete the entries from any backups on which other backups depend. As a result, you may find that entries are deleted later than you might expect.

In the illustration shown in Figure 4-5, the browse policy is set to one week, which happens to equal one complete backup cycle.

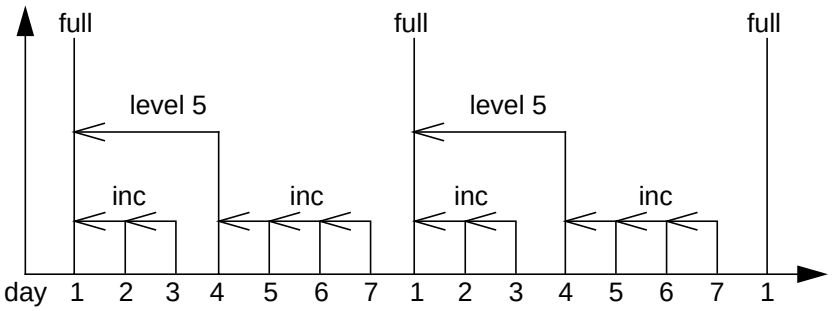

Figure 4-5 Backups for a Browse Policy of One Week

NetWorker does not remove the first full backup from the online file index until all the incremental and level 5 backups that depend on it have expired. As a result, the full backup actually stays in the online index for a period of time equal to the browse policy plus one full backup cycle.

The first full backup is not removed from the online index in exactly one week, however, because there are unexpired incrementals and a level 5 backup that depend on the full backup. Each incremental backup is removed from the online index one week after it was completed. The level 5 backup is removed one week after the last incremental that depends on it is removed, and then the full backup is removed at that same time.

The rule to remember is that a full backup actually remains in the online index for a period of time equal to the browse policy plus one complete backup cycle. A backup cycle is measured from one full backup to the next full backup. Also note that the browse policy is set for an entire client (or

filesystem, if the filesystems are separately scheduled). Consequently, whatever policy you have for keeping full backups online and browsable in the file index you must also use for all incremental and level backups. With NetWorker you manage backup cycles (the period from one full backup to the next); you do not independently manage different levels of backups.

Recovery is considerably easier if the file information is still in the NetWorker online index. That is why you want to set a browse policy that is long enough to cover most recovery requests.

Media Retention Policy

Your need to conserve disk space may lead you to establish a short browse period. The NetWorker media retention policy complements the browse policy by letting you specify a longer period of time during which files can still be recovered, although with more difficulty. The retention policy is also used by NetWorker to automatically recycle backup volumes.

Remember, NetWorker maintains a file index for each client system and a much smaller media index that tracks which save sets are stored on each backup volume. When NetWorker removes entries that are older than the specified browse time from a file index, it leaves the corresponding save set information in the media index. The retention policy controls how long this information is kept and, as a result, how long a backup volume is kept before it can be overwritten with new backups.

As with the backup schedule and browse policy, you set the retention policy for each NetWorker client. Different clients can have different policies. The retention period can be any number of days, weeks, months, or years as long as the retention period is equal to or longer than the browse policy.

A NetWorker backup volume can contain save sets for many different clients over many days. As the retention period is reached for each save set, information about that save set is removed from the media index. When the retention period for every save set on a backup volume is reached, NetWorker marks the volume “recyclable.” This volume can then be reused for backups. At the time that the volume is actually reused, the old files are overwritten and can no longer be recovered.

NetWorker browse and retention policies combine to give you a hierarchy of recovery capability while keeping the disk space needed for the online indexes to a minimum. Recovering a file is quick and easy using the Recover window up until the browse policy time is reached and the file information is removed from the file index. Then you can use the more tedious process described to recover your files until the retention policy time is reached and the backup volume is recycled.

Browse and Retention Policy Examples

NetWorker is shipped with five pre-configured browse and retention policies: Week, Month, Quarter, Decade, and Year. Use these policies to choose the length of time to retain the entries in both the file index and media index. Remember, the *retention policy* you select affects the size of the *media index* and controls the length of time NetWorker tracks the backup volumes and the data on each volume.

The *browse policy* affects the size of the *file index* and the length of time that NetWorker retains entries for every file that is backed-up and visible in the Recover window. You must always choose a retention policy that is greater than or equal to the browse policy.

For example, if you choose Quarter for the retention policy for a client, and Month as the browse policy, the client can browse all the file entries for backed-up files dating back to a month. Each month the oldest entries for the client's files are automatically removed from the server's file index. However, the backup tapes that contain the data for the files are still tracked by NetWorker in the media index.

Week Policy

This policy maintains the file index entries or the media index entries for one week. If you use this as a browse policy, the users can only view and mark for recovery files that go back in time for a week. As a browse policy, it is useful when you have a limited amount of disk space and users do not expect to be able to recover versions of their data that are older than a week.

As a retention policy, Week means that your backup volumes turn over quickly, and NetWorker recycles through the tapes at a faster rate. Use this policy if you schedule weekly full backups, and need only to keep backup data for one backup cycle plus a week.

Month Policy

This browse policy allows users to view and recover versions of files dating back at least a month. The Recover window would display versions for files backed up for one full month plus a number of weeks. As a retention policy, NetWorker maintains and tracks the backup volumes for one full backup cycle plus a month.

Quarter Policy

Use this policy if you need to keep backed-up data longer than a month. With this browse policy, the client can view and recover files for at least three months into the past. The retention policy, tracks the backup volumes for at least three months plus one full backup cycle.

Year Policy

If you need to keep backed-up data online for several months, use the Year policy. For example, if your company requires ready access to information going back for at least three quarters, this is a good browse and retention policy. Realize, however, that NetWorker requires more disk space to maintain all the information online.

Decade Policy

This policy retains the entries in the server's indexes for ten years. It is useful for organizations that are required to keep records for very long periods.

Your NetWorker server requires lots of disk space for the online indexes if you choose Decade for your browse policy. Depending upon how much data you are backing up, ten years of file index entries could take up gigabytes of disk space.

It would make more sense to use Decade as the retention policy and use Quarter or Year as the browse policy. NetWorker can then track the backup volumes and the data on each one. You would always be able to retrieve data from an old backup volume if you needed to do so. NetWorker would still require disk space to maintain the media index, but it would be a much smaller amount of space using the Quarter or Year browse policies.

Setting Policies When Using a Jukebox

A NetWorker Support for Jukebox option automates your backup and recover activity. The capacity of the jukebox, the backup schedule you select, and the browse and retention policies you use determine whether you can walk away from backups for a week, a month, or even longer.

Jukebox Capacity for One Backup Cycle

A jukebox is most useful if it has at least enough capacity to complete one entire backup cycle without intervention. This allows backups to run while you are out ill, on vacation, or busy with a user emergency. It also helps minimize the time that you spend on backup (particularly if the backup server and jukebox are located some distance away). At the end of the cycle, you can move the used backup volumes off site and load fresh tapes into the jukebox.

A jukebox with the capacity for one entire backup cycle also speeds file recovery. If a user accidentally deletes a file, there is at least one version (more if the user has recently edited the file) in the jukebox. With NetWorker, the user can quickly identify the lost file and initiate the recovery. The jukebox loads the needed tape and NetWorker completes the recovery without your help. Depending on the speed of the jukebox, the file should be recovered very quickly.

You need to design a schedule that fits the capacity of your jukebox. Start with your ideal schedule and then consider these suggestions to reduce the size of your complete backup cycle:

- Use more incremental backups and fewer level 1–9 backups.

- Back up systems with less critical files less often—perhaps only once a week.
- Use NetWorker directives to skip files during the backup, for example, *core* files.
- Shorten the length of the backup cycle.

Although your jukebox may only have enough capacity for one backup cycle, you can still set the browse and retention policies for a longer period. If a user tries to recover a file stored on a volume that is not in the jukebox, NetWorker prompts you to load that volume. You can use the Location field in the Volume Management window to keep track of volumes. Users can refer to this information when deciding which version of a file to recover and choose the one stored on a tape that is located in the jukebox.

Jukebox Capacity for More Than One Backup Cycle

With just enough capacity in the jukebox for a single backup cycle, you must reload tapes at the end of each cycle. With more capacity you can set the schedule and the browse and recover policies so that the jukebox runs unattended for a long period of time. To continue backups virtually indefinitely, the jukebox automatically recycles tapes that contain save sets that have passed their browse and retention times.

Suppose you have established a backup schedule for your network of systems that takes one week to complete (for example, you schedule a full backup once a week) and consumes a total of 12 GB of tape during the week. Assume that you are using a 50 GB EXB-10i jukebox. Each of these combinations of browse and retention times allows the jukebox to operate without intervention for an extended period:

- Browse policy = 1 week, retention policy = 1 week
- Browse policy = 1 week, retention policy = 2 weeks
- Browse policy = 2 weeks, retention policy = 2 weeks

Each of these sets of policies has its advantages. With a browse and retention policy of just one week, your online indexes are kept small. With a browse and retention policy of two weeks, your indexes are larger but your users have more versions to select from when they need to recover a file. A browse

policy of one week and a retention policy of two weeks keeps your indexes small and does allow you to recover older files, although with a great deal more effort than if those files were still browsable in the index.

If you set the browse policy to four weeks, 4 * 12 GB = 48 GB fits in the jukebox. First, a full backup actually remains in the online index for a period of time equal to the browse policy plus one complete backup cycle. Thus with a browse policy of four weeks, essentially five weeks of backups would need to fit into the jukebox.

Second, since NetWorker cannot recycle a tape until all the save sets on that tape have expired, there is often some amount of “unavailable” tape in the jukebox.

Now suppose that one year later the number of files that you have has grown so that the one week backup cycle needs 18 GB of tape capacity. A browse policy of one week and a retention policy of one week still allows the jukebox to run unattended on an on-going basis.

If you want to keep files online in the jukebox longer then you can use the methods listed earlier to reduce the size of the backup cycle. Or, you can stretch out the backup cycle. For example, you can perform full backups every other week rather than every week. This should not greatly increase the size of a backup cycle, and gives you more versions of files online in the jukebox.

Summary

There are no right or wrong answers to the questions of how to configure NetWorker. The challenge is to understand how to best take advantage of the power and flexibility that NetWorker offers for your specific environment. You should get started with NetWorker by using the pre-configured schedules and policies and then undertake small experiments. As your network of systems grows larger, as there are more and more files to back up, and as users see the advantages of fast file recovery, you need to continue to make adjustments. Fortunately, NetWorker was designed to change and adapt as your needs expand.

Configuring a NetWorker Server

This chapter covers the system administration tasks for configuring the NetWorker server. These configuration tasks include:

- Configuring backup groups
- Setting up backup schedules
- Creating index policies
- Using directives
- Configuring the server‘s clients
- Labeling and mounting backup volumes
- Using label templates
- Using volume pools
- Adding and deleting backup devices
- Selecting server options
- Setting up event notification

Tip: Set up the groups, backup schedules, policies, and directives before you configure any clients. After you have created these custom configurations, apply them to specific clients in the Clients window. You can also edit the configurations in use by existing clients. ♦

You select the system administration windows for the NetWorker server from the Administration pull-down menu in the main window. The Administration pull-down menu (Figure 3-5) is available for users who have administration privileges for configuring the NetWorker server.

Configuring Backup Groups

NetWorker allows you to bundle clients into backup *groups*. This feature allows you to easily schedule clients to be backed up at different times. A client can be in one or many backup groups. Backup groups allow you to stagger the backup times of groups of clients to avoid overloading the server.

NetWorker is shipped with a pre-configured backup group named "Default." The automatic backup of the Default group starts at 3:33 a.m. When a client is added, it automatically belongs to the Default backup group. If this backup start time suits your needs, you do not need to change it.

If you have a large number of clients, or if you prefer to start backing up certain systems at different times, you can easily do so. For example, you may want to start the backup of the engineering department systems at four o'clock in the morning, and all the other clients on the network at midnight.

After creating a new backup group in the Groups window, you assign clients to the group in the Clients window.

You can have any number of backup groups on your NetWorker server. The clients in each backup group start their automatic backups according to the start time of the group.

Creating a Backup Group

Create a backup group and set the group backup start time in the Groups window.

Select "Groups" from the Administration pull-down menu (shown in Figure 3-5) to open the Groups window.

The Groups window appears, as shown in Figure 5-1.

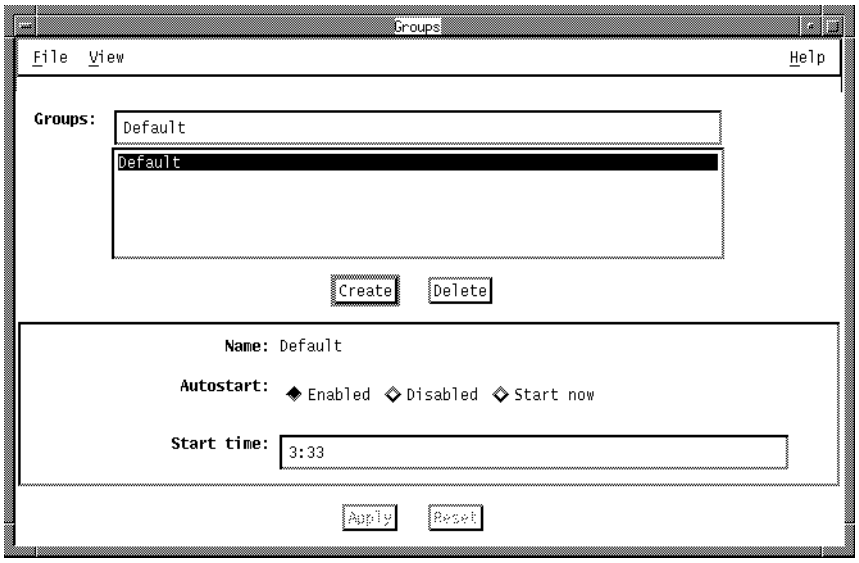

Figure 5-1 Groups Window

The Groups scrolling list displays all the backup groups known to the NetWorker server. Selecting a group name in the scrolling list displays its name in the Name field and its backup start time in the Start time field.

The Autostart choices allow you to disable the scheduled backup, or initiate a network-wide backup immediately. For example:

Enabled	Means allow the network-wide backup of the highlighted group to start at the scheduled time
Disabled	Do not start the network-wide backup of the group at all
Start now	Initiate the network-wide backup of the group immediately, instead of using the scheduled start time

The Start time field displays the time NetWorker starts the backup of the clients in the group currently selected in the Groups scrolling list.

To create a new group and assign a backup start time to the group, follow these steps:

1. Open the Groups window.
2. Press the *Create* button. Notice the Name field displays an editable line.
3. Enter a new group name into the Name field. Choose a name that describes the systems in the group, either by department or schedule.
4. Delete the time in the Start time field and enter a new time, using the 24-hour clock convention. (For example, 10 p.m. is entered as "22:00.")
5. Use the sliding bar to set a value for client retries.
6. Press the *Apply* button to apply the changes. Your new group name appears in the Groups scrolling list.

   If you make a mistake, clear your changes and start over by pressing the *Reset* button.

   Note: If you get the error message `user` *user_name* `needs to be on administrator's list`, it means you do not have permission to make configuration changes. See the section "Adding or Changing Administrators" in this chapter for more information. ♦

When you are finished creating a backup group and setting the start time for it, the group appears as a checkbox in the Clients window. You then assign clients to the group using the Clients window. See the section "Configuring a Server's Clients" in Chapter 5 for more information.

Setting Retry Times for Failed Client Backups

NetWorker normally tries to back up a client in a group once during a scheduled backup. If NetWorker cannot back up a client in a group (because it is down, for example) it does not try again unless you configure it to do so.

Use the Client retries sliding bar in the Groups window to retry failed clients during a scheduled backup.

1. Using the mouse, select the sliding bar and move it to the right or left.
2. The number of times NetWorker tries again to back up the failed client appears in the Client retries field.

Changing a Backup Time

To change the backup start time for a group, follow these steps:

1. Open the Groups window.
2. Select the group from the Groups scrolling list for which you wish to change the backup time.
3. Delete the time in the Start time field and enter a new time, using the 24-hour clock convention. (For example, 11 p.m. is entered as “23:00.”)
4. Press the *Apply* button to apply the changes.

   If you make a mistake, clear your changes and start over by pressing the *Reset* button.

Deleting a Backup Group

NetWorker does not let you delete a backup group if any clients are assigned to it. Before you try to delete a group, make sure no clients are assigned to the group in the Clients window.

To delete a group, follow these steps:

1. Select the name of the group you want to delete from the Groups scrolling list. Press the *Delete* button. An `Ok to delete?` message appears.
2. Select *OK* to delete the group. If no clients belong to the group, the group name disappears from the Groups scrolling list.

   If any clients belong to the group you are trying to delete, you see a message `The group` *group* `is still used by some clients`. Select *OK* to dismiss the message. To delete the group, you must first remove the clients from the group using the Clients window, then repeat this procedure.

Setting Up the Backup Schedules

NetWorker automatically backs up all the clients in a group, starting at the time you specify in the Groups window. The level and schedule of the backup is determined by the individual backup schedule of the client.

You create backup schedules for the clients in the Schedules window. To open the Schedules window, select “Schedules” from the Administration pull-down menu (shown in Figure 3-5). The Schedules window appears, as shown in Figure 5-2.

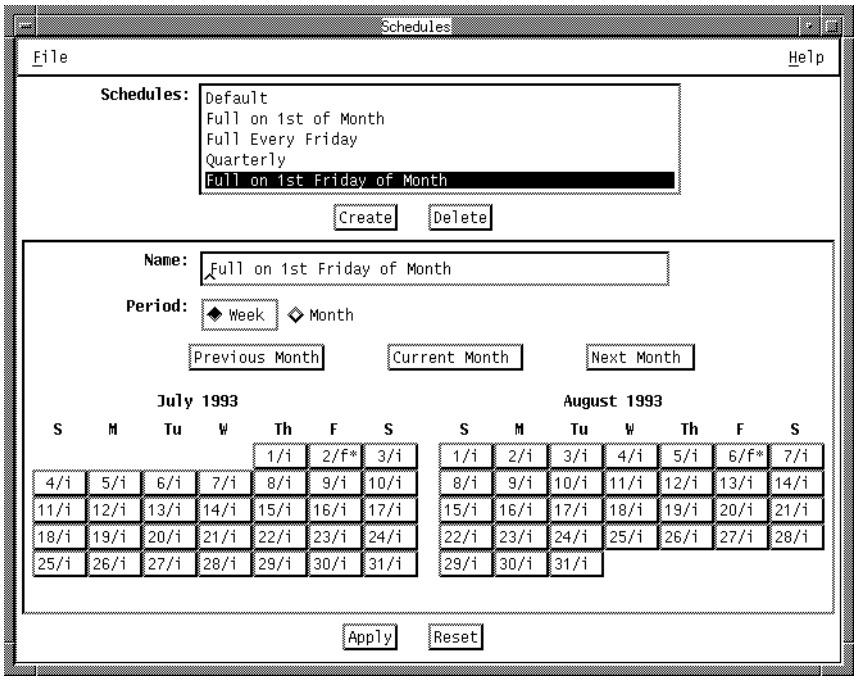

Figure 5-2 Schedules Window

The Schedules window has these areas:

Schedules scrolling list
: Displays the names of the schedules for automatic, network-wide backups known to the NetWorker server. Five pre-configured backup schedules are provided for your convenience. You may not delete the schedule named "Default." The five pre-configured schedules are described in "Pre-Configured Schedules" in Chapter 4.

Name field
: Displays the name of the currently selected schedule.

Period choices
: Lets you set the calendars to a weekly or monthly period. If you select Week, you set the schedule for one week, and that same schedule appears in all the calendar weeks. If you select Month and set the schedule for one month, the same schedule applies to all the calendar months.

Previous Month and *Next Month* buttons
: Scroll to the previous and next months, one month at a time.

Current Month button
: Pressing the *Current Month* button displays the current month and next month.

Calendar
: The calendar displays the day of the month and the backup level that is scheduled for that day. An asterisk (*) next to a backup level means you have forced a different level (an override) on that day. For example, suppose you scheduled a full backup on every Monday of the month, but the second Monday is a holiday. You can force a "skip backup" for the second Monday, and force a full backup on Tuesday instead.

Before learning how to use this window to set up a schedule, you might want to decide what schedule best fits the needs of your network and also learn about the backup levels that NetWorker supports. See "NetWorker Backup Schedules" in Chapter 4.

Note: You can make changes to an existing schedule, but you may not change its name. If you want to change the name of a schedule, you must delete it and recreate it, giving it a new name. ♦

Creating a New Backup Schedule

To create a backup schedule, follow these steps:

1. Choose “Schedules” from the Administration pull-down menu in the main window.
2. In the Schedules window, press the *Create* button to create a schedule.
3. Enter a name for the new schedule into the Name field.
4. Choose a weekly or monthly period for the schedule.
5. Place the cursor on a calendar day, and select it to pull down the Backup level menu. Set the backup level for each day (or week, or month):
   - Press the **F** key for a full backup on a calendar day.
   - Press the **I** key for an incremental backup on a calendar day.
   - Press the **S** key to skip a backup on a calendar day.
   - Press any number key between **1** and **9** for a level backup.
   - Select the “Overrides” command from the Backup level menu, to bring up the Overrides menu. Then press the corresponding speed key for an override on a calendar day.
   - To remove an existing override, pull down the Overrides menu and press **R**.
6. When you are done, press the *Apply* button to create the new schedule.

When you set up one month in the Schedules window, that setup applies to all calendar months, and carries over from year to year. In the same way, if you set up a weekly schedule, it applies for all calendar weeks. This allows you to plan all the weeks or months in one session, without having to repeat the process every week or month.

After you create a schedule, you can then apply the schedule to a client in the Clients window.

Example 1 – A Weekly Schedule

This schedule is suitable for NetWorker clients with files that change often. You want to do a full backup every Monday because a weekly full backup makes recovery from a disaster easier. Also, someone can change backup volumes and monitor the server on Mondays. The other days of the week, incremental backups protect the daily changes. You are going to name the backup schedule “Monday Full” to remind yourself that this schedule does a full backup every week, on Mondays.

Follow these steps:

1. Open the Schedules window.
2. Press the *Create* button.
3. Enter **`Monday Full`** into the Name field.
4. Select the *Week* button, if it is not already selected.

   The calendars show a full backup on Sundays, followed by incremental backups all the other days of the month.
5. In the current month calendar, select any Sunday and pull down the Backup Level menu, as shown in Figure 5-3.

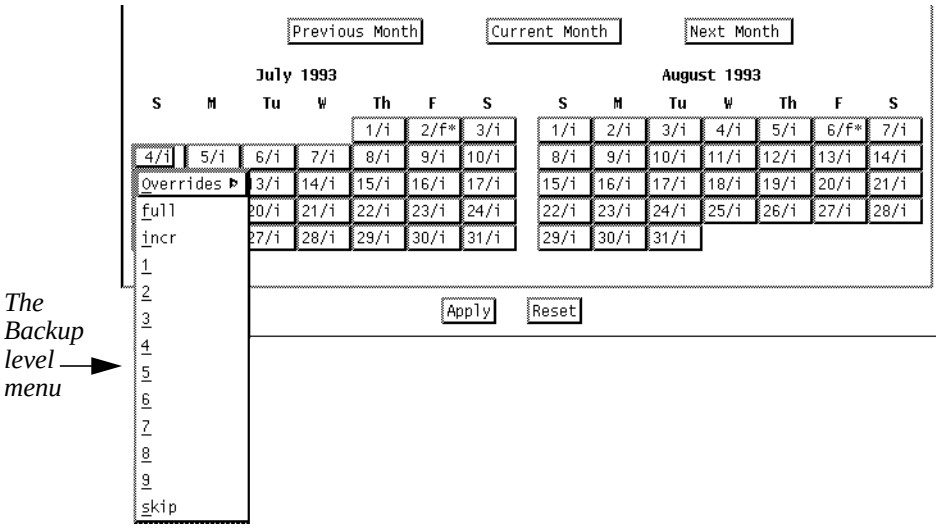

Figure 5-3 Backup Level Menu in the Schedules Window

6. Select “incr” from the menu.

   Notice all the Sundays of the calendar change to a backup level “i,” which means incremental backup.

Now set the calendar to do a full backup every Monday:

1. In the current month calendar, select any Monday, and pull down the Backup level menu.
2. Select “full” from the menu.
3. Press *Apply* to save the schedule.

   Note: If you see the error message `user` *user_name* `needs to be on administrator's list`, it means you do not have permission to make configuration changes. See the section “Adding or Changing Administrators” in this chapter for more information. ♦

Notice how all the Mondays in both calendars now display “f” next to the date, indicating a full backup takes place instead of the incremental backup.

Scroll through all the months, and notice how the schedule you set up for the current month is maintained throughout the entire calendar.

Example 2 – A Monthly Schedule

This monthly schedule is for the clients with files that do not change very much, and therefore need a full backup only once a month. A full backup takes place on the first day of the month. In the middle of the month, a level 5 backup backs up all the files that have changed since the full backup. All the other days of the month, an incremental backup protects any daily changes. You name this schedule "Monthly Fulls" to remind you that this schedule does a full backup only once a month. You are going to skip the level 5 backup with an override on May 15, because it is a company holiday, and force the backup on May 14 instead.

Follow these steps:

1. Open the Schedules window.
2. Press the *Create* button.
3. Enter **`Monthly Fulls`** into the Name field.
4. Select the Monthly schedule, if it is not already selected.

   Notice the months are already set up to do a full backup on the first day.

Now set the month for a level 5 backup on the fifteenth day:

1. In the current month, select the fifteenth day (15/i).
2. Select "5" from the Backup level menu.

Scroll through the months, and notice how the monthly schedule is carried through every month: a full backup on the first day, a level 5 on the fifteenth day, and incremental backups on the other days of the month.

Now you are going to override the scheduled level 5 backup on May 15 with a level "skip," to skip the backup for that day, and schedule the level 5 backup on May 14. Follow these steps:

1. Press the *Previous Month* or *Next Month* buttons to display the May calendar.
2. In the May calendar, select the fifteenth day.
3. Pull down the Backup level menu, shown in Figure 5-3, and select Overrides.

4. Slide the cursor to the right, to display the Overrides menu.
5. Select “skip*” from the Overrides menu.
6. Select the fourteenth day in the May calendar.
7. Select “5*” from the Overrides menu.
8. Press *Apply* to save the schedule.

Notice the date on May 15 displays an “s*,” indicating you have forced a “skip backup” instruction for that day. The date on May 14 displays a “5*” to indicate a level 5 backup takes place instead of the incremental. Any override must be scheduled explicitly each time. In other words, an override does not automatically repeat in a monthly or weekly period.

You may set up as many NetWorker backup schedules as you like, as long as you give each one a unique name. To assign a client to a particular backup schedule, you must go to the Clients window. See the section “Configuring a Server’s Clients” in this chapter for more information.

Creating Index Policies

This section describes how to create policies that automatically manage the online indexes. You can also manage the indexes manually using the Indexes and Volume Management windows. Manual index management and index management concepts are described in detail in Chapter 7, “Managing Indexes and Volumes Manually.”

When NetWorker starts a backup, it creates entries for the saved files in the online indexes. NetWorker maintains two types of indexes: a file index and a media index. The file index stores information about files backed up by NetWorker, and the media index maps the saved files to the backup volumes. NetWorker maintains one file index per client and one media index per NetWorker server. NetWorker uses the indexes as databases to locate the files that are marked for recovery.

Every backup adds entries to the indexes, so the indexes require management in order to control their size and contents. NetWorker automatically manages the contents of the indexes with policies that you specify for each client. Automatic index management with policies preserves valuable disk space by removing old entries from the indexes. You may use pre-configured policies or customize your own using the Policies window.

Each client requires two separate policies: a browse policy and a retention policy. The browse policy determines how long entries for your files remain in the online file index and thus browsable in the Recover window. Entries older than the browse policy are automatically removed from the online file index. The retention policy determines how long entries are retained in the media index and thus are recoverable. Entries older than the retention policy are marked as recyclable in the media index.

If you create new policies for automatic index management using the Policies window, the policies appear as selections for both the browse and retention policies in the Clients window. Every client requires both a Browse and retention policy. When you select browse and retention policies in the Clients window, you are telling NetWorker the minimum time period for data to remain browsable and recoverable for that client.

Periodically, NetWorker compares the backup date of the entries in the indexes with the time period specified by the policies. If a file entry has passed the time period specified by the browse policy, it is automatically removed from the file index, thus freeing up space on the disk. When a media entry has passed the time period specified by the retention policy, it is marked as recyclable in the media index. The entry still needs to be removed from the media index.

To create policies for automatic index management, open the Policies window by selecting “Policies” from the Administration pull-down menu (shown in Figure 3-5). The Policies window is shown Figure 5-4.

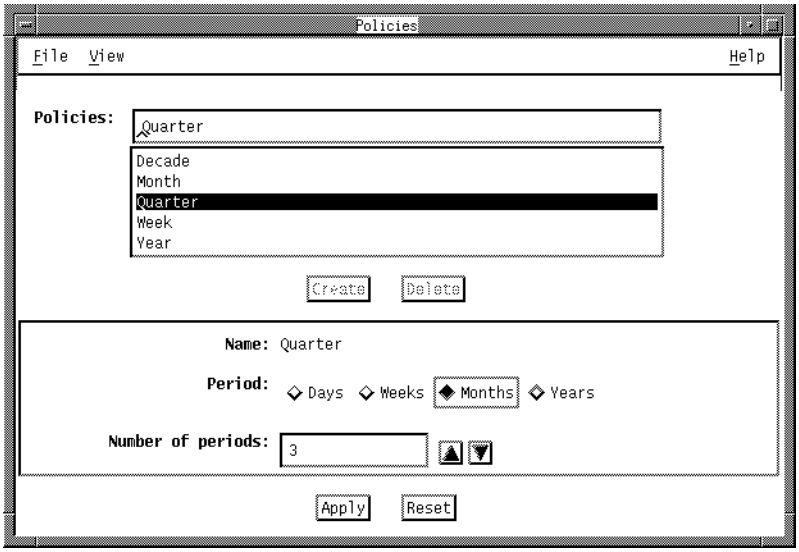

Figure 5-4 Policies Window

The Policies scrolling list displays the names of all policies known to the current NetWorker server. If you have not created any new policies, the scrolling list displays five pre-configured policies: Decade, Month, Quarter, Week, Year.

When a policy is highlighted in the scrolling list, its name, period, and number of periods appear in the lower section of the window.

To create a new policy, follow these steps:

1. Press the *Create* button.
2. Enter a name for the policy in the Name field.
3. Select a Period for the policy.
4. Select the Number of periods for the policy by clicking the counter or entering a number in the field.
5. Press the *Apply* button to finish the process. After you press *Apply*, the newly created policy appears in the Policies window scrolling list and also in the Clients window as both a browse policy and a retention policy.

If you make a mistake, press the *Reset* button to reset the window to where it was before the last *Apply*.

Enter any name for the policy that you want, but you may want to describe the time period to help you remember the length of the policy. For example, when you specify Quarter as a browse policy for a client, it is easy to tell that the entries are kept in the online file index for three months.

Follow these steps to delete a policy:

1. Highlight the desired policy in the scrolling list.
2. Press the *Delete* button. A warning message appears asking if it is OK to delete the selected policy. Press *Yes* if you wish to delete the policy.

Tip: You are not allowed to delete policies that are currently in use or the pre-configured policies. The pre-configured policies are Quarter and Year. ♦

Follow these steps to change a policy:

1. Highlight the desired policy in the scrolling list.
2. Select the Period and Number of periods for the policy. The name cannot be changed.
3. Press the *Apply* button to change the policy.

Note: A policy cannot be changed so that the client browse policy exceeds its retention policy. This means that an entry must be removed from the file index before it can be marked recyclable or removed from the media index. ♦

Using Directives

In a typical directory tree, there are many files that do not need to be backed up. For example, *core* files that are generated when a process terminates abnormally, or object files (".o" files), which are easily regenerated from source. You probably do not want to waste backup volumes or network bandwidth backing up these files.

Or, suppose your NetWorker client is a fast system, but your network is slow or busy. You may want to compress the client's files in order to use fewer backup volumes and less network bandwidth backing up its files.

NetWorker provides the capability of processing individual client files in very efficient methods through *directives*. A directive contains instructions to assist the backup process. Sometimes the directives require execution of special commands called Application Specific Modules (ASMs).

You have lots of flexibility in using directives. For example, you can apply backup instructions to specific directories in the filesystem. You can use pattern matching to apply the instructions to specific files in the directory tree. For example, using "skip: *.o" skips the backup on any file that has a suffix of ".o" in the directory to which the "skip: *.o" directive applies.

NetWorker is shipped with four sets of pre-configured directives: "Default," "Default with compression," "DOS standard directives," and "NetWare standard directives." Each set of directives covers the most important and most useful backup instructions. For example, they apply the directive "+skip: core" to the *root* directory (/), thus skipping the backup of all *core* files throughout the directory tree. They contain a *swapasm* directive to back up the relevant information about all NFS® based and local swap files, but not the data in them. They also contain a *mailasm* directive to ensure that your mail files are backed up, yet not marked as read. These directives are designed for these purposes:

Default — Use for most of your backups and when you do not need one of the other specialized directives.

Default with compression — Use when you want to compress your backup data. Compressing client files saves you media space and network bandwidth, but it takes more time and CPU cycles

on the client. Overall, the entire network may back up faster if all the clients are compressing their files, and the parallelism is set appropriately.

DOS standard directives
: Use when you are backing up your DOS clients.

NetWare standard directives
: Use when you are backing up your NetWare clients.

Tip: NetWorker works just fine if you use the pre-configured directives without ever changing them. If you are an advanced user, and want to add custom directives, please read this section and see the *nsr*(1M) reference page. ♦

To see the Directives window, select “Directives” from the Administration pull-down menu (shown in Figure 3-5). The Directives window is shown in Figure 5-5.

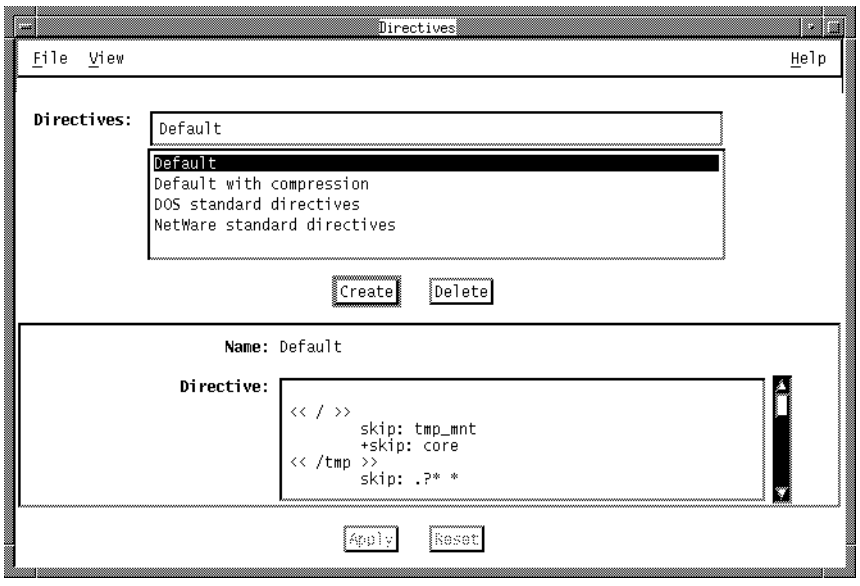

Figure 5-5 Directives Window

The Directives scrolling list displays the names of the directives known to the NetWorker server. The Directive display shows you the contents of the currently selected set of directives. Each directive in the list is preceded by the directory to which it applies (for example, << */tmp* >>).

To add a set of directives or a single directive instruction, press the *Create* button.

The bottom half of the window changes, as shown in Figure 5-6, allowing you to change the name and contents of the directive.

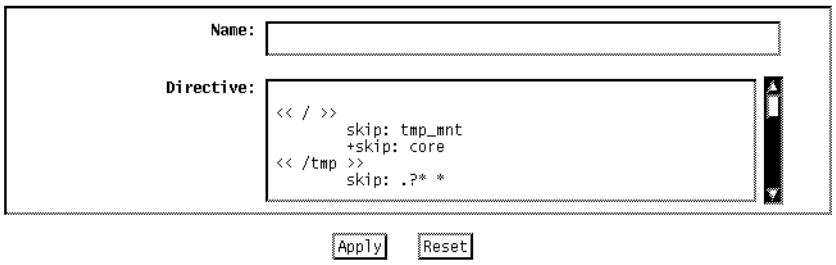

Figure 5-6 Alternate Directives Window Bottom

You can type directly into the Directive display; it is a text window. The correct syntax for directives is explained in more detail in the *nsr*(1M) reference page. After you add a directive or set of directives, press the *Apply* button to apply the change. To change a directive, press the *Change* button and edit the window.

Also, if you would like more information about directives, and the algorithm used to apply directives when both server and clients have directives, see the *nsr*(1M) reference page.

Configuring a Server's Clients

Before a client can communicate with the NetWorker server, it must have the NetWorker client software installed and the client must recognize the server. See the section "Installing NetWorker Software on Clients" in Chapter 2 for instructions. After the software has been successfully installed on the client and the client recognizes the server, you may configure the NetWorker server for that client.

NetWorker is shipped with easy-to-use pre-configured settings described in the section "Pre-Configured Settings" in Chapter 4. When you configure a client manually, you choose:

- A NetWorker server, if you have more than one
- A backup schedule
- A browse policy and a retention policy
- A directive
- A backup group (none, one, or many)
- Which client files you want NetWorker to back up, if not all of them
- What other systems, if any, are allowed to recover the client's files

The client configuration tasks are completed in the Clients window. Select "Clients" from the Administration pull-down menu (shown in Figure 3-5) to open the Clients window. The Clients window is shown in Figure 5-7.

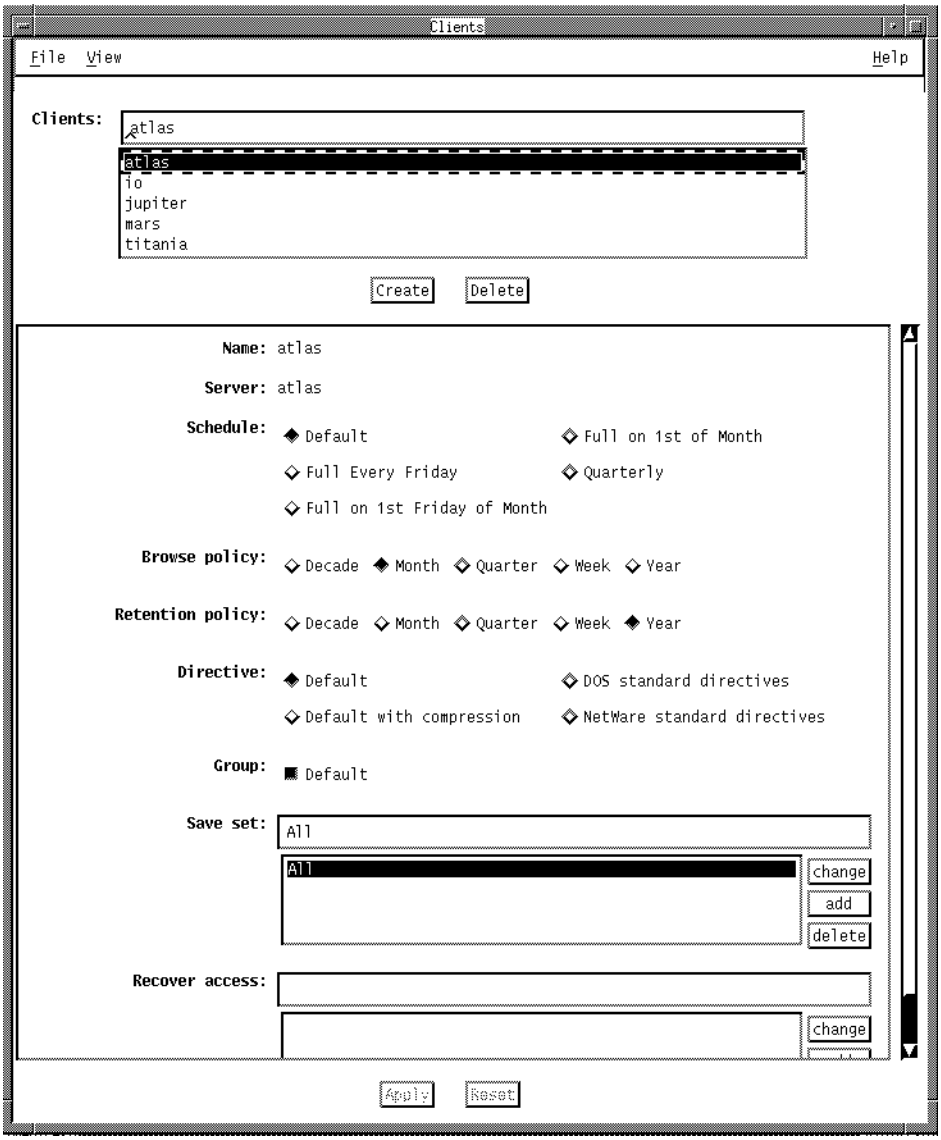

Figure 5-7 Clients Window

The fields in the Clients window are:

Clients	The Clients scrolling list displays all the NetWorker clients configured for the NetWorker server. The NetWorker server is automatically listed in the Clients scrolling list prior to creating any clients.
Name	The Name field displays the hostname of the currently selected client.
Server	The Server field displays the hostname of the currently selected NetWorker server.
Schedule	The Schedule choices display all the schedules known to the NetWorker server. NetWorker is shipped with five pre-configured schedules for your convenience. Any other schedule you create using the Schedules window also appears here as a choice.
Browse policy and Retention policy	The browse policy and retention policy choices display the policies for automatic index management known to the NetWorker server. NetWorker is shipped with five pre-configured policies for your convenience. Any other policy you create using the Policies window also appears here as a choice.
Directive	The Directive choices display the directives recognized by the NetWorker server. There are four sets of pre-configured directives shipped with NetWorker, and any new ones you create using the Directives window also appears here.
Group	The Group choices display all the backup groups known to the NetWorker server.
Save set	The Save set scrolling list displays the filesystems NetWorker backs up for the client. The pre-configured setting "All" is a keyword that means "back up all locally-mounted filesystems for this client."
Recover access	The Recover access scrolling list displays the hostnames or netgroups of the systems that are allowed to browse and recover the client's files. NetWorker clients are pre-configured so that only the client itself can browse and recover its files.

NetWorker clients can manually back up and recover files from a NetWorker server and can browse the online file index entries for files. A client may not browse and recover any other client files, unless specifically configured to do so. Normally clients can also be backed up on a regularly scheduled network-wide backup.

Adding a New Client

To configure a new NetWorker client, follow these steps:

1. Open the Clients window.
2. Press the *Create* button.
3. Enter the new client hostname into the Name field.
4. Add the client to one or more backup groups by checking the Group choices.

Next, choose which files you want NetWorker to back up for the client.

If you want all the client's files to be backed up, leave the word "All" in the Save set field.

If you want only a specific filesystem to be backed up:

1. Select All in the Save set scrolling list.
2. Press the *delete* button.
3. Enter the pathname for the filesystem that you want backed up into the Save set field.
4. Press the *add* button. The pathname appears in the Save set scrolling list.

   Tip: This feature allows you to schedule filesystems to be backed up at different times. For example, if a client has a large amount of data, you may want to schedule its filesystems separately for backup. For more information, see the section "Scheduling Large Client Filesystems" in this chapter. ♦

If you try to add more clients to your NetWorker server beyond the number you have purchased, you receive this error message:

`Too many clients - maximum is` *number*.

All NetWorker clients are pre-configured so that only the client itself can browse or recover its own files. If your company is concerned about security, we recommend you do not change the recover access.

If you want to give other systems access to the client's files, follow these steps:

1. Enter the hostname of the system or netgroup name to which you are giving access to the client's files in the Recover access field.
2. Press the *add* button next to the Recover access scrolling list. The hostnames or netgroup names (if you are using NIS) of any systems allowed to browse and recover the client's files appear in the Recover access scrolling list for that client.

Next, choose a backup schedule, browse policy, retention policy, and directive for the client:

1. Select a schedule from the Schedules choices. Pre-configured schedules provided by NetWorker, and any new schedules you created with the Schedules window, appear here.
2. Select both a browse and a retention policy for the client indexes. You may use the pre-configured policies of Quarter for the browse policy and Year for the retention policy.
3. Select a set of directives for the client. The four pre-configured sets of directives appear as Directive choices.
4. Press the *Apply* button to apply the changes and add the new client to the server.
5. Your new client appears in the Clients scrolling list of the window. If you make a mistake, press the *Reset* button to reset the window to your last *Apply*.

Changing Policies for a Client

After you have created the policies in the Policies window, you select them for a client as a browse policy or as a retention policy.

Notice the browse policy and retention policy selections in the Clients window, shown in Figure 5-7. The five pre-configured policies and any custom policies that you have created appear as buttons for both browse and retention policy choices.

To change a policy for a client, select the button for the desired browse or retention policy. The pre-configured selections are Quarter for the browse policy and Year for the retention policy.

Note: Remember, a client's browse policy may not exceed the retention policy. An error message appears if you attempt to assign a browse policy to a client that is longer than the retention policy assigned to that client. For example, one month for the browse policy and one week for the retention policy is unacceptable because a month is greater than a week. ♦

Scheduling Large Client Filesystems

At a conservative backup rate of 300 KB per second for an 8 mm tape, a full backup of a client with 5 GB of data in several filesystems would take about 5 hours to complete. Consequently, it may not be convenient to complete a scheduled, unattended, full backup for this client, because of the amount of time it takes.

You can, however, schedule the client filesystems to be backed up at different times. You may want to consider this when you have several very large filesystems, or a large number of small filesystems. By separating the client's filesystems into different backup groups, you can still save the client's files without trying to do a time-consuming full backup that requires many changes of the backup volumes.

The Save set scrolling list in the Clients window, shown in Figure 5-7, displays the filesystems that NetWorker backs up for the client. All the filesystems are backed up as long as the keyword All is left in the list.

To separate the filesystems, you add the client twice to the server list of clients to back up. In one case, you configure the client to back up half its filesystems, and in the other case, the other half of its filesystems. These repeated clients can also have different schedules and belong to different backup groups for more efficient backups.

The example below illustrates how to separately schedule a client's filesystems. First, find out the names and sizes of the client locally-mounted filesystems with the *df*(1) command:

```
% df -lk
Filesystem              Type  kbytes     use   avail %use  Mounted on
/dev/root                efs   31270   12549   18721  40%  /
/dev/usr                 efs 1125799  546991  578808  49%  /usr
/dev/dsk/lv6             efs 4581709 4318432  263277  94%  /repo
/dev/dsk/lv4             efs 4581709 3678982  902727  80%  /online
/dev/dsk/dks1d3s6        efs  929736  846320   83416  91%  /d2
/dev/dsk/dks2d3s7        efs 1357229 1190607  166622  88%  /d1
/dev/dsk/dks1d3s0        efs   15737     204   15533   1%  /tmp
```

The largest filesystems are */repo* and */online*, with 4581709 KB of space.

Next, estimate how long it would take to back up one of these filesystems on 8 mm tape:

```
4581709 KB / 400 KB/second = 11454 seconds
11454 seconds/ 60 seconds/minute = 190.9 minutes
```

You can repeat the same exercise for all the filesystems in order to decide how to separate them into different backup schedules.

For example, this client's filesystems can be separated so that these file systems are backed up according to a "Monday Full" schedule:

```
/dev/root                efs   31270   12549   18721  40%  /
/dev/usr                 efs 1125799  546991  578808  49%  /usr
/dev/dsk/lv6             efs 4581709 4318432  263277  94%  /repo
/dev/dsk/dks1d3s0        efs   15737     204   15533   1%  /tmp
```

These file systems are backed up according to a "Wednesday Full" schedule:

```
/dev/dsk/lv4             efs 4581709 3678982  902727  80%  /online
/dev/dsk/dks1d3s6        efs  929736  846320   83416  91%  /d2
/dev/dsk/dks2d3s7        efs 1357229 1190607  166622  88%  /d1
```

Each full backup should take no more than five hours to complete. (The NetWorker server has schedules called “Monday Full” and “Wednesday Full” that were previously created.)

Next, use the Clients window to configure the client:

1. Open the Clients window.
2. Select the client whose filesystems you are separates in the scrolling list, or press *Create* to create a new client.
3. Configure the client by choosing a backup group, directive, policy, and the “Monday Full” schedule.
4. Delete “All” from the Save set list and add the filesystems you want to back up on the “Monday Full” schedule: */*, */usr*, */repo*, and */tmp*.
5. Press the *Apply* button.

Now follow the same procedure for the remaining filesystems you want to back up on the “Wednesday Full” schedule.

1. Press the *Create* button to add the client a second time with different filesystems scheduled.
2. Configure the client by choosing the backup group, directive, and policy; make sure you choose the “Wednesday Full” schedule for it.
3. Delete “All” from the Save set field, and enter each filesystem you want to back up on the “Wednesday Full” schedule: */online*, */d2*, and */d1*.
4. Press the *Apply* button. NetWorker now backs up the filesystems on the client disks using two separate schedules, making it possible to run unattended full backups on this client.

Note: When you use the filesystem scheduling feature, make sure you do not leave any filesystems off the Save set list. Any filesystem left off the list is never backed up! ♦

Removing a Client

To remove a client's access to the server follow these steps:

1. Select the name of the client in the Clients scrolling list of the Clients window.
2. Press the *delete* button. NetWorker asks for a confirmation to delete the client.

Deleting a client means it cannot back up its files to the NetWorker server or recover its files. All the backup history for the client still remains in the file index and media index, until you specifically remove it. See the section "Removing a Backup Volume" in Chapter 7 for instructions on how to remove the backup history for a client from the indexes.

Labeling and Mounting Backup Volumes

To track backup volumes, NetWorker requires that you label and mount a backup volume before it can be used to back up or recover files. Use the Operation pull-down menu (see Figure 3-4) in the main window to mount, unmount, and label backup volumes.

The labels of the backup volumes are tracked by the NetWorker media index. A record of each file on every backup volume is maintained in the NetWorker file index. NetWorker uses these two indexes to tell you (or the jukebox) which backup volume to mount when you want to recover lost data.

Every backup volume belongs to a volume pool. You may use the pre-configured pools or create your own. If you choose not to separate your backup volumes into pools, NetWorker automatically uses a pool named "Default" for all your backup volumes.

Each volume pool has a matching label template associated with it. NetWorker generates labels for backup volumes according to the rules of a label template. Label templates provide a method for consistently naming and labeling your backup volumes. You can use the pre-configured label templates, or create a custom label template using the Label Templates window.

NetWorker automatically labels the backup volumes with the next sequential label from a template unless you choose to override the label with a label not associated with a pool. Volume pools and label templates are described in detail in "Using Volume Pools" and "Using Label Templates" in this chapter.

Each backup volume should have an adhesive label attached to it which matches the internal NetWorker label. There are no restrictions for labeling the backup volumes except that each volume requires a unique label. If you choose not to use a pre-configured template, you can label the volumes with names appropriate to your network. For example, you may choose to label your volumes 1, 2, 3, or A,B,C. No matter what naming scheme you choose, keep in mind that a convention should be easily understood by operators and administrators.

Tip: In the NetWorker environment, each NetWorker server has its own collection of backup volumes. If you have more than one NetWorker server, you may find it helpful to label your backup volumes with the name of the server used for the backup and a number. For example, atlas.001 for the backup volume from the NetWorker server named atlas, and mars.010 for the backup volume from the NetWorker server named mars. ♦

Sections below explain how to label, mount, and unmount volumes. If you are using a jukebox, the volume labeling and mounting operations can be automated. See Chapter 8, "Using NetWorker with Jukeboxes," for more information.

Note: Backup volumes are not overwritten, but appended to each time they are used. Therefore, you can leave the same backup volume(s) in the server backup device(s) no matter what backups are scheduled. When one backup volume is full, NetWorker requests a new one to be mounted either by you or by the jukebox until the accumulated backups have completed. Since NetWorker maintains a record of the data stored on each volume in the indexes, it is not necessary to calculate tape capacity requirements. ♦

Labeling and Mounting a Backup Volume

This section applies only if you are labeling and mounting backup volumes in a backup device that is not associated with a jukebox.

To label and mount a backup volume in one operation, follow these steps:

1. Place a blank backup volume in the NetWorker server backup device.

   Your NetWorker server may have one or more backup devices connected to it. The device currently highlighted in the Devices display of the main window appears in the Label and Mount window. To select another device, press “Cancel” to close the Label and Mount window, highlight the new device in the main window, and select “Label and Mount” again.

2. In the main window, select “Label and Mount” from the Operation pull-down menu to display the Label and Mount window, shown in Figure 5-8.

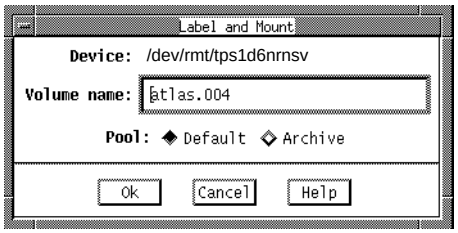

Figure 5-8 Label and Mount Window

3. Choose a volume pool from the Pool choices. Only the pools that have been enabled in the Pools window appear in the Label and Mount window. Both the Default and the Archive pools are pre-configured to be enabled. NetWorker automatically uses the label template associated with the pool to label the backup volume. For more information about volume pools, see the section “Using Volume Pools” in this chapter.

4. If you do not want NetWorker to label the backup volume by following the label template associated with the volume pool, delete the contents of the Volume name field and enter a name for the backup volume into the field.

5. Press the *Ok* button when you are finished naming a backup volume. If you make a mistake, press the *Cancel* button to cancel the label operation. Pressing *Ok* labels and mounts the backup volume. The name of the backup volume appears in the Devices display of the main window beside the path of the device.

Note: Any time you try to relabel a volume that already has a valid NetWorker label, NetWorker prompts you with a notice to make sure you really want to relabel the volume. Relabeling a backup volume destroys all record of its contents under the old label. ♦

Labeling a Backup Volume Without Mounting

This section applies only if you are labeling and mounting backup volumes in a device not associated with a jukebox. To label backup volumes in a jukebox, see the section “Starting a Labeling Session” in Chapter 8.

You may want to label several backup volumes in one session and not mount any of them. To label a backup volume without mounting it, follow these steps:

1. In the main window, select “Label” from the Operation pull-down menu to display the Label window, shown in Figure 5-9.

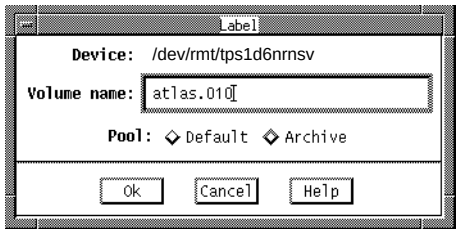

Figure 5-9 Label Window

   The device that is currently highlighted in the Devices display of the main window is selected for labeling volumes.

2. Choose a volume pool from the Pool choices. NetWorker uses a label template associated with the pool and automatically labels the backup volume with the appropriate name.

3. If you do not want NetWorker to use a label template, delete the contents of the Volume name field, and enter the name for the backup volume into the Volume name field.
4. Press the *Ok* button. Pressing the *Ok* button labels the backup volume in the currently selected device in the Devices display. You see the name of the backup volume in the Devices display of the main window with an `(unmounted)` message following the media type. You must mount the newly labeled volume before sending backups to it. (See the section "Mounting and Unmounting Backup Volumes" in this chapter for instructions on mounting volumes.)
5. After each labeling operation is complete, remove the newly labeled volume from the drive and repeat the label procedure for each volume that you wish to label without mounting.

Note: You cannot use the same name for a volume label more than once. You can, however, relabel a volume. Relabeling a volume destroys the records for the volume under the previous label. ♦

Mounting and Unmounting Backup Volumes

Before you can back up files to a backup volume or recover files from it, you must mount it in the server backup device. If you are using a jukebox, NetWorker automatically mounts the backup volumes when they are needed.

You may have more than one device for backups. All the server backup devices used for backing up and recovering files appear in the Devices display of the main window.

To mount a backup volume in a specific device:

1. Select the device name in the Devices display of the main window.
2. Select "Mount" from the Operation pull-down menu. The Devices display changes to show the name of the backup volume mounted in the device.

Tip: NetWorker allows you to pre-mount backup volumes, so that you can complete unattended network-wide backups using backup devices in a series or concurrently. ♦

To unmount a backup volume from a specific backup device:

1. Select the name of the device in the Devices display.
2. Select “Unmount” from the Operation pull-down menu. The Devices display changes to show the backup volume unmounted in the backup device.

If you try to back up files when no backup volumes are mounted, NetWorker requests a writable volume with this message in the Pending display:

```
media waiting: backup to pool ‘Default’ waiting for 1
writable backup tape or disk
```

A writable volume is one that is labeled and has room for data.

If you are recovering files, NetWorker requests by name the backup volume that you need to mount in the device.

```
media waiting: recover waiting for 8mm 5GB tape volume name
```

If you need more than one backup volume to recover the file(s), NetWorker gives you a list of all the backup volumes in the order they are needed in the Pending display, so you can prepare to mount all of them at once. As the files are recovered, NetWorker requests each backup volume it needs, one at a time. If you are using a jukebox with one of the NetWorker Support for Jukebox options, volume mounting is automatic for backup volumes already stored in the jukebox.

Finding a Backup Volume Name

If the physical, adhesive label on the backup volume is missing or illegible, you can find out its name by placing it in a device and pressing the *Label* button. When the Label window appears, as shown in Figure 5-9, you can see the name of the label in the Volume name field. Once you have determined the name of the volume, press *Cancel*, because you do not want to rename the volume; you are just determining the existing label name.

Using Label Templates

NetWorker generates labels for backup volumes according to the rules of a label template. *Label templates* provide a method for consistently naming and labeling your backup volumes. You can use the pre-configured label templates, or create a custom label template using the Label Templates window.

This section describes how to use label templates, gives a description of the pre-configured templates, describes how to create a custom label template, and provides examples of label templates for your use.

NetWorker uses label templates to label and help keep track of your backup volumes. All of the backup volumes belong to volume pools that require corresponding label templates. For more information on pools, see the section “Using Volume Pools” in this chapter.

Using the Pre-Configured Templates

The pre-configured label templates shipped with NetWorker are: Archive, Default, Full, NonFull, Offsite, and Two Sided. These are provided so that you can easily start labeling your backup volumes. There are also pre-configured volume pools with corresponding names. The pre-configured volume pools automatically use the pre-configured label template by the same name.

The number range for all of the pre-configured label templates starts at 001 and ends with 999 to allow for expansion of the volume pools.

The formats for each pre-configured label template are:

Archive — The Archive label template has three fields, separated by a period. The first field contains the name of the NetWorker server, the second field is “archive,” and the third field contains a number. The Archive label template is used only for clients that need to archive data.

Default — The Default template has two fields separated by a period. The first field contains the name of the NetWorker server and the second field contains a number.

Full, NonFull, and Offsite
: The three pre-configured label templates (Full, NonFull, and Offsite) use the same labeling conventions. The name of the label template appears in the first field, and the second field contains a number.

Two Sided
: The Two Sided template is for use with two-sided media such as optical media. When labeling two-sided media you need to be able to label both sides of the media. The first field contains the name of the server, the second field contains a number, and the third field contains either an “a” or “b” to differentiate between the two sides of the media.

Table 5-1 shows the format and examples for each pre-configured label template.

Table 5-1 Pre-Configured Label Templates

Label Template	Format	Examples
Archive	*server*.archive.*number*	space.archive.001 space.archive.099 atlas.archive.325
Default	*server* . *number*	space.675 space.800 atlas.054
Full	*label_name* . *number*	Full.076
NonFull	*label_name* . *number*	NonFull.003
Offsite	*label_name* . *number*	Offsite.120
Two Sided	*server* . *number* . *side*	phoenix.001.a phoenix.001.b

Choosing a Label Template

Before you choose a label template for labeling your volumes, you must first choose the device that has tapes mounted for labeling from the Devices display in the main window. Next, choose a label template in the Pools window, then start the labeling process by selecting “Label” from the Operation pull-down menu.

Select a label template from the Label template display in the Pools window.

Note: Whether you use a pre-configured template or a custom template to label the backup volumes, remember to attach an external adhesive label to each volume with a name that corresponds to the template you have chosen. ♦

Creating a Custom Label Template

To create and add a label template, open the Label Templates window by selecting “Label Templates” from the Administration pull-down menu. The Label Templates window is shown in Figure 5-10.

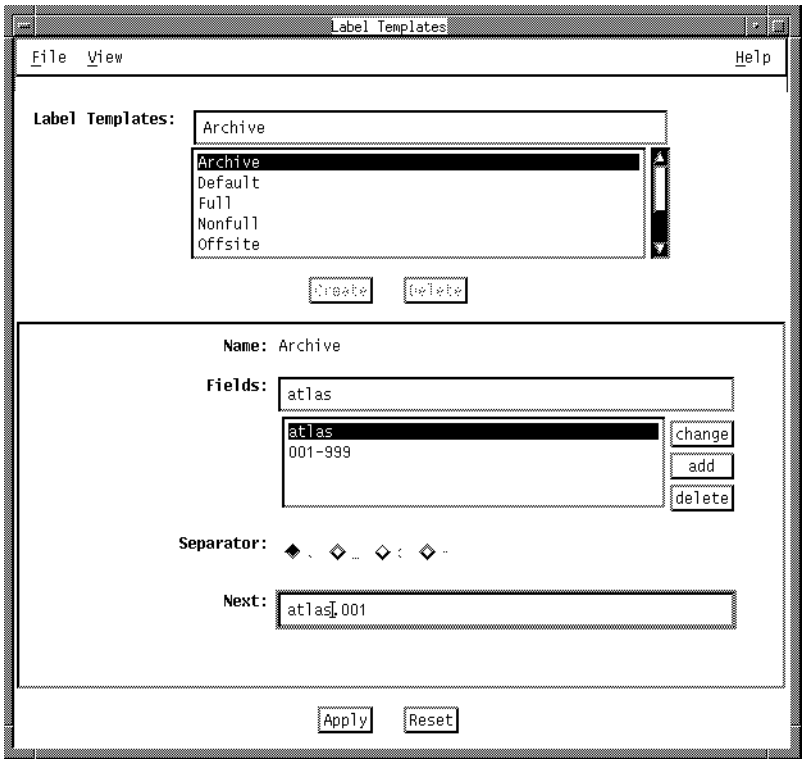

Figure 5-10 Label Templates Window

The Label Templates scrolling list displays the label templates known to the NetWorker server. The pre-configured label templates and any new templates you create appear in this list.

The Name field displays the name of the currently selected label template.

The Fields field displays the components of the label template. The components appear as one component per line in the display. There are four types of components:

- Range of numbers, for example, 000–999
- Range of lowercase letters, aa–zz

- Range of uppercase letters, AA–ZZ
- Character string, for example, Accounting and 001

Each range includes a starting value, a dash (–), and an ending value. The starting value and the ending value must have the same number of characters; for example, use “aaa–zzz,” not “aa–zzz.” (This rule does not apply to a list of strings or words.) You may have as many components as you want, but it is best to keep the template simple, with few components. The total length of the label must be less than 64 characters.

Note: When you create a label template, the order in which you enter each component of the template is important. That is, NetWorker applies each component in a left-to-right order, starting with the first one you enter. The components are displayed from top to bottom in the Fields scrolling list, with the first component on the top. ♦

Each component of the label template may be separated by a period, dash, colon, or underscore, represented by the Separator buttons. If none of the separators are selected, the components have no separators, like this: “AA00aa.”

The Next field displays the next label NetWorker uses to label the backup volume according to the template. If you want to force a label or start the labeling scheme at a certain point, you may enter the starting label into the Next field. NetWorker continues to generate labels from that point on, according to the rules of the template.

Tip: If your label template matches your backup media storage system, it can help you organize and locate the media in storage. For example, if you store backup media in bins or racks, you should include a place for the bin or rack number in the label template. (See “Example 1 – A Storage-Oriented Template” in the next section.) ♦

It is also helpful if the label template name matches the name of the corresponding pool. Table 5-2 shows an example.

Table 5-2 Label and Pool Names

Name	Label	Pool Name
AcctFull	AcctFull.001 AcctFull.002 AcctFull.003	Accounting
EngTest	EngTest.001 EngTest.002 EngTest.003	Engineering Test

Example 1 – A Storage-Oriented Template

In this example, assume you have only one NetWorker server and one jukebox. Your backup media is magnetic tape, arranged in numerical order, and organized in three racks. You want to create a scheme that is simple so anyone can easily store and find the backup volumes on the rack shelves.

NetWorker does not care how the volumes are labeled, as long as each one has a unique name. It tracks the backups and maps them to the backup volumes, so you do not have to remember which backups are on which volumes. When NetWorker needs a backup volume to fill a recovery request, it requests it by name in the Pending display of the main window.

In this example, shown in Figure 5-11, three racks are named “1,” “2,” and “3.” Each rack has five shelves; the top shelf is “1” and the bottom shelf is “5.” Each shelf holds 100 tapes, arranged left to right.

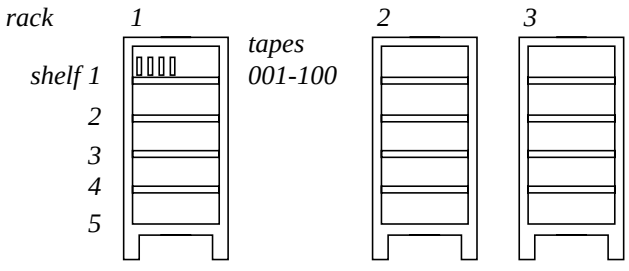

Figure 5-11 Example Racks of Magnetic Tapes

Using this labeling scheme, a tape labeled “2-3-54” is stored in the second rack, on the third shelf, and is positioned between the fifty-third and fifty-fifth tapes on the shelf. NetWorker labels the tapes in the jukebox consecutively according to the label template. NetWorker starts with the tapes in the first rack, on the first shelf, and numbers the tapes 1-1-001 to 1-1-100. Then, it labels the tapes on the second shelf of the first rack, numbering them from 1-2-001 to 1-2-100, and so forth, until it labels the last tape in the third rack “3-5-100.” If you want to add a fourth rack to your tape storage system, you may easily do so by changing the label template.

Tip: Your label template should allow for expansion of your backup media storage system. For example, it would be wiser to create a template allowing for 100 tapes and not use all of them, than to create a template for only 10 tapes and soon use all 10 labels. ♦

Follow these steps to create the storage oriented label template:

1. Open the Label Templates window.
2. Press the *Create* button.
3. Enter the name of the labeling scheme into the Name field (for example, “Engineering backups”).
4. Enter the component of the first field into Fields. Remember, this field holds the rack number, so you enter “1-3” (do not enter the quotes).
5. Press the *add* button.
6. Enter the second component of the label template into Fields. This field holds the shelf number, so enter “1–5” into the field.
7. Press the *add* button.
8. Now enter the third component of the label template, the tape position numbers. Enter “001–100” into Fields.

   You must enter the same number of characters for any numbers in the label template. For example, use 01–20 not 1–20, and 1–9 not 01–9.
9. Press the *add* button.
10. Choose the separator for each component of the label template, by pressing the dash (–) in the Separators list.
11. Press the *Apply* button to apply the new template to the NetWorker server. The Label Templates window now looks similar to Figure 5-12.

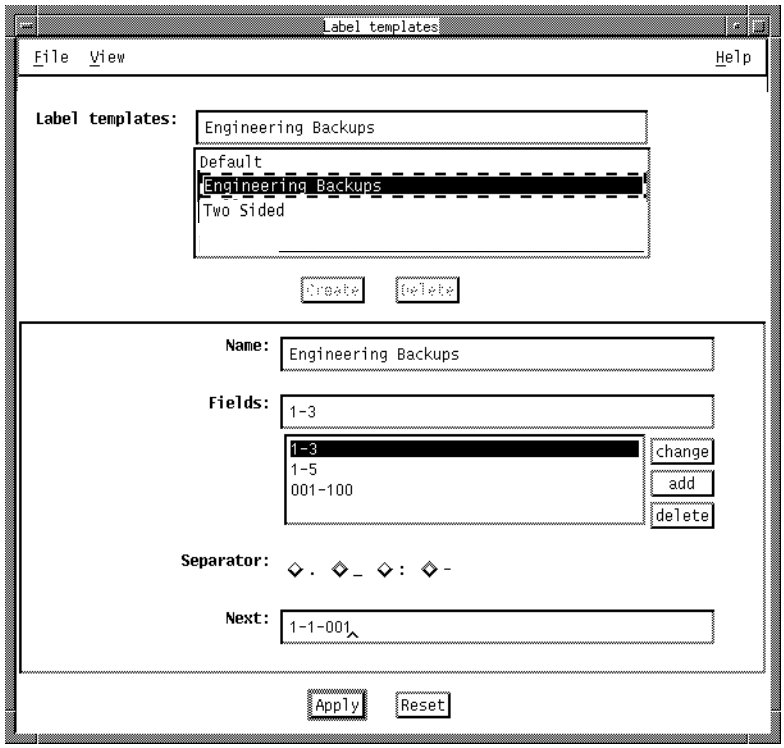

Figure 5-12 Example Label Templates Window

Notice your new template appears in the Label templates scrolling list, the components of the label template appear in the Fields scrolling list, and the Next field displays the label of the next tape.

Example 2 – A Sequential Label Template

This example is for a sequential labeling scheme. In this scheme, there is no storage system pattern to explain the labels; the labels are simply a way for NetWorker to identify the backup volumes. This label template generates lots of different labels; you will probably never “run out” of labels for your backup volumes.

The label template in this example has two fields: “aa–zz” and “00–99.” It generates 67,600 different labels (26^2 times 10^2). To give you an idea of how NetWorker generates the labels, some examples of labels are:

aa.00, aa.01, aa.02... aa.98, aa.99,
ab.00, ab.01,... ab.99,
ac.00, ac.01,... ac.99,
...
az.00,... az.99,
ba.00,... bz.99,
...
zz.00,... zz.99,

Follow these steps to create the sequential label template:

1. Open the Label Templates window.
2. Press the *Create* button.
3. Enter the name of the labeling scheme into the Name field (for example, “Personnel backups”).
4. Enter the component of the first field into Fields. In this example, this field contains dual character strings, so you enter “aa-zz” into the field.
5. Press the *add* button.
6. Enter the second component of the label template into Fields. This field contains double digits, so enter “00-99” into the field.
7. Press the *add* button.
8. Choose the separator for each component of the label template by pressing the period (.) in the Separators list.
9. Press the *Apply* button to apply the new template to the NetWorker server.

This template is useful if you do not want to attach any meaning to the labels, but want to be able to generate lots of them over the years and not worry about having to come up with a new template.

Using Volume Pools

This section describes volume pools, how to use pre-configured pools, and how to create new pools. It also provides several examples of why volume pools are useful.

Volume pools is a feature that allows you to sort your backup data to selected backup volumes. A volume pool contains a collection of backup volumes that have specific data sorted during the backup process. All NetWorker volumes belong to a pool, either the Default pool or a pool you have chosen.

If a backup is not sorted into either a pre-configured pool or a pool you have created, NetWorker automatically sends that backup data to the Default pool.

You can sort data into a volume pool by selecting the type of backup data to be included in the pool. NetWorker uses the choices you make in the Pools window to sort the backup data to specific backup volumes.

Leaving a choice for Groups, Clients, Save sets, or Levels unselected in the Pools window means that NetWorker does not sort the data by that choice. For example, if you do not choose a level from the Levels choices, NetWorker does not sort the data by levels for that pool. NetWorker sorts the data based on the other selections for that pool.

For each pool you must select either a group, client, or save set. Unless you have data to sort from one of these choices for a pool, NetWorker does not allow you to create the pool.

For example, you can sort by:

- A backup group
- A backup client
- A list of save sets (filesystems)
- Backup levels: fulls, levels 1– 9, incremental, or manual
- Backups for archival only (applies only to clients that archive data)

You can further organize your backup data by:

- Choosing a special label template
- Sending all the backup data to a particular backup device
- Choosing to store entries for the files in the online index (or not, if you are sending the backup media to an off-site vault)

NetWorker backs up all the clients in a group according to a schedule, and mixes the clients' data onto backup volumes. NetWorker tracks the backed-up data and the volumes to which the data is backed up. The data, however, is essentially combined on the backup volumes.

Volume pools establish a logical and systematic method for tracking and organizing your NetWorker backup volumes. For example, you may want to create a separate pool for each department in your company or a pool which contains only files with confidential information. Or you may want to assign all of your full backups to a particular pool so you can easily store them off-site. Volume pools allow you to select and sort specific files or data.

Each pool has an accompanying label template which you first create in the Label Templates window. You should use the same name for both your label template and volume pool to easily keep track of the backups and to which pools or tapes they belong. If you do not select a label template in the Pools window while creating a pool, NetWorker automatically creates a template for you with the same name as the pool. The advantage to creating your own label template in the Label Templates window is that you have more control over its design and content.

Note: You cannot create a new pool if NetWorker is busy doing a backup; this ensures that NetWorker sends the backup data to the correct pool. Nor can you delete a volume pool if any backup volumes still belong to that pool. ♦

Using the Pools window, it is easy to create a new volume pool. To open the Pools window, select the "Pools" command from the Administration pull-down menu (shown in Figure 3-5). The Pools window appears, as shown in Figure 5-13.

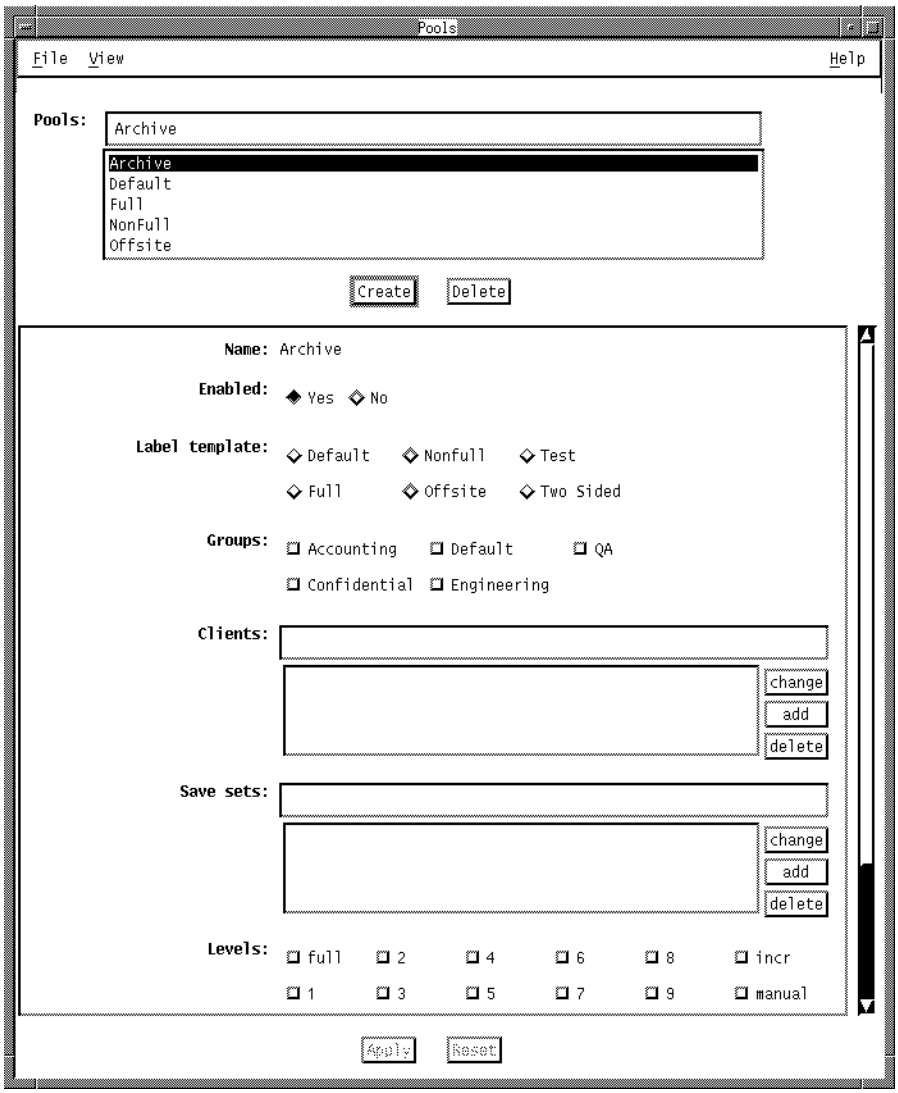

Figure 5-13 Pools Window

If necessary, use the scroll bar or resize the window to view the entire Pools window.

The Pools window contains all of the choices necessary for sorting your client‘s data to selected backup volumes. Following is an explanation of each of the elements in the window and instructions on how to use them for modifying and creating custom pools.

Pools	The Pools field displays the pool currently selected in the pools scrolling list. You may enter the name of the pool in the Pools field or select it from the scrolling list. A scroll bar appears to the right of the scrolling list if the list of pools extends beyond the display area.
Create button	Press the *Create* button to add a new pool.
Delete button	Press the *Delete* button to eliminate a pool. (You cannot delete a pool as long as it still contains backup volumes.)
Name	The Name field displays the name of the currently selected pool. It is also where you enter the name of a new pool after pressing the *Create* button.
Enabled	If you want NetWorker to use a pool during the backup process, choose “Yes” from the Enabled choices. If you want to exclude a pool during the backup process, select “No.”
Label template	Select a label template from the Label template choices. Each new label template you create in the Label Templates window appears as a choice. It is highly recommended that you use the same name for both the label template and the selected pool.
Groups	The Groups choices represent all of the groups known to the NetWorker server. There is no limitation on how many groups you can include in a pool. You can also select individual clients for a volume pool without selecting a group.
Clients	You can use the Clients field to: • Add an individual client(s) to a pool without selecting a group. • Pick a specific client belonging to a group. Note that if you pick a specific NetWorker client from a group, you exclude all the other clients from that group. Also note that if you have a group selected, the client you select must belong to that group.

Save sets	Use the Save sets field to: • Send a specific filesystem to a pool (see the section "Example 4 – Specific Filesystem" in this chapter for an example). • Send a specific filesystem, from a specific client, to a volume pool without selecting a group (see the section "Example 2 – Secure Device" in this chapter for an example). • Send a specific filesystem, from a specific client of a group, to a volume pool (see the section "Example 1 – Separate Departments" in this chapter for an example).
Levels	Indicates the backup levels that are included in this pool.
Archive only	The Archive only choices apply only if the NetWorker server is backing up data for archival. Typically clients that archive data are DOS, OS/2, and NetWare clients. If the volume pool is for archiving your clients' data, select "Yes." Usually, the Archive only choice is "No." (See the *Legato NetWorker Administrator's Guide, NetWare Version*, for information about archiving data.)
Devices	The Devices choices display the devices recognized by NetWorker. This is where you choose which devices you want to use for the selected pool. For example, you might want one pool for optical disks and one for tapes, if you have both media devices on the same server. If you do not choose any devices, NetWorker uses any device.
Store index entries	Store index entries allows you to choose, with the "Yes" and "No" options, whether or not you want to include the index entries from the backup in the online index. If you choose "No," the index entries are not included in the online index. For example, if you are using the pre-configured pool Offsite, you may not want the index entries online. However, an entry for the save set is still made in the media database.
Apply button	Press the *Apply* button to apply all of the selections you have chosen for a particular pool.

Reset button	Press the *Reset* button to restore your original selections, and override any new selections you may have chosen.

Use the Pools window to choose the pre-configured pools, create new pools, and change existing pools. Use this window for all administrative tasks relating to volume pools.

Using the Pre-Configured Pools

NetWorker is shipped with five pre-configured pools and matching label templates. Each pre-configured volume pool has a set of unique pre-selected choices. If you do not choose a pool for your backups they are automatically be assigned to the pre-configured Default pool and are labeled using the Default label template.

The pre-configured pools have been included for your convenience and provide a variety of ways for organizing your data.

The five pre-configured volume pools and their matching label templates are shown in Figure 5-13. (The Two Sided label template is for labeling optical media, and is the only template that does not have a matching volume pool.)

You can use the Default and Archive pools without making any selections. To use the other pre-configured pools you must first complete the selections and choose “Yes” from the Enabled choices. A pool must be enabled in order for NetWorker to sort data to that pool.

The five pre-configured pools are:

Archive	For archiving client data only. This pool cannot be modified or deleted. The pre-configured settings are: Enabled – Yes, Label template – Archive, Archive only – Yes, Store Index entries – Yes. The are no selections for you to make for this pool.
Default	Automatically used if you do not choose a pool. If you decide not to use the pools feature, NetWorker automatically places all of your backup volumes in this pool. The Default pool cannot be deleted or modified. The

	pre-configured settings are: Enabled – Yes, Label template – Default, Archive only – No, Store Index entries – Yes. There are no selections for you to make for this pool.
Full	Use this pool for full backups only. This pool separates all of your full backups from the incremental and level backups. Using the Full pool provides you with the ability to easily track and separate your full backups from the incremental and level backups. Typically you use this pool in conjunction with the NonFull pool. The pre-configured settings are: Enabled – No, Label template – Full, Levels – full, Archive only – No, Store Index entries – Yes.
NonFull	Use for any backups other than full backups. This pool includes all incremental and level backups. Use the NonFull pool to easily keep your incremental and level backups separate from the fulls. Typically you use this pool in conjunction with the Full pool. The pre-configured settings are: Enabled – No, Label template – NonFull, Levels – all level and incremental backups, Archive only – No, Store Index entries – Yes.
Offsite	For volumes being stored off-site. The Offsite pool allows you to easily create a set of volumes to be stored off-site. If your on-site backup volumes are destroyed, you can still recover your valuable data with the volumes you have stored off-site. If you are also using the Full pool, you must disable it while you are sending data to the Offsite pool to ensure that all of the full backups go only to the Off-site pool. The pre-configured settings are: Enabled – No, Label template – Offsite, Levels – full, Archive only – No, Store Index entries – No.

The Full, NonFull, and Offsite pools are intended for sorting data by levels.

Note: Remember to enable the pools you wish to have in effect during the scheduled backups by selecting “Yes” from the Enabled choices. ♦

Creating a New Pool

You can create as many pools as you need to effectively organize and sort your backup volumes. There is no limitation on the number of new pools you can create. This section uses an example to show you how to create a new pool.

Suppose you want to create a pool named “Test” that selects all of the full backups from a group called QA. The QA group backs up all of the data from the systems in the quality assurance lab. You want to sort the full backups so you can have a complete set of data on your backup volumes to store in a secured vault. This is data that you do not expect to need to recover, but plan to keep for a year.

All NetWorker pools require a label template, described earlier in this chapter in the section “Using Label Templates.” Before creating a new pool you should first create a label template with the same name, in this example “Test.” It is strongly recommend that you keep the pool names and their corresponding label templates consistent. If you do not use the exact name, you should at least use names that have a logical connection.

The Label Templates window looks like Figure 5-14 after you create the Test label template.

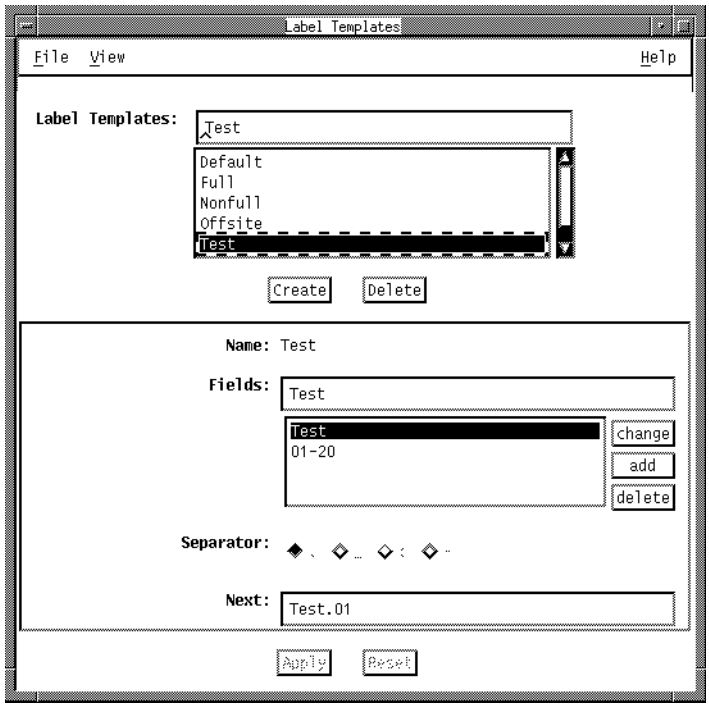

Figure 5-14 Label Templates Window

After creating the label template, open the Pools window (Figure 5-13) and follow these steps to create a pool named “Test”:

1. Press the *Create* button and enter “Test” into the Name field.
2. Select “Yes” from the Enabled choices. (“Yes” is the pre-configured choice.)
3. Choose the label template Test, which you previously created.
4. Choose the group QA, because it contains the clients you want to include in the Test pool. You do not want to selectively include clients or save sets, so you do not need to use either the Clients or Save sets fields.
5. Select “full” from the levels choices.
6. Leave the Archive only choice as “No.”

7. If your NetWorker server has more than one device, you may select one of them from the Devices choices.
8. Select “No” from the Store index entries display. Selecting “No” means that you do not include the index entries in the online index, saving space on your hard disk.
9. Press the *Apply* button to apply the selections. The Pools window looks like Figure 5-15 after creating the pool “Test.”

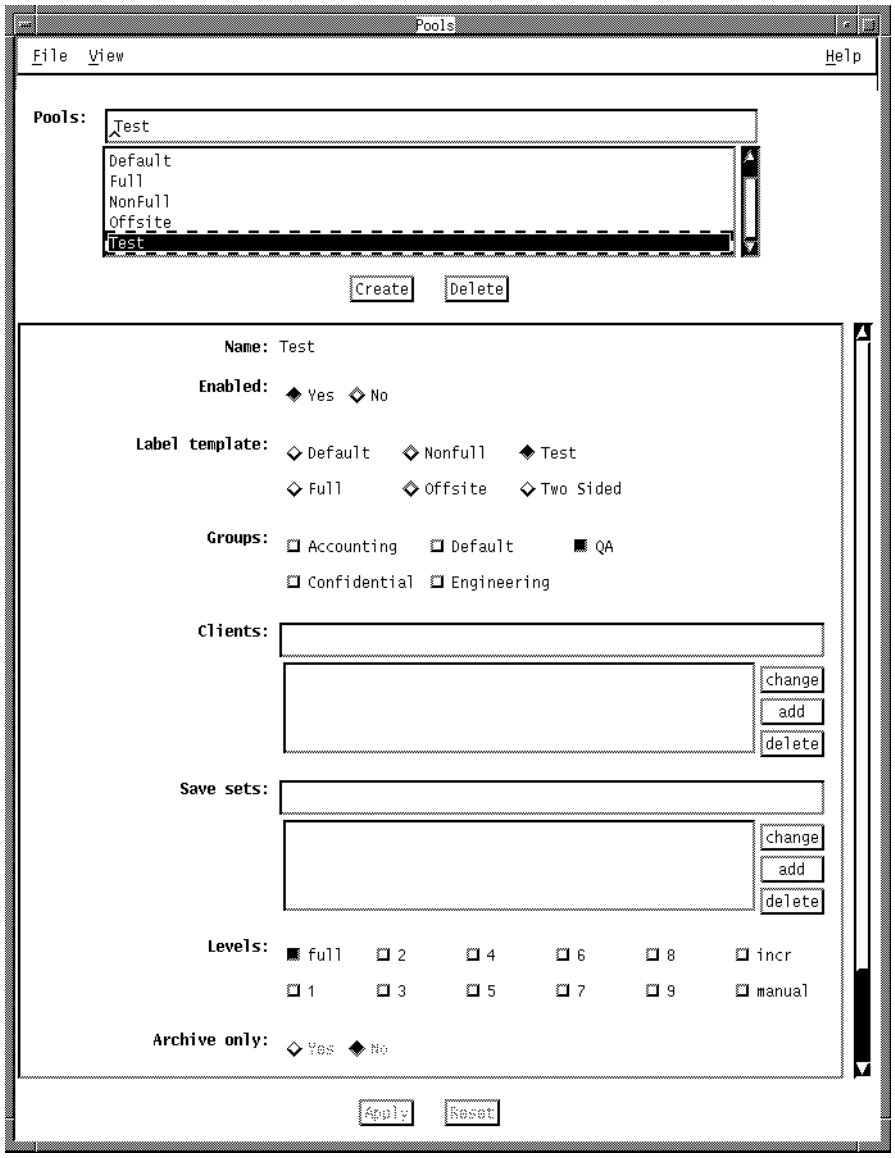

Figure 5-15 Pools Window

Once you create a new pool you can easily modify it by choosing the pool from the Pools scrolling list and changing the current selections. When you have completed making the modifications press the *Apply* button. If you have changed your mind and do not want to implement the new selections press the *Reset* button to restore the Pools window to its original configuration.

Note: NetWorker does not allow you to create two different pools with duplicate choices for Groups, Clients, Save sets, Levels, or Archive only in the Pools window. If you try to create two pools with the same choices for all of these items, NetWorker displays an error message. ♦

Pool Examples

This section provides some examples of volume pools.

Example 1 – Separate Departments

Your company needs to track department resources for accounting requirements which include the related costs of each department's backups. To sort each department's data, create a separate pool for each one. Sorting the data into different pools for each department makes it easy for accounting to determine how many tapes are being used, which backup devices are being used, and how much time is being spent on administering each department's backup needs.

To create a pool for each department, follow these steps:

1. Create a label template with the name of the department in the Label Templates window.
2. Use the Pools window to create a new pool with the same name as the label template.
3. Select the groups that belong to each department.

Example 2 – Secure Device

You have confidential company information that needs to be backed up to a secure device in an area that only authorized personnel can access. You do not want to include an entire group, just a select set of files from a small number of clients in a pool named “Confidential.”

To create the “Confidential” pool, follow these steps:

1. Create a label template named “Confidential.”
2. Create a pool with the same name.
3. Enter the name of each client in the Clients field.
4. Enter the filesystems for each of the clients in the Save sets field.
5. Select the device they will be backed up to from the Devices choices.

Example 3 – Targeted Backups

Your company creates large multi-gigabyte graphic files that require many backup volumes to complete a full backup. You want to back up these files to the jukebox on your network, so you do not need to load new backup volumes as they fill up with data.

To back up the graphics files on the jukebox, follow these steps:

1. Create a label template named “Graphics Full.”
2. Create a new pool by the same name.
3. Choose the group(s) that need to be included.
4. Select full from the Levels choices.
5. Choose the jukebox device from the Devices choices.

Example 4 – Specific Filesystem

Your company requires that you save all of the employees' electronic mail. To keep the e-mail files separate from the rest of the backups, create a pool named "E-mail."

To create a pool named "E-mail," follow these steps:

1. Create a label template named "E-mail."
2. Create a pool with the same name. You do not need to select a specific group or client because you are backing up all of the client systems' electronic mail.
3. In the Save sets field enter:

   `/usr/spool/mail`

   NetWorker backs up all the electronic mail from all the clients to the volumes in the "E-mail" pool.

Adding and Deleting Backup Devices

This section explains how to use the Devices window to add and delete devices on a server. NetWorker supports multiple devices either in a series, concurrently, or in a jukebox. If your server is configured to support more than one backup device in a series, NetWorker uses the backup volume in one device until it is full and then uses the backup volume in another device until it is full, and so on. Using NetWorker Advanced for IRIX or the Concurrent Device Support for NetWorker option (with NetWorker for IRIX) spreads the backups evenly over all the backup devices. Using a NetWorker Support for Jukebox option eases the automated handling of backup volumes for unattended backups. See the section "Backup Devices and Media" in Chapter 1 for a list of supported backup devices.

To view current devices or to add a new device, select "Devices" from the Administration pull-down menu (shown in Figure 3-5). The Devices window appears, similar to the one in Figure 5-16.

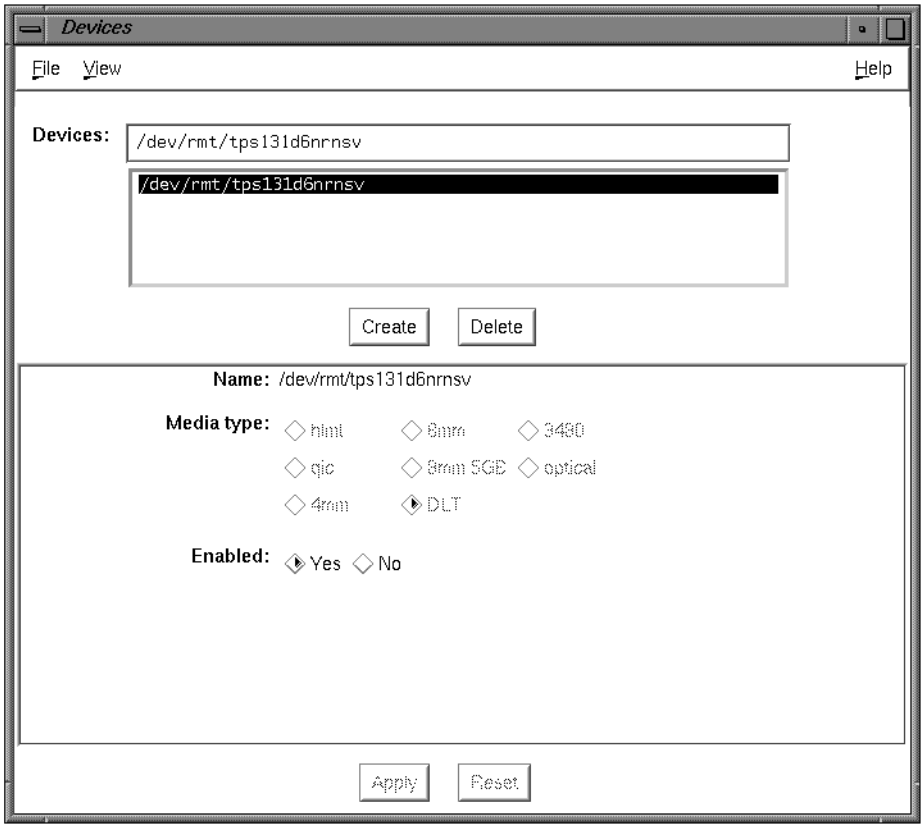

Figure 5-16 Devices Window

The fields in the Devices window are:

Devices scrolling list
: The device pathnames displayed in the Devices scrolling list represent the backup devices connected to the NetWorker server. They may be stand-alone devices or devices located inside of a jukebox. These devices can be used for backing up and recovering client files.

Name
: The Name field displays the pathname of the currently selected device or accepts a pathname of a new device.

Media type	The Media type of the currently selected device is highlighted. The Media type choices are also used to select the type of new devices. The choices represent eight millimeter tape drive (8mm), eight millimeter five gigabyte tape drive (8mm 5GB), digital linear tape (DLT), four millimeter tape drive (4mm), 3480 tape drive (3480), optical disk drive (optical), quarter-inch cartridge tape drive (qic), or half-inch magnetic tape drive (himt). These buttons are inactive until you press the *Create* button to add a device. The media types displayed in the Devices window vary depending upon what type of backup devices are supported by the current NetWorker server.
Enabled	If Enabled is "Yes,", NetWorker uses the device. If Enabled is "No," NetWorker doesn't use the device: it won't read or write volumes in it and won't load tapes into the jukebox if it is a jukebox device.

Before adding a device, determine this information:

- The pathname of the device

  The pathname of a device is similar to */dev/rmt/tps1d6nrnsv*.

- The Media type of the device (what type of media it supports)

  Note: A no-rewind tape backup device is required (except for optical drives) because NetWorker writes a file mark on the backup volume at the end of each backup and then appends data onto the volume based on the position of the file mark. If the device rewinds the media, the file mark position is lost and previously written data is overwritten by the next backup. ♦

To add a new backup device to the server, follow these steps:

1. Select "Devices" from the Administration pull-down menu. The Devices window appears, as shown in Figure 5-16.
2. Press the *Create* button in the Devices window.
3. Enter the device pathname for the new device in the Name field.
4. Select the appropriate Media type choice for the type of device.

5. Press the *Apply* button. Any additions you made appear in the Devices window.

To delete a backup device from the server, follow these steps:

1. Select the device you want to delete in the Devices scrolling list.
2. Press the *Delete* button. An “ok to delete?” confirmation box appears.
3. Press *Ok* to delete the device. Any deletions you made appear in the Devices window.

Selecting Other Server Options

This section contains information about server options and includes information on changing server parallelism, using concurrent devices, and adding or changing NetWorker administrators.

Changing Server Parallelism

A NetWorker server may back up files from many clients in parallel and mix the files onto the backup volume. This feature keeps a steady stream of files supplied to the server backup devices so that they operate at high speed.

To optimize the efficiency of the server, you can control how many clients can back up their files at one time by changing the value in the Parallelism field in the Server window. You may want to adjust the number of clients allowed to back up at a time if:

- The server is taking too long to back up all the clients (increase the parallelism)
- The server is so busy backing up clients it is not available for any other tasks (decrease the parallelism)
- The server runs out of swap space or memory

To open the Server window, select “Servers” from the Administration pull-down menu (shown in Figure 3-5). The Server window is shown in Figure 5-17.

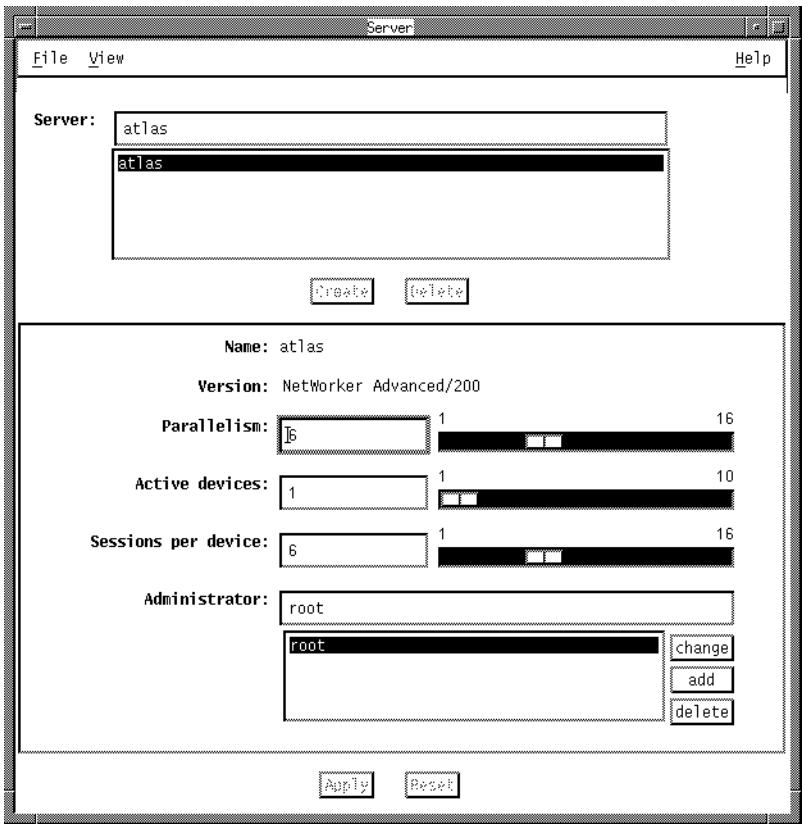

Figure 5-17 Server Window

The fields in the Server window are:

Server	Shows the name of the current NetWorker server.
Name	The Name field displays the name of the current NetWorker server.
Version	The Version field displays the version of the software currently installed on the NetWorker server.
Parallelism	The Parallelism value is controlled by a sliding bar. You can set the parallelism to any value between 1 and 16, by using the mouse to slide the bar to the left and right.

Active devices and Sessions per device
: The Active devices and Sessions per device values refer to using concurrent devices, an optional feature explained in the section “Using Concurrent Devices” in this chapter. The Active devices and Sessions per device fields appear in the Server window, but are only available for use if you have purchased the Concurrent Device Support for NetWorker option.

Administrator
: The Administrator scrolling list displays the names of the users or user groups who have permission to change the configuration of the NetWorker server. For more information, see the section “Adding or Changing Administrators” in this chapter.

To change the number of clients that can simultaneously back up their files to the NetWorker server, follow these steps:

1. Select “Servers” from the Administration pull-down menu.
2. Select the Parallelism sliding bar and move it to the right or left to display the value you want, or enter the value in the field.
3. Press the *Apply* button.

When a client finishes a backup, another client may start a backup, but the parallelism value is not exceeded. For example, if there are eight NetWorker clients and parallelism is set to 4, after the first client finishes a backup, the fifth client starts, so that a total of four clients are backing up at one time. Any four clients may back up at any one time.

Tip: To “turn off” the parallelism so that only one client can back up to the server at a time, set the Parallelism value to 1. ♦

Using Concurrent Devices

In addition to setting the number of parallel clients per NetWorker server, you can configure the server to back up to several devices concurrently. The devices operate simultaneously to back up the data, thus speeding backups.

To be able to use the concurrent devices feature you must have NetWorker for IRIX with the Concurrent Device Support for NetWorker option or have NetWorker Advanced for IRIX. To back up to concurrent devices, you enter the maximum number of Active devices and the desired number of Sessions per device in the Server window, as shown in Figure 5-17.

The Active devices and Sessions per device values are controlled by a sliding bar. You can set the number of active devices to any value between 1 and 16. You can set the number of save sessions per device to any number between 1 and 16. A save session is generated when a client starts a backup. A single client can generate multiple overlapping save sessions.

The Active devices value sets the maximum number of media devices NetWorker that uses concurrently for backups. An active device is one that is being used by the NetWorker server for backups or recovers.

The Sessions per device value is the target number of save sessions accepted by an active device. Sessions per device also determines which device processes the next save session. If a device is receiving the target number of save sessions, then the server sends the next session to the next under-utilized device. If all devices are receiving the target number of sessions, NetWorker overrides the Sessions per device value and forces the backup onto the device with the least activity.

Together with Parallelism, the Active devices and Sessions per device values control the backup traffic from the NetWorker server to the media devices.

To configure the NetWorker server to back up to concurrent devices:

1. Select “Servers” from the Administration pull-down menu.
2. Set the Parallelism value. See the section “Changing Server Parallelism” in this chapter.
3. Select the Active devices slide bar and move it to the right or left to display the value you want.
4. Select the Sessions per device slide bar and move it to the right or left to display the value you want.
5. Press the *Apply* button.

Tip: To distribute your client backups evenly across the available backup devices, simply divide the number in the Parallelism field by the number in the Active devices field. Then enter that number in the Sessions per device field. For example, if the number you entered in the Parallelism field is 8, and you entered 2 in the Active devices field, the number you enter in the Sessions per device field is 4. ♦

Adding or Changing Administrators

NetWorker is shipped with a pre-configured settings so that only *root* has permission to change its system configuration. You can add, delete, or change the permission to give other users or user groups system administration privileges. When using NetWorker for the first time, run it as *root* to add the user or user group names to the Administrator list.

The system administration permissions are modified in the Server window.

To change the setting, follow these steps:

1. Open the Server window by selecting “Servers” from the Administration pull-down menu.
2. Enter the new user name or NIS (network information service) netgroup name into the Administrator field. Netgroup names must be preceded by an ampersand (&) in the Administrator field.

   For example, you can restrict administrator access to a particular system with the name *root@server_name*.
3. Press the *add* button. (The *change* button lets you change the currently selected name.)
4. Press the *Apply* button to apply the changes.

   Note: If you get the error message `user` *user_name* `needs to be on administrator's list`, it means you do not have permission to make configuration changes. ♦

To delete a name from the Administrator list:

1. Select the name in the scrolling list.
2. Press the *delete* button.
3. Press the *Apply* button.

Every user or user group listed in the Administrator scrolling list has permission to modify the NetWorker server configuration.

Setting Event Notification

As system administrator, you may be interested in knowing about events taking place in the NetWorker environment. You see messages on the system console (*/dev/console*) or have them mailed to you electronically.

There are four kinds of notification that are of particular interest to you:

- Did the network-wide backup complete for all the clients scheduled for the backup?
- Is NetWorker requesting any backup media to be mounted?
- Is it time to reduce the size of the online index?
- Are your NetWorker products registered properly?

Note: These notices alert you regarding important NetWorker events. If a group of clients did not complete a nightly backup, for example, you are informed of this by the savegroup completion notices in your electronic mail. ♦

Open the Notifications window by selecting “Notifications” from the Administration pull-down menu, shown in Figure 3-5. The Notifications window is shown in Figure 5-18.

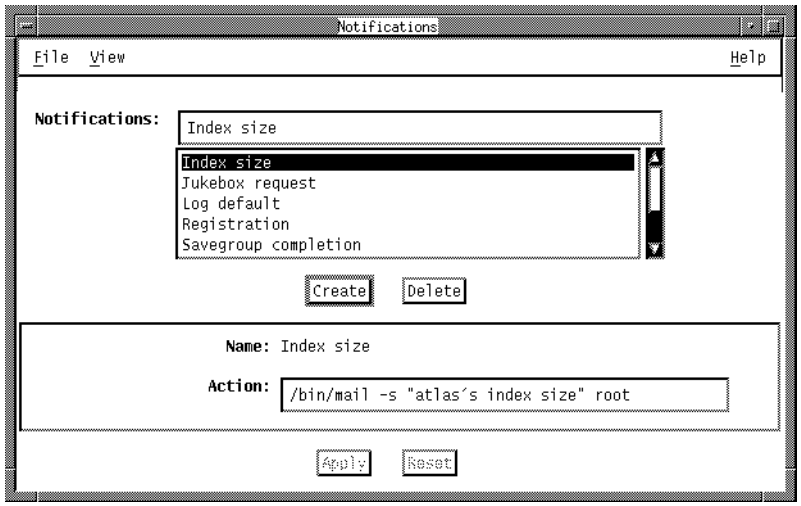

Figure 5-18 Notifications Window

The Notifications scrolling list displays the names of all the notifications known to the NetWorker server. Information about the currently selected notification is displayed in the lower half of the window.

The Name field displays the name of the currently selected event notification.

The Action field displays the type of action NetWorker takes with the notice. For example, NetWorker can use electronic mail to notify individuals that a backup volume needs to be mounted in the server. You can change the Action field to customize how the notifications are posted.

NetWorker is shipped with seven types of notification: Registration, Savegroup completion, Log default, Index size, Tape mount request 1, Tape mount request 2, and Tape mount request 3. If you are using a jukebox with NetWorker you also receive an additional Jukebox request notification.

Registration
: The registration notification sends a message to *root* notifying you that your NetWorker products are not properly registered. You receive the registration notification once a day or each time you start NetWorker. The notification message includes related information about each of the NetWorker products that are not licensed correctly.

Log Default
: The log default notification uses a IRIX facility called *syslog* to log and distribute notification about all NetWorker events. These events include requests for backup volume mounts, index size notices, and savegroup completion notices. How this information is distributed depends on how you have configured *syslog*. When NetWorker was installed, it created entries for logging and contacting operators. You can customize these entries. See the *syslogd*(1M) reference page for information on configuring the distribution of log information.

Index Size
: NetWorker checks the size of its online indexes and sends a notification if it looks as if the indexes may run out of disk space. NetWorker automatically sends the electronic mail message to *root*. If you want the message to be mailed to someone other than *root*, you can edit Action and substitute *root* with a different user login name or mailing list, for example. If you see this message, see the section “Managing the Indexes Manually” in Chapter 7 for information on reducing the size of the indexes.

Savegroup Completion
: When NetWorker finishes backing up a group of clients, it sends a completion message via electronic mail to *root*.

Backup Media Request Notices
: When NetWorker needs backup media mounted for a backup, or a specific backup volume mounted to fill a recovery request, it displays a media request message in the NetWorker main window. If no one fills the request, NetWorker sends another request after 15 minutes. NetWorker sends a third request after another 37 minutes, if no one fills the request.

The first mount request has a blank Action field, so the request appears only in the Pending display of the NetWorker main window. The second mount request sends an alert to the logger, and the third request sends electronic mail messages to *root*.

Jukebox Request

NetWorker sends a jukebox request when a backup volume is required. A jukebox request is the NetWorker response to a media request when a jukebox is in use.

NetWorker Daily Operations

This chapter describes how to operate NetWorker using the pre-configured settings described in the section “Pre-Configured Settings” in Chapter 4. It also describes the everyday tasks for operating NetWorker.

Generally, there are five daily tasks required to operate NetWorker:

- Checking the server status
- Starting and stopping backups
- Managing the backup volumes
- Monitoring the indexes
- Checking NetWorker notices

Checking the NetWorker Server Status

The main window displays the status of the NetWorker server in five displays. If you do not already have the main window on your screen, enter the *networker*(1M) command at the prompt in a shell window to start NetWorker and to display the main window:

```
# /usr/etc/networker &
```

The NetWorker main window appears, as shown in Figure 3-1.

To check the status of the NetWorker server, follow these steps:

1. In the Messages display, scroll through the available messages. Error messages in this display indicate problems that should be investigated.
2. Look at the Pending display. If there are messages in this display, there may or may not be a problem:

- If there are active save sets running (denoted by changing messages in the Messages display), then NetWorker is operating normally.
- If there are no active save sets running, then there may be a problem and it should be investigated.

3. Open the Group Control window by selecting the “Group Control” command from the Operation pull-down menu. For each group, select the group, then press the *Details* button. Messages in the Failed Save Sets display indicate problems. For more information, see the section “Displaying the Backup Details” later in this chapter.
4. Check the contents of */var/adm/SYSLOG* for the last 24 hours. Look for:
   - Messages output by NetWorker as it works. Check to see if there are any error messages.
   - Error messages output by the kernel that might affect the operation of NetWorker; for example, messages about SCSI hardware errors.

Starting a Network-Wide Backup

This section describes how to start a network-wide backup. NetWorker provides you with the flexibility of backing up your files in several different ways. Using the Groups window, you can enable or disable a scheduled backup, or initiate a scheduled backup immediately. Using the Group Control window, you can start, stop, or restart a scheduled backup.

Tip: Make sure the NetWorker server has a labeled backup volume mounted in its device before you initiate a backup. If you do not, NetWorker requests a volume in the Pending display of the main window so it can start the backup for the clients in the group. See the section “Labeling and Mounting Backup Volumes” in this chapter for more information. ♦

Enabling a Scheduled Backup

NetWorker is shipped with a Default group with an automatic backup start time of 3:33 a.m. After you install NetWorker and enable the Default group, NetWorker automatically initiates a network-wide backup at this time every day and backs up the clients according to the Default backup schedule.

First you need to label the backup volumes and mount them in the NetWorker server's backup devices before you go home (unless you have a jukebox, in which case NetWorker mounts the volumes it needs automatically.)

To enable a scheduled backup, follow these steps:

1. Select "Groups" from the Administration pull-down menu (shown in Figure 3-5). The Groups window appears, as shown in Figure 6-1.

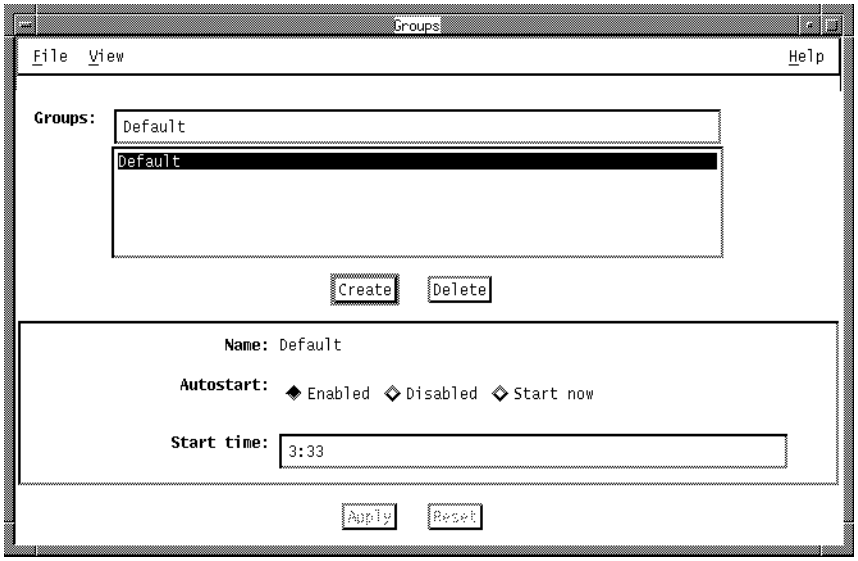

Figure 6-1 Groups Window

2. Select the Enabled from the Autostart choices. NetWorker begins backing up the clients in the Default group at the time shown in the Start time field.

Starting a Scheduled Backup Immediately

If you want to start a scheduled backup immediately, you may do so with the Groups window. This is useful, for example, if you must disable the network for repair and want to back up all the systems immediately.

To start a scheduled backup immediately, follow these steps:

1. Select “Groups” from the Administration pull-down menu.
2. Select the name of the group of clients you want to back up in the Groups scrolling list. You can select one group at a time.
3. Select Start now from the Autostart choices.
4. Press the *Apply* button.

NetWorker starts the scheduled backup of the clients in the selected backup group. For more information about backup groups, see the section “Creating a Backup Group” in Chapter 5. The backup level is determined by the schedule in effect for the clients in the selected group. For more information about backup schedules, see the section “Setting Up the Backup Schedules” in Chapter 5.

Tip: You can also start a backup immediately by pressing the *Start* button in the Group Control window. The procedure is explained in the section “Starting a Backup Now” in Chapter 3. ♦

Monitoring a Scheduled Backup

Open the Group Control window by selecting the “Group Control” command from the Operation pull-down menu (shown in Figure 3-4). The Group Control window appears, as shown in Figure 6-2.

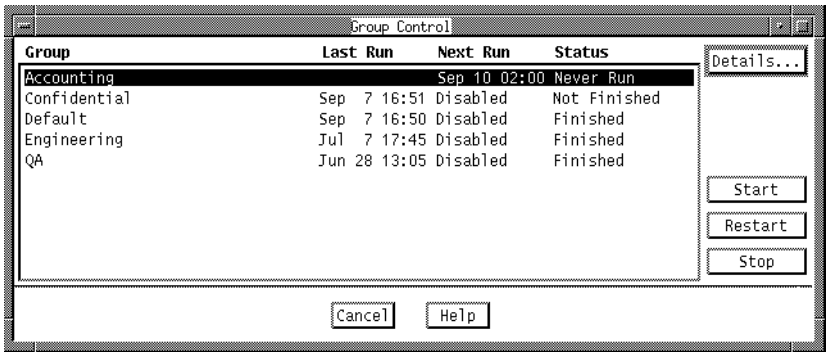

Figure 6-2 Group Control Window

The Group Control window displays information about all of the backup groups known to the NetWorker server.

Group	Displays the name of the backup group
Last Run	Displays the date and time the group was last backed up
Next Run	Displays the date and time scheduled for the next backup of the group, or whether the scheduled backup is disabled
Status	Displays the progress of the backup

The Status area displays four progress messages:

Never Run	The group has never been backed up
Finished	The backup has finished
Not Finished	The backup is still running or the backup has exited prematurely without finishing

Stopping a Backup Group

If you need to stop a scheduled backup that is in progress, you may do so by pressing the *Stop* button in the Group Control window.

Follow these steps:

1. Select the group you wish to stop in the Group scrolling list of the Group Control window.
2. Press the *Stop* button.

NetWorker halts the scheduled backup, and displays “not finished” in the Status field of the group in the Group Control window.

Restarting a Backup Group

If you wish to restart a scheduled backup that you have stopped, use the *Restart* button in the Group Control window.

Follow these steps:

1. Select the name of the halted backup group in the Groups list of the Group Control window.
2. Press the *Restart* button.

NetWorker resumes the scheduled backup for the group, and displays "running" in the Status field for the group.

Displaying the Backup Details

To view more detailed information about the backup of the group currently selected in the Group Control window, press the *Details* button.

NetWorker displays the Group Control Details window, as shown in Figure 6-3.

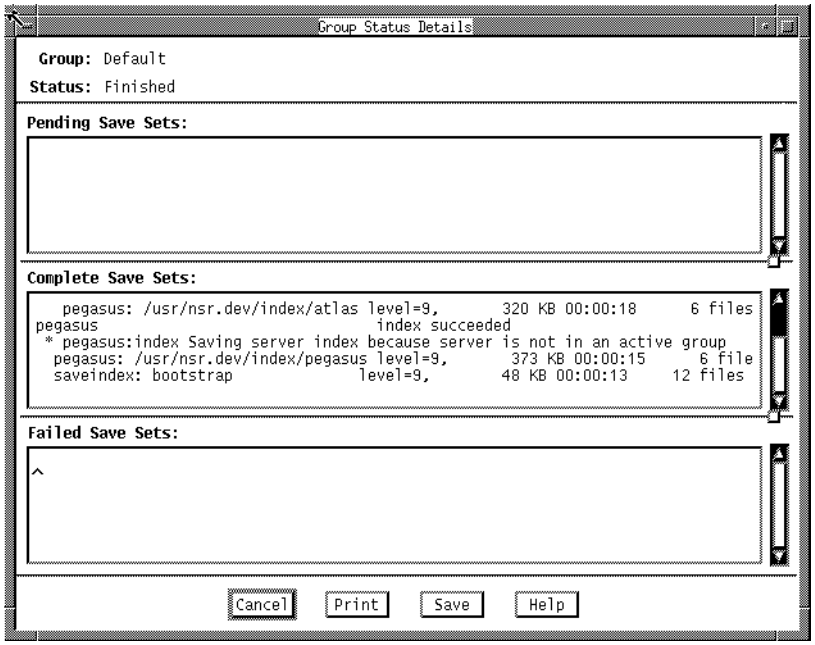

Figure 6-3 Group Control Details Window

There are three fields in the Group Control Details window which display information about each client in the backup group:

Pending Save Sets
: Displays the filesystems which have not yet been backed up

Complete Save Sets
: Displays the filesystems which NetWorker has successfully backed up

Failed Save Sets
: Displays the filesystems which NetWorker was unable to back up

If a client's open file changes during a scheduled backup, NetWorker backs up the file and "notices" that it is changing. The file (save set) that changed during the backup displays a warning message in the Group Control Details window similar to this:

`warning: file` *name* `changed during save`

You may restart the group backup, back up the client manually, or allow NetWorker to back up the client during the next scheduled backup.

If NetWorker was unable to back up the filesystems for a client in the group, you need to determine the cause for the failed backup. Typical reasons for failed save sets include:

- The server crashed during the backup
- The client crashed during the backup
- The network connection failed during the backup

If NetWorker fails to back up a client in a group, and you have set the Client again tries in the Groups window to a number greater than zero, you may see filesystems in the Failed Save Sets scrolling list temporarily while NetWorker tries again to back up the client.

Displaying Backup Volume Information

The Volume Management window displays information about the backup volumes. It gives you a global look at the NetWorker server's collection of backup volumes.

To see the Volume Management window, select "Volumes" from the Operation pull-down menu (shown in Figure 3-4). The Volume Management window appears, as shown in Figure 6-4.

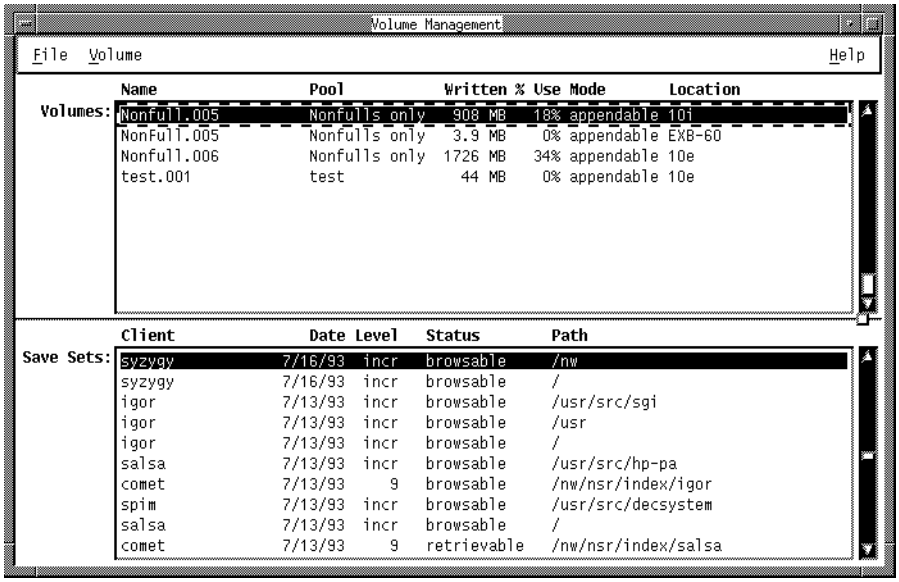

Figure 6-4 Volume Management Window

The Volumes scrolling list displays the names and modes of the backup volumes with entries in the server media index. The columns are:

Name	Contains the names of the backup volumes, sorted in alphabetical order, for the current server.
Pool	Displays the name of the pool to which the backup volume belongs.
Written	Displays the amount of data written on the backup volume.

% Use	The percentage of the backup volume used compared to its total capacity (% Use)
Mode	The mode of the backup volume, either appendable, full, or recyclable. Appendable means that there is room for more data on the backup volume. Full means that there is no more room for data on the backup volume, and that the save sets have not yet passed the time period specified by the browse and retention policies. Recyclable means that all the save sets on the volume have passed both the browse and retention policies and are eligible to be overwritten.
Location	The location of the volume as entered by the user. This serves as a reminder of where your volumes are physically located.

You can use the Volumes scrolling list to view the backup volumes for a server. When you select a volume name in the Volumes scrolling list, its contents appears in the Save Sets scrolling list. A *save set* is typically a filesystem backed up by NetWorker.

The Save Sets scrolling list provides this information about each save set stored on a volume:

Client	The name of the client system that created the save set.
Date	The date that the save set was created.
Level	The level of the backup that generated the save set. Backup levels apply only to scheduled backups. If no level is listed, the save set was generated by a manual backup initiated by a client system, or it is a save set from a backup volume that was created with NetWorker version 1.0, which did not support backup levels.
Status	The status of the save set. Save set status may be either browsable, retrievable, or recyclable. Browsable status means that the save set has an entry in the file index for the client because it has not passed the time period specified by the browse policy for the client. The files contained in a browsable save set can be browsed and marked for recovery using the Recover window.

	Retrievable status means that the entry for the save set has been removed from the client file index, either automatically due to the client browse policy, or manually by pressing the *Remove oldest cycle* button in the Indexes window. In order to recover any files contained in this save set, the file index entries must be recreated using the *scanner*(1M) command. (See the *scanner*(1M) reference page for information on using the *scanner* command.) Recyclable status for a save set means that it has passed both the browse and retention policies time period and is eligible to be overwritten.
Path	The pathname of the filesystem contained in the save set.

See the section “Managing the Volumes Manually” in Chapter 7 for more information on managing backup volumes.

Monitoring Index Disk Space Usage

Every time a backup completes, NetWorker creates entries for the files saved for each client in online indexes. These indexes require disk space and must be monitored to be sure they are not getting too large. Entries can be removed from the indexes when they become too large. You can also manage your indexes automatically by selecting different index policies in the Policies window. See the section “Creating Index Policies” in Chapter 5 for more information.

To view the disk space usage of the indexes, select “Indexes” from the Operation pull-down menu (shown in Figure 3-4). The Indexes window appears, as shown in Figure 6-5.

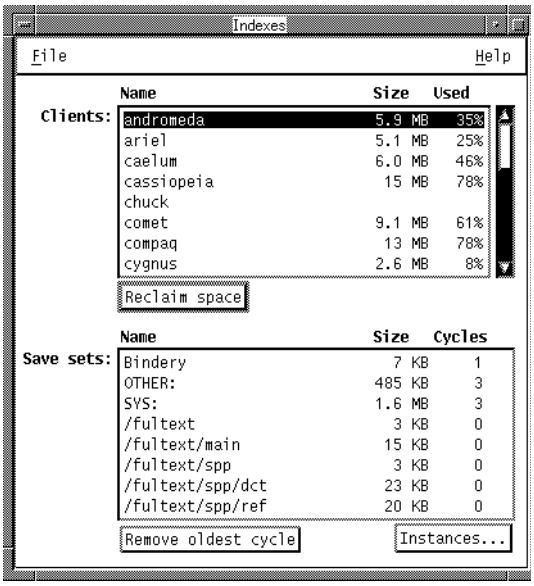

Figure 6-5 Indexes Window

Used indicates the percentage of the index file being used. If the percent listed is 100%, that means the index has completely filled the allocated disk space and there is very little, if any, disk space to reclaim. The smaller the percentage, the more disk space there is to reclaim, because the index is not using all of the currently allocated disk space. The allocated disk space grows automatically as the index size increases.

For more information on reclaiming disk space in the indexes, see the section “Managing the Indexes Manually” in Chapter 7.

Checking NetWorker Notices

Checking NetWorker notices is an important daily task for the smooth operation of NetWorker. NetWorker sends notices about significant NetWorker *events*. These notices include:

- Messages requesting backup volumes to be mounted
- Nightly backup completion notices
- Messages concerning the size of the online indexes
- Jukebox request messages
- Registration status

NetWorker is shipped with pre-configured notification instructions to send electronic mail to *root* about most events.

There are three ways for you to check NetWorker notices:

1. Log on as *root*, and read your electronic mail.
2. Look at the system console messages.
3. Use the NetWorker main window to watch for notices in the Pending and Messages displays.

See “Setting Event Notification” in Chapter 5 for more information.

Displaying Backup Volume Information

The Volume Management window displays information about the backup volumes. It gives you a global look at the NetWorker server's collection of backup volumes.

To see the Volume Management window, select "Volumes" from the Operation pull-down menu (shown in Figure 3-4). The Volume Management window appears, as shown in Figure 6-4.

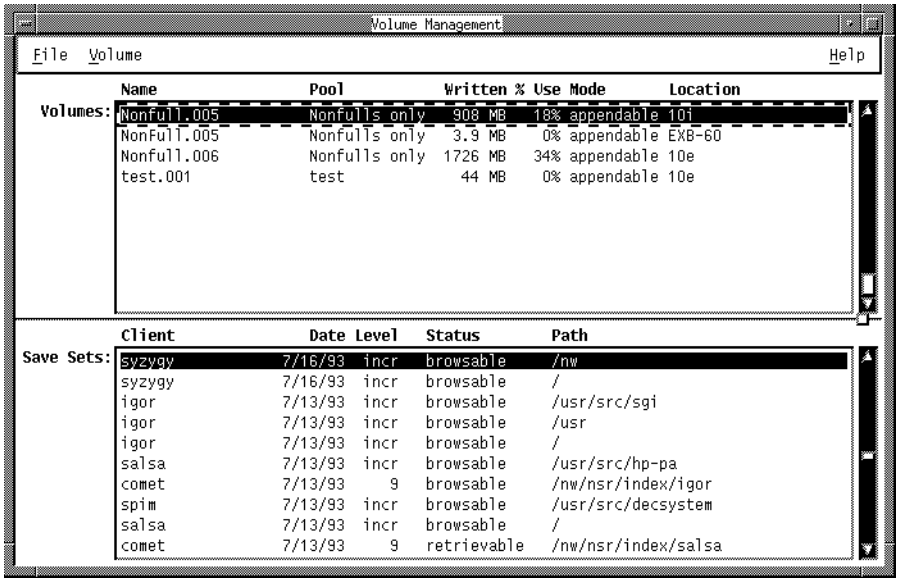

Figure 6-4 Volume Management Window

The Volumes scrolling list displays the names and modes of the backup volumes with entries in the server media index. The columns are:

Name	Contains the names of the backup volumes, sorted in alphabetical order, for the current server.
Pool	Displays the name of the pool to which the backup volume belongs.
Written	Displays the amount of data written on the backup volume.

% Use	The percentage of the backup volume used compared to its total capacity (% Use)
Mode	The mode of the backup volume, either appendable, full, or recyclable. Appendable means that there is room for more data on the backup volume. Full means that there is no more room for data on the backup volume, and that the save sets have not yet passed the time period specified by the browse and retention policies. Recyclable means that all the save sets on the volume have passed both the browse and retention policies and are eligible to be overwritten.
Location	The location of the volume as entered by the user. This serves as a reminder of where your volumes are physically located.

You can use the Volumes scrolling list to view the backup volumes for a server. When you select a volume name in the Volumes scrolling list, its contents appears in the Save Sets scrolling list. A *save set* is typically a filesystem backed up by NetWorker.

The Save Sets scrolling list provides this information about each save set stored on a volume:

Client	The name of the client system that created the save set.
Date	The date that the save set was created.
Level	The level of the backup that generated the save set. Backup levels apply only to scheduled backups. If no level is listed, the save set was generated by a manual backup initiated by a client system, or it is a save set from a backup volume that was created with NetWorker version 1.0, which did not support backup levels.
Status	The status of the save set. Save set status may be either browsable, retrievable, or recyclable. Browsable status means that the save set has an entry in the file index for the client because it has not passed the time period specified by the browse policy for the client. The files contained in a browsable save set can be browsed and marked for recovery using the Recover window.

	Retrievable status means that the entry for the save set has been removed from the client file index, either automatically due to the client browse policy, or manually by pressing the *Remove oldest cycle* button in the Indexes window. In order to recover any files contained in this save set, the file index entries must be recreated using the *scanner*(1M) command. (See the *scanner*(1M) reference page for information on using the *scanner* command.) Recyclable status for a save set means that it has passed both the browse and retention policies time period and is eligible to be overwritten.
Path	The pathname of the filesystem contained in the save set.

See the section “Managing the Volumes Manually” in Chapter 7 for more information on managing backup volumes.

Monitoring Index Disk Space Usage

Every time a backup completes, NetWorker creates entries for the files saved for each client in online indexes. These indexes require disk space and must be monitored to be sure they are not getting too large. Entries can be removed from the indexes when they become too large. You can also manage your indexes automatically by selecting different index policies in the Policies window. See the section “Creating Index Policies” in Chapter 5 for more information.

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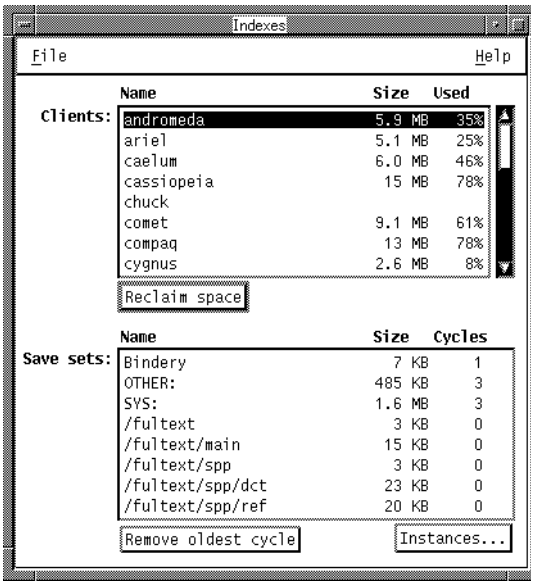

Figure 6-5 Indexes Window

Used indicates the percentage of the index file being used. If the percent listed is 100%, that means the index has completely filled the allocated disk space and there is very little, if any, disk space to reclaim. The smaller the percentage, the more disk space there is to reclaim, because the index is not using all of the currently allocated disk space. The allocated disk space grows automatically as the index size increases.

For more information on reclaiming disk space in the indexes, see the section “Managing the Indexes Manually” in Chapter 7.

Checking NetWorker Notices

Checking NetWorker notices is an important daily task for the smooth operation of NetWorker. NetWorker sends notices about significant NetWorker *events*. These notices include:

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NetWorker is shipped with pre-configured notification instructions to send electronic mail to *root* about most events.

There are three ways for you to check NetWorker notices:

1. Log on as *root*, and read your electronic mail.
2. Look at the system console messages.
3. Use the NetWorker main window to watch for notices in the Pending and Messages displays.

See “Setting Event Notification” in Chapter 5 for more information.

Managing Indexes and Volumes Manually

This chapter describes powerful NetWorker index management features for manually managing the online indexes. You can also configure NetWorker to automatically manage the indexes using the Policies window. (See the section “Creating Index Policies” in Chapter 5 for more information on automatic index management.)

This chapter describes the following concepts of indexes and index management:

- Online indexes
- Save sets
- The four actions that can be performed on an online index

Also included in this chapter are instructions on manually managing the indexes and backup volumes:

- Removing the oldest cycle and reclaiming index space from a file index
- Managing the backup volumes by changing the mode of a volume or by removing a volume

Online Indexes

NetWorker maintains two types of indexes: a *file index* and a *media index*. The file index stores information about the files backed up by NetWorker, and the media index maps the backed-up files to backup volumes. These indexes are used by NetWorker to locate the files requested for recovery.

Each entry in the file index typically includes this information for a backed-up file: filename, number of blocks, access permissions, number of links, owner, group, size, last modified time, and backup time. The file index changes with each backup, as entries for the newly backed up files are inserted. As long as an entry for a file remains in the file index and the backup volume is not damaged, the file may be recovered using the NetWorker Recover window.

The media index is usually much smaller than the file index. The media index maps each file to the backup volume or volumes where it is stored. NetWorker uses the media index to tell you or the jukebox which backup volume to mount during a recover.

The file and media indexes require disk space. The size of an index is proportional to the number of entries stored in it. With NetWorker Policies, Indexes, and Volume Management windows, you create policies for automatic index management, monitor the contents of the indexes, select entries for removal, and mark backup volumes as recyclable.

Save Sets

Save sets are groups of files, usually contained in a single filesystem, that have been backed up by NetWorker. Save sets are created each time a backup is started. Generating a save set creates one or more entries in both indexes.

To conserve both index and backup volume space, NetWorker provides a variety of backup levels. For example, a *full backup* contains all files in a given filesystem, while an *incremental backup* contains only the files that have changed since the previous backup. Since directories often contain some files that do not change together with files that do change, incremental backups conserve both index and volume space. (See “Backup Levels” in Chapter 4 for more information on backup levels.)

To recover a complete directory, some files are needed from the incremental backup and some from the full backup. Without the underlying full backup, the directory could not be completely recovered. Without the incremental backup, only the old version of the directory could be recovered. The incremental backup depends on the full backup. Since both the full and incremental backups are needed to recover the complete directory, NetWorker checks these dependencies when removing save sets from the indexes either manually or automatically. A save set is not removed until all of its dependent save sets have been removed.

The diagram in Figure 7-1 shows the relationship between incremental and full backups.

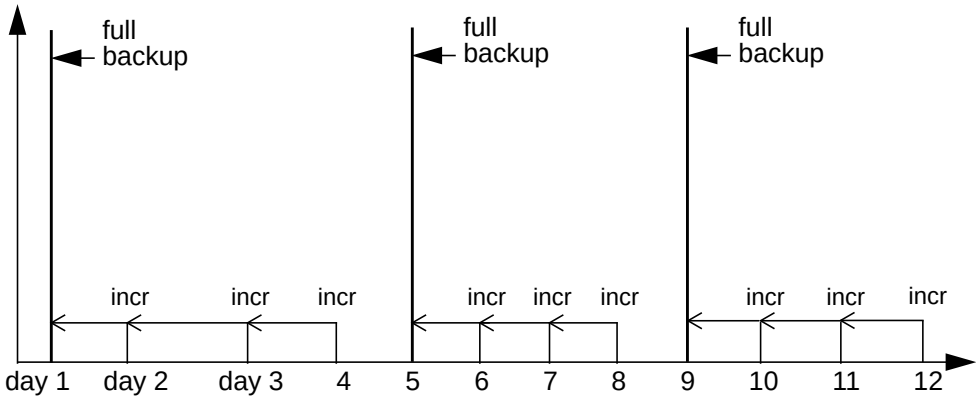

Figure 7-1 Relationship Between Incremental and Full Backups

Note: Incremental backups are dependent upon the previous full backup. A save set is not removed until all of its dependent save sets have been removed. ♦

Index Actions

There are four actions that can be performed on an index: inserting entries, browsing, removing entries, and reclaiming space. They are described below.

- Inserting entries in an index occurs during a backup. The entries are inserted into the free space in the indexes. If there is no free space in an index, more space is acquired from the filesystem to hold the new entries.
- Browsing the file index occurs when you are using the Recover window to locate a file. Browsing the media index occurs when you are using the Volumes or Indexes windows to view the contents of a backup volume. Browsing neither increases nor decreases the size of an index. When browsing an index, you are simply looking through the index for information concerning your saved files or the contents of your backup volumes.
- Removing entries frees space in the index. The free space is used when new entries are inserted. Entries are automatically removed based on the length of time they have been stored in the index using the browse and retention policies. They may also be removed manually by selecting “Remove oldest cycle” in the Indexes window or “Remove” on the Volume menu in the Volume Management window.
- Reclaiming space returns the empty space, created when entries are removed from the index, to the filesystem. It occurs when you use the *Reclaim space* button in the Indexes window.

Managing the Indexes Manually

Using the Policies and Clients windows, you configure NetWorker to automatically maintain your online indexes at a steady size, containing only the most current backups. (For instructions on creating policies that automatically manage your indexes, see the section “Creating Index Policies” in Chapter 5.)

Using the Indexes and Volume Management windows, you can manually remove entries for save sets from the file index and remove entries for backup volumes from the media index.

To manually manage your file indexes, open the Indexes window by selecting “Indexes” from the Operation pull-down menu (shown in Figure 3-4). The Indexes window appears, as shown in Figure 7-2.

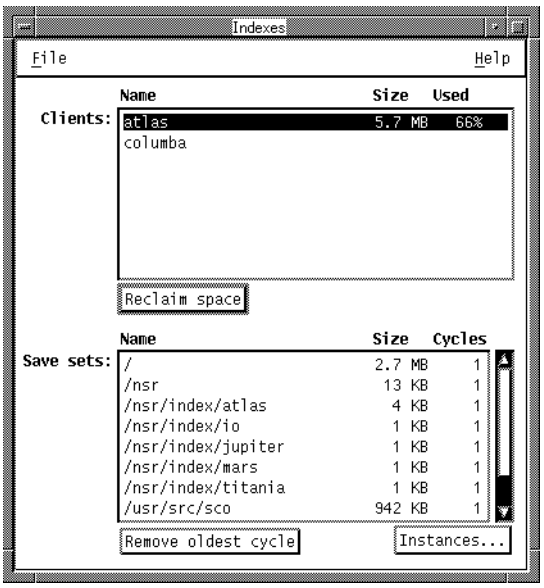

Figure 7-2 Indexes Window

The Indexes window has two scrolling lists: “Clients” and “Save sets.”

The Clients scrolling list provides the names of the client systems configured for the current NetWorker server and this information about each client file index:

Name	NetWorker client names
Size	The current allocated size of the client file index
Used	The percentage of this space actually used by the entries in the file index

Pressing the *Reclaim space* button decreases the size of the highlighted client file index by compressing the space in the index left by removed entries, thus freeing up disk space.

The Save sets scrolling list displays the save sets contained in the file index for the highlighted client. The save sets are grouped according to their unique save set names. For example, all backups of */usr* in a client file index are grouped under the save set name */usr*.

The Save sets scrolling list provides this information about a client save set:

Name	The client save set names.
Size	An estimate of the amount of index space used by the save set group in the client file index.
Cycles	The number of cycles of the save set group contained in the client file index. One cycle starts with a full backup and ends with the next full backup. A cycle includes the incremental and level 1–9 backups, if any exist.

The *Remove oldest cycle* button removes the oldest full-to-full cycle of the highlighted save set group.

The *Reclaim space* and *Remove oldest cycle* buttons are used for the index operations described below.

The *Reclaim space* button in the Indexes window displays a dialog box that starts an index operation. The *Remove oldest cycle* button displays a confirmation box that starts an index operation. Since the index can perform only one operation at a time, the Reclaim index space dialog box has a message line that reflects the current action on an index. For example, if an index is busy reclaiming space, this message appears in the Reclaim Index Space dialog box:

```
Reclaiming space may take considerable time
```

This message applies to the “Remove oldest cycle” operation only. It appears when there are no entries for files in the client file index, and thus there are no save sets to remove.

```
There are no save sets to purge for client_name
```

Removing the Oldest Cycle

To remove the oldest full-to-full cycle of a group of save sets from the file index for a client, select the client and the save set in the scrolling lists in the Indexes window.

Press the *Remove oldest cycle* button to remove the oldest cycle of the save sets highlighted in the Save sets scrolling list. A confirmation box appears, prompting you to confirm that you want to remove the oldest cycle of the selected save set for a client.

Note: If you do not highlight any save sets in the Save sets scrolling list, then NetWorker removes all the oldest cycles of all the save sets displayed in the scrolling list for the client highlighted in the Clients scrolling list. ♦

The diagram in Figure 7-3 illustrates what happens when you remove a cycle from the index. Removing the oldest cycle opens up space so that other entries can fit into the empty space without increasing the size of the index.

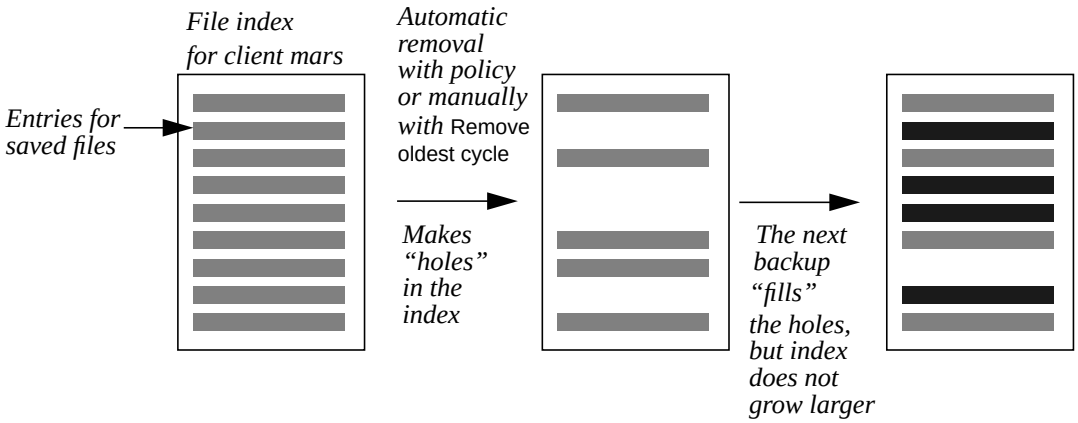

Figure 7-3 Removing a Cycle From an Index

Note that removing index entries does not decrease the size of the index file, so it still takes up as much space as it did before. To decrease the amount of space the index uses, press the *Reclaim space* button.

Tip: The last full cycle may not be removed using the *Remove oldest cycle* button. ♦

Reclaiming Index Space

NetWorker automatically reclaims disk space that is freed up when entries are deleted from the online file indexes. However, the space is not returned immediately to your system. NetWorker takes some time, processing power, and swap space in order to reclaim this space, and to have this constantly taking place on your backup server would be inefficient. Instead, NetWorker first reuses this space to store information about new files that are backed up. When the file index for a client reaches a point where less than 50% of its space is being used by files that have not reached the end of their browse period, NetWorker automatically invokes a process that returns the space to your system.

You may also reclaim disk space at any time by pressing the *Reclaim space* button in the Indexes window.

To reclaim the empty space created in the client file index when entries are automatically or manually removed, press the *Reclaim space* button.

The Reclaim Space window appears, as shown in Figure 7-4.

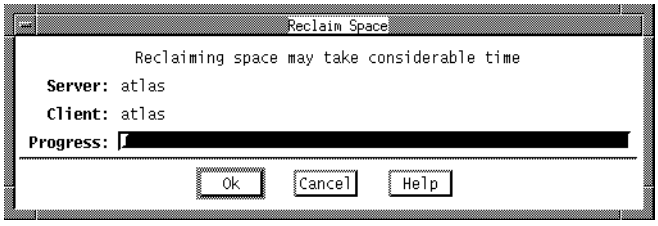

Figure 7-4 Reclaim Space Window

To start the Reclaim Space operation, press the *Ok* button. The Progress bar moves to show the progress of the index operation. When an index is busy, the *Ok* button is disabled.

To dismiss the window, press the *Cancel* button. This closes the window; however, the Reclaim space operation continues in the background. You can check the progress of the operation at any time by pressing the *Reclaim space* button to redisplay the window. When you display a window for a busy index, the Progress bar is updated.

The diagram in Figure 7-5 illustrates what happens when you press the *Reclaim space* button. Because the index is rewritten without the deleted entries, it shrinks in size and opens up space for new entries. The space is returned to the filesystem.

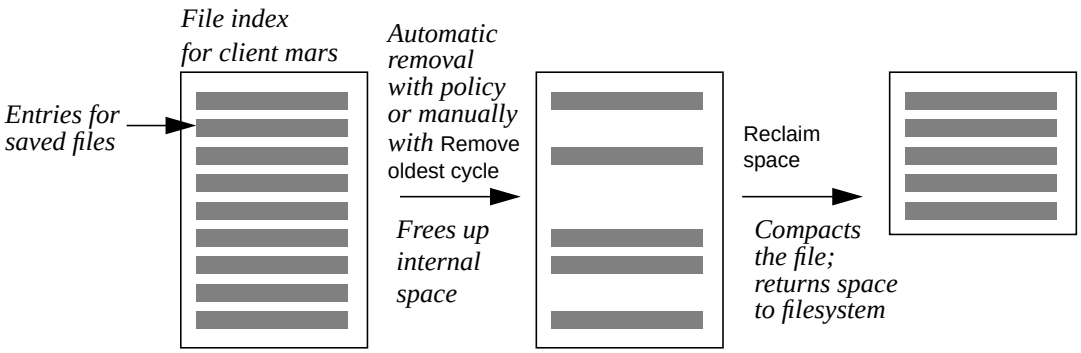

Figure 7-5 Reclaiming Space in an Index

Note: You may not simultaneously Reclaim space and Remove oldest cycle for one client. The index is busy during both operations. ♦

After either the Reclaim space or Remove oldest cycle operation has finished, the statistics in the Indexes window are updated to reflect the current state of the file index.

Viewing Save Set Details

NetWorker provides you with more detailed information about save sets in the Instances window.

The Instances window contains information on the number of files in a save set, its size, the date it was backed up, and the level of the save set: full, incr, and level.

You can use the information in this window to determine how your resources are being used. For example, you may need to see how large a save set is so you can plan the amount of disk space you need for the online indexes. Or you may need to generate a report that details your NetWorker client backups to fulfill administrative requirements.

To open the Instances window, follow these steps:

1. Select a client from the Clients scrolling list in the Indexes window.
2. Select a client save set from the Save sets scrolling list.
3. Press the *Instances* button.

The Instances window appears, as shown in Figure 7-6.

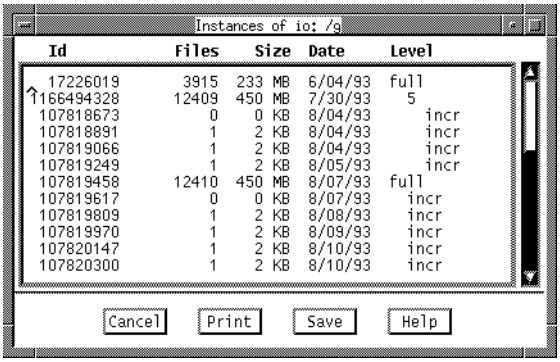

Figure 7-6 Instances Window

The title bar for the Instances window includes the name of the save set you are currently viewing. The Instances scrolling list contains this information:

Id	Internal NetWorker ID number for the save set
Files	Number of files in the save set
Size	The size of the save set in megabytes or kilobytes
Date	The date the save set was backed up
Level	Level of backup: full, incr, or level

The Instances window contains the *Cancel*, *Print*, *Save*, and *Help* buttons. Pressing the *Help* button opens the Save Set Instances Help window which contains information on related subjects; pressing the *Cancel* button closes the Indexes window.

To print the contents of the Instances window, press the *Print* button. The Print Options window appears, as shown in Figure 7-7.

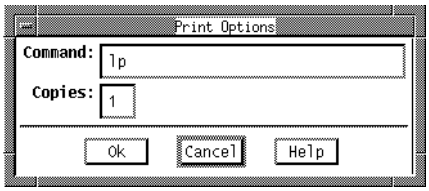

Figure 7-7 Print Options Window

Enter the print command (for example, *lp*(1)) in the Command field, enter the number of copies you want in the Copies field, and press *Ok* to print.

To save the contents of the Instances window to a file, press the *Save* button. The Save Options window appears, as shown in Figure 7-8.

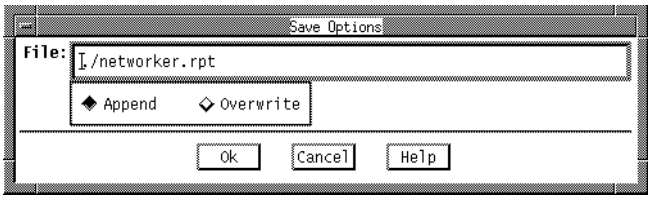

Figure 7-8 Save Options Window

The information is saved to a file named *networker.rpt,* which NetWorker automatically creates. However, you can save the data to a file of your choice by entering its name into the File field. You can press either the *Append* button to add the information, or the *Overwrite* button to replace the existing information in the file. Pressing *Ok* saves the information from the Instances window to the file.

Recovering Files Removed From the Index

You can recover files whose entries have been removed from the online index because they have passed the browse policy period as long as the files are still stored on a backup volume. The recover process is not as easy as when the entries are still in the online index, however. The basic steps for recovering a file whose entries have been removed from the online index are:

1. Use the Volume Management window to find out the name of the backup volume that contains the save set.

   Use the *mminfo*(1M) command to determine the save set ID. Use this command:

```
mars% /usr/etc/mminfo -v -s server -c client -N saveset volume_name
```

2. Rebuild the file index entries for the save set using the *scanner –i –s save_set_id* command at the prompt in a shell window. Enter the save set ID number determined above for *save_set_id*. Rebuilding the file index using the *scanner*(1M) command may take some time.
3. Use the NetWorker Recover window to identify the needed file(s) and initiate the recovery.

Managing the Volumes Manually

With automatic index management using policies, a backup volume is marked as recyclable when all of its save sets have passed the time period designated by the retention policy. A recyclable volume is eligible for overwriting with new backups. Using the Volume Management window, you can manually mark entire backup volumes as recyclable, which also marks all the save sets on the volume as recyclable. Or, you can manually change a recyclable backup volume to appendable. This prevents it from being overwritten.

The Volume Management window, shown in Figure 6-4, displays the information stored in the media index (located on the server) about the backup volumes and their save sets. It is described in the section “Displaying Backup Volume Information” in Chapter 6.

You can manually manage your backup volumes using the Volume pull-down menu on the Volume Management window. You can set a location for a volume, change the mode of a volume, or remove a volume from the media index with the Volume pull-down menu commands.

Setting the Location for Your Backup Volumes

As an optional reminder to yourself, you can set a location for a backup volume. This helps you find a backup volume when it is needed for recovering a file. A location can be a numbered bin, shelf, jukebox job pack, or any place that you physically store backup media.

To set the location for a backup volume:

1. Highlight a backup volume in the Volumes scrolling list.
2. Select “Set Location” from the Volume pull-down menu. The Set Location window appears, as shown in Figure 7-9.

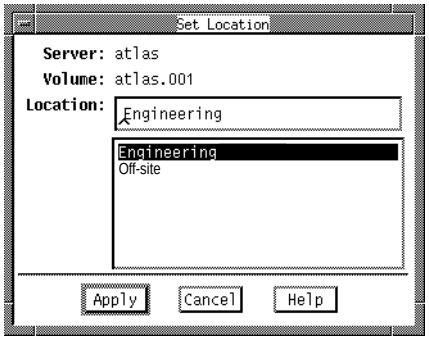

Figure 7-9 Set Location Window

3. Enter the location of the backup volume. You may want to specify the location of the backup volumes that are loaded in your jukeboxes or that are stored off-site.

Note: Each time a volume is moved within a jukebox, NetWorker automatically updates the volume's location with the name of that jukebox. This feature is useful because if you are using volumes that were previously assigned another location, their new location is updated automatically. If you plan to move the volumes off-site or to a different location, change their assigned location manually to accurately reflect where they will be stored. ♦

4. Press the *Apply* button to designate this location for the selected backup volume. The Volume Management window is updated to reflect the location for that backup volume.

   After you apply a location to a backup volume, it is listed in the Set Location window and can be applied to any backup volume in the Volume Management window.

   Tip: When NetWorker requests that you mount a backup volume during a recovery, you can find the volume by referring to its location in the Volume Management window. ♦

Changing the Mode of a Backup Volume

The mode of a backup volume determines whether NetWorker can write to it during a backup. There are three possible modes for a backup volume:

Appendable	There is room on the backup volume for more backups. NetWorker can append data to the backup volume and use this backup volume for backups.
Full	The capacity of the volume has been reached. A volume may also be in full mode if a "write error" is encountered during a backup. If this happens, NetWorker continues the backup on the next appendable volume or requests a new writable volume.
Recyclable	The volume is available to be relabeled and overwritten by future backups. You can manually mark an entire volume as recyclable by changing its mode. If a backup volume's mode is manually changed to recyclable, then all the save sets stored on the volume are also marked as recyclable.

Note: A backup volume is automatically recyclable if all the save sets on the volume are recyclable. Recyclable save sets have passed the time period designated by the retention policy for the client. ♦

To change the mode of a volume to recyclable so that it can be overwritten with new backups:

1. Highlight a volume that is in either full or appendable mode in the Volumes scrolling list. Notice that the save sets stored on the volume appear in the Save sets scrolling list.

   Tip: Look at the status of the save sets stored on the volume. If the status of all of the save sets is recyclable, then NetWorker automatically marks the volume as recyclable. ♦

2. Select "Change Mode" from the Volume pull-down menu in the Volume Management window, then slide the cursor to the right to select "Recyclable" from the Change Mode menu.

   A Notice confirmation box appears with a message similar to this:

   ```
   Change volume atlas.001's status to recyclable?
   ```

3. Press the *Ok* button if you want to change the mode of the selected volume to recyclable. Notice that the mode of the volume changes to recyclable in the Volumes scrolling list. Press *Cancel* to leave the mode unchanged.

To change the mode of a recyclable volume to appendable:

1. Highlight the volume in the Volume Management window.
2. Select "Appendable" from the Change Mode menu. A Notice confirmation box appears with a message similar to this:

   ```
   Change volume atlas.004's status to appendable?
   ```

3. Press the *Ok* button in the confirmation box.

Note: When you manually change the mode of a volume to recyclable in the Volumes Management window, all of its save sets are given recyclable status, regardless of their relationship to the browse or retention policies specified in the Clients window. If you are not certain that you want all of the save sets on a volume to be recyclable, then do not manually change the mode. ♦

Removing a Backup Volume

Removing a backup volume occurs in two stages. First, remove the entries from the appropriate file indexes. This changes the status of the browsable save sets to retrievable. Remove the file index entries when you do not need to browse and recover the files any longer using the Recover window.

Second, remove the name of the backup volume from the media index, thus destroying all record of it. Remove a backup volume from the media index only if you will never need the data on the volume again, or if the volume has been physically damaged and is unusable. It is very rare that you need to remove a backup volume from the media index.

Tip: If a backup volume is lost or destroyed, you should remove it from both the file and media indexes. Otherwise, NetWorker may request the backup volume to be mounted on the server backup device during a recover. ♦

To remove a backup volume follow these steps:

1. Highlight the desired volume in the Volumes scrolling list. Notice that the save sets stored on the volume appear in the Save sets scrolling list.
2. Select “Remove” from the Volume pull-down menu. A Notice dialog box appears with a message similar to this:

   ```
   Remove volume atlas.001's on-line index entries?
   ```

3. Press the *Ok* button to remove the entries for the files stored on the volume from the appropriate file indexes. The status of the save sets containing these files changes to retrievable in the Save sets scrolling list. A Notice dialog box appears with a message similar to this:

   ```
   Remove volume atlas.001 from the media index?
   ```

4. If you want to remove the backup volume from the media index for the server, press the *Ok* button. All record of the data on this backup volume is removed from the NetWorker indexes.
5. Press the *Cancel* button if you do not want to remove the volume from the server media index.

If you accidentally delete a backup volume from the media index, you may still recover the data from it using the *scanner* command, as long as you have not relabeled the volume.

Using NetWorker with Jukeboxes

If you are using a jukebox as one of your backup devices, this chapter provides the information you need to configure and operate NetWorker with a jukebox. Jukeboxes automate the time-consuming task of loading, mounting, and labeling backup media. Once you have installed both NetWorker and one of the optional NetWorker Support for Jukebox options, enabled the jukebox, and loaded the jukebox with backup volumes, you can run unattended backups and recovers.

By using a jukebox, users are able to recover files easily and efficiently without assistance from an administrator. NetWorker automatically mounts the correct volume so that the recovery proceeds as long as the volume is loaded in the jukebox. If NetWorker requires backup volumes for a recovery that are not loaded in the jukebox, you will receive a notice in the Pending display of the main window.

NetWorker sends a notice with electronic mail if the jukebox requires operator intervention. For example, NetWorker sends a notice if all the backup media available in the jukebox is full, or if 90% of the backup media is full, or if there is a mechanical problem with the jukebox that interferes with the ability to back up or recover files.

Testing the Jukebox Connection

To test the jukebox connection, run the *jbexercise*(1M) command with two pieces of “scratch” media loaded in the first and last slots of the jukebox. The tape drives should be empty with their door(s) open. See the *jbexercise*(1M) reference page for complete instructions.

When running *jbexercise*, you specify the control port and the device type. The control port for SCSI jukebox models is typically */dev/scsi/sc1d6l0*. For example, this command runs *jbexercise* on the EXB-10i jukebox:

```
# /usr/etc/jbexercise -c /dev/scsi/sc1d6l0 -m EXB-10i
```

If you are using a second jukebox, the control port is typically */dev/scsi/sc1d4l0*.

Note: The EXABYTE EXB-10i must be the only device on its SCSI bus.

The control port for RS-232 jukebox models is typically */dev/ttyd2*. For example, this command runs *jbexercise* on the ATL jukebox:

```
# /usr/etc/jbexercise -c /dev/ttyd2 -m ATL
```

If you are using a second jukebox, the control port is typically */dev/ttyd3*.

Configuring a Jukebox

This section describes NetWorker jukebox configuration options. Use the "Jukeboxes" command from the Administration pull-down menu, shown in Figure 3-5, for jukebox configuration. This command is activated for those sites that have enabled one or more NetWorker Support for Jukebox options. (See the section "Enabling Jukeboxes" in Chapter 2 for information on enabling Jukebox options.)

Jukebox configuration is displayed in the Jukeboxes window. Most jukebox configuration occurs when enable your NetWorker Support for Jukebox option (described in the section "Enabling Jukeboxes" in Chapter 2). Once the jukebox is installed and enabled, the only change you can make to your jukebox in the Jukeboxes window are to the Available slots field.

Open the Jukeboxes window by selecting "Jukeboxes" from the Administration pull-down menu. The Jukeboxes window is shown Figure 8-1.

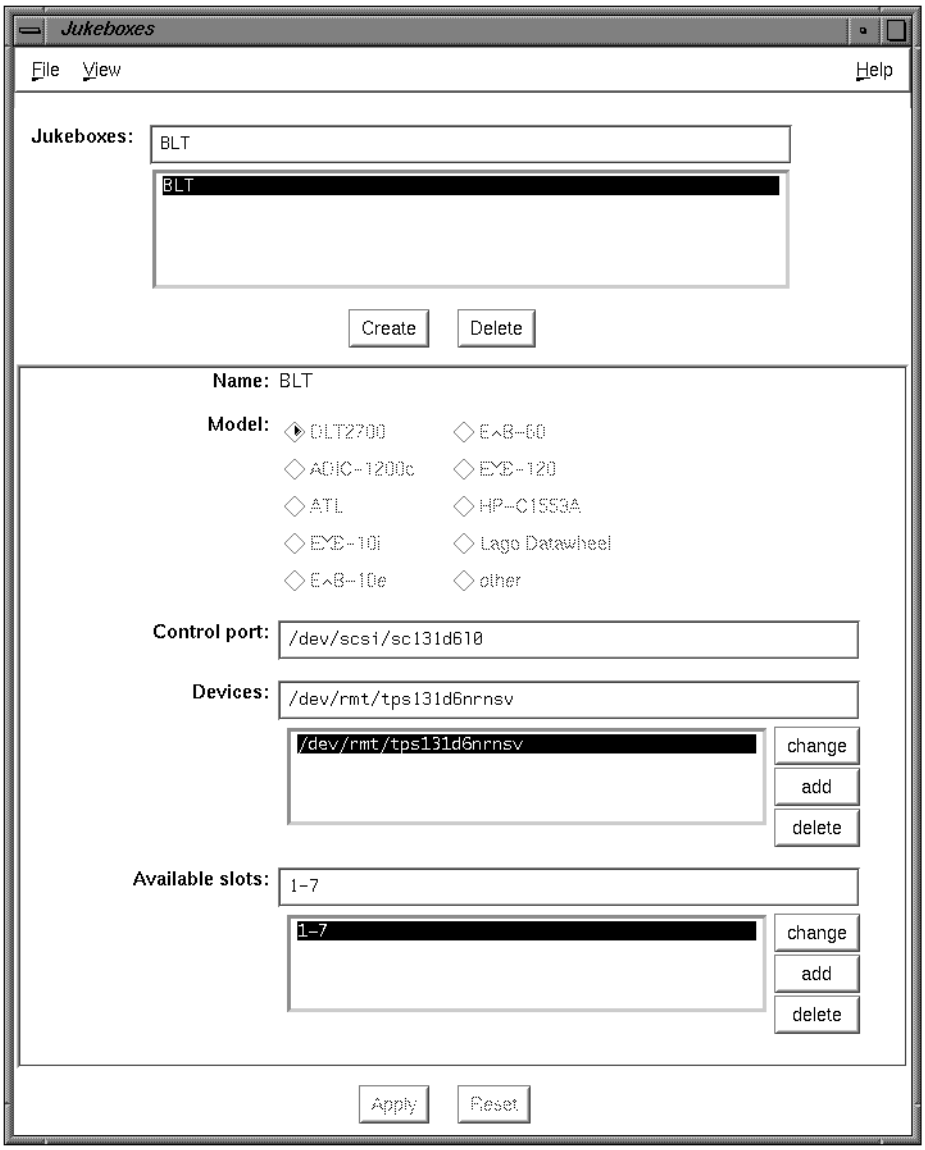

Figure 8-1 Jukeboxes Window

Listed below are the jukebox configurations found in the Jukeboxes window. All these configurations are determined when you install and enable the NetWorker Support for Jukebox option.

Jukeboxes scrolling list
: Displays the names of the jukeboxes known to the NetWorker server.

Name field
: Displays the name of the jukebox currently selected in the jukeboxes scrolling list.

Model choices
: Display model types) of jukebox(es) supported by NetWorker.

Control port
: Displays the system pathname of the device that controls the jukebox loading mechanism. The loading mechanism loads and unloads the backup volumes into and out of the device(s) in the jukebox.

Devices scrolling list
: Displays the system pathnames of the device(s) located in the jukebox. The device(s) inside of the jukebox are configured in the Devices window exactly like single-media devices prior to configuring the jukebox. Devices inside of a jukebox are designated by a “J” next to their pathname in the Devices display of the main window.

Available slots scrolling list
: Displays the range of backup volumes available for automatic selection by the NetWorker server. NetWorker uses any backup volumes in this range to back up the data from the clients on the network. The Available slots correspond to the numbered slots available for holding backup volumes inside the jukebox. The slots are identified by a range of numbers. Entering a single number, for example 10, restricts access to just slot 10. Entering the number 10 is not the same as entering 1-10.

The Available slots feature allows you to control exactly which slots in the jukebox hold backup volumes that are available to NetWorker for backing up files. NetWorker uses all of the volumes in the jukebox for recovers. However, you can control which volumes NetWorker automatically selects for backups by designating the available slots in the jukebox.

For example, for a jukebox that contains 10 slots, you may designate slots 1 through 5 for NetWorker backups. The entries can be a range of slot numbers or a single slot number.

To change the number of available slots, follow these steps:

1. Enter the range of available slots into the Available slots field.
2. Press the *change* button. The slot numbers or range appears in the Available slots scrolling list.
3. Apply the jukebox configuration changes to the NetWorker server by pressing the *Apply* button.

Note: Make sure you have placed backup volumes in all the available slots of the jukebox so NetWorker can proceed with an automatic backup. ♦

Jukebox Notices

NetWorker uses electronic mail to send notices about NetWorker events. The NetWorker Support for Jukebox option also sends an event notification, called a jukebox request. The Jukebox request notification is triggered when NetWorker needs a backup volume for a device inside a jukebox.

The jukebox Notifications window is shown in Figure 8-2.

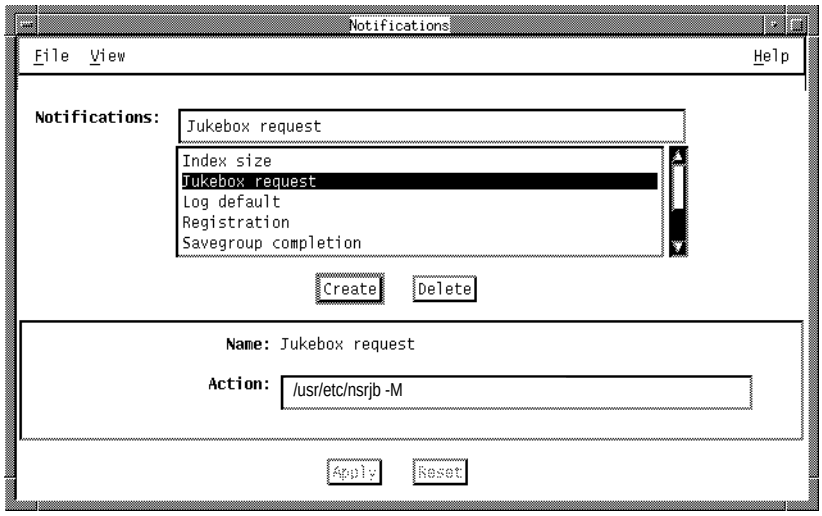

Figure 8-2 Notifications Window with Jukebox Request

The jukebox software also uses the three “tape mount request” notices to inform the system administrator that the jukebox needs attention. The message in each notice describes the nature of the event. The situations that require attention are:

- The backup volumes in the jukebox are 90% full. NetWorker may run out of space during the nightly backup.
- The jukebox is out of space for the backups and needs more backup volumes to continue.
- The jukebox has a mechanical problem.

See the section “Setting Event Notification” in Chapter 5 for more information.

Note: After you correct a jukebox problem, you must mount a backup volume (using the “Mount” command from the Operation pull-down menu in the main window) before continuing to back up or recover files. ♦

Operating the Jukebox

This section contains information and suggestions for operating the jukebox on a day-to-day basis. Tasks include labeling the backup volumes, mounting backup volumes, monitoring the jukebox capacity, and taking inventory of jukebox contents.

Starting a Labeling Session

NetWorker uses the label template currently selected in the Pools window to label the backup volumes loaded in the jukebox. Choose a label template from the Pools window or create your own before starting a labeling session.

Note: It takes NetWorker some time to label the volumes in the jukebox. You may want to perform the labeling process at a time when you do not need to back up or recover any files. ♦

To actually start labeling the backup volumes in the jukebox, follow these steps:

1. Select the jukebox device in the Devices display in the main window. A jukebox device is identified by a (J) next to its pathname. For example, `/dev/rmt/tps1d6nrnsv (J)` indicates a device inside a jukebox.
2. Select “Label” from the Operation pull-down menu in the main window (see Figure 3-4). Selecting the “Label” command when a jukebox device is selected in the main window opens the Jukebox Labeling window, as shown in Figure 8-3.

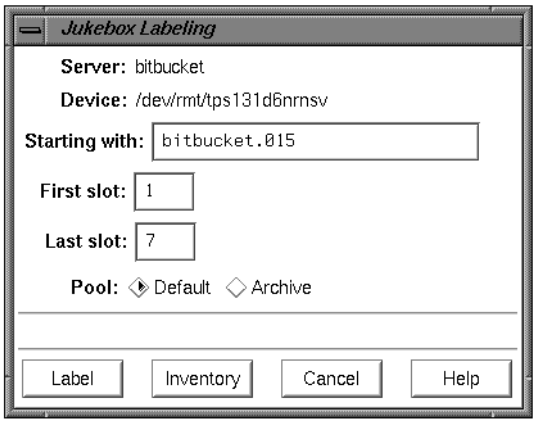

Figure 8-3 Jukebox Labeling Window

The Jukebox Labeling window displays the name of the NetWorker server and the system pathname of the selected jukebox device.

The Jukebox Labeling window gives you control over the volume labeling. You can use a label template to generate names as needed, or you can specify a single unique name. The First slot and Last slot feature allow you to control the range of slots in the jukebox to be labeled or updated.

3. Enter the first label in the “Starting with” field. NetWorker starts labeling the media in the jukebox with the label displayed in the “Starting with” field.
4. To label a single volume, enter identical numbers in the First slot and Last slot fields. For example, to label a single volume in slot 7, enter 7 in both the First slot and Last slot fields.

   To label volumes in a series of slots, enter the range of slots in the jukebox containing the backup volumes that NetWorker will label in the First slot and Last slot fields. For example, if you previously labeled five tapes and need to label five more, the First slot could be 6 and the Last slot 10.

   Note: If you label a specific range of backup volumes, the “Starting with” name must match the label template format. If you label a single backup volume, you can use any name; it does not have to match the label template. ♦

5. Press the *Apply* button.
6. Select a pool from the Pool choices for the volumes being labeled in the jukebox.

   Tip: Remember, only the pools that have been enabled in the Pools window appear in the Jukebox Labeling window. ♦
7. Press the *Label* button to start the labeling process. If a valid NetWorker label already exists on the media you are trying to label, this confirmation message appears:

   ```
   Ok to label the volumes in slots 1-10?
   ```

   The confirmation is important because it keeps you from accidentally relabeling the media. When a backup volume is relabeled, its contents under the previous label cannot be recovered. When you confirm by selecting *Ok*, the backup volumes in the range of slots are mounted, labeled, and unmounted.

   Whenever you start a label (or inventory) operation for a jukebox, NetWorker displays a status message above the buttons in the Jukebox Labeling window to show the progress. For example:

   ```
   Labeling volume phoenix.009 in slot1(9 to go)
   ```

   You can cancel the label operation by pressing the *Cancel* button. When the labeling is complete, you see another message that tells you the labeling operation is finished.
8. Press the *Cancel* button to close the window.

Note: If you are removing the backup volumes from the jukebox, remember there may still be one or more volumes left in the jukebox devices. Make sure you unmount them by selecting the jukebox devices and selecting "Unmount" from the Operation pull-down menu in the main window. This prevents you from accidentally relabeling these volumes when you reload the jukebox with new volumes. ♦

For more information on labeling volumes, see the section "Labeling and Mounting Backup Volumes" in Chapter 5.

Mounting Jukebox Backup Volumes Manually

To mount a backup volume in a jukebox, you must first make sure the jukebox device is selected in the NetWorker main window. This is especially important if you have the NetWorker server configured to use more than one device.

Tip: Although jukebox devices are identified by a "J" next to the pathname in the main window, it is a good idea to place an adhesive label on the outside of a jukebox identifying its device pathname(s), to remind you of which device pathname(s) belong to the jukebox. This practice is especially helpful when you are using more than one jukebox. ♦

Pressing the *Mount* button for a jukebox device opens the Jukebox Mounting window, shown in Figure 8-4.

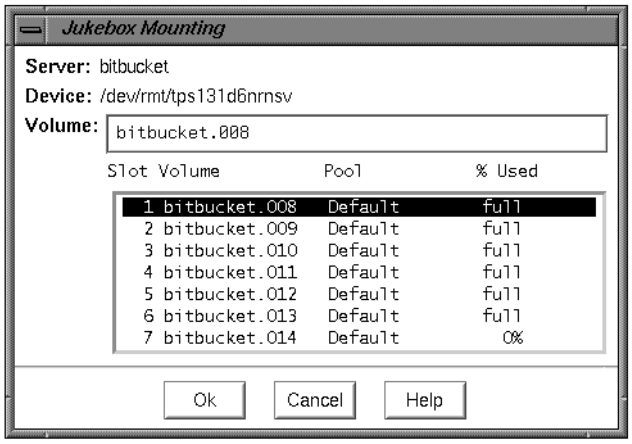

Figure 8-4 Jukebox Mounting Window

The Jukebox Mounting window displays the name of the NetWorker server and the system pathname of the selected jukebox device. The Volume scrolling list displays the slot numbers (Slot), the label of volume stored in the slot (Volume), and the percent capacity filled of the volume (% Used). The window also displays the pool (Pool) to which the volumes belongs. This information can be used to determine which volumes to mount in the jukebox. You may not want to mount volumes that are full or near capacity. The currently selected backup volume name appears in the Volume field.

To mount the selected backup volume in the jukebox, first select it from the list, then press the *Ok* button.

Checking Jukebox Space

To find out how much space is available in the jukebox, you may use either the Jukebox Mounting window (shown in Figure 8-4) or the *nsrjb*(1M) command. The Jukebox Mounting window displays all the media in the jukebox and the percentage used of each tape.

If you prefer to use the *nsrjb* command, follow the steps below:

1. Open a shell.
2. Give the *nsrjb -v* command:

   ```
   mars# /usr/etc/nsrjb -v
   ```

   NetWorker displays information about the backup volumes in the jukebox that looks similar to this:

   ```
   Jukebox BLT:
     slot  volume             used  pool
        1: bitbucket.008      full  Default
        2: bitbucket.009      full  Default
        3: bitbucket.010      full  Default
        4: bitbucket.011      full  Default
        5: bitbucket.012      full  Default
        6: bitbucket.013       20%  Default
        7: -*                      -

         * not registered in the NetWorker media database
         6 volumes, 1 less than 80% full.
        56 GB total capacity, 10 GB remaining (85% full)

   drive 0 (/dev/rmt/tps131d6nrnsv) slot  1: bitbucket.008
   ```

   Notice the information about the registered volumes, total capacity, and remaining capacity. This information tells you how much space is still available in the jukebox.

Recycling Versus Adding More Backup Volumes

NetWorker can save files on volumes in either appendable or recyclable mode as indicated in the Volume Management window. If the volumes inside of the jukebox are in full mode, they cannot receive backups.

If your volumes are all in full mode, you can do one of the following:

- If you need to keep the volumes for long-term storage, remove the full volumes and replace them with new media. Label and mount the new volumes.
- If you do not need the data on the full volumes, you can manually change the mode to recyclable in the Volume Management window. NetWorker overwrites the data on the volumes with new backups and maintains the existing labels.

  Note: The mode of a volume is automatically changed to recyclable when all of the save sets on the volume have passed the time period specified by the retention policy of the client that generated them. ♦

There are advantages to either recycling or adding more media to the pool. By recycling, you reuse the same backup volumes and do not add new volumes to the pool. However, the media may wear out over time and have a higher failure rate.

On the other hand, if your site requires that you maintain the backups in storage for a certain period of time, then you may have to add more media to the pool instead of recycling it. For example, if the jukebox needs new backup volumes every three months, and the company policy is to maintain the backups for a year, you have to keep adding new media to the pool until you can recycle the backup volumes that contain expired or old backups.

Taking Inventory of the Jukebox Contents

When NetWorker labels the contents of the jukebox, it registers the location of the volumes in the jukebox slots when it assigns the volume label. If you do not change the volumes in the jukebox after labeling them, NetWorker can access the volumes because each volume label is assigned to a specific slot.

However, if you change the contents of the jukebox without performing the labeling process or if you move volumes into new slots, you must tell NetWorker that the jukebox now holds a different set of labeled volumes or that the volumes are in a different order. This is called taking an *inventory*. When you take an inventory of the volumes in the jukebox, NetWorker reads the label of each volume and remembers its slot number. For example, if you have more than one job pack (removable rack of tapes) for a jukebox, you must take an inventory each time you remove one job pack and load another one into the jukebox, unless you perform the label process for the new job pack.

To tell NetWorker you have changed the contents of the jukebox, follow these steps:

1. Load the new backup volumes into the jukebox.
2. Select the jukebox device in the Devices panel of the main window. Remember, jukebox devices are marked with a "J."
3. Select "Label" from the Operation pull-down menu in the main window.
4. Press the *Inventory* button in the Jukebox Labeling window. The Jukebox Labeling window displays a message above the buttons that monitors the progress of the inventory operation.
5. You may cancel the inventory operation after the current volume by pressing *Cancel* in the Jukebox Labeling window.
6. Press *Cancel* to close the window when the inventory is complete.

After completing an inventory, NetWorker has registered the contents of the jukebox and can therefore proceed with its network-wide backup and recover services.

Using Pools with a Jukebox

If you plan to have full and nonfull backups, we recommend that you estimate the number of volumes needed for your full backups and assign them to the Full pool in the Label window. This ensures that your full backups are located in a consecutive range of slots in the jukebox so the volumes can be easily removed.

Cleaning the Devices

Check the jukebox manufacturer's documentation for information about the frequency and cleaning method for the jukebox's devices. It is important to keep the jukebox in good working order with regular maintenance. Refer to the jukebox hardware manuals for information about preventive maintenance.

Calibrating the Devices

Check the jukebox manufacturer's documentation for information about the frequency and method for calibrating the loading mechanism for the jukebox device.

Chapter 9

NetWorker Performance

The performance of a server system is affected by the speed of the backup device, the network speed, the amount of main memory, the disk speed, the CPU speed, and the number of CPUs. The factors affecting the performance of a client system are filesystem traversing, generation of data, data on multiple disks, CPU speed, and number of CPUs.

The next sections explain how to use information about performance to configure NetWorker servers and clients, and how to measure the performance of servers and clients.

Guidelines for Choosing a Configuration

There are several factors that determine which NetWorker server configuration best suits your backup and recover needs. The configuration consists of the hardware and software, which includes tape drives, jukeboxes, client systems, and network connection.

This section provides a few simple rules that you can use to guide your choices, and focuses on backup, since backup requires far more server capacity than recover.

Note: Please keep in mind that these are guidelines, and actual performance may vary. ♦

The goal in selecting a configuration is to balance the different hardware and software limitations to achieve the overall data handling capabilities you require. Start by looking at the limits of the major NetWorker configuration components: tape drives, network connection, jukeboxes, clients, and the NetWorker server itself.

Tape Drives

Tape drives have a fixed maximum data transfer rate that they can handle. Since NetWorker automatically spans multiple tapes, the total tape capacity is not as important as the data rate. Table 9-1 shows the data transfer rate for several tape drives.

Table 9-1 Tape Drives and Data Transfer Rates

Drive	Data Transfer Rate
DAT	200 KB / s
EXABYTE 8200	250 KB / s
EXABYTE 8500	500 KB / s
Digital Linear Tape	1.25 MB / s

Clients

Different clients can generate data at different rates and, even within a single client, different types of files can generate different data rates. For example, symbolic links require as much processing as large data files, but produce no data. Consequently, the data rate produced by a backup of a single client can vary quite a bit. The numbers listed below are considered average transfer rates for each client system. However, it is a good idea to run several clients simultaneously to help smooth out fluctuations in each client's data transfer rate. Table 9-2 shows the data transfer rates for several types of clients.

Table 9-2 Client Data Transfer Rates

Client/1-backup	Data Transfer Rate
Silicon Graphics	600 KB / s
PC / DOS / SPX	80 KB / s
PC / DOS / TCP	150 KB / s
Sun SS2	200 KB / s
IBM RS / 6000	300 KB / s

Network

Ethernet has an upper limit on bandwidth of about 1 MB per second, but in practice, most networks are limited to about 800 KB per second between a set of clients and a single server. For higher performance, use FDDI. Table 9-3 shows the data transfer rates for several networks.

Table 9-3 Data Transfer Rates for Networks

Network	Data Transfer Rate
Ethernet	800 KB / s
FDDI	6 MB / s

Server

The server must be able to handle the load of network packets, data movement, and tape drives in order to achieve the rates listed above. Most of the work on the server side is in data movement, context switching, and interrupt handling. The performance of all of these functions improves as the number of CPUs increases.

Jukeboxes

Jukeboxes provide automatic loading and unloading of tapes or optical disks. This assists the administrator in two different ways. During nightly backups, NetWorker uses the jukebox to automatically switch to the next tape when a tape fills up. During recovers, NetWorker uses the jukebox to load all of the tapes needed for the recovery without operator intervention. Table 9-4 shows data transfer rates and capacities for several jukeboxes.

Table 9-4 Jukebox Data Transfer Rates and Capacities

Jukebox	Data Transfer Rate	Capacity
EXB-10i	480 KB / sec	50 GB
DLT2700	1.25 MB / sec	70 GB

To determine the capacity requirements of a jukebox for a scheduled unattended backup simply pick the jukebox with a capacity large enough to handle the largest possible amount of backup data. For example, a full backup of 60 GB requires a DLT2700 jukebox or two EXB-10i's.

To determine how much disk space you need for the online indexes for quick recovers, first do a rough calculation of the amount of data backed up in a single schedule period (for example, week, month, or quarter). To do this use the guidelines in Table 9-5 for how much data is backed up with different levels of backup.

Table 9-5 Percent of Data Backed Up for Each Type of Backup

Level	% of data backed up
Full	100%
Level 1-9	25%
Incremental	10%

For example, a monthly schedule that has 1 full on the first Sunday, a level 5 on other Sundays, and incrementals every other day looks like Table 9-6.

Table 9-6 Example of the Percent of Data Backed Up

Level	% of data backed up
1 Full	100%
26 Incremental	260%
4 Level 5	100%
Total	460%

This illustrates that over the course of a month 460% of the total amount of data is backed up. For example, a total of 10 GB of client data backed up using this schedule would result in about 46 GB of data on tape per month.

Now assume that you have decided on a browse policy of 2 months for all the client systems and a retention policy of 6 months. These policies let your users quickly recover any file, and any version of a file that they had during the past 2 months. And with some effort you can recover for them files that they had any time during the past 6 months. So you need 6 months * 46 GB = 276 GB of capacity.

In practice you need a little extra jukebox capacity since there are a small number of “unavailable” volumes as NetWorker must wait to recycle a tape until after all the save sets on that tape have expired.

Finally, remember to plan for growth in the number of your files. While sites differ in the rate at which their files are growing, a rule of thumb is that you should purchase a jukebox, or set of jukeboxes, with about 50% more capacity than your current requirement.

Example 1 - Networker Configuration

Site A has approximately 70 GB of data on 2 networks of 50 clients and wants to schedule full backups for all of their data in one night (12 hours). This equation calculates the required data transfer rate to achieve this goal.

```
70000 MB / 12 hours = 6700 MB / hour = 1660 KB / second
```

To back up the data with a single NetWorker server, this configuration is suggested:

- NetWorker Advanced for IRIX
- Two DLT2700 jukeboxes containing DLT tape drives connected to the NetWorker server, with licenses for each
- Two network interfaces
- At least 1600 MB of free disk space on the server for the client index files
- A 50 Client upgrade license

Example 2 - Networker Configuration

Site B has 50 GB of data on a single network with 80 clients and they want to be able to schedule backups in a single night (8 hours). The full backups for the clients must be staggered due to the limit of 800 KB / sec data transfer rate per network. Calculate the backup capacity required to complete the backups in one night:

```
800 KB / second * 8 hours = 23 GB / night
```

By staggering their full backups into three nights instead of one, by using three different backup schedules, they reduce the load of the nightly backup data from 50 GB / night to about 20 GB / night.

```
Full: 50 GB / 3 = 16.7 GB
```

```
Incr: (50 GB - 16.7 GB) * .1 = 3.3 GB
```

```
Total: (16.7 GB + 3.3 GB) / 8 hours = 694 KB / second
```

To back up the data with a single NetWorker server, this configuration is suggested:

- NetWorker Advanced for IRIX
- Two EXB-10i jukeboxes with EXABYTE 8500 tape drives connected to the server, with licenses for each
- One network interface
- Approximately 1 GB of free disk space on the server for client index files
- A 50 Client upgrade license

Measuring Server Performance

This section provides examples of how to measure the performance of a server.

Backup Device Speed

Most tapes have a step function in their data rate. NetWorker uses 32 KB per record. To measure tape speed, follow these steps:

1. Create a large file (at least 20 MB) with non-zero data and list its size. For example:

```
# cat /unix /unix /unix /unix /unix /unix /unix /unix /unix /unix > big
# ls -l big
-rw-rw-r--    1 root     sys      20675420 Mar  5 16:11 big
```

2. Use the *dd*(1M) command to write the large file to tape four times and measure the time results:

```
# time dd if=big of=/dev/rmt/tps1d6nrnsv bs=32k conv=sync
95.2 real 13.0 user 11.9 sys
# time dd if=big of=/dev/rmt/tps1d6nrnsv bs=32k conv=sync
78.2 real 12.9 user 12.7 sys
# time dd if=big of=/dev/rmt/tps1d6nrnsv bs=32k conv=sync
78.0 real 12.8 user 12.5 sys
# time dd if=big of=/dev/rmt/tps1d6nrnsv bs=32k conv=sync
76.8 real 13.0 user 12.4 sys
```

3. Divide the file's size by the average of the last three real times. For example:

   ```
   Rate: 20675 KB / 77.66 seconds = 266 KB / second
   ```

   This number gives you the rate of the tape speed.

Network Speed

NetWorker uses TCP and RPC/XDR as network communication protocols. To measure the network speed, follow these steps:

1. Create a large file (as in the tape speed measurement example) on a fast client.

```
# cat /unix /unix /unix /unix /unix /unix /unix /unix /unix /unix > big
# ls -l big
-rw-rw-r--    1 root     sys      20675420 Mar  5 16:11 big
```

2. Use the *rcp*(1C) command to copy the file from the client to the server and time the result:

   ```
   # time rcp big server:/dev/null
   38.2 real 0.2 user 30.7 sys
   ```

3. To find the network speed, divide the number of bytes in the file by the real time. For example:

   ```
   Rate: 20675 KB / 38.2 seconds = 541 KB / seconds
   ```

The most important factor affecting network speed is network errors. To determine the input error rate, the output error rate, and the collision rate, use the *netstat –i* command. If the input or output error rate is above 0.5%, or the collision rate is above 5%, the network errors are slowing down the network speed.

CPU Speed

The speed and the number of the CPU(s) of a server limits the following:

- The total data throughput to tape
- The interrupts per second for network data
- The context switches per second between processes

The best measure is the number of CPUs for the server. More CPUs means a faster system.

Memory

The memory on the server limits the amount of data buffered between the NetWorker *save*(1M) command, agent daemon, and media management daemon. In general, the more memory the server has, the better performance is.

Measuring Client Performance

This section provides examples on how to measure the performance of a NetWorker client.

Filesystem Traversing

To measure the filesystem traversing speed, follow the steps below:

1. Time the *uasm*(1M) command with the **–bi** option. For example:

```
# time /usr/etc/uasm -bi /usr
33848 records 6961176 header bytes 644814472 data bytes

real 51.86
user 7.73
sys  27.95
7.7u/27.9s (68% of 0:51)  0k+0k+0k  0pf+0sw  2993i+16o
```

2. Divide the number of records by real time for rate per file. For example:

```
33848 records / 51.86 seconds = 652.7 files / second
```

Data Generation Rate

To measure the rate at which a client generates data for a backup, follow the steps below:

1. Time the *uasm* command with the **–si** option and redirect the output to */dev/null*. For example:

```
# time /usr/etc/uasm -si /usr > /dev/null

real 6:39.49
user 12.62
sys  1:27.19
12.6u/87.2s (24% of 6:39)  0k+0k+0k  0pf+0sw  45302i+27o
```

2. Divide the number of bytes obtained (filesystem traversing) with the *uasm –bi* command by the real time generated by the *uasm –si* command. For example:

   ```
   629701 KB / 399.49 = 1576 KB / second
   ```

Data on Multiple Disks

NetWorker automatically backs up multiple disks in parallel.

To measure parallel disk speeds, follow these steps:

1. Use the *df*(1) or *du*(1M) command to find two directories of approximately the same size.
2. Run the same *uasm* speed tests for filesystem traversing and data generation rate as for one disk, but run the tests simultaneously on the two directories.
3. Add the data from each test (files / sec and KB / sec) to obtain a combined rate.

This rate reflects the performance of NetWorker backing up data on multiple disks.

Troubleshooting

This appendix contains troubleshooting information that answers common questions about operating and configuring NetWorker.

Checking the NetWorker Daemons

If you have trouble starting NetWorker or see error messages in */var/adm/SYSLOG* from NetWorker daemons, the daemons may not be running properly. To check the daemons, enter this command:

```
# ps -ef | grep nsrd
```

If you discover that you need to start the NetWorker daemons, enter the commands below:

```
# cd /
# /etc/init.d/networker start
```

/nsr Not Configured

If you have not created the directory */nsr* during installation and enabling of the NetWorker server software (see the section “Enabling Server Software” in Chapter 2), this message appears on the system console and in */var/adm/SYSLOG* when the NetWorker daemons are started:

```
nsrd: error: /nsr must be a directory or a symlink to a directory
nsrd: info: Please create a symbolic link called /nsr that points
nsrd: info: to a directory in a filesystem with sufficient space
nsrd: info: to store Networker's index files
```

Follow steps 5 through 6 in the section “Enabling Server Software Except Jukeboxes” in Chapter 2 to solve this problem.

Licensing Problems

The following messages, and others, indicate that NetLS licenses for NetWorker products have not been properly enabled:

```
NetWorker Registration: (notice) server disabled; No valid
Base or Advanced licenses found,
```

```
nsrd: either install new licenses or recover a valid
resource file. (15017)
```

```
NetWorker registration: (info) Server is disabled (Install
base enabler).
```

```
nsrcap: RPC error, Program not registered (24015)
nsrcap: nsrd did not respond. nsrd must be started before
running nsrcap. If nsrd is running, you may have exceeded a
resource limit.
```

To correct licensing problems, follow the procedures in the section “Enabling Server Software” in Chapter 2 to enable your NetLS licenses. To verify that licenses have been enabled, display them in the Registration window, as described in the section “Displaying NetWorker Licenses” in Chapter 3. Licenses that don’t appear in this window aren’t enabled.

Renaming a Client

NetWorker maintains an index for every client it backs up. If you change the name of the client, the index for that client is no longer associated with the client, and NetWorker cannot recover any files it backed up under the client’s old name.

To change the name of a NetWorker client, you must first delete the old client name, then add the new client name, and rename the directory which contains the corresponding index.

Follow these steps:

1. Open the Clients window, and delete the old client name.
2. Create and configure the new client.

Use the IRIX *mv*(1) command to rename the old client index directory to the new name.

1. Open an IRIX shell.
2. Become *root* on the NetWorker server.
3. Change directories to */nsr/index*.
4. Use the *mv* command to rename the client's index. For example:

   # **mv** *old_client_name new_client_name*

These steps cause the database daemon *nsrmmdbd*(1M) to rename the client inside its database:

1. Make the old client name an alias of the new name.
2. Kill the NetWorker daemons. To kill the daemons, use the *nsr_shutdown*(1M) command:

   # **/usr/etc/nsr_shutdown**

3. Restart the NetWorker daemons. To restart the daemons, use this command:

   # **/etc/init.d/networker start**

As soon as possible, complete a full backup of the renamed client's files.

Recover Access Issues

System administrators control client recover access by configuring the client. The Recover access list in the Clients window displays which systems can recover the client's files.

These users have the ability to recover any files on any client:

- *root*
- *operator*
- A member of the *operator* group

Other users can only recover files for which they have read permission, relative to the file mode and ownership at the time the file was backed up. Files recovered by a user other than *root*, *operator*, or the *operator* group, are owned by that user.

Previewing a Backup

Every time you add a new client to NetWorker, it is a good idea to check if NetWorker can access the client in order to back up its files. Use the *savegroup –p* command at the system prompt to see a "preview" of a group backup without actually backing up any files.

For example:

/usr/etc/savegroup -p *group_name*

shows you a backup preview of the clients assigned to the backup group *group_name*. If NetWorker cannot access a client in the backup group, you see an error message. If you see an error message, make sure *nsrexecd*(1M) is running and that it lists the server's hostname in the command line. To make sure that *nsrexecd* is running, you can use the command *ps*(1) on the client. See the section "Installing NetWorker Software on Clients" in Chapter 2 for more information on *nsrexecd*.

Halting a Network Backup

To stop running a network-wide backup via the NetWorker X Windows interface, press the *Stop* button in the Group Control window, shown in Figure A-1.

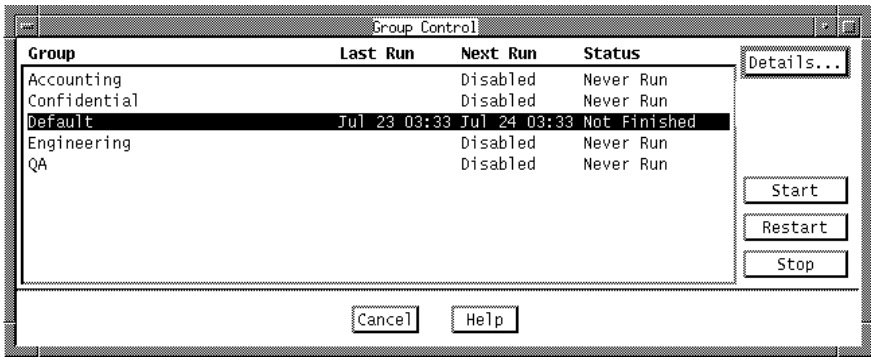

Figure A-1 Group Control Window

The next network-wide backup starts as scheduled in the Start time field of the Groups window, or you may restart the backup by pressing the *Restart* button in the Group Control window.

Backup Media Capacity

Occasionally NetWorker marks backup volumes as “full” when they are not really full. (The Volume Management window and the *mminfo -m* command display the details of the backup volumes.)

NetWorker marks magnetic tape as being full when it reaches the end of the tape or when there is a bad spot on the tape. For example, a backup tape that is reported as only “13% used” and is marked as “full” has a bad spot on 13% of the length in the beginning of the tape. A tape like this may still be used for recoveries, but may not be used for any more backups.

If you see this “bad spot” behavior on many of the backup volumes, it may indicate the device needs cleaning or maintenance.

Tapes are also marked “full” when they are recovered after being deleted from the media index.

Savegroup Completion Messages

In the Notifications window, you configured NetWorker to mail the event notification about your savegroups. The Notifications window is pre-configured to mail the savegroup completion messages to *root@server_name*. Following are descriptions of error messages that may appear in the savegroup completion mail. Possible solutions are included.

Binding to Server Errors

NetWorker is designed to follow the client / server model. In a client / server model, servers provide services to the client through the Remote Procedure Call (RPC). These services live inside of long-lived IRIX processes, known as daemons.

For clients to find these services, the services must be registered with a registration service. When daemons start up, they register themselves with the registration service. In IRIX, the *portmapper* provides the registration service.

NetWorker servers provide a backup and recover service: they receive data from clients, store the data on backup media, and retrieve it on demand. If the NetWorker daemons are not running and a service is requested (for example, *save*, *recover*, *mminfo*, and so on) then these messages may appear in your savegroup completion mail:

```
Server not available
```

```
RPC error, remote program is not registered (24015)
```

These messages indicate that the NetWorker daemons *nsrd*, *nsrindexd*, *nsrmmd*, and *nsrmmdbd* are not running.

To restart the *nsr* daemons, enter *nsrd* at the system prompt:

```
mars# /usr/etc/nsrd
```

Saving Remote Filesystems

You may receive this error message in your savegroup completion mail when backing up a remote filesystem:

```
All: host hostname cannot request command execution
```

You may also see this message:

```
All: sh: permission denied
```

This means the *nsrexecd* on the client was not configured to allow the server *hostname* to back up its files. See the *nsrexecd*(1M) reference page for information on how to reconfigure *nsrexecd*.

When saving remote filesystems, files, or remote clients, NetWorker first tries to use *nsrexecd*, and if that fails, invokes an *rsh*(1M) to that client as the *rcmd*(3N) user (the default *rcmd*(3N) user is *root*). If the client is supposed to run *nsrexecd*, restart it. If not, make sure the NetWorker server can *rsh* as the *rcmd* user to the remote clients by adding this entry in the clients' */.rhosts* file(s):

NetWorker_server rcmd_user

There are two areas where you may encounter problems with NetWorker and *rsh*:

- Remote shell

  The remote shell is determined by the *rcmd* user's login shell (the login shell is determined by */etc/passwd* file). One of the actions of *rshd*(1M) is to read commands from a file. This file is usually named .<*type_of_shell*>*rc*. For example, in the C shell this file is called *.cshrc*.

  One of the commands *rshd* may find is the PATH variable. The PATH has to have the directory in which the NetWorker executables are located. If the PATH command is not in the remote shell's *rc* file or does not have the correct directory where the NetWorker executables are located, then NetWorker is unable to find client executables.

These error messages may be sent if the PATH is not correct:

clientname `probe unexpectedly exited`

`...: savefs not found`

If the remote shell's *rc* file does not have the PATH variable set, then the hidden attribute *executable path* in the NSR client resource has to have the full pathname of the NetWorker executables as its value. If the PATH does not have the directory of the executables, then add the directory and give a command to read the .<*remote_shell*>*rc* file.

Also, the remote shell has to allow an interactive session.

- *rcmd* user and *.rhosts*

  The *rcmd* user is the user login name the NetWorker server uses to remotely log in and run commands on the client. The default *rcmd* user is *root*. If you are using *root* as the *rcmd* user then *root@NetWorker_server_name* should be in the */.rhosts* file. Otherwise, *NetWorker_server rcmd_user* has to be in */etc/hosts.equiv* or *.rhosts* file in the home directory of the local user on whom access is being attempted.

  The hidden attribute *rcmd* user is displayed in the Clients window when NetWorker is invoked with the **–x** option. If you are using an *rcmd* user other than *root*, enter a valid *user_name* in the *rcmd* user hidden attribute field.

  If the above conditions are not met, then these error messages may appear:

  `.... : client rcmd(3) problem for command....`

  `.... : Permission denied`

  Make sure that *rcmd* user is either *operator* or in *operator*'s group.

File Changed During Backup

NetWorker backs up the image that is in the filesystem at the time it comes across the file. NetWorker notifies you that the file was changed during the backup in the Backup Status window and the savegroup completion mail. You can back up the file manually after it is through being used, or wait until the next incremental backup.

Cannot Print Bootstrap Information

If your bootstraps are not being printed, you may need to enter the printer name as a hidden attribute using these steps:

1. Start NetWorker with the expert option by entering **`networker -x`** at the system prompt.
2. Open the Groups window and enter the name of the printer you are using to print the bootstrap in the Printer field.
3. Press *Apply* to save your changes.

Savegroup Completion Warning Messages

Occasionally the savegroup completion message includes one or more messages. These messages contain information that help the administrator understand why NetWorker performs certain tasks.

Below is one of the messages you might see:

```
quattro:/usr no cycles found in media db; doing full save
```

In this example, the filesystem, */usr*, on the client quattro has no full saves listed in the media database. Therefore, despite the backup level pre-selected for that client's schedule, NetWorker performs a full backup. This feature is important because it allows you to perform disaster recoveries for that client.

This message may also appear if the server and client's clocks are not synchronized. To avoid this, make sure the NetWorker server and client:

- Are in the same time zone
- Have their clocks synchronized

Also make sure that a non-full save both begins and ends after midnight.

This *savegroup* message may also appear:

```
NetWorker_server:index Saving server index because server is
not in an active group
```

If your server belongs to a group that is not enabled, NetWorker saves the server's bootstrap information along with this group to avoid a long recovery process. As soon as possible you should enable the group your NetWorker server belongs to, or add the server to another group that is enabled.

Errors in Executing External ASMs

This error message may appear during a backup:

```
client:/ save: external ASM '/xxxxxxasm' not found or not
executable
```

All external ASMs (see *uasm*(1M) for a complete list of external ASMs) are separate commands, and invoked as needed. For security reasons, external ASM names must end in "asm" and be located in the same directory as the originally invoked command (typically *save* or *recover*). Rename or move the ASM following these conventions to correct this error.

Xview Errors

This error message may appear when the *networker &* command is executed:

```
Xlib: connection to "client:0.0" refused by server
Xlib: Client is not authorized to connect to Server
XView error: Cannot open display on window server:
client:0.0 (Server package)
```

This indicates the client is not authorized to display NetWorker.

To correct this situation give this command at the client system:

client% **/usr/bin/X11/xhost** *Networker_server*

Remotely log in to the NetWorker server and give this command at the server prompt:

```
Networker_server% setenv DISPLAY client:0.0
```

For shells other than *csh* use the following commands instead:

```
# DISPLAY=client:0.0
# export DISPLAY
```

Moving Indexes

To move indexes, give this command in the */nsr/index* directory:

mars# **/usr/etc/uasm -s -i** *client_index_directory_name* **| (cd** *target_dir***; uasm -r)**

Recovering Files From an Interrupted Backup

You cannot recover files from a backup terminated by killing the NetWorker daemons because the media index was not updated before the daemons died. Consequently, NetWorker does not know on which volume the requested file is located.

Using nsrexecd

The *nsrexecd* daemon runs on NetWorker client systems. This daemon provides a secure and restrictive way for NetWorker to start automatic backups on clients. The *nsrexecd* daemon allows you to restrict access to a select set of NetWorker servers. When you install an IRIX client, *nsrexecd* is started, and statements are added to */etc/rc2.d/S95networker* to restart *nsrexecd* each time the client reboots.

Security is increased by the use of a challenge / response scheme to ensure that only the NetWorker server is initiating connections, and not another command. Commands are restricted to those needed for saving data (the *save* and *savefs* commands are described in Appendix C, “Theory of Operations”).

If you ever need to reconfigure *nsrexecd*, for example, to allow a different NetWorker server to back up the client, edit the file */etc/rc2.d/S95networker* on the client, and make the changes to the *nsrexecd* startup command (see the *nsrexecd*(1M) reference page for a description of the command line configuration options). Then restart *nsrexecd* by giving these commands:

```
# /etc/init.d/networker stop
# /etc/init.d/networker start
```

Using the networker -x Option

NetWorker can be invoked in an expert mode by starting it with the **–x** option. This displays hidden attributes that are used for advanced configuration and troubleshooting. To invoke NetWorker in expert mode, enter this command:

```
mars# /usr/etc/networker -x &
```

You may be asked to invoke the expert mode by Silicon Graphics Technical Assistance Center staff.

Recovering from a Disk Crash

This chapter contains procedures to follow to prepare for and recover from a major disk crash. Three different types of disk crash situations are covered:

- The primary disk, which contains the operating system and NetWorker binaries, is damaged. This can apply to a client system or a NetWorker server.
- A secondary disk, which contains other filesystems, is damaged. This can apply to a client system or a NetWorker server.
- The NetWorker server's disk, which contains the online indexes (the */nsr* filesystem), is damaged. You have to recover the indexes before using NetWorker to recover any filesystems.

If a primary disk suffers a head crash, you may need to replace the disk, boot from mini-root, format and partition the disk, reinstall the operating system and NetWorker binaries, and then recover the filesystems, one at a time. In this case, you must consult the system administration manuals you used to set up your fileserver for the first time before using NetWorker to recover the data on the disk.

If a secondary disk suffers a head crash, its recovery procedure is simpler, since you do not have to reinstall the operating system and NetWorker binaries.

Note: It is impossible to provide step-by-step instructions on how to recover your system from a disaster, since every site is unique. The discussions in this chapter are designed to give you general principles on how to recover a primary or secondary disk, and to help you understand the procedure. They are meant to be examples only, not instructions. ♦

Preparing for a Crash

The ultimate disaster for a system is to lose all the files on its disk. Most sites back up their fileservers daily in preparation for this event. If a system's primary disk suffers a crash, you can rebuild its filesystems with NetWorker, after you reinstall the operating system (if necessary).

If the NetWorker server's filesystem or disk that contains */nsr* is destroyed, the recovery procedure involves an extra step: you must recover the server's online indexes as well as the server's filesystems. The server's */nsr* filesystem contains one index for each client, including an index for the server as a client of itself.

If your NetWorker server was destroyed (in a fire, for example), you need to replace it with another system. You may do this as long as you:

- Name the replacement server with the same hostname as the original NetWorker server.
- Get new NetLS licenses for the new system. If you replace the hardware, you must also replace the licenses.
- Reinstall NetWorker using the same directory locations for the online indexes as in the original installation.

Tip: Once you understand the procedure for a disaster recovery, make sure you have carefully thought of a disaster recovery plan for your site. If possible, you should test your ability to recover from a disaster at your site. ♦

If you have set up your network and enabled NetWorker to execute automatic, network-wide backups, you are well-prepared for a disaster. Every time NetWorker backs up a group of clients, it also backs up all the online indexes for those clients, including the indexes for the server itself. The server's index backup is named *bootstrap*, and is assigned an identification number called the *save set ID* (ssid). This information is sent to a default printer, providing a hard copy for your files.

We recommend you take two additional precautionary steps to help you recover from a future crash:

- Keep a file containing hard copies of the daily bootstrap records. Place these sheets of paper in a three-ring binder or a file folder.

- Make a hard copy record of the disks, partition sizes, and mount points for the server and any clients that have a local hard disk. This information makes the recovery procedure much smoother for you in the future.

File the Bootstrap Information

NetWorker sends a record of the index backup to your default printer, so you have a piece of paper with the date, name of the backup media, and save set ID number for bootstrap. If you ever need to recover the server's online indexes, you need the information on this piece of paper. Save this information in a safe place.

The information sent to the printer looks similar to this:

```
March 11 16:42 1994 Networker boostrap information            Page 1

  date     time  level       ssid  file  record       volume
3/10/94  2:46:02     9  1148868949   56       0  bitbucket.002
3/11/94  2:53:34     9  1148868985   77       0  bitbucket.003
```

NetWorker prints all the bootstrap save sets for the past month. The bootstrap save set may span more than one backup volume. The file and record numbers are used to find the associated save set quickly.

You can also manually back up the NetWorker server's indexes by using the *saveindex* command. Using this command also sends the bootstrap information to a printer. For example:

```
# /usr/etc/saveindex -c server_name
March  7 03:30 1994 Networker bootstrap information   Page 1

  date     time  level       ssid   file  record     volume
3/01/94  7:44:38  full  1148869706     55      0 bitbucket.008
3/02/94  6:12:09     9  1148869754     48      0 bitbucket.008
3/03/94  6:14:23     9  1148869808     63      0 bitbucket.009
3/04/94  6:29:58     9  1148869870     88      0 bitbucket.009
```

To use the *saveindex* command, you must be *root* on the NetWorker server.

File the Disk Information

Use the disk information commands to find out how the NetWorker server's disks are partitioned and mounted, and make a hard copy of this information. Do the same for any NetWorker clients that have local hard disks. The information you need is:

- The output of the *df*(1M) command.
- The output of the *prtvtoc*(1M) command.
- A copy of the file */etc/lvtab*.

For example, the *df* information looks similar to this:

```
mars% df
Filesystem              Type  blocks     use   avail %use  Mounted on
/dev/root               efs    46550   32127   14423  69%  /
/dev/usr                efs  3266470 1355057 1911413  41%  /usr
/dev/dsk/lv0            efs 15307160 7367621 7939539  48%  /b
/dev/dsk/lv4            efs 15307160 9305204 6001956  61%  /a
```

The *prtvtoc*(1M) command gives you information about how each disk is partitioned. It takes device volume header names as arguments; you can construct these from the output of *hinv*(1M). For example:

```
mars% hinv -c disk
Integral SCSI controller 131: Version WD33C95A
Integral SCSI controller 130: Version WD33C95A
Integral SCSI controller 4: Version WD33C95A
Integral SCSI controller 3: Version WD33C95A
Integral SCSI controller 2: Version WD33C95A
Disk drive: unit 4 on SCSI controller 2
Disk drive: unit 3 on SCSI controller 2
Disk drive: unit 2 on SCSI controller 2
Disk drive: unit 1 on SCSI controller 2
Integral SCSI controller 1: Version WD33C95A
Disk drive: unit 4 on SCSI controller 1
Disk drive: unit 3 on SCSI controller 1
Disk drive: unit 2 on SCSI controller 1
Disk drive: unit 1 on SCSI controller 1
Integral SCSI controller 0: Version WD33C95A
```

One device volume header name is constructed from each of the disk drive lines. The device name for the first disk drive line in the example is */dev/rdsk/dks2d4vh*.

Give the *prtvtoc* command with the device names as arguments (the */dev/rdsk/* prefix can be omitted). For the example above, the command is:

```
mars# prtvtoc dks2d4vh dks2d3vh dks2d2vh dks2d1vh \
dks1d4vh dks1d3vh dks1d2vh dks1d1vh
* /dev/rdsk/dks2d4vh (bootfile "/unix")
*     512 bytes/sector
*      94 sectors/track
*      15 tracks/cylinder
*      34 spare blocks/cylinder
*    2858 cylinders
*       3 cylinders occupied by header
*    2855 accessible cylinders
*
* No space unallocated to partitions

Partition  Type  Fs   Start: sec   (cyl)    Size: sec
(cyl)  Mount Directory
 0    efs             4128  (   3)        49152  (  35.7)
 1    raw            55040  (  40)       524288  ( 381.0)
 6    efs           579328 ( 421.0)     3353280  (2437.0)
 7   lvol             4128  (   3)      3928480   (2855)
 8 volhdr                0  (   0)         4128   (   3)
10 volume                0  (   0)      3932608   (2858)
...
```

The file */etc/lvtab* describes the logical volumes used. This file, along with the information from the *df* command, tells how the disk partitions are combined and used and how to map names onto partitions. */etc/lvtab* looks similar to this:

```
mars% cat /etc/lvtab
lv0:/b volume:stripes=4:devs=/dev/dsk/dks1d2s7,/dev/dsk/dks1d5s7, \
/dev/dsk/dks2d1s7, /dev/dsk/dks2d2s7
lv4:/a volume:stripes=4:devs=/dev/dsk/dks1d3s7,/dev/dsk/dks1d4s7, \
/dev/dsk/dks2d3s7, /dev/dsk/dks2d4s7
```

Print and file this information in case you ever have to recover from a disk crash. If a disk is destroyed in a head crash, you can rebuild it exactly as it was and recover the filesystems to their original state using the hard copy information from the disk information commands.

Recovering a Secondary Disk

This section gives you an outline of how to recover a secondary disk using NetWorker. The outline applies to either a NetWorker server or a client.

The example below assumes the primary disk is still operational, so the system has an operating system and can run NetWorker. However, a secondary disk is lost due to a head crash. See Figure B-1.

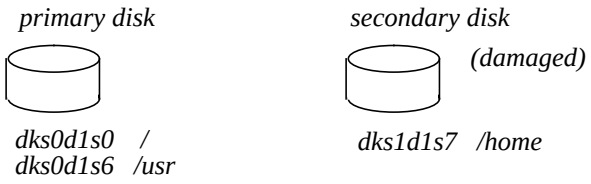

Figure B-1 Damaged Secondary Disk

If the disk is damaged, replace it with a new disk of the same type. Try to get a disk of the exact same size as the old one. You need a disk large enough to hold all the filesystems to be recovered.

1. Install the replacement disk. Make sure that IRIX recognizes the new disk.
2. Label the new disk, partition it, and make filesystems. This procedure is outlined in the section “Repartitioning a Hard Disk” in Chapter 8 of the *IRIX Advanced Site and Server Administration Guide.* Use the hard copy of the disk information to remember how large each partition was. (See the section “File the Disk Information” in this appendix.)
3. Recreate logical volumes on this disk, if used. Use the procedure in the section “Logical Volumes and Disk Striping” in Chapter 8 of the *IRIX Advanced Site and Server Administration Guide* and again use the hard copy of the disk information.

4. Invoke the *recover* command:

   ```
   venus# /usr/etc/recover
   ```

5. Select one filesystem to recover. You should recover one filesystem at a time, because NetWorker adds all the files in one filesystem but stops at a mount point, and you may run out of swap space if you add too many filesystems at once to your list of data to recover.

6. Add the directories and files under the filesystem to be recovered:

   ```
   NetWorker> add /home
   ```

7. Recover the filesystem:

   ```
   NetWorker> recover

   /home is being recovered into its original location
   Requesting 33023 files, this may take a while...
   ```

8. Repeat steps 5 through 7, adding and recovering one filesystem at a time. Remember to open a main window on your screen (or use the *nsrwatch* command) so you can monitor NetWorker requests for backup media during the recovery.

9. Exit the *recover* command:

   ```
   NetWorker> quit
   ```

Recovering a Primary Disk on a Client

In this example, a disk with the operating system or the NetWorker binaries is damaged (see Figure B-2).

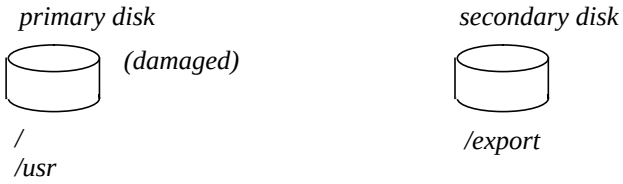

Figure B-2 Damaged Primary Disk

After replacing the damaged disk, format it and reinstall the operating system, using the original software distribution. Next, reinstall NetWorker from the original software distribution, reinstall the NetWorker licenses, and activate the licences as described in the section “Installing and Enabling NetWorker Software on Servers” in Chapter 2.

With the operating system and NetWorker back in place, you are ready to start recovering the remainder of the data lost from the disk.

1. Using the original partition information, make filesystems for each partition you are going to recover, and mount them. If a filesystem is already created and mounted, you do not need to do this. For example, if you reinstalled */* and */usr*, you do not need to recreate them.
2. Invoke NetWorker to recover each filesystem on the disk being recovered, one at time. For example:

   ```
   venus# /usr/etc/recover
   NetWorker> add /
   ```

3. Use the `list` command to check the list of directories and files you are about to recover. Use the `force` command so that you are not prompted every time a file naming conflict occurs. For example:

   ```
   NetWorker> list
   NetWorker> force
   NetWorker> recover
   ```

4. Recover the lost filesystems, one at time. Open the main window or use the *nsrwatch* command to monitor NetWorker requests for backup media during the recovery.

Note: You should always reboot a system after recovering a primary disk. ♦

Recovering /nsr on a NetWorker Server

This section addresses the case where the */nsr* filesystem on a NetWorker server is lost, due to a disk crash. The */nsr* filesystem contains the indexes that hold the necessary information to recover the NetWorker clients.

If the server loses its operating system and NetWorker commands, these have to be reinstalled first. (See “Recovering a Primary Disk” in this appendix.)

The next important step is to recover the server's indexes from the backup media, using the *recoverindex* command. The *recoverindex* command asks you for the bootstrap save set ID (ssid). If you followed the procedure recommended to prepare for a disk crash, you have a piece of paper with the name of the backup media you need and the bootstrap save set ID.

For example, save set ID `1148869870` below is the most recent bootstrap backup:

```
March 11 16:42 1994 Networker boostrap information            Page 1

  date     time  level      ssid  file  record       volume
3/10/94  2:46:02     9  1148868949    56       0  bitbucket.002
3/11/94  2:53:34     9  1148868985    77       0  bitbucket.003
```

If you do not have this piece of paper, you can still recover the indexes by finding the save set ID using the *scanner* command. (See the section "Finding the Bootstrap Save Set ID" in this appendix.)

You may need more than one backup media to recover the server's indexes. During the recovery, you can use the *nsrwatch* command or open the main window to watch for pending messages requesting backup media.

With the operating system and NetWorker in place, recover the indexes from the backup media:

1. Find the printout of the bootstrap save set ID information. You need it for the next two steps.
2. Retrieve the backup media that contains the most recent backup named bootstrap, and load it into the server's device.
3. Use the *recoverindex* command to extract the contents of the bootstrap backup. For example:

   ```
   mars# /usr/etc/recoverindex
   recoverindex: Using mars as server

       NOTICE: recoverindex is used to recover the NetWorker
       server's on-line file and media indexes from media
       (backup tapes or disks) when either of the server's
       on-line file or media index has been lost or damaged.
       Note that this command will OVERWRITE the server's
       existing on-line file and media indexes. recoverindex
       is not used to recover NetWorker clients' on-line
   ```

```
    indexes; normal recover procedures may be used for
    this purpose. See the recoverindex(1M) and
    nsr_crash(1M) man pages for more details.

What is the name of the tape drive you plan on using
[dev/rmt/tps1d6nrnsv]?
Enter the latest bootstrap save set id []: 1148869870
Enter starting file number (if known) [0]: 88
Enter starting record number (if known) [0]: 0

Please insert the volume on which save set id 1148869870
started into dev/rmt/tps1d6nrnsv. When you have done
this, press <RETURN>:

Scanning dev/rmt/tps1d6nrnsv for save set 1148869870;
this may take a while...
scanner: scanning 8mm 5GB tape space.006 on
dev/rmt/tps1d6nrnsv
uasm -r nsr/res/nsr.res
uasm -r nsr/res/nsrjb.res
uasm -r nsr/res/
nsrmmdbasm -r nsr/mm/mmvolume
nsr/mm/mmvolume: file exists, overwriting
uasm -r nsr/index/space/
nsrindexasm -r nsr/index/space/db
scanner: ssid 449955156: scan complete
scanner: ssid 449955156: 31 KB, 10 files
nsr/index/space/db: file exists, overwriting
uasm -r nsr/index/
uasm -r nsr/mm/
uasm -r nsr/
uasm -r
space: 31 records recovered, 0 discarded.
nsrindexasm: Building indexes for mars...
nsrindexasm: Caching save times for mars...
8mm 5GB tape space.006 mounted on dev/rmt/tps1d6nrnsv,
write protected

The bootstrap entry in the on-line index for mars has
been recovered. The complete index is now being
reconstructed from the various partial indexes which were
saved during the normal saves for this server.
# nsrindexasm: Pursuing index pieces of
nsr/index/space/db from mars.
Recovering 2 files into their original locations
```

```
Total estimated disk space needed for recover is 11 MB
Requesting 2 files, this may take a while...

nsrindexasm -r .db
.db: file exists, overwriting
: 25711 records recovered, 0 discarded.
nsrindexasm -r .db
.db: file exists, overwriting
nsrindexasm: waiting for lock on ../db.SCAVENGE
nsrindexasm: lock on ../db.SCAVENGE acquired
Received 2 files from NSR server ‘mars’
: 733 records recovered, 0 discarded.
nsrindexasm: Building indexes for mars...
nsrindexasm: Caching save times for mars...
nsrindexasm: Suppressing duplicate entries in mars - 50
duplicates discarded.

The on-line index for space is now fully recovered.
```

Notice how the shell prompt appears once bootstrap is recovered. You can use NetWorker commands such as *nsrwatch* to watch the progress of the server, or *networker* to bring up the NetWorker main window during the recovery of the index.

Replacing the /nsr/res Directory

The *recoverindex* command also recovers the */nsr/res* directory, which is used by NetWorker to store configuration information such as the list of NetWorker's clients and registration information. However, this directory, unlike the indexes, can not be overwritten or relocated; instead, the recovered */nsr/res* directory is renamed */nsr/res.R*.

After *recoverindex* has finished, this final message appears:

```
nsrindexasm: The on-line index is now fully recovered.
```

To complete the recovery of the */nsr/res* directory, you need to shut down NetWorker, move the recovered */nsr/res* directory into its original location, and then restart NetWorker:

1. Shut down the NetWorker server using the *nsr_shutdown* command:

   ```
   # /usr/etc/nsr_shutdown
   ```

2. Save the original */nsr/res* directory, and move the recovered version into the correct location.

   ```
   # cd /nsr
   # mv res res.orig
   # mv res.R res
   ```

3. Restart the NetWorker server:

   ```
   # cd /
   # /etc/init.d/networker start
   ```

   When NetWorker restarts, it uses the recovered configuration data.

4. Once you have verified that the NetWorker configuration is correct, you can remove the */nsr/res.orig* directory.

   ```
   # rm -r /nsr/res.orig
   ```

To recover other filesystems, see the section “Recovering a Secondary Disk” in this appendix.

Finding the Bootstrap Save Set ID

If you did not file a hard copy of the bootstrap information, you can still find the save set ID of the most recent bootstrap by using the *scanner* command.

For example:

1. Place the most recent media used for backups in the server device.
2. Read the contents of the backup media with the *scanner* command:

   ```
   mars# /usr/etc/scanner /dev/rmt/tps1d6nrnsv
   ```

   Substitute the pathname for your server device.

The *scanner* command displays the contents of the backup media, for example:

```
# scanner /dev/rmt/tps1d1nrnsv
scanner: scanning 8mm 5GB tape atlas.005 on /dev/rmt/tps1d1nrnsv
client name      save set        save time     level   size  files     ssid  S
atlas.engr.s     /               3/10/94  3:37  f   6072660   1053      3388 E
atlas.engr.s     /usr            3/10/94  3:37  f  57315808   2985      3387 E
atlas.engr.s     /usr/people     3/10/94  3:33  f 504417356  19737      3372 S
atlas.engr.s     /usr/people     3/10/94  3:33  f 1340638812  41067      3372 E
scanner: done with 8mm 5GB tape atlas.005
```

In this example, the bootstrap save set ID is `1340638812`. Once you find the most recent bootstrap save set ID, you can use the *recoverindex* command to recover the server's index.

Disaster Recovery with Jukeboxes

To use jukeboxes during disaster recovery, follow these steps:

1. Read the disaster recovery procedures listed in the reference page *nsr_crash*(1M). Perform all steps up to giving the *recoverindex* command. If only one volume is needed to recover your NetWorker file indexes, follow the instructions in *nsr_crash*(1M).
2. Give the command *nsrjb -H*. This resets the jukebox for operation. If there are any volumes loaded in the media drives, they are moved back to a slot. This operation may take a few minutes to finish.
3. Using the instructions in *nsr_crash*(1M), determine which volumes are needed to retrieve the NetWorker file indexes. Load these volumes into the jukebox.
4. Give the command *nsrjb -I*. This reinventories the jukebox. All the volumes currently loaded in the jukebox are marked with an asterisk because there is no media database.
5. Load the first volume that *recoverindex* requests into the first drive in the jukebox. Give this command:

   # **/usr/etc/nsrjb -l -n -S** *slot* **-f** *device_name*

   slot is the slot where the first volume is located and *device_name* is the pathname of the first drive.

6. Run *recoverindex*. Provide the same device name as in step 5 above and the last save set ID requested by *recoverindex*. At this point, NetWorker recovers the file indexes.
7. After the indexes have been recovered, give the command *nsrjb -u*.
8. If you need to recover whole filesystems, use the *recover* command to determine which volumes are needed. If any of the volumes are not located in the jukebox, load them into the jukebox and inventory those slots. Continue with this process until all your filesystems have been restored.

Summary

The steps below summarize what you need to do if a primary or secondary disk is damaged, destroying the filesystems of a NetWorker server or client:

1. If the operating system is lost, reload and boot the system using the same hostname and disk partitioning.
2. Replace the damaged disk, if necessary, and format it, partition it, and make new filesystems. Mount the filesystems in the same locations as before.
3. If it was lost, reinstall the NetWorker software from the NetWorker software distribution CD.
4. If the */nsr* filesystem is destroyed on a NetWorker server, use *recoverindex* to recover the NetWorker server's indexes.
5. Recover the lost filesystems, one at a time.

Appendix C

Theory of Operations

This appendix is for the system administrator or operator who is familiar with the *NetWorker for IRIX Administrator's Guide* and is interested in more information about NetWorker and how it works. You should be familiar with IRIX administrative concepts, the X Window System interface, and the *nsradmin* command.

Introduction

The NetWorker reference pages provide complete and detailed information to help you administer NetWorker. The reference pages list the commands in alphabetical order, so you may verify them easily.

This appendix gives a pictorial overview of the major components of NetWorker and how they are controlled. The pictures illustrate basic points; they are not meant to be detailed or precise. This appendix lists the various NetWorker reference pages that contain details about each section. The reference page equivalent to this appendix is *nsr*(1M).

You should read this appendix while sitting at your workstation so that you can read the IRIX and NetWorker reference pages, execute NetWorker commands (especially *nsradmin*), and verify the pictures (using IRIX administrative commands like *ps*).

The basic picture elements used in this appendix are shown in Figure C-1.

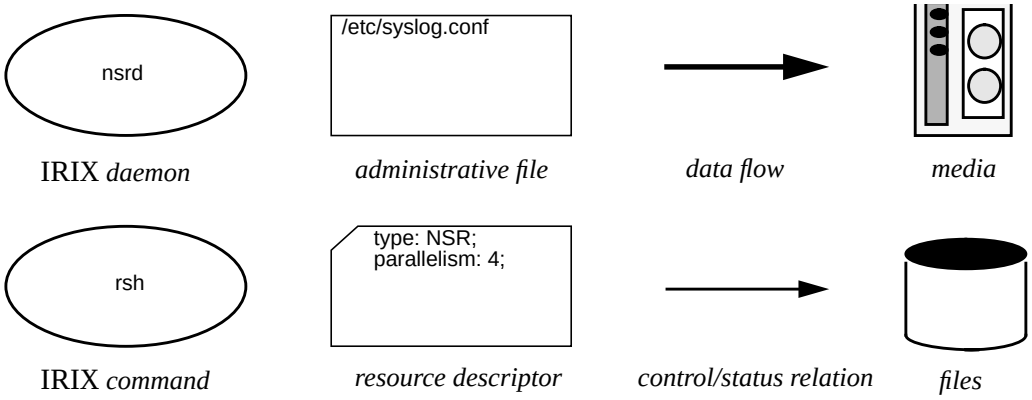

Figure C-1 Major Components of NetWorker

NetWorker Media Format

The NetWorker media format is designed to meet these requirements:

- Ability to multiplex data from several clients simultaneously to maximize performance.
- Machine architecture independence (such as byte order differences) through the eXternal Data Representation (XDR) format.
- Filesystem independence, allowing NetWorker to back up heterogeneous clients with different operating systems and filesystems.
- Ability to fully utilize media capacity by appending to the media until it is full, and then continuing to additional media.
- Support for quick seeking on media, by writing occasional file marks.
- Special handling for certain types of files via the Application Specific Module (ASM) architecture.
- Ability to track media through media labels.

No other existing media format meets these requirements.

The NetWorker media format is fully documented in the *mm_data*(5) reference page. Third parties are welcome to adopt the format.

The NetWorker System at Rest

There are four daemons that continue running on the NetWorker server system even when it is at rest. The two internal server daemons, *nsrmmd* and *nsrmmdbd*, are not meant to be *networker* client-accessible; their only clients are forked copies of *nsrd*. As these internal daemons execute, they may send status messages (or "events") to the controlling *nsrd*.

The controlling *nsrd* is the root of all NetWorker functionality. It receives status information from the internal daemons and reports the status to commands such as *nsrwatch* and *networker*. The *nsrd* daemon allows the browsing and editing of NetWorker resource descriptors by clients using the *nsradmin* command. Finally, *nsrd* accesses save and recover sessions from network clients and forks "agent" copies of itself to handle each session.

From a monitoring point of view, the NetWorker main window and *nsrwatch* are functionally equivalent. They monitor the dynamic state of the NetWorker server. A very important field in these monitors is the Pending display, which shows you what the server needs to make progress.

The *networker* daemon provides an X Window System graphical interface for all the system configuration tasks. The *nsradmin* daemon provides a character-based administrative interface to the NetWorker server that can be used from any ASCII terminal.

The four daemons that are always running on the NetWorker server and three network-based monitors are shown in Figure C-2.

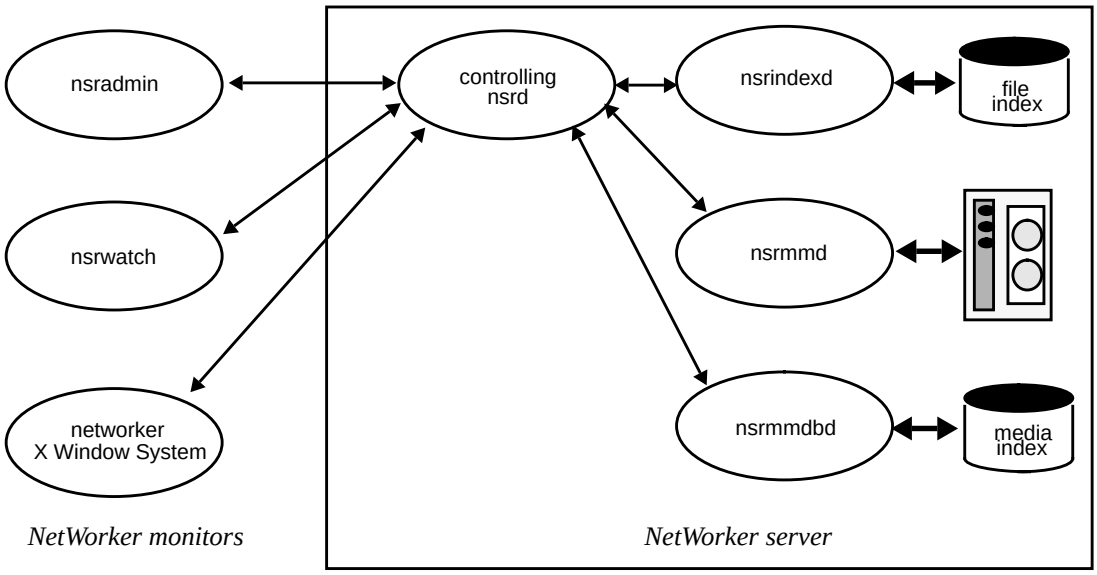

Figure C-2 NetWorker Monitors and Daemons

The relevant reference pages are shown in Table C-1.

Table C-1 Reference Pages for NetWorker at Rest

Reference Page	Comments
nsradmin(1M)	Controls all aspects of NetWorker server administration
nsrwatch(1M)	Character-based monitor
networker(1M)	X Window System interface for NetWorker system administration
nsrd(1M)	NetWorker server
nsrmmd(1M)	Internal daemon interfaces to all backup devices
nsrmmdbd(1M)	Internal daemon that manages the media index

Browsing and Modifying Resources

There are two ways to configure NetWorker: by using the X Window System interface and by editing the configuration information (called *resources*) from an ASCII terminal.

If you are not using the X Window System, you can browse and edit the NetWorker server's resources with the *nsradmin* command. You can either use your IRIX editor to browse and modify the NetWorker server's resource descriptors, or you can use the visual mode of *nsradmin*. See the *nsradmin*(1M) reference page for more information.

When using your editor, *nsradmin* copies the resource descriptors from the server into a temporary file on your system. When you are finished making changes, *nsradmin* compares any edits you may have made with the original copies and prompts you for confirmation for any additions, deletions, or changes you may have made to the resource descriptors.

Changes are passed back to the server and are immediately applied to the NetWorker server subsystems that are affected. This way, administrators do not have to kill and restart daemons or reboot systems in order to have changes applied. In addition, the changes can be applied from a client workstation using the administrator's favorite editor. All administrative aspects of a NetWorker server are handled by resource modifications.

The resource types that describe the NetWorker server configuration are shown in Figure C-3.

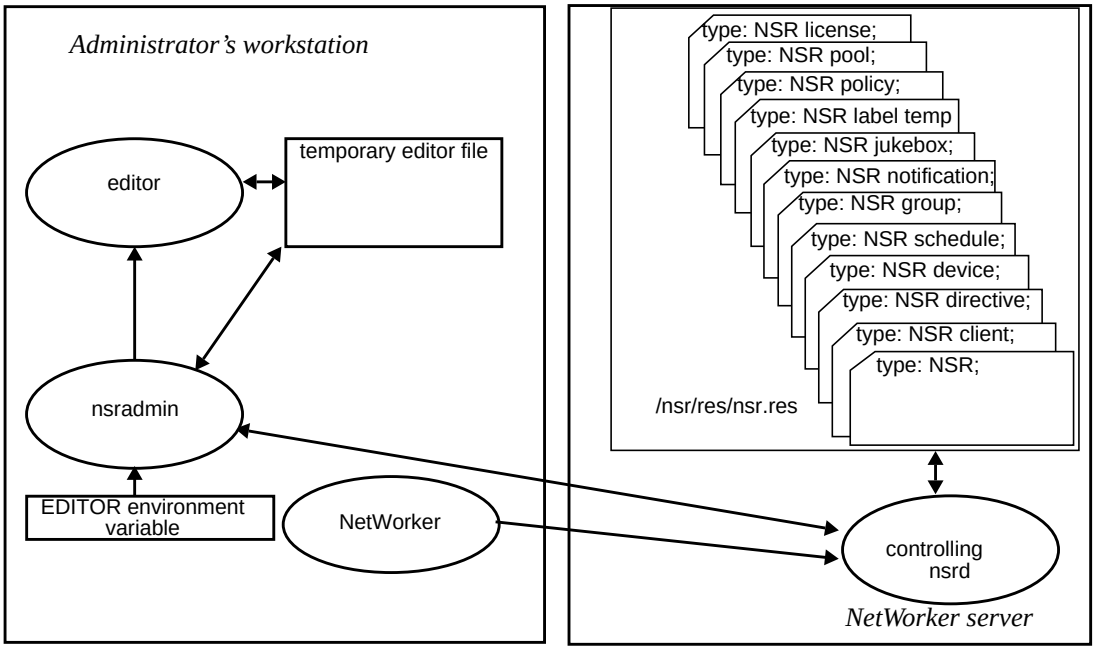

Figure C-3 NetWorker Resource Types

The relevant reference pages are shown in Table C-2.

Table C-2 Reference Pages for Browsing and Modifying Resources

Reference Pages	Comments
networker(1M)	X Window System interface
nsradmin(1M)	Invokes your editor on resource descriptor copies
nsr_resource(5)	Describes resource file format and types
nsrd(1M)	NetWorker server checks and applies changes

Backing Up Files

This section describes the operation of backups, called “saves.”

The *save* command traverses a clients filesystems and backs up a client’s files subject to “directives.” The *nsr*(1M) reference page documents the use of directives.

The *save* daemon first initiates a session with the server’s controlling *nsrd*. The server accepts a connection if it originates from a privileged port on a client listed in the server’s “NSR client” resource descriptor. Once the network connection is accepted, a forked agent *nsrd* handles all subsequent requests from the client.

After session establishment with the server, *save* reads files and sends a save set to its agent *nsrd*. Upon completion, the client calls upon the server to commit the save set. To commit the save set, the agent *nsrd* instructs the *nsrmmd* to commit the save set data to the backup media. At this point, the agent returns from the commit call. *save* then terminates the session and both *save* and the agent *nsrd* exit.

Under normal circumstances, in order to acquire a privileged port, *save* must be a “set uid root” command. Upon acquiring the privileged port, *save* reverts back to the invoking the user ID, unless the user is *operator* or the user is in the group *operator*.

The controlling *nsrd* does the original access control, then forks an agent to handle the actual saved data. By forking one agent per save session, the server can handle an arbitrary number of sessions simultaneously.

The illustration in Figure C-4 describes a typical *save* session between client and server.

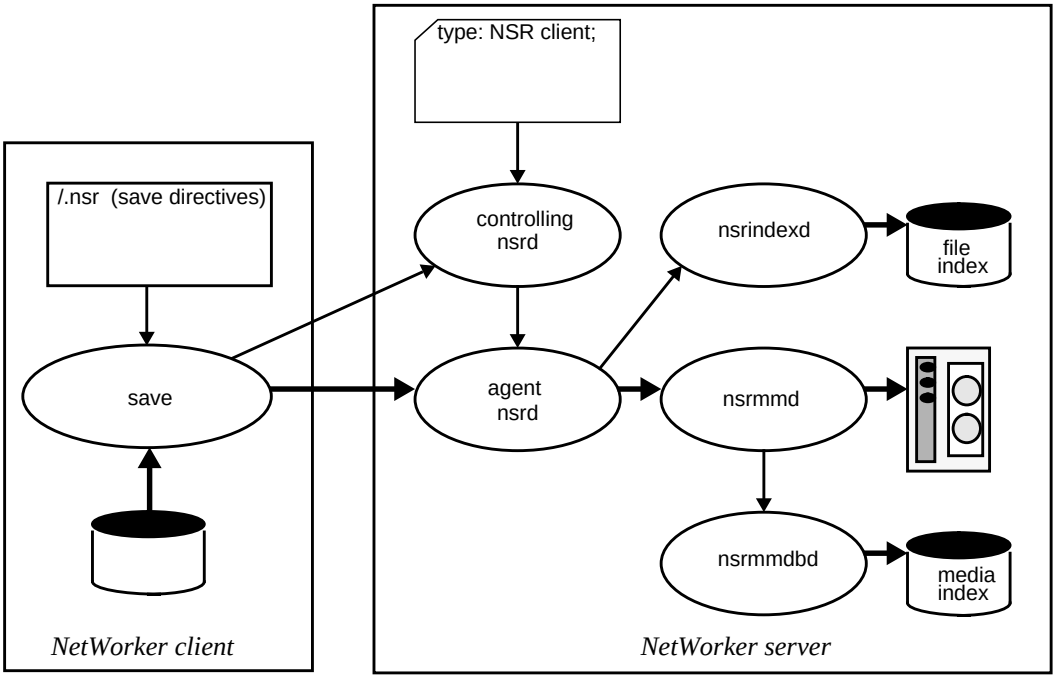

Figure C-4 Typical *save* Session

The relevant reference pages are listed in Table C-3.

Table C-3 Reference Pages for Backing Up Files

Reference Pages	Comments
nsr(5)	Documents *save* directives
nsr_client(5)	Documents the resource descriptor type “NSR client”
save(1M)	Command that saves files to the server
nsrd(1M)	NetWorker server daemon checks access control
nsrexecd(1M)	NetWorker client execution daemon
rcmd(3N)	Discusses privileged ports

Table C-3 (continued) Reference Pages for Backing Up Files

Reference Pages	Comments
nsr(1M)	Security section discuss policies and issues
nsr_data(5)	Describes basic data types passed from client to server

Recovering Files

The *recover* command is the counterpart of *save* and subject to similar security and session establishment policies. Once a session is established, two major functions of *recover* are used: file browsing and recovery.

Saved files are browsed by using commands that are familiar to the IRIX user. Since file attributes are kept online, the browsing is possible even when no backup volume is mounted on a device. During browsing, media information may be needed if the user requests information associated with the `versions` command.

As users browse, they may build a recover list. Eventually the user may give the `recover` command and the client submits the recovery list to the agent *nsrd* on the server. At this point, the file and media indexes are used to determine the backup volume(s) and position(s) of the desired file(s).

The *nsrmmd* requests backup volumes and reads them until the entire file recovery list is processed.

Clients browse the online indexes via remote procedure calls to their agent daemons. The device and *nsrmmd* are involved only when files are actually requested for recovery. Thus, NetWorker supports multiple concurrent browsers.

A typical *recover* session between client and server is illustrated in Figure C-5.

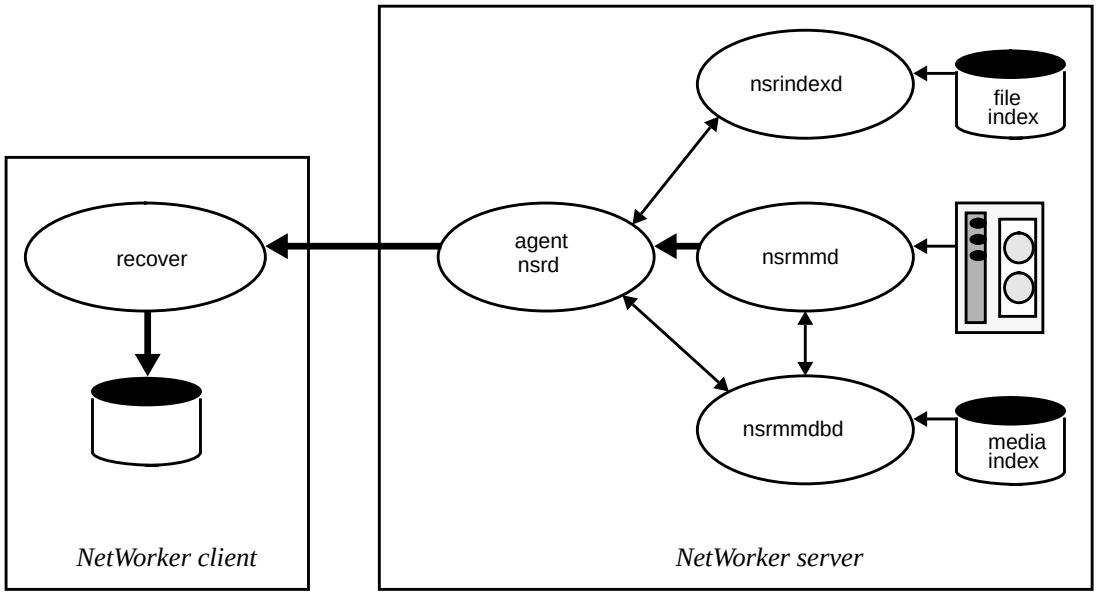

Figure C-5 Typical *recover* Session

The relevant reference page is shown in Table C-4.

Table C-4 Reference Page for Recovering Files

Reference Page	Comments
recover(1M)	Documents browsing and recovery subcommands

Backing Up the Whole System

While it is useful that the *save* command allows individuals to back up their directories, an unattended backup system has to back up whole systems according to predefined backup levels. The *savefs* command accomplishes this.

The *savefs* daemon determines which backup schedule to use for a client by looking for the schedule name in the "NSR client" resource. It then consults the appropriate "NSR schedule" resource to determine which backup level to use (full, incremental, or a level 1–9. Given the save level and a filesystem, *savefs* saves only files within the filesystem that have been modified since the most recently recorded lesser-level save. Upon completion, the current save level and the time at which *savefs* began are recorded in the media database.

If the client has been configured to back up all its filesystems, *savefs* uses all local filesystems.

After compiling information about the local filesystems and when they were last saved, and determining the desired save level, the *savefs* command invokes *save* against each of the client's filesystems.

The *savefs* command is shown saving two filesystems in parallel in Figure C-6.

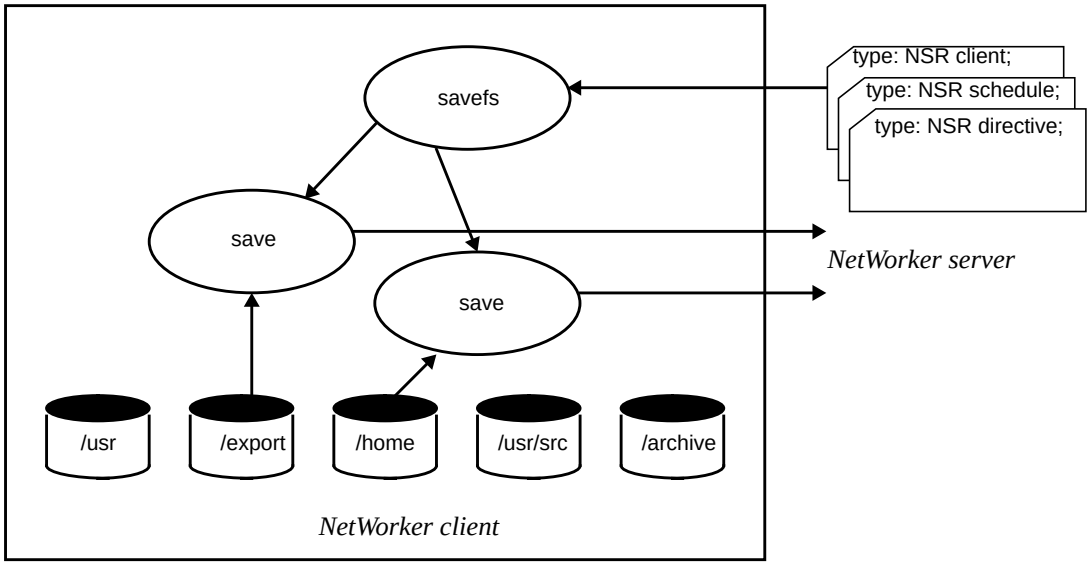

Figure C-6 Saving Two Filesystems in Parallel

The relevant reference pages are listed in Table C-5.

Table C-5 Reference Pages for Backing Up the Whole System

Reference Page	Comments
savefs(1M)	Saves the client's filesystems
nsr_client(5)	Determines the client configuration and which filesystems are backed up
nsr_directive(5)	Determines which save directives apply to the client
nsr_schedule(5)	Determines save level
save(1M)	Does the actual save, given many arguments

Automatic Network-Wide Backups

NetWorker uses the "NSR group" resource to find the start time of a network-wide backup. The pre-configured time is 3:33 each morning. Each "NSR client" resource describes the groups to which it belongs.

The controlling *nsrd* starts the *savegroup* command at the appropriate time for each group that is enabled. The *savegroup* daemon uses the "parallelism" attribute of the "NSR" resource to determine how many client sessions to save concurrently.

Upon completing all client saves, *savegroup* invokes the *saveindex* command to insure that the NetWorker server index is safely backed up.

The NetWorker server *nsrd* starts the nightly saves by invoking *savegroup*. Each client's *savefs* is initiated by *savegroup* in an orderly manner. After the clients are backed up, *saveindex* backs up the server's index.

The daemon *savegroup* also uses *nsrexeced* to run *savefs* on clients. This daemon uses *rshd* if *nsrexecd* is not present and running on a client.

The NetWorker server *nsrd* starts the nightly save by invoking *savegroup*, as illustrated in Figure C-7.

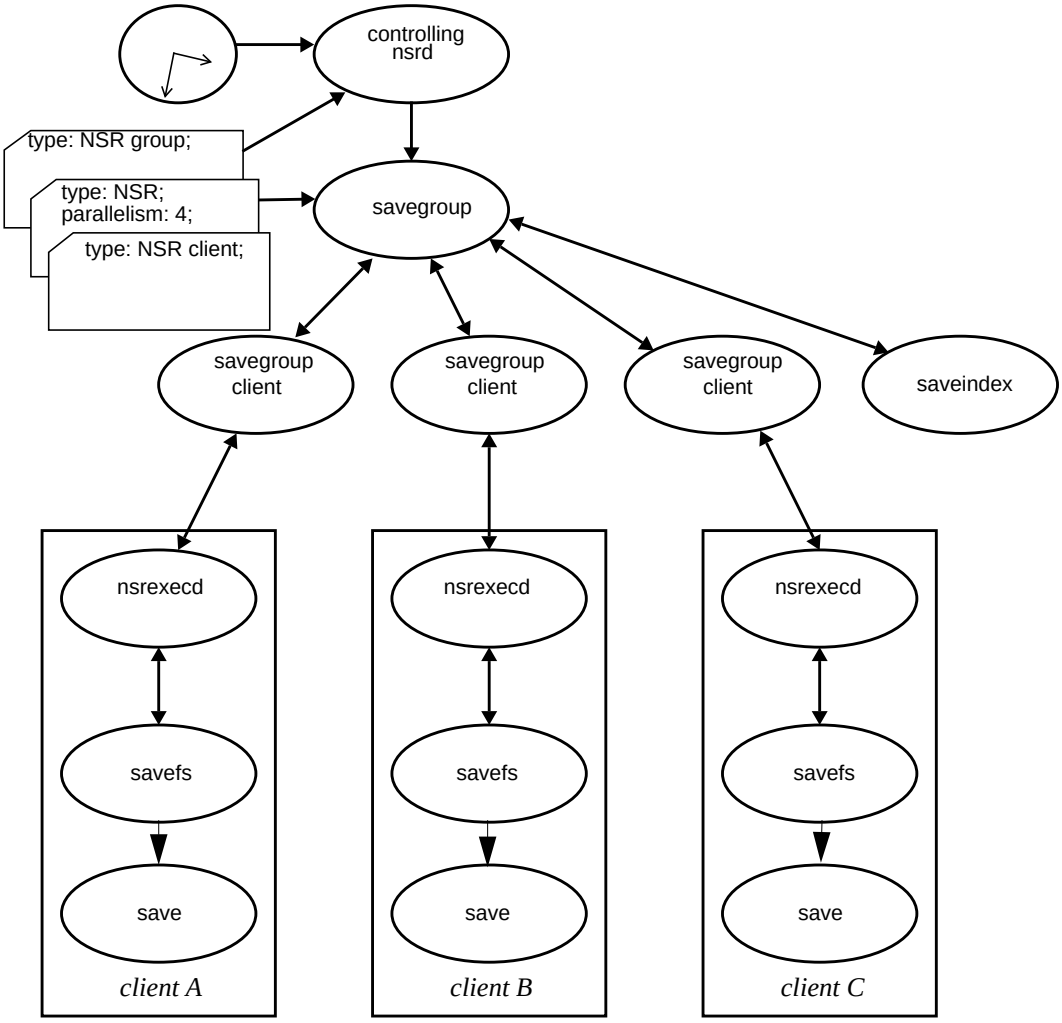

Figure C-7 Starting the Nightly Save

A nightly network backup is shown in Figure C-8. (Not shown are the server's controlling *nsrd* and *nsrmmdbd*, and the client's *nsrexecd*.)

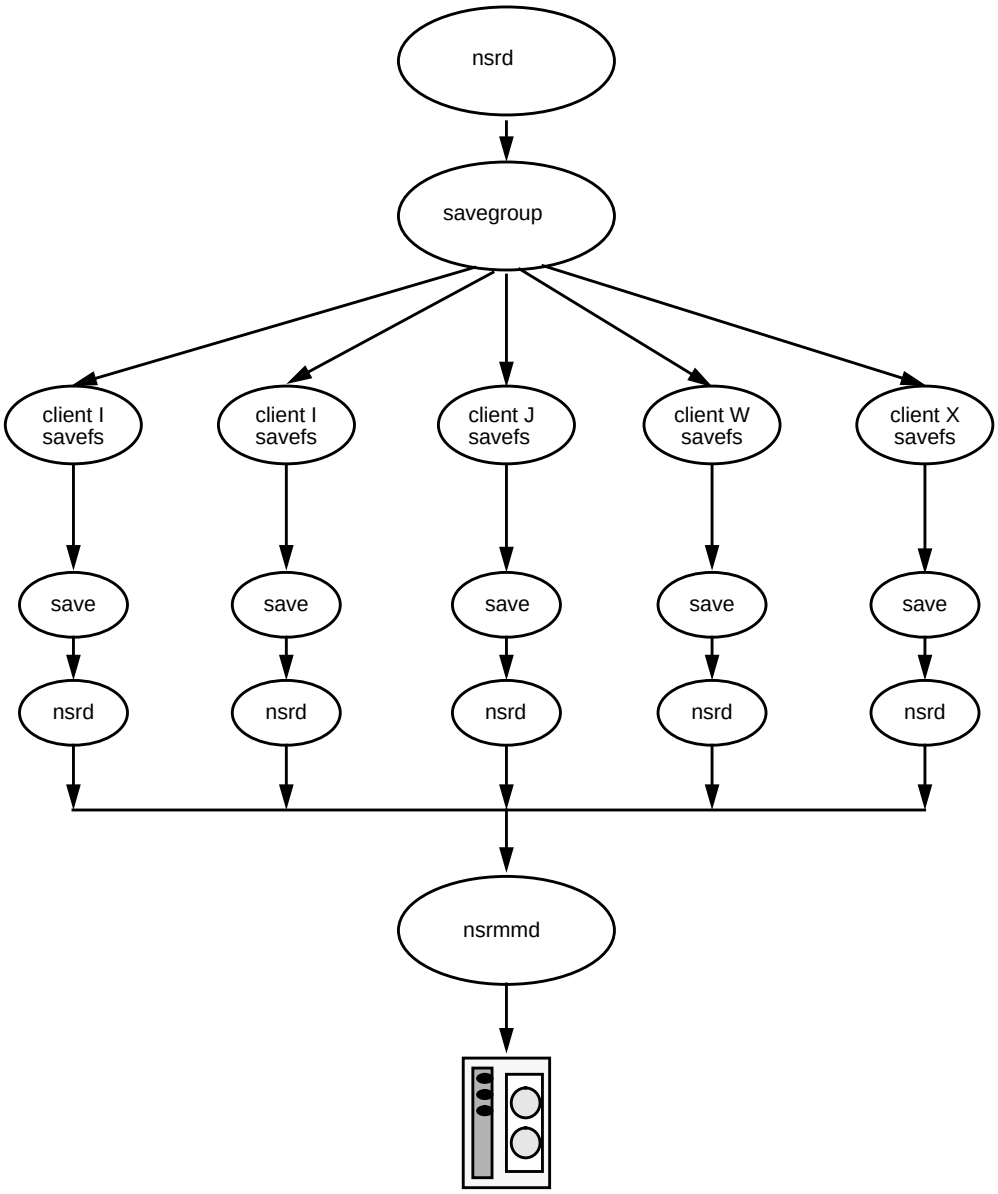

Figure C-8 Nightly Network Backup

The relevant reference pages are listed in Table C-6.

Table C-6 Reference Pages for Automatic Nightly Backups

Reference Page	Comments
savegroup(1M)	Conducts the nightly network saves
nsr_service(5)	Parallelism attribute controls how many clients save at once
nsr_group(5)	Selects the time of nightly saves
nsrexecd(1M)	Remote execution system used to start *savefs*
rshd(1M)	Remote execution system used to start *savefs* if *nsrexecd* is not present
savefs(1M)	Saves each client's filesystems
saveindex(1M)	Saves the server's index; detailed in a later section

Event Processing

Besides reporting routine status to the controlling *nsrd*, the NetWorker subsystems are set to report major events. The administrator can cause any IRIX command to be invoked when an event occurs. He or she does this simply by modifying an "NSR notification" resource on the NetWorker server.

When an event occurs, the controlling *nsrd* inspects all "NSR notification" resources. An action is taken if the event type matches any event type listed in the hidden "event" attribute list, and if the event's priority matches any priority listed in the hidden "priority" attribute. Therefore, one event may trigger any number of actions, and one "NSR notification" may match any number of events.

All NetWorker daemons post events to the controlling *nsrd*. As each event is posted, the controlling *nsrd* matches the event against all NSR notification resources and acts on every match by executing the corresponding IRIX command. NetWorker defaults provide interfaces to the *syslog* system and electronic mail.

The notification subsystem is shown in Figure C-9.

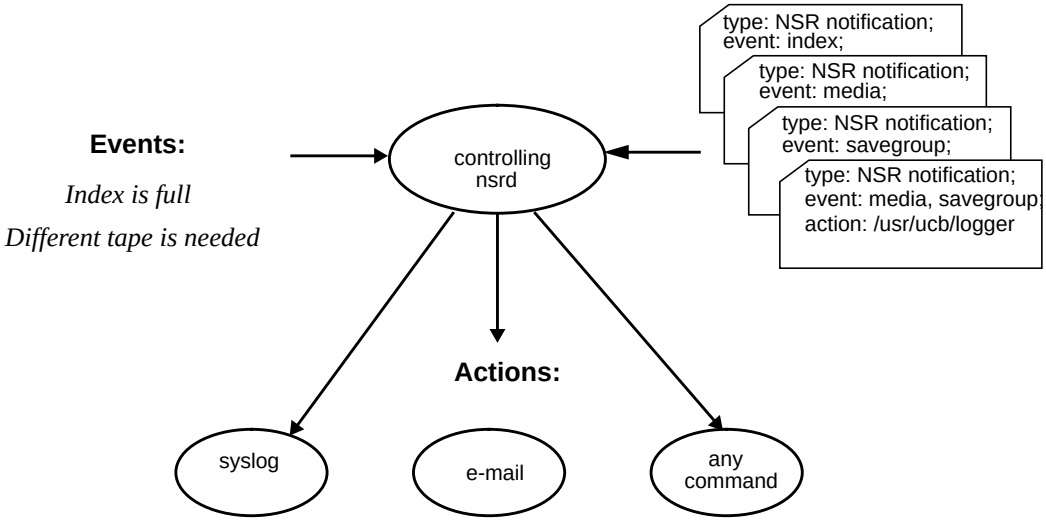

Figure C-9 Notification Subsystem

The relevant reference page is listed in Table C-7.

Table C-7 Reference Page for Event Processing

Reference Page	Comments
nsr_notification(5)	Describes the notification process

Media Management

There is a working relationship among *nsrmmd*, the other daemons, the device resources, and the media manipulation commands. As shown, the *nsrmmd* daemon may be writing to one device while the operator brings a second device online. When *nsrmmd* needs a new backup volume, it polls the controlling *nsrd* for the backup volume and the device on which it is located. The *nsrmmd* daemon also records save set information to the *nsrmmdbd* daemon each time a backup volume filemark is written.

During recovery, *nsrmmd* queries *nsrmmdbd* to discover the backup volume and volume-file location of the desired data. The administrator uses the *mminfo* command to display information about the backup volume library.

nsrmmd and its relation to other processes are illustrated in Figure C-10.

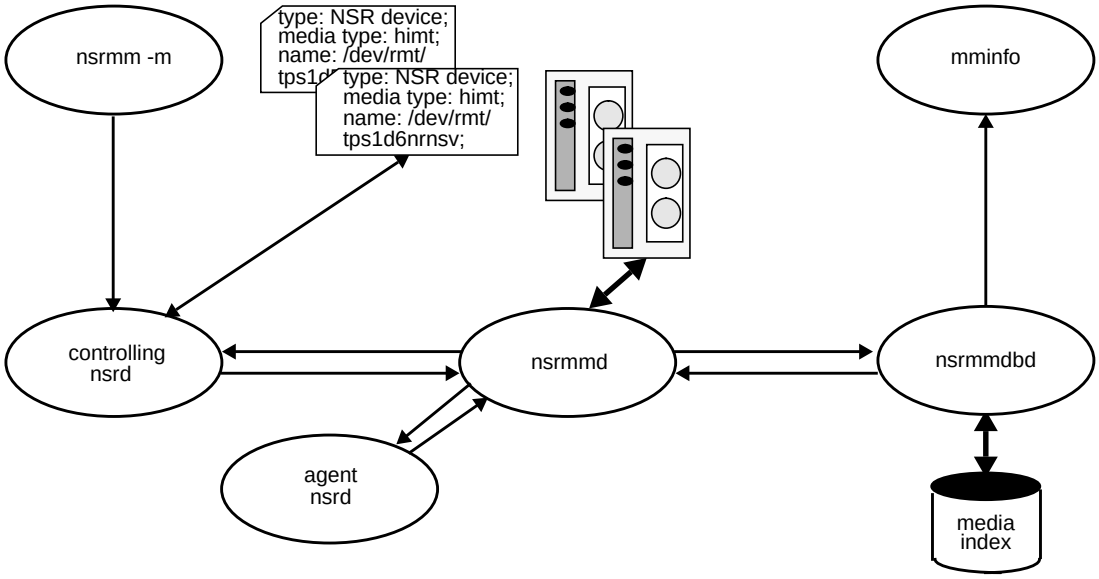

Figure C-10 *nsrmmd* and Other Processes

The relevant reference pages are listed in Table C-8.

Table C-8 Reference Pages for Media Management

Reference Page	Comments
nsrmm(1M)	Media manager mounts, unmounts, deletes backup volumes
nsr_device(5)	Describes and names backup devices
nsrmmd(1M)	Writes and reads data to and from the backup devices
nsrmmdbd(1M)	Manages the backup media library
mminfo(1M)	Displays information about the backup media library

Index Management

The online index is built during saves, and queried during browsing and recovering. The *nsrls* command allows the administrator to gather information about the index sizes and record counts. Index entries are purged by the *nsrmm* command after it deletes a backup volume from the media index. The *nsrck* command is automatically invoked after failure (for example, an operating system crash) to guarantee the index database consistency before the NetWorker service is enabled.

The file index and its relationship to processes is illustrated in Figure C-11.

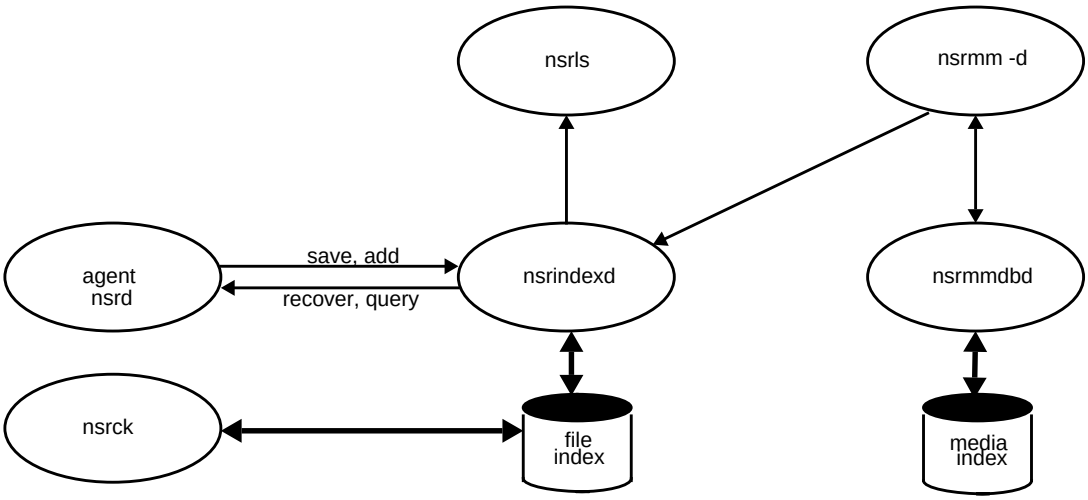

Figure C-11 The File Index and Processes

The relevant reference pages are listed in Table C-9.

Table C-9 Reference Pages for Index Management

Reference Page	Comments
nsrmm(1M)	Media manager deletes backup volumes
nsrindexd(1M)	Manages the online index
nsrls(1M)	Displays index usage statistics

Table C-9 (continued) Reference Pages for Index Management

Reference Page	Comments
nsrck(1M)	Rebuilds indexes after a hard crash
nsr_layout(5)	Explains where all the NetWorker server's files are located

Disaster Recovery

The last act that *savegroup* performs each morning is backing up the NetWorker server's own index so that the index can be recovered without using itself. Besides saving the index, *saveindex* sends bootstrap recovery information to the line printer. Should the server's index ever need to be recovered, this bootstrap information is sufficient to find the saved index on a NetWorker backup volume.

The *saveindex* daemon is invoked by *savegroup*; its job is to save index information vital to the server itself and to print recovery parameters to the line printer. Should the server's indexes ever need to be recovered, these parameters will be fed to the *recoverindex* command. Once the server's indexes are recovered, all other files may be recovered in the normal manner.

The illustration in Figure C-12 shows the progression of index information from saving to recovering.

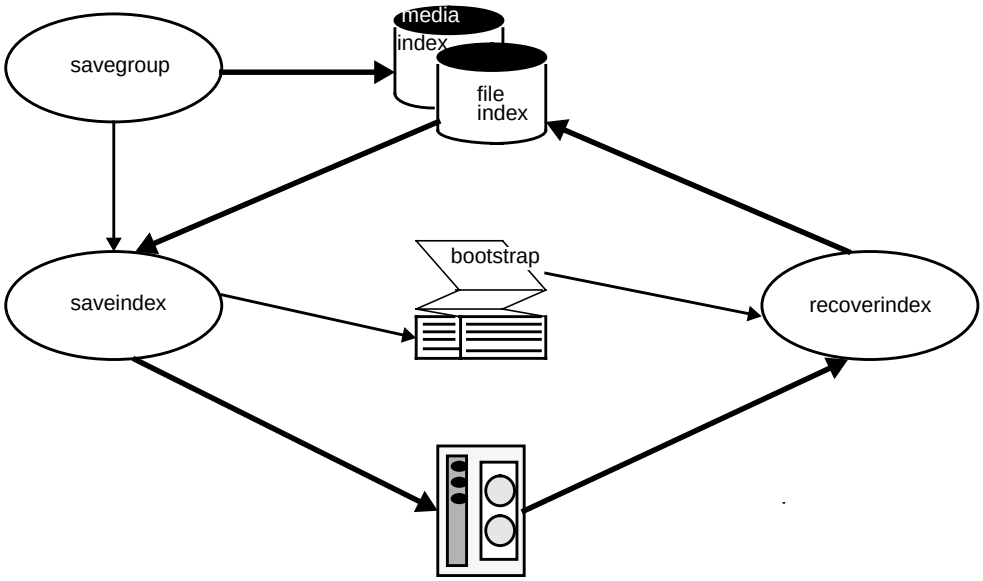

Figure C-12 Index Information From Saving to Recovering

The relevant reference pages are listed in Table C-10.

Table C-10 Reference Pages for Disaster Recovery

Reference Page	Comments
savegroup(1M)	Typically invokes *saveindex*
saveindex(1M)	Also covers *recoverindex*
scanner(1M)	Used by *recoverindex*; reads raw NetWorker backup volumes
mm_data(5)	Describes backup media format
nsr_crash(1M)	More general information on recovering after a disk crash

NetWorker Security

The NetWorker server validates client access by checking the list of clients known to the server. The server accepts only connections that are initiated from a secure port on the client. Secure ports can be opened only by *root*, so NetWorker commands run setuid to *root*. This access control is similar to that used by the *rsh* (remote shell) command, except that instead of using the */.rhosts* file, NetWorker uses the Recover access list in the Clients window.

Once a connection has been established, the client commands *save*, *savefs*, and *recover* set their effective uid to the uid of the user who initiated the command so that all local filesystem and system call access is done as that user. This prevents users from recovering or backing up files to which they should not have access. The exception to this rule is that the user name *operator* and users in the group *operator* have filesystem access privileges of *root*. This allows the administrator to set up a login or group for the operators who initiate backups and recovers on behalf of other users, without giving the operators *root* access to client systems.

Note: Since any user named *operator* or any user belonging to a group named *operator* can access all data on all clients, care should be taken in assigning these names. ♦

NetWorker is pre-configured to allow the clients to browse and recover only their own files. To give other clients recover access to a client's files, the administrator must explicitly add the access to the Recover access list in the Clients window.

Access control for the client commands can be further tightened by turning off the set-uid bit. This restricts the client systems' use of the *save*, *savefs*, and *recover* commands to *root*. To allow access by *root* and *operator*, but not by other users, change the group ownership of these commands to *operator*, and set the mode bits to allow execution by owner and group, but not by others.

The *savegroup* command initiates the *savefs* command on each client system in a backup group by sending a remote command request to the *nsrexecd* command.

The *nsrexecd* command runs on NetWorker client systems. This command provides a secure and restrictive way for NetWorker to start automatic backups on clients. The *nsrexecd* command allows you to restrict access to a select set of NetWorker servers. When you install a client, *nsrexecd* is started, and statements are added to the appropriate boot files to restart *nsrexecd* each time the client reboots.

For more information about security, see the *nsr*(1M) reference page.

Command Summary

This appendix contains a list of the most commonly-used NetWorker commands entered at the system prompt, and lists of the NetWorker reference pages for NetWorker commands and resources.

Common NetWorker Commands

If you are using NetWorker from an ASCII terminal, the commands shown in Table D-1 are the ones you may use most often.

Table D-1 Commonly-Used NetWorker Commands

Command	Purpose
nsrmm -l *volume_name*	Label a backup volume with the name *volume_name*
nsrmm -m	Mount the backup volume in the server drive
nsrmm -u	Unmount the backup volume in the server drive
nsrmm -d -P *volume_name*	Purge the backup volume named *volume_name*
nsrmm -d *volume_name*	Delete the backup volume named *volume_name*
nsrmm -m -R	Recycle the backup volume
mminfo	Display information about the backup volumes
nsradmin	Configure networker resources
nsrck -F	Compact the index size after purging or deleting backup volumes
nsrexecd	NetWorker client execution daemons
nsrjb	List the backup volumes in the jukebox

Table D-1 (continued) Commonly-Used NetWorker Commands

Command	Purpose
nsrls	Display information about the server's online indexes
nsrwatch	Display the character-based NetWorker status monitor
savegroup -p *group_name*	See a preview of the backup of the group named *group_name*
savegroup *group_name*	Start the backup of the clients in the group *group_name*

NetWorker Reference Pages

Table D-2 lists the reference pages for NetWorker client commands.

Table D-2 Reference Pages for NetWorker Client Commands

Reference Page	Description
compressasm(1M)	NetWorker program for compressing and decompressing files
logasm(1M)	NetWorker program for saving log files
mailasm(1M)	NetWorker program for saving and recovering mail files
mminfo(1M)	NetWorker media information reporting command
mmlocate(1M)	Reports the backup volume location information contained in the media database
mmpool(1M)	Reports on pool information stored in the media database
networker(1M)	A window-based display of the NetWorker server status
nsr_shutdown(1M)	Kills NetWorker processes on a NetWorker server
nsrexecd(1M)	NetWorker client execution daemon
nsrmm(1M)	NetWorker media interface command
nsrwatch(1M)	Displays the NetWorker server status from an ASCII terminal

Table D-2 (continued) Reference Pages for NetWorker Client Commands

Reference Page	Description
recover(1M)	Command to browse the online indexes and recover files from the NetWorker server
save(1M)	Command to save files to the NetWorker server
savefs(1M)	Command to save filesystems to the NetWorker server
swapasm(1M)	NetWorker program for saving and recovering swap files
uasm(1M)	NetWorker program for saving and recovering generic IRIX files
xlateasm(1M)	NetWorker program for encoding and decoding files

Table D-3 lists other reference pages for NetWorker clients.

Table D-3 Other NetWorker Client Reference Pages

Reference Page	Description
getdate(3)	Explains the formats of dates that can be entered in date fields
mm_data(5)	Data format that *nsrmmd* uses
nsr(5)	Format of *.nsr* directive files
nsr_client(5)	NSR client resource type
nsr_data(5)	Data formats for *save* and *recover*
nsr_device(5)	NSR device resource type
nsr_directive(5)	NSR directive resource type
nsr_group(5)	NSR group resource type
nsr_jukebox(5)	NSR jukebox resource type
nsr_label(5)	NSR label resource type
nsr_layout(5)	NetWorker file layout
nsr_license(5)	NSR license resource type

Table D-3 (continued) Other NetWorker Client Reference Pages

Reference Page	Description
nsr_notification(5)	NSR notification resource type
nsr_policy(5)	NSR policy resource type
nsr_pool(5)	NSR pool resource type
nsr_resource(5)	NetWorker resource format
nsr_schedule(5)	NSR schedule resource type
nsr_service(5)	NSR resource type
rap(1M)	Command-line based resource administration program (RAP)
rapcheck(1M)	RAP resource directory consistency checking program
rapd(1M)	RAP server daemon
rapxfer(1M)	RAP resource directory manual area transfer
resource(5)	RAP resource file format

Table D-4 lists the reference pages for NetWorker server commands.

Table D-4 Reference Pages for NetWorker Server Commands

Reference Page	Description
jbexercise(1M)	Jukebox diagnostic command
jbm_enabler(1M)	Jukebox resource activator
nsr(1M)	Guide to using NetWorker
nsr_crash(1M)	How to use NetWorker to recover from a disk crash
nsradmin(1M)	NetWorker character-based command for system administration
nsrcap(1M)	Update NetWorker's information about licenses
nsrck(1M)	NetWorker check and repair command for the server indexes

Table D-4 (continued) Reference Pages for NetWorker Server Commands

Reference Page	Description
nsrd(1M)	NetWorker server daemon
nsrim(1M)	NetWorker index management command, usually invoked from the *savegroup* command
nsrindexasm(1M)	Program for saving and recovering NetWorker indexes
nsrindexd(1M)	NetWorker index daemon
nsrjb(1M)	NetWorker optional jukebox program
nsrls(1M)	Lists the statistics of NetWorker index files
nsrmmd(1M)	NetWorker media management daemon
nsrmmdbasm(1M)	Program for saving and recovering NetWorker media databases
nsrmmdbd(1M)	NetWorker media index daemon
recoverindex(1M)	Command to recover the online indexes of a NetWorker server
savegroup(1M)	Command to start saving the files of a group of NetWorker clients
saveindex(1M)	Command to save the online indexes of a NetWorker server
scanner(1M)	Command to read the contents of a volume to recover from NetWorker server crashes
tapeexercise(1M)	Command to exercise a tape drive in order to uncover problems

Glossary

1-9

Values for *override* in “NSR schedule” resource. Each number represents a backup level. Lower levels back up more files.

8 mm

Choice in the Devices window; represents eight-millimeter magnetic tape.

archive

The process by which NetWorker backs up directories or files that have not been accessed for a period of time to an archive volume, then optionally deletes them to free up disk space.

ASM

Application Specific Module. 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.

attribute

A piece of information that describes a NetWorker resource. It has a name and a list of values.

bootstrap

In NetWorker, the bootstrap consists of three files: the server‘s file index (*server.db*), the media index (*mmvolume*), and the server configuration information (*nsr.res*).

browse policy

The browse policy determines how long entries for your files remain in the online file index.

client

A system that accesses the NetWorker server to back up or recover files. Clients may be workstations, PCs, or fileservers with gigabytes of data.

command line

The shell prompt, where you enter commands.

compressasm

The NetWorker directive used for compressing and decompressing files.

daemon

A long-lived program that implements a service. For example, *nsrd* is a daemon that implements the NetWorker backup and recover service.

device

The backup device connected to the NetWorker server; used for backing up and recovering client files.

directive

Instruction to maximize the efficiency of a backup and handle special files.

file index

A database of information maintained by NetWorker that tracks every file or filesystem backed up.

fileserver

A system with disks that provides services to other systems on the network.

filesystem

1. A subtree of an IRIX file tree which is on a specific disk partition or other mount point. 2. The entire set of all IRIX files. 3. A method of storing files.

full (f)

A backup level in which all files are backed up, regardless of when they last changed.

group

A client or group of clients that starts backing up files at a designated time.

head (h)

Represents the beginning of a save set that spans multiple backup volumes.

heterogenous

Heterogenous networks are networks with different platforms that interact across the network.

himt

A choice of media type in the Devices window; stands for “half-inch magnetic tape.”

holey

A directive used to efficiently back up files that do not have all of their data blocks allocated.

incremental (i)

A backup level in which only files that have changed since the last backup are backed up.

interactive

A program or script that asks questions requiring input from the user.

interoperability

The ability of software and hardware on multiple systems from multiple vendors to communicate.

job pack

A tray or carousel that holds several backup volumes.

jukebox

A device that has the ability to move media among various components located in the device including slots, media drives, media access ports, and transports. Jukeboxes automate the media loading, labeling, and mounting functions during backups and recovers.

level 1-9

A backup level that backs up files that have changed since the last backup of any lower level.

mailasm

The directive that adheres to spool mail file-locking conventions and resets a file's access time back to its pre-saved values, so users can still tell if new mail arrived before NetWorker backed up their mail.

media

Magnetic tape or optical disks used to back up files.

media index

A database of information maintained by NetWorker which tracks every backup volume.

media manager

The NetWorker component that tracks save sets to backup volumes.

media pool

The collection of backup volumes recognized and managed by NetWorker.

middle (m)

A command that requests a middle portion of a save set that spans multiple backup volumes.

mminfo

The NetWorker command that displays information about the backup volumes.

NetWorker

The network-based software product that backs up and recovers filesystems.

NetWorker client

A system that can access the backup and recover services from a NetWorker server.

NetWorker daemons

Daemons specific to the NetWorker environment.

NetWorker server

The system on a network running NetWorker software, containing online indexes, and providing backup and recover services to clients on a network.

NetWorker resources

Components of NetWorker software configuration information, described by a list of attributes and values.

notice

A response to a NetWorker event.

nsrhost

The logical hostname of the system that is the NetWorker server.

nsrjb

Command line interface to a jukebox device.

nsrls

The NetWorker command to display information about the online indexes.

nsrwatch

A command that gives you a character-based display of NetWorker status information.

online indexes

The databases located on the server that contain all the information pertaining to the client backups and backup volumes.

operator

The person who monitors the server status, loads backup volumes into the server devices, and otherwise executes day-to-day tasks using NetWorker.

override

A backup level that takes place instead of the scheduled one.

pre-configured

Existing selections or configurations for different NetWorker features.

preview

A look at what a NetWorker command will do without actually executing the command.

print

Send data to a printer.

qic

A choice in the Devices window; stands for “quarter-inch cartridge tape.”

recover

The NetWorker command used to browse the server index and recover files from a backup volume to a client’s disk.

retention policy

A policy that determines how long entries are retained in the media index and thus how long they are recoverable.

recycle

Relabel a backup volume with the same name, thus removing all entries associated with the backup volume from the server’s index.

resources

See *NetWorker resources*.

save

The NetWorker command that backs up client files to backup volumes and makes data entries in the server index.

save set

A set of files or a filesystem backed up onto backup media using NetWorker.

save set id

An internal identification number assigned to a save set by NetWorker.

scanner

The NetWorker command used to read a backup volume.

server

The system running the NetWorker software, containing the online index, and providing backup and recover services to clients on a network.

skip (s)

A backup level in which files are skipped and not backed up.

skip

The directive to skip files during a backup. Useful for skipping files that do not require a backup.

swapasm

The directive used to back up NFS swap files.

system administrator

The person normally responsible for installing, configuring, and maintaining NetWorker.

tail (t)

Represents the end of a save set that spans multiple backup volumes.

user

The person who can use NetWorker from his or her workstation to back up and recover files.

volume

Backup media, such as magnetic tape or optical disk.

volume id

The internal identification assigned to a backup volume by NetWorker.

volume name

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

volume pools

A feature that allows you to sort your backup data to selected backup volumes. A volume pool contains a collection of backup volumes that have specific data sorted during the backup process.

Index

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