StorageWorks NAS B3000 by Compaq

Administration Guide

Part Number 260617-001

February 2002 (First Edition)

This guide provides information on performing the administrative tasks necessary to manage the *StorageWorks*™ NAS B3000 by Compaq. Overview information as well as procedural instructions are included in this guide.

COMPAQ

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About This Guide

This guide provides step-by-step instructions for managing the *StorageWorks*™ NAS B3000 by Compaq.

Intended Audience

This guide is intended for administrators with a moderate level of experience in Windows and UNIX environments.

⚠ Important Safety Information

Before installing this product, read the *Important Safety Information* document provided.

Symbols on Equipment

The following symbols may be placed on equipment to indicate the presence of potentially hazardous conditions:

WARNING: This symbol, in conjunction with any of the following symbols, indicates the presence of a potential hazard. The potential for injury exists if warnings are not observed. Consult your documentation for specific details.

This symbol indicates the presence of hazardous energy circuits or electric shock hazards. Refer all servicing to qualified personnel.

WARNING: To reduce the risk of injury from electric shock hazards, do not open this enclosure. Refer all maintenance, upgrades, and servicing to qualified personnel.

This symbol indicates the presence of electric shock hazards. The area contains no user or field serviceable parts. Do not open for any reason.

WARNING: To reduce the risk of injury from electric shock hazards, do not open this enclosure

This symbol on an RJ-45 receptacle indicates a network interface connection.

WARNING: To reduce the risk of electric shock, fire, or damage to the equipment, do not plug telephone or telecommunications connectors into this receptacle.

This symbol indicates the presence of a hot surface or hot component. If this surface is contacted, the potential for injury exists.

WARNING: To reduce the risk of injury from a hot component, allow the surface to cool before touching.

These symbols, on power supplies or systems, indicate that the equipment is supplied by multiple sources of power.

WARNING: To reduce the risk of injury from electric shock, remove all power cords to completely disconnect power from the system.

Weight in kg
Weight in lb

This symbol indicates that the component exceeds the recommended weight for one individual to handle safely.

WARNING: To reduce the risk of personal injury or damage to the equipment, observe local occupational health and safety requirements and guidelines for manual material handling.

Rack Stability

WARNING: To reduce the risk of personal injury or damage to the equipment, be sure that:

- **The leveling jacks are extended to the floor.**
- **The full weight of the rack rests on the leveling jacks.**
- **The stabilizing feet are attached to the rack if it is a single-rack installation.**
- **The racks are coupled in multiple-rack installations.**
- **Only one component is extended at a time. A rack may become unstable if more than one component is extended for any reason.**

Symbols in Text

These symbols may be found in the text of this guide. They have the following meanings.

WARNING: Text set off in this manner indicates that failure to follow directions in the warning could result in bodily harm or loss of life.

CAUTION: Text set off in this manner indicates that failure to follow directions could result in damage to equipment or loss of information.

IMPORTANT: Text set off in this manner presents clarifying information or specific instructions.

NOTE: Text set off in this manner presents commentary, sidelights, or interesting points of information.

Text Conventions

This document uses the following conventions:

- *Italic type* is used for complete titles of published guides or variables. Variables include information that varies in system output, in command lines, and in command parameters in text.
- **Bold type** is used for emphasis, for onscreen interface components (window titles, menu names and selections, button and icon names, and so on), and for keyboard keys.
- `Monospace typeface` is used for command lines, code examples, screen displays, error messages, and user input.
- Sans serif typeface is used for uniform resource locators (URLs).

Related Documents

For additional information on the topics covered in this guide, refer to the following documentation:

- *StorageWorks NAS Quick Start Guide*
- *StorageWorks NAS Hardware Reference Guide*
- *SANworks Virtual Replicator User Guide*
- *Remote Insight Lights-Out Edition User Guide*
- *Fast Ethernet and Gigabit NIC User Guide*
- *Safety and Comfort Guide*
- *Servers Troubleshooting Guide*
- *CLI Reference Guide for MA2200 Based Storage*
- *64-Bit PCI-to-Fibre Channel Host Bus Adapter User Guide*
- *NC3134 Fast Ethernet Server NIC User Guide*
- SecurePath documentation

Getting Help

If you have a problem and have exhausted the information in this guide, you can get further information and other help in the following locations.

Compaq Technical Support

In North America, call the Compaq Technical Support Phone Center at 1-800-OK-COMPAQ. This service is available 24 hours a day, 7 days a week. For continuous quality improvement, calls may be recorded or monitored. Outside North America, call the nearest Compaq Technical Support Phone Center. Telephone numbers for worldwide Technical Support Centers are listed on the Compaq website, www.compaq.com.

Be sure to have the following information available before you call Compaq:

- Technical support registration number (if applicable)
- Product serial number
- Product model name and number
- Applicable error messages
- Add-on boards or hardware
- Third-party hardware or software
- Operating system type and revision level

Compaq Website

The Compaq website has information on this product as well as the latest drivers and flash ROM images. You can access the Compaq website at www.compaq.com.

Compaq Authorized Reseller

For the name of your nearest Compaq authorized reseller:

- In the United States, call 1-800-345-1518.
- In Canada, call 1-800-263-5868.
- Elsewhere, see the Compaq website for locations and telephone numbers.

1

System Overview

The *StorageWorks*™ NAS B3000 by Compaq is a complete server and storage solution designed for the entry level to mid-range Storage Area Network (SAN). The NAS B3000 can be used in many types of computing environments, from basic Microsoft Windows workgroups to complicated multiprotocol domains using CIFS, NFS, NCP, AFP, FTP, and HTTP. The corresponding varieties of clients that can be serviced include any Windows, UNIX, Linux, Novell, or Macintosh variant.

NAS B3000 deployments can be clustered or non-clustered and can be deployed as a SAN island, a SAN that other servers can join, or can integrate into an existing SAN.

This chapter provides an overview of these environments and deployments and includes brief descriptions of system user interfaces, applications, and options.

- Product Definition and Information
  - — Server Hardware Features
  - — MSA1000 Storage Enclosure Hardware Features
  - — Software Features
  - — Product Information
- Deployment Scenarios
- Environment Scenarios
- User Interfaces
  - — NAS B3000 Web-Based User Interface
  - — NAS B3000 Microsoft Management Console

Product Definition and Information

The NAS B3000 is a business-class NAS solution that provides reliable performance, manageability, fault tolerance, and scalable storage.

Server Hardware Features

The following features are included in the NAS B3000 server:

- Intel Pentium III Xeon 900-MHz processors, with 2-MB RAM
- 64-bit I/O technology (66/33 MHz)
- 2-GB or 4-GB synchronous dynamic random access memory (SDRAM)
- One or two Emulex Host Bus Adapters (HBAs)
- Two 36.4-GB, 10-KRPM hot-pluggable hard drives for the operating system
- Remote Insight Lights-Out Edition board
- 4-port Ethernet network interface controller (NIC)
- IDE CD-ROM drive
- Redundant hot-plug power supplies and fans
- Open PCI hot-plug controller slots

MSA1000 Storage Enclosure Features

The following features are included in the MSA1000 storage enclosure:

- 4U rack-mount design combining both the controller and disk shelf
- 2-GB Fibre Channel connections to the server
- Optional embedded 2-Gb Fibre Channel Switch (MSA Fabric Switch 6)
- Support for Compaq Universal 1-inch Ultra 3 SCSI hard disk drives
- Support for 14 drives in the MSA1000 storage enclosure, scalable to 42 drives with two additional disk storage enclosures

- Support for 1-Gb and 2-Gb Fibre Channel infrastructures
- Online capacity expansion, online stripe size migration, and online RAID migration

Software Features

Advanced features included and supported by the NAS B3000 include:

- Array Configuration Utility (ACU)
- Compaq Insight Manager performance monitoring
- Microsoft Services for Macintosh
- Microsoft Services for Netware
- Microsoft Services for UNIX (SFU)
- NAS Web-Based User Interface (WebUI)
- RAID 0, 1, 1+0, 5, and Advanced Data Guarding (ADG) support
- SecurePath
- Selective Storage Presentation (SSP)
- *StorageWorks* Data Copy
- Virtual Replicator (VR)
- Windows-powered OS plus service pack 2
- Third-party supported software, including:
  - Backup software
  - Management software
  - Quota management
  - Virus protection

For specific software product recommendations, go to the Compaq website:

www.compaq.com

Product Information

The NAS B3000 provides significant performance gains over general-purpose servers by integrating optimized hardware components and specialized software. Integrating NAS devices into the network improves the performance of existing servers because NAS devices are optimized for file-serving tasks.

Product Manageability

The NAS B3000 ships with the following utilities and features that ease the administration tasks associated with managing the system:

- The Rapid Startup Utility is a user-friendly configuration utility that ensures easy configuration.
- The WebUI is a simple, graphical user interface (GUI) that helps with administration tasks.
- The Remote Insight Lights-Out Edition board also provides remote access, sends alerts, and performs other management functions, even if the host server operating system is not responding or the server has lost power.
- Compaq Insight Manager is a comprehensive tool designed to be a key component in the systems management environment. It monitors the operations of Compaq servers, workstations, and clients. Compaq Insight Manger provides system administrators more control through visual interface, comprehensive fault and configuration management, and industry-leading remote management.
- The Rapid Launch Utility allows customer-specific configuration data to be saved to a diskette to configure remote locations.

Product High Availability

The NAS B3000 is specifically designed to perform file-serving tasks for networks. Using industry standard components, redundancy of power supplies, Host-Bus Adapters (HBAs), NICs, fans, and processors ensure reliability.

The clustering ability of the NAS device further ensures continuous data availability, because data being processed by one server head will transition over to the other server head in a failover situation.

Other industry-standard features such as Redundant Array of Independent Drives (RAID) and remote manageability further enhance the overall dependability of the NAS B3000.

The server contains dual 36.4-GB hard drives preconfigured so that the active system volume is mirrored (RAID 1) to the second drive. If one of the internal drives fail, the integrity of the system is preserved, because the system will use the copy of the operating system on the remaining healthy drive. The drives in the server are hot-pluggable, so the failed drive can be replaced while the system is running. When the failed drive is replaced, the system automatically uses the version of the operating system on the healthy drive to rebuild the replacement.

Power supplies can be replaced while the server is running. To ensure redundancy, it is important to connect each power supply to a separate power source. If one power source fails, the server remains operational through the second power source.

Through a seamless, hardware-based, graphical remote console, the Remote Insight Lights-Out Edition board provides the administrator with full control of the server from a remote location. Using a client browser, the administrator can remotely power up, power down, and operate the console. A built-in processor, combined with an external power supply, makes the board independent of the server and the operating system.

Product Scalability

The NAS B3000 offers optimized performance for a growing environment. As the SAN grows, this system can grow with it. Storage capacity can increase as a business grows without downtime or compromised performance.

Deployment Scenarios

The NAS B3000 represents a fusion of SAN and NAS technologies and is designed for deployment in either a no single point of failure (NSPOF) clustered configuration or as a standalone file server. Additionally, the NAS B3000 can integrate into an existing SAN or other servers can join the NAS B3000 SAN.

By employing SAN storage for a NAS server device, the B3000 capitalizes on the efficiency, reliability, and performance of a SAN and extends these advantages to a wider group of systems on the data network through standard network file-sharing protocols.

A SAN deploys storage to servers in a special network through which many servers can access individually-assigned sets of storage from a common set of storage devices. A SAN has a strong advantage over direct attached storage (DAS) because the implementation is network-centered rather than server-centered. The network is specifically designed and implemented for storage. Because SAN storage can be made available to any server on the SAN, it can be quickly redeployed to meet changing needs without any physical rearrangements of cabling, disks, or disk storage enclosures.

SAN storage is partitioned among fibre-channel-connected servers through a process called selective storage presentation (SSP). The SAN administrator chooses and designates segments of SAN storage for the exclusive use of servers by controlling access through the disk controllers of the storage subsystem. The NAS B3000 uses its SAN storage to form large pools from which virtual disks are created. This virtual storage is eventually presented to other servers, workstations, and laptops on the data network in the form of file shares, using industry-standard file-sharing protocols.

As previously stated, the NAS B3000 can be deployed singly or in a NSPOF cluster arrangement, greatly enhancing file service availability.

Typical deployment scenarios include:

- **File server consolidation**

  As businesses continue to expand their information technology (IT) infrastructures, they must find ways to manage larger environments without a corresponding increase in IT staff. Consolidating many servers into a single NAS device decreases the number of points of administration and increases the availability and flexibility of storage space.

- **Multi-protocol environments**

  Some businesses require several types of computing systems to accomplish various tasks. The multi-protocol support of the NAS B3000 allows it to support many types of client computers concurrently.

- **Protocol and platform transitions**

  When a transition between platforms is being contemplated or planned, the ability of the NAS B3000 to support most popular file-sharing protocols allows companies to continue to invest in file storage space without concerns about obsolescence. For example, an administrator planning a future transition from Windows to Linux can deploy the NAS B3000 with the confidence that it can support both CIFS and NFS simultaneously, thereby assuring not only a smooth transition, but also a firm protection of their investment.

- **Remote office deployment**

  Frequently, branch offices and other remote locations lack dedicated IT staff members. An administrator located in a central location can use the WebUI of the NAS B3000, Microsoft Terminal Services, and other remote administration methods to configure and administer all aspects of the NAS B3000.

Environment Scenarios

The NAS B3000 is deployed into one of two modes:

- Workgroup
- Domain (Windows NT Domain or Active Directory Domain)

The NAS B3000 uses standard Windows user and group administration methods in each of these environments. For procedural instructions on managing users and groups, see the "User and Group Management" chapter later in this guide.

Regardless of the deployment, the NAS B3000 integrates easily into multi-protocol environments, supporting a wide variety of clients. The following protocols are supported:

- Common Internet File System (CIFS)
- Network File System (NFS)
- Novell Core Protocol (NCP)
- Hypertext Transfer Protocol (HTTP)
- File Transfer Protocol (FTP)
- AppleTalk for Macintosh (AFP, also called MAC)

Workgroup

In a workgroup environment, users and groups are stored and managed separately, on each member server of the workgroup. Workgroups are typical for very small deployments where little or no computing environment planning is required. Workgroup environments cannot support clustered configurations of the NAS B3000.

NOTE: In a clustered deployment, the clusters must be members of a domain. Therefore, workgroup environments are supported only in non-clustered deployments.

Domain

When operating in a Windows NT or Active Directory domain environment, the NAS B3000 is a member of the domain and the domain controller is the repository of all account information. Client machines are also members of the domain and users log on to the domain through their Windows-based client machines. The domain controller also administers user accounts and appropriate access levels to resources that are a part of the domain. Additional information about planning for domain environments can be found at the Compaq *ActiveAnswers*™ website in the eBusiness Infrastructure solutions area:

www.compaq.com/ActiveAnswers/

The NAS B3000 obtains user account information from the domain controller when deployed in a domain environment. The NAS B3000 itself cannot act as a domain controller.

User Interfaces

There are several user interfaces that administrators can use to access and manage the NAS B3000. Two of these interfaces are:

- NAS B3000 WebUI
- NAS B3000 Microsoft Management Console (MMC)

Each interface contains the same or similar capabilities, but presents them in a different manner. Each of these interfaces are illustrated in the following sections.

NAS B3000 Web-Based User Interface

The WebUI provides for system administration, including cluster management, user and group management, share management, and local storage management. In addition to dialog boxes, the WebUI includes wizards to guide the administrator while performing repetitive tasks such as creating shares.

To access the WebUI, launch a Web browser and enter the following in the address field:

http://<your NAS machine name or IP Address>:3201/

Extensive online help for the WebUI is available by clicking Help on the primary WebUI screen.

The primary screen of the WebUI is illustrated in Figure 1-1.

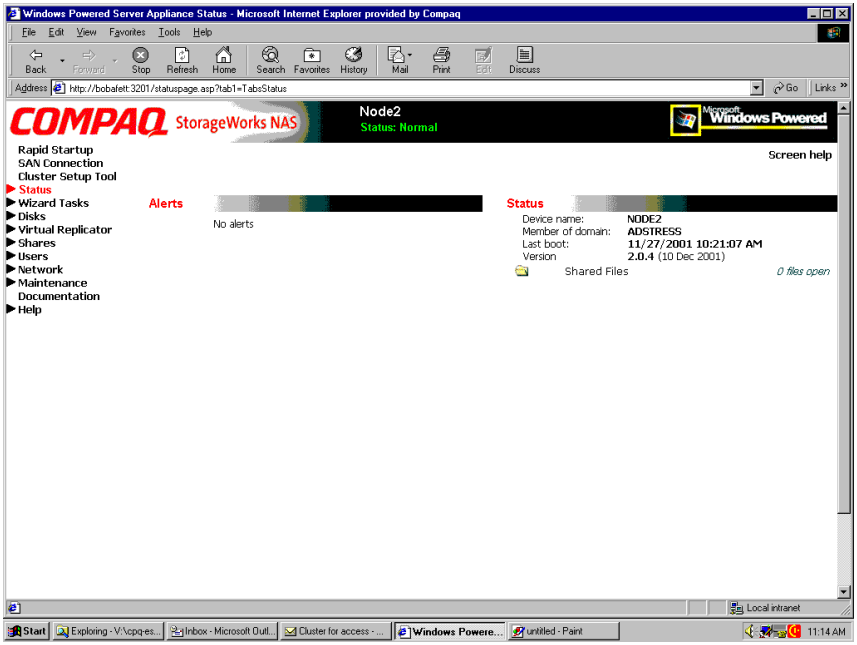


Figure 1-1: Primary WebUI screen

As shown in Figure 1-1, the following areas are administered through this interface:

- Rapid Startup
- SAN Connection Wizard
- Cluster Setup Tool
- Status Information
- Wizard Tasks
- Disks
- Virtual Replicator
- Shares
- Users

- Network
- Cluster Management
- Maintenance
- Help

Each of these administration areas is briefly discussed in the following paragraphs.

Rapid Startup

Use this utility to enter system setup and configuration information.

SAN Connection Wizard

This utility completes the configuration of the NAS device, and is automatically activated during the Rapid Startup and the RapidLaunch processes. While this is an important step of configuring the NAS B3000, no user input is required.

Cluster Setup Tool

This tool is automatically activated by the Rapid Startup and Rapid Launch processes.

The Cluster Setup Tool (CST) is a guided checklist containing all of the steps required to cluster two nodes together.

Status

The Status option displays system information, including disk status data and system information

Wizard Tasks

Wizards ease administration by guiding the administrator through common, repetitive system tasks. Primary administration tasks of the NAS B3000 include setting up and managing: shares, users and groups, system storage, and the cluster. A wizard is provided for each of these management tasks.

Disks

Use this option to manage disks, volumes, and disk quotas. The Compaq ACU is included in this menu option. The ACU is used to create and manage RAID arrays and LUNs, as well as configure the MSA1000 storage subsystem.

See the "Physical Storage Management" chapter for procedural information regarding managing the arrays and LUNs using ACU.

Virtual Replicator

VR provides advanced, logical-storage management capabilities in Windows-based computing environments. Innovative storage management features simplify storage configuration and management, and enhance availability and scalability.

VR uses pools, virtual disks, and snapshots to manage storage. See the "Virtual Storage Management" chapter for information on VR.

Shares

The administrator creates folders and shares to control access to files. When a share is created, the administrator indicates the protocols that can be supported by that share as well as the users and groups of users that have access. Protocol parameters are entered in this Shares option. See the "Folder and Shares Management" chapter for additional information.

Users

When deployed as a non-clustered device, the administrator uses this option to manage local users and groups. Local users and groups are discussed in the "User and Group Management" chapter.

Network

The Network option contains system settings, including system identification, global settings, interfaces settings, administration settings, Telnet settings, and SNMP settings.

Cluster Management

Use this option to enter cluster system settings, and manage cluster resources and groups, including file shares. This option is not displayed in a single-node deployment. See the “Cluster Management” chapter for detailed information.

Maintenance

Some of the maintenance tasks include setting date and time, performing system restarts and shutdowns, viewing audit logs, accessing Terminal Services, and setting up Email alerts. SecurePath is set up in the Maintenance screen.

Help

This option contains help information for the WebUI.

NAS B3000 Microsoft Management Console

The NAS B3000 includes a console screen that shows only those items required for NAS administration.

The functionality of the MMC is similar to the WebUI, but the contents and procedures are arranged and performed differently. The MMC is shown in Figure 1-2.

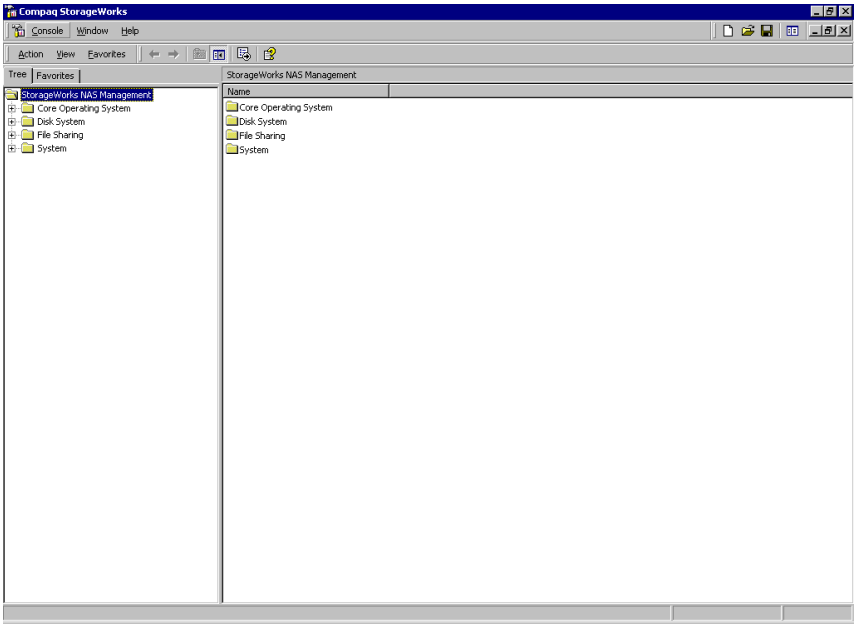


Figure 1-2: Microsoft Management Console

To access the MMC from the WebUI, select **Maintenance**, **Terminal Services**. A session in Terminal Services is opened, and the NAS device desktop is displayed. Click the icon for the MMC.

