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HP NetRAID Series User Guide



HP Part Number 5969-5983
February 2000

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Hewlett-Packard Company
Network Server Division
Technical Communications/MS 45SLE
10955 Tantau Avenue
Cupertino, CA 95014 USA

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Audience Assumptions

This *HP NetRAID Series User Guide* is for the person who installs, administers, and troubleshoots LAN servers. Hewlett-Packard Company assumes you are qualified in the servicing of computer equipment and trained in recognizing hazards in products with hazardous energy levels.

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Introduction

The HP NetRAID-1Si and HP NetRAID-3Si adapters and the integrated HP NetRAID controllers built into certain HP NetServers let you link multiple hard disk drives together to write data across them as if they were one large drive. You configure your linked drives in a RAID (redundant array of independent disks) subsystem.

Initial installation and configuration of HP NetRAID Series adapters is described in the *HP NetRAID Series Installation and Configuration Guide*. Initial configuration of the integrated HP NetRAID controller is described in the *HP NetServer Integrated NetRAID Controller Configuration Guide*.

This *HP NetRAID Series User Guide* contains information on the HP NetRAID utilities that let you manage and make changes to an existing RAID system. This guide covers the following topics:

- Overview of HP NetRAID Utilities
- HP NetRAID Assistant (for Windows NT and Windows 2000)
- HP NetRAID Config (for Novell NetWare, IBM OS/2, and SCO OpenServer and UnixWare)
- HP NetRAID Express Tools (use with all supported network operating systems)
- Reconstructing and Rebuilding Drives
- Capacity Expansion
- Monitor Alert List
- Alarm Control and Audible Warnings
- Glossary

1 Overview of HP NetRAID Utilities

Three HP NetRAID utilities can configure and manage HP NetRAID Series subsystems. Integrated HP NetRAID controllers and HP NetRAID Series adapters (HP NetRAID-1Si and HP NetRAID-3Si) use the same utilities. However, all utilities are not available to all network operating systems.

- **HP NetRAID Assistant** is used only with Microsoft Windows NT and Windows 2000. (This utility is similar to the one that you ran from the *HP NetServer Navigator CD-ROM* to initially configure your HP NetRAID subsystem.)
- **HP NetRAID Config** is a text-based RAID configuration utility that runs under Novell NetWare, IBM OS/2, SCO OpenServer, and SCO UnixWare.
- **HP NetRAID Express Tools** is a text-based RAID configuration utility available to all operating systems. HP NetRAID Express Tools has some advanced features not available in the other utilities.

Table 1-1. HP NetRAID Management Utilities and Network Operating Systems

Network Operating System	HP NetRAID Assistant	HP NetRAID Config	HP NetRAID Express Tools
Microsoft Windows 2000	X		X
Microsoft Windows NT	X		X
Novell NetWare		X	X
IBM OS/2		X	X
SCO OpenServer		X	X
SCO UnixWare		X	X

NOTE Consult the Hewlett-Packard World Wide Web site (<http://www.hp.com/go/netserver>) or your local HP dealer for compatibility of your adapter with the most current versions of the network operating systems listed in the preceding table.

HP NetRAID Assistant

HP NetRAID Assistant is an object-oriented GUI management utility. It runs under Microsoft Windows NT and Windows 2000, and it allows you to reconfigure and manage your HP NetRAID subsystem and to monitor its status.

For complete instructions on using this utility, see Chapter 2, "HP NetRAID Assistant," in this guide.

NOTE Users of *all* operating systems run HP NetRAID Assistant from the *HP NetServer Navigator CD-ROM* to configure their systems during initial installation.

HP NetRAID Assistant Menus

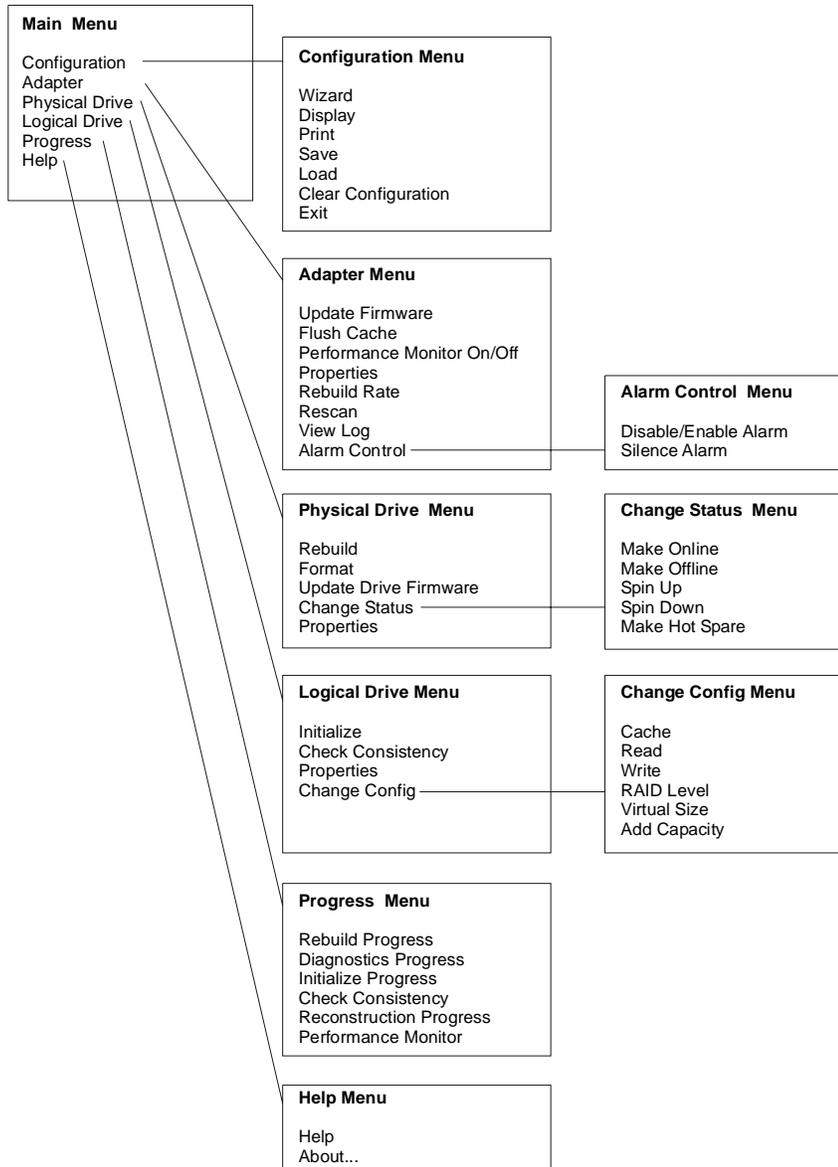


Figure 1-1. HP NetRAID Assistant Menus
(Alarm Control menu is not available for integrated HP NetRAID.)

HP NetRAID Config

HP NetRAID Config is a character-based, non-GUI utility that runs under all supported operating systems other than Microsoft Windows NT and Windows 2000. HP NetRAID Config allows you to reconfigure and manage your HP NetRAID subsystem and to monitor its status.

HP NetRAID Config performs most of the same functions as HP NetRAID Assistant as well as some additional ones, but it runs under Novell NetWare, IBM OS/2, SCO OpenServer, and SCO UnixWare.

The command you use to start the HP NetRAID Config utility depends on which NOS you are using.

- For Novell Netware, type **load megamgr**
- For IBM OS/2, type **megaconf**
- For SCO OpenServer, type **megamgr**
- For SCO UnixWare, type **megamgr**

For instructions on using this utility, see Chapter 3, "HP NetRAID Config," in this guide.

HP NetRAID Config Menus

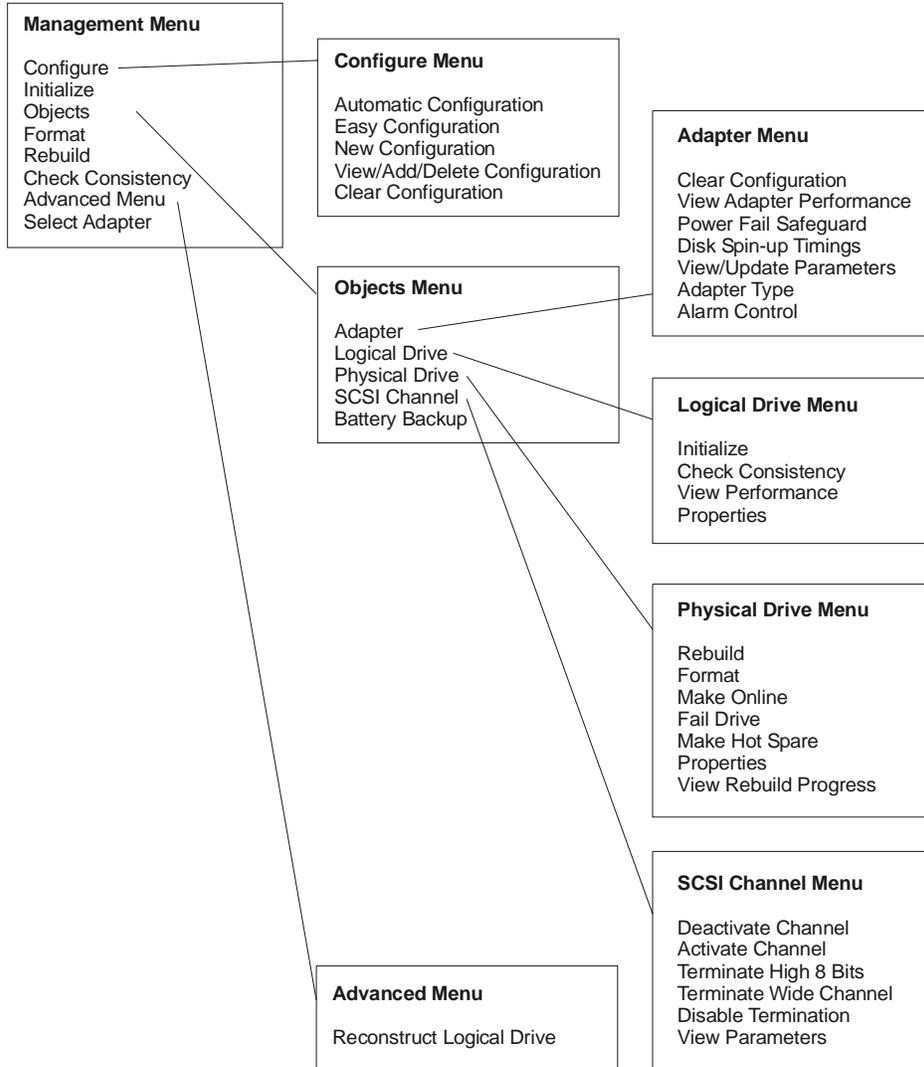


Figure 1-2. HP NetRAID Configuration Menus
 (Alarm Control menu is not available for integrated HP NetRAID. Battery Backup menu is not available for HP NetRAID-1Si or for integrated HP NetRAID if Battery Backup Module is not present.)

HP NetRAID Express Tools

HP NetRAID Express Tools is available to all network operating systems because this utility is contained in the firmware. HP NetRAID Express Tools contains some advanced management and diagnostic utilities that are not available with HP NetRAID Assistant or HP NetRAID Config.

NOTE To access HP NetRAID Express Tools you must restart the HP NetServer.

To start HP NetRAID Express Tools:

1. Log off all users, close all applications, and power down the HP NetServer.
2. Restart the HP NetServer.
3. When the following prompt appears, press <Ctrl> <M>.

**Option: Experienced users may press <Ctrl> <M> for HP NetRAID Express Tools now.
Firmware Initializing**

For complete information on this utility, see Chapter 4, "HP NetRAID Express Tools," in this guide.

HP NetRAID Express Tools Menus

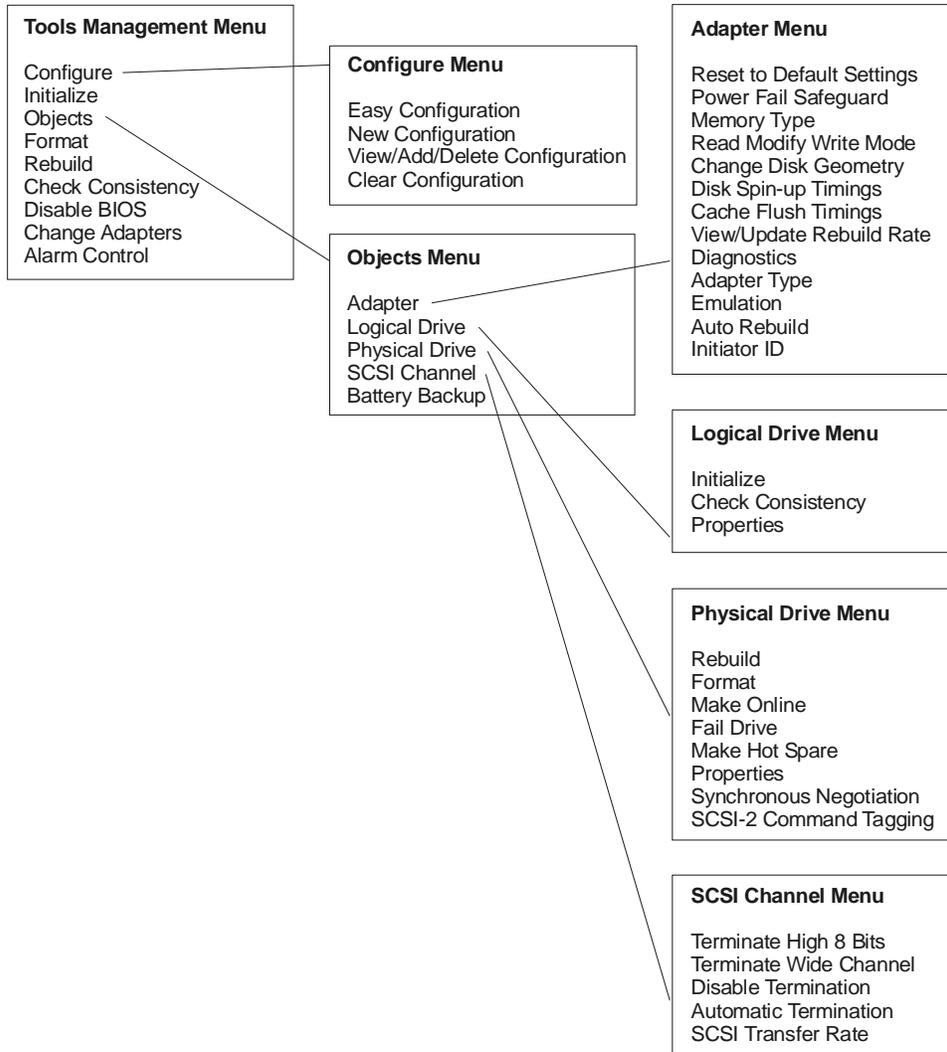


Figure 1-3. HP NetRAID Express Tools Menus
 (Alarm Control menu is not available for integrated HP NetRAID. Battery Backup menu is not available for HP NetRAID-1Si or for integrated HP NetRAID if Battery Backup Module is not present.)

HP NetRAID Utility Comparison Chart

The three HP NetRAID utilities (HP NetRAID Assistant, HP NetRAID Config, and HP NetRAID Express Tools) perform many of the same functions, but they are not identical.

Parameters with default values and functions that are *not shared* by each of these utilities are listed in the Table 1-2. (Most functions common to all three utilities are not listed.)

Table 1-2. Comparison of Available Functions of HP NetRAID Utilities

Function/Selection	Defaults* (if applicable)	HP NetRAID Assistant	HP NetRAID Config	HP NetRAID Express Tools
Adapter Type			X	X
Add Capacity		X	X	
Alarm Control HP NetRAID-1Si & HP NetRAID-3Si Integrated HP NetRAID	Enable* Not Available	X	X	X
Autorebuild	Enabled*			X
Battery Backup (HP NetRAID-3Si & with Battery Backup Module in HP NetServer LH 3000/3000r, LH 6000/6000r & LT6000r)			X	X
Cache Flush Timings	4 seconds*			X
Cache Policy	Cached*	X	X	X
Change Disk Geometry	8 GB*	X	X	X
Channel Activate/Deactivate	Activated*		X	
Diagnostics				X
Disable BIOS	NO*			X
Disk Spin-Up Timings	Automatic*		X	X
Emulation (Sets PCI Class Code to I ₂ O or Mass Storage mode)	Mass Storage*			X
Initiator ID	7*			X

Memory Type HP NetRAID-1Si HP NetRAID-3Si & integrated HP NetRAID	EDO* Not Available			X
Power Fail Safeguard	Enabled*		X	X
Print Config		X		
RAID Level		X		
Read Modify Write Mode	OFF*			X
Read Policy	Adaptive*	X	X	X
Rebuild Rate	50%*	X	X	X
Reset to Default Settings				X
Save/Load Config from File		X		
SCSI-2 Command Tagging	Enhanced Qtag Scheduling*			X
SCSI Termination HP NetRAID-3Si & HP NetServer LH 3000/3000r, LH 6000/6000r & LT 6000r HP NetRAID-1Si & HP NetServer LH 3/3r & 4/4r	Terminate Wide Channel* Not Available		X	X
SCSI Transfer Rate	Ultra-2*			X
Span	NOSPAN*			X
Spin Down/Spin Up		X		
Synchronous Negotiation	Enabled*			X
Stripe Size	64 KB*	X	X	X
Update Drive Firmware		X		
View/Add/Delete Config			X	X
View Log		X		
Virtual Sizing	Disabled*			X
Write Policy HP NetRAID-1Si & HP NetServer LH 3/3r & LH 4/4r HP NetRAID-3Si & HP NetServer LH 3000/3000r, LH 6000/6000r & LT 6000r	Write- Through* Write-Back* (See note below table.)	X	X	X

NOTE

Write-Back means that data is written to disk only when it is forced out of the cache. Write-Back is efficient because an entry may be written many times in the cache without a disk access. While this setting increases performance, data can be lost if power fails.

Write-Back is NOT recommended unless one of the following is true:

- The HP NetRAID adapter is an HP NetRAID-3Si, which has a Battery Backup Unit.
- Your system is equipped with a UPS (uninterruptible power supply).
- Your system is an HP NetServer LH 3000/3000r, LH 6000/6000r, or LT 6000r that is equipped with a charged accessory Battery Backup Module.

Write-Back is not certified for any logical drive used as a Novell NetWare volume.

HP NetRAID Drivers and Utilities

Table 1-3 lists the filenames of drivers and utilities specific to your network operating system (NOS). For information on installing drivers and configuration utilities for HP NetRAID, see the *HP NetRAID Installation and Configuration Guide* or the *HP NetServer Integrated NetRAID Controller Configuration Guide*.

Table 1-3. HP NetRAID Drivers and Utility Files for Network Operating Systems

Network Operating System	Drivers	Monitor Utilities	Configuration Utilities
Microsoft Windows 2000	mraid35x.sys	megaserv.exe megactrl.exe	nraid.exe
Microsoft Windows NT	mraidnt.sys	megaserv.exe megactrl.exe	nraid.exe
Novell NetWare 4.2 and 5 (Conventional, non-I ₂ O)	Mega4_xx.ham Mega4_xx.ddi	Megamon.nlm	Megamgr.nlm
Novell NetWare 4.2 and 5 (I ₂ O support)	HP NetRAID I ₂ O OSM mrl4_xx.ham	Megamon.nlm	Megamgr.nlm
IBM OS/2	mraid.add	monitor.cmd	megaconf.exe
SCO OpenServer	amird	amirdmon	megamgr
SCO UnixWare	mega	amirdmon	megamgr

2 HP NetRAID Assistant

Overview

HP NetRAID Assistant is an object-oriented, graphical user interface (GUI) management utility that runs under Microsoft Windows NT or Windows 2000. HP NetRAID Assistant allows you to control and monitor the status of hard disk drives on the local HP NetServer or over a network with several servers.

This section provides the following information:

- A. HP NetRAID Assistant Main Window
- B. HP NetRAID Assistant Menu Options
- C. Using the Wizard to Configure Arrays and Logical Drives
- D. Managing RAID with HP NetRAID Assistant
- E. Managing Servers Over the Network
- F. Windows NT Monitor Service for HP NetRAID (also for Windows 2000)

A HP NetRAID Assistant Main Window

Start HP NetRAID Assistant.

- To start HP NetRAID Assistant under Windows 95 or 98, click the NetRAID Assistant icon in the NetRAID program group (or group you specified).
- To start HP NetRAID Assistant under Windows NT or Windows 2000, click the **Start** button, point to **Programs**, point to **NetRAID** in the Programs menu, and click **NetRAID Assistant**.

Figure 2-1 shows an example of the main window of HP NetRAID Assistant.

NOTE

Since HP NetRAID-1Si is a single-channel adapter, the HP NetRAID Assistant Main window for HP NetRAID-1Si contains only Channel 0 information. In HP NetServer LH 3/3r and LH 4/4r, the integrated HP NetRAID controller can show either one or two channels depending upon how many channels you enabled for HP NetRAID. Integrated HP NetRAID controllers in other HP NetServers show two channels.

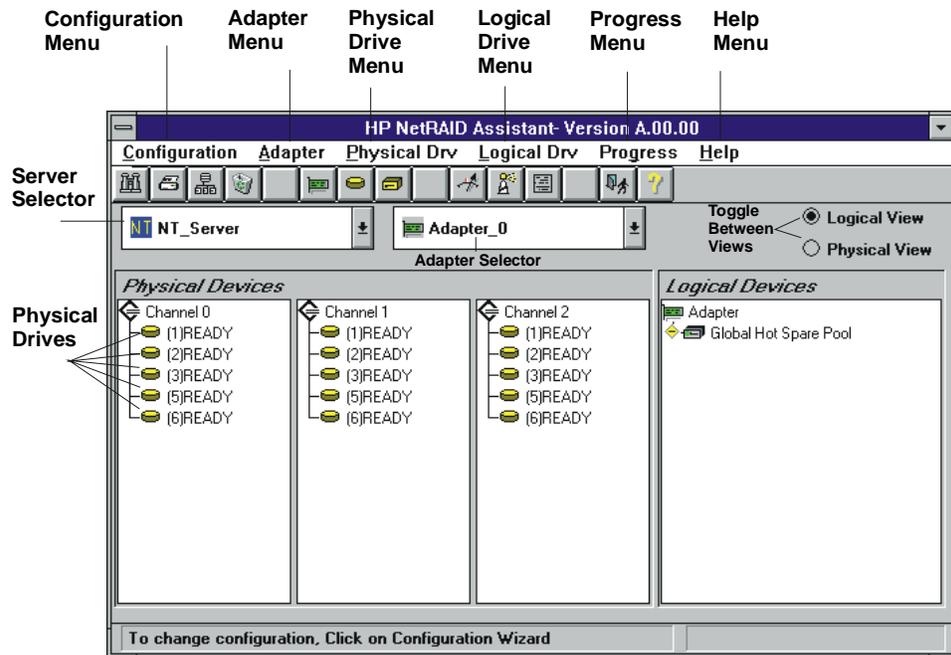


Figure 2-1. HP NetRAID Assistant Main Window

The HP NetRAID Assistant window contains the following elements:

- **Menu bar:** The menu bar activates pull-down menus for Configuration, Adapter, Physical Drives, Logical Drives, Progress, and Help.
- **Toolbar:** The toolbar icons, which are shown in Figure 2-2, are separated into four categories of functions: Configuration, Properties, Miscellaneous, and Other. They provide shortcuts to access the menu options.

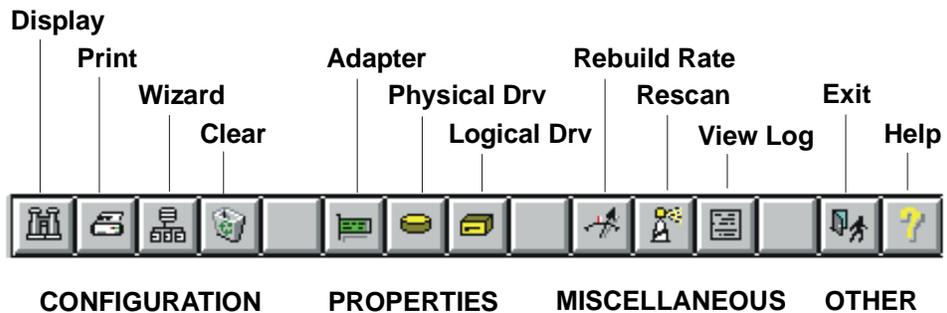


Figure 2-2. HP NetRAID Assistant Main Menu Toolbar Options

- **Server Selector box:** The Server Selector box shows the name of the current server. If HP NetRAID Assistant is started on a client or server over the network, you must select the server you want to access from the pull-down list.
- **Adapter box:** The Adapter box shows the number of the current adapter. If the HP NetServer contains more than one adapter, you can change the current adapter by using the Adapter box pull-down list.
- **Physical Devices box:** The Physical Devices box contains either one channel column (for an HP NetRAID-1Si adapter), one or two channel columns (for an integrated HP NetRAID controller), or three channel columns (for an HP NetRAID-3Si adapter), which show the physical drives on the SCSI channels of the current adapter. The number in parentheses to the right of each physical drive icon is its SCSI ID (Target) on the channel.

NOTE

For internal mass storage in HP NetServer LH 3000/3000r, LH 6000/6000r, and LT 6000r, SCSI ID 5 is reserved for the SAF-TE processor that manages the hot-swap mass storage cage.

For an external mass storage enclosure with a SAF-TE processor, a SCSI ID is reserved for that processor. The number of the reserved SCSI ID varies with the type of external enclosure.

The SAF-TE processor is displayed in the Physical Devices box with the rectangular green icon that is used for adapters.

The state of each physical drive appears to the right of the SCSI ID or array designation. The possible states of a physical drive are as follows:

- ◇ **Onln:** The physical drive is online, functioning normally, and part of a configured logical drive.
- ◇ **Ready:** The physical drive is functioning normally, but is not part of a configured logical drive, nor configured as a hot spare.
- ◇ **HotSp:** The drive is configured as a hot spare, and is powered up and ready for use as a spare in case an online drive fails.
- ◇ **Failed:** The physical drive failed and is out of service.
- ◇ **Rebuilding:** The drive is in the process of being rebuilt with data from a failed drive.

- **Logical Devices box:** The Logical Devices box shows the current adapter and its global hot spare pool. When arrays, logical drives, and hot spares have been defined, they are displayed here. Clicking on Logical View or Physical View switches between showing logical drives and physical drives. Clicking on the + sign in the yellow diamond expands the view if it is collapsed (physical or logical drives, or hot spares are hidden).

The possible states of a logical drive are as follows:

- ◇ **Online:** All participating physical disks are online.
 - ◇ **Degraded:** (Critical) A single physical disk in a redundant array (not RAID 0) is not online. Data loss may result if a second physical disk fails.
 - ◇ **Offline:** Two or more physical disks in a redundant array (not RAID 0) or one or more physical disks in a RAID 0 array are not online.
- **Status line:** The status line at the bottom of the window shows the progress of the scan required to build the displays on the HP NetRAID Assistant window. It also suggests possible actions.

B HP NetRAID Assistant Menu

HP NetRAID Assistant offers several menu options to assist you in configuring and monitoring RAID systems. The menu options are listed below in the order they appear on the HP NetRAID Assistant menu bar:

- The **Configuration menu** lets you create, display, print, clear, and save your configuration of arrays and logical drives.
- The **Adapter menu** lets you view and change settings specific to each adapter or integrated HP NetRAID controller.
- The **Physical Drive menu** lets you rebuild, format, view properties, or change the status of a physical drive.
- The **Logical Drive menu** lets you initialize, check consistency, view properties, and change the status of a logical drive.
- The **Progress menu** lets you view various utility monitors.
- The **Help menu** provides additional instructions about HP NetRAID Assistant.

Configuration Menu

The following Configuration menu options assist you in configuring your HP NetRAID system.

- **Wizard:** Lets you configure the arrays, logical drives, and parameters of your system. For complete information on the Wizard, see Part C of this chapter, "Using the Wizard to Configure Arrays and Logical Drives."
- **Display:** Displays the current configuration properties:
 - ◇ Logical drive properties include State, RAID Type, Write Policy, Read Policy, Cache Policy, Stripe Size, Number of Stripes, Size (in MB)
 - ◇ Physical drives properties include Rank, Channel, and Target (SCSI)
- **Print:** Prints a hardcopy of the current configuration display.
- **Save:** Saves the current configuration to a binary file. A dialogue box prompts you to give your configuration a file name with a `.cfg` extension. Clicking an **X** in the Read Only box makes the file read only. This option is *not* an alternative to saving your configuration by using the Wizard.

NOTE	You should always save your current configuration to a file. This file is essential if you ever have to replace a failed adapter.
-------------	---

- **Load:** Loads a configuration from a previously saved binary file. A dialogue box prompts you to choose your configuration from among `.cfg` files in the directory. Use this option if you are replacing a failed adapter. This selection does *not* cause a reconstruction to occur.
- **Clear Configuration:** Select this option to erase the current configuration information from the selected adapter's non-volatile memory. The current RAID configuration becomes invalid after you select this option. *This option should be used only when configuring a new system.*

NOTE	If you have inadvertently erased your configuration, you can recover it by immediately loading a previously saved configuration. If you do not have a file copy of the previous configuration, you can reconfigure the physical drives into the exact same array and logical drive structure in which they had been, and save the configuration. Do <i>not</i> select the Initialize menu selection.
-------------	--

- **Exit:** Select this option to quit HP NetRAID Assistant. You cannot exit if disk operations are ongoing.

NOTE New configurations are not saved when exiting unless you saved them by using the Wizard.

Adapter Menu

The options on the HP NetRAID Assistant Adapter menu are described below.

- **Update Firmware:** This selection is not available.
- **Flush Cache:** Writes all data in cache to physical drives. The HP NetRAID system allows logical drives to be configured in write-back mode. If configured in this mode, data is retained in cache and is not immediately written to the physical drives. If your system is configured for write-back mode, and if the adapter must be powered down rapidly, you must flush the contents of the cache memory to preserve data integrity.
- **Performance Monitor On/Off:** Displays a graphic representation of the performance of the logical drive you select. To use this selection, first click the left mouse button on a drive icon and then select Performance Monitor. Performance for each logical drive is displayed in two ways: as the data transfer rate and as the number of I/O operations per second. You can choose different logical drives, the type of graph (bar or line), and the window arrangement from the Performance Monitor menus.
- **Properties:** Displays the adapter properties, including the firmware and BIOS versions, the rebuild rate, and cache memory size.
- **Rebuild Rate:** Sets the rebuild rate for rebuilding a failed drive. The rebuild rate determines the percentage of IOP (input/output processor) resources devoted to the rebuild. A 100% rebuild rate means that 100% of the IOP's resources are applied to the rebuild, leaving no resources available for other tasks until the rebuild is complete. The default rebuild rate is 50%.
- **Rescan:** Reads the current configuration for the currently selected adapter. It displays the updated configuration on the main window of HP NetRAID Assistant. Use this selection if any physical drives were moved, added, removed, changed, or whose state changed after HP NetRAID Assistant was started.

- **View Log:** Displays the contents of the View Log File, which records adapter activities and conditions such as battery backup charge, logical drive properties, and changes to configurations along with the date and time changes are made.
- **Alarm Control:** Changes the onboard tone generator settings as described below. (This option is not available with the integrated HP NetRAID controller.)
 - ◇ **Enable/Disable Alarm:** Enables or disables the onboard tone generator. The default setting is Enabled.
 - ◇ **Silence Alarm:** Stops the alarm when it goes off. To silence a sounding alarm, choose **Alarm Control** and **Silence Alarm**.

For complete information, see Chapter 8, "Alarm Control and Audible Warnings."

Physical Drive Menu

The Physical Drive menu options are described below.

- **Rebuild:** Rebuilds one or more failed disk drives. Click Cancel to stop the rebuild process at any time. The drive returns to its original status before the rebuild began. A configuration of RAID level 1, 3, 5, 10, 30 or 50 has built-in redundancy. If a drive in one of these RAID groups fails, the RAID subsystem continues to work but no additional redundancy is provided. Another drive failure will take the logical drive offline. Rebuilding the failed drive replaces and adds it into the RAID system. The rebuild process can take place while the RAID system is still running, although performance may be affected.
- **Format:** Low-level formats one or more physical drives. You can format a drive only if it is in the Fail or Ready state and is not part of any configuration.

Since most SCSI disk drives are low-level formatted at the factory, this step is usually not necessary. You must format a disk only if:

- ◇ The disk drive was not low-level formatted at the factory.
- ◇ There is an excessive number of media errors detected on the disk drive.

NOTE

You do not need to use the Format option if you simply want to erase existing information on your hard drives, such as a DOS partition. That information is erased when you choose Initialize from the Logical Drive menu to initialize the logical drive(s). Hewlett-Packard drives are factory-formatted.

- **Update Drv Firmware:** This selection is not available.
- **Change Status:** Changes the status of the physical drive:
 - ◇ **Make Online:** Puts the drive online and available to the adapter.
 - ◇ **Make Offline:** Puts the drive offline and unavailable to the adapter.
 - ◇ **Spin Up:** Sets the method and timing for spinning up the hard disk drives.
 - ◇ **Spin Down:** Sets the method and timing for spinning down the hard disk drives.
 - ◇ **Make Hot Spare:** Makes a hot spare of the drive you selected. To use this selection, first click on the drive icon, then select Make Hot Spare.
- **Properties:** Displays the physical drive properties of a selected drive. The properties include Device Identification, Device Attributes, and Device Error.

Physical Drive Right Mouse Button Menu

To access this menu, select (and highlight) a physical drive in the Physical Devices box, then click the right mouse button. The following popup menu options appear:

- **Rebuild**
- **Abort Rebuild**
- **Format**
- **Tools**
 - ◇ **Make Online**
 - ◇ **Make Hot Spare**
 - ◇ **Fail Drive**
 - ◇ **Spin Down** (used to spin down the motor of a disk drive)
 - ◇ **Spin Up** (used to spin up the motor of a disk drive)
- Firmware Download (not available)
- Remove (not available)
- **Properties**

Logical Drive Menu

The Logical Drive menu options are described below.

- **Initialize:** Initializes one or more logical drives. To initialize one or more drives, first select the logical drive(s) to be initialized, then choose Initialize.

After configuration, a logical drive must be initialized before it can be used. This option initializes the logical drives by writing zeros to the data fields and generating corresponding parity fields on drives with RAID levels 3, 5, 10, 30, or 50.

CAUTION	HP NetRAID Assistant allows you to initialize a drive at any time. Make sure that the drive being initialized does not hold active data. All data will be lost when you choose the Initialize menu selection.
----------------	---

- **Check Consistency:** Ensures that parity or mirroring is correct for the selected drives. Click on the drive to be checked (LD0-LD7). RAID levels 3, 5, 30, and 50 use an extra drive to store parity data blocks; parity is checked between these parity data blocks and the selected drives. RAID levels 1 and 10 use duplicate data drives (mirroring); the duplicate data is verified.

Check Consistency should be run if the system shuts down irregularly, such as after a power failure. It is also recommended that you run consistency checks every two to four weeks to ensure that bad blocks on the disk drive are mapped out. Check Consistency always remedies inconsistencies. Check Consistency will fail only if the firmware could not complete parity and data writes due to a power-failure or a system hang, or because the logical drive degraded or failed when a physical drive went offline.

You can use a Windows NT Monitor Service for HP NetRAID Series adapters to schedule and perform Consistency Checks automatically. For more information, see Part F of this chapter, "Windows NT Monitor Service for HP NetRAID."

- **Properties:** Displays the logical drive properties of the selected logical drive. Each logical drive can be displayed by selecting the Previous or Next buttons.

- **Change Config:** Changes the parameters of a logical drive. To use this option, first select the logical drive or drives to change, then click Change Config.
 - ◇ **Cache:** There are two Cache policies:
 - * **Direct I/O** specifies that only repeated reads to same locations are cached.
 - * **Cached I/O** specifies that all reads are cached.
 - ◇ **Read:** There are three Read policies:
 - * **Read Ahead** tells the adapter to read sequentially ahead of requested data and cache the further data in memory, anticipating that the further data will be requested.
 - * **Normal** specifies that the controller does not use Read-Ahead for the current logical drive.
 - * **Adaptive Read Ahead** specifies that the adapter begins using Read-Ahead if the two most recent disk accesses occurred in sequential sectors.
 - ◇ **Write:** There are two Write policies:
 - * **Write-Back** specifies that data is written to disk only when it is forced out of the cache. Write-back is efficient, because an entry may be written many times in the cache without a disk access.
 - * **Write-Through** specifies that data is written to disk at the same time as it is cached. Write-Through caching has a data security advantage over Write-Back caching.
 - ◇ **RAID Level:** This option allows you to change the RAID level.
 - ◇ **Virtual Size:** This selection is not available. Use HP NetRAID Express Tools to enable the Virtual Sizing parameter.
 - ◇ **Add Capacity:** Use this option to add a physical disk to the logical drive. HP NetRAID reconstructs your data to incorporate the new physical drive into the array.

Logical Drive Right Mouse Button Menu

To access this menu, select (highlight) a logical drive in the Logical Devices box and click the right mouse button. The following pop-up menu options appear:

- **Delete** (deletes the last array created, one at a time)

- **Initialize**
- **Check Consistency**
- **Change Policy** (changes Write, Read, and Cache Policies)
- **Advanced Menu**
 - ◇ **Change Config** (changes RAID level only)
 - ◇ **Add Drive**
- **Properties**

Progress Menu

Using the Progress option, you can access and view the following utility monitors:

- **Rebuild Progress**
- **Diagnostics Progress**
- **Initialize Progress**
- **Check Consistency Progress**
- **Reconstruction Progress**
- **Performance Monitor**

Help Menu

The Help Menu option yields the following choices:

- **Help:** Accesses the Help Menu for assistance.
- **About:** Provides information about the version of the adapter you are running.

C Configuring Arrays and Logical Drives

You configure arrays and logical drives by using the HP NetRAID Assistant Main window as shown in Figure 2-3.

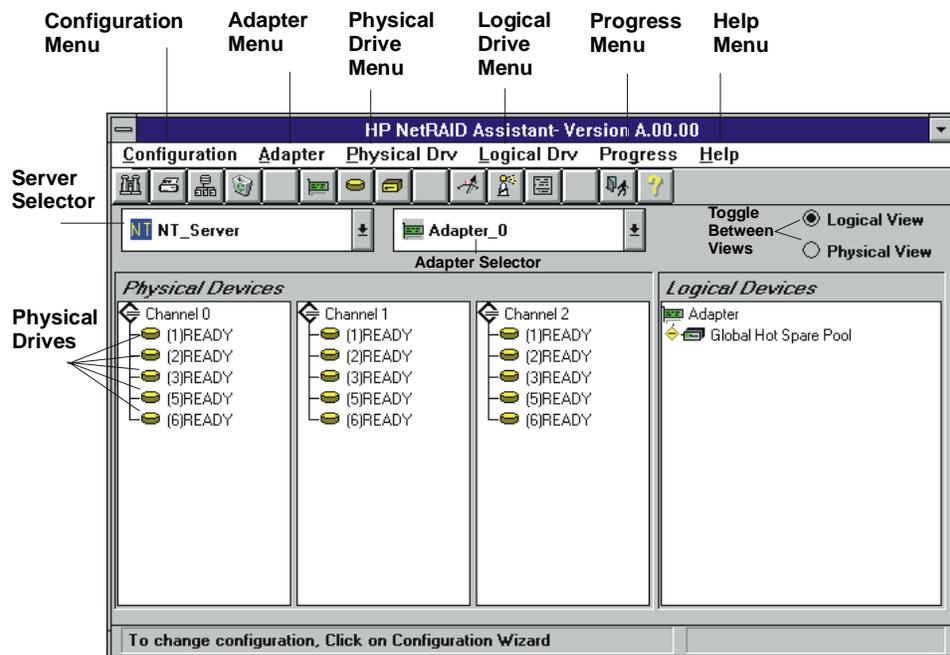


Figure 2-3. HP NetRAID Assistant Main Window

NOTE

Since HP NetRAID-1Si is a single-channel adapter, the HP NetRAID Assistant Main window for HP NetRAID-1Si contains only Channel 0 information. In HP NetServer LH 3/3r and LH 4/4r, the integrated HP NetRAID controller can show either one or two channels depending upon how many channels you enabled for HP NetRAID. Integrated HP NetRAID controllers in other HP NetServers show two channels.

To configure arrays and logical drives, follow these steps:

- Select adapter to configure.
- Clear previous configuration, if necessary.
- Check the Rebuild Rate.
- Assign global hot spares.
- Select the Wizard.

- Define your physical arrays.
- Assign dedicated hot spares, if desired.
- Define logical drives.
- Preview configuration and save it to NVRAM (non-volatile memory).
- Save the configuration to a binary file.
- Print the configuration.
- Configure any other adapters.
- Initialize logical drives.
- Exit HP NetRAID Assistant.

Select the Adapter to Configure

Look in the Adapter box to see if the adapter you wish to configure is displayed. If not, select it from the pull-down list.

Clear Configuration (if necessary)

If you want to set up a brand-new configuration, you should clear the existing configuration.

To clear the existing configuration:

1. Select the **Configuration** menu.
2. Choose **Clear Configuration**.
3. Click **OK**.

Check Rebuild Rate

During a rebuild, the contents of a complete physical drive is rewritten. Normal operations can go on during a rebuild, but performance may be degraded. The Rebuild Rate controls the rate at which a rebuild is done. A high Rebuild Rate (over 50%) speeds up the rebuild, but slows system performance. A low Rebuild Rate (under 50%) slows the rebuild process, but speeds up system performance. The default setting for the Rebuild Rate is 50%.

To check the Rebuild Rate from the HP NetRAID Assistant window:

1. Select the adapter for which you want to check the Rebuild Rate.
2. Select **Rebuild Rate** from the Adapter menu.

3. Reset the rate as necessary by dragging the slider with the mouse.
4. Click **OK**.
5. If you have more than one adapter, select the next adapter, and repeat this procedure.

NOTE Clearing the configuration does *not* affect the rebuild rate.

Assign Global Hot Spares

To assign any physical drives to the global hot spare pool for the adapter:

1. Click on a Ready physical drive in the Physical Devices box.
You can select more than one Ready drive if you want to create more than one global hot spare. Clicking on a Ready drive either selects it or deselects it.
2. Drag the selected drives into the global hot spare pool.

Select Wizard

NOTE If any physical drives have been moved, added, removed, changed, or changed in state since HP NetRAID Assistant was started, rescan the drives by choosing the **Adapter** menu and then selecting the **Rescan** option.

To launch the HP NetRAID Assistant Wizard:

1. Select the **Configuration** menu.
2. Choose the **Wizard**. The Wizard starting window is displayed with a choice of Custom and Automatic configuration modes, as shown in Figure 2-4.

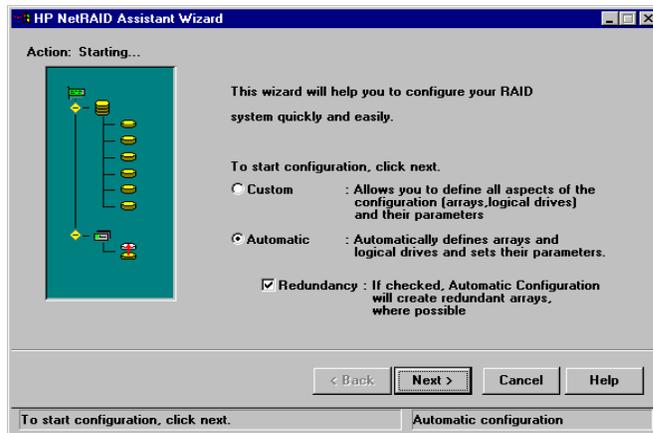


Figure 2-4. HP NetRAID Assistant Wizard Starting Window

3. Click one of the following configuration modes:

- ◇ Select **Custom** if you want to define the arrays and logical drives and set their parameters.
- ◇ Select **Automatic** if you want the HP NetRAID Assistant Wizard to define the arrays and logical drives and set their parameters for you automatically.

When you select Automatic mode, you can toggle the Redundancy check box at the bottom of the window. If the Redundancy box contains a check mark, the arrays are automatically configured with redundant logical drives if possible. They are assigned RAID levels of 0, 1, or 5, depending on the number and capacities of the physical drives. If the Redundancy box is empty, all logical drives are configured as RAID 0, which are not redundant. Automatic mode uses the following rules to define arrays and logical drives.

- * Automatic mode scans the physical drives, starting at SCSI ID 0 on Channel 0, and groups the physical drives by capacity, with up to five drives in an array.
- * Each array is defined as a single logical drive, and array spanning is not used.
- * For each array, the system looks to see if you have asked to implement redundancy (checked the Redundancy box). If you are not using redundancy, all logical drives are assigned RAID level 0.

- * If an array contains two drives, and you checked Redundancy, the logical drive is assigned RAID level 1.
 - * If an array contains three to five drives, and you checked Redundancy, the logical drive is assigned RAID level 5.
 - * If an array contains only one drive, the logical drive is assigned RAID level 0. (No redundancy is possible on a logical drive containing just one physical drive.)
 - * Automatic configuration does *not* create hot spares.
4. Click the **Next** button.
 5. If you chose Automatic mode, skip to "Preview Configuration" later in this section.

Define Physical Arrays and Dedicated Hot Spares

The HP NetRAID Assistant Wizard Array Definition window appears, displaying the Physical Devices and Logical Devices configured on your system. A sample is shown in Figure 2-5. The "new array" in the Logical Devices box shows where a new array can be defined.

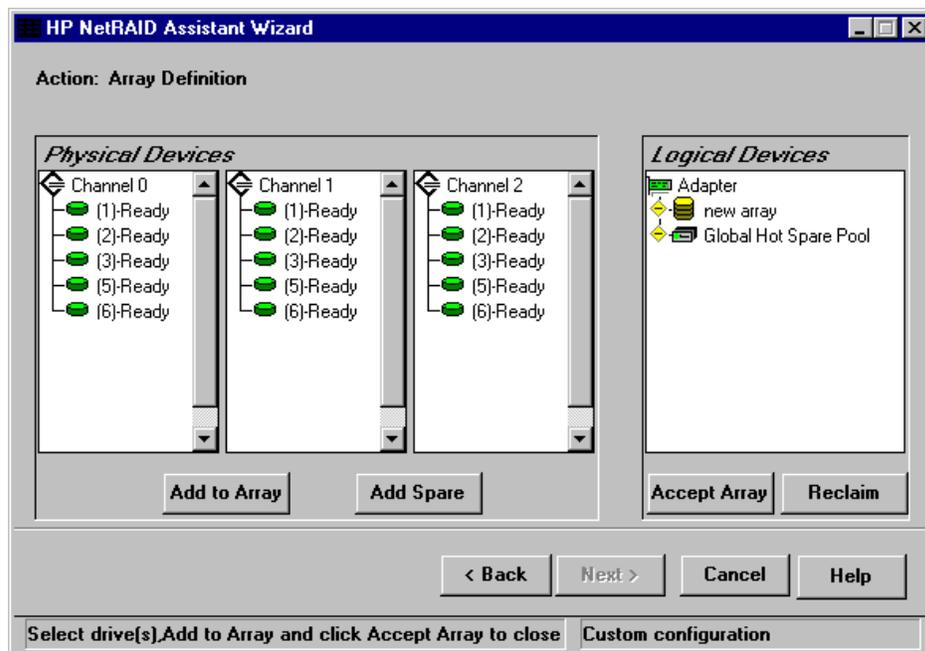


Figure 2-5. HP NetRAID Assistant Wizard Array Definition Window

To assign physical drives to the new array:

1. Select all the Ready physical drives that you want to put into the new array. Clicking on a drive either selects or deselects it.
2. Click the **Add to Array** button.
Physical drives show "A:new" to indicate the drive has been added to a new array, but has not been accepted yet.
3. If you want to remove a physical drive from a new array, select the drive in the new array and click the **Reclaim** button.
4. When the array is complete, click the **Accept Array** button.

All physical drives assigned to arrays display their array numbers to the right of the SCSI ID. The numbering is zero-based. For example, A0 designates a physical drive assigned to Array 0.

5. The next new array appears. Assign physical drives to it as described above. Be sure to click the **Accept Array** button to close the array.

To assign physical drives to an existing (not new) array:

1. Click one or more Ready physical drives to select (or deselect) them.
2. Drag the drives into the existing array. All selected Ready drives are added to the array.

Drives cannot be removed selectively from an existing array, but the entire array can be undone. An array cannot be reclaimed if it has any logical drives defined.

To remove an entire array:

1. Select the array. (Make sure that nothing else is selected.)
2. Click the **Reclaim** button.
3. Click **OK**.

Assign Dedicated Hot Spares

Hot spares can be assigned to the global hot spare pool for the adapter, or they can be dedicated to a specific array. Only one hot spare can be dedicated to a given array.

To assign a dedicated hot spare:

1. Select a Ready physical drive. Be sure nothing else is selected.
2. Click the **Add Spare** button. The Hot Spare Target window appears.

3. Click the **Dedicated to** button, and then click the down arrow to pull down a list of valid arrays.
4. Click the array to which you want to dedicate the hot spare.
5. Click **OK**.
6. Continue defining arrays and hot spares.

To reclaim (undo) one or more hot spares:

1. Select one or more hot spares.
2. Click the **Reclaim** button to convert the hot spares to Ready physical drives.

When you are finished defining arrays and hot spares:

Click the **Next** button.

Define Logical Drives

After you finish defining arrays and hot spares, and click **Next**, the HP NetRAID Assistant Wizard Logical Drive Definition window appears. A sample window is shown in Figure 2-6.

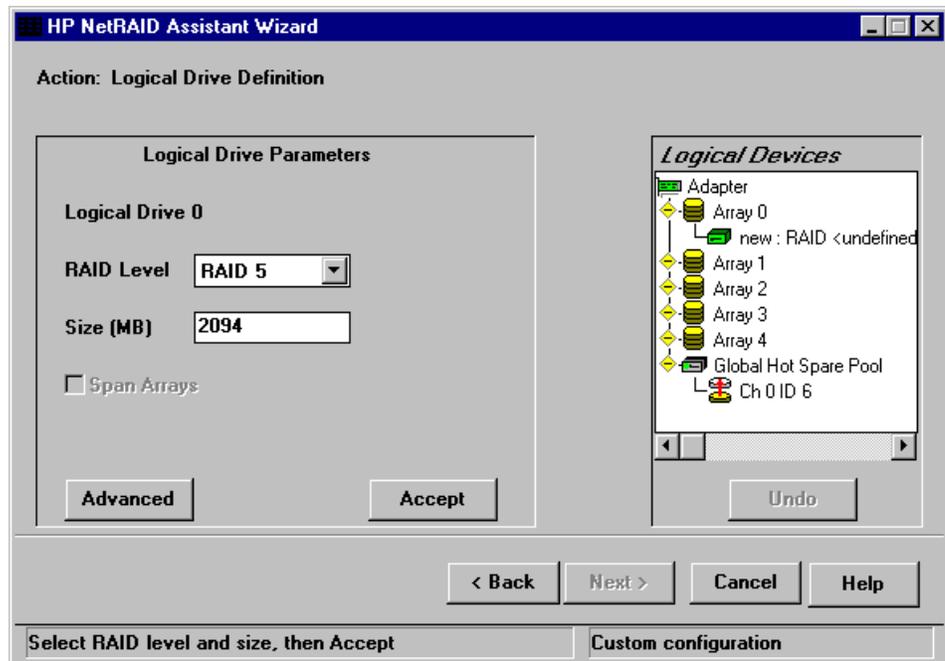


Figure 2-6. HP NetRAID Assistant Wizard Logical Drive Definition Window

- The **Logical Drive Parameters box** shows the number of the logical drive being defined and has boxes to set its RAID level and size.
- The **Advanced button** leads to more parameters, which are preset but can be changed.
- The **Span Arrays check box** turns array spanning on or off.
- The **Logical Devices box** depicts the arrays on the current adapter, the logical drives on each array, and the global hot spare pool for the adapter. Logical drives are labeled as "new" and as LD0 through LD7. Click the + sign in the yellow diamond if the view is collapsed (logical drives are hidden).

The HP NetRAID Assistant Wizard is ready for you to set the parameters of the new logical drive.

To define a logical drive that does *not* span:

1. Make sure that the Span Arrays box does not have a check mark in it; if it does, click the box to remove the check mark.
2. Set the RAID level by clicking the arrow and selecting the RAID level from the pull-down menu.
3. Set the size by either accepting the default in the box, or by clicking in the Size box and typing a smaller size. Setting a smaller size leaves space for another logical drive on the same array.
4. Set the stripe size, read policy, write policy, or cache policy, by clicking the **Advanced** button to display the Advanced Parameter window. Click the arrows to view the choices, and select the ones you want. Disregard the Virtual Sizing check box. Click **OK** to return to the Logical Drive Definition window.
5. When the logical drive parameters are set, click the **Accept** button.

The next logical drive to be defined is displayed. If there is still space in the current array, the new logical drive is on it.

6. Define any other logical drives on the current array that will not span. HP NetRAID Assistant Wizard keeps creating logical drives on the same array until its capacity is used fully, or until there are eight logical drives on the adapter.

To create a logical drive that spans two or more arrays:**NOTE**

The arrays to be spanned must have sequential array numbers and must contain the same number of physical drives.

HP NetRAID Assistant will attempt to span up to four arrays. Array spanning stops when:

- It has created a logical drive of the size you specify in Step 2 below.
- The next sequentially numbered array has a different number of drives.

Spanned arrays must contain the same number of drives in each array.

1. Click the **Span Arrays** box to mark it with a check. An array labeled with a hyphenated number, such as A0-1 or A0-3, appears in the Logical Devices box.
2. If you know the exact size of the logical drive you want, enter it in the Size (MB) box.

If you don't identify the size of the logical drive, the default size reflects the maximum number of arrays that can be spanned.

3. Define the logical drive as described above.

To remove the last logical drive that was added:

1. Click the **Undo** button.
2. You can continue undoing logical drives by clicking Undo.

When you are done defining logical drives:

- When all the logical drives are defined for the adapter and you have clicked the Accept button for the last one, click the **Next** button.

The Next button does not operate until one of the following conditions has been satisfied:

- ◇ All capacity has been assigned to logical drives.
- ◇ Eight logical drives have been defined.

Preview Configuration

The HP NetRAID Assistant Wizard Configuration Preview window, shown in Figure 2-7, displays the configuration proposed for the physical and logical drives.

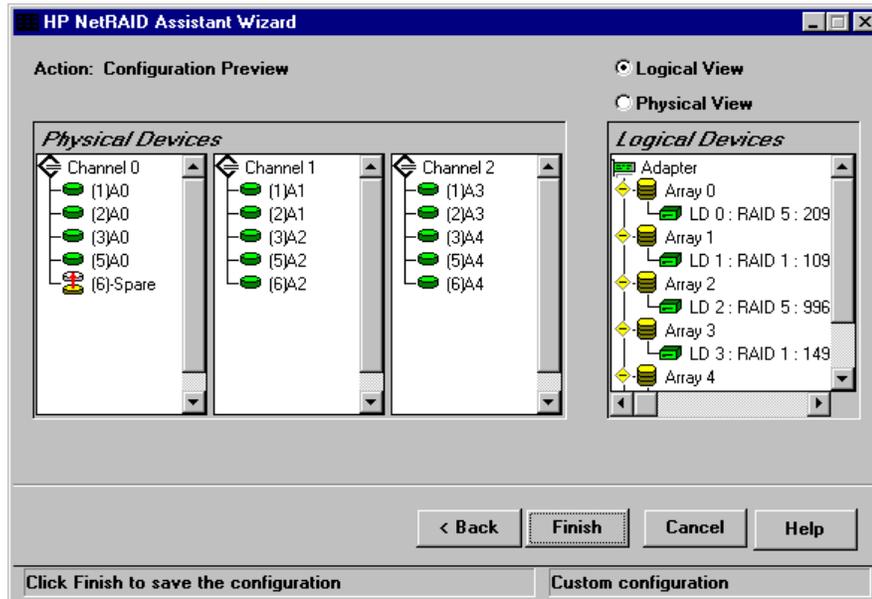


Figure 2-7. HP NetRAID Assistant Wizard Configuration Preview Window

NOTE The RAID level of a logical drive that spans arrays lacks the terminal zero. Mentally add it to make RAID 1 into RAID 10, RAID 3 into RAID 30, and RAID 5 into RAID 50.

To switch between showing logical drives and physical drives:

Click Logical View or Physical View.

To expand a view that has been collapsed (physical or logical drives, or hot spares are hidden):

Click the + sign in the yellow diamond.

To display the properties of a logical drive:

Double-click the logical drive in the Logical Devices box.

To display the properties of a physical drive:

Double-click the physical drive in the Physical Devices box.

To change a logical drive:

1. Click the **Back** button to back up to the previous window.
2. Delete the last logical drive defined (accepted) by clicking the **Undo** button. Keep clicking **Undo** until you have removed the logical drive you want to change.
3. Configure the logical drives again, or click **Back** to back up and change array definitions.

To correct the assignment of physical drives:

1. Undo any logical drives that are defined on the array by clicking the **Back** button, then click **Undo** as necessary to delete the last logical drive.
2. Click the **Back** button to go to the Array Definition window.
3. Select the array to be reclaimed, and click the **Reclaim** button.
4. Configure the physical drives and logical drives again.

To start the configuration over again:

Click the **Cancel** button.

To accept the final configuration:

Click the **Finish** button on the Configuration Preview window.

To save your configuration and initialize logical drives:

1. Click **OK** at the message asking if you want to save the configuration.

A "Writing Configuration" message appears briefly, indicating that the configuration information is being written to the adapter's NVRAM. This is *not* a binary file that can be loaded to restore the configuration.

HP NetRAID Assistant asks if you want to initialize your logical drives now. Logical drives must be initialized before they can be used. If you have other adapters to configure, you may wish to do that first and then initialize all the logical drives.
2. Click the **Cancel** button to defer initialization of the logical drives until later, or click **OK** to initialize logical drives now.

Save Your Configuration and Initialize

In this step you will do the following:

- Save the configuration to a binary file.
- Print a copy of the configuration.
- Initialize the logical drives.

Save the Configuration to a File

To save the configuration to a binary file:

1. Choose **Save** from the Configuration menu. The Save Configuration dialog box appears.
2. Type the file name and directories to be used to save the configuration. The file type should be *.cfg.
3. Click **Save** to save the configuration to the designated file.

NOTE Be sure to save your adapter configuration to a file. This information is essential when replacing a failed adapter.

Print Configuration

To print a copy of the configuration:

1. Choose **Print** from the Configuration menu.
2. File the printed copy of your configuration file in a safe place. It will help you understand your configuration, replace a failed adapter, or communicate with HP Customer Support.

Configure Any Other Adapters

To configure another adapter from the HP NetRAID Assistant window:

1. Click the **Adapter** pull-down list and select the adapter.
2. Clear its configuration by choosing **Clear Configuration** from the Configuration menu. Click **OK** to the warning prompts.
3. Check the Rebuild Rate by choosing **Rebuild Rate** from the Adapter menu and reset the rate if necessary.
4. If global hot spares are needed, drag the desired Ready physical drives into the global hot spare pool.

5. Launch the HP NetRAID Assistant Wizard by selecting **Wizard** from the Configuration menu.
6. Use the Wizard to configure the adapter's arrays and logical drives.
7. Save the configuration and print it.

Initialize Logical Drives

All logical drives must be initialized.

CAUTION	Initializing a logical drive by using the Initialize menu selection destroys all data currently on the disk modules.
----------------	--

To initialize the logical drives you defined for the adapter in the HP NetRAID Assistant Wizard:

1. If you have more than one adapter, click the **Adapter** pull-down list and select the adapter.
2. Select the logical drives to be initialized.
3. Choose **Initialize** from the Logical Drive menu and click **OK**.

The Initialize screen appears with separate windows for each logical drive. The bar graph for each logical drive shows the progress of the initialization.

4. Click the **Abort** button if you need to stop the initialization of that logical drive.
5. To rearrange individual windows, click the **Arrange** menu and make a selection.
6. Repeat the initialization process for other logical drives and adapters as necessary.

Exit HP NetRAID Assistant

To exit HP NetRAID Assistant, select **Exit** from the Configuration menu. You cannot exit if disk operations are still occurring.

D Managing RAID with HP NetRAID Assistant

Procedures for performing some of the most common RAID management functions are described in this section. Many of the adapter's management functions can be performed by using the drag-and-drop feature of the HP NetRAID Assistant window.

Rebuilding a Failed Physical Drive

For complete information, see Chapter 5, "Reconstructing and Rebuilding Drives."

Adding a Hot Spare

Hot spares can be global or dedicated. A global hot spare is available to every array controlled by the adapter, while a dedicated hot spare is available only to a specific array.

- To make a global hot spare, you can use the drag-and-drop method or use the menus.
- To make a dedicated hot spare, you must use the menus.

Making a Global Hot Spare by Using the Drag-and-Drop Method

With at least one drive in the Ready state, drag a Ready drive icon to the Global Hot Spare Pool icon.

Making a Hot Spare by Using the Menus

Follow these steps:

1. Select (highlight) the Ready drive.
2. Choose **Change Status** from the Physical Drive menu.
3. Select **Make Hot Spare**.
4. Click **Global** or **Dedicated**.
5. To make a dedicated hot spare, select the array to which you want to dedicate the hot spare from the pull-down menu. Click **OK**.

Adding a New Logical Drive

If one or more of your physical drives are in the Ready state, you can use the Wizard on the Configuration menu to add new logical drives to an existing configuration.

Changing Logical Drives Currently in Use

You can make several kinds of changes to logical drives that are currently in use. You can:

- Change the RAID level.
- Remove a physical drive.
- Add a physical drive. See Chapter 6, "Capacity Expansion," in this guide for complete instructions.

All such changes to existing logical drives require reconstructing the data. Reconstruction is the process of reorganizing the data to correspond to a change in the HP NetRAID system. Reconstruction occurs in the background, so the HP NetServer and the affected logical drive remain available throughout the reconstruction process.

NOTE Once started, the reconstruction process cannot be stopped.

The Power Fail Safeguard feature protects logical drives against data loss during the reconstruction process should a power failure occur. For complete information, see "Power Fail Safeguard Feature" in Chapter 5 in this guide.

Changing the RAID Level of a Logical Drive

To make RAID level changes, refer to the valid RAID level changes listed in the following table when altering a logical drive.

NOTE You cannot change the RAID level of any logical drive that spans arrays (RAID levels 10, 30, or 50).

Table 2-1. Valid HP NetRAID Configuration Changes

Existing RAID Configuration	Valid RAID Configuration Change	Configuration Event
RAID 3 or RAID 5 Optimal	RAID 3 or RAID 5 Optimal	Expanding capacity
RAID 3 or RAID 5 Optimal	RAID 0	Stopping parity
RAID 3 or RAID 5 Optimal	RAID 0	Deleting a drive, or adding drives
RAID 3 or RAID 5 Optimal or Degraded	RAID 0	Reconfiguring as Optimal RAID 0
RAID 1 Optimal	RAID 3 or RAID 5 Optimal	Adding drives
RAID 1 Optimal	RAID 0	Deleting a drive
RAID 1 Degraded	RAID 0	Reconfiguring as Optimal RAID 0
RAID 0 Optimal	RAID 3 or RAID 5 Optimal	Adding drives
RAID 0 Optimal (with one drive)	RAID 1 Optimal	Adding a drive
RAID 0 Optimal	RAID 0	Adding drives

You can change RAID levels by using the Logical Drive Menu of the HP NetRAID Assistant.

1. Select the **Logical View** button.
2. Highlight the logical drive you want to change from the Logical Devices box on the right side of the window.
3. Choose **Logical Drv** from the main menu, then select **Change Config**.
4. Choose **RAID Level** from the Change Config menu. A dialog box opens.
5. Select your new RAID Level from the levels available for the new logical drive configuration.
6. Select **Apply**. Reconstruction starts immediately. The Reconstruction Progress of the logical drive rebuild is displayed in a message box and in the Logical Devices box.

NOTE Once started, reconstruction cannot be stopped.

Removing a Physical Drive from a Logical Drive

The procedures for removing a physical drive from a logical drive vary depending on the RAID level of the logical drive.

RAID Level 0

There is no data redundancy in a RAID 0 system, so you cannot remove a physical drive while the HP NetServer is available. To remove a physical drive from a RAID 0 logical drive, you must back up your data, reconfigure the logical drive, then restore the data.

RAID Levels 1, 3, or 5

RAID levels 3 and 5 use parity to provide data redundancy. RAID level 1 provides data redundancy through mirroring. In either case, follow these procedures to remove a physical drive from any logical drive of RAID levels 1, 3, or 5.

1. Change to "Fail" the status of the drive you want to remove following these steps:
 - a. Choose **Physical Drv** from the main menu of HP NetRAID Assistant.
 - b. Choose **Change Status** from the Physical Drive menu.
 - c. Select **Make Offline**. An audible warning sounds if the drive is controlled by an HP NetRAID Series adapter. (For an integrated HP NetRAID controller, there is no audible warning.)
 - d. Turn off the audible warning by selecting the **Adapter** menu, then choosing **Alarm Control**, then **Silence Alarm**.
 - e. Return to the main menu of HP NetRAID Assistant.
2. Change the RAID level of the logical drive to RAID 0 by using the instructions in "Changing the RAID Level of a Logical Drive" in this chapter. The logical drive will be rebuilt as a RAID 0 and will not include the drive you just took offline (now in the Fail state).
3. If you want to convert the logical drive to a RAID level with redundancy, change the RAID level once again to RAID 3 or 5.
4. Change the status of the drive you removed back to the Ready state by using these instructions:
 - a. Choose **Physical Drv** from the main menu of HP NetRAID Assistant.
 - b. Choose **Change Status** from the Physical Drive menu.
 - c. Select **Make Online**.

- d. Return to the main menu of HP NetRAID Assistant.
5. Configure this Ready disk by using the Configuration Wizard.

Reclaiming a Hot Spare

If a physical drive has been configured as a Hot Spare, you can reclaim it and convert it to the Ready state at any time.

1. Select **Configure** from the main menu of HP NetRAID Assistant.
2. Select **Wizard**.
3. Select (highlight) the hot spare in the Logical Devices box.
4. Click the **Reclaim** box.
5. Use the Wizard to reconfigure this drive or accept the changes and save the new configuration.

Changing Logical Drive Parameters

You can change the following logical drive parameters at any time:

- Cache
- Read
- Write

Changing any of these parameters does not require reconstruction of your data.

To change these logical drive parameters:

1. Click the **Logical View** button.
2. Select (highlight) the logical drive you want to change.
3. Choose **Logical Drv** from HP NetRAID Assistant's main menu.
4. Select **Change Config**.
5. Change the logical drive parameters. As long as you do not change the RAID level, your data will not be reconstructed.

Taking a Drive Offline/Online

An HP NetServer physical drive can be taken offline or put online in one of two ways:

- You can remove or insert the disk drive by hand from an HP NetServer hot-swap bay.

- From the main menu, you can choose **Physical Drv**, then **Change Status**. You can change the drive status by using the Make Offline or Make Online selection.
 - ◊ When you select **Make Offline**, the physical drive is changed to the Fail state. An audible warning sounds if the drive is controlled by an HP NetRAID Series adapter. (For an integrated HP NetRAID controller, there is no audible warning.)

The logical drive state also changes. With just one physical drive offline, logical drives of RAID 1, 3, 5, 10, 30, and 50 change to Degraded. Logical drives with RAID level 0 change to Offline.
 - ◊ When you select **Make Online**, you can change a drive from the Failed state to the Ready state. (Do not use this option on a Ready drive. To bring a Ready drive online, use the Configuration Wizard.)

E Managing Servers Over the Network

The *HP NetRAID Series Installation and Configuration Guide* and the *HP NetServer Integrated NetRAID Controller Configuration Guide* list the requirements for clients and servers that manage HP NetRAID over the network. They also tell how to install the software necessary for HP NetRAID Assistant to manage HP NetRAID over the network.

Before Starting HP NetRAID Assistant

The Registration Server must be running before any other servers are started.

- If the Registration Server is a NetWare server, it must be running `reg_serv.nlm`.
- If the Registration Server is a Windows NT or Windows 2000 server, it must be running the NetRAID Registration Server icon (under the NetRAID program group).

To access an HP NetRAID Series adapter in a server from the network, the three services listed below must be running. Start them in the order listed. You may set them for automatic start, if desired.

1. **NobleNet Portmapper**: It should have been installed by the HP NetRAID software and set for automatic start in Windows NT or Windows 2000. In NetWare 4.x, load `rpcstart.nlm`. In NetWare 5, it is not needed because sockets are used instead.

2. **HP NetRAID Registration Server:** Start it before the others by double-clicking on its Windows icon or by loading NetWare module `reg_serv.nlm`.
3. **HP NetRAID Access Service:** Start it by double-clicking on its Windows icon or by loading NetWare module `raidserv.nlm`.

NOTE To change the password for a server using Windows NT or Windows 2000, run `setpass.exe` under `\netraid\dll\`.

To change the password for a server using NetWare, reinstall the HP NetRAID management software, as described in the *HP NetRAID Series Installation and Configuration Guide* or in the *HP NetServer Integrated NetRAID Controller Configuration Guide*, with the new password.

Start HP NetRAID Assistant

Run HP NetRAID Assistant from a client or server in which the HP NetRAID Assistant utility was installed.

- To start HP NetRAID Assistant under Windows 95 or 98, click the NetRAID Assistant icon in the NetRAID program group (or group you specified).
- To start HP NetRAID Assistant under Windows NT or Windows 2000, click the **Start** button, point to **Programs**, point to **NetRAID** in the Programs menu, and click **NetRAID Assistant**.

If HP NetRAID Assistant is started on a standalone server, the main window (shown in Figures 2-1 and 2-3) is displayed immediately.

If HP NetRAID Assistant is started on a client or server that can access integrated HP NetRAID controllers (or HP NetRAID Series adapters) over the network, you must select the server you want to access. The HP NetRAID Assistant Main window has a Server pull-down list next to the Adapter pull-down list.

When you select a server from the server selector box on HP NetRAID Assistant, a window appears with the choice of access modes: Full Access and View Only. Select one.

- **Full Access** mode requires that authorized users enter a password. *The password is case-sensitive.* The password must be given before full access can be established to a server, and each server can require a unique

password. Full Access mode activates features that let you change the HP NetRAID configuration and the states of physical and logical drives. For example, in Full Access mode, you can initiate recovery from a disk failure, or make a new hot spare.

- **View Only** mode does not require a password, and does not permit users to change the configuration. All menu selections that would change the configuration are inactive. Examples of operations that you can perform in View Only mode are displaying the properties of physical and logical drives and viewing the configuration.

NOTE You cannot enter Full Access mode on a server if it is already being managed by HP NetRAID Assistant in Full Access mode, or by another HP NetRAID utility. However, View Only mode can always be entered.

The only distinction the Main Screen shows between the Full Access and View Only modes is that in View Only mode various actions are inoperative and the related menu options are grayed out.

To change to another adapter within the server, use the Adapter pull-down list.

Select Another Server-Adapter Pair

Use these pull-down lists on the HP NetRAID Assistant Main Screen to select the next server-adapter pair to be viewed or modified.

NOTE You cannot leave the current server-adapter pair if any operations--such as Performance Monitor or the rebuilding or reconstruction of a drive--are running in Full Access mode.

You cannot change from View Only mode to Full Access mode. Instead, exit HP NetRAID Assistant and restart. Choose the server and Full Access mode. Then enter the password.

When selecting a new server in Full Access mode, a dialog box appears. Enter the new server's password, which is case-sensitive. The new server cannot be accessed if it is already being managed by a system in Full Access mode, or if either of the following utilities is running on the new server:

- HP NetRAID Assistant
- HP NetRAID Config

Exit HP NetRAID Assistant

Exit HP NetRAID Assistant by choosing **Exit** from the Configuration menu, or by clicking the **Exit** button in the toolbar, or by double-clicking the upper-left corner of the main window.

F Windows NT Monitor Service for HP NetRAID

NOTE HP NetRAID NT monitor service for HP NetRAID supports Windows NT and Windows 2000.

The HP NetRAID NT monitor service tracks the status changes of HP NetRAID Series adapters, integrated HP NetRAID controllers, and all of their logical drives and physical drives. It also performs consistency checks for all optimal, redundant logical drives at scheduled intervals. (Redundant logical drives include all drives of RAID levels 1, 3, 5, 10, 30, and 50.) All status changes are logged in the Windows NT Event Viewer Application Log.

The two ways of controlling the HP NetRAID NT monitor service are:

- Through the Control Panel Service
- Through a DOS utility

To display the DOS utility options, type

```
megactrl ?
```

To start, stop, pause, resume, or delete the HP NetRAID NT monitor service use one of the following commands:

```
megactrl -start
```

```
megactrl -stop
```

```
megactrl -pause
```

```
megactrl -resume
```

```
megactrl -del
```

The default consistency check happens every Sunday at midnight starting from the date of installation.

To specify a different consistency check schedule, type the following at the DOS shell of Windows NT or Windows 2000:

```
megactrl -cons -w# -d# -h# -datemm/dd/yyyy
```

The options are defined as follows:

- cons Perform consistency check.
- w# Scheduled intervals. Valid options are:
 - w0 = daily
 - w1 = every week
 - w2 = biweekly
 - w4 = every month
 - w12 = every three months
 - w24 = every six months
- d# Day of the week. Valid options are -d1(Sunday) through -d7 (Saturday)
- h# Hour in 24-hour format. Valid options are -d0 (12:00 a.m.) through -d23 (11:00 p.m.)
- date Start date in mm/dd/yyyy format. The consistency check starts from this date on. Valid years are 1900 through 2038.
- enChkCon Do consistency check at the next scheduled time. This is the default.
- disChkCon Do *not* do the consistency check at the next scheduled time.

Examples:

- `megactrl -cons -w2 -d0 -h1 -date05/01/1998`

The consistency check starts after 05/01/1998 and happens every other Sunday at 1:00 a.m.

- `megactrl -cons -w4 -d6 -h0 -date04/01/2001`

The consistency check starts after 04/01/2001 and happens on Saturday every month at midnight.

- `megactrl -cons -w0 -d3 -h1`

The consistency check happens every day at 1:00 a.m.

To stop a consistency check in progress, and to prevent future scheduled consistency checks, type:

```
megactrl -cons -abort
```

3 HP NetRAID Config

Overview

HP NetRAID Config is a character-based, non-GUI utility that configures and monitors RAID systems. HP NetRAID Config runs under the following operating systems:

- Novell NetWare
- IBM OS/2
- SCO OpenServer
- SCO UnixWare

NOTE	The instructions in this section on using HP NetRAID Config refer specifically to the Novell NetWare network operating system. Specific features may not be available in all network operating systems, and the exact location of specific menu options may vary.
-------------	---

This section describes the following functions:

- A. Starting and Exiting HP NetRAID Config
- B. HP NetRAID Config Management Menu Options
- C. Configuring Arrays and Logical Drives
- D. Designating Drives as Hot Spares
- E. Initializing Logical Drives
- F. Changing Logical Drives Currently in Use
- G. Formatting Physical Drives

A Starting and Exiting HP NetRAID Config

You do not need to restart your HP NetServer to use HP NetRAID Config.

To start HP NetRAID Config, make sure the program file is in your file path and type the command appropriate for your network operating system, as follows:

- For Novell NetWare, type **load megamgr**
- For SCO UnixWare, type **megamgr**
- For SCO OpenServer, type **megamgr**
- For IBM OS/2, type **megaconf**

NOTE For internal mass storage in HP NetServer LH 3000/3000r, LH 6000/6000r, and LT 6000r, SCSI ID 5 is reserved for the SAF-TE processor that manages the hot-swap mass storage cage.

For an external mass storage enclosure with a SAF-TE processor, a SCSI ID is reserved for that processor. The number of the reserved SCSI ID varies with the type of external enclosure.

The SAF-TE processor is displayed as PROC.

To exit HP NetRAID Config, press **Esc** at the Management menu and choose **Yes** at the prompt. A message appears if there are uninitialized logical drives in the system.

B HP NetRAID Config Management Menu Options

HP NetRAID Config offers several menu options to assist you in configuring and monitoring RAID systems. The menu options are listed below in the order they appear on the HP NetRAID Config Main menu:

- The **Configuration** menu lets you create, display, and save your configuration of arrays and logical drives.
- The **Initialize** option lets you initialize your logical drives.
- The **Objects** menu lets access the adapters, logical drives, physical drives, and SCSI channels individually.

- The **Format** option lets you format physical drives.
- The **Rebuild** option lets you rebuild a logical drive in which one physical drive has failed.
- The **Check Consistency** option lets you verify the data in your logical drives.
- The **Advanced** menu lets you reconstruct a logical drive.

Configure Menu

Choose the Configure option to select a method for configuring arrays and logical drives. Refer to "Configuring Arrays and Logical Drives" in this chapter for instructions.

Initialize Option

You *must* initialize your logical drives before they can be used. This option initializes the logical drives by writing zeros to the data fields and generating corresponding parity fields on drives with RAID levels 3, 5, 30, or 50. This option can initialize one or more logical drives.

When you choose Initialize from the Management menu, a window appears listing your physical drives. Use the arrow keys to highlight the drive you want to initialize, then press the Spacebar. You can select more than one drive. To select all the drives, press **F2**. To initialize the selected drive(s), press **F10**.

To cancel initialization once you have started it, press **Esc**.

CAUTION	When you initialize logical drives by using the Initialize menu selection, all data on the physical drives is erased.
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Objects Menu

Choose the Objects option to access the adapters, logical drives, physical drives, and SCSI channels individually. You can also change certain settings for each object.

Adapter

Choose Adapter from the Objects menu to select an integrated HP NetRAID controller or HP NetRAID Series adapter (if your HP NetServer has more than one) and to modify parameters.

- **Clear Configuration:** Erases the current configuration from the adapter's nonvolatile memory.
- **View Adapter Performance:** Displays the selected adapter's read/write performance.
- **Power Fail Safeguard:** Lets you enable or disable the Power Fail Safeguard feature. This feature allows users to protect a disk array during the reconstruction process should a power failure occur. If Power Fail Safeguard is enabled, reconstruction takes longer, but your data is protected against loss. The default setting is Enabled.

For complete information about the Power Fail Safeguard feature, see "Power Fail Safeguard Feature" in Chapter 5 of this guide.

- **Disk Spin-Up Timings:** Sets the method and timing for spinning up the hard disk drives in the HP NetServer. The default setting is Automatic.
- **Alarm Control:** For HP NetRAID Series adapters there are two onboard tone generator settings, described below. (This option is not available for integrated HP NetRAID controllers.)
 - ◇ **Enable/Disable Alarm:** Choose this option to enable or disable the onboard tone generator. The default setting is Enabled.
 - ◇ **Silence Alarm:** This setting stops the alarm when it goes off.

For complete information, see Chapter 8, "Alarm Control and Audible Warnings."

- **View/Update Parameters:** Displays the properties of the selected adapter: Rebuild Rate (default is 50%), Firmware Version, BIOS Version, DRAM Size, and logical drive properties. The only parameter you can change is the Rebuild Rate. (For complete information on the Rebuild Rate, see "Changing the Rebuild Rate" in Chapter 5 in this guide.)

Logical Drive

Choose this option to perform the listed actions. You must first select the logical drive on which you want to perform these options.

- **Initialize:** After configuration, a logical drive must be initialized before it can be used. This option initializes the logical drives by writing zeros to the data fields and generating corresponding parity fields on drives with RAID levels 3, 5, 30, or 50.
- **Check Consistency:** Ensures that parity or mirroring is correct for the selected drives. RAID levels 3, 5, 30, and 50 use parity data blocks to provide redundancy; parity is checked between these parity data blocks and the selected drives. RAID levels 1 and 10 use duplicate data drives (mirroring); the duplicate data is verified.

If Check Consistency finds any errors, it fixes the inconsistencies. This selection both identifies problems and takes corrective action.

Check Consistency should be run if the system shuts down irregularly, such as if the system hangs or suffers a power failure. It is also recommended that you run consistency checks every two to four weeks to ensure that bad blocks on the disk drive are mapped out.

NOTE	Check Consistency might fail if the firmware could not complete parity and data writes due to a power-failure or a system hang, or if the logical drive degraded or failed when a physical drive went offline.
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- **View Performance:** Displays the read/write performance of the selected adapter.
- **Properties:** Displays the following properties of the selected logical drive: RAID level, Size of the logical drive, Stripe Size, Write Policy, Read Policy, Cache Policy, Virtual Sizing, Number of Stripes, and State.

Physical Drive

Choose this option to select a physical device and to perform the operations listed below. When you choose this option, a selection menu is displayed showing the physical drives in the HP NetServer. Move the cursor to the desired disk drive and press Enter. The following menu options become available:

- **Rebuild:** Choose this option to rebuild the selected disk drive.
- **Format:** Choose this option to low-level format the selected hard disk drive.
- **Make Online:** Choose this option to change the status of a Failed drive back to Online.
- **Fail Drive:** Choose this option to change the state of the selected disk drive to Fail. Changing a drive to the status of Fail also changes the status of the logical drive in these ways:
 - ◇ Optimal logical drives of RAID level 1, 3, 5, 10, 30, or 50 change to Degraded.
 - ◇ Degraded logical drives of RAID level 1, 3, 5, 10, 30, or 50 change to Offline.
 - ◇ Optimal logical drives of RAID level 0 change to Offline.
- **Make Hot Spare:** Choose this option to designate the selected disk drive as a hot spare.
- **Properties:** Displays the following properties of the selected physical drive: Device Type, Capacity, Vendor ID, Product ID, Revision, SCSI Standard, Queue Tags, predictive failures, and device errors.
- **View Rebuild Progress:** Displays the Rebuild progress.

SCSI Channel

Choose this option to select a SCSI channel on the currently selected adapter. You can perform the following operations on the selected channel.

- **Deactivate Channel:** Deactivates the selected channel.
- **Activate Channel:** Activates the selected channel. Be sure that TermPWR is provided for all active channels.
- **Terminate High 8 Bits:** Enables termination on the selected channel for the upper eight bits and disables termination on the adapter for the lower

eight bits. This setting is required if the selected SCSI channel is terminated with 8-bit devices at both ends.

- **Terminate Wide Channel:** Enables Wide termination for the selected channel. This is required if the HP NetRAID Series adapter is at one end of the SCSI bus for the selected channel. The default setting is Wide Termination.
- **Disable Termination:** Disables termination on the adapter for the selected channel. This option should be used if the selected SCSI channel is terminated with Wide devices at both ends.
- **View Parameters:** Displays the termination and active status of the selected channel.

Battery Backup (HP NetRAID-3Si Adapters and Optional for Integrated HP NetRAID in HP NetServer LH 3000/3000r, LH 6000/6000r, and LT 6000r Only)

View the Battery Backup properties from this option. The properties of your Battery Backup Unit (in HP NetRAID-3Si) or Battery Backup Module (optional for integrated HP NetRAID in HP NetServer LH 3000/3000r, LH 6000/6000r, and LT 6000r) should be identical or similar to the following properties:

- Battery Card Present
- Battery Pack Present
- Temperature Good
- Voltage Good
- Fast Charging Completed
- Charge Counter 1
 - ◇ Reset Charge Count Cycles
 - * Yes
 - * No

This menu item produces an error message (missing battery) if accessed with the HP NetRAID-1Si adapter or with an integrated HP NetRAID controller without battery backup. Disregard the message for these cases.

Format Option

Choose the Format option to low-level format one or more physical drives.

Since most SCSI disk drives, including all HP drives, are low-level formatted at the factory, this step is usually not necessary. You typically must format a disk only if:

- The disk drive was not low-level formatted at the factory.
- There is an excessive number of media errors detected on the disk drive.

You do not need to use the Format option if you simply want to erase existing information on your SCSI disks, such as a DOS partition. That information is erased when you choose the Initialize menu selection to initialize the logical drive(s).

You cannot format a drive that is online.

Rebuild Option

Choose the Rebuild option to rebuild one or more failed disk drives. For complete information on rebuilding drives, see "Rebuilding Data" in Chapter 5 in this guide.

Check Consistency Option

Ensures that parity or mirroring is correct for the selected drives. RAID levels 3, 5, 30, and 50 use parity data blocks to ensure redundancy; parity is checked between these parity data blocks and the selected drives. RAID levels 1 and 10 use duplicate data drives (mirroring); the duplicate data is verified. If Check Consistency finds any errors, it fixes the inconsistencies. This selection both identifies problems and takes corrective action.

Check Consistency should be run if the system shuts down irregularly, such as if the system hangs or suffers a power failure. It is also recommended that you run consistency checks every two to four weeks to ensure that bad blocks on the disk drive are mapped out.

When you choose Check Consistency, the parameters of the existing logical drives on the current adapter appear. The logical drives are listed by number.

1. Press the arrow keys to highlight the desired logical drives.
2. Press the **Spacebar** to select or deselect a drive for consistency checking. Press **F2** to select or deselect all the logical drives.
3. Press **F10** to begin the consistency check. A progress indicator for each selected logical drive appears.

4. When the consistency check is finished, press any key to clear the progress display and press **Esc** to return to the Management menu.

NOTE	Check Consistency might fail if the firmware could not complete parity and data writes due to a power failure or a system hang, or if the logical drive degraded or failed when a physical drives went offline.
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Advanced Menu

Reconstruct Logical Drive

Use this option if you want to add a physical drive or change a RAID level. For complete information on adding a physical drive, see Chapter 6, "Capacity Expansion," in this guide. For information on changing RAID levels, see "Changing the RAID Level of a Logical Drive" in part F of this chapter, "Changing Logical Drives Currently in Use."

C Configuring Arrays and Logical Drives

Each configuration method requires a different level of user input. However, the general flow of operations for array and logical drive configuration is outlined below.

1. Choose a configuration method.
2. Designate hot spares (optional).
3. Configure the logical drives.
4. Initialize the logical drives.

Configuration Methods

HP NetRAID Config has five configuration options:

- **Auto Configuration** examines the physical drives and automatically configures them into arrays and logical drives. It does not disturb existing configuration information. For instructions on using this selection, see "Using Auto Configuration" in this chapter.
- **Easy Configuration** lets you create arrays, hot spares, and logical drives, but it does not modify an existing configuration. This selection does not permit array spanning. If there are already logical drives configured, their

configuration information is not disturbed. For instructions on using this selection, see "Using Easy Configuration" in this chapter.

- **New Configuration** also lets you create arrays and hot spares, but this selection lets you configure spanned arrays. If you select New Configuration, the existing configuration information on the selected adapter is destroyed when the new configuration is saved. For instructions on using this selection, see "Using New Configuration" in this chapter.
- **View/Add/Delete Configuration** lets you view an existing configuration or configure new arrays. This selection does not disturb existing configuration information. It does not allow you to delete configuration information. For instructions on using this selection, see "Using View/Add Configuration" in this chapter.
- **Clear Configuration** deletes the existing configuration.

Using Auto Configuration

Auto Configuration creates a configuration by following these steps:

1. Gathers drives with the same capacity into groups of five, four, or three. These groups become arrays with RAID level 5 logical drives.
2. Gathers pairs of drives with the same capacity together. These pairs become arrays with RAID 1 logical drives.
3. Configures any remaining single disk drives as arrays with RAID 0 logical drives.

Auto Configuration does not create any hot spares. If you want to configure hot spares, use the Easy Configuration or New Configuration selections.

Logical Drive Settings

Auto Configuration uses the following defaults to configure your drives:

Table 3-1. HP NetRAID Config Automatic Settings for Logical Drives

Parameter	Setting
Stripe size	64 KB
Write Policy	Write-Back in HP NetRAID-3Si and integrated HP NetRAID in HP NetServer LH 3000/3000r, LH 6000/6000r, and LT 6000r (See note below table.) Write-Through in HP NetRAID-1Si and integrated HP NetRAID in HP NetServer LH 3/3r and LH 4/4r
Read Policy	Adaptive
Cache Policy	Cached I/O
Spanning	NoSpan

NOTE

Write-Back means that data is written to disk only when it is forced out of the cache. Write-Back is efficient because an entry may be written many times in the cache without a disk access. While this setting increases performance, data can be lost if power fails.

Write-Back is NOT recommended unless one of the following is true:

- The HP NetRAID adapter is an HP NetRAID-3Si, which has a Battery Backup Unit.
- Your system is equipped with a UPS (uninterruptible power supply).
- Your system is an HP NetServer LH 3000/3000r, LH 6000/6000r, or LT 6000r that is equipped with a charged accessory Battery Backup Module.

Write-Back is not certified for any logical drive used as a Novell NetWare volume.

You can change the write policy, read policy, and cache policy after the configuration is complete. Choose **Objects**, then **Logical Drive**, then **Properties** to change this information.

User Actions

Perform the following steps when using Auto Configuration.

1. Choose **Configure** from the HP NetRAID Config Management menu.
2. Designate hot spares if desired by using the Easy Configuration selection. (Auto Configuration does not create any hot spares.)
3. Choose **Auto Configuration** from the Configure menu and respond to the confirmation prompt. The logical drives that result from Auto Configuration are displayed with a save prompt. Choose **Yes** to save the configuration.
4. Initialize the logical drives you have just configured. See "Initializing Logical Drives" in this chapter for more information.

Using Easy Configuration

Easy Configuration does not permit you to create spanned arrays; however, you can create more than one logical drive per array. Follow the steps below to create arrays by using Easy Configuration.

1. Choose **Configure** from the HP NetRAID Config Management menu.
2. Choose **Easy Configuration** from the Configure menu. The array selection menu appears. The hot key information appears at the bottom of the window. The hot key functions are:

Space	Select or deselect the highlighted drive.
Enter	Stop adding drives to the current array, and configure the logical drive.
F2	Display drive information for the highlighted drive.
F3	Display the logical drives that have been configured.
F4	Designate the highlighted drive as a hot spare.
3. Press the arrow keys to highlight specific physical drives.
4. Press **F4** to configure a highlighted drive as a hot spare.

5. Press the **Spacebar** to add the highlighted physical drive to the current array. The indicator for the selected drive changes from Ready to Onlin A [array number]-[drive number]. For example, Onlin A2-3 refers to array 2 drive 3.

Add physical drives to the current array as needed. Try to use drives of the same capacity in the same array. If you use drives with different capacities in an array, all the drives in the array are treated as though they have the capacity of the smallest drive.

The number of physical drives in a specific array determines which RAID levels can be implemented with the array.

6. Press **Enter** when you are finished creating the current array. The logical drive configuration window appears.

The window shows the logical drive that is currently being configured as well as any existing logical drives. The column headings are:

LD	The logical drive number
RAID	The RAID level
Size	The logical drive size
#Stripes	The number of stripes (physical drives) in the array
StrpSz	The stripe size
Drive-State	The state of the logical drive

7. Set the size of the logical drive. If you want to create more than one logical drive in an array, set a size of *less* than the actual capacity.
8. To set the RAID level for the logical drive, highlight **RAID** and press **Enter**. The available RAID levels for the current logical drive are displayed. Select a RAID level and press **Enter** to confirm.
9. Select **Advanced** to set the stripe size, Write policy, Read policy, and Cache policy.
 - **Stripe size:** This parameter identifies the size of the segment written to each disk in a logical drive.
 - **Write policy:** This parameter identifies the cache write policy. You can set the write policy to Write-Back or Write-Through.
 - **Read policy:** This parameter identifies the read policy for the logical drive. You can set this parameter to Normal, Read-Ahead, or Adaptive.

- **Cache policy:** This parameter identifies the read cache mode during data transfers involving the current logical drive.

(For definitions of the Write policy, Read policy, Cache policy, and their options, see the "Glossary" in this guide.)

Press **Esc** to exit the Advanced menu.

10. When you are finished defining the current logical drive, highlight **Accept** and press **Enter**. The array selection window appears if there are any unconfigured disk drives left.
11. Repeat Steps 3 through 10 to configure another array and logical drive. HP NetRAID supports up to eight logical drives per adapter.
12. When you are finished configuring logical drives, press **Esc** to exit Easy Configuration. A list of the currently configured logical drives appears.
13. Save your configuration, and you return to the Configure menu.
14. Initialize the logical drives you have just configured. See "Initializing Logical Drives" in this chapter for more information.

Using New Configuration

The New Configuration option allows you to create arrays with just one logical drive, arrays with multiple logical drives, spanned arrays, and hot spares.

NOTE The New Configuration option *erases* the existing configuration information for the selected adapter.

1. Choose **Configure** from the HP NetRAID Config Management menu.
2. Choose **New Configuration** from the Configure menu. An array selection window is displayed showing the devices connected to the current adapter. Hot key information appears at the bottom of the window. The hot key functions are:

Space	Select or deselect the highlighted drive.
Enter	Stop adding drives to the current array, and configure the logical drive.
F2	Display the manufacturer data and the adapter error count for the highlighted drive.
F3	Display the logical drives that have been configured.
F4	Designate the highlighted drive as a hot spare.
F10	Display the logical drive configuration window.

3. Press the arrow keys to highlight specific physical drives.
4. Press **F4** to configure the highlighted drive as a hot spare.
5. Press the **Spacebar** to add the highlighted physical drive to the current array. The status of the selected drive changes from Ready to Onlin A *[array number]-[drive number]*. For example, Onlin A2-3 means array 2, disk drive 3.

Add physical drives to the current array as needed. Try to use drives of the same capacity in the same array. If you use drives with different capacities in an array, all the drives in the array are treated as though they have the capacity of the smallest drive. The number of physical drives in an array determines the RAID levels that can be implemented with the array.
6. Press **Enter** when you are finished creating the current array. To continue defining arrays, repeat Steps 3 through 5. To configure your logical drives, go to Step 7.
7. Press **F10** to configure logical drives. The logical drive configuration window appears. The window shows the logical drive that is currently being configured as well as any existing logical drives.
8. To set the RAID level for the logical drive, highlight **RAID** and press **Enter**. The available RAID levels for the current logical drives are listed. Select a RAID level and press **Enter** to confirm.
9. If you want to create a spanned array, highlight **Span** and press **Enter**. The choices are:
 - **CanSpan**: Array spanning is enabled for the current logical drive. The drive can occupy space in up to four arrays.
 - **NoSpan**: Array spanning is disabled for the current logical drive. The drive can occupy space in only one array.

The default setting is NoSpan.

NOTE

The arrays to be spanned must have sequential array numbers and must contain the same number of physical drives.

If you select **CanSpan**, HP NetRAID Assistant will attempt to span up to four arrays. Array spanning stops when:

- It has created a logical drive of the size you specify in Step 10 below.
- The next sequentially numbered array has a different number of drives.

Spanned arrays must contain the same number of drives in each array.

10. To set the logical drive size, move the cursor to **Size** and press **Enter**. By default, the logical drive size is set to use all available space in the array(s) associated with the current logical drive. If you set the Span parameter to CanSpan in Step 9, the current logical drive uses all space in the current array, and all space in up to three subsequent arrays with the same number of drives.

- If you want to create more than one logical drive in an array, set a size of *less* than the actual capacity.
- If you want to span only two or three arrays, rather than the four-array maximum, set a size that reflects the number of arrays you want to span.

11. Choose the **Advanced** menu to set the following options.

- **Stripe size:** This parameter specifies the size of the segment written to each disk in a logical drive.
- **Write Policy:** This parameter identifies the cache write policy. You can set the write policy to Write-Back or Write-Through.
- **Read Policy:** This parameter identifies the read policy for the logical drive. You can set this parameter to Normal, Read-Ahead, or Adaptive.
- **Cache Policy:** This parameter identifies the cache policy for the selected logical drive.

(For definitions of the Write policy, Read policy, Cache policy, and their options, see the "Glossary" in this guide.)

Press **Esc** to exit the Advanced Menu.

12. When you are finished defining the current logical drive, highlight **Accept** and press **Enter**. If there is space remaining in the arrays, the next logical drive to be configured appears. Repeat Steps 8 to 11 to configure another logical drive. If the array space has been used up, a list of the existing logical drives appears.
13. Save your configuration by responding to the save prompt.
14. Initialize the logical drives you have just configured. See "Initializing Logical Drives" in this chapter for more information.

Using View/Add Configuration

View/Add Configuration leaves the existing configuration intact, so you can use it to view the current configuration or add new arrays to the current configuration.

1. Choose **Configure** from the HP NetRAID Config Management menu.
2. Choose **View/Add Configuration** from the Configure menu. An array selection window is displayed showing the devices connected to the current adapter. Hot key information appears at the bottom of the window. The hot key functions are:

Space	Select or deselect the highlighted drive.
Enter	Stop adding drives to the current array, and configure the logical drive.
F2	Display the manufacturer data and the adapter error count for the highlighted drive.
F3	Display the logical drives that have been configured.
F4	Designate the highlighted drive as a hot spare.
F10	Display the logical drive configuration window. (This selection is valid only if you have added a new array and pressed Enter.)
3. Press the arrow keys to highlight a drive with the status of Ready. You cannot change the configuration of a drive with any other status.
4. Press **F4** to configure the Ready drive as a hot spare.
5. Press the **Spacebar** to add the Ready drive to a new array. The status of the selected drive changes from Ready to Onlin A *[array number]-[drive number]*. For example, Onlin A2-3 means array 2, disk drive 3.

Add physical drives to the current array as needed. Try to use drives of the same capacity in the same array. If you use drives with different capacities

in an array, all the drives in the array are treated as though they have the capacity of the smallest drive. The number of physical drives in an array determines the RAID levels that can be implemented with the array.

6. Press **Enter** when you are finished creating the current array. To continue defining arrays, repeat Steps 3 through 5. To configure your logical drives, go to Step 7.
7. Press **F10** to configure logical drives. The logical drive configuration window appears. The window shows the logical drive that is currently being configured as well as any existing logical drives.
8. To set the RAID level for the logical drive, highlight **RAID** and press **Enter**. The available RAID levels for the current logical drives are listed. Select a RAID level and press **Enter** to confirm.
9. If you want to create a spanned array, highlight **Span** and press **Enter**. The choices are:
 - **CanSpan**: Array spanning is enabled for the current logical drive. The drive can occupy space in more than one array.
 - **NoSpan**: Array spanning is disabled for the current logical drive. The drive can occupy space in only one array.

The default setting is NoSpan.

NOTE

The arrays to be spanned must have sequential array numbers and must contain the same number of physical drives.

If you select **CanSpan**, HP NetRAID Assistant will attempt to span up to four arrays. Array spanning stops when:

- It has created a logical drive of the size you specify in Step 10 below.
- The next sequentially numbered array has a different number of drives.

Spanned arrays must contain the same number of drives in each array.

-
10. To set the logical drive size, move the cursor to **Size** and press **Enter**. By default, the logical drive size is set to use all available space in the array(s) associated with the current logical drive. If you set the Span parameter to CanSpan in Step 9, the current logical drive uses all space in the current array, and all space in up to three subsequent arrays with the same number of drives.

- If you want to create more than one logical drive in an array, set a size of *less* than the actual capacity.
 - If you want to span only two or three arrays, rather than the four-array maximum, set a size that reflects the number of arrays you want to span.
11. Choose the **Advanced** menu to set the following options.
 - **Stripe size:** This parameter specifies the size of the segment written to each disk in a logical drive.
 - **Write Policy:** This parameter identifies the Write policy for the logical drive. You can set the write policy to Write-Back or Write-Through.
 - **Read Policy:** This parameter identifies the Read policy for the logical drive. You can set this parameter to Normal, Read-Ahead, or Adaptive.
 - **Cache Policy:** This parameter identifies the Cache policy for the logical drive.

(For definitions of the Write policy, Read policy, Cache policy, and their options, see the "Glossary" in this guide.)

Press **Esc** to exit the Advanced Menu.
 12. When you are finished defining the current logical drive, highlight **Accept** and press **Enter**. If there is space remaining in the arrays, the next logical drive to be configured appears. Repeat Steps 8 to 11 to configure another logical drive. If the array space has been used up, a list of the existing logical drives appears.
 13. Save your configuration by responding to the save prompt.
 14. Initialize the logical drives you have just configured. See "Initializing Logical Drives" in this chapter for more information.

D Designating Drives as Hot Spares

HP NetRAID Config lets you create *global* hot spares. Users with Microsoft Windows NT and Windows 2000 can use HP NetRAID Assistant to create a hot spare that is dedicated to one specific logical drive. Users with other operating systems do not have the ability to create hot spares that are dedicated to one logical drive.

There are two methods for designating physical drives as hot spares:

- **Configuration Menu.** You can create a hot spare by using the Easy, New, or View/Add Configuration mode. When you choose any of these configuration options in the Configure menu, a window listing all physical devices connected to the current adapter is displayed. Press the arrow keys to highlight a disk drive that has a Ready indicator and press **F4** to designate it as a hot spare. The indicator changes to HotSp.
or
- **Objects Menu.** Choose Objects from the Configure menu, then select Physical Drive. A physical drive selection window appears. Highlight the drive and press **Enter** to display the action menu for the drive. Select Make Hot Spare and press **Enter**. The indicator for the selected drive changes to HotSp.

E Initializing Logical Drives

You must initialize each new logical drive you configure. The Initialize menu selection initializes the logical drives by writing zeros to the data fields and generating corresponding parity fields on drives with RAID levels 3, 5, 30, or 50.

You can initialize the logical drives in two ways:

- **Batch Initialization** lets you initialize up to eight logical drives simultaneously.
- **Individual Initialization** lets you initialize an individual logical drive.

CAUTION	When you choose the Initialize menu selection, initialization destroys all existing data on the physical disk drive.
----------------	--

Batch Initialization

To initialize multiple logical drives, perform the following steps:

1. Choose **Initialize** from the HP NetRAID Config Management Menu. A list of the current logical drives appears.
2. To select all logical drives to be initialized, do one of the following:
 - ◇ Press **F2**.
 - or*
 - ◇ Use the arrow keys to highlight the first drive to be initialized. Press the **Spacebar** to select the highlighted logical drive for initialization. Continue to select drives by using the arrow keys and the Spacebar.

3. When you have selected the logical drives you want to initialize, press **F10** and choose **Yes** at the confirmation prompt. The progress of the initialization for each drive is shown in bar graph format.
4. When initialization is complete, press any key to continue. Press **Esc** to return to the Management menu.

Individual Initialization

To initialize one logical drive, perform the following steps:

1. Choose **Objects** from the HP NetRAID Config Management menu.
2. Choose **Logical Drive** from the Objects menu.
3. Select the logical drive to be initialized.
4. Choose **Initialize** from the Action menu. The progress of the initialization appears as a bar graph.
5. When initialization completes, press any key to return to the previous menu.

F Changing Logical Drives Currently in Use

You can make several kinds of changes to logical drives that are currently in use. You can:

- Change the RAID level.
- Remove a physical drive.
- Add a physical drive. See Chapter 6, "Capacity Expansion," in this guide for complete instructions.

All such changes to existing logical drives require reconstructing the data. Reconstruction is the process of reorganizing the data to correspond to a change in the HP NetRAID system. Reconstruction occurs in the background, so the HP NetServer and the affected logical drive remain available throughout the reconstruction process.

NOTE Once started, the reconstruction process cannot be stopped.

The Power Fail Safeguard feature protects logical drives against data loss during the reconstruction process should a power failure occur. For complete information, see "Power Fail Safeguard Feature" in Chapter 5 in this guide.

Changing the RAID Level of a Logical Drive

To make RAID level changes, refer to the valid RAID level changes listed in Table 3-1 before altering a logical drive.

NOTE You cannot change the RAID level of any logical drive that spans arrays (RAID levels 10, 30, or 50).

Table 3-1. Valid HP NetRAID Configuration Changes

Existing RAID Configuration	Valid RAID Configuration Change	Configuration Event
RAID 3 or RAID 5 Optimal	RAID 3 or RAID 5 Optimal	Expanding capacity
RAID 3 or RAID 5 Optimal	RAID 0	Stopping parity
RAID 3 or RAID 5 Optimal	RAID 0	Deleting a drive, or adding drives
RAID 3 or RAID 5 Optimal or Degraded	RAID 0	Reconfiguring as Optimal RAID 0
RAID 1 Optimal	RAID 3 or RAID 5 Optimal	Adding drives
RAID 1 Optimal	RAID 0	Deleting a drive
RAID 1 Degraded	RAID 0	Reconfiguring as Optimal RAID 0
RAID 0 Optimal	RAID 3 or RAID 5 Optimal	Adding drives
RAID 0 Optimal (with one drive)	RAID 1 Optimal	Adding a drive
RAID 0 Optimal	RAID 0	Adding drives

To change the RAID level of a logical drive that is currently in use, the logical drive must be reconstructed. Follow these steps:

1. Choose **Advanced Menu** from the HP NetRAID Config Management menu.
2. Select **Reconstruct Logical Drive**.
3. Select the logical drive to be changed. A Reconstruct window is displayed.
4. Press **Enter** to see the Reconstruct menu.
5. Select **RAID level**.
6. Choose the **new RAID level**.

Removing a Physical Drive from a Logical Drive

The procedures for removing a physical drive from a logical drive vary depending on the RAID level of the logical drive.

RAID Level 0

There is no data redundancy in a RAID 0 system, so you cannot reconstruct this data while the HP NetServer is available. To remove a physical drive from a RAID 0 logical drive, you must back up your data, reconfigure the logical drive, then restore the data.

RAID Levels 1, 3, or 5

RAID levels 3 and 5 use parity to provide data redundancy. RAID level 1 provides data redundancy through mirroring. In either case, follow these procedures to remove a physical drive from any logical drive of RAID level 1, 3, or 5.

1. Change the status of the drive you want to remove to Fail by following these steps:
 - a. Choose **Objects** from the HP NetRAID Config Management menu.
 - b. Select **Physical Drive** from the Objects menu.
 - c. Use the arrow keys to highlight the drive you want to remove.
 - d. Press **Enter**. An action menu appears.
 - e. Select **Fail Drive**.
 - f. Press **Esc** repeatedly to return to the HP NetRAID Config Management menu.
2. Change the RAID level of the logical drive to RAID 0 by using the instructions in "Changing the RAID Level of a Logical Drive" in this chapter. The logical drive will be rebuilt as a RAID 0 without the drive put in the Fail state.
3. If you want to convert the logical drive to a RAID level with redundancy, change the RAID level once again to RAID 3 or 5.
4. Change the status of the drive you removed back to the Ready state by using these instructions:
 - a. Choose **Objects** from the HP NetRAID Config Management menu.
 - b. Choose **Physical Drive** from the Objects menu.

- c. Use the arrow keys to highlight the Failed drive that you want to make available.
 - d. Press **Enter**. An action menu appears.
 - e. Select **Make Online**.
 - f. Press **Esc** repeatedly to return to the HP NetRAID Config Management menu.
5. Configure this Ready disk by using the **Easy Configuration** or **View/Add Configuration** option from the Configure menu.

Reclaiming a Hot Spare

To change a hot spare into a Ready drive:

1. Choose **Objects** from the HP NetRAID Config Management menu.
2. Select **Physical Drive**.
3. Use the arrow keys to select the physical drive that is configured as a hot spare and press **Enter**.
4. Select **Fail Drive** and press **Enter**. The status of the drive changes to Ready.

G Formatting Physical Drives

Since most SCSI disk drives are low-level formatted at the factory, this step is usually not necessary. Hewlett-Packard drives do not require formatting. You typically must format a disk if:

- The disk drive was not low-level formatted at the factory.
- An excessive number of media errors is detected on the disk drive.

CAUTION Formatting a physical drive erases all information on the disk.
--

Media Errors

Check the Properties window for the drive you wish to format. You can check this window by choosing **Objects** from the **Physical Drive** menu, pressing the arrow keys to highlight the selected drive, and pressing **F2**.

The error count appears at the bottom of the Properties window. If you feel that the number of errors is excessive, you can format the disk drive.

You do not have to use the Format option to erase existing information on your SCSI disks, such as a DOS partition. That information is erased when you choose the Initialize menu selection to initialize logical drives.

Formatting Options

Since most SCSI disk drives are low-level formatted at the factory, this step is usually not necessary.

You can format the physical drives by using one of HP NetRAID Config's two formatting options:

- **Batch Formatting** lets you format up to eight disk drives simultaneously.
- **Individual Formatting** lets you format a single disk drive.

Batch Formatting

1. Choose **Format** from the HP NetRAID Config Management menu. A device selection window is displayed showing the devices connected to the current adapter.
2. Press the arrow keys to highlight the first drive to be formatted. Press the **Spacebar** to select the highlighted physical drive for formatting. The selected drive flashes.
3. Continue selecting drives to be formatted by using the arrow keys and the Spacebar.
4. When you have selected the physical drives, press **F10** and choose **Yes** at the confirmation prompt to begin formatting. The indicators for the selected drives change to FRMT[number], where the number reflects the drive selection order. Formatting can take some time, depending on the number of drives you have selected and the drive capacities.
5. When formatting is complete, press any key to continue. Press **Esc** to return to the Management menu.

Individual Formatting

1. Choose **Objects** from the HP NetRAID Config Management menu. Choose **Physical Drive** from the Objects menu. A device selection window is displayed showing the devices connected to the current adapter.
2. Press the arrow keys to highlight the physical drive to be formatted and press **Enter**. An action menu appears.
3. Choose **Format** from the action menu and respond to the confirmation prompt. Formatting can take some time, depending on the drive capacity.
4. When formatting is complete, press any key to return to the previous menu.

4 HP NetRAID Express Tools

Overview

HP NetRAID Express Tools resides in the HP NetRAID BIOS, and is therefore available to all supported operating systems. This utility duplicates many of the management functions found in HP NetRAID Assistant and HP NetRAID Config. Because you must restart the HP NetServer to start HP NetRAID Express Tools, it is recommended that you use HP NetRAID Assistant or HP NetRAID Config whenever possible.

However, HP NetRAID Express Tools contains several options that are *not* available with HP NetRAID Assistant or HP NetRAID Config. Use HP NetRAID Express Tools to view or change the following parameters:

- Adapter Type (also available with HP NetRAID Config)
- Autorebuild
- Battery Functions Status (also available with HP NetRAID Config)
- BIOS Enable/Disable
- Cache Flush Timings
- Diagnostics
 - ◇ On-board memory test
 - ◇ NVRAM test
 - ◇ Parity check
 - ◇ DMA test
 - ◇ Timer test
 - ◇ Interrupt test
 - ◇ Hardware register test
- Disk Spin-Up Timings (also available with HP NetRAID Config)
- Emulation
- Initiator ID

- Memory Type (for HP NetRAID-1Si)
- Power Fail Safeguard Parameter (also available with HP NetRAID Config)
- Read Modify Write Mode
- Reset to Default Settings
- SCSI-2 Command Tagging
- SCSI Termination (for HP NetRAID-3Si and integrated HP NetRAID in HP NetServer LH 3000/3000r, LH 6000/6000r, and LT 6000r; also available with HP NetRAID Config)
- SCSI Transfer Rate
- Span
- Synchronous Negotiation
- View/Add/Delete Config (also available with HP NetRAID Config)
- Virtual Sizing

This section describes the following topics:

- A. Starting and Exiting HP NetRAID Express Tools
- B. HP NetRAID Management Menu
- C. Configuring Arrays and Logical Drives
- D. Formatting Physical Drives
- E. Changing the HP NetRAID Series Adapter
- F. Swapping Physical Drives

A Starting and Exiting HP NetRAID Express Tools

To start HP NetRAID Express Tools

1. Log off all users, close all applications, and power down the HP NetServer.
2. Restart the HP NetServer.
3. When the following prompt appears, press <Ctrl> <M>.

Option: Experienced users may press <Ctrl> <M> for HP NetRAID Express Tools now.

Firmware Initializing

When the system stops scanning, HP NetRAID Express Tools starts immediately.

To exit HP NetRAID Express Tools

1. Press **Esc** at the Tools Management menu.
2. Choose **Yes** at the prompt.
3. Restart the HP NetServer.

B HP NetRAID Express Tools Management Menu

The HP NetRAID Express Tools Management menu options are described below.

- The **Configure** menu provides several options for configuring physical arrays and logical drives.
- The **Initialize** option initializes one or more logical drives.
- The **Objects** menu individually accesses adapters, logical drives, and physical drives.
- The **Format** option low-level formats selected hard disk drives.
- The **Rebuild** option rebuilds failed disk drives.
- The **Check Consistency** option ensures that parity or mirroring is correct for the selected logical drive and remedies inconsistencies as necessary.
- The **Disable/Enable BIOS** option disables the BIOS to boot off the embedded SCSI instead of the adapter. The default setting is Enabled.
- The **Change Adapters** option lets you select an adapter if more than one is installed.
- The **Alarm Control** option is available for HP NetRAID-1Si and HP NetRAID-3Si. It lets you enable/disable the onboard tone generator or silence it.

NOTE For internal mass storage in HP NetServer LH 3000/3000r, LH 6000/6000r, and LT 6000r, SCSI ID 5 is reserved for the SAF-TE processor that manages the hot-swap mass storage cage.

For an external mass storage enclosure with a SAF-TE processor, a SCSI ID is reserved for that processor. The number of the reserved SCSI ID varies with the type of external enclosure.

The SAF-TE processor is displayed as PROC.

Configure Menu

For information on configuring, refer to "Configuring Arrays and Logical Drives" in this chapter.

Initialize Option

You *must* initialize your logical drives before they can be used. This option initializes the logical drives by writing zeros to the data fields and generating corresponding parity fields on drives with RAID levels 3, 5, 30, or 50.

Choosing Initialize from the Tools Management menu opens the Logical Drives Configured box, which states the properties for the logical drives configured. The hot key options available at the bottom of the window are:

**SPACE-(De)Select, F2-(De)Select All Drives,
F10-Initialize**

Select the logical drive(s) you want to initialize with the **Spacebar** or **F2** button, then press **F10** to initialize the logical drives. You are asked to confirm that you want to initialize the logical drives. Choosing Yes begins initialization. The Initialize Logical Drives in Progress box opens to report on the progress of the initialization process.

If you want to cancel the initialization process once you have started it, press the **Esc** key. You are asked to confirm that you want to abort initialization.

CAUTION	When you initialize logical drives by using the Initialize menu selection, all data on the physical drives is erased.
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Objects Menu

Choose the Objects option from the HP Express Tools Management Menu to access the adapters, logical drives, physical drives, and SCSI channels individually. You can also change settings for each object. The Objects submenu options are described below.

Adapter

To modify parameters of an HP NetRAID Series adapter or an integrated HP NetRAID controller, choose Adapter from the Objects menu. After selecting your adapter, the following submenu is displayed.

- **Reset to Default Settings:** Resets all user-defined parameters of the selected adapter to the factory default settings.
- **PowerFail Safeguard:** If enabled, this feature prevents data loss if the power fails during a reconstruction. The default setting is Enabled. For a complete discussion of this feature, see "Power Fail Safeguard Feature" in Chapter 5, "Reconstructing and Rebuilding the Drive," in this guide.
- **Memory Type:** Displays the type of memory installed for HP NetRAID.
- **Read Modify Write Mode:** Selects between Read Modify Write Mode and Read Peer Mode.
 - ◇ The default setting is OFF, which selects Read Peer Mode. This is appropriate if there are three physical drives in the arrays supporting RAID 5 logical drives.
 - ◇ When set to ON, Read Modify Write Mode is selected. This improves performance in RAID 5 logical drives *only* if the number of physical drives in the array is four or greater.
 - * Read Modify Write Mode set to ON requires complete initialization of new logical drives controlled by the adapter.

NOTE	The complete initialization required for Read Modify Write Mode can take up to several hours for a large logical drive.
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- * Changing the Read Modify Write Mode setting to ON immediately forces consistency checks of all existing logical drives controlled by the adapter.

- ◇ For optimal performance of RAID 5 logical drives, use separate adapters to control arrays with three physical drives and arrays with four or more physical drives.
- **Change Disk Geometry:** Changes the layout of logical drives presented to the NOS. The default setting is 8 GB, and the alternative is 2 GB. Different operating systems use different disk geometries. Your NOS documentation may indicate the disk geometry it uses.

NOTE Changing the disk geometry setting only changes the geometry of logical drives created after the change. It does not change the geometry of existing logical drives.

- **Disk Spin-Up Timings:** Sets the method and timing for spinning up the hard disk drives in the HP NetServer. The default setting is Automatic.
- **Cache Flush Timings:** Sets the cache flush interval to once every 2, 4, 6, 8, or 10 seconds. The default setting is 4 seconds.
- **View/Update Rebuild Rate:** View or change the Rebuild Rate for the adapter.
- **Diagnostics:** The hardware diagnostic tool performs the following hardware tests:
 - ◇ **On-board memory test**
 - ◇ **NVRAM test**
 - ◇ **Parity check**
 - ◇ **DMA test**
 - ◇ **Timer test**
 - ◇ **Interrupt test**
 - ◇ **Hardware register test**
- **Adapter Type:** Displays the adapter type: HP NetRAID-1Si, HP NetRAID-3Si, or integrated HP NetRAID.
- **Emulation:** Sets PCI class code to **I2O** (for I₂O operation) or **Mass Storage** (for conventional non-I₂O mass storage). The default setting is Mass Storage.
- **Autorebuild:** Enables or disables the Autorebuild parameter. For complete information, see "Rebuilding Data" in Chapter 5 in this guide.

- **Initiator ID:** Changes the Initiator ID assumed by the HP NetRAID controller (adapter) at system boot-up. The default setting is SCSI ID 7.

Logical Drive

To perform a logical drive procedure, choose Logical Drive from the Objects menu. The logical drive options are:

- **Initialize:** Initializes the selected logical drive. See "Initializing Logical Drives" in this chapter for more information.
- **Check Consistency:** Ensures that parity or mirroring is correct for the selected drives. Click on the logical drive to be checked. RAID levels 3, 5, 30, and 50 use an extra drive to store parity data blocks; parity is checked between these parity data blocks and the selected drives. RAID levels 1 and 10 use duplicate data drives (mirroring); the duplicate data is verified.

Check Consistency should be run if the system shuts down irregularly, such as if the system hangs or suffers a power failure. It is also recommended that you run consistency checks every two to four weeks to ensure that bad blocks on the disk drive are mapped out. Check Consistency always remedies inconsistencies. Check Consistency will fail only if the firmware could not complete parity and data writes due to a power-failure or a system hang, or if the logical drive degraded or failed when the physical drives went offline.

- **Properties:** Displays the selected logical drive properties of RAID level, size of the logical disk, stripe size, Write Policy, Read Policy, Cache Policy, Virtual Sizing, power-on rights, number of stripes, and state.

Physical Drive

Selecting Physical Drive opens the Physical Drive Selection menu. The hard disk drives in the HP NetServer are listed. Hot key functions are displayed at the bottom of the window. To access drive information, press **F2**, and view logical drives by pressing **F3**. Use the arrow keys to move the cursor to the desired device, and press **Enter** to display the following options.

- **Rebuild:** Rebuilds the selected disk drive.
- **Format:** Low-level formats the selected disk drive. Choose the Format option only if:
 - ◇ The disk drive was not low-level formatted at the factory
 - ◇ There is an excessive number of media errors detected on the disk drive

NOTE You do not need to use the Format option if you simply want to erase existing information on your hard drives, such as a DOS partition. Choosing the Initialize menu selection, and initializing the logical drive(s) erases that information.

- **Make Online:** Changes the state of the selected disk drive to Online.
- **Fail Drive:** Changes the state of the selected disk drive to Fail. One Failed physical drive changes the logical drive as follows:
 - ◇ Optimal RAID 1, 3, 5, 10, 30, or 50 logical drives change to Degraded.
 - ◇ Degraded RAID 1, 3, 5, 10, 30, or 50 logical drives change to Offline.
 - ◇ Optimal RAID 0 logical drives change to Offline.
- **Make Hot Spare:** Designates the selected disk drive as a hot spare.
- **Properties:** Displays the selected physical drive properties of Device Type, Capacity, Vendor ID, Product ID, Revision, SCSI Standard, and Device Errors.
- **Synchronous Negotiation:** Disables synchronous negotiation for the selected physical device. The default is Enabled.
- **SCSI-2 Command Tagging:** Sets the number of queue tags per target device to 2, 3, 4, or Enhanced Qtag Scheduling, or it disables command tagging. The default setting is Enhanced Qtag Scheduling, which allows the firmware to automatically adjust itself to each target device's queuing capabilities and to use this optimized value for the queue depth.

SCSI Channel

The SCSI Channel option allows you to select a SCSI channel on the currently selected adapter. Select a channel to perform the operations described below.

- **Terminate High 8 Bits:** Available for HP NetRAID-3Si and integrated HP NetRAID in HP NetServer LH 3000/3000r, LH 6000/6000r, and LT 6000r. Enables termination on the selected channel for the upper eight bits and disable termination on the adapter for the lower eight bits. Use this setting if the selected SCSI channel is terminated with 8-bit devices at both ends.
- **Terminate Wide Channel:** Available for HP NetRAID-3Si and integrated HP NetRAID in HP NetServer LH 3000/3000r, LH 6000/6000r, and LT 6000r. Enables Wide termination for the selected channel. If the

adapter is at one end of the SCSI bus for the selected channel, you must use this option. This is the default setting.

- **Disable Termination:** Available for HP NetRAID-3Si and integrated HP NetRAID in HP NetServer LH 3000/3000r, LH 6000/6000r, and LT 6000r. Disables termination on the adapter for the selected channel. Use this option if the selected SCSI channel is terminated with Wide devices at both ends.
- **Automatic Termination:** Available for HP NetRAID-3Si and integrated HP NetRAID in HP NetServer LH 3000/3000r, LH 6000/6000r, and LT 6000r. Enables Automatic Termination on the adapter for the selected channel.
- **SCSI Transfer Rate:** Identifies the SCSI transfer rate of the channel. The options are Fast, Ultra, and Ultra2. New parameters become effective on the next system restart.

Battery Backup

Available for HP NetRAID-3Si, as well as for integrated HP NetRAID in HP NetServer LH 3000/3000r, LH 6000/6000r, and LT 6000r if accessory Battery Backup Module is installed. Displays the battery status.

This menu item produces an error message (missing battery) if accessed with the HP NetRAID-1Si adapter or integrated HP NetRAID without a Battery Backup Module. Disregard the message for these cases, because they do not have battery backup.

Format Option

Since most SCSI disk drives are low-level formatted at the factory, this step is usually not necessary.

Formatting a hard drive destroys all data on the drive. Choose the Format option to low-level format one or more physical drives *only* if:

- The disk drive was not low-level formatted at the factory.
- There is an excessive number of media errors detected on the disk drive.

NOTE	You do not need to use the Format option to erase existing information on your SCSI disks, such as a DOS partition. Choosing the Initialize menu selection, and initializing your logical drives erases existing data on the physical drives.
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To format a physical drive, it must be in the Fail state. (You can change it to the Fail state by choosing **Objects**, then **Physical Drive**, then **Fail Drive**.)

To format a hard drive, select Format, then select the drive you want to format from the drives listed. Press F10 to start the format.

Rebuild Option

Choose the Rebuild option from the HP NetRAID Express Tools Management menu to rebuild one or more failed disk drives. When the Physical Drives Selection menu opens, choose the drive you want to rebuild by highlighting it. Press the **Spacebar** to select the drive, **F10** to start the Rebuild, **F2** to view drive information, and **F3** to view logical drives. See "Rebuilding Data" in Chapter 5 for further information.

Check Consistency Option

Choose this option to verify the redundancy data in logical drives using RAID levels 1, 3, 5, 10, 30, or 50. RAID levels 3, 5, 30, and 50 use an extra drive to store parity data blocks; parity is checked between these parity data blocks and the selected drives. RAID levels 1 and 10 use duplicate data drives (mirroring); the duplicate data is verified.

When you choose Check Consistency, the parameters appear of the existing logical drives on the current adapter and a selection menu listing the logical drives by number is displayed.

1. Press the arrow keys to highlight the desired logical drives.
2. Press the **Spacebar** to select or deselect a drive for consistency checking.
3. Press **F2** to select or deselect all the logical drives.
4. Press **F10** to begin the consistency check. A progress indicator for each selected logical drive is displayed.
5. You may cancel a consistency check in progress by pressing **Esc**.
6. When the consistency check is finished, press any key to clear the progress display and press **Esc** to return to the Tools Management menu.

Check Consistency should be run if the system shuts down irregularly, such as if the system hangs or suffers a power failure. It is also recommended to run consistency checks every two to four weeks to ensure that bad blocks on the disk drive are mapped out. Check Consistency always remedies inconsistencies. Check Consistency will only fail if the firmware could not complete parity and data writes due to a power-failure or a system hang, or if the logical drive degraded or failed when a physical drive went offline. In an inconsistent stripe, firmware always updates the parity stripe to restore consistency.

Disable/Enable BIOS Option

This option disables or enables the BIOS firmware. The default setting is Enabled. If the BIOS is disabled, DOS cannot read logical drives, and you cannot boot from RAID. You might disable the BIOS in order to boot off the embedded SCSI instead of the adapter.

Change Adapters Option

If you have more than one HP NetRAID Series adapter installed, or if you have an integrated HP NetRAID controller with one or more HP NetRAID Series adapters installed, use this selection to choose which adapter you want to affect.

Alarm Control Option

This option is available for HP NetRAID-1Si and HP NetRAID-3Si. The two settings for the onboard tone generator are described below.

- ◇ **Enable/Disable Alarm:** Choose this option to enable or disable the onboard tone generator. The default setting is Enabled.
- ◇ **Silence Alarm:** This setting stops the alarm when it goes off.

For complete information, see Chapter 8, "Alarm Control and Audible Warnings."

C Configuring Arrays and Logical Drives

Each configuration method requires a different level of user input. The general flow of operations for array and logical drive configuration is described below.

1. Designate global hot spares (optional).
2. Create arrays using the available physical drives.
3. Initialize the new logical drives.

Designating Drives as Global Hot Spares

Global hot spares are physical drives that are powered up along with the RAID drives and remain in a standby state. If a disk drive used in any logical drive fails, a hot spare can automatically take its place. The data on the failed drive is reconstructed onto the hot spare. Hot spares can be used for RAID levels 1, 3, 5, 10, 30, and 50. Each adapter supports up to eight hot spares.

HP NetRAID Express Tools lets you create *global* hot spares. Users with Microsoft Windows NT and Windows 2000 can use HP NetRAID Assistant to

create a hot spare that is dedicated to one specific logical drive. Users with other operating systems do not have the ability to create hot spares that are dedicated to one logical drive.

Use one of the two methods described below to designate physical drives as global hot spares.

- You can create a global hot spare by using the Objects selection from the Management menu.
 1. Choose **Objects** from the Tools Management menu.
 2. Select **Physical Drive**. After scanning devices, the Physical Drive selection window appears.
 3. Use the arrow keys to select a Ready disk drive, and press **Enter** to display the action menu for the selected drive.
 4. Press the arrow keys to select **Make Hot Spare** and press **Enter**. The indicator for the selected drive changes to HotSp.
- You can create a global hot spare while creating arrays in Easy Configuration, New Configuration, or View/Add Configuration mode by pressing **F4**.

Creating Arrays Using Available Physical Drives

HP NetRAID Express Tools has four configuration options to create arrays and logical drives:

- **Easy Configuration** lets you create arrays and hot spares, but does not modify an existing configuration. This selection lets you set the following parameters: RAID level, size of logical drive, stripe size, Write policy, Read policy, and Cache policy.

NOTE Easy Configuration does not permit array spanning. To do array spanning, use the "New Configuration" selection.

- **New Configuration** clears the existing configuration on the adapter you select and lets you create a new configuration. It does permit array spanning. For each logical drive, you can modify these parameters: RAID level, size of logical drive, stripe size, Write policy, Read policy, Cache policy, and spanning of arrays.
- **View/Add/Delete Configuration** lets you view or add new logical drives to an existing configuration.
- **Clear Configuration** deletes all existing configuration information for the adapter you select.

Creating Arrays by Using Easy Configuration

In Easy Configuration, each array is associated with exactly one logical drive. (It does not permit array spanning.) Follow the steps described below to create arrays by using Easy Configuration.

1. Choose **Configure** from the HP NetRAID Express Tools Management menu.
2. Choose **Easy Configuration** from the Configure menu, and the array selection menu appears. Hot key information is displayed at the bottom of the window. The hot key functions are:

Space	Add the highlighted drive to the current array.
Enter	Stop adding drives to the current array, and configure the current logical drive.
F2	Display drive information.
F3	Display the logical drives that have been configured so far.
F4	Designate the highlighted drive as a hot spare.
3. Press the arrow keys to highlight specific physical drives. Press the **Spacebar** to add the highlighted physical drive to the current array. The indicator for the selected drive changes from Ready to Onlin A/*array number*]-*[drive number]*. For example, Onlin A2-3 means array 2, disk drive 3. Add physical drives to the current array as desired.

NOTE Try to use drives of the same capacity in a specific array. If you use drives with different capacities in an array, all drives in the array are treated as if they have the capacity of the smallest drive in the array.

The number of physical drives in a specific array determines the RAID levels that can be implemented with the array.

4. Press **Enter** when you have finished adding drives to the current array. The Logical Drive Configuration window appears, prompting you to confirm the configuration settings. The window shows the logical drive that is currently being configured as well as any existing logical drives. The column headings are, from left to right:

LD	The logical drive number
RAID	The RAID level
Size	The logical drive size

- #Stripes** The number of stripes (physical drives) in the associated physical array
- StrpSz** The stripe size
- DriveState** The state of the logical drive

5. To set the RAID level for the logical drive, highlight **RAID** and press **Enter**. The available RAID levels for the current logical drive are displayed. Select a RAID level and press **Enter** to confirm.
6. Set the stripe size, Write policy, Read policy, and Cache policy from the Advanced Menu.
 - **Stripe size:** This parameter specifies the size of the segments written to each disk in a RAID logical drive.
 - **Write Policy:** This option sets the caching method to Write-Back or Write-Through.
 - **Read-Ahead:** This option enables the SCSI Read-Ahead feature for the logical drive. You can set this parameter to Normal, Read-Ahead, or Adaptive.
 - **Cache Policy:** This parameter sets read cache operation during data transfers involving the selected logical drive.

(For definitions of the Write policy, Read policy, Cache policy, and their options, see the "Glossary.")

Press **Esc** to exit the Advanced Menu.

7. When you have defined the current logical drive, highlight **Accept** and press **Enter**. The array selection window appears if there are any unconfigured disk drives left.
8. Repeat Steps 3 through 7 to configure another array and logical drive. You can configure up to eight logical drives per adapter. When you finish configuring logical drives, press **Esc** to exit Easy Configuration. A list of the currently configured logical drives appears.

After you respond to the Save prompt, you return to the Configure menu.
9. Initialize the logical drives you have just configured. See "Initializing Logical Drives" in this chapter for more information.

Creating Arrays by Using New Configuration

The New Configuration option allows you to associate logical drives with partial arrays and/or multiple physical arrays (array spanning).

NOTE The New Configuration option erases the existing configuration information on the selected adapter.

To create arrays by using New Configuration:

1. Choose **Configure** from the HP NetRAID Express Tools Management menu.
2. Choose **New Configuration** from the Configure menu. An array selection window is displayed showing the devices connected to the current adapter. Hot key information appears at the bottom of the window. The hot key functions are:

Space	Add the highlighted drive to the current array.
Enter	Stop adding drives to the current array, and configure the logical drive.
F10	Display the logical drive configuration window.
F2	Display drive information.
F3	Display the logical drives that have been configured so far.
F4	Designate the highlighted drive as a hot spare.

3. Press the arrow keys to highlight specific physical drives. Press the **Spacebar** to add the highlighted physical drive to the current array. The indicator for the selected drive changes from Ready to Onlin A[*array number*]-[*drive number*]. For example, Onlin A2-3 means array 2, disk drive 3. Add physical drives to the current array as desired.

NOTE Try to use drives of the same capacity in a specific array. If you use drives with different capacities in an array, all the drives in the array are treated as though they have the capacity of the smallest drive in the array.

The number of physical drives in a specific array determines the RAID levels that can be implemented with the array.

4. Press **Enter** when you finish creating the current array. To continue defining arrays, repeat Step 3. To begin logical drive configuration, go to Step 5.

NOTE Before you press **F10** to start the configuration of the logical drive, you must press **Enter** to end configuration of the array.

5. Press **F10** to configure logical drives. The logical drive configuration window appears, as shown below:

The window shows the logical drive that is currently being configured as well as any existing logical drives. The column headings are, from left to right:

LD	The logical drive number
RAID	The RAID level
Size	The logical drive size
#Stripes	The number of stripes (physical drives) in the associated physical array
StrpSz	The stripe size
Drive-State	The state of the logical drive

6. To set the RAID level for the logical drive, highlight **RAID** and press **Enter**. A list of the available RAID levels for the current logical drive appears. Select a RAID level and press **Enter** to confirm.
7. To set the logical drive size, move the cursor to **Size** and press **Enter**. By default, the logical drive size is set to all available space in the array(s) being associated with the current logical drive.
- If you want to create more than one logical drive in an array, set a size of *less* than the actual capacity.
 - If you want the logical drive to span arrays, but you want it to span only two or three arrays, rather than the four-array maximum, set a size that reflects the number of arrays you want to span.
8. Open the **Advanced** menu to set the remaining options.
- **Stripe Size:** This parameter specifies the size of the segments written to each disk in a RAID logical drive.
 - **Write Policy:** This option sets the caching method to Write-Back or Write-Through.
 - **Read-Ahead:** This option enables the SCSI Read-Ahead feature for the logical drive. You can set this parameter to Normal, Read-Ahead, or Adaptive.
 - **Cache Policy:** This parameter sets read cache operation during data transfers involving the selected logical drive. You can set this parameter to Cached IO or Direct IO.

(For definitions of the Write policy, Read policy, Cache policy, and their options, see the "Glossary.")

Press **Esc** to exit the Advanced Menu.

9. Highlight **Span** and press **Enter** to set the spanning mode for the current logical drive. The options are:
 - **CanSpan**: Array spanning is enabled for the current logical drive. The logical drive can occupy space in up to four arrays.
 - **NoSpan**: Array spanning is disabled for the current logical drive. The logical drive can occupy space in only one array.

If you select CanSpan, HP NetRAID Express Tools attempts to span up to four arrays. Array spanning stops when:

- It has created a logical drive of the size you specify in Step 7 above.
- The next sequentially numbered array has a different number of drives. (Spanned arrays must contain the same number of drives in each array.)

For example, assume Array 1 contains four disk drives. Also assume that Arrays 2 and 3 have four disk drives, but Array 4 has three disk drives. HP NetRAID Express Tools will span Arrays 1, 2, and 3 but not Array 4.

10. When you are finished defining the current logical drive, highlight **Accept** and press **Enter**. If there is space remaining in the arrays, the next logical drive to be configured appears. To configure another logical drive, repeat Steps 6 to 9. If the array space has been used up, a list of the existing logical drives appears. Press any key to continue and respond to the Save prompt.
11. Initialize the logical drives you have just configured. See "Initializing Logical Drives" for more information.

Creating Arrays by Using View/Add/Delete Configuration

View/Add/Delete Configuration allows you to add new arrays to an existing configuration. The new arrays you create can use array spanning. The existing configuration is left intact, so you can use this selection simply to look at the current configuration.

1. Choose **Configure** from the HP NetRAID Express Tools Management Menu.
2. Choose **View/Add/Delete** Configuration from the Configure menu. An array selection window is displayed showing the devices connected to the

current adapter. Hot key information appears at the bottom of the window. The hot key functions are:

Space	Add the highlighted drive to the current array.
Enter	Stop adding drives to the current array, and configure the logical drive.
F2	Display the manufacturer data and the adapter error count for the highlighted drive.
F3	Display the logical drives that have been configured.
F4	Designate the highlighted drive as a hot spare.
F10	Display the logical drive configuration window for the current array.

3. Press the arrow keys to highlight Ready physical drives. Press the **Spacebar** to associate the highlighted physical drive with the current array. The indicator for the selected drive changes from Ready to *Onlin A[array number]-[drive number]*. For example, *Onlin A2-3* means array 2, disk drive 3.

Add physical drives to the current array as desired.

NOTE	Try to use drives of the same capacity in a specific array. If you use drives with different capacities in an array, all the drives in the array are treated as if they have the capacity of the smallest drive in the array.
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The number of physical drives in a specific array determines the RAID levels that can be implemented with the array.

4. Press **Enter** when you are finished creating the current array. To continue defining arrays, repeat Step 3. To begin logical drive configuration, go to Step 5.

NOTE	Before you press F10 to start the configuration of the logical drive, you must press Enter to end configuration of the array.
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5. Press **F10** to configure logical drives. The logical drive configuration window appears, as shown below:

The window shows the logical drive that is currently being configured as well as any existing logical drives. The column headings are, from left to right:

LD	The logical drive number
RAID	The RAID level
Size	The logical drive size
#Stripes	The number of stripes (physical drives) in the associated physical array
StrpSz	The stripe size

Drive-State The state of the logical drive

6. To set the RAID level for the logical drive, highlight **RAID** and press **Enter**. The available RAID levels for the current logical drive appear. Select a RAID level and press **Enter** to confirm.
7. Set the spanning mode for the current logical drive. Highlight **Span** and press **Enter**. The choices are:
 - **CanSpan**: Array spanning is enabled for the current logical drive. The logical drive can occupy space in more than one array.
 - **NoSpan**: Array spanning is disabled for the current logical drive. The logical drive can occupy space in only one array.

If you select CanSpan, HP NetRAID Express Tools will attempt to span up to four arrays. Array spanning stops when:

- It has created a logical drive of the size you specify in Step 8 below.
- The next sequentially numbered array has a different number of drives. (Spanned arrays must contain the same number of drives in each array.)

For example, assume Array 1 contains four disk drives. Also assume that Arrays 2 and 3 have four disk drives, but Array 4 has three disk drives. HP NetRAID Express Tools spans Arrays 1, 2, and 3 but not Array 4.

8. To set the logical drive size, move the cursor to **Size** and press **Enter**. By default, the logical drive size is set to all available space in the array(s) being associated with the current logical drive. If you set the Span parameter to CanSpan in Step 7, the current logical drive will use all space in the current array, and all space in the spanned arrays.
 - If you want to create more than one logical drive in an array, set a size of *less* than the actual capacity.
 - If you want the logical drive to span arrays, but you want it to span only two or three arrays, rather than the four-array maximum, set a size of less that reflects the number of arrays you want to span.

9. Open the Advanced menu to set the remaining options.
 - **Stripe Size:** This parameter specifies the size of the segment written to each disk in a RAID logical drive.
 - **Write Policy:** This parameter specifies the cache write policy. You can set the write policy to Write-Back or Write-Through.
 - **Read-Ahead:** This parameter enables the SCSI Read-Ahead feature for the logical drive. You can set this parameter to Normal, Read-Ahead, or Adaptive.
 - **Cache Policy:** This parameter sets read cache operation during data transfers involving the current logical drive.

(For definitions of the Write policy, Read policy, Cache policy, and their options, see the "Glossary.")

Press **Esc** to exit the Advanced Menu.

10. When you are finished defining the current logical drive, highlight **Accept** and press **Enter**. If there is space remaining in the arrays, the next logical drive ready to be configured appears. Repeat Steps 6 to 9 to configure another logical drive. If the array space has been used up, a list of the existing logical drives appears. Press any key to continue and respond to the Save prompt.
11. Initialize the logical drives you have just configured. See "Initializing Logical Drives" in this chapter for more information.

Initializing Logical Drives

You must initialize each new logical drive you configure. The Initialize menu selection initializes the logical drives by writing zeros to the data fields and generating corresponding parity fields on drives with RAID levels 3, 5, 30, or 50.

You can initialize the logical drives in two ways:

- **Batch Initialization:** The Initialize option in the Tools Management menu lets you initialize up to eight logical drives simultaneously.
- **Individual Initialization:** The Objects/Logical Drive action menu for an individual logical drive has an Initialize option.

Batch Initialization

To initialize logical drives by using the batch initialization procedure, following these steps:

1. Choose **Initialize** from the HP NetRAID Express Tools Management menu. A list of the current logical drives appears.
2. Press the arrow keys to highlight the drives you want to initialize. Press the **Spacebar** to select the highlighted logical drive for initialization. Press **F2** to select/deselect all logical drives.
3. When you finish selecting logical drives, press **F10** and choose **Yes** at the confirmation prompt. Initialization progress is displayed for each drive.
4. When initialization is complete, press any key to continue. Press **Esc** to return to the Tools Management menu.

Individual Initialization

To initialize logical drives by using the individual initialization procedure, follow these steps:

1. Choose **Objects** from the HP NetRAID Express Tools Management menu. Choose **Logical Drive** from the Objects menu.
2. Select the logical drive to be initialized.
3. Choose **Initialize** from the action menu. The progress of the initialization appears as a bar graph.
4. When initialization completes, press any key to return to the previous menu.

D Formatting Physical Drives

Since most SCSI disk drives are low-level formatted at the factory, this step is usually not necessary. Usually, you must format a disk only if:

- The disk drive was not low-level formatted at the factory.
- There is an excessive number of media errors detected on the disk drive.

NOTE Formatting a physical drive deletes all information on the disk.

Media Errors

Check the Physical Drive Information window for the drive to be formatted. You can view this window by following these steps:

1. Choose **Objects** from the Management menu.

2. Select **Physical Drives**, and choose a device.
3. Press **F2** to display the Physical Drive Information window.

The error count is displayed at the bottom of the Properties window. If you feel that the number of errors is excessive, you should probably format the disk drive.

NOTE You do not need to use the Format option if you simply want to erase existing information on your SCSI disks, such as a DOS partition. That information is erased when you choose the Initialize menu selection to initialize logical drives.

Formatting Drives

To format a drive:

1. Choose **Objects** from the HP NetRAID Express Tools Management menu.
2. Choose **Physical Drive** from the Objects menu. A device selection window is displayed showing the devices connected to the current adapter.
3. Press the arrow keys to highlight the physical drive to be formatted and press the **Spacebar** to select or deselect the drive you want to format.

NOTE You cannot format a disk that is online or that is part of any configuration.

4. Press **F10** to start the format process. Formatting can take some time, depending on the drive capacity.
5. When formatting is finished, press any key to return to the previous menu.

E Changing the HP NetRAID Series Adapter

If you remove one HP NetRAID Series adapter and insert another, you need to update the NVRAM of the new adapter to match the configuration of the physical and logical drives.

To swap adapters:

1. Back up your data.
2. Verify that you have the correct HP NetRAID drivers.
3. Write down all of the adapter settings for the adapter you plan to remove. These settings include parameters such as the Rebuild Rate, Autorebuild,

Power Fail Safeguard, Alarm Control, and Cache Flush Timings. (You do *not* need to record the configuration of your physical and logical drives.)

4. Remove the old HP NetRAID Series adapter and insert the new one following these steps:
 - a. Turn off the system, unplug the power cord(s) from the system, remove the HP NetServer cover or panel, and disconnect the SCSI cables from the existing HP NetRAID Series adapter. Remove the existing adapter, and place it on a grounding mat or other anti-static surface. If you have removed an HP NetRAID or HP NetRAID-3Si adapter, disconnect the Battery Backup Unit by unplugging the connector. (See "Battery Backup Unit" in the *HP NetRAID Series Installation and Configuration Guide* for complete information.)
 - b. Install the new HP NetRAID Series adapter, as described in the *HP NetRAID Series Installation and Configuration Guide*. For HP NetRAID-3Si, be sure to plug in the Battery Backup Unit.
 - c. Connect all SCSI cables to the HP NetRAID Series adapter.
 - d. Replace the HP NetServer cover or panel, plug in the power cord(s), and turn on power to the HP NetServer.

5. After you see the flashing message "**Firmware Initializing**," this message appears:

```
Configuration of NVRAM and drives mismatch for
Host Adapter X
Run View/Add Configuration option of Configuration
Utility
Press any key to enter the Configuration Utility.
```

This message tells you that the configuration information stored in the drives (the correct configuration) does not match the configuration information stored in NVRAM on the newly installed HP NetRAID adapter.

NOTE	If you have more than one HP NetRAID Series adapter installed, the message tells you which adapter number has the mismatch. Be sure to note which adapter needs to be reconfigured.
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6. Press any key and the HP NetRAID Express Tools utility starts automatically. You see the Tools Management menu.
7. If you have more than one HP NetRAID Series adapter installed, do the following to select the adapter you have just installed:

- a. Choose **Select Adapter** from the Tools Management menu.
- b. Choose the adapter with the mismatched configuration.
8. Choose **Configure** from the Tools Management menu.
9. Choose **View/Add/Delete** from the Configure menu.
10. Choose **View Disk Configuration** from the View/Add/Delete menu.
11. After scanning has finished, press **Esc**.
12. Choose **Yes** to save the configuration. The HP NetRAID Express Tools utility now updates the configuration stored in NVRAM on the newly installed adapter.
13. Press **Esc** repeatedly to exit HP NetRAID Express Tools.
14. Press **Ctrl+Alt+Delete** to restart the system. The HP NetRAID Series adapter should recognize all the drives and the previous logical configuration.
15. Verify that the new adapter has all of the same adapter settings as the adapter you removed, and make changes as necessary. These settings include parameters such as the Rebuild Rate, Autorebuild, Power Fail Safeguard, Alarm Control, and Cache Flush Timings.

5 Reconstructing and Rebuilding Drives

Reconstructing and rebuilding are two important features of HP NetRAID systems. It is important to know the difference between these two terms.

- **Reconstructing** is the process of reorganizing data when you make a fundamental change to your system such as changing RAID levels. See "Reconstructing Data" in this chapter for more information.
- **Rebuilding** is the process of recreating data on a replacement drive after a drive failure. See "Rebuilding Data" in this chapter for more information.

Reconstructing Data

Reconstruction is the process of reorganizing data to correspond with a change in the HP NetRAID system. The following changes require reconstructing your data:

- Adding a physical drive to an existing logical drive.
- Removing a physical drive from an existing logical drive.
- Changing a logical drive from one RAID level to another.

NOTE Reconstruction can be done only on arrays containing just one logical drive each. HP NetRAID cannot reconstruct an array using array spanning or arrays containing multiple logical drives.

Reconstruction occurs in the background, so the HP NetServer and the affected drives remain available throughout the reconstruction process.

The reconstruction rate is about 80 to 180 MB per minute (depending on drive performance, system loading, and whether or not you have enabled the Power Fail Safeguard parameter). Count the capacity to be reconstructed as the number of physical drives participating in the reconstruction multiplied by drive capacity.

Power Fail Safeguard Feature

The Power Fail Safeguard feature (PFS) allows users to protect a disk array during the reconstruction process should a power failure occur. When you use this feature, a copy of the data currently being reorganized always remains on disk, so

there is no risk of losing any data. The Power Fail Safeguard feature is an option that you can enable or disable by using HP NetRAID Express Tools (if you are using Windows NT or Windows 2000) or HP NetRAID Config utilities (if you are the Novell NetWare, IBM OS/2, SCO OpenServer, or SCO UnixWare). With or without PFS enabled, a reconstruction restarts automatically where it was interrupted by a power failure.

NOTE The Power Fail Safeguard feature is enabled by default.

When a new logical drive is initialized, the last 1 MB of each physical disk is reserved for use by the adapter. Three blocks (sectors) are used to store configuration information, and the remaining area is used for the Power Fail Safeguard feature. (The 1 MB of space is reserved even if PFS is not enabled.)

When the PFS feature is enabled. The reserved space in the 1-MB segment on each disk is used to temporarily store data which will be reorganized and written during a reconstruction. Thus, there is always a copy of data which resides on disk during the reconstruction process so there is no risk of losing any data.

When the PFS feature is disabled. The data is read from the original set of disks into memory, and the reorganized data is written to the disks. Because the data transitions through memory, there is a brief exposure where data could be lost if a power loss occurs. The reconstruction process is not able to recover data from memory after a power loss (even with battery backup).

Although PFS protects the reconstruction operation, it decreases reconstruction performance. When PFS is enabled, the reconstruction time increases by a factor of about 2.5 times due to the extra overhead of always having data saved on disk. However, there is no effect on normal array performance (when no reconstruction is going on) with PFS enabled. A typical reconstruction time for a 4-drive RAID 5 array using 2-GB disks to a 5-drive RAID 5 array is about 90 minutes with PFS disabled and no other data transfers. With PFS enabled, the same reconstruction requires about 230 minutes.

PFS is enabled/disabled through either the HP NetRAID Express Tools or HP NetRAID Config utilities. The default setting is Enabled. Since there is a performance penalty only during the reconstruction operation itself, it is recommended that you leave this feature enabled unless there are some rigid time constraints on reconstruction activities.

Using HP NetRAID Express Tools to Change the PFS Setting

To change the PFS setting by using HP NetRAID Express Tools:

1. Log off all users, close all applications, and power down the HP NetServer.

2. Restart the HP NetServer. Look for the following prompt during startup:
**Option: Experienced users may press <Ctrl> <M> for HP NetRAID Express Tools now.
Firmware Initializing**
3. Press <Ctrl> <M>. When the system stops scanning, HP NetRAID Express Tools starts.
4. Choose **Objects** from the Tools Management menu.
5. Choose **Adapter** from the Objects menu.
6. If you have more than one adapter, select the adapter for which you want to change the PFS setting.
7. Choose **Power Fail Safeguard** from the Adapter menu.
8. If you want to change the PFS setting on another adapter, press **Esc** to return to the Objects menu. Then repeat Steps 4 through 7 for that adapter.
9. When you have changed the PFS settings on all adapters, press **Esc** repeatedly to return to the Tools Management menu.
10. To exit HP NetRAID Express Tools, press **Esc** at the Tools Management menu. Choose **Yes** at the prompt. You must then restart the HP NetServer.

Using HP NetRAID Config to Change the PFS Setting

To change the PFS setting by using the HP NetRAID Config utility:

1. Start HP NetRAID Config by using the command appropriate for your network operating system.
2. Choose **Objects** from the Management menu.
3. Choose **Adapter** from the Objects menu.
4. If you have more than one adapter, select the adapter for which you want to change the PFS setting.
5. Choose **PowerFail Safeguard** from the Adapter menu.
6. If you want to change the PFS setting on another adapter, press **Esc** to return to the Objects menu. Then repeat Steps 3 through 5 for that adapter.
7. When you have changed the PFS settings on all adapters, press **Esc** repeatedly to return to the Management menu. You do not need to restart the server for this parameter to take effect.

Rebuilding Data

If a disk drive fails in an array that is configured as a RAID 1, 3, 5, 10, 30, or 50 logical drive, you can recover the lost data by rebuilding the drive. If you have configured one or more hot spares, the drive can be rebuilt automatically. If you have not configured any hot spares, you can remove the failed drive, install a new one, and the HP NetRAID system begins rebuilding your data automatically.

A configuration of RAID 1, 3, 5, 10, 30, or 50 has built-in redundancy. If a drive in one of these RAID levels fails, the RAID subsystem continues to work, but no additional redundancy is provided. Another drive failure will cause data loss. The rebuild process goes on in the background without stopping the HP NetRAID system. (However, performance may be affected during the rebuild process.)

NOTE	For information on about replacing a hard drive with another hard drive, refer to your HP NetServer documentation.
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The Autorebuild Feature

The Autorebuild feature detects the availability of a hot spare or the replacement of a failed disk drive and automatically rebuilds onto it the data that was on the failed disk. For Autorebuild to occur, all of the following conditions must be satisfied:

- A hot spare was configured, or the failed drive was replaced with a good drive in the *same* physical slot as the failed drive.
- The replacement drive capacity is at least as large as the failed drive capacity.
- The drive to be rebuilt contains one or more logical drives of RAID level 1, 3, 5, 10, 30, or 50. The drive *cannot* contain a RAID 0 logical drive.
- Autorebuild is enabled. (This is the default setting.)

If any of the conditions are not met, the HP NetRAID firmware cannot rebuild the drive automatically. In this case, you must initiate a manual rebuild. See "Rebuilding Drives Manually" in this chapter for instructions.

Changing the Autorebuild Setting

The default setting for Autorebuild is enabled, so you normally do not need to change it. However, if you want to change this parameter, follow these instructions:

1. Log off all users, close all applications, and power down the HP NetServer.
2. Restart the server. Look for the following prompt during startup:
**Option: Experienced users may press <Ctrl> <M> for HP NetRAID Express Tools now.
Firmware Initializing**
3. Press **<Ctrl> <M>**. When the system stops scanning, HP NetRAID Express Tools starts.
4. If you have more than one adapter, choose **Select Adapter** from the Tools Management menu, and then select the adapter for which you want to change the Autorebuild setting.
5. Choose **Objects** from the Tools Management menu.
6. Choose **Adapter** from the Objects menu.
7. Choose **Autorebuild** to change the setting.
8. If the Autorebuild parameter must be changed on another adapter, press **Esc** to back up to the Tools Management menu. Then repeat Steps 4 through 7 for that adapter.
9. When you have changed the Autorebuild settings on all adapters, press **Esc** repeatedly to back up to the Tools Management menu.
10. If you want to view or change the Rebuild Rate, you can do so now. For complete information, see "Changing the Rebuild Rate" next in this section.
11. To exit HP NetRAID Express Tools, press **Esc** at the Tools Management menu. Choose **Yes** at the prompt. You must then reboot the HP NetServer.

Changing the Rebuild Rate

During a rebuild, the contents of a complete physical drive is rewritten. Normal operations can go on during a rebuild, but performance may be degraded. The Rebuild Rate controls the rate at which a rebuild is done. A high Rebuild Rate (over 50%) speeds up the rebuild, but slows system performance. A low Rebuild Rate (under 50%) slows the rebuild process, but speeds up system performance. The default setting for the Rebuild Rate is 50%.

You can view or change the Rebuild Rate from any of the three HP NetRAID utilities.

To view or change the Rebuild Rate from HP NetRAID Express Tools:

1. If you have more than one adapter, choose **Select Adapter** from the Tools Management menu, and then select the adapter for which you want to change or view the Rebuild Rate.
2. Choose **Objects** from the HP NetRAID Express Tools Management menu.
3. Choose **Adapter** from the Objects menu.
4. Select **View/Update Rebuild Rate**.
5. Use the arrow keys to increase or decrease the amount of processor time dedicated to rebuilding the failed disk.
6. If you want to change the Rebuild Rate on another adapter, press **Esc** to return to the Tools Management menu. Then repeat Steps 1 through 5 for that adapter.
7. When you have changed the Rebuild Rate on all adapters, press **Esc** repeatedly to back up to the Tools Management menu.

To view or change the Rebuild Rate from HP NetRAID Assistant:

1. If you have more than one adapter, click on the Adapter box and choose the adapter from the pull-down list.
2. Choose **Adapter** from the HP NetRAID Assistant Management menu.
3. Choose **Rebuild Rate** from the Adapter menu.

To view or change the Rebuild Rate from HP NetRAID Config:

1. Choose **Adapter** from the HP NetRAID Config Management menu.
2. Choose **View/Update Parameters** from the Adapter menu.

Rebuilding Drives Manually

You must initiate a manual rebuild under any of several conditions:

- Autorebuild was disabled.
- The hot spare or replacement drive does not have enough capacity to rebuild the failed drive.

- You installed a replacement drive in a different physical slot from the failed drive.
- A logical drive of RAID level 0 shared space on the drive that needs to be rebuilt.

*To rebuild drives manually, you must have a Ready drive of equivalent size. The HP NetRAID system will *not* rebuild data onto a hot spare when you initiate the rebuild manually.*

You can select Manual Rebuild from all HP NetRAID management utilities.

Manual Rebuild from HP NetRAID Assistant (under Microsoft Windows NT or Windows 2000)

1. Start HP NetRAID Assistant.
2. Choose **Physical Drives** from the Main menu.
3. Select the **Rebuild** option. Select **Cancel** to stop the rebuild process at any time. The drive will return to its original status before the rebuild began.
4. To check the progress of the rebuild, choose **Progress** from the Main menu, then select **Rebuild Progress**.

Manual Rebuild from HP NetRAID Config (under Novell NetWare, IBM OS/2, SCO OpenServer, or SCO UnixWare)

Using HP NetRAID Config, you can rebuild drives individually or in batch mode.

Manual Rebuild of an Individual Drive from HP NetRAID Config

1. Start HP NetRAID Config by using the command appropriate for your network operating system.
2. Choose **Objects** from the Management menu.
3. Choose **Physical Drive** from the Objects menu. A device selection window is displayed showing all physical drives.
4. Use the arrow keys to highlight the physical drive that has failed, and press **Enter**.
5. Select the **Rebuild** option. Press **Esc** to stop the rebuild process at any time. The drive will return to its original state before the rebuild began.

Manual Rebuild Using Batch Mode from HP NetRAID Config

1. Start HP NetRAID Config by using the command corresponding to your network operating system.

2. Choose **Rebuild** from the Management menu. A device selection window is displayed showing the devices connected to the current adapter. The failed drives have FAIL indicators.
3. Use the arrow keys to highlight the first physical drive to be rebuilt then press the **Spacebar** to select it.
4. Use the arrow keys and Spacebar to select any additional physical drives to be rebuild.
5. Press **F10** and type **Yes** at the confirmation prompt. The indicators for the selected drives change to REBLD.
6. When the rebuild is complete, press any key to continue. Press **Esc** to return to the Management menu.

Manual Rebuild from HP NetRAID Express Tools (under any NOS)

1. Log off all users, close all applications, and power down the HP NetServer.
2. Restart the server. Look for the following prompt during startup:
Option: Experienced users may press <Ctrl> <M> for HP NetRAID Express Tools now.
Firmware Initializing
3. Press **<Ctrl> <M>**. When the system stops scanning, HP NetRAID Express Tools starts.
4. Choose **Rebuild** from the Tools Management menu.
5. Use the arrow keys to highlight one or more physical drives to be rebuilt.
6. Use the **Spacebar** to select (or deselect) the drive to be rebuilt.
7. Press **F10** to start the rebuilding process.

6 Capacity Expansion

With HP NetRAID, you can expand capacity at any time by adding one or more new hard disks to your system. If you prepared for Online Capacity Expansion as described in the *HP NetRAID Series Installation and Configuration Guide* or the *HP NetServer Integrated NetRAID Controller Configuration Guide*, you can add disks to an existing logical drive without restarting the HP NetServer.

Online Capacity Expansion has these restrictions:

- You can use Online Capacity Expansion with any logical drive of RAID level 0, 3, or 5. (Capacity expansion is an offline operation for logical drives of RAID levels 10, 30, or 50. It cannot be done for RAID 1 logical drives because mirroring requires exactly two physical drives.)
- You cannot use Online Capacity Expansion with an array that contains more than one logical drive. The logical drive being expanded must be the only logical drive in the array.
- Online Capacity Expansion is supported only for the NetWare 4.2, NetWare 5, Windows NT, and Windows 2000 operating systems. (You cannot use Online Capacity Expansion with IBM OS/2, SCO OpenServer, or SCO UnixWare.)

This chapter contains separate sections covering capacity expansion under NetWare 4.2, NetWare 5, Windows NT, and Windows 2000. Each of these sections discusses online and offline capacity expansion.

For information about offline capacity expansion under another network operating system (NOS), refer to your NOS documentation.

Capacity Expansion under NetWare 4.2

This section describes how to expand disk capacity under Novell NetWare 4.2 after the system has been in operation for a time. This section is divided into these parts:

- **About Online Capacity Expansion under NetWare 4.2** describes the Online Capacity Expansion feature. This feature allows new storage capacity to be added to an existing logical drive and put online for use without restarting the server.

- **Preparation Steps for NetWare 4.2** explains how to enable Virtual Sizing and how to partition your physical drives to use Online Capacity Expansion.
- **Expanding Capacity Online under NetWare 4.2** describes how to use the Online Capacity Expansion feature to add physical drives to your system without restarting the HP NetServer.
- **Expanding Capacity under NetWare 4.2 with Virtual Sizing Disabled** describes how you can add disk capacity to an existing logical drive if you didn't set up your logical drive initially to use the Online Capacity Expansion feature.

About Online Capacity Expansion under NetWare 4.2

Normally, to add capacity you must shut down the server to reconfigure and then restore data, or you must add the new storage space as a new volume. The Online Capacity Expansion feature allows you to expand an *existing* logical drive without shutting down the server.

Under NetWare 4.2, use Virtual Sizing to prepare for online capacity expansion. Virtual Sizing is enabled separately on each logical drive. When enabled, the controller presents to the operating system a logical drive of 144 GB, which is the default size. Only a part of the 144-GB logical drive exists as actual physical storage; the remainder is virtual storage. You configure volumes to use only the actual physical space, while the virtual space allows room for online expansion.

NOTE	The 144-GB default size of the logical drive that the controller initially presents to the operating system is the minimum size. The size can be increased.
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For example, assume you have one RAID-5 logical drive built from four physical hard disk drives of 4 GB each. The result is 12 GB of actual storage space. If you enable Virtual Sizing for this logical drive, then the operating system will see a logical drive of 144 GB. Only the first 12 GB are real, 4 GB are used for parity, and the last 128 GB are virtual.

Under NetWare 4.2, you create a 144-GB *partition*, but within that partition you only create a logical drive totaling 12 GB or less. Since there is unused partition space, the physical storage of 12 GB can be expanded online by adding another hard disk drive, but the partition remains at 144 GB.

Precautions

When using the Online Capacity Expansion feature, it is very important that you do *not* create volumes that exceed the actual physical capacity. You must add up the capacities of all volumes that may be using the physical storage space, such as a DOS volume, SYS volume, Hot Fix Area, and any user volumes. This is most important if NetWare 4.2 will be installed on the disk array (rather than a SCSI disk outside of the HP NetRAID system). During installation, if the total physical capacity is exceeded during volume creation, a NetWare abend and loss of the installation occurs. As long as the physical capacity is not exceeded, the installation will be successful.

Although undesirable, NetWare 4.2 allows you to create volumes into the virtual space. (This is because during volume creation, NetWare 4.2 only looks at the beginning of the volume, and if there is real storage space there, the volume will be created.) However, when writing to this volume, you cannot write beyond the physical limit; write errors will be generated when the physical space is filled. You need to be careful when creating volumes in a partition containing virtual space. Use the HP NetRAID Config module to check the actual physical capacity available, and be sure the total size of NetWare volumes does not exceed this value.

One other useful measure is to set the capacity alarms under NetWare 4.2 so that warnings will be generated when you approach the limit of a volume.

The Online Capacity Expansion feature cannot be used if a logical drive spans multiple arrays. Each array can contain only one logical drive. Reconstruction (for the purposes of adding a drive to an array) can be done only on an array having a single logical drive. It is also important to plan future storage expansion into your installation. This ensures that you can easily expand capacity without the need for backup/restore operations or reconfiguration.

NOTE

SFT-3 and mirroring users: Novell's NetWare 4.2 operating system, which provides system level fault tolerance by mirroring two systems, is not compatible with the Online Capacity Expansion feature. SFT-3 mirrors disk storage on a partition basis rather than a volume basis. Because of the virtual space created within the partition, SFT-3 cannot successfully mirror the partitions. This limitation also applies to regular mirroring (without SFT-3) of volumes. SFT-3 users may add storage capacity online without bringing the two systems down if enough drives are added to create a new array and logical drive on an HP NetRAID Series adapter or on an integrated HP NetRAID controller. Under the Install module, NetWare 4.2 can then scan for new devices and detect the new logical drive.

Planning for Online Capacity Expansion under NetWare 4.2

To permit easy capacity expansion of a NetWare 4.2 installation, plan ahead and consider your storage use.

- Since NetWare 4.2 permits only one NetWare partition per logical drive, make the NetWare partition the size of the virtual logical drive in advance so that you can expand that volume.
- Under NetWare 4.2, you cannot grow a partition, but you can add additional segments within an existing partition. The added segments can be "joined" to be part of the same volume, or they can be made into separate volumes.
- NSS volumes are not supported in NetWare 4.2.

NOTE

If NetWare 4.2 must be installed on the disk array, create a single logical drive with Virtual Sizing enabled. Create a DOS partition of 500 MB or less for booting. NetWare volumes can then be added after the DOS partition on the same logical drive. The unused space on the partition can be used later for capacity expansion. Be sure to follow the precautions above.

In most installations, the operating system is installed on a SCSI drive connected outside of the HP NetRAID system. However, NetWare can reside on a disk array in the HP NetRAID system to achieve redundancy.

Preparation Steps for NetWare 4.2

This section tells you how to enable Virtual Sizing and set up your partitions to permit easy capacity expansion. It assumes that you have already installed NetWare 4.2.

The following steps are necessary to prepare your logical drive for online capacity expansion:

- I. Connect disk drives to HP NetRAID
- II. Configure HP NetRAID
- III. Enable Virtual Sizing in HP NetRAID Express Tools
- IV. Create the NetWare partition in NetWare 4.2
- V. Create the NetWare volume in NetWare 4.2

I. Connect Disk Drives to HP NetRAID

Connect physical drives to the HP NetRAID Series adapter or integrated HP NetRAID controller. For example, you might have four drives of 4 GB each connected to the HP NetRAID Series adapter.

II. Configure HP NetRAID

NOTE The Online Capacity Expansion feature is supported only on arrays that contain just one logical drive each.

Configure your HP NetRAID Series adapter or integrated HP NetRAID controller and create your logical drives. (This can be done in either HP NetRAID Config or in HP NetRAID Express Tools. See Chapter 3, "HP NetRAID Config," or Chapter 4, "HP NetRAID Express Tools," for complete instructions.) Save your configuration and initialize your logical drives.

NOTE It is important to initialize your logical drives. If the drives have been previously configured under an operating system, there can sometimes be residual partition/format information which subsequently causes misrepresentation of logical drives under the NetWare 4.2 Install module.

For example, your array of four drives (of 4 GB each) might be configured as a single RAID 5 logical drive. This produces a logical drive of 12 GB of real storage capacity, with 4 GB used for parity.

III. Enable Virtual Sizing

1. Restart the host HP NetServer, and watch for the message:
**Option: Experienced users may press <Ctrl> <M> for HP NetRAID Express Tools now.
Firmware Initializing**
2. When the message is displayed, press <Ctrl> <M>. When the system stops scanning, HP NetRAID Express Tools starts and displays the Tools Management menu.
3. If you have installed one or more HP NetRAID Series adapters, do the following to select the integrated controller or adapter controlling a logical drive you want to prepare for expansion:
 - a. Choose **Adapter** from the Tools Management menu.
 - b. Choose the adapter controlling the logical drive.

4. Choose **Objects** from the Tools Management menu.
5. Choose **Logical Drive** from the Objects menu.
6. From the Logical Drives menu, choose the logical drive you want to prepare for expansion.
7. From the Logical Drive menu for the drive you want to prepare, choose **Properties**.
8. Choose **Virtual Sizing**.
9. On the Virtual Size Feature menu, choose **Enable**, and confirm your choice.
10. Press **Esc** twice to return to the Logical Drive menu.
If you need to enable Virtual Sizing on another logical drive, choose the logical drive and repeat Steps 6 through 10.
11. If you have installed one or more HP NetRAID Series adapters, press **Esc** to return to the Objects menu. Enable Virtual Sizing on the logical drives of all adapters as necessary.
12. To exit, press **Esc** until you see the Exit? box, then choose **Yes**.

NOTE

Clearing a previous configuration does not reset the Virtual Sizing setting for a logical drive. Use the Reset to Factory Defaults option in Express Tools to disable Virtual Sizing for all logical drives, or manually change the setting.

IV. Create the NetWare Partition

1. Start NetWare 4.2.
2. Type **NetWare load install**.
3. Select **Standard Disk Options**.
4. Select **Modify Disk Partitions and Hot fix**.
5. The Available Devices are displayed. For an initial installation, only Free Space will be displayed. Select **Create NetWare disk partition** to create a NetWare partition on the logical drive (which has Virtual Sizing enabled). The partition size will be 144 GB. Press **Enter**.
6. Press the **F10** key to save the partition. The free space becomes a NetWare partition. The Available Disk Options menu is displayed.

V. Create the NetWare Volume

How you create the NetWare volume depends on where you installed NetWare.

- For drives that do not contain the NetWare 4.2 operating system, see "Create Volumes on Drives that do *not* Contain NetWare 4.2."
- If NetWare 4.2 was installed on a disk array, see "Create Volumes on Drives That Contain NetWare 4.2."

Create Volumes on Drives that do *not* Contain NetWare 4.2

Do the following to create a volume that does not contain the NetWare 4.2 operating system:

1. The Available Disk Options menu is displayed. Select **Volume Options**. Press **Enter**.
2. Press the **Inset key** or the **F3** key to add a volume segment.
3. The available free space is displayed. Press **Enter**.
4. Select **Make this segment a new volume**. Press **Enter**.
5. Type the volume name. Press **Enter**.
6. Edit the disk segment size to be the actual physical size of the logical drive.
7. Press the **F10** key to save the changes.
8. The Volume Disk Segment list shows the volume size. Press **F10** to save.
9. The volume name and size are displayed. Press **Esc** to save.
10. Select **Yes** when asked "Save Volume changes?"
11. Supply the administrator name and login.
12. The changes are displayed. Press **Enter** to continue.
13. Mount the volume.

The new volume is now ready for use.

Assume, for example, that the volume is called VOL1 and that its physical capacity is 12 GB. Its partition is 144 GB. Leave the remaining virtual storage space (144 GB minus 12 GB) as unused. You can write data up to 12 GB on the drive.

Create Volumes on Drives that Contain NetWare 4.2

Sometimes it is desirable to have the network operating system reside on a disk array. The advantage is that the NOS resides on a redundant drive.

NOTE A NetWare 4.2 SYS volume should be limited to 2 GB or to a smaller size appropriate for your system. Use the balance for a user volume.

Virtual Sizing can be used with a disk array that is used as the boot device and also contains user data. If NetWare 4.2 must reside on the disk array, follow these steps:

1. Create a DOS partition of 500 MB or less for booting.
2. Create additional NetWare volumes after the DOS partition on the same logical drive for data. Do not exceed the physical space capacity. Create these volumes as described in "Create Volumes on Drives that do *not* Contain NetWare 4.2."
3. The remaining virtual capacity must be left unpartitioned, and will be available for future partitions as you add disk drives to the array.

NOTE Be sure *not* to create volumes that exceed the actual physical capacity. You must add up the capacities of all volumes that may be using the physical storage space such as a DOS volume, SYS volume, Hot Fix Area, and any user volumes.

Expanding Capacity Online under NetWare 4.2

After using a logical drive, you might want to add another physical drive. If you prepared the logical drive for Online Capacity Expansion, this can be done without shutting down the server or restarting the system.

In the example used throughout this section, you might be nearing the 12-GB limit, and you want to add another 4-GB drive to the existing array.

To expand capacity online, follow the instructions later in this section to do the following:

- **First:** Install the added physical capacity into the internal hot-swap mass storage cage or into the external enclosure.
- **Second:** Use the HP NetRAID Config utility to reconstruct the logical drive to include the added capacity. For instructions, refer to "Second, Reconstruct to Add Capacity" later in this section.
- **Third:** In NetWare 4.2, create a new volume consisting of the added capacity and make that new free segment part of the existing volume. For instructions, refer to "Third, Add Capacity in NetWare 4.2" later in this section.

First, Install Additional Capacity

Install the additional physical capacity (hot-swap disk drive modules) into the internal hot-swap mass storage cage or into the external enclosure. The cage or enclosure must already be connected to the integrated HP NetRAID controller or HP NetRAID Series adapter controlling the logical drive that you want to expand.

Second, Reconstruct to Add Capacity

1. Load the HP NetRAID Config utility (megamgr.nlm module) under NetWare.
2. Select **Advanced** menu, then select **Reconstruct Logical Drive**.
3. Select the logical drive to reconstruct. The controller scans for new drives.
4. Select the drive to be added per the on-screen instructions and enter the Reconstruct menu.

In our example, this allows you to add the drive and reconstruct the four-drive RAID 5 array to a five-drive RAID 5 array.

Reconstruction is done in the background so there is no need to shut down the server. When reconstruction finishes, our sample drive now has 16 GB of available physical capacity. The original 12-GB volume VOL1 is still intact.

The reconstruction rate is about 80 to 180 MB per minute (depending on drive performance and system loading). Count the capacity to be reconstructed as the number of physical drives participating in the reconstruction multiplied by drive capacity.

Third, Make the Added Capacity Available in NetWare 4.2

After the logical drive has been reconstructed in HP NetRAID Config, make the added capacity available in NetWare 4.2, as follows:

1. Return to the NetWare Install module.
2. Select **Volume Options**.
3. Add a new segment under the NetWare partition. You can either make the added capacity a new volume or it can be part of the original volume. If made part of the original volume, the original volume need not be dismounted.

In our example, the new segment size must be 4 GB or less as this is the amount of added capacity.

4. Save your changes. If the new capacity is part of an existing volume, it is mounted automatically (if the existing volume was already mounted). If the new volume is separate, mount the volume. The new capacity is now available for use.

Expanding Capacity under NetWare 4.2 with Virtual Sizing Disabled

If you already are using a logical drive *without* Virtual Sizing enabled, but now wish to add capacity to an existing volume, your options are limited. Here are the likely scenarios when Virtual Sizing has *not* been enabled.

Without Restart

Without restarting the HP NetServer, you can only add capacity as a new volume. You will need to add enough physical drives to create a *new* array and logical drive by using HP NetRAID Config. Then under NetWare Install, you need to **Scan For New Devices**, and configure the new logical drive as a new NetWare volume.

With Restart

CAUTION	Back up your data before you begin this procedure. You will repartition the logical drive and destroy the data in it.
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If a restart is acceptable, then you can bring down the HP NetServer. If the logical drive has already been partitioned and used, you need to backup the data, enable Virtual Sizing in HP NetRAID Express Tools, repartition the drive, and restore the data. Now the logical drive can be expanded online whenever required.

Capacity Expansion under NetWare 5

This section describes how to expand disk capacity under NetWare 5 after the system has been in operation for a time. This section is divided into these parts:

- **About Online Capacity Expansion under NetWare 5** describes the Online Capacity Expansion feature. This feature allows new storage capacity to be added to an existing logical drive and put online for use without restarting the server.
- **Planning for Online Capacity Expansion under NetWare 5** explains restrictions regarding online capacity expansion under NetWare 5.
- **Preparation Steps for NetWare 5** explains how to disable Virtual Sizing if it has been enabled.
- **Expanding Capacity Online under NetWare 5** describes how to use the Online Capacity Expansion feature to add physical drives to your system without restarting the HP NetServer.

- **Expanding Capacity under NetWare 5 with Virtual Sizing Enabled** describes how you can add disk capacity to an existing logical drive if you did not prepare your logical drive initially to use the Online Capacity Expansion feature.

About Online Capacity Expansion under NetWare 5

Normally, to add capacity you must shut down the server to reconfigure and then restore data, or you must add the new storage space as a new volume. The Online Capacity Expansion feature allows you to expand an *existing* logical drive without shutting down the server.

The Online Capacity Expansion feature cannot be used if a logical drive spans multiple arrays. Each array can contain only one logical drive. Reconstruction (for the purposes of adding a drive to an existing array) can only be done on an array having a single logical drive. It is also important to plan future storage expansion into your installation. This will ensure that you can easily expand capacity without backup/restore operations or reconfiguration.

Preparation of the logical drive for Online Capacity Expansion under NetWare 5 is simply to leave Virtual Sizing disabled (the factory default), or to disable it if it has been enabled.

Planning for Online Capacity Expansion under NetWare 5

To permit easy capacity expansion of a NetWare 5 installation, plan ahead and consider your storage use.

- Under NetWare 5, you cannot grow a partition, but you can add additional partitions within an existing logical drive. The added volumes can be "joined" to be part of the same volume, or they can be made into separate volumes.
- Under NetWare 5 you can expand the capacity of a logical drive three times online before you need to go offline to expand its capacity a fourth time. The fourth expansion involves backing up your data and restoring it. Then you can expand online three more times before you need to go offline for the next expansion, and so forth.
- NSS volumes are not supported in NetWare 5.

NOTE	If NetWare 5 must be installed on the HP NetRAID disk array, create a single logical drive with Virtual Sizing disabled.
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In most installations, the operating system is installed on a SCSI drive connected outside of the HP NetRAID system. However, NetWare 5 can reside on a disk array in the HP NetRAID system to achieve redundancy.

Preparation Steps for NetWare 5

This section tells you how to enable Virtual Sizing and set up your partitions to permit easy capacity expansion. It assumes that you have already installed NetWare 5.

The following steps are necessary to prepare your logical drive for online capacity expansion:

- I. Connect drives to the HP NetRAID Series adapter or integrated HP NetRAID controller
- II. Configure the HP NetRAID Series adapter or integrated HP NetRAID controller
- III. Disable Virtual Sizing in HP NetRAID Express Tools

I. Connect Drives

Connect physical drives to the HP NetRAID Series adapter or integrated HP NetRAID controller. For example, you might have four drives of 4 GB each connected to the adapter.

II. Configure the HP NetRAID Series Adapter or Integrated HP NetRAID Controller

NOTE	The Online Capacity Expansion feature is supported only on arrays that contain just one logical drive each.
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Configure your adapter and create your logical drives. (This can be done in either HP NetRAID Config or in HP NetRAID Express Tools. See "HP NetRAID Express Tools" or "HP NetRAID Config" for complete instructions.) Save your configuration and initialize your logical drives.

NOTE	It is important to initialize your logical drives. If the drives have been previously configured under an operating system, there can sometimes be residual partition/format information which subsequently causes misrepresentation of logical drives under NetWare 5.
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For example, your array of four drives (of 4 GB each) might be configured as a single RAID 5 logical drive. This produces a logical drive of 12 GB of real storage capacity, with 4 GB used for parity.

III. Disable Virtual Sizing

The only other requirement for online capacity expansion of your logical drive is that Virtual Sizing is disabled. This is the factory default setting.

- **If Virtual Sizing is Disabled** (the factory default setting), no other preparation is necessary.
- **If Virtual Sizing is Enabled**, disable Virtual Sizing in HP NetRAID Express Tools, as described below.

To Disable Virtual Sizing

NOTE

Clearing a previous configuration does not reset the Virtual Sizing setting for a logical drive.

Using the Reset to Factory Defaults option in Express Tools disables Virtual Sizing for all logical drives.

To enable Virtual Sizing for a logical drive, manually change the setting.

1. Restart the host HP NetServer, and watch for the message:
**Option: Experienced users may press <Ctrl> <M> for HP NetRAID Express Tools now.
Firmware Initializing**
2. When the message is displayed, press <Ctrl> <M>. When the system stops scanning, HP NetRAID Express Tools starts and displays the Tools Management menu.
3. If you have installed one or more HP NetRAID Series adapters, do the following to select the integrated HP NetRAID controller or HP NetRAID Series adapter controlling the logical drive you want to prepare for expansion:
 - a. Choose **Adapter** from the Tools Management menu.
 - b. Choose the adapter controlling the logical drive.
4. Choose **Objects** from the Tools Management menu.
5. Choose **Logical Drive** from the Objects menu.
6. From the Logical Drives menu, choose the logical drive you want to prepare for expansion.

7. From the Logical Drive menu for the drive you want to prepare, choose **Properties**.
8. Choose **Virtual Sizing**.
9. On the Virtual Size Feature menu, choose **Disable**, and confirm your choice.
10. Press **Esc** twice to return to the Logical Drive menu.

If you need to disable Virtual Sizing on another logical drive, choose the logical drive and repeat Steps 6 through 10.
11. If you have installed one or more HP NetRAID Series adapters, press **Esc** to return to the Objects menu. Disable Virtual Sizing on the logical drives of all adapters as necessary.
12. To exit, press **Esc** until you see the Exit? box, and then choose **Yes**.

Expanding Capacity Online under NetWare 5

After using a logical drive, you might want to add another physical drive. If you prepared the logical drive for Online Capacity Expansion, this can be done without shutting down the server or restarting the system.

In the example used throughout this section, you might be nearing the 12-GB limit and you want to add another 4-GB drive to the existing array.

To expand capacity online, follow the instructions later in this section to do the following:

- **First:** Install the added physical capacity into the internal hot-swap mass storage cage or into the external enclosure.
- **Second:** Use the HP NetRAID Config utility to reconstruct the logical drive to include the added capacity. For instructions, refer to "Second, Reconstruct to Add Capacity" later in this section.
- **Third:** In NetWare 5, create a new volume consisting of the added capacity and make that new free segment part of the existing volume. For instructions, refer to "Third, Add Capacity in NetWare 5" later in this section.

First, Install Additional Capacity

Install the additional physical capacity (hot-swap disk drive modules) into the internal hot-swap mass storage cage or into the external enclosure. The cage or enclosure must already be connected to the integrated HP NetRAID controller or HP NetRAID Series adapter controlling the logical drive that you want to expand.

Second, Reconstruct to Add Capacity

After you have installed the additional physical capacity, run HP NetRAID Config to reconstruct the HP NetRAID logical drive to include the added capacity, as follows:

1. Load the HP NetRAID Config utility (megamgr .nlm module) under NetWare.
2. The HP NetRAID Config Management menu is displayed. Choose the **Advanced** menu, and press **Enter**.
3. In the Advanced menu, the only item is Reconstruct Logical Drive. Press **Enter** to choose it.
4. The configured logical drives are displayed. Choose the one you want to expand, and press **Enter**.
5. After the physical drives are rescanned, the Reconstruct screen shows the configured logical drives and the Ready physical drives, which include the physical drive that you installed.
6. Choose the Ready physical drive to add to the array supporting the logical drive that you want to expand. Choose **Reconstruct**, and press **Enter**.
7. Confirm your choice. Reconstruct of the logical drive begins.

In our example, this allows you to add the drive and reconstruct the four-drive RAID 5 array to a five-drive RAID 5 array.

Reconstruction is done in the background so there is no need to shut down the server. When reconstruction finishes, our sample drive now has 16 GB of available physical capacity. The original 12-GB volume VOL1 is still intact.

The reconstruction rate is about 80 to 180 MB per minute (depending on drive performance and system loading). Count the capacity to be reconstructed as the number of physical drives participating in the reconstruction multiplied by drive capacity.

Third, Make the Added Capacity Available in NetWare 5

After the logical drive has been reconstructed in HP NetRAID Config, make the added capacity available in NetWare 5, as follows:

1. In NetWare 5, type **nwconfig** and press **Enter**.
2. The Configuration Options screen is displayed. Choose **Standard Disk Options**, and press **Enter**.
3. Choose **Scan for additional devices**, and press **Enter**.

4. Choose **Modify disk partitions and Hot Fix**, and press **Enter**.
5. The available devices are shown. Choose the logical drive that you reconstructed in HP NetRAID Config, and press **Enter**.
6. The Disk Partition Type display shows the free space in the logical drive. On the Disk Options Selections menu, choose **Create NetWare disk partition**, and press **Enter**.

NOTE

If you see a message that four disk partitions already exist on this logical drive, you cannot expand its capacity online. To add capacity offline, do the following:

- Back up your data.
- Delete all partitions on the logical drive that you want to expand.
- Create a new partition on the logical drive that uses all the available space.
- Restore your data from backup.

For more information, refer to your NetWare 5 documentation.

7. The Disk Partition Information screen displays the available free space. Press the **F10** function key to save changes.
8. Answer **Yes** to the "Create NetWare partition?" question. Then press **Enter**.
9. The Disk Partition Type screen now shows the NetWare partition that you just created, which contains the added capacity. Press **Esc** twice to return to the Available Disk Options menu.
10. On the Available Disk Options menu, choose **NetWare Volume options**, and press **Enter**.
11. The existing volume size, before adding new capacity, is shown. To add the new segment to the existing volume, press **Ins**.
12. Free space is now displayed. Select it, and press **Enter**.
13. In the "What would you like to do with this free segment?" box, choose **Make this segment a part of another volume**. Press **Enter**.
14. Select the volume to which to add the new segment. Press **Enter**.

15. The segment is added to the existing volume, and the Volume Disk Segment List shows the new segment. Press the **F10** function key to save changes and return to the Volume Name List.
16. Press **Esc** to save changes and return to the previous screen.
17. Answer **Yes** to the "Save volume changes?" question. Press **Enter**.
18. On the Select an action menu, choose **Mount all volumes**, and press **Enter**.
19. You return to the main menu. Press **Esc** repeatedly until the question "Exit nwconfig?" is displayed. Choose **Yes**, and press **Enter**.

Expanding Capacity under NetWare 5 with Virtual Sizing Enabled

If you already are using a logical drive *with* Virtual Sizing enabled, but now wish to add capacity to an existing volume, your options are limited. Here are the likely scenarios when Virtual Sizing has been enabled.

Without Restart

Without restarting the HP NetServer, you can only add capacity as a new volume. You will need to add enough physical drives to create a *new* array and logical drive by using HP NetRAID Config. Then under the nwconfig Standard Disk Options, scan for new devices and configure the new logical drive as a new NetWare volume.

With Restart

CAUTION	Back up your data before you begin this procedure. You will repartition the logical drive and destroy the data in it.
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If a restart is acceptable, then you can bring down the HP NetServer. If the logical drive has already been used, you need to back up the data, disable Virtual Sizing, install additional capacity, reconstruct the logical drive, repartition and create the new volume, and restore the data. Now the logical drive can be expanded online whenever required.

Capacity Expansion under Windows NT

This section describes how to expand disk capacity under Microsoft Windows NT after the system has been in operation for a time. This section is divided into these parts:

- **About Online Capacity Expansion under Windows NT** describes the Online Capacity Expansion feature. This feature allows new storage capacity to be added to an existing logical drive and put online for use without restarting the server.
- **Preparation Steps for Windows NT** explains how you enable Virtual Sizing and how to partition your drives to use this feature of HP NetRAID.
- **Expanding Capacity Online under Windows NT** describes how to use the Online Capacity Expansion feature to add physical drives to your system without restarting the server.
- **Expanding Capacity under Windows NT with Virtual Sizing Disabled** describes how you can add disk capacity to an existing logical drive if you didn't set up your logical drive initially to use the Online Capacity Expansion feature.

About Online Capacity Expansion under Windows NT

Normally, adding capacity requires shutting down the server to reconfigure/restore an existing volume or to add the new storage space as a new volume. Using the Online Capacity Expansion feature allows you to expand an *existing* logical drive without shutting down the server.

NOTE

The additional capacity will have a different drive letter than the original logical drive. If the expanded capacity and the original capacity must share the same drive letter, you must restart the HP NetServer. For more information about drive letters, see "Expanding Capacity Online under Windows NT" later in this section.

Capacity Expansion is enabled separately on each logical drive. When enabled, the adapter presents to the operating system a logical drive of 500 GB. However, only a part of the 500-GB logical drive exists as actual physical storage. You configure logical drives to use only the actual physical space, while the virtual space allows room for online expansion.

For example, assume you have one logical RAID-5 drive built from four physical hard disk drives of 9 GB each; the result is 27 GB of actual storage space. If you enable Virtual Sizing for this logical drive, then the operating system sees a logical drive of 500 GB. Only the first 27 GB are real, 9 GB are used for parity, and the last 464 GB are virtual. Since there is unused logical drive space, the physical storage of 27 GB can be expanded online, but the total logical drive remains at 500 GB.

Precautions

When using the Online Capacity Expansion feature, it is important that you do *not* create volumes that exceed the actual physical capacity. If you attempt to do this under Windows NT, the format operation will fail. If you extend an existing partition into virtual space, this is detected upon rebooting. In either case, be sure to use no more than the actual available physical capacity. Capacity of the logical drive can be checked with the HP NetRAID Assistant under Windows NT.

The Online Capacity Expansion feature cannot be used if a logical drive spans multiple arrays. Each array can contain only one logical drive. Reconstruction (for the purposes of adding a drive to an existing array) can only be done on an array having a single logical drive. It is also important to plan future storage expansion into your installation. This will ensure that you can easily expand capacity without backup/restore operations or reconfiguration.

Preparation Steps for Windows NT

This section repeats information found in the *HP NetRAID Series Installation and Configuration Guide* and in the *HP NetServer Integrated NetRAID Controller Configuration Guide*. It tells you how to enable Virtual Sizing and set up your partitions to permit easy capacity expansion.

The following steps are necessary to prepare your array for capacity expansion.

- I. Connect disk drives to HP NetRAID
- II. Configure HP NetRAID
- III. Enable Virtual Sizing in HP NetRAID Express Tools
- IV. Start Windows NT and enter the Disk Administrator
- V. Partition and format the drive under Windows NT

I. Connect Disk Drives

Connect physical drives to the HP NetRAID Series adapter or integrated HP NetRAID controller. For example, you might have four drives of 4 GB each connected to the adapter.

II. Configure HP NetRAID

Configure your HP NetRAID Series adapter or integrated HP NetRAID controller and create a logical drive. (This can be done in either HP NetRAID Assistant or in HP NetRAID Express Tools. See Chapter 2, "HP NetRAID Assistant," or Chapter 4, "HP NetRAID Express Tools," for complete instructions.) Save your configuration and initialize your logical drives.

NOTE The Online Capacity Expansion feature is supported only on arrays that contain just one logical drive each.

For example, your array of four drives (of 4 GB each) might be configured as a single RAID 5 logical drive. This produces a logical drive of 12 GB of real storage capacity.

III. Enable Virtual Sizing

1. Restart the host HP NetServer, and watch for the flashing message:
**Option: Experienced users may press <Ctrl> <M> for HP NetRAID Express Tools now.
Firmware Initializing**
2. While the message is flashing, press <Ctrl> <M>. When the system stops scanning, HP NetRAID Express Tools starts and displays the Tools Management menu.
3. If there is more than one HP NetRAID Series adapter, do the following to select the adapter controlling a logical drive you want to prepare for expansion:
 - a. Choose **Adapter** from the Tools Management menu.
 - b. Choose the adapter controlling the logical drive.
4. Choose **Objects** from the Management menu.
5. Choose **Logical Drive** from the Objects menu.
6. From the Logical Drive menu, choose the logical drive you want to prepare for expansion.
7. Choose **Properties** from the Logical Drive menu.
8. Choose **Virtual Sizing**.
9. On the Virtual Size menu, choose **Enable**, and confirm your choice.
10. Press **Esc** twice to return to the Logical Drive menu.

If you need to enable Virtual Sizing on another logical drive on the same adapter, choose the logical drive and repeat Steps 6 through 10.
11. If you have multiple adapters, press **Esc** to return to the Objects menu. Enable Virtual Sizing on the logical drives of all adapters as necessary.
12. To exit, press **Esc** until you see the Exit? box, and choose **Yes**.

NOTE Clearing a previous configuration does not reset the Virtual Sizing setting for a logical drive. Use the Reset to Factory Defaults option in HP NetRAID Express Tools to disable Virtual Sizing for all logical drives or manually change the setting.

IV. Start Windows NT and Enter the Disk Administrator.

Start Windows NT and enter the Disk Administrator. Here you see the new logical drive shown as a single unpartitioned/unformatted drive of 500 GB. Although there might be only 12 GB of real storage space on the logical drive, the Online Capacity Expansion feature creates a virtual drive of 500 GB.

V. Partition and Format the Drive.

How you partition and format a drive depends on where you installed Windows NT.

- For drives that do not contain the Windows NT operating system, see "Partition and Format Drives that do *not* Contain Windows NT" below.
- If Windows NT was installed on a disk array, see "Partition and Format a Drive that Contains Windows NT" below.

Partition and Format Drives that do *not* Contain Windows NT

Follow these instructions for drives that do not contain Windows NT.

1. Create a partition equal to (or less than) the real storage capacity.

In our ongoing example, you would create a 12-GB partition.

NOTE If you try to create a partition that is larger than the real storage capacity, the format operation generates a message, "Warning: NT was unable to complete the format."

2. Format the partition.

The formatted drive is now ready for use. Assume for this example that the drive is now E: and was partitioned as a primary partition. The remaining virtual storage space (500 GB minus 12 GB) must be left unpartitioned. You can write data up to 12 GB on the drive. Windows NT will not allow you to write beyond 12 GB and lose any data.

Partition and Format a Drive that Contains Windows NT

Sometimes it is desirable to have the network operating system reside on a disk array. The advantage is that the NOS resides on a redundant drive.

Virtual Sizing can be used with a disk array that is used as the boot device and also contains user data. The key limitation is that Windows NT only allows a FAT boot partition size of 4 GB or less.

If the NOS and data need to be on a single array (and single logical drive), and you want to allow for capacity expansion, you must create multiple partitions.

1. Create a FAT boot partition of 4 GB or less for the NOS, which becomes the C: volume.
2. Create a second partition for the data, which becomes, for example, the D: volume.
3. The remaining virtual capacity must be left unpartitioned, and is available for future partitions as you add disk drives to the array.

Expanding Capacity Online under Windows NT

After using a logical drive, you might want to add another physical drive. If you prepared the logical drive for the Online Capacity Expansion feature, this can be done without shutting down and restarting the system.

In the example used throughout this section, you might be nearing the 12-GB limit, and you want to add another 4-GB drive to the logical drive.

1. Add Capacity by Reconstruction.

1. Add the new physical drive to the adapter by plugging the additional drive into an empty hot-swap storage slot connected to the adapter.
2. Bring up HP NetRAID Assistant under Windows NT.
3. Select the logical drive and the new physical drive.
4. Select **Logical Drive**, then **Change Config**, then **Add Capacity**.

In our example, this reconstructs the current four-drive RAID 5 array to a five-drive RAID 5 array.

Reconstruction occurs in the background, so there is no reason to shut down the server. The original 12-GB volume is available throughout the reconstruction process. When reconstruction finishes, our sample drive now has 16 GB of available physical capacity.

The reconstruction rate is about 80 to 180 MB per minute (depending on drive performance and system loading). Count the capacity to be reconstructed as the number of physical drives participating in the reconstruction multiplied by drive capacity.

2. Partition and Format New Capacity.

1. When the reconstruction is complete, enter the Disk Administrator.
In our example, the original drive is still shown as E: and is 12 GB.
2. Select the unpartitioned area, and create a primary partition of 4 GB.
3. Format the new partition.
In our example, you now have another drive (say F:) of 4 GB without restarting.
4. Exit the Disk Administrator and begin use of the new capacity on the F volume.

If the expanded capacity and the original capacity must share the same drive letter, you must restart Windows NT. Next identify the added capacity as an extended partition, and then select the original and new (extended) partition. Use the selection **Extend Partition** to make the two partitions share the same drive letter (E: for this example). You need to restart Windows NT before any part of E: becomes available again. If you accidentally enter more capacity than is actually available, Windows NT will detect the error upon restarting as it executes a check-disk operation on the extended volume.

Expanding Capacity under Windows NT with Virtual Sizing Disabled

If you already are using a logical drive *without* Virtual Sizing enabled, but now wish to add capacity to it, your options are limited. Here are the likely scenarios when Virtual Sizing has *not* been enabled.

Without Restarting the HP NetServer

Unless Virtual Sizing was enabled during installation, you cannot add capacity without restarting the HP NetServer. Windows NT does not recognize new logical drives unless you restart the HP NetServer.

With Restart

CAUTION	Back up your data before you begin this procedure. You will repartition the logical drive and destroy the data in it.
----------------	---

If a restart is acceptable, then you can bring down the HP NetServer. If the logical drive has already been used, you need to back up the data, enable Virtual Sizing, repartition and format the new capacity, and restore the data. Now the logical drive can be expanded online whenever required.

Capacity Expansion under Windows 2000

This section describes how to expand disk capacity after the system has been in operation for a time. This section is divided into these parts:

- **About Online Capacity Expansion under Windows 2000** describes the Online Capacity Expansion feature. This feature allows new storage capacity to be added to an existing logical drive and put online for use without restarting the server.
- **Preparation Steps for Windows 2000** explains how to disable Virtual Sizing if it has been enabled.
- **Expanding Capacity Online under Windows 2000** describes how to use the Online Capacity Expansion feature to add physical drives to your system without restarting the server.
- **Expanding Capacity under Windows 2000 with Virtual Sizing Enabled** describes how you can add disk capacity to an existing logical drive if you did not prepare your logical drive initially to use the Online Capacity Expansion feature.

About Online Capacity Expansion under Windows 2000

Normally, adding capacity requires shutting down the server to reconfigure or restore an existing volume or to add the new storage space as a new volume. Using the Online Capacity Expansion feature allows you to expand an *existing* logical drive without shutting down the server.

The Online Capacity Expansion feature cannot be used if a logical drive spans multiple arrays. Each array can contain only one logical drive. Reconstruction (for the purposes of adding a drive to an existing array) can only be done on an array having a single logical drive. It is also important to plan future storage expansion into your installation. This will ensure that you can easily expand capacity without backup/restore operations or reconfiguration.

The Online Capacity Expansion feature requires the logical drive to be operating in Basic Disk Mode under Windows 2000. (Capacity cannot be expanded online for logical drives operating in Dynamic Disk Mode.) Preparation for capacity expansion under Windows 2000 operating in Basic Disk mode is simply to leave Virtual Sizing disabled (the factory default), or to disable it if it has been enabled.

When you expanding capacity online under Windows 2000, you create a new volume with a new drive letter. Capacity can be expanded online again in the future.

Preparation Steps for Windows 2000

This section tells you how to disable Virtual Sizing to permit online capacity expansion. Online capacity expansion under Windows 2000 requires the following:

- Windows 2000 is already installed.
- HP NetRAID Assistant is already installed. The version of HP NetRAID Assistant must be the same or newer than version A.02.02.
- The logical drive that you plan to expand must be running in Basic Disk Mode in Windows 2000. Refer to your Windows 2000 documentation for information.
- The logical drive that you plan to expand must have Virtual Sizing disabled (the factory default condition). Instructions for disabling appear later in this section.

The following steps are necessary to prepare your logical drive for online capacity expansion:

- I. Connect drives to the HP NetRAID Series adapter or integrated HP NetRAID controller
- II. Configure the HP NetRAID Series adapter or integrated HP NetRAID controller
- III. Disable Virtual Sizing in HP NetRAID Express Tools

I. Connect Drives

Connect physical drives to the HP NetRAID Series adapter or integrated HP NetRAID controller. For example, you might have four drives of 4 GB each connected to the adapter.

II. Configure the HP NetRAID Series Adapter or Integrated HP NetRAID Controller

NOTE	The Online Capacity Expansion feature is supported only on arrays that contain just one logical drive each.
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Configure your adapter and create your logical drives. (This can be done in either HP NetRAID Assistant or in HP NetRAID Express Tools. See Chapter 2, "HP NetRAID Assistant," or Chapter 4, "HP NetRAID Express Tools," for complete instructions.) Save your configuration and initialize your logical drives.

NOTE It is important to initialize your logical drives. If the drives have been previously configured under an operating system, there can sometimes be residual partition/format information which subsequently causes misrepresentation of logical drives under the Windows 2000 Disk Management.

For example, your array of four drives (of 4 GB each) might be configured as a single RAID 5 logical drive. This produces a logical drive of 12 GB of real storage capacity, with 4 GB used for parity.

III. Disable Virtual Sizing

Online capacity expansion of your logical drive requires that Virtual Sizing is disabled. This is the factory default setting.

- **If Virtual Sizing is Disabled** (the factory default setting), no other preparation is necessary.
- **If Virtual Sizing is Enabled**, disable Virtual Sizing in HP NetRAID Express Tools, as described below.

To Disable Virtual Sizing

NOTE Clearing a previous configuration does not reset the Virtual Sizing setting for a logical drive. Use the Reset to Factory Defaults option in HP NetRAID Express Tools to disable Virtual Sizing for all logical drives, or manually change the setting as described below.

The factory default is that Virtual Sizing is disabled. If Virtual Sizing has been enabled, disable it as follows:

1. Restart the host HP NetServer, and watch for the message:
**Option: Experienced users may press <Ctrl> <M> for HP NetRAID Express Tools now.
Firmware Initializing**
2. When the message is displayed, press <Ctrl> <M>. When the system stops scanning, HP NetRAID Express Tools starts and displays the Tools Management menu.
3. If you have installed one or more HP NetRAID Series adapters, do the following to select the integrated HP NetRAID controller or HP NetRAID Series adapter controlling the logical drive you want to prepare for expansion:

- a. Choose **Adapter** from the Tools Management menu.
- b. Choose the adapter controlling the logical drive.
4. Choose **Objects** from the Tools Management menu.
5. Choose **Logical Drive** from the Objects menu.
6. From the Logical Drive menu, choose the logical drive you want to prepare for expansion.
7. From the Logical Drive menu for the drive you want to prepare, choose **Properties**.
8. Choose **Virtual Sizing**.
9. On the Virtual Size menu, choose **Disable**, and confirm your choice.
10. Press **Esc** twice to return to the Logical Drive menu.
If you need to enable Virtual Sizing on another logical drive, choose the logical drive and repeat Steps 6 through 10.
11. If you have installed one or more HP NetRAID Series adapters, press **Esc** to return to the Objects menu. Enable Virtual Sizing on the logical drives of all adapters as necessary.
12. To exit, press **Esc** until you see the Exit? box, and choose **Yes**.

Expanding Capacity Online under Windows 2000

After using a logical drive, you might want to add another physical drive. If you prepared the logical drive for the Online Capacity Expansion feature, this can be done without shutting down the server or restarting the system.

In the example used throughout this section, you might be nearing the 12-GB limit and you want to add another 4-GB drive to the logical drive.

To expand capacity online, follow the instructions later in this section to do the following:

- **First:** Install the added physical capacity into the internal hot-swap mass storage cage or into the external enclosure.
- **Second:** Use the HP NetRAID Assistant utility to reconstruct the logical drive to include the added capacity. For instructions, refer to "Second, Reconstruct to Add Capacity" later in this section.
- **Third:** In Windows 2000, create a new volume consisting of the added capacity and make that new free segment part of the existing volume. For instructions, refer to "Third, Add Capacity in Windows" later in this section.

First, Install Additional Capacity

Install the additional physical capacity (hot-swap disk drive modules) into the internal hot-swap mass storage cage or into the external enclosure. The cage or enclosure must already be connected to the integrated HP NetRAID controller or HP NetRAID Series adapter controlling the logical drive that you want to expand.

Second, Reconstruct to Add Capacity

After you have installed the additional physical capacity, run HP NetRAID Assistant to reconstruct the HP NetRAID logical drive to include the added capacity, as follows:

1. Start HP NetRAID Assistant under Windows 2000 by clicking **Start** on the taskbar, pointing to **Programs**, pointing to **NetRAID**, and clicking **NetRAID Assistant**.
2. HP NetRAID Assistant shows the added physical drive in the Ready state in the Physical Devices box. Select the Ready physical drive, drag it to the logical drive that you want to expand in the Logical Devices box, and drop it on the logical drive.
3. The Change RAID Level window appears. In it, select the RAID level of the logical drive, and click **Apply**.

In our example, this reconstructs the current four-drive RAID 5 array to a five-drive RAID 5 array.

Reconstruction occurs in the background, so there is no reason to shut down the server. The original 12-GB volume is available throughout the reconstruction process. When reconstruction finishes, our sample drive now has 16 GB of available physical capacity.

The reconstruction rate is about 80 to 180 MB per minute (depending on drive performance and system loading). Count the capacity to be reconstructed as the number of physical drives participating in the reconstruction multiplied by drive capacity.

Third, Create the New Volume in Windows 2000

1. When the reconstruction is complete, enter Windows 2000 Disk Management by clicking **Start** on the taskbar, pointing to **Programs**, pointing to **Administrative Tools**, clicking **Computer Management**, and clicking the **Disk Management** folder.

In our example, the original drive is still shown as E: and is 12 GB.

2. The current disk configuration is displayed. The added capacity of the added physical drive is shown as Unallocated space. Right click the Unallocated space, and choose **Create Partition**.

NOTE	Verify that "Basic" is displayed below the disk number to the left of the existing volume to the left of the unallocated space. This confirms that the logical drive is in Basic Disk Mode. If "Dynamic" is displayed, the logical drive is in Dynamic Disk Mode, and you cannot expand capacity online as described in this section.
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In our example, Select the unpartitioned area, and create a primary partition of 4 GB.

3. Follow the onscreen instructions to create the new volume with a new drive letter.

In our example, you now have another drive (say F:) of 4 GB without rebooting.

4. Exit Disk Management, and begin use of the new capacity on the new volume.

NOTE	If the expanded capacity and the original capacity must share the same drive letter, you must restart Windows 2000. You must identify the added capacity as an extended partition, then select the original and new (extended) partition. Use the selection "Extend Partition" to make the two partitions share the same drive letter (E: for this example). You need to restart Windows 2000 before any part of E: becomes available again.
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Expanding Capacity under Windows 2000 with Virtual Sizing Enabled

CAUTION	Back up your data before you begin this procedure. You will repartition the logical drive and destroy the data in it.
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If you already are using a logical drive *with* Virtual Sizing enabled, but now wish to add capacity to it, you must restart the HP NetServer to run HP Express Tools to disable Virtual Sizing.

If the logical drive has already been used, you need to back up the data, disable Virtual Sizing, install additional capacity, reconstruct the logical drive, repartition and create the new volume, and restore the data. Now the logical drive can be expanded online whenever required.

7 Monitor Alert List

This chapter lists monitor messages for the supported network operating systems that provide information about the monitor utility, adapters (HP NetRAID adapters and integrated HP NetRAID controllers), physical drives, and logical drives.

For BIOS error messages and other troubleshooting, refer to the "Troubleshooting" chapter in the *HP NetRAID Series Installation and Configuration Guide* or the *HP NetServer Integrated NetRAID Controller Configuration Guide*.

Microsoft Windows NT and Windows 2000

NOTE For Windows NT and Windows 2000, the monitor capability is integrated into the HP NetRAID Assistant utility.

Novell NetWare Monitor Messages

Table 7-1. NetWare Monitor Messages

Condition	Messages
Physical drive state change	HP NetRAID-Adapter # (Channel: SCSI ID#) state (<i>previous state</i>) to (<i>new state</i>)
Logical drive state change	HP NetRAID-Adapter # LD-# state (<i>previous state</i>) to (<i>new state</i>)
Physical drive rebuilding at startup of monitor	Warning: HP NetRAID-Adapter # Channel: SCSI ID# at startup is in REBUILD state
Logical drive state at startup	HP NetRAID-# LD-# state at startup is X
The number of adapters found by monitor	HP NetRAID Mon: # HP NetRAID Adapters Found

IBM OS/2 Monitor Messages

Table 7-2. OS/2 Monitor Messages

Condition	Messages
Logical drive state change	Adp = # LogDrv # state changed from (<i>previous state</i>) to (<i>new state</i>).
Physical drive state change	Adp = # PhysDrv at Ch # Tid # state changed from (<i>previous state</i>) to (<i>new state</i>).
Monitor started	HP NetRAID Monitor for OS/2
Memory allocation failure	Malloc Failure
Adapter not identified	No HP NetRAID Adapters Found
Adapter rebuild completed X%	Adp = # Rebuilding Ch# Tid # Percent Rbld = X

SCO OpenServer and UnixWare Monitor Messages

Table 7-3. SCO OpenServer and UnixWare Monitor Messages

Condition	Messages
Monitor starts	HP NetRAID Monitor activated
Monitor deactivated	HP NetRAID Monitor deactivated
No adapter found	No HP NetRAID adapter found
Adapter inquiry failed	HP NetRAID inquiry failed for adapter x
Physical drive state change	Adapter: # PDrv Channel: SCSI ID # state change from <i>(previous state)</i> to <i>(new state)</i> .
Physical drive rebuilding (when monitor starts)	Adapter: # PDrv Channel: SCSI ID# At startup is in Rebuild state
Rebuild percentage completed	Adapter: # PDrv Channel: SCSI ID# Rbld X% over
Rebuild failed	Adapter: # PDrv Channel: SCSI ID# Rbld failed
Rebuild over (completed)	Adapter: # PDrv Channel: SCSI ID# Rbld over
Logical drive state change	Adapter: # LDrv # state change from <i>(previous state)</i> to <i>(new state)</i> .
Logical drive state at startup	Adapter: # LDrv # state at startup is <i>(current state)</i>

8 Alarm Control and Audible Warnings

HP NetRAID Series adapters have onboard tone generators that indicate events and errors.

NOTE The integrated HP NetRAID controller does not have alarm control or audible warnings.

Table 8-1. Audible Warnings

Tone Pattern	Meaning	Examples
Three seconds on and one second off	A logical drive is offline.	One or more drives in a RAID 0 configuration failed. Two or more drives in a RAID 1, 3, 5, 10, 30, or 50 configuration failed.
One second on and one second off	A logical drive is running in degraded mode.	One drive in a RAID 3, 5, 30, or 50 configuration failed.
One second on and three seconds off	An automatically initiated rebuild has been completed.	While you were away from the system, a disk drive in a RAID 1, 3, 5, 10, 30, or 50 configuration failed and was rebuilt.

To silence a sounding alarm (or to disable or enable the alarm), you must use the Alarm Control selection in one of the HP NetRAID management utilities. To reach the Alarm Control setting do the following:

- In HP NetRAID Assistant, select the **Adapter** menu, then **Alarm Control**.
- In HP NetRAID Config, select **Objects**, then **Adapter**, then **Alarm Control**.
- In HP NetRAID Express Tools, select **Objects**, then **Adapter**, then **Alarm Control**.

Alarm Control has two options:

- **Enable/Disable Alarm:** Choose this option to enable or disable the onboard tone generator. The default setting is Enabled.
- **Silence Alarm:** This setting stops the alarm when it goes off.

Glossary

HP NetRAID Terms and Technology

Array: An array of disk modules combines the storage space on the disk modules into a single segment of contiguous storage space. HP NetRAID can group disk modules on one or more of its SCSI channels into an array. A hot spare disk module does not participate in an array.

Array Spanning: Array spanning by a logical drive combines storage space of two, three, or four arrays of disk modules into a logical drive's single, contiguous storage space.

Logical drives can span consecutively numbered arrays that each consist of the same number of disk modules. Array spanning promotes RAID levels 1, 3, and 5 to RAID levels 10, 30, and 50, respectively.

BIOS: (Basic Input/Output System) The part of the operating system of the computer that provides the lowest level interface to peripheral devices.

Cache Policy: HP NetRAID lets you choose one of two cache policies:

- **Cached I/O:** Reads are always cached regardless of randomness, and the selected Read policy (Read Ahead, Normal, or Adaptive) and Write policy (Write-Through and Write-Back) applies.
- **Direct I/O:** First reads to a new location always come directly from the disk. If a location is read repeatedly, then the Read policy (Read Ahead, Normal, or Adaptive) as selected applies and the read data is cached. Read data is cached only if accessed repeatedly. With 100% random reads, nothing is cached.

Capacity Expansion (or Volume Expansion): Allows you to increase the size of an existing volume while remaining online under Microsoft Windows NT or Windows 2000 or under Novell NetWare 4.2 or 5.

- Under Microsoft Windows 2000 or NetWare or 5, leave virtual sizing disabled to prepare for online capacity expansion.
- Under Windows NT or NetWare 4.2, enable virtual sizing to prepare for capacity expansion. The controller creates virtual space when the Virtual Sizing option is enabled in the HP NetRAID Express Tools utility. A volume can then be expanded into the virtual space by adding a physical disk through reconstruction.

Reconstruction is only permitted on a logical drive that occupies a single array and is the only logical drive in the array. You cannot use online capacity expansion on logical drives that span arrays (RAID levels 10, 30, or 50).

Channel: An electrical path for the transfer of data and control information between a disk and a disk adapter or controller.

Consistency Check: An examination of the disk system on a stripe-by-stripe basis to verify that data and parity are valid. Inconsistent data or parity is repaired if enough redundant/valid data remains.

Degraded: A logical drive that has decreased in performance due to a failed physical drive. The data on the logical drive remains available, but no additional redundancy is provided.

Disk: A physical drive. A hard disk drive. A non-volatile, randomly addressable, rewritable mass storage device.

Disk Array: A collection of disks from one or more disk subsystems combined with array management hardware and software. It controls the disks and presents them to the operating system as one or more logical disks.

Failed Drive: A drive that has ceased to function, that consistently functions improperly, or that has been changed to the Fail state.

Fast SCSI: A variant on the SCSI-2 bus. It uses the same 8-bit bus as the original SCSI-1, but runs at up to 10 MB/s, (double the speed of SCSI-1).

Firmware: Software stored in read-only memory (ROM) or Programmable ROM (PROM). Firmware is responsible for the behavior of a system when it is first switched on.

Format: The process of writing zeros to all data fields in a physical drive (hard drive) and to map out unreadable or bad sectors. Because most hard drives are factory formatted, formatting is usually only done if a hard disk generates several media errors.

GB: A gigabyte; an abbreviation for 1,073,741,824 (2 to the 30th power) bytes; used for memory or disk capacities.

Hot Spare: An idle, powered/on stand-by disk module ready for use should another disk module fail. It does not contain any user data. A hot spare can be dedicated to a single array, or it can be part of the global hot-spare pool for all the arrays controlled by the adapter. Only one hot spare can be dedicated to a given array.

When a disk fails, the adapter's firmware automatically replaces and rebuilds the data from the failed disk onto the hot-spare disk. Data can only be rebuilt from logical drives with redundancy (RAID levels 1, 3, 5, 10, 30, or 50; not RAID 0),

and the hot-spare disk must have sufficient capacity. The system administrator can replace the failed disk module and designate the replacement disk module as a new hot spare.

Hot-Swap Disk Module: Hot-swap modules allow a system administrator to replace a failed disk drive in a server without powering down the server and suspending network services. The hot-swap module simply pulls out from its slot in the drive cage because all power and cable connections are integrated into the server backplane. Then the replacement hot-swap module can slide into the slot. Hot swapping only works for RAID 1, 3, 5, 10, 30, and 50 configurations.

I₂O: Intelligent Input/Output (I₂O) is an industry-standard, I/O subsystem architecture independent of the network operating system and the peripheral devices supported. I₂O uses drivers that are split into operating system services modules (OSMs) and hardware device modules (HDMs).

Initialization: The process of writing zeros to the data fields of a logical drive and generating corresponding parity to put the logical drive in a Ready state. Initializing erases previous data, generating parity so that the logical drive will pass a Consistency Check. Arrays work without initializing, but they may fail a Consistency Check because parity fields may not have been generated.

I/O Driver: A host HP NetServer software component (usually part of the operating system) that controls the operation of peripheral adapters or adapters attached to the host HP NetServer. I/O drivers communicate between applications and I/O devices, and in some cases participate in data transfer.

Logical Drive: A virtual drive within an array, which may occupy more than one physical drive.

Logical drives divide up the contiguous storage space of an array of disk modules or a spanned group of arrays of disks. The storage space in a logical drive is spread across all the disks in the array or spanned arrays. Each HP NetRAID Series adapter or integrated HP NetRAID controller can be configured with up to eight logical drives in any combination of sizes. Configure at least one logical drive for each array.

A logical drive can be in one of three states (also see the SCSI Disk Status below):

- **Online:** All participating disk modules are online.
- **Degraded:** (Critical) a single disk module in a redundant array (not RAID 0) is not online. Data loss may result if a second disk module fails.
- **Offline:** Two or more disk modules in a redundant array (not RAID 0) or one or more disk modules in a RAID 0 array are not online.

- **Reconstructing:** Participating disk modules are being reconstructed.
- **Rebuilding:** Participating disk modules are being rebuilt.

I/O operations can only be performed with logical drives that are online or degraded (critical).

Logical Volume: An array virtual disk made up of logical disks rather than physical ones. Also called a partition.

MB: A megabyte; an abbreviation for 1,048,576 (2 to the 20th power) bytes; used for memory or disk capacities.

Mirroring: The style of redundancy in which the data on one disk completely duplicates the data on another disk. RAID levels 1 and 10 use mirroring.

Online Capacity Expansion: Capacity expansion by adding volume or another hard drive without restarting the HP NetServer.

Parity: Parity is an extra bit added to a byte or word to reveal errors in storage (in RAM or disk), or transmission. It is used to generate a set of redundancy data from two or more parent data sets. The redundancy data can be used to reconstruct one of the parent data sets; however, parity data do not fully duplicate the parent data sets. In RAID, this method is applied to entire drives or stripes across all disk drives in an array. Parity consists of Dedicated Parity, in which the parity of the data on two or more disks is stored on an additional disk, and Distributed Parity, in which the parity data are distributed among all the disks in the system. If a single disk fails, it can be rebuilt from the parity of the respective data on the remaining disks.

Partition: An array virtual disk made up of logical disks rather than physical ones. Also called logical volume.

Physical Drive: In HP NetRAID, a disk drive.

Physical Disk Roaming: The ability of an adapter to keep track of a hot-swap disk module that has been moved to a different slot in the hot-swap cages. Both slots must be controlled by the same HP NetRAID Series adapter or integrated HP NetRAID controller.

RAID: Redundant Array of Independent Disks (originally Redundant Array of Inexpensive Disks) is an array of multiple small, independent hard disk drives that yields performance exceeding that of a Single Large Expensive Disk (SLED). A RAID disk subsystem improves I/O performance using only a single drive. The RAID array appears to the host HP NetServer as a single storage unit. I/O is expedited because several disks can be accessed simultaneously.

RAID Levels: A style of redundancy applied to a particular logical drive. It may increase the performance of the logical drive, and it may decrease its usable capacity. Each logical drive must have a RAID level assigned to it.

RAID levels 0, 1, 3, and 5 are for logical drives that occupy a single array (do not span arrays). Briefly,

- **RAID 0** has no redundancy. It requires one or more physical drives.
- **RAID 1** has mirrored redundancy. It requires two physical drives in an array.
- **RAID 3** has parity redundancy with a dedicated parity disk. It requires three or more physical drives in an array.
- **RAID 5** has parity redundancy distributed over all the disks in the array. It requires three or more physical drives in an array.

RAID levels 10, 30, and 50 result when logical drives span arrays.

- **RAID 10** results when a RAID 1 logical drive spans arrays.
- **RAID 30** results when a RAID 3 logical drive spans arrays.
- **RAID 50** results when a RAID 5 logical drive spans arrays.

Read Policy: The three Read policies for HP NetRAID are:

- **Read-Ahead:** This is a memory caching ability that tells the adapter to read sequentially ahead of requested data and cache the further data in memory, anticipating that the further data will be requested. Read-Ahead supplies sequential data faster, but is not as effective when accessing random data.
- **Normal:** This policy does not use the read-ahead memory caching feature. This policy is efficient when most of the data reads are random.
- **Adaptive:** Adaptive policy causes the read-ahead feature to be used if the last two disk accesses were in sequential sectors.

Ready State: A condition in which a workable hard drive is neither online nor a hot spare, and therefore is available to add to an array, or to designate as a hot spare.

Rebuild: The regeneration of all data from a failed disk in a RAID level 1, 3, 5, 10, 30, or 50 array to a replacement disk. A disk rebuild normally occurs without interruption of application access to data stored on the array virtual disk.

Rebuild Rate: The speed at which a rebuild operation occurs. Each HP NetRAID Series adapter or integrated HP NetRAID controller is assigned a rebuild rate, which specifies the percentage of processor resources to be devoted to rebuild operations.

Reconstruct: The act of remaking a logical drive after changing RAID levels.

Redundancy: The provision of multiple interchangeable components to perform a single function to cope with failures and errors. Redundancy normally applies to hardware, such as using two or even three computers to do the same job. The computers could all be active all the time, thus giving extra performance through parallel processing and extra availability. Another type of redundancy is for one computer to be active while the others monitor its activity, ready to take over if it failed (warm standby). Alternatively, the "spares" could be kept turned off and only switched on when needed (cold standby). Another common form of hardware redundancy is disk mirroring.

Replacement Disk: A disk available for use to replace a failed member disk in a RAID array.

SCSI: (Small Computer System Interface) A processor-independent standard for system-level interfacing between a computer and intelligent devices, including hard disks, flexible disks, CD-ROM, printers, and scanners. SCSI can connect up to eight devices to a single adapter (or host adapter) on the computer's bus. SCSI transfers eight bits in parallel in Narrow, or 16 bits in Wide.

SCSI Channel: HP NetRAID Series adapters and integrated HP NetRAID controllers control the disk drives via SCSI-2 buses called "channels" over which the system transfers data in Fast/Wide, Ultra/Wide, or Ultra2 SCSI mode. The HP NetRAID-3Si adapter has three channels, and the HP NetRAID-1Si adapter has one channel. In HP NetServer LH 3/3r and LH 4/4r, the integrated HP NetRAID controller can have either one or two channels. In other HP NetServers, the integrated HP NetRAID controller has two channels.

SCSI Disk Status: A SCSI disk module (physical drive) can be in one of these six states:

- **Ready:** A powered-on and operational disk that has not been configured.
- **Online:** A powered-on and operational disk.
- **Hot Spare:** A powered-on, stand-by disk ready for use if a disk fails.
- **Failed:** Errors on the disk have caused it to fail, or you have used an HP NetRAID utility to take the drive offline.
- **Rebuild:** A disk to which one or more critical logical drives is restoring data.

SCSI ID: Each SCSI device on an HP NetRAID SCSI bus must have a different SCSI address number (Target ID, or TID) from 0 to 15, but not 7, which is reserved for the SCSI controller. Drives IDs are determined by the slot positions or are set by switches. Consult your HP NetServer documentation and chassis labels for slot position IDs or correct switch settings.

SNMP: (Simple Network Management Protocol) The Internet standard protocol developed to manage nodes on an Internet Protocol (IP) network.

Spare: A hard drive available to back up the data of other drives.

Striping: Segmentation of logically sequential data, such as a single file, so that segments can be written to multiple physical devices in a round-robin fashion. This technique is useful if the processor is capable of reading or writing data faster than a single disk can supply or accept it. While data is being transferred from the first disk, the second disk can locate the next segment. Data striping is used in some modern databases and in certain RAID devices. In an inconsistent stripe, firmware always updates the parity stripe to restore consistency.

Stripe Size: The amount of data contiguously written to each disk. Also called "stripe depth." You can specify stripe sizes of 2 KB, 4 KB, 8 KB, 16 KB, 32 KB, 64 KB, and 128 KB, for each logical drive. For best performance, choose a stripe size equal to or smaller than the block size used by your host operating system. A larger stripe depth produces higher read performance, especially if most of the reads are sequential. For mostly random reads, select a smaller stripe size. You can specify a stripe size for each logical drive.

Stripe Width: The number of disk modules across which the data is striped. The stripe width is equivalent to the number of disks in the array.

Terminator: A resistor or other mechanism connected to a signal wire in a bus or network for the purpose of impedance matching to prevent reflections. SCSI chains require terminators.

Ultra2 SCSI: Drives that operate at SCSI bus data rates of up to 80 MB per second--double the rate of Ultra/Wide SCSI. Ultra2 drives are sometimes referred to as LVD (low voltage differential) drives.

Ultra SCSI: An extension of SCSI-2, proposed by a group of manufacturers, which doubles the transfer speed of Fast-SCSI to give 20 MB/s on an 8-bit connection and 40 MB/s on a 16-bit connection.

Wide SCSI: A variant on the SCSI-2 interface. It uses a 16-bit bus, double the width of the original SCSI-1, and therefore cannot be connected to a SCSI-1 bus. It supports transfer rates up to 20 MBs, like Fast SCSI.

Write Policy: When the processor writes to disk, the data is first written to the cache on the assumption that the processor will probably read it again soon. The two Write policies for HP NetRAID are:

- **Write-Through:** In a write-through cache, data is written to disk at the same time as it is cached. Write-through is simpler than write-back, because an entry that is to be replaced can be overwritten in the cache, as it will already have been copied to disk.
- **Write-Back:** In a write-back cache, data is written to disk only when it is forced out of the cache. Write-back is efficient, because an entry may be written many times in the cache without a main memory access.

NOTE

Write-Back is NOT recommended unless one of the following is true:

- The HP NetRAID adapter is an HP NetRAID-3Si, which has a Battery Backup Unit.
- Your system is equipped with a UPS (uninterruptible power supply).
- Your system is an HP NetServer LH 3000/3000r, LH 6000/6000r, or LT 6000r that is equipped with a charged accessory Battery Backup Module.

Write-Back is not certified for any logical drive used as a Novell NetWare volume.

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