From within the MMC, the following folders are available:

- Core Operating System
- Disk System
- File Sharing
- System

Core Operating System

Use this folder to manage local users and groups, access performance logs and alerts, and manage the Event Viewer.

Disk System

Storage management functions are contained in this folder. These functions are managed by the Virtual Replicator. Virtual Replicator is used to configure storage pools, virtual disks, and snapshots.

File Sharing

The File Sharing folder contains modules for the configuration of file sharing exports. CIFS and UNIX file shares are managed though this folder.

System

The System folder contains system summary information.

2

Setup Completion and Basic Administrative Procedures

This chapter continues the process of setting up the system that was started using the *StorageWorks NAS B3000 by Compaq Quick Start Guide* by discussing additional setup procedures and options.

Basic system administration functions are also included in this chapter.

Unless otherwise instructed, all procedures are performed using the NAS Web-Based User Interface (WebUI.)

The following topics are included in this chapter:

- Setup completion
  - — Setting up Ethernet NIC teams (optional)
  - — Setting up and using SecurePath
  - — Clustering the NAS B3000
  - — Managing system storage
  - — Creating and managing users and groups
  - — Creating and managing file shares
  - — Configuring data replication software

- Basic administrative procedures
  - — Setting the system date and time
  - — Powering down and restarting the server
  - — Viewing and maintaining audit logs
  - — Using terminal services
  - — Setting up email alerts
  - — Changing system network settings

Setup Completion

After the NAS device is physically set up and the basic configuration is established, additional setup steps must be completed. Depending on the deployment scenario of the NAS device, these steps may vary.

Additional setup steps may include:

- Setting up Ethernet NIC teams (optional)
- Setting up and using SecurePath
- Clustering the NAS B3000
- Managing system storage
- Creating and managing users and groups
- Creating and managing file shares
- Configuring data replication software

Each of these setup steps is discussed in the following sections.

Setting up Ethernet NIC Teams (Optional)

The NAS B3000 is equipped with the Compaq Network Teaming and Configuration (CPQTeam) utility. The CPQTeam utility allows administrators to configure and monitor Ethernet network interface controllers (NIC) teams in a Windows-based operating system. These teams provide options for increasing fault tolerance and throughput.

Fault tolerance provides automatic redundancy. If the primary NIC fails, the secondary NIC takes over. Load Balancing provides the ability to balance transmissions across NICs.

NOTE: The NAS B3000 does not ship with NIC teaming set up.

IMPORTANT: Installing NIC teaming requires a restart of the server.

Procedures include:

- Installing the CPQTeam utility
- Opening the CPQTeam utility
- Adding and configuring NICs in a team
- Configuring the NIC team properties
- Checking the status of the team

Installing the CPQTeam Utility

Before using the CPQTeam utility, it must be installed. To do this:

1. From the WebUI, use Terminal Services to go to the NAS B3000 desktop. Double click the **CPQTeam Setup** icon on the desktop.

   If the CPQTeam icon is not displayed, enter the following command:

   `c:\compaq\nicteam\cpqsetup.exe`

2. When the following message box is displayed, click **Install**.

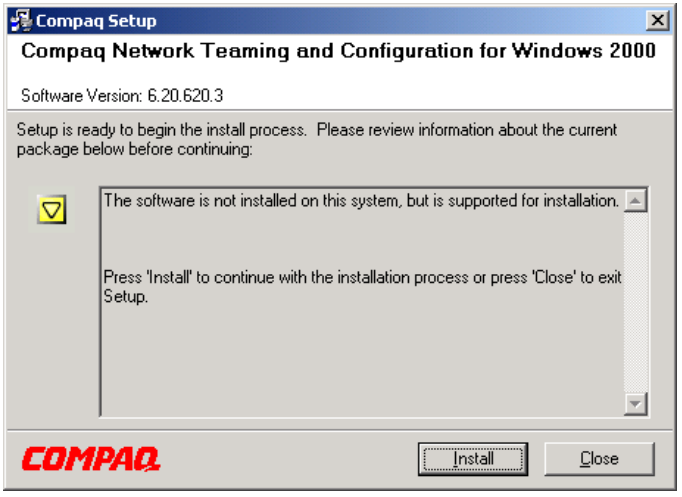


Figure 2-1: Installing CPQTeam

3. When the installation process is complete, the following screen is displayed. Click **Close**.

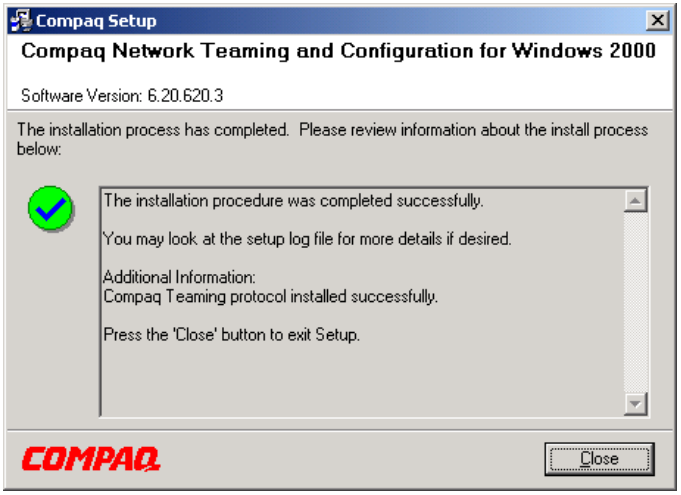


Figure 2-2: CPQTeam installation complete

4. Restart the system.

Opening the CPQTeam Utility

The CPQTeam utility is now accessible from the Windows toolbar at the bottom of the NAS B3000 desktop. To open the CPQTeam utility, click the Tray icon.

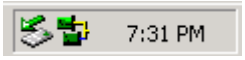


Figure 2-3: CPQTeam utility icon

Adding and Configuring NICs in a Team

Before a NIC is teamed, verify the following:

- The NICs must be on the same network.
- The NICs must be DHCP-enabled and the DNS server address must be left blank.

  NOTE: The Teaming utility becomes unstable if static IP addresses, subnets, and DNS addresses are set before Teaming.

- Duplex and speed settings must be set to use the default values.

To team the NICs:

1. Open the CPQTeam utility. The Network Teaming and Configuration dialog box is displayed. Included in the screen display is the type of NIC and the slot and port used.

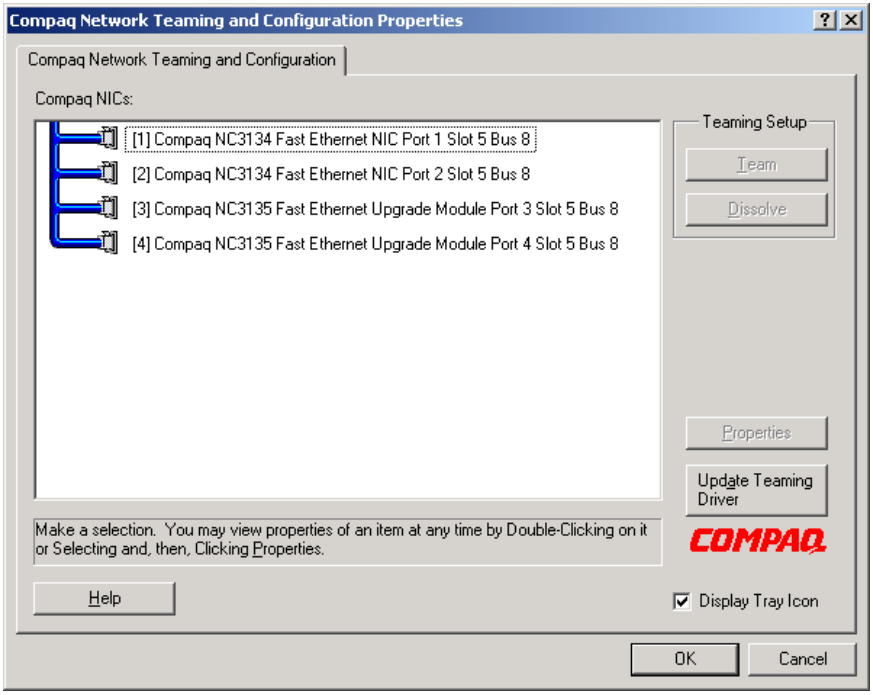


Figure 2-4: CPQTeam Properties dialog box

2. Highlight the NICs to team.

   IMPORTANT: Do not select NIC Bus 0.

3. Click the **Team** button. The **Teaming Controls** tab of the Properties dialog box is displayed.

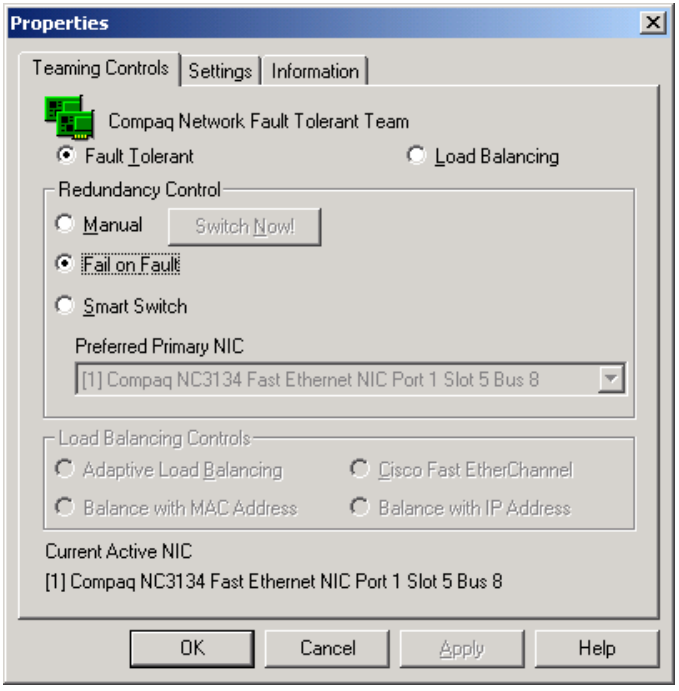


Figure 2-5: NIC Properties, Teaming Controls tab, Fault Tolerant option

4. Configure the team by choosing either **Fault Tolerance** or **Load Balancing**.

   The fault tolerance and load balancing options are discussed in the following sections.

Fault Tolerance

The fault tolerance teaming option provides three redundancy control options:

- **Manual**—This setting lets the user change from a Primary NIC to a Secondary NIC only when the user clicks **Switch Now!**

  NOTE: The Switch Now! option is disabled until the user selects **Manual** and then clicks **Apply**.

- **Fail on Fault**—This setting automatically switches from a Primary NIC to a Secondary NIC when the Primary NIC fails.
- **Smart Switch**—This setting lets a member of a team be selected as the preferred Primary Smart Switch NIC. As long as this NIC is operational, it is always the active NIC. If the NIC fails and it is eventually restored or replaced, it automatically resumes its status as the active NIC.

  NOTE: Smart Switch is the recommended choice for fault tolerance.

Detailed information about configuring teams for fault tolerance can be found in the CPQTeam Utility help.

Load Balancing

The load balancing teaming option provides four load balancing control options:

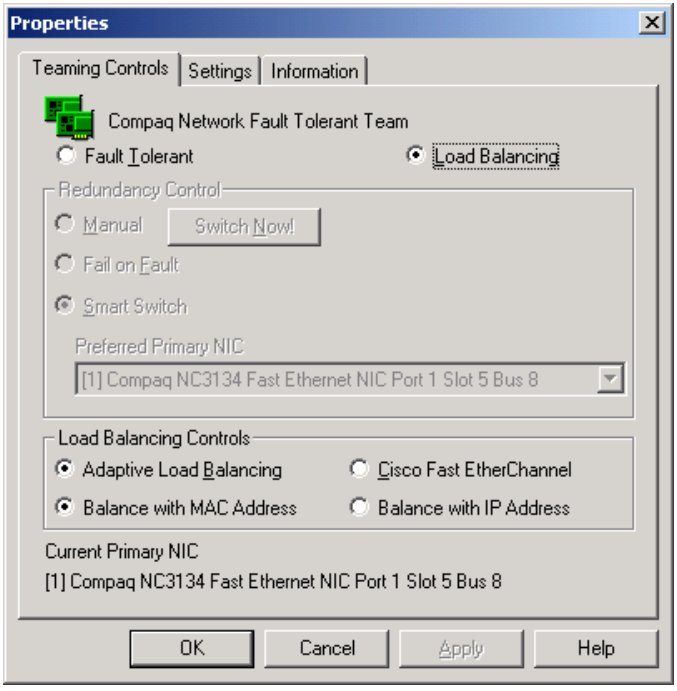


Figure 2-6: NIC Properties, Teaming Controls tab, Load Balancing option

Detailed information about these four load-balancing teaming options can be found in the CPQTeam help.

- **Adaptive Load Balancing (ALB)**—Creates a team of NICs to increase a server transmission throughput and works with any 100Base-TX or Gigabit switch. With ALB, NICs can be grouped into teams to provide a single, virtual NIC with increased transmission bandwidth. To use ALB, link at least two teamed Compaq NICs in the server to the same network switch.
- **Cisco Fast EtherChannel (FEC)**—This feature creates a team of NICs to increase transmission and reception throughput. Unlike ALB, Cisco FEC can be configured to increase both transmission and reception channels between the server and switch. For example, a Cisco FEC team containing four Compaq Fast Ethernet NICs configured for full-duplex operation provides an aggregate maximum transmit rate of 400 Megabits per second (Mbits/s) and an aggregate maximum receive rate of 400 Mbits/s resulting in a total bandwidth of 800 Mbits/s.
- **Balance with MAC Address**—This feature allows load-balancing of IP packets among the teamed NICs using the last four bits of the MAC Address. (See Note.)
- **Balance with IP Address**—This feature allows load-balancing of IP packets among the teamed NICs using the last four bits of the IP Address. (See Note.)

NOTE: The Teaming utility can load balance IP packets among the teamed NICs installed in a server. The primary NIC in the team receives all incoming packets. The choice is available to load balance with the source MAC address (the address transmitted form the workstation) or the source IP address.

Using the last four bits of either source address, the teaming driver algorithm assigns this source address to the port of one of the NICs in the team. This port is then used to transmit all packets destined for that source address. If there are four NICs in the team, the packets are received b the primary NIC on the team. The packets are retransmitted through on of the four ports.

5. After entering the teaming control settings, click **OK**.

   Warnings similar to the following are displayed.

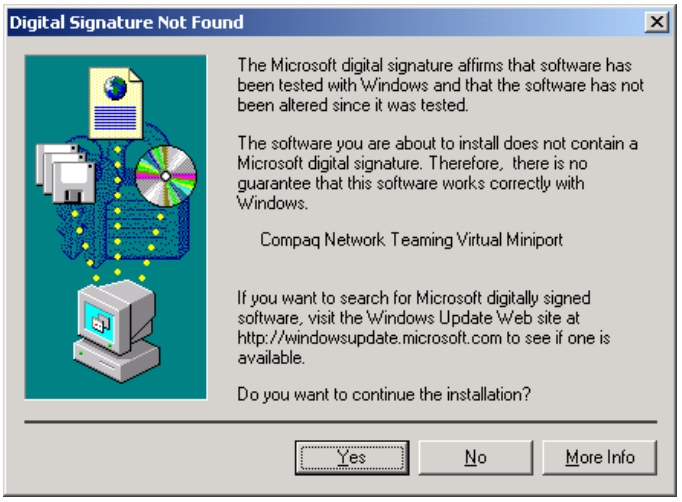


Figure 2-7: License Warning dialog box

6. Click **Yes** to continue. The following screen is displayed, indicating that there are additional procedures to perform in the NIC teaming process.

Figure 2-8: CPQTeam dialog box

7. Click **OK** to continue.

8. A restart dialog box is displayed, indicating that the system must now be restarted. Close all other open applications, and then click **Yes**.

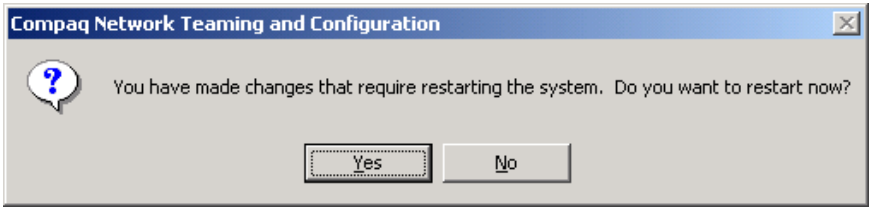


Figure 2-9: CPQTeam Restart dialog box

Configuring the NIC Team Properties

At this point, the NICs are teamed but are not completely configured. Additional procedures include:

- Renaming the teamed connection
- Selecting the option to show an icon on the taskbar
- Configuring the TPC\IP Protocol on the new team

Renaming the Teamed Connection

The assigned name for the new NIC team connection is "Local Area Connection *X*," where *X* represents the next available connection number generated by the system. Compaq recommends changing this name to a more meaningful name, such as "NIC Team."

To change the name of the connection:

1. From the desktop, right-click the **My Network Places** icon, then click **Properties**. The Network and Dial-up Connections screen is displayed.
2. Move the cursor over each connection icon to view the pop-up box of the icon's name. Locate "Compaq Network Teaming Virtual Miniport."
3. Right-click the connection icon for "Compaq Network Teaming Virtual Miniport," and select **Rename**. Enter a name that is more descriptive than "Local Area Connection X," such as "NIC Team."

Selecting the Option to Show a Connection Icon on the Taskbar

To show a connection icon:

1. In the **Network and Dial-up Connections** screen, double-click the NIC Team connection, and then click **Properties**.
2. At the bottom of the screen, select **Show icon in task bar when connected**, and then click **Close**.

Configuring the TCP/IP Protocol on the New Team

After teaming the NICs, a new virtual network adapter for the team is automatically created. However, the team's IP address, subnet mask, and DNS server address information must be entered.

To enter the TCP/IP address information for the team:

1. From the desktop, go to the **Network and Dial-up Connections** screen and click **Properties**. Right-click the NIC Team icon and then select **Properties**. A screen similar to the following is displayed.

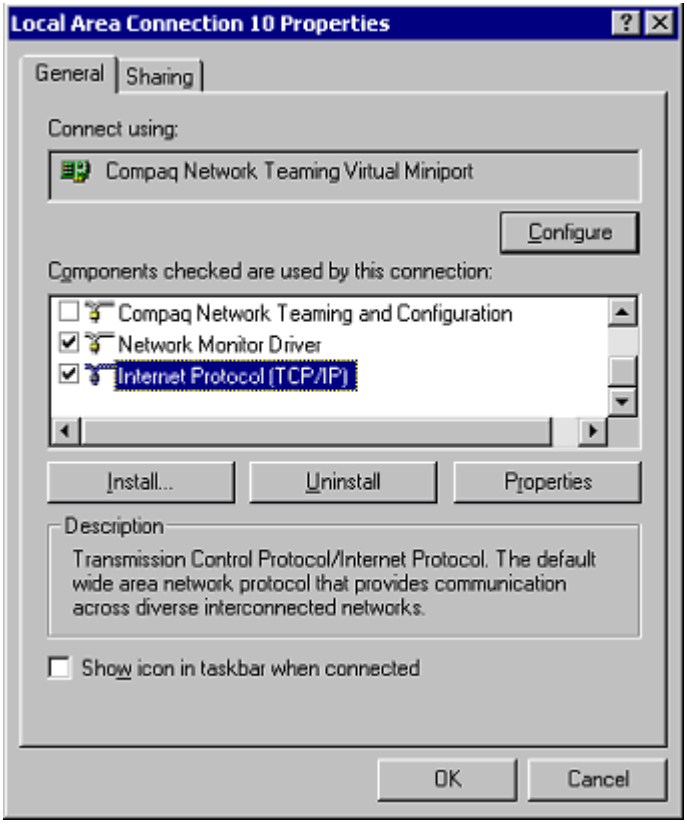


Figure 2-10: NIC Team Properties dialog box

2. Use the arrows and the scroll bar on the right of the screen to scroll through the **Components** list.

3. Click **Internet Protocol (TCP\IP)** and then click **Properties**. The following screen is displayed:

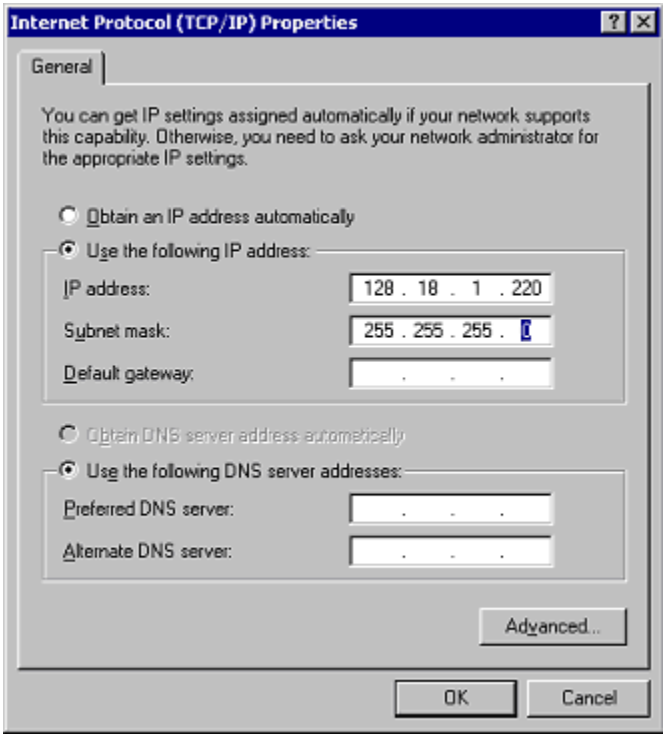


Figure 2-11: NIC Team TCP\IP Properties dialog box

IMPORTANT: If a NIC is teamed, do not modify the TCP/IP Protocols for the individual NIC ports.

4. *For teamed NICs*, select **Obtain an IP address automatically**.

   For un-teamed NICS, select **Use the following IP address**, and enter the IP address and subnet mask. If desired, enter the default gateway.

5. Click **OK**. The Ethernet Team should be working.

Checking the Status of the Team

To check the status of the Ethernet Team, open the CPQTeam utility. The Configuration Properties screen is displayed, showing the teamed NICs.

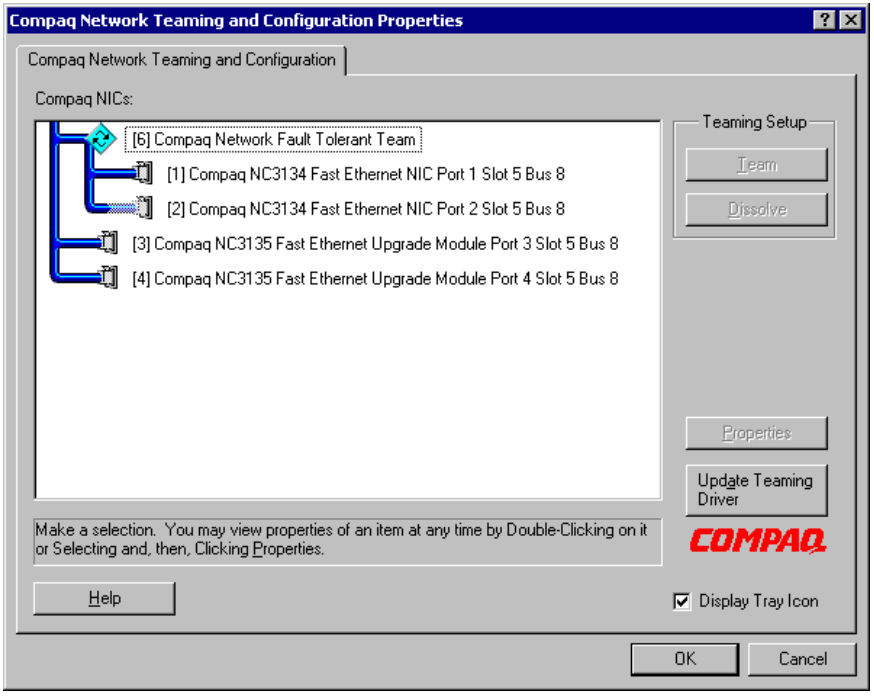
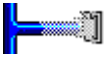
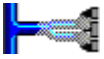
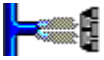


Figure 2-12: Updated CPQTeam Properties dialog box

NIC Teaming Troubleshooting

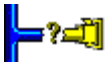
Problems with the NIC teaming feature are diagnosed by the connection icons displayed in the Compaq Network Teaming and Configuration dialog box. The following table lists the error icons for RJ-45 and Gigabit Fibre NICs.

Table 2-1: NIC Teaming Troubleshooting

RJ-45	Gigabit Fibre	Description
		**Active OK**—The NIC is operating properly. The driver is installed in the registry and is loaded. If the NIC is a member of a team, the NIC is active.
		**Installed inactive**—The NIC is installed and is OK, but is not active
		**Cable fault**—The driver is installed in the registry and is loaded. The broken cable indicator means that the cable is unplugged, loose, broken, or the switch or hub is not operating properly. If this icon is displayed, check all network connection and make sure the hub/switch is working properly. When the connection is restored, this icon will change.
		**Inactive cable fault**—A cable fault has occurred while the NIC was inactive.

continued

Table 2-1: NIC Teaming Troubleshooting *continued*

RJ-45	Gigabit Fibre	Description
		**Hardware failure**—The driver is installed in the registry and is loaded. The driver is reporting a hardware problem with the NIC. This indicates a serious problem. Contact your authorized Compaq service provider.
		**Unknown**—The server is unable to communicate with the driver for the installed NIC. The NIC is installed in the registry, but the driver is not. This error occurs when the NIC has been installed but the server has not been restarted. If this problem persists after the server has been restarted, the driver has not been loaded or the Advanced Network Control utility is unable to communicate with the driver Note: Only NIC assigned as members of a team are displayed as Unknown. If a teamed NIC is turned off, it displays as Unknown.
		**Disabled**—The NIC has been disabled through the Device Manager or NCPA.

For more advanced problems with NIC Teaming, refer to the help section in the CPQTeam utility.

Setting Up and Using SecurePath

This section provides basic information about SecurePath for use in clustered and non-clustered deployments of the NAS B3000. For additional information that is unique to a clustered environment, see the "Cluster Management" chapter.

The following topics are discussed in this section:

- Overview of SecurePath
- Overview of SecurePath Manager
- Setting up SecurePath
- Managing storagesets and paths

Overview of SecurePath

SecurePath is a high-availability software product that monitors and controls redundant data paths from the NAS B3000 server to the MSA1000 storage subsystems. Redundant hardware, advanced RAID technology, and automated failover capability (in a cluster) are also used in the NAS B3000 configuration to further enhance fault tolerance and availability. SecurePath eliminates the host bus adapter and interconnect hardware as single points of failure in the storage subsystem. SecurePath allows the storage subsystem to be cabled to two or more Fibre channel switch paths, using two separate host bus adapters in each server. SecurePath monitors each path and automatically reroutes I/O to a functioning alternate path(s) should an adapter, cable, switch, or controller failure occur.

In a no single point of failure (NSPOF) configuration, each server head contains two fibre host bus adapters (HBAs) for dual redundancy. Each HBA connects to one of the two SAN switches through a fibre cable. In turn, the SAN switches connect to a port on the MSA1000. The NAS B3000 provides multiple paths to the data through these dual redundant fibre connections.

Failure detection is designed to prevent false or unnecessary failovers. The SecurePath utility provides continuous monitoring capability and identifies failed paths and storage units that have been failed over from the other controller. A storage unit refers to a logical container in which RAID arrays reside.

SecurePath consistently monitors the health of available storage units and physical paths through its path verification process. A redundant physical connection defines a physical path in SecurePath Manager. Each path originates at a unique HBA port in a server, and ends at a unique port on MSA1000.

Overview of SecurePath Manager

SecurePath Manager (SPM) is used to monitor and manage the SecurePath environment. SPM displays specific information about the state of RAID storage systems and I/O paths, both of which are configured through the MSA1000. Use SPM to set various properties and modes associated with a managed storage profile and to set failback policy. SPM automatically detects and indicates path failures and provides the capability to distribute and move RAID arrays across controller pairs for static load balancing.

Setting up SecurePath

To access the SecurePath Manager, from the WebUI, select **Maintenance, SANworks SecurePath**. A session in Terminal Services session is opened to allow access to SecurePath.

Figure 2-13 illustrates the SecurePath Manager screen display.

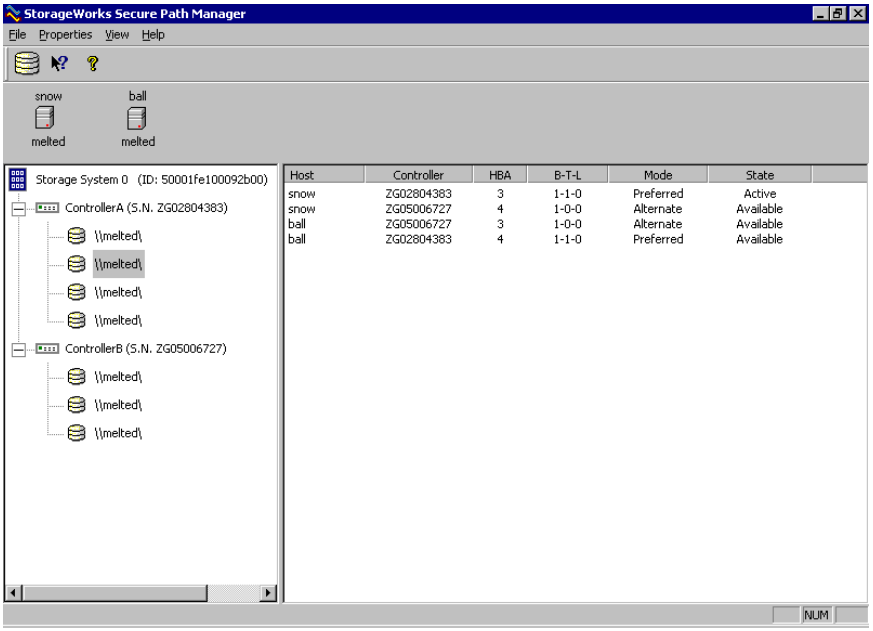


Figure 2-13: SecurePath Manager screen

Within SPM, physical storage objects are displayed in the frame on the left side, and the paths to those components are displayed in a frame on the right side. The administrator selects the method SPM uses to identify storagesets.

Controlling the Screen Display

Click the **View** drop-down menu. Options include:

- **Disk LUN UID** – is a unique 128-bit value assigned by SecurePath.
- **Disk Number** – refers to the logical disk number assigned by the Windows Disk Administrator.
- **Drive Letter** – refers to the logical drive letter assigned by the Windows Disk Administrator.
- **Bus/Target/LUN** – is the physical address representing the connection to the host server.

- **Volume Label** – is the volume label assigned by the user with Windows Explorer or Disk Administrator.

NOTE: If the drive letter or disk number options are selected, then the presentation of information is not accurate with regards to SANworks Virtual Replicator. Because advanced disk virtualization is being used, the pool and virtual disk information is not represented within SecurePath Manager. If the volume label option is selected, only the labels of disks created within logical volume manager are displayed.

SPM always displays the owning host name, or cluster name (for clustered hosts), along with the chosen storageset identifier. When a storageset from the Storage System view is highlighted, SPM displays information about the physical paths that have been configured for access to that storageset in the frame on the right. The Physical Path view includes the following information for each path:

- **Host** – refers to the SecurePath host system, with an established access path to the storageset.
- **Controller** – is the RAID storage system controller servicing the path.
- **HBA** – is the physical port number of the HBA servicing the path. The HBA is a relative number determined by Windows order of discovery for adapters on that host.
- **B-T-L** – is the physical bus, target, and logical unit number (LUN) describing the path address for the storageset.
- **Mode** – is a user-selectable parameter that specifies path behavior during normal and failure conditions.
- **Path mode** - can be set to Preferred, Alternate, Pre-Offline (Preferred and Offline), or Alt-Offline (Alternate and Offline).
- **State** – refers to the current status of the path.

NOTE: In a clustered deployment, the Quorum Disk always displays only one active path, while other storagesets display two active paths. This is directly related to the fact that the Quorum Disk is owned by only one node at a time, therefore limiting the paths to one active, one preferred, and two alternates.

Modifying Storage Profile Properties

This section discusses settings that can be altered for a storage profile. It is important to note that these properties have a global effect on all resources managed by an SPM storage profile.

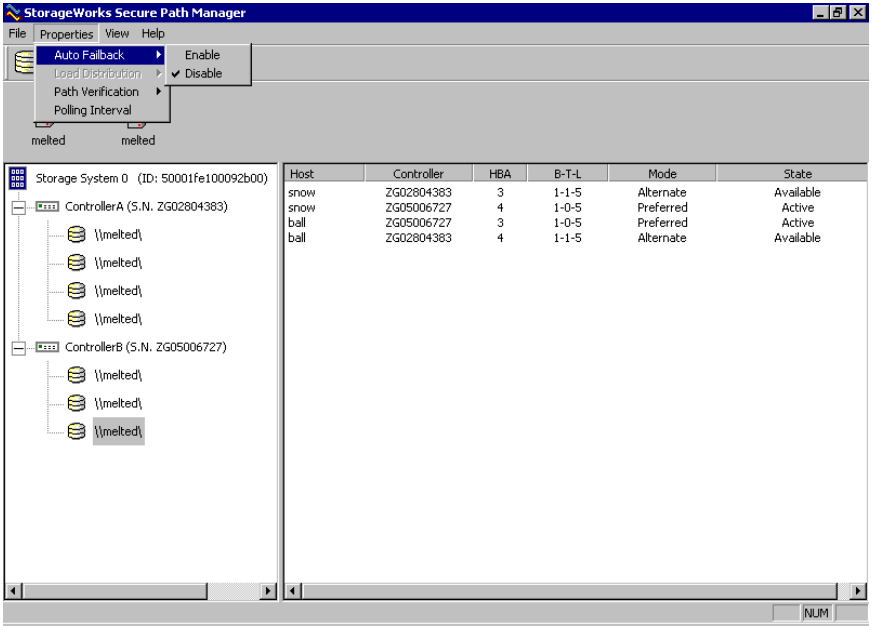


Figure 2-14: SecurePath Manager, Properties tab

To modify SecurePath Agent properties, click the **Properties** pull-down menu. The following options are available:

- **Auto Failback** (default = disabled). When Auto Failback is enabled, all storagesets that have failed over to an alternate path will automatically fail back to their preferred path when access to that path is restored. Storagesets fail back automatically only if I/O operations to those storagesets are in progress. Auto failback enabled in conjunction with Path Verification permits failback to occur for inactive storagesets.

- **Load Distribution** (default = disabled). Load Distribution allows multiple paths between a host and a specific storageset to be used in parallel for I/O, maximizing performance potential.

  NOTE: Load Distribution is disabled in Microsoft Cluster Server (MSCS).

- **Path Verification** (default = enabled). With Path Verification enabled, SecurePath periodically runs diagnostics on all preferred and alternate paths to determine their current state. If a path is diagnosed with a problem that would prevent reliable I/O operations to complete, it is marked as FAILED and no further I/O operations are permitted on that path.
- **Polling Interval** (default = 90 seconds). This setting determines the rate at which SPM will request configuration change information from the SecurePath Agent(s) in the storage profile. The Polling Interval setting affects only the rate at which displayed information is updated and has no effect on the current configuration. The polling interval is user-selectable from a minimum of 5 seconds to a maximum of 30 minutes.

Managing Storagesets and Paths

The following actions can be performed on storagesets and paths managed by SPM:

- Moving a storageset
- Making a path alternate
- Making a preferred path
- Changing a preferred path
- Making a path offline
- Making a path online
- Verifying a path
- Repairing a path

Figure 2-15 displays all of the options. (In this image, only the **Make Offline** and **Verify Path** options are highlighted.)

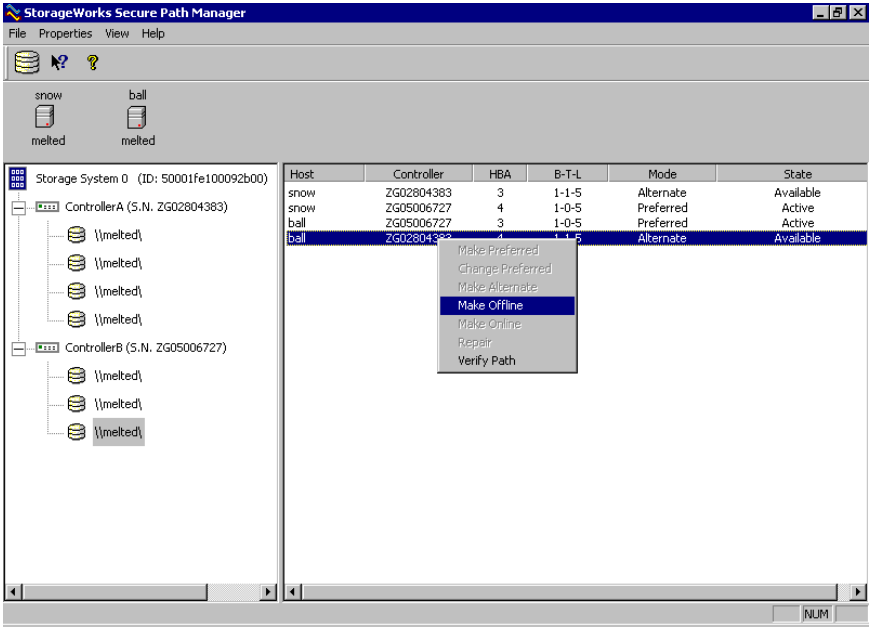


Figure 2-15: Action options for a path

Moving a Storageset

Select **Move a Storageset** to change the ownership from the current RAID array controller to another. This action is useful to load balance I/O across controllers or to return a failed over storageset manually to its preferred path when Auto-Failback has been disabled. There are two methods available to move a storageset:

- Click the drive to highlight it in the storage system view.
- Drag the drive to the other controller or right-click to select **Move to Other Controller**.

Making a Path Alternate

To disable I/O operations to one or more paths:

1. Select **Make a Path Alternate** when Load Distribution is enabled.
2. Click the preferred path to change.
3. Select **Make Alternate**.

Making a Path Preferred

To re-enable I/O operations to a path that has previously been disabled:

1. Select **Make a Path Preferred** when Load Distribution is enabled.
2. Click the alternate path to change.
3. Select **Make Preferred**.

Changing a Preferred Path

When there are multiple paths available to a storageset on the same controller, and a new preferred path is needed for normal I/O operations.

1. Select **Change a Preferred Path** when Load Distribution is disabled.
2. Click the alternate path to change to Preferred.
3. Right-click **Change Preferred**.

Making a Path Offline

To prevent a path from being used for any I/O operations under any circumstances: (For instance, use the offline mode to replace or repair a storage interconnect component.)

1. Select **Make a Path Offline**.
2. Click the path to take offline.
3. Right-click to select **Make Offline**. If the path was an alternate, its mode will change to Alt-Offline. If the path was preferred, its mode will change to Pre-Offline.

Making a Path Online

To return a path that is currently in the alt-offline or pre-offline mode to its original mode:

1. Select **Make a Path Online**.
1. Click a path in the Alt-Offline or Alt-Online mode.
2. Right-click to select **Make Online**. If the path was Alt-Online, its mode will change to Alternate. If the path was Pre-Offline, its path will change to Preferred.

Verifying a Path

To have SPM determine the current state of a path:

1. Select **Verify a Path**.
2. Click the path to view.
3. Right-click **Verify Path**. SPM will generate a pop-up message when the verification completes to indicate the result of the operation. No state change occurs as a result of this operation.

Repairing a Path

To have SPM restore access to a failed path after the problem has been corrected:

1. Select **Repair a Path**.
2. Click a path that is in a failed state.
3. Right-click **Repair Path**. If the repair action completes successfully, the path state changes to Available if its mode is Alternate. The path state changes to Active if its mode is Preferred.

Clustering the NAS B3000

The NAS B3000 is equipped with the Cluster Setup Tool (CST), which guides the administrator through the processes of setting up a cluster.

During initial system setup, the Rapid Startup program prompts the administrator for system information, including a checkbox to indicate if the NAS B3000 is being deployed as a cluster.

If the clustering checkbox is selected during Rapid Startup, the CST is automatically displayed. Otherwise, this setup option can be selected from the WebUI main menu.

See the "Cluster Management" chapter for complete information on:

- Cluster definitions
- CST
- Cluster storage management
- Cluster administration procedures
- Cluster resource and group management

Managing System Storage

The primary task after the basic configuration of the NAS Device is completed is the planning and the managing of the storage.

Storage management is discussed in the following chapters:

- "Storage Management Overview" includes information on:
  - Physical storage
  - Virtual storage
- "Storage Management Planning" includes information on:
  - Fundamental storage configuration
  - Physical storage planning
  - Virtual storage planning
- "Physical Storage Management" includes information on:
  - Hard drive management
  - Array and LUN management
- "Virtual Storage Management" includes information on:
  - Storage Management Wizard
  - Pool management
  - Virtual disk management
  - Snapshot management
  - Policy management
  - Drive quotas

Creating and Managing Users and Groups

User and group information and permissions determine whether a user can access files. If the NAS device is deployed into a workgroup environment, this user and group information is stored locally on the device. By contrast, if the NAS device is deployed into a domain environment, user and group information is stored on the domain.

To enter local user and group information, see the "User and Group Management" chapter.

The following information is included in this chapter:

- Domain compared to workgroup environments
- Workgroup user administration
  - — Adding new users
  - — Deleting users
  - — Modifying user properties
- Workgroup group administration
  - — Adding new groups
  - — Deleting groups
  - — Modifying group properties — including group members

Creating and Managing File Shares

Files shares must be set up, granting and controlling file access to users and groups. See the "Shares Management" chapter for complete information on managing file shares.

The following information is included in this chapter:

- Managing folders
  - — Creating new folders
  - — Deleting new folders
  - — Modifying folder properties
- Managing shares
  - — Creating new shares
  - — Deleting shares
  - — Modifying share properties
- Managing sharing protocol settings
  - — Enabling and disabling protocols
  - — Modifying protocol settings for Common Internet File System (CIFS), File Transfer Protocol (FTP), Hypertext Transfer Protocol (HTTP)

UNIX-specific information is discussed in the "UNIX File System Management" chapter.

Configuring Data Replication Software

Data replication is the process of making a copy of system data. *StorageWorks* NAS Data Copy is a real-time data replication and failover software product that augments existing data protection and tape backup strategies. This product is not intended to replace regular tape backups.

Using NAS Data Copy, mission-critical data and data that must be protected is marked. NAS Data Copy replicates this data in real-time from the production machine (source) to a backup machine (target). The target machine can be either on-site or off-site. After the initial copy-out, NAS Data Copy monitors any changes to the specified data files and sends only the changes to the target machine.

NAS Data Copy can operate in many different system environments, including:

- **Single machine**—Source and target components are loaded on the same machine, allowing data to be replicated from one location to another on the same machine.
- **One-to-one**—One target machine, having no production activity, is dedicated to support one source machine. An alternative one-to-one scenario is when each machine acts both as a source and a target, actively replicating data to each other.
- **Many-to-one**—Many source machines are protected by one target machine.
- **One-to-many**—One source machine sends data to multiple target machines. The target machines may or may not communicate with each other.
- **Chained**—One or more source machines send replicated data to a target machine that in turn acts as a source machine and sends selected data to a final target machine.

NAS Data Copy is supported for all deployments of the NAS B3000, including stand-alone and clustered device deployments. In clustered deployments, NAS Data Copy must be properly configured on each node of the cluster.

A temporary license of NAS Data Copy is included in the NAS B3000 software. To access a permanent user license, order the NAS Data Copy kit from Compaq. Further information and user instructions about NAS Data Copy can be found in the *NAS Data Copy Users Guide,* located in the online help menus and at the Compaq website.

Basic Administrative Procedures

Basic administrative procedures include:

- Setting the system date and time
- Powering down and restarting the server
- Viewing and maintaining audit logs
- Using terminal services
- Setting up email alerts
- Changing system network settings

These functions are performed in the **Maintenance** menu of the WebUI.

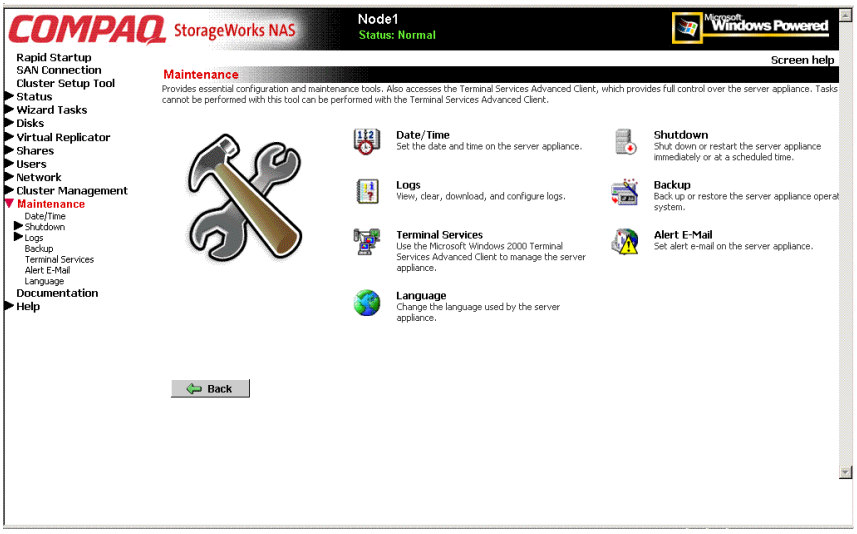


Figure 2-16: Maintenance menu

Setting the System Date and Time

To change the system date or time:

1. From the WebUI, select **Maintenance** and **Date/Time**. The **Date and Time Settings** dialog box is displayed.
2. Enter the new values and then click **OK**. The **Maintenance** menu is displayed.

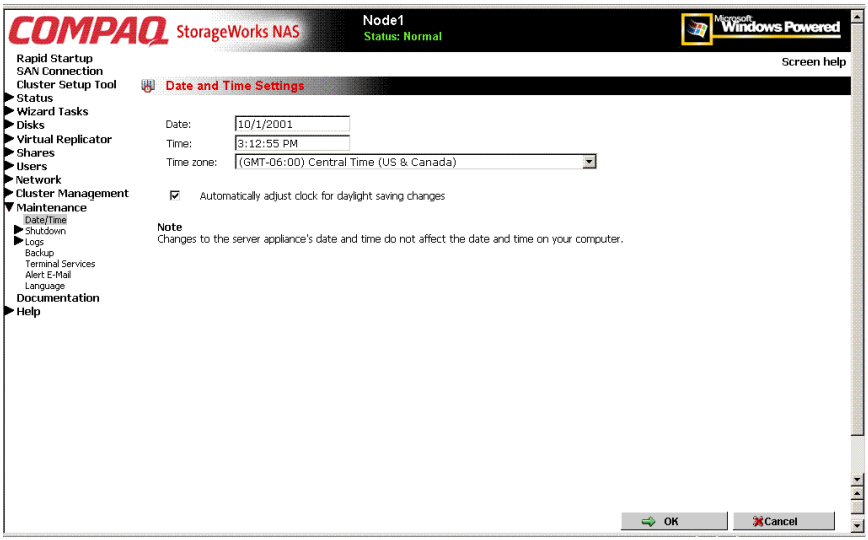


Figure 2-17: Date and Time dialog box

NOTE: In a clustered deployment, be sure to synchronize the time on the nodes.

Powering Down and Restarting the Server

IMPORTANT: Notify users before powering down the system. Both UNIX and Windows NT users can be drastically affected if they are not prepared for a system power-down.

1. From the NAS B3000 Web UI, select **Maintenance**, **Shutdown**. Several options are displayed: Shutdown, Restart, and Scheduled Shutdown.

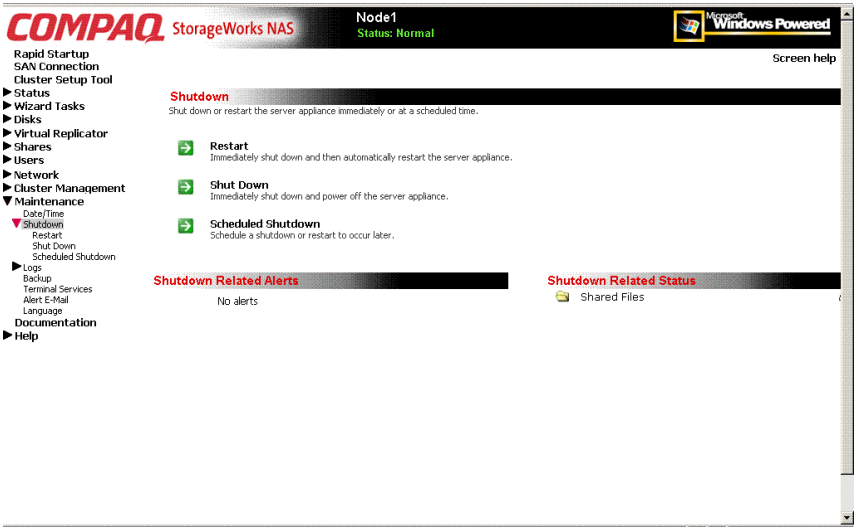


Figure 2-18: Shutdown menu

CAUTION: Restarting or shutting down a server in a clustered deployment is more complex than in a single node deployment. See the "Cluster Management" chapter for instructions on restarting, shutting down, powering down, and powering up servers in a clustered environment.

   a. To shut down and automatically restart the server, click **Restart**.

   b. To shut down and power off the server, click **Shutdown**.

   c. To schedule a shutdown, click **Scheduled Shutdown**.

2. Regardless of the choice, a confirmation prompt is displayed. After verifying that this is the desired action, click **OK**. Several status messages are displayed during the shutdown process.

Viewing and Maintaining Audit Logs

A variety of audit logs are provided on the NAS B3000. System events are grouped into similar categories, representing the eight different logs.

To access the logs from the WebUI, select **Maintenance**, **Logs**. The Logs menu is displayed.

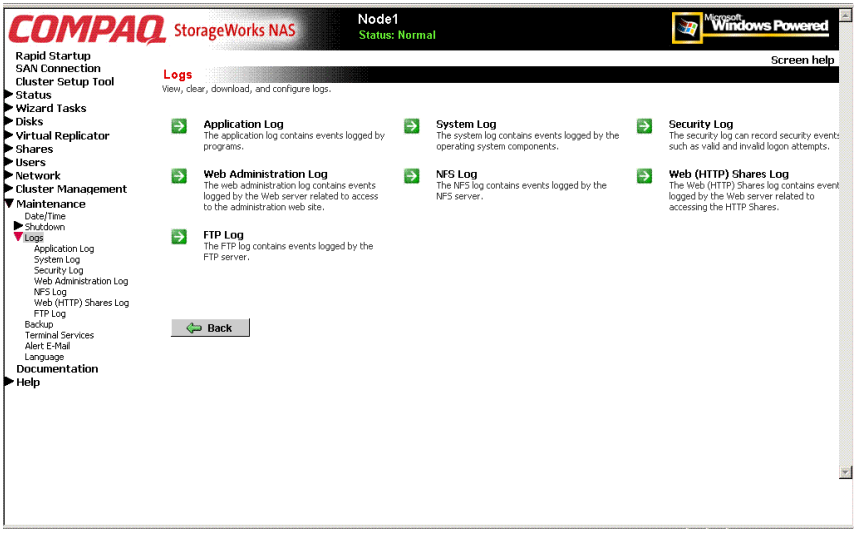


Figure 2-19: Logs menu

A variety of logs are available and are listed in Figure 2-19.

Each log has viewing, clearing, printing, and saving options.

Using Terminal Services

Terminal Services is provided in the WebUI to allow for additional remote system administration and the use of approved third-party applications. SecurePath, backup software, and antivirus programs are examples of approved applications.

In addition, Terminal Services is used to access the Microsoft Management Console (MMC) of the NAS device.

To open a Terminal Services session from the WebUI, select **Maintenance**, **Terminal Services**. A Terminal Services session is opened. Enter the appropriate password to log on to the server.

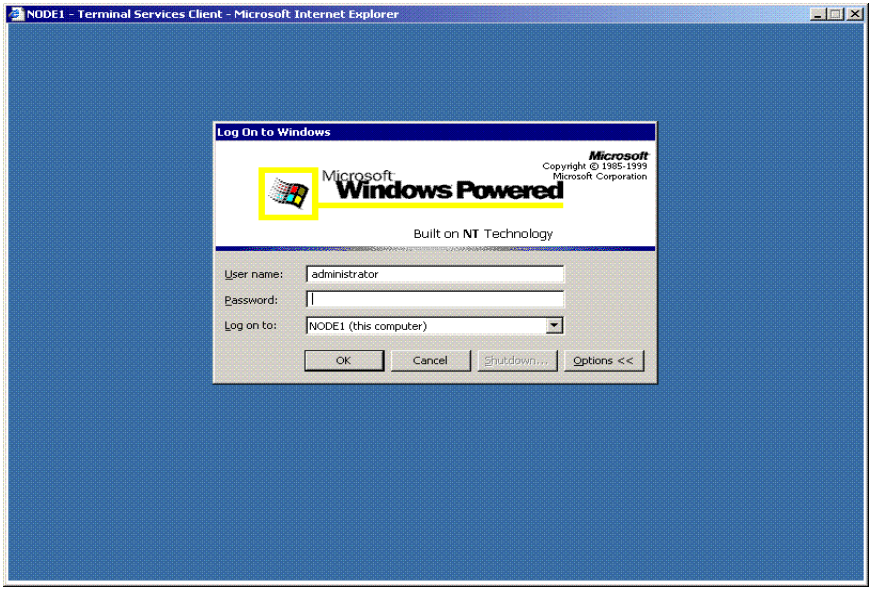


Figure 2-20: Terminal Services session

IMPORTANT: Two open sessions of Terminal Services are allowed to operate at the same time. After completing an application, close that session of Terminal Services by clicking the "x" at the top of the Terminal Services window.

Setting up Email Alerts

If desired, the system sends emails to of system events to a specified email account. When activated, this feature sends an email whenever system alerts occur.

To activate this option:

1. From the WebUI, select **Maintenance**, **Alert Email**. The Set Alert E-Mail dialog box is displayed.
2. Select **Enable alert e-mail**.

3. Indicate the types of messages to be sent.
   - Critical alerts
   - Warning alerts
   - Informational alerts
4. Enter the desired e-mail address in the appropriate boxes.
5. To send test e-mails, click **Test**.
6. After all settings have been entered, click **OK**. The Maintenance menu is displayed again.

Changing System Network Settings

Network properties are entered and managed from the **Network** menu. Most of these settings are entered as part of the Rapid Startup process. Settings made from this menu include adding the NAS B3000 to a domain.

Excellent online help is available for these settings. Figure 2-21 is an illustration of the **Network** settings menu.

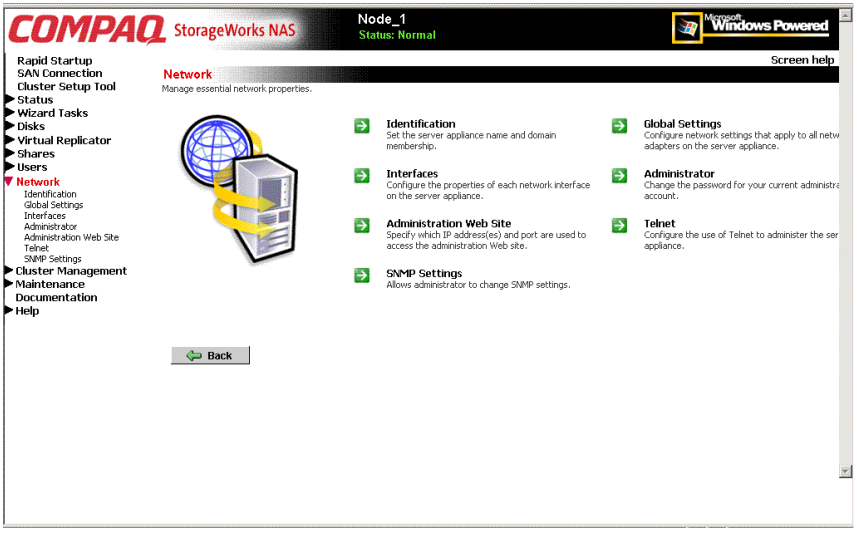


Figure 2-21: Network menu

3

Storage Management Overview

Typically, when a server joins an existing SAN, the SAN administrator is responsible for managing the physical storage (hard drives, arrays, and LUNS) and the administrator of the server is responsible for managing the virtual storage (pools, virtual disks, and snapshots.)

With the NAS B3000 fusion of NAS and SAN, the administrator of the NAS B3000 has complete control over all storage issues. The NAS administrator uses the Compaq Array Configuration Utility (ACU) to manage the hardware storage and uses Virtual Replicator (VR) software to manage the virtual storage.

The *StorageWorks* NAS B3000 is configured at the factory with default system and storage parameter settings. Any shipped storage is not pre-configured, allowing the NAS administrator to tailor the organization of and the configuration of the storage to their specific environmental needs.

This chapter defines and discusses both physical and virtual storage concepts on the *StorageWorks* NAS B3000, including:

- Storage Management Process
- Physical Storage Overview
  - — Physical Hard Drives
  - — Arrays
  - — Logical Drives (LUNs)
  - — Fault-Tolerance Methods
  - — Physical Storage Best Practices

- Virtual Storage Overview
  - — Pools
  - — Virtual Disks
  - — Snapshots
  - — VR Lifeguard Service
  - — Virtual Storage Best Practices

Additional storage management information is included in the following chapters:

- "Storage Management Planning" — discusses planning decisions in detail
- "Physical Storage Management' — discusses hard drive, array, and LUN management procedures
- "Virtual Storage Management" — discusses pool, virtual disk, and snapshot management procedures
- "Folder and Share Management" — discusses folder and share management procedures

Storage Management Process

The lowest level of storage management occurs at the physical drive level. Physical drives are placed into the external storage enclosures and grouped into arrays for better performance.

The arrays are then configured with RAID fault-tolerance and presented to the operating system as logical drives or units called LUNs.

At the virtual level of storage, VR software is used to take the LUNs and group them together into large capacity storage pools. These pools are then segmented into virtual disks and re-presented to the operating system as the disks on which to write the data.

Folders, sub-folders, and file shares are created on the virtual disks to organize, store, and give access to the system data.

For organizational and documentation purposes, this Administration Guide separates physical storage from virtual storage. While this chapter provides an overview of storage components and concepts, additional chapters discuss storage management planning and storage management procedures.

See Figure 3-1: Storage Management process for an illustration of these storage management elements.

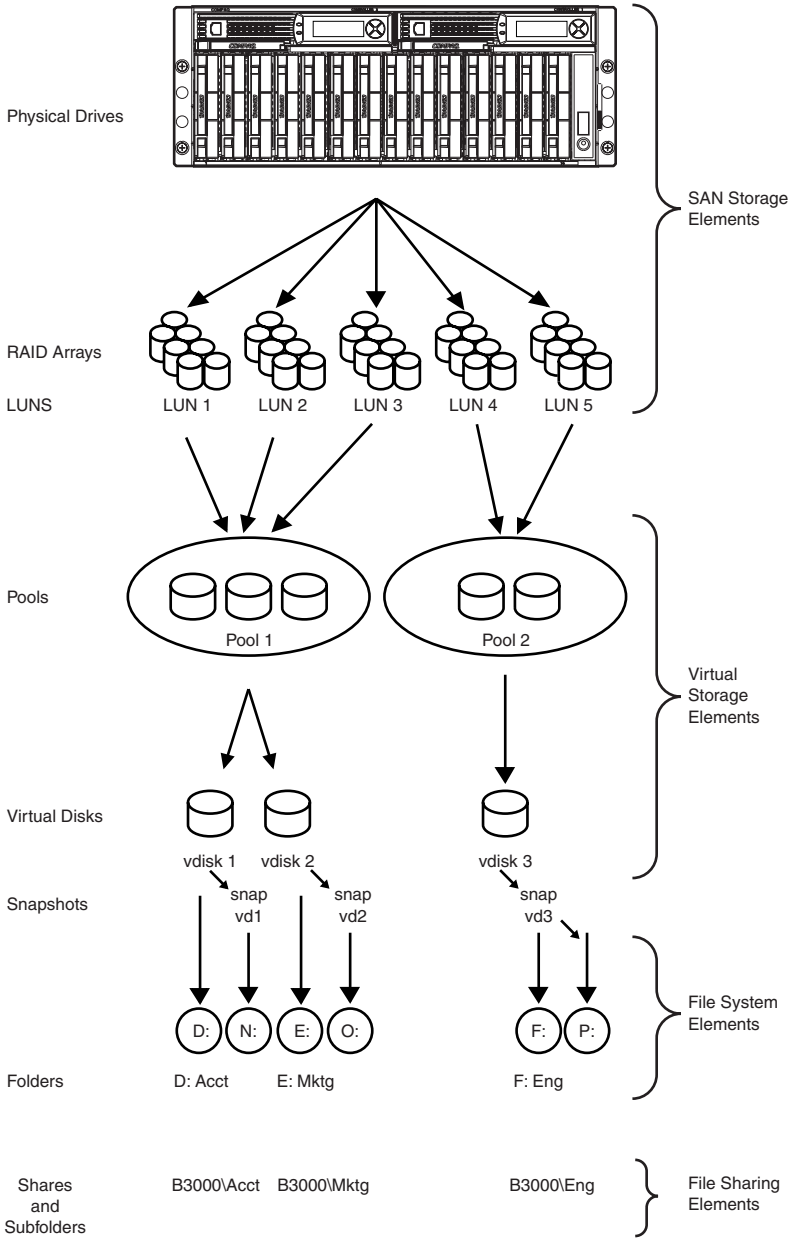


Figure 3-1: Storage Management process

Physical Storage Overview

The NAS B3000 is specifically designed for file serving and can support up to 27-TB of raw storage capacity, spanning 378 72-GB hard drives spread over 9 storage enclosure sub-systems. (Each fully populated storage enclosure sub-system supports 42 hard drives, for a maximum raw capacity of 3TB, when using 72-GB hard drives.)

Preliminary physical storage management tasks involve managing:

- Physical Hard Drives
- Arrays
- Logical Drives (LUNs)

Drive array concepts and data protection methods, including fault tolerance options are discussed in this section. This information will help guide decisions on how to best configure the arrays.

Physical Hard Drives

For personal or small business use, the capacity and performance of a single hard drive is adequate. However, larger businesses demand higher storage capacities, higher data transfer rates, and greater security from data loss if drives fail.

Merely adding extra drives to the system increases the total storage capacity, but has little effect on the system efficiency, because data can only be transferred to one hard drive at a time.

Figure 3-2 illustrates the read/write process with separate physical hard drives.

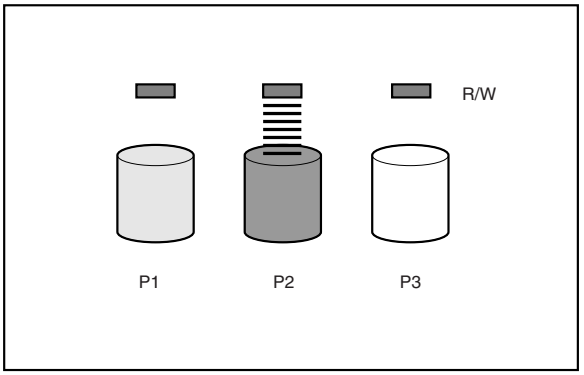


Figure 3-2: Separate physical drive (P1, P2, P3) read/write (R/W) operations

Arrays

With an array controller installed in the system, the capacity of several physical drives can be logically combined into one or more logical units termed **arrays**. When this is done, the read/write heads of all the constituent physical drives are active simultaneously, dramatically reducing the overall time required for data transfer.

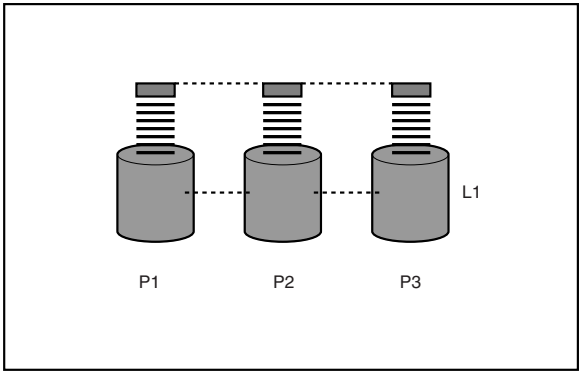


Figure 3-3: Configuring the physical drives into an array (A1) dramatically improves read/write efficiency

Because the read/write heads are active simultaneously, the same amount of data is written to each drive during any given time interval. Each unit of data is termed a **block**. The blocks form a set of data **stripes** over all the hard drives in an array, as shown in Figure 3-4.

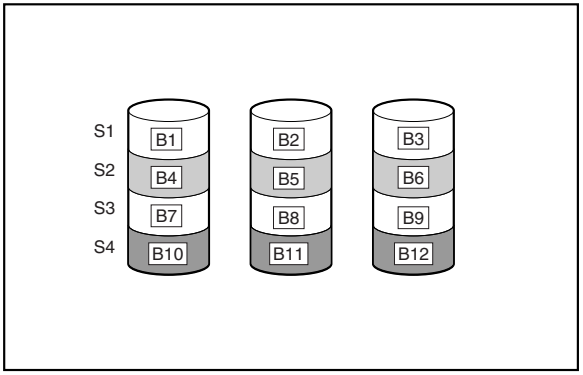


Figure 3-4: RAID 0 (data striping) (S1-S4) of data blocks (B1-B12)

For data in the array to be readable, the data block sequence within each stripe must be the same. This sequencing process is performed by the array controller, which sends the data blocks to the drive write heads in the correct order.

A natural consequence of the striping process is that each hard drive in a given array will contain the same number of data blocks. If one hard drive has a larger capacity than other hard drives in the same array, the extra capacity is wasted because it cannot be used by the array.

Logical Drives (LUNs)

As previously stated, drive array technology distributes data across a series of individual hard drives to unite these physical drives into one or more higher-performance arrays. Distributing the data allows for concurrent access from multiple drives in the array, yielding faster I/O rates than non-arrayed drives.

While an array is a physical grouping of hard drives, a logical drive is the configuration of the arrays that is presented to the operating system.

When planning to allocate space on the NAS device, consider that the maximum number of LUNs in a virtual storage pool is eight. To have large pools from which to create virtual disks, make LUNs as large as possible. Pools and virtual disks are discussed in a later section of this chapter.

NOTE: LUNs cannot be expanded after they are created. To increase system capacity, new hard drives or unassigned hard drives can be configured into new arrays and new LUNs and can then be placed into new pools or added to existing pools.

After the physical drives are grouped into fault-tolerant arrays, they are ready to be converted into logical drives. Options include creating one large logical drive using the entire space of the array or dividing each array into multiple logical drives. Compaq recommends creating one logical drive from the array. Additional physical drives can be added to the array at a later time.

It is important to note that a LUN may extend over (span) all physical drives within a storage controller sub-system, but cannot span over multiple storage controller sub-systems.

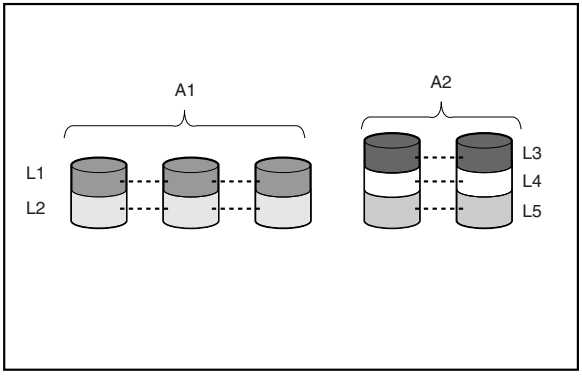


Figure 3-5: Two arrays (A1, A2) and five logical drives (L1 through L5) spread over five physical drives

Drive failure, although rare, is potentially catastrophic. For example, in the previous figure using simple striping, failure of *any* hard drive will lead to failure of *all* logical drives in the same array, and hence to data loss.

To protect against data loss from hard drive failure, arrays should be configured with **fault tolerance**. Several fault tolerance methods have been devised and are described in the following sections.

Fault-Tolerance Methods

Different RAID (redundant array of independent disks) types use different methods of striping the arrays and different ways of writing data and parity to the drives to offer a variety of fault-tolerance and capacity usage. The RAID methods supported by the NAS B3000 include:

- RAID 0 — Data Striping only, no fault tolerance
- RAID 1 and RAID 1+0 — Drive Mirroring
- RAID 5 — Distributed Data Guarding
- RAID ADG — Advanced Data Guarding

Further protection against data loss can be achieved by assigning an online spare to an array. This hard drive contains no data and is contained within the same storage sub-system as the other drives in the array. When a hard drive in the array fails, the controller can then automatically rebuild information that was originally on the failed drive onto the online spare. This quickly restores the system to full RAID-level fault tolerance protection.

These fault-tolerance methods are discussed in the following paragraphs.

RAID 0 – Data Striping

This configuration provides striping of the array to improve read and write performance, but offers no redundancy of data and therefore no protection against data loss when a drive fails. However, RAID 0 is useful for rapid storage of large amounts of non-critical data (for printing or image editing, for example) or when cost is the most important consideration.

When creating RAID 0 arrays, carefully consider how many drives to include in the array. While there is no theoretical limit to the number of drives that can be included in a RAID 0 array, there is a practical limit. Statistically, the chance of a drive failure increases with each additional drive that is included in an array. Based upon laboratory testing, Compaq recommends including no more than 7 drives in a RAID 0 array.

See Figure 3-4for an illustration of the data striping technique.

Advantages

- Highest performance method for reads and writes
- Lowest cost per unit of data stored
- All drive capacity is used to store data – none is used for fault tolerance

Disadvantages

- All data on logical drive is lost if a hard drive fails
- Cannot use an online spare
- Data can only be preserved by being backed up to external drives

RAID 1 – Drive Mirroring

In this configuration, information on one drive is duplicated onto a second drive, creating identical copies of the information as shown in Figure 3-6. Therefore, this method provides the best fault tolerance. RAID 1 requires an even number of drives and is the only method for fault-tolerance protection if only two drives are installed or selected for an array. If more than two drives are in an array, the data is striped across all of the drives in the array. This is referred to as RAID 1+0.

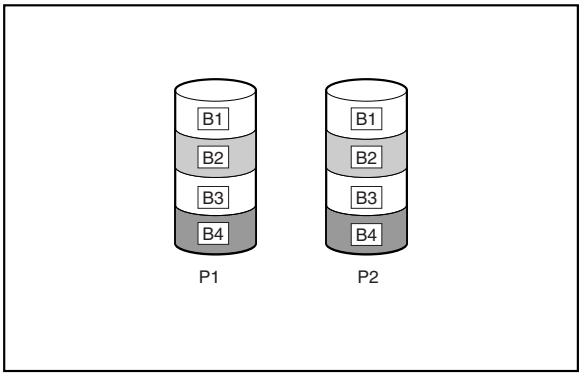


Figure 3-6: RAID 1 (drive mirroring) of P1 onto P2

This method is useful when high performance and data protection are more important than the cost of hard drives. The operating system drives are mirrored. If one drive fails, the mirror drive immediately takes over and normal system operations are not interrupted.

IMPORTANT: Compaq supports a configuration that uses RAID 1 on the system drives in a two-drive RAID array.

IMPORTANT: If two drives being mirrored to each other both fail, data loss occurs.

Advantages

- Highest read and write performance of any fault-tolerant configuration
- No data is lost if one drive fails
- In a RAID 1+0 system, data is preserved when more than one drive fails, as long as none of the failed drives are mirrored to another failed drive.

Disadvantages

- Expensive, since many drives must be used for fault tolerance
- Useable storage capacity is only 50% of the total drive capacity
- Data will be lost if two failed drives happen to be mirrored to each other
- Hard drives must be added in pairs

RAID 5 – Distributed Data Guarding

By this method, a block of parity data (rather than redundant data) is calculated for each stripe from the data that is in all other blocks within that stripe. The blocks of parity data are distributed over every hard drive within the array, as shown in the figure below. When a hard drive fails, data on the failed drive can be rebuilt from the parity data and the user data on the remaining drives. This rebuilt data can be written to an online spare.

This configuration is useful when cost, performance, and data availability are equally important.

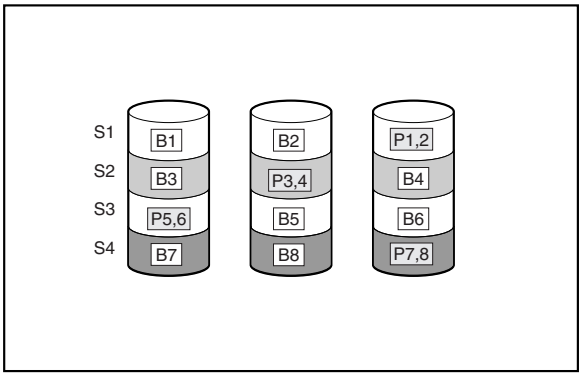


Figure 3-7: RAID 5 (distributed data guarding) showing parity information (P)

Spreading the parity across all the drives allows more simultaneous read operations and higher performance than data guarding (RAID 4). If one drive fails, the controller uses the parity data and the data on the remaining drives to reconstruct data from the failed drive. RAID 5 allows the system to continue operating with reduced performance until the failed drive is replaced. However, if more than one drive fails, RAID 5 also fails and all data in the array is lost.

Distributed data guarding uses the equivalent of 1 drive to store parity information and requires an array with a minimum of three physical drives. In an array containing three physical drives, distributed data guarding uses 33 percent of the total logical drive storage capacity for fault tolerance; a 14-drive configuration uses seven percent.

NOTE: Given the reliability of a particular generation of hard drive technology, the probability of an array experiencing a drive failure increases with the number of drives in an array. Compaq recommends the number of drives in an array not exceed 14.

Advantages

- High read performance
- No data is lost if one drive fails
- Usable storage capacity is high, since a capacity equivalent to only one physical drive is used to store parity information

Disadvantages

- Relatively low write performance
- Data will be lost if a second drive fails before data from the first failed drive has been rebuilt

RAID ADG – Advanced Data Guarding

RAID ADG is similar to RAID 5 in that parity information is generated (and stored) to protect against data loss caused by drive failure. With RAID ADG, however, two different sets of parity data are used. This allows data to still be preserved if two drives fail. As can be seen from Figure 3-8, each set of parity data uses up a capacity equivalent to that of one of the constituent drives, for a total parity usage of 2 drives of space.

This method is most useful when data loss is unacceptable, but cost must also be minimized. The probability that data loss will occur when configured with RAID ADG is less than when configured with RAID 5.

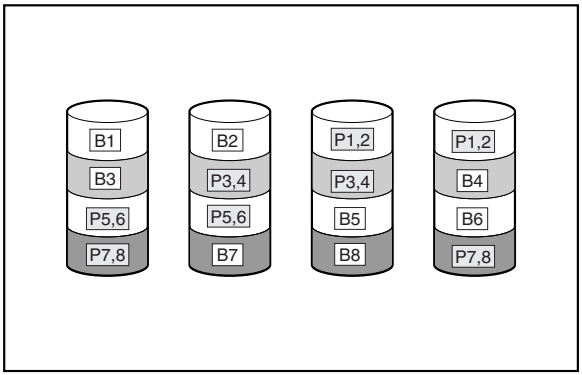


Figure 3-8: RAID ADG (advanced data guarding) with two sets of parity data

Advanced Data Guarding technology offers the best combination of fault tolerance and usable disk space among RAID levels.

This patented Compaq technology allows the safe deployment of large capacity disk drives and the creation of very large storage volumes without expensive overhead to protect business critical data. This technology provides more flexibility in responding to drive failures without the fear of costly server downtime.

Advance Data Guarding protects against multiple disk failures while requiring the capacity of 2 drives in an array of up to 56 disk drives to be set aside for dual sets of distributed parity data. It provides data protection greater than RAID 0+1 while having the capacity utilization efficiency similar to RAID 5.

Advantages

- High read performance
- High data availability – any two drives can fail without loss of critical data

Disadvantage

The only significant disadvantage of RAID ADG is a relatively low write performance (lower than RAID 5), due to the need for two sets of parity data.

The table below summarizes the important features of the different kinds of RAID supported by the MSA1000 Controller. The decision chart in the following table may help determine which option is best for different situations.

Table 3-1: Summary of RAID methods

	RAID 0	RAID 1 / RAID 1+0	RAID 5	RAID ADG
	Striping (no fault tolerance)	Mirroring	Distributed Data Guarding	Advanced Data Guarding
Usable drive space*	100%	50%	67% to 93%	50% to 95%
Usable drive space formula	n	n/2	(n-1)/n	(n-2)/n
Minimum number of hard drives	1	2	3	4
Maximum number of hard drives	N/A	N/A	14	56
Tolerant of single hard drive failure?	No	Yes	Yes	Yes
Tolerant of multiple simultaneous hard drive failure?	No	For RAID 1+0, if the failed drives are not mirrored to each other	No	Yes

continued

Table 3-1: Summary of RAID methods *continued*

	RAID 0	RAID 1 / RAID 1+0	RAID 5	RAID ADG
Read performance	High	High	High	High
Write performance	High	Medium	Low	Lowest
RAID overhead	Low	High	Medium	Medium

***Note:** The value for usable drive space is calculated assuming a maximum of 14 hard drives of the same capacity (or a maximum of 42 for RAID ADG, which is the maximum number of drives in a single MSA1000 storage subsystem) with no online spares. Compaq recommends that these maximum figures (excluding any allowable online spares) are not exceeded when configuring a drive array, due to the increased likelihood of logical drive failure with more hard drives.

Online Spares

Further protection against data loss can be achieved by assigning an **online spare** (or **hot spare**) to any configuration except RAID 0. This hard drive contains no data and is contained within the same storage sub-system as the other drives in the array. When a hard drive in the array fails, the controller can then automatically rebuild information that was originally on the failed drive onto the online spare. This quickly restores the system to full RAID-level fault tolerance protection. However, unless RAID ADG is being used that can support two drive failures in an array, in the unlikely event that another drive in the array should fail while data is being rewritten to the spare, the logical drive will still fail.

Each MSA1000 can support up to four online spares. When an online spare is configured for an array, it is automatically assigned to all logical drives in the same array. A spare can also be assigned to several arrays contained within the same storage sub-system (using the same controller.)

Follow these guidelines when configuring spares:

- The size of the spare must be greater than or equal to any drive that it is intended to replace. If different size drives are used in an array, all drives are brought down to the size of the smallest drive; therefore, the spare only needs to be the size of that smallest drive.
- A spare must be assigned to each array separately.
- The same spare can be assigned to multiple arrays as long as its capacity is sufficient to replace any of the drives in those arrays.

IMPORTANT: Do not interrupt the process of rebuilding the spare and do not replace the failed drive until the rebuilding process is complete. Data loss may occur if the rebuilding process is interrupted.

NOTE: After the failed hard drive is replaced, the controller will rebuild the replacement and reset the spare to its original state.

IMPORTANT: Do not interrupt the process of rebuilding the replacement drive or the resetting process of the spare. Data loss may occur if the rebuilding process is interrupted.

Physical Storage Best Practices

Minimally, choosing the best disk carving strategy includes the following policies:

- Analyze current corporate and departmental structure.
- Analyze the current file server structure and environment.
- Plan properly to ensure the best configuration and use of storage.
  - — Determine the desired priority of fault tolerance, performance, and storage capacity
  - — Use the determined priority of system characteristics to determine the optimal striping policy and RAID level.
- Include the appropriate number of physical drives in the arrays to create LUNs of desired sizes.
  - — For RAID 0, include between 2 and 7 drives in each array.

— For RAID 5, include between 3 and 14 drives in each array.

— For RAID ADG, do not exceed 56 drives in an array.

Complete and detailed planning information is included in the "Storage Management Planning" chapter.

RAID arrays and LUNs are created and managed using the Compaq Array Configuration Utility (ACU). See the chapter "Physical Storage Management" for detailed information on creating and managing arrays and LUNs.

Virtual Storage Overview

After the LUNs are created, they are presented to the operating system for use. At this time, the virtual storage management software (Virtual Replicator) acquires the LUNs, groups them into pools, divides the pools into virtual disks, and re-presents the virtual disks to the operating system.

Virtual storage elements are managed using the Virtual Replicator (VR) software. VR provides advanced storage management capabilities in Windows-based computing environments. Innovative storage management features simplify storage configuration and management and enhance availability and scalability.

Virtual storage includes the following:

- Pools—formed from LUNs, can be up to 8 TB
- Virtual disks—created from available pool space, can be up to 2 TB
- Snapshots—are instant copies of the virtual disks

For specific information on pools, virtual disks, and snapshots, see the topic-specific sections of this chapter.

Pools

VR enables the grouping of hardware LUNs into a logically proportioned pool of drive space. Any number of pools can be created, using industry-standard storage components and controller-based, fault-tolerant drive RAID arrays and LUNs. The LUNs provide space for the pool in the same way that physical drives provide drive space for a RAID array.

Pool Facts:

- Each pool can contain up to 8 logical disks (LUNs).
- If multiple LUNs are used to form a pool, they must all be from the same controller.
- All LUNs that make up a pool should have the same high-availability characteristics (RAID levels, striping methods, and drive capacity.)
- Each pool can be up to 8 TB (each LUN can be as large as 1 TB.)
- By default, 30% of the pool space is reserved for snapshots, leaving 70% of the pool available for the creation and use of the virtual disks.
- Virtual disks are created from pools.

Virtual Disks

Virtual Replicator controls how data is stored on a virtual disk. A virtual disk is composed of storage from a single pool and cannot be composed of storage from different pools. The virtual disks perform and behave in exactly the same way as physical drives do. They can be formatted and drive letters can be mapped to them, and the system can read from and write to them.

Disk virtualization allows drive space to be tailored to the size required by users and their applications. From a pool, the administrator may wish to create three separate virtual disks that exactly match the space needs of the users or groups requesting space, or they may create a single, large virtual disk from a pool. For example, if a user needs 650 MB of drive space, a 650-MB virtual disk can be created. Alternatively, if a system has a 2-TB database, LUNs can be combined into a single pool and a 2-TB virtual disk that spans the physical storage can be created. The size of the virtual disks can range from 10 MB to 2 TB, depending on free pool space and other limits set at the time of pool creation. A limitation is that virtual disks may not "span" pools—they must be created from a single pool.

Virtual disks are the storage entities that the operating system recognizes as drives and upon which data is placed.

Virtual Disk Facts:

- Must be between 10 MB and 2 TB.
- Currently, a limit of 8 virtual disks can be created from a pool.
- Can initially be small, and then expanded through an online volume growth procedure.
- Can use up to 70% of the pool space, with 30% reserved for snapshots by default.

Snapshots

Virtual Replicator lets the administrator make instant replicas, called snapshots, of virtual disks in a matter of seconds. Snapshots enable the instant creation of multipurpose virtual replicas of production data without having to physically copy the data. They can be used to immediately recover a lost file or directory, to test a new application with realistic data without affecting the "real" data, and to serve as a source of data for backups. Snapshots are a temporary backup of the data and are not meant to be permanent.

When using snapshots, performance of the virtual disk may be affected, depending on the rate that data is changing and the number of snapshots kept for each virtual disk. Read performance of the virtual disk remains constant, regardless of the presence of snapshots. Read performance of the snapshot is identical to that of the virtual disk. Write performance, however, may vary. Each initial write to a virtual disk area causes a copy-out to the snapshot, and the initial write is slower than if a snapshot is not being used. Copy-out is not performed on subsequent writes to the same virtual disk block, so write performance is unaffected after the initial write to each block.

Predicting the exact effect of snapshots on any particular virtual disk is difficult, because several variables are involved. These variables include the type of applications accessing the data and the rate of change of the files on the virtual disk. When a high percentage of writes is made to the same area, as when a file is constantly rewritten, the effect is called write locality. Virtual disks with high write locality experience less performance degradation due to snapshots.

Snapshots can be read-write, and if they are shared, users can access a snapshot and edit the data. If snapshots are shared with write access enabled, a snapshot of the original snapshot should be created. There is no backup of the original snapshot unless a snapshot of it is taken. By controlling the share permissions, administrators can make snapshots read-only.

Snapshot Facts:

- Snapshots are created on a per-virtual disk basis.
- Snapshots of snapshots can be created.
- Snapshots can be read-only or read-write.
- Snapshots must be assigned to a drive letter to be accessible.
- Snapshots can be shared in the same manner as virtual disks.
- Snapshots are meant to be temporary in nature.
- Snapshots are automatically deleted if pool space becomes critical.

Snapshots and Pool Sizing

When initially implementing snapshots, the first priority is to gain an understanding of the amount of additional pool space required by the snapshots. As previously described, this assessment is a function of the write activity, its locality, the projected lifetime of the snapshot, and the number of snapshots per virtual disk. Because the space required for snapshots tends to grow over time, by default, 30 percent of the pool is reserved for snapshots

Virtual Replicator includes a Snapshot Planner utility that can be used before moving to a NAS device. The Snapshot Planner gathers information about your current server and its configuration to use when configuring the pools and logical drives on the new server. The Snapshot Planner utility must be installed and run only on existing servers and must not be run on the NAS device. This utility is included on the Compaq StorageWorks NAS Servers Configuration Utilitiy CD. The Snapshot Planner provides complete pool and volume sizing information. The size of the virtual disks and the size of the pool are equally important.

Snapshots and Drive Defragmentation

A drive defragmenter attempts to consolidate files on a drive by reading various parts of the files and rewriting them to become contiguous on the drive. When virtual disks are created from the drive space pool, the software attempts to make them as contiguous as possible on the underlying storage units (RAID arrays and LUNs).

CAUTION: Defragmentation must not be performed if snapshots exist. To defragment a disk, first delete the snapshots.

IMPORTANT: The Windows 2000 operating system native defragmenter does not work on VR virtual disks.

IMPORTANT: Drive defragmentation only operates on virtual disks formatted with a 4-KB or smaller allocation size. By default, the NAS device uses a 16-KB allocation cluster size.

Snapshot Naming

Snapshots should be named to reflect the relationship with their parent virtual disk. In the case of a snapshot of a snapshot, the parent-child relationship of snapshots of snapshots is not maintained on the server. Appropriate snapshot naming and volume naming must be used to identify each snapshot individually. For example, if the virtual disk is named A:

- Name the parent "SnapshotA"
- Name the child "ChildofSnapshotA"

Snapshots and Backup

Because snapshots are quick to create, it is possible to capture a coherent view of the virtual disk data with little or no application downtime. Lack of application downtime removes the traditional backup window or the amount of time taken to back up to offline media. While many applications must be shut down to capture an accurate backup, snapshots capture a point-in-time view of the data that can be used as the source of backup data. Applications can continue processing against the virtual disk data. Therefore, applications may only have to be interrupted for a few seconds during the snapshot process.

CAUTION: Snapshots are not a replacement for reliable, periodic data backup. If free pool space becomes critical, snapshots are automatically deleted. See VR Lifeguard ServiceIn addition, snapshots are a short-term convenience and reside on the same physical drives as the data. If something happens to the data drives, the snapshots are also affected. Read Appendix A, "Backup Utility Management," for suggestions on how to back up the NAS device.

Snapshots, Restoring Files, and Directories

Snapshots can be used as a highly efficient way to maintain online backups of a virtual disk, enabling immediate file and directory recovery. Snapshots can be assigned to a drive letter and used exactly like virtual disks. If a file or directory is lost or corrupted, it can be recovered easily. The administrator can switch to the snapshot drive and copy the file or directory back to its original location on the virtual disk or an alternate location.

IMPORTANT: To preserve the integrity of a point-in-time snapshot of a virtual disk, ensure that it is exported as read-only.

VR Lifeguard Service

VR Lifeguard is a utility that watches storage pools for pool-full conditions and deletes snapshots when a pool is nearly full. Pool-full conditions cause writes to the drive to be delayed. These conditions can occur when snapshots are being used and insufficient space is left in the pool to allow copying the data from the original virtual disk to the snapshot. If this situation occurs, the system delays the write to both the original virtual disk and the snapshot.

CAUTION: If the pool is improperly sized and there is an insufficient amount of free space in the pool, Lifeguard automatically deletes the oldest snapshots. This action prevents a critical space deficit that could delay or lose writes.

Because snapshots use free space in the pool, a pool-full condition can be a result of poor or improper pool space planning. Make sure there is sufficient space for snapshots. By default, 30 percent of the pool space is reserved for snapshots.

Before attempting to use a snapshot to restore a virtual disk, special care must be taken to make sure there is sufficient free space in the pool. If space becomes critical during the restore, the potential for a pool-full condition exists. In this case, Lifeguard may delete the snapshot from which it is restoring.

The Lifeguard service is installed and automatically started. The service checks each drive letter on a system to see if it is a virtual disk or a snapshot. If it is a snapshot, Lifeguard checks the storage pool that the drive belongs to for its amount of current free space. If the amount of free space goes below the threshold, Lifeguard deleted one or more snapshots to make more space available in the pool. This check is performed, by default, once every 10 seconds.

Lifeguard facts:

- Checks for pool-full situations periodically based upon pool policy settings.
- Begins deleting snapshots when the free pool space drops below the default 1,024-MB threshold
- Deletes the oldest snapshot first
- Continues to delete up to 12 snapshots at the pre-set interval until free pool space is above the threshold
- Reserves 30 percent of the total pool for snapshot use and restricts online volume growth from causing a pool-full condition by not allowing a volume to grow into this reserved space
- Deletes a snapshot, even if it is the only snapshot in existence
- Posts events in the Application Event Log. An event is entered for each drive that exceeds the threshold, and additional events will be entered when a snapshot is deleted.

Virtual Storage Best Practices

Virtual Replicator is the software used to manage the storage on the NAS B3000. Some administrators may be familiar with other storage management software programs, such as Windows Disk Management and Cluster Administrator.

Use the following guidelines when managing the storage on the NAS Device:

- If a task can be performed using either VR or another tool, always use VR.
  - — Use VR to delete a pool in a cluster, not Cluster Administrator.
  - — Use VR to map drive letters to virtual disks and snapshots, not Disk Management.

- Use VR to monitor free space in a pool, rather than Windows Explorer. Windows Explorer does not recognize pools.
- Do not use VR in conjunction with Windows Disk Management/Logical Disk Manager. Doing so can result in unpredictable behavior.
- When using VR management tools, close Logical Disk Manager.
- Do not perform Disk Management tasks on disks that belong to VR pools.
- Do not perform online volume growth of either basic or virtual disks at the same time as other major disk management operations, such as defragmenting and disk checking.
- As an extra precaution, before performing any task with Disk Management, use Device Manager to scan for hardware changes to update disk information.

Refer to the *Compaq SANworks Virtual Replicator System Administration Guide* for additional information about VR.

4

Storage Management Planning

This chapter details issues surrounding storage configuration, storage sizing, and performance planning for the *StorageWorks* NAS B3000. Proper planning for system storage and performance is critical to the successful deployment of the NAS B3000. Improper planning or implementation can result in wasted storage space, degraded performance, or inability to expand the system to meet growing storage needs.

There are several key points to keep in mind when planning system storage needs. These range from desired priorities of different system characteristics, to software restrictions, to hardware behaviors, to the ramifications of specific configurations.

This chapter documents the main issues and rules to follow when planning and configuring the storage of the NAS B3000, including:

- Fundamental Storage Configuration Planning Issues
  - — System Priorities
  - — Array Configuration (Striping) Methods
  - — Recommended System Configurations
- Physical Storage Planning Issues
  - — Hard Drive Sizes and Types
  - — Use and Number of Spare Disks
  - — LUN Sizing

- Virtual Storage Planning Issues
  - Pool Considerations
  - Virtual Disk Considerations
  - Shares Considerations
- Storage Management Planning Scenarios
  - A Complete and Detailed Storage Planning Example
  - A Simple Sizing Comparison
  - An Example of a Storage Subsystem Using Different Array Configurations
  - Planning Worksheet
- Migration Issues

All of the factors mentioned in this chapter must be taken into consideration when planning, laying out, and implementing the storage architecture. The decisions and implementations made during the planning and configuration stage affect the performance, availability, and expandability of the configuration. Any oversights or mistakes made during this phase will be difficult to correct later.

Fundamental Storage Configuration Planning Issues

Prior to actually configuring the drives in the storage enclosures into arrays, LUNs, pools, virtual disks, and shares, extensive analysis of desired system performance must be completed. Therefore, preliminary storage planning topics include:

- System Priorities
- Array Configuration (Striping) Methods
- Recommended System Configurations

System Priorities

The first and most important part of storage management planning is the ranking of basic desired system characteristics. Based on the type of data that will be stored on and accessed from the system, the importance of the following three system characteristics must be determined:

- Fault Tolerance
- Capacity Utilization
- I/O Performance

The optimal configuration method of the system storage depends on the ranking of these characteristics.

As shown in Figure 4-1, these system traits are independent and unrelated. One trait must be chosen as the most important. The ranking of one trait as most important automatically ranks the other characteristics as second and third. After the primary characteristic has been determined, one of the remaining two traits must be declared as second in importance. With the desired system characteristics now ranked, the optimal configuration method can be selected from the following paragraphs and figures in this section of this document.

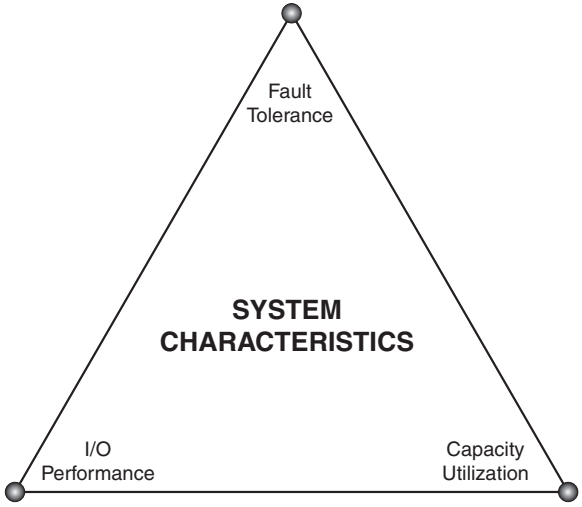


Figure 4-1: System characteristics

Because the physical configuration of the arrays determines whether the system is optimized for fault tolerance, performance, or capacity utilization, a preliminary discussion on the configuration striping methods is warranted.

Array Configuration (Striping) Methods

LUNs are composed of the physical storage arrays (RAID arrays) and are presented to the operating system as disk devices. The physical configuration of the arrays affects both the performance and the high-availability characteristics of the units.

The arrays must be configured in a manner that strikes the desired balance between fault tolerance, storage efficiency, and performance.

There are two methods for configuring the physical layout of the disk arrays:

- Vertical striping
- Horizontal striping

In a vertical configuration, a single RAID array uses one physical drive from each storage enclosure. In a horizontal configuration, the RAID array uses multiple drives contained within one or more storage enclosures. Figure 4-2 and Figure 4-3 illustrate examples of possible array striping configurations.

As a point of planning, horizontal and vertical arrays have their advantages and disadvantages. Each should be used in the appropriate environment to optimize the desired system characteristics.

Vertical Array Configurations

For most RAID configurations, vertical striping of arrays is the only configuration method that ensures no single point-of-failure (NSPOF.) Because vertical striping uses drives from different storage enclosures in the same array, an MSA1000 storage enclosure with no additional disk storage enclosures does not permit vertically striped arrays. To most effectively implement vertical striping of RAID arrays, Compaq recommends using a fully populated MSA1000 storage enclosure with two additional disk storage enclosures. This configuration allows for greater choices of RAID configurations, as well as for the creation of larger arrays than one additional disk storage enclosure would allow.

Using an example of RAID 5 vertically striped arrays with one drive from each enclosure included in an array and parity information distributed throughout the array, if a single storage enclosure fails, only one drive in each array will fail. All arrays are still online and the data can be rebuilt from the distributed parity information. For some RAID configurations, vertical striping must be used for ultimate fault tolerance.

Depending on the RAID configuration chosen, a vertical array will consist of at least one drive from each storage enclosure. See Figure 4-2 and Table 4-1 for RAID-specific disk use information of vertical carving configurations.

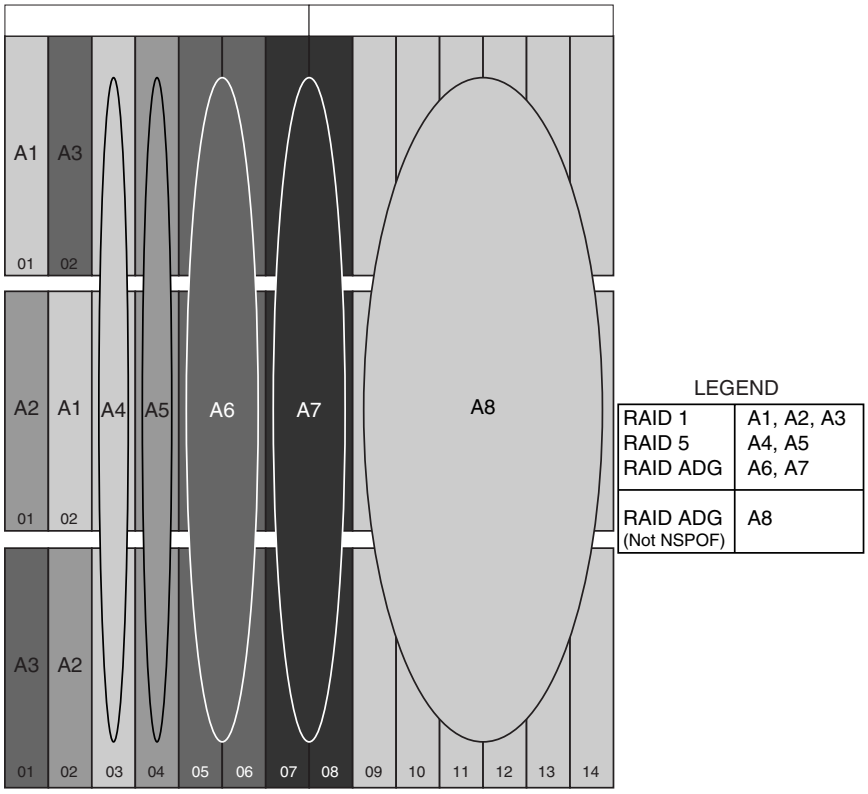


Figure 4-2: Vertical Array configurations

Table 4-1: Vertical Carving Disk Use per RAID Level

RAID Method	Number of Drives	Space Used for Fault Tolerance
RAID 0	Not recommended	
RAID 1 (NSPOF)	2 (one per enclosure)	1 drive (50%)
RAID 1+0	Not recommended	
RAID 5 (NSPOF)	3 (one per enclosure)	1 drive (33%)
RAID ADG (NSPOF)	6 (two per enclosure)	2 drives (33%)
RAID ADG	User defined	2 drives

IMPORTANT: RAID 0 and RAID 1+0 are not recommended when using vertical striping.

One disadvantage of vertical configurations is that the arrays are relatively small, which may result in the rapid exhaustion of available drive letters. After all letters have been used, no additional virtual disks can be presented to or used by the system. Creating small arrays divides the storage capacity among more LUNs, pools, and virtual disks than large arrays. With each virtual disk and snapshot using a letter, deployments using vertical striping can quickly run out of available letters.

One potentially major disadvantage of vertical arrays is that they are not very flexible when it comes to growing the storage at a later date. Using small arrays means that the same amount of storage would occupy more LUNs. Because a pool can contain no more than eight LUNs, the pool configuration resulting from adding many small LUNs into a single pool would limit or eliminate the ability of the pool to be expanded.

An additional disadvantage of vertical configurations is that the creation of many small arrays, LUNs, pools, virtual disks, snapshots, and shares increases administrative and management overhead.

A final disadvantage of vertical array configurations and their small arrays and LUNs is that a greater proportion of the total capacity must be used for fault tolerance.

Horizontal Array Configurations

Horizontal striping allows for the creation of large arrays and LUNs, and offers the best combination of capacity utilization and performance. See Figure 4-3 and Table 4-2 for information about horizontal array configurations and disk use.

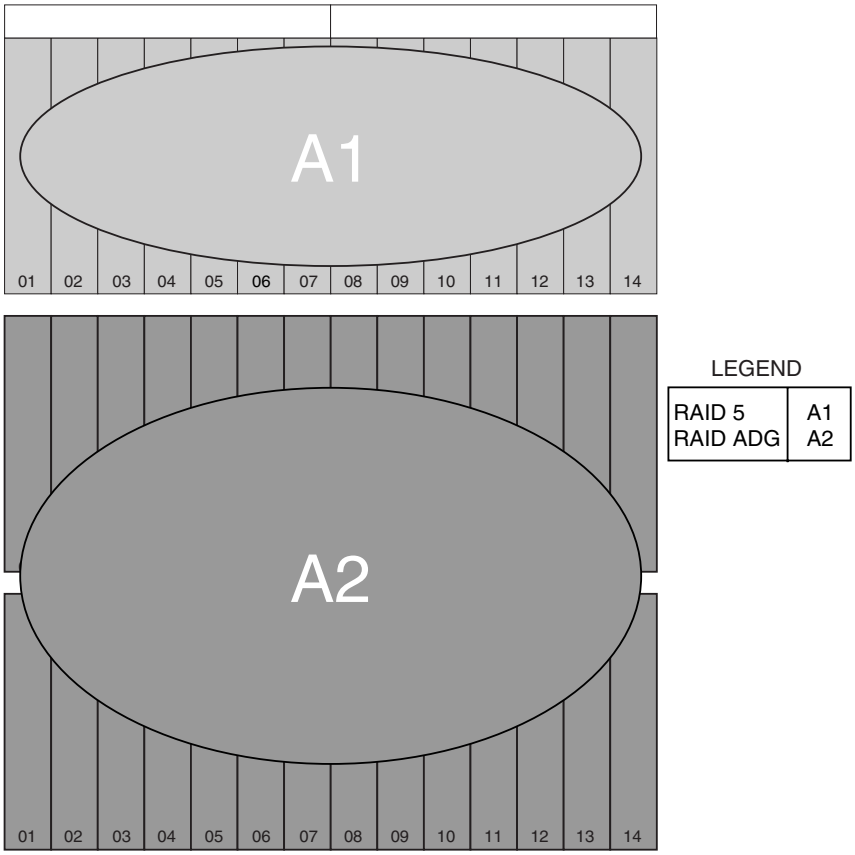


Figure 4-3: Horizontal Array configurations

Table 4-2: Horizontal configuration Disk Use per RAID Level

RAID Method	Number of Drives	Space Used for Fault Tolerance
RAID 0	Between 2 and 42	None
RAID 1	2	1 (50%)
RAID 1+0	Between 2 and 42	(50%)
RAID 5	Between 3 and 14	1 drive (33% to 7%)
RAID ADG	Between 4 and 42	2 drives (50% to 5%)

In addition to creating larger LUNs than vertical configurations, the biggest advantage of horizontal arrays is the ability to dynamically grow the storage on an as-needed basis. It is very easy to purchase an additional storage enclosure full of drives, connect the storage enclosure, set up the arrays and LUNs, and create additional pools and virtual disks. Alternatively, the new capacity could be used to expand existing arrays, pools and virtual disks.

The major disadvantage of horizontal arrays is loss of access to the data if a storage enclosure fails. The array and its data may not survive the failure, depending on the circumstances in which the failure occurred. In the worst case, there is a total loss of data and the array must be reconfigured and the data must be restored from backup. In the best case, the array and its data will reappear after the failure is repaired.

Keep in mind that regardless of the number of drives in an array, RAID 5 reserves one disk worth of space to contain the parity data, meaning that one disk worth of space is not available for data storage. Similarly, RAID ADG uses the equivalent of 2 drives of space for the 2 sets of parity information maintained. Using horizontal striping rather than vertical striping allows more drives to be incorporated into an array, thus reducing the proportion of capacity reserved for parity information.

NSPOF Horizontal Array Configurations

A hybrid RAID striping configuration combines horizontal striping with vertical mirroring, allowing NSPOF fault protection in horizontally striped arrays. This configuration offers the best NSPOF combination of fault tolerance, I/O performance, and capacity utilization.

Using horizontal RAID 1+0 arrays with the mirrored drives in a separate disk storage enclosure permits the creation of larger arrays than a vertically striped RAID 1 NSPOF configuration.

See Figure 4-4 for an illustration of this technique.

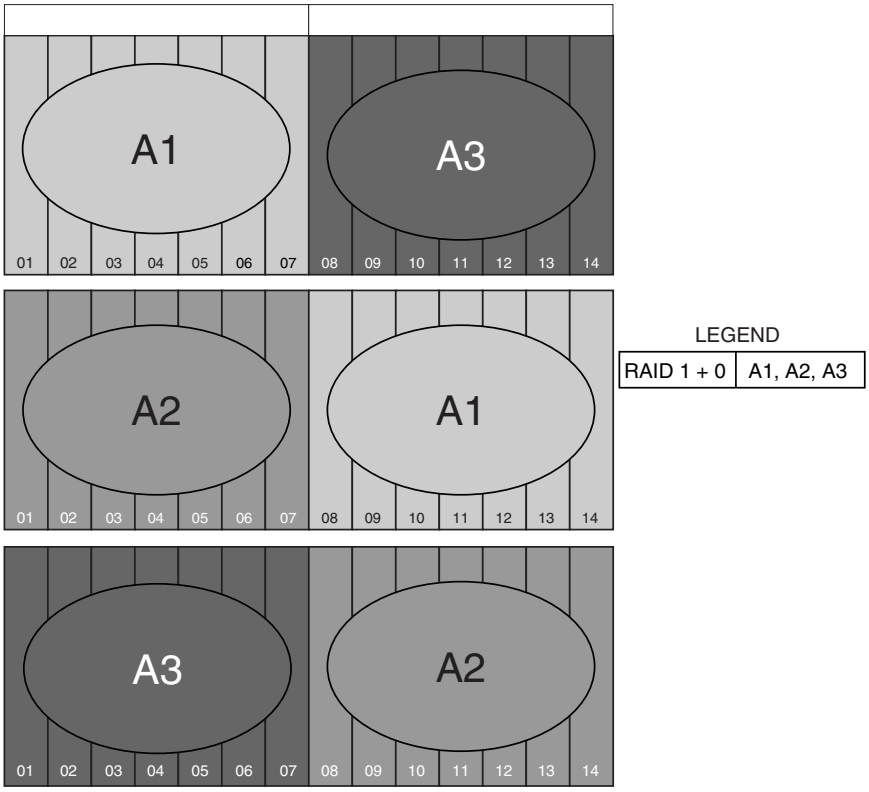


Figure 4-4: NSPOF Horizontal Array configuration

The only requirement of this configuration is that the array must have an equal number of drives in each storage enclosure, with the drives in one storage enclosure containing the data and the drives in the other storage enclosure mirroring the data.

The example in Figure 4-4 illustrates a configuration that maximizes storage capacity and I/O performance, while maintaining an NSPOF configuration and reducing administrative overhead. This configuration divides each storage enclosure in half, including seven drives from each storage enclosure in an array, resulting in a total of 14 drives per array (of which seven drives are available for data storage.) Three arrays are created using this hybrid configuration, compared to 14 arrays when using vertically striped RAID 1 or RAID 5 arrays.

Recommended System Configurations

- Storage Enclosure Configuration Options
- Recommended Configuration Methods
- When Fault Tolerance is Most Important
- When Capacity Utilization is Most Important
- When I/O Performance is Most Important

Storage Enclosure Configuration Options

The number of disk storage enclosures attached to the MSA1000 determines the possible configuration methods. Table 4-3 provides a list of the striping and array configuration methods available for the different hardware configurations.

Table 4-3: Suggested Storage Enclosure Configurations

Striping Method	MSA1000 only	MSA1000 with one additional disk storage enclosure	MSA1000 with two additional disk storage enclosures
Vertical (NSPOF)	None	RAID 1	RAID 1 RAID 5 RAID ADG
Horizontal	RAID 0 RAID 1 (quorum disk in a cluster) RAID 5 RAID ADG	RAID 0 RAID 5 RAID ADG	RAID 0 RAID 5 RAID ADG
NSPOF Horizontal	None	RAID 1+0	RAID 1+0

Recommended Configuration Methods

As discussed in the previous sections of this chapter, a variety of configuration methods is available to choose from when configuring the system storage of the NAS B3000. Different RAID levels and array striping methods can be combined to create many possible configurations for each NAS B3000 deployment. Administrators must choose between RAID levels and striping methods that offer different levels of fault tolerance, capacity utilization, and I/O performance.

Figure 4-5 illustrates the same System Characteristics triangle that was presented earlier. Depending on the system environment and the type of data that will be stored on the NAS device, different administrators will prioritize different desired system characteristics.

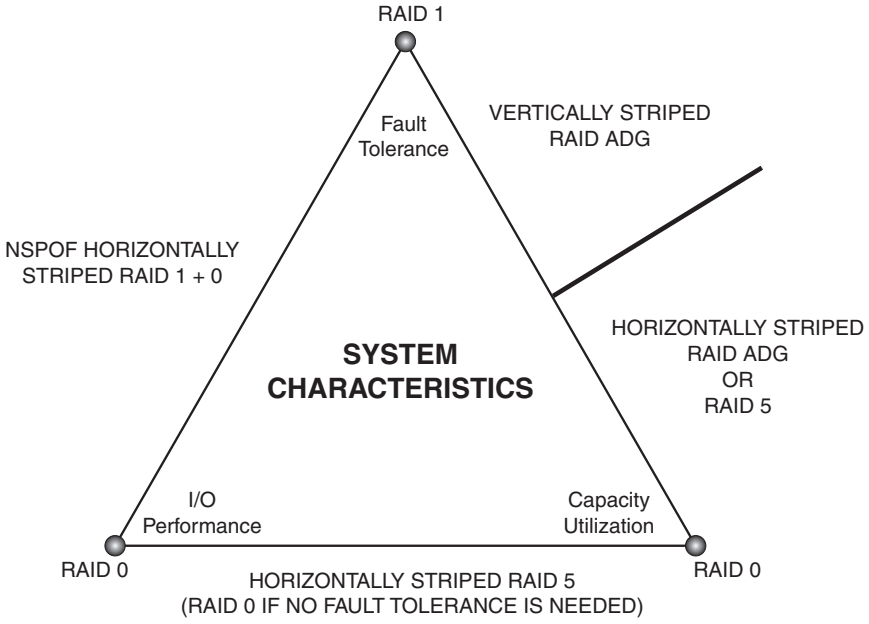


Figure 4-5: Recommended Configuration methods

The following paragraphs discuss the best configurations for the different priority rankings of these desired system characteristics.

When Fault-Tolerance is Most Important

When high availability is of paramount importance, arrays must be configured using an NSPOF configuration. In this configuration, if a storage enclosure fails or if one of the SCSI channels fails, all the arrays are still available.

As shown in Figure 4-5, if I/O performance is considered important as well as fault tolerance, the arrays should be striped using an NSPOF horizontal RAID 1+0 configuration. These mirrored drives offer the ultimate protection against data loss. Although RAID 1 and RAID 1+0 are mirrored configurations with 50% of raw capacity reserved for fault tolerance, RAID 1+0 incorporates more drives into an array, allowing the creation of larger LUNs than RAID 1.

In large deployments, only the most sensitive data should be stored on mirrored drives, with the remainder of the data stored on larger, more capacity-efficient arrays.

If capacity utilization is considered second to fault tolerance, the arrays should be striped vertically using RAID 5 or RAID ADG. One set of parity information is maintained for RAID 5, so one disk from each storage enclosure can be included in an array. Because RAID ADG maintains two sets of parity information, two drives from each storage enclosure can be included in an array. These fault-tolerance methods offer a high level of protection against data loss and reserve much less space for fault tolerance than RAID 1 or RAID 1+0.

NSPOF configurations offer ultimate data protection, trading off some capacity utilization and I/O performance for high availability.

When Capacity Utilization is Most Important

When the maximum utilization of storage capacity is considered more important than fault tolerance or performance, large horizontally striped arrays should be created.

If no fault tolerance is necessary, drives in a storage enclosure can be incorporated into one or several horizontally striped RAID 0 arrays.

More commonly, some level of fault tolerance protection is needed. Therefore, the arrays should be horizontally striped RAID ADG or RAID 5 arrays. Figure 4-5 illustrates that if fault tolerance is more important than I/O performance, the arrays should be striped horizontally using RAID ADG. If I/O performance is more important, the arrays should be striped horizontally using RAID 5. These fault-tolerance methods offer efficient use of capacity, while offering appropriate levels of security and performance.

When I/O Performance is Most Important

If I/O performance is determined to be more important than fault tolerance or capacity utilization, horizontal striping should be used.

If capacity utilization is the next most important system characteristic, then the storage can be configured into horizontally striped RAID 5 arrays. (If no level of fault tolerance is necessary, use RAID 0 striping.)

Alternatively, if fault tolerance is ranked second to I/O performance, the most effective configuration uses NSPOF horizontal RAID 1+0 arrays.

Physical Storage Planning Issues

- Hard Drive Sizes and Types
- Use and Number of Spares
- LUN Sizing

Hard Drive Sizes and Types

RAID arrays should be composed of hard drives of the same size and type. When drive types are mixed within a storage enclosure, the usable capacity and the processing ability of the entire storage sub-system is affected. Figure 4-6 provides several examples of arrays in a mixed-drive storage sub-system.

Mixed Drive Sizes

When a RAID array is composed of different sized drives, the RAID array defaults to the smallest individual drive size, and capacity in the larger drives goes unused.

For example, array A9 in Figure 4-6 includes seven drives, with three 18.2-GB drives and four 36.4-GB drives. The controller creates the array as if it were composed of seven 18.2 GB drives. This process results in a waste of 72.8 GB (18.2-GB wasted per 36.4-GB disk x 4 disks = 72.8 GB.) The better solution is to create two different RAID arrays, one with the three 18.2-GB drives and one with the four 36.4-GB drives.

Although it is an extreme example, array A8 in Figure 4-6 illustrates another example of inefficient drive placement. In this vertical array, one drive is 18.2 GB and two drives are 72.8 GB. This configuration results in a waste of 109.2 GB (72.8 - 18.2 = 54.6 GB per disk x 2 disks = 109.2 GB.)

Note: Except for the indicated drives, all drives are 72 GB Ultra 3 drives.

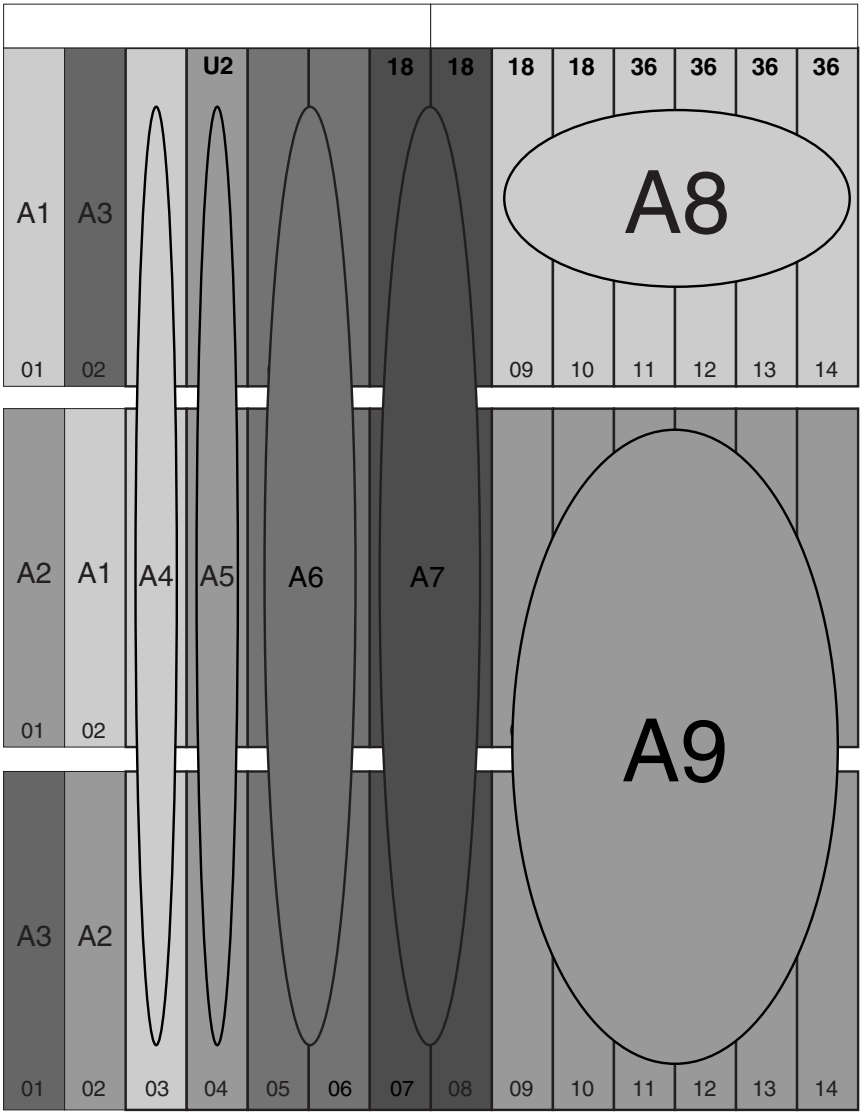


Figure 4-6: How drive characteristics affect array performance

Table 4-4: Table 4-6 Legend

Array Number	Array Configuration	Processing Characteristics	Effective Drive Capacity
A1, A3	Vertically striped RAID 1	U2	72 GB
A2	Vertically striped RAID 1	U3	72 GB
A4, A5, A6, A7	Vertically striped RAID 5	U2	72 GB
A8	Vertically striped RAID 5	U2	18 GB
A9	Horizontally striped RAID 5	U2	18 GB
A10	Horizontally striped RAID ADG	U3	72 GB

Mixed Drive Types

When different drive types are included in the same enclosure, the processing characteristics of the entire enclosure are reduced to that of the slowest drive.

In addition to the size of the drive affecting the usable capacity in an array, the processing characteristics of the drives must be considered. Do not mix different generations of hard drives (such as Ultra 2 and Ultra 3) in the same storage enclosure.

The processing characteristic of any array that includes a drive from that storage enclosure is reduced to that of the slowest drive. Using the arrays in Figure 4-6 as an example, any array containing a drive in the top storage enclosure is reduced to the processing ability of the Ultra 2 drive in drive bay 4. This includes array: A1, A3, A4, A5, A6, A7, A8, and A9

Spare Drive Sizes

The sizes of spare drives in relation to the active drives must be taken in to consideration.

A RAID array composed of 36.4 GB drives cannot use an 18.2 GB spare to replace a failed drive, but a RAID array composed of 18.2 GB drives can use a 36.4 GB spare. Compaq recommends that the spare set consist of the largest drives in the entire storage sub-system. This configuration ensures that any array in the storage sub-system can use any of the spares.

The following section defines and discusses using spares.

Use and Number of Spare Disks

Compaq recommends that spare disks be designated for use on the NAS B3000. Spares are disks that are not active members of any particular array, but have been configured to be used in the event that a disk in one of the arrays should fail. If a spare is present, it will immediately be used to begin rebuilding the information that was on the failed disk, using the parity information from the other member disks. During the rebuilding process, the array is operating in a reduced state and, unless it is a RAID ADG or RAID 1+0 array, it cannot tolerate another disk failure in the same array. If another disk should fail at this time, the array would become inaccessible and the information stored there would have to be restored from backup.

After the rebuild of the data onto the spare is completed, when a replacement drive is inserted to replace the failed drive, the system will automatically transfer the data from the spare onto the replacement drive and return the spare to an available-spare state. It is important to note that the process of rebuilding the spare or the replacement drive must not be interrupted or the process will be aborted.

Some administrators deem it necessary or desirable to have multiple spare disks, so that multiple arrays can experience failure and successfully recover, before administrative intervention would be required to replace the spare or failed disk. When assigning a spare to an array, the administrator chooses which arrays and how many arrays are protected by that spare.

LUN Sizing

When planning for optimal file serving performance, the number of hard drives necessary to maintain an optimum performance level must be determined. As a general rule, the greater the number of drives that are included in an array, the greater the performance level that can be achieved. However, the performance considerations are offset by fault tolerance considerations. The greater the number of drives in an array, the higher the probability of one or more disk failures in that array. The administrator must strike a balance between performance and fault tolerance.

In addition to other reasons mentioned throughout this chapter, planning the size of the arrays and LUNs is important for the following reasons:

- LUNs cannot be extended
- LUNs are concatenated when they are added into a pool

These limitations lead to the recommendation that system administrators create large LUNs and place a single LUN into a pool. Each of these points is discussed in further detail in the following paragraphs.

LUNs Can Not be Extended

The array controller does not support the growing of LUNs (called logical drives in the Array Configuration Utility) after they have been created. In order to grow an array and its corresponding LUN, the LUN and the array would have to be deleted and then recreated; including more drives in the new array and LUN. Doing this results in the loss of the data in the array. After the decision to recreate the arrays has been made, but prior to actually deleting and recreating the array and LUN, all data on the underlying folders and virtual disks must be backed up. This backup will be used to restore the data onto the system after the new configuration is established. The data need not be erased before deleting or recreating the arrays and LUNs, as the recreation process deletes the data.

An alternate method of incorporating new drives in the array is to expand the array itself. This does not alter the size of the existing LUN, but does allow the array to incorporate the new drives and gain the additional performance benefit of having more drives in the array. Additionally, the LUN and all of its data will remain intact. However, this means that the original LUN is not taking advantage of the new storage space. In order to use the additional space that was added by incorporating these new drives into the array, a second LUN will have to be carved out of the new free space inside the array. This LUN will then need to be incorporated into an existing pool or used to create a new pool. This method is the most flexible with respect to adding storage on an as-needed basis. However, it comes with the same planning issues as using vertical array striping (creating a large number of LUNs out of smaller storage chunks.) Compaq recommends that no less then seven drives be added each time this procedure is used. This will help reduce the overhead required by the new storage, while also helping to preserve the flexibility and ability of the pools to dynamically grow as storage needs increase.

Although both methods allow for modification of existing array configurations, each has its own challenges and issues. Thus, planning for future growth and creating the arrays wisely is extremely important.

LUNs are Concatenated When They are Added into a Pool

The VR software included with the NAS B3000 device does not stripe data across the LUNs that are incorporated into a pool. Rather, LUNs are concatenated together inside the pool. This means that data is not written to subsequent LUNs until the capacity of the first LUN is fully used.

When multiple LUNs are members of a pool, performance will typically be less than if one larger LUN containing all of the hard disks was used to form the pool. All writes will go to a single LUN, until there is no more space available on the LUN. After that LUN is full, then the writes will move to the second LUN, and so on. This performance will typically be less than if a single LUN comprises the pool and all drives are incorporated initially. In configurations where performance is the paramount concern, Compaq recommends importing only one large LUN into a pool, rather than composing the pool of multiple smaller LUNs.

Virtual Storage Planning Issues

The rules associated with the Virtual Replicator (VR) software must also be taken into consideration when planning system storage size and capabilities. These issues directly affect the planning and configuration of the storage. Knowing and understanding these rules is crucial to properly configuring the storage.

Virtual storage planning issues includes:

- Pool Considerations
- Virtual Disk Considerations
- Share Considerations

Pool Considerations

The primary consideration that must be addressed when planning VR pools is that there is a limit to the amount of growth a single pool can undergo. Pools are limited in size and are limited to a maximum of eight separate LUNs. VR pools cannot exceed 8 TB worth of disk space. (This size limit is not applicable for the NAS B3000, because a fully populated storage sub-system using forty two 72-GB drives, equals 3 TB. Because the LUNs cannot span storage sub-systems, 3 TB becomes the maximum capacity of an array, LUN or pool on the NAS B3000.) When using vertically striped RAID 1 arrays 21 LUNs will be created and when using vertically striped RAID 5 arrays, 14 LUNs will be created. A single pool cannot span all of these arrays. Because a pool can contain no more than eight LUNs, these vertical configurations require the administrator to divide the storage into at least two or three separate pools.

The RAID level of the LUNs included in a pool must be considered. All the units that make up a pool should have the same high-availability characteristics. In other words, the units should all be of the same RAID level. For example, it would be a bad practice to include both a RAID 1 and a RAID 5 array in the same pool. By keeping all the units the same, the entire pool retains the same performance and high-availability characteristics, making managing and maintaining the pool much easier.

Finally, the administrator must carefully consider how the pools will be carved up and what groups or applications will be using them. For example, putting several storage-intensive applications or groups into the same pool would not be efficient. These applications or groups would be better served by being divided up into separate pools, which could then grow as their space requirements increased, following the allowable growth limits.

Virtual Disk Considerations

The primary considerations when planning VR virtual disk carving are that virtual disks are limited in size and that there is a limit to the number of virtual disks that can be carved out of a VR pool. Currently, a virtual disk cannot be larger than 2 TB and a maximum of eight virtual disks can be carved out of a single pool. This means that in larger configurations, storage must be divided up and organized into these 2-TB chunks. For example, if a group has 20 different departments, it is not feasible to create an 8-TB pool and then carve out a separate virtual disk for each department. Rather, the storage would have to be broken down into several separate pools, and then the virtual disks for the departments would be carved out of those pools. (As mentioned later in this chapter, an alternative method of dividing out storage space among departments is to create file shares on the virtual disk for each department.)

Unless mount-points are being used, in order for users and the operating system to be able to access the virtual disk, each virtual disk must be presented as a drive letter on the device. Although it is possible to create a virtual disk and not map it to a drive letter, neither the users nor the administrator have access to the storage space contained within that virtual disk. After a drive letter is mapped, the space becomes available for use. This is also true of snapshots. A snapshot can be made, but is not accessible until it is assigned a drive letter.

A finite number of drive letters can be assigned. There are theoretically a maximum of 26 drive letters available, of which several are already reserved. For example, the diskette drive is A:, and the boot disk is C:. Because snapshots are competing with virtual disks for available drive letters, the administrator must carefully plan the number of virtual disks to create and the number of snapshots to keep. After all the available drive letters are used up, there is no mechanism to make additional virtual disks or snapshots available.

Share Considerations

Planning the content, size, and distribution of shares on the NAS B3000 can improve performance, manageability, and ease of use.

The content of shares should be carefully chosen to avoid the two common pitfalls of either having too many shares of a very specific nature or of having very few shares of a generic nature. For example, shares for general usage are easier to set up in the beginning, but can cause problems later. Frequently, a better approach is to create separate shares with a specific purpose or group of users in mind. However, creating too many shares also has its drawbacks. Take care to avoid creating shares unnecessarily. For example, if it is sufficient to create a single share for user home directories, create a "homes" share rather than creating separate shares for each user.

In a clustered environment, it is important to note that the best performance is achieved by using the fewest number of shares. The more shares and other resources there are, the more overhead is required for monitoring and management by the clustering software. This overhead directly detracts from the performance of the server. By keeping the number of shares and other resources low, the performance of the NAS B3000 is optimized. For example, instead of sharing out each individual user's home directory as its own share, share out the top-level directory and let the users map personal drives to their own sub directory.

Storage Sizing Considerations

Estimating the number and configuration of storage enclosures, disks, arrays, pools, and virtual disks that are needed in a particular environment can be a complicated endeavor. A variety of factors affect the actual usable amount of space on a particular NAS B3000, including:

- RAID Issues
- Spare Disk Issues
- Snapshot Issues
- Growth Issues
- Allocation Unit Size Issues
- Consolidation Concerns

RAID Issues

The RAID level defines the high-availability characteristics of the RAID array. The variety of RAID types offers different combinations of fault tolerance, performance, and efficiency.

NOTE: For a complete description of RAID types, see the "Storage Management Overview" chapter. Additional information on configuring the RAID types is included in the "Fundamental Storage Configuration Planning Issues" section earlier in this chapter.

Unless drives are being mirrored using RAID 1, no fewer than three disks should be included in an array, so that more efficient RAID types can be used. As more disks are used in a RAID array, the percentage of total space devoted or "lost" to parity for fault tolerance goes down. Thus, in general, larger RAID arrays are more space efficient. For example, in a three disk RAID 5 array, the equivalent of one disk of the three is devoted to parity, accounting for about 33 percent of the total raw storage capacity. In a 14 disk RAID 5 array, the equivalent of a single disk is still needed for parity, but the percentage drops to one in 14 disks, or about 7 percent. Larger arrays offer better performance and use of storage capacity than smaller arrays.

Adequate planning must increase the amount of raw storage capacity needed by the estimated amount of storage space used for fault tolerance.

Spare Disk Issues

Compaq recommends that spare disks be designated for use on the NAS B3000. Spares are disks that are not active members of any particular array, but have been configured to be used in the unlikely event that a disk in one of the arrays should fail.

Some administrators deem it necessary or desirable to have multiple spare disks, so that multiple arrays can experience failure and successfully recover, before administrative intervention would be required to replace the spare or failed disk. When assigning a spare to an array, the administrator chooses which arrays and how many arrays are protected by that spare.

The administrator must include in the storage planning process the increase of raw storage capacity needed to account for the hard drives that will be used as spares.

Snapshot Issues

Snapshots are a feature of VR and are a point-in-time view of a VR virtual disk. Even though snapshots do not use up any space initially, maintaining the point-in-time view of the virtual disk requires that snapshots must allocate space and create a copy of original data before allowing any changes to be made to the parent virtual disk. Thus, snapshot space usage tends to climb over time, and the rate of usage is related to the rate of change of the data on a virtual disk, the total lifetime of the snapshot, and the number of snapshots maintained for a virtual disk.

By default, the NAS B3000 reserves 30 percent of the pool space exclusively for the use of snapshots. This percentage may be altered for those expecting to generate more or less snapshot data.

The administrator must include in the storage planning the increase in raw storage capacity needed by either 30% or the estimated amount of space that will be reserved for snapshot use.

Growth Issues

It is also important to allow for significant changes in the total size of all files on a particular virtual disk. Some applications generate large temporary files during their execution, or create extremely detailed log files that can cause a significant, but temporary, expansion in needed disk space. Knowing the type of data that will occupy a particular share or disk is valuable in planning for this type of variability.

Planning for growth can seriously alter sizing requirements. Storage needs commonly grow from 50% to over 500% in a single year, depending on the system deployment. In general, it is better to accommodate an expected rate of growth from the beginning rather than attempting to address it in several smaller changes throughout the year.

When necessary, an additional storage enclosure or groups of storage enclosures can be added to the original configuration. After new arrays and LUNs are created, they can be formed into additional pools and virtual disks, mounted on drive letters, and put into use.

Allocation Unit Size Issues

Depending on the allocation unit size, a given amount of data from one server may take up either more or less disk space when moved to the NAS B3000.

Allocation units define the smallest segment of a disk that is read or written at a time. If a file size is smaller than the allocation unit, the extra space is "wasted" because it is not used. If there are a large number of files that are smaller than the allocation unit size, a large amount of unused space may exist in those files. In contrast to the storage space considerations, larger allocation unit sizes offer better disk I/O and file-serving performance. If the allocation unit size is too small relative to the size of the files, more disk I/Os are required to read and write the data, and consequently, both the disk I/O and the file-serving performance degrades. To achieve a good balance between performance and space efficiency, the default allocation unit size on the NAS B3000 is 16 KB.

When migrating data from an existing server to the NAS B3000, the administrator must make sure that the allocation unit size on the NAS B3000 virtual disk exactly matches that of the original virtual disk, unless this modification is intentionally being performed and the impact on required space has been planned. If the administrator does not carefully compare and plan for the allocation unit size, the performance and storage space can be negatively impacted. Depending on the allocation unit size of the destination virtual disk, the allocation unit size of the source virtual disk, and the actual file sizes, the destination disk may need to be smaller than or larger than the source disk. If the raw capacity of the destination virtual disk is not larger than the capacity of the source disk, and during the migration process the difference in allocation unit size causes the storage used to grow in relation to the source disk, the destination disk may fill up before all of the data is migrated. The allocation unit size of the virtual disks is easily selectable when creating virtual disks on the NAS B3000.

Consolidation Issues

Consolidating the data from several file servers into a single NAS B3000 can improve availability and decrease the administrative burden of fileserver management. However, care should be taken when estimating the amount of space that will be required to replace existing servers. In most cases, it is not merely a matter of adding all the space used by the replaced servers. All of the previously mentioned factors must be taken into account.

Storage Management Planning Scenarios

This section provides examples of system configurations. The first scenario details the analysis and planning process of determining the configuration of an example system deployment. Other examples compare different possible configurations of the same amount of system storage.

Additionally, a planning worksheet is included at the end of this section. System administrators can use this worksheet to guide them through the storage planning process.

Therefore, this section includes:

- A complete and detailed storage planning example
- A simple sizing comparison
- An example of a storage subsystem using different array configurations
- Planning worksheet

A Complete and Detailed Storage Planning Example

This example progresses through the analysis and planning process of setting up and configuring the storage for a NAS B3000 device. The assumptions and numbers used in this example are also illustrated in a completed Planning Worksheet located at the end of this section.

Assume that a NAS B3000 device is obtained to consolidate file storage. Before any migration of data can occur and before any configuration of the storage on the NAS device can take place, complete analysis of the current file-serving environment must be completed. Primary analysis of the current file-serving environment involves the determination of amount of space that is currently used to store the data that will be migrated.

Initial Storage Needs

Assume the following information was obtained during the analysis process:

- 1000 GB of space is needed to accommodate data that will be migrated.
- 500 GB of additional space for data is needed to accommodate a projected 50% future growth in storage needs.
- Therefore, the initial usable storage need is 1500 GB.

See Table 4-5 for a sample for the initial entries to the Planning Worksheet.

Snapshot Storage Needs

Snapshots may be a new feature to many environments that are moving up to the NAS B3000. As mentioned previously in the "Storage Management Overview" chapter, a snapshot is an instantaneous copy of pointers to data on the disk. When the data on the disk changes, the original blocks are copied to a reserved snapshot area of the same pool in which the parent virtual disk is located. In environments where a large volume of data changes rapidly, it is possible for snapshots to use a significant amount of storage capacity.

- Determine the percentage of space to reserve for snapshots.

  When snapshots are going to be used, proper planning includes an allowance for an adequate amount of space to be reserved for snapshots. For most environments, Compaq recommends that an additional 30% of disk space beyond the storage requirements be allocated for snapshots.

  — Determine the percentage of pool space that will be reserved for snapshots, such as 30%.

  — Convert the percentage to a decimal equivalent, such as 0.30.

- Manipulate this percentage to derive a factor that can be applied to the Initial Usable Storage Need, resulting in a Total Storage Need.

  The following formula ensures that the required space will be available after the snapshot reserve is deducted:

  — The Snapshot Factor is 1.00–the reserve percentage, such as 1.00–0.30=0.70.

This scenario will use snapshots and will use the default snapshot reserve of 30%.

Total Storage Need

By applying the Snapshot Factor to the Initial Usable Storage Need, the Total Storage Need can be calculated. The result is the amount of required storage space. This figure can then be used as a constant during other steps of the planning process, such as determining the best array size and configuration.

If the Initial Usable Storage Need is divided by the Snapshot Factor, the needed space is increased by a sufficient amount to allow for the snapshot reserve.

For example: this Total Storage Need is 1500 GB / .70 = 2142.86 GB, or 2143 GB.

Table 4-5: Example Storage Need Worksheet

		Formula	Value
Initial Storage Need			
1.	Data Space Needed		1000 GB
2.	Future Growth Space		500 GB
3.	Total Initial Usable Storage Need	Data Space + Growth Space (Step 1 + Step 2)	1000+500=1500 GB
		Initial Storage Need	**1500 GB**
Snapshot Storage Need			
4.	Reserve Percentage		30% = 0.30
5.	Snapshot Factor	1.00 – Reserve Percentage 1.00-Step 4	1.00-0.30=0.70
Revised Storage Need			
6.	Total Storage Need	Total Initial Usable Storage Need / Snapshot Factor (Step 3 / Step 5)	1500 / .70 = 2142.86 GB
		Total Storage Need	**2143 GB**

Array Configuration Requirements

Before the physical hard drives can be configured into arrays and LUNs, the preliminary planning steps as outlined in the beginning of this chapter must be completed. These primary planning decisions include:

NOTE: See Table 4-6 for an example of a completed Planning Worksheet for this scenario.

- Determine the sizes and types of physical hard drives that will be used.

  The NAS B3000 supports the use of 1 inch Compaq Ultra 2 and Ultra 3 drives in the following capacities: 18 GB, 36.4 GB, and 72.8 GB.

  In this scenario, the decision was made to use Compaq Ultra 3 72.8-GB drives. These drives were chosen instead of the 36.4 drives to maximize the use of the MSA1000 storage subsystem and its available drive bays. Using these larger drives should allow for all of the needed storage space to be housed in one MSA1000. If 36.4-GB drives were used, it is likely that two MSA1000 storage subsystems would be needed.

- Determine which array configuration strategy will be used, how many drives will be reserved for parity, and how many drives will be included in each array

  — The NAS B3000 supports the use of several different RAID configurations of the arrays and LUNs. In conjunction with striping strategies, these RAID configurations offer varying combinations of fault tolerance, I/O performance, and capacity utilization.

  This scenario assumed that while fault tolerance is important, capacity utilization and I/O performance were important as well. For this reason, horizontally striped RAID 5 arrays will be used.

  — After the RAID level has been selected, the amount of space required for fault tolerance per array can be determined.

  In this scenario using horizontally striped RAID 5 arrays, one drive from each array must be reserved for parity information.

— As in previous discussions in this chapter, more drives translates into more space, and more drives per array means that the percentage of space required for parity is reduced. However, the effective reliability of the underlying disk system is lessened, as more and more drives are included in any individual array. Using moderately sized RAID 5 arrays of 14 or fewer drives, it is unlikely that two drives within the same array would fail at the same time. While fourteen drives is still a reasonable RAID 5 array size, increasing the size to twenty-eight or forty-two drives steadily increases the potential for multiple-drive failure within the same array. It is for this reason that Compaq recommends placing 14 or fewer drives in a RAID 5 array.

An additional point to consider when deciding on the array size is consideration of the potential restore window for data recovery from offline media in case of a disk subsystem failure. Fourteen drives worth of data may be restorable in a few hours, and users of data resident on other arrays can continue using that data while the restore takes place. However, the time required to restore arrays containing twenty-eight or forty-two drives is much greater. Since the failure of a larger array takes with it a greater chunk of the potential storage capacity of the NAS B3000, fewer arrays are available for use while the restore takes place.

Based on these considerations, this scenario will create seven-drive RAID 5 arrays.

- Determine how many drives in the array will be usable for storage.

  This figure is easily obtained using the decision from the previous steps. With the RAID configuration, array size, and fault tolerance requirement known, the following equation can be formed:

Usable Drives per Array = Number of Drives per Array – Number of Drives for Fault Tolerance

In this scenario, the numbers are:

7 drives per array – 1 drive for fault tolerance = 6 usable drives per array

- Determine the amount of usable space in the array.

  As these calculations progress, it can be seen that these figures are building upon one another to ultimately determine the total number of arrays, the number of drives that must purchased, and the number of storage enclosures needed to hold all of the drives. Therefore:

Usable Space per Array = Usable Drives per Array x Individual Drive Size

In this scenario, the numbers are:

6 Usable Drives x 72.8-GB drives = 436.8 GB usable space per array

- Determine the total number of arrays required.

  One of the most important steps in the storage planning process is the determination of how many arrays must be created to house the needed storage. Knowing the required number of arrays leads to a conclusion of how many drives and storage enclosures must be purchased to house the storage.

  Additionally, because the arrays and LUNs are used to build the pools, the number of arrays in a system directly affects the size of the storage pools and virtual disks that are created from the arrays.

  The formula for determining the required number of arrays is straightforward: simply divide the total amount of usable storage needed by the amount of usable storage in each array. The Total Storage Need can be determined and obtained from the Usable Storage Needs Worksheet.

Total Number of Arrays Required = Total Storage Need / Usable Space per Array

In this scenario, the numbers are:

2143 GB Total Storage Need / 436 GB Usable Space per Array = 4.92 Total Number of Arrays Required = 5 arrays required

Table 4-6: Example Array Configuration Requirements Worksheet

		Formula	Value
Array Configuration Requirements			
1.	Individual Drive size		72.8 GB
2.	Number of Drives per Array		7 drives
3.	Number of Drives for Fault Tolerance per Array		1 drive
4.	Usable Drives per Array	Number of Drives per Array – Number of Drives for Fault Tolerance (Step 2 - Step 3)	6 drives
5.	Usable Storage Space per Array	Usable Drives per Array x Individual Drive Size (Step 4 x Step 1)	6 x 72.8 GB = 436.8 GB
6.	Total Number of Arrays Required	Total Storage Need / Usable Storage Space per Array (Step 6 from previous worksheet / Step 5 from this worksheet)	2143 GB / 436 = 4.92
		Total Number of Arrays Required	**5 arrays**

Drives Required

At this point in the planning process, one potential configuration strategy has been presented, and the number of arrays required to support the needed amount of usable storage has been calculated.

To continue with the planning process, the required number of drives must be determined, as well as the number of storage enclosures needed to house them.

See Table 4-7 for an example of a completed worksheet.

- Determine the number of hard drives required for all of the arrays.

  This figure is an interim figure, that when increased by the number of spare drives to be used, results in the total number of drives needed for the entire storage subsystem of the NAS B3000.

Number of Drives Required for all Arrays = Total Number of Arrays Required x Number of Drives per Array

For this scenario:

5 Arrays x 7 Drives per Array = 35 Drives Required for all Arrays

- Determine the number of spare drives that will be used.

  Compaq recommends that at least one online spare be allocated for each storage subsystem. One spare can dedicated to each array or a single spare can be shared with multiple arrays. These extra drives must be added to the Number of Drives Needed for an Array to show the Total Number of Required Drives.

  This example will use a single spare, shared between the five seven-drive RAID 5 arrays.

- Determine the total number of drives required

Total Number of Drives Required = Drives Required for all Arrays + Spare Drives

Therefore, at this time, 36 drives must be purchased, seven each for the five arrays, plus an additional drive to be used as an online spare.

35 Drives Required for the Arrays + 1 Spare Drive = 36 Total Drives Required

Table 4-7: Example Drives Required Worksheet

Drives Required for the Arrays		
1. Number of Drives Required for the Arrays	Total Number of Required Arrays x Number of Drives per Array (Step 6 x Step 2)	5 x 7 = 35 drives
Spare Drives Need		
2. Number of Spare Drives		1 drive
Drives Required for the Storage Subsystem		
3. Total Number of Drives Required	Number of Drives for the Arrays + Number of Spare Drives	35 + 1 = 36 drives
	Total Drives Required	**36 drives**

Storage Enclosures Required

After the number of required drives is calculated, then the number of storage enclosures that are required to house them can be determined. Depending on the results, the array configuration may need to be adjusted. For example, the number of drives may expand the configuration into an additional storage enclosure by only one or two drives. In this case, different array configurations should be studied that may meet the storage needs, while not requiring an additional enclosure.

- Determine how many disk storage enclosures are required.

  Because each disk storage enclosure accommodates fourteen drives, calculate this figure by dividing the Total Number of Drives Required by a constant of 14.

Number of Storage Enclosures = Total Number of Drives Required / 14

For this scenario, 3 storage enclosures are required:

36 Total Number of Drives Required / 14 = 2.57 = 3 storage enclosures

- Determine the number of MSA1000s that are required.

  Each MSA1000 can support two additional storage enclosures, for a total of three shelves, each holding up to 14 drives. Therefore:

Number of MSA1000s = Number of Storage Enclosures / 3

For this scenario:

3 storage enclosures needed / 3 shelves per MSA1000 = 1 MSA1000 needed

Table 4-8: Example Enclosures Required Worksheet

Storage Enclosures			
1.	Total Number of Storage Enclosures Required	Total Number of Drives / 14	36 / 14 = 2.57 enclosures
		Total Number of Storage Enclosures Needed	**3 enclosures**
MSA1000s			
2.	Total Number of MSA1000s Required	Total Number of Storage Enclosures / 3	3 / 3 = 1 MSA1000
		Total Number of MSA1000s	**1 MSA1000**

Conclusion

A final look at the figures in this scenario shows the following:

- One MSA1000 with two additional storage enclosures must be purchased to house the needed storage.
- 36 hard drives must be obtained and placed into the storage enclosures.

  Because the storage subsystem can house up to 42 drives, six open drive bays are available for future drive purchases.
- Five seven-drive horizontal RAID 5 arrays will be created.
- One spare will be assigned to serve all of the arrays.

At this time, one possible storage configuration has been presented. This scenario was planned to provide a conclusion that needs no adjustments.

For most deployments, this analysis and configuration process must be repeated several times, each time using different variables.

If all data is considered equal and will be placed in identical arrays, the Total Usable Storage Need will remain constant. However, when differing RAID configurations and array sizes are suggested, the resulting storage configurations will be quite different.

If some data needs special protection, the Total Usable Storage Need may need to be divided into different groups. A combination of configurations can be created in order to protect the most sensitive data in an NSPOF configuration, while other data may be stored in more capacity-efficient configurations.

A Simple Sizing Comparison

In terms of raw storage capacity, a fully populated MSA1000 storage subsystem using 42 72.8 GB drives provides about 3057 GB or 3 TB of raw storage space. This compares to approximately 1528 GB, or 1.5 TB of raw storage space if 36.4 GB drives are used. Twice the amount of space per drive translates to twice the amount of total capacity in the storage subsystem available for carving into arrays and virtual disks.

An Example of a Storage Subsystem Using Different Array Configurations

Assume a fully populated MSA1000 storage subsystem using 42 72.8 GB drives is available. The examples in the following paragraphs illustrate how different configuration strategies provide different levels of fault tolerance and deliver slightly different total capacities.

If fault tolerance is of paramount importance when configuring the system, the arrays should be configured using an NSPOF horizontal RAID 1+0 array configuration, 3 arrays will be created, each using seven drives from one storage enclosure and seven drives from a different enclosure to serve as the mirrored drives. Because RAID 1 and RAID 1+0 reserve 50% of raw storage capacity for the mirrored fault tolerance, the usable storage space is 1528 GB.

(14 drives – 7 drives for mirroring = 7 drives; 7 drives x 72.8 GB = 509.6 GB per array)
(3 arrays x 509.6 GB per array = 1528.8 GB)

If fault tolerance is still important, but better capacity utilization is desired, 6 horizontal seven-drive RAID 5 arrays can be created. 1 drive per array will be used for parity information, resulting in 2620 GB of total usable storage space.

(7 drives – 1 drive for parity = 6 drives; 6 drives x 72.8 GB = 436.8 GB)
(6 arrays x 436.8 GB = 2620.8 GB)

If even better capacity utilization is needed, 3 fourteen-drive RAID 5 arrays can be created. 1 drive per array is still used for parity information, but because the arrays incorporate more drives than the previous example, only 3 drives in total will be used for parity. The resulting usable space is 2839 GB of total usable space. Simply creating larger arrays has resulted in 219 GB of additional usable storage space.

(14 drives – 1 drive for parity = 13 drives; 13 drives x 72.8 GB = 946.4 GB)
(3 arrays x 964.4 GB = 2839.2 GB)

A final example offers the ultimate capacity utilization while still offering an acceptable level of fault tolerance. All 42 drives of the storage subsystem are placed into one large RAID ADG array. Regardless of the number of drives in the array, RAID ADG arrays reserve 2 drives of capacity for parity information. So this example configuration presents 2912 GB of usable storage space.

(42 drives – 2 drives for parity = 40 drives; 40 drives x 72.8 GB = 2912 GB)

Table 4-9 consolidates these calculations.

Table 4-9: Example Usable Space Using Different Configurations

Array Configuration	Usable Space	Fault Tolerance
RAID 1 arrays	1528 GB	21 drives - 50%
7-drive RAID 5 arrays	2620 GB	6 drives - 14%
14-drive RAID 5 arrays	2839 GB	3 drives - 7%
42 drive RAID ADG arrays	2912 GB	2 drives - 5%

NOTE: This example highlights usable capacity.

Planning Worksheet

In general, the following steps should be performed to effectively plan the needed storage capacity and its configuration:

- Analyze current data storage demands and determine the amount of data that will be migrated to the NAS B3000.
- Determine the amount of space to allow for future growth.
- Determine if snapshots will be used, and if so, if a 30% reserve is adequate.
- Determine the total amount of space needed.
- Determine the sizes and types of hard drives that will be used.
- Determine the ranking of desired system characteristics and decide upon the RAID striping and configuration method, space for fault tolerance, and the size of the arrays.
- Determine the number of arrays that will be required.
- Determine the number of drives required to build these arrays.
- Determine the number of spare drives to use to support these arrays.
- Determine the number of drives required to build this system configuration.
- Determine the number of storage enclosures necessary to hold all of the drives.
- Determine the number of MSA1000 storage subsystem necessary to hold all of the drives in their storage enclosures.
- Adjust, rework, and finalize and the sizing and configuration plan.

Use the following worksheet as a guide when evaluating different storage configurations.

Table 4-10: Usable Storage Need Worksheet

	Formula	Value
Initial Storage Need		
1. Data Space Needed		
2. Future Growth Space		
3. Total Initial Usable Storage Need	Data Space + Growth Space (Step 1 + Step 2)	
Snapshot Storage Need		
4. Reserve Percentage		
5. Usable Storage Percentage	1.00 – Reserve Percentage 1.00-Step 4	
Revised Storage Need		
6. Total Storage Need	Total Initial Usable Storage Need / Usable Storage Percentage (Step 3 / Step 5)	
	Total Storage Need	

Table 4-11: Array Configuration Storage Needs Worksheet

		Formula	Value
Array Configuration Requirements			
1.	Individual Drive size		
2.	Number of Drives per Array		
3.	Number of Drives for Fault Tolerance per Array		
4.	Usable Drives per Array	Number of Drives per Array – Number of Drives for Fault Tolerance (Step 2 - Step 3)	
5.	Usable Storage Space per Array	Usable Drives per Array x Individual Drive Size (Step 4 x Step 1)	
6.	Total Number of Arrays Required	Total Storage Need / Usable Storage Space per Array (Step 6 from previous worksheet / Step 5 from this worksheet)	
		Total Number of Arrays Required	

Table 4-12: Drive and Enclosure Requirements

Drives Required for the Arrays		
1.	Number of Drives Required for the Arrays	Total Number of Required Arrays x Number of Drives per Array (Step 6 x Step 2)
Spare Drives Need		
2.	Number of Spare Drives	
Drives Required for the Storage Subsystem		
3.	Total Number of Drives Required	Number of Drives for the Arrays + Number of Spare Drives
	Total Number of Drives Required	
Storage Enclosures		
4.	Total Number of Storage Enclosures Required	Total Number of Drives / 14
	Total Number of Storage Enclosures Needed	
MSA1000s		
5.	Total Number of MSA1000s Required	Total Number of Storage Enclosures / 3
	Total Number of MSA1000s	

Migration Issues

The process of moving data from the old file servers over to the NAS B3000 includes the following steps:

- Developing a migration plan
- Performing the migration

The following sections discuss the conceptual aspects and procedural highlights of different migration methods.

Developing a Migration Plan

There are only two ways to transition from one file server to another. Each method requires some down-time, but the amount of down time varies, as does the impact on the client users. These migration methods are:

- System-wide migration
- Departmental migration

System-Wide Migration

During a system-wide migration, the entire system is taken off-line. During this down-time, the entire content of the old system is migrated over to the NAS B3000. All migration procedures are performed once, perhaps over a weekend.

In large deployments, this method may not be practical. If the amount of data to transfer is great, a system-wide migration may not be possible, due to the increased amount time necessary to move all data.

Departmental Migration

During a departmentalized migration, sections of the operation are individually taken off-line, migrated over, and brought on-line. This method is also referred to as a "rolling" migration. The migration steps are performed several times, once for each department. During a departmental migration, one department is brought over at a time according to a set schedule, such as each Sunday night or each weekend.

In addition to requiring a relatively small window of time, there are additional advantages of a departmental migration. A departmental migration allows for a "trial run" of a portion of the business to go live on the new system. During this trial run, the administrator can address any questions or concerns about the migration process.

Departmental migration is accomplished by first identifying the level at which data will be transitioned as a unit. Transitioning data to the NAS Server in more granular logical units has the advantage of allowing the administrator to carefully analyze and plan an appropriate storage management scheme, rather than simply moving the data. Regardless of the name, the departmental migration method may be applied at many distinct levels, as outlined below:

- Server level: Much like a system-wide migration, data from each particular file server is transitioned "en masse", when one is performing the consolidation of many individual file servers into a single NAS B3000.
- Volume level: In many cases, the volume is the unit of transition, since a volume is typically the unit at which a particular group of users is granted storage. In the case of the NAS B3000, a volume is called a virtual disk.
- Project Directory level: Some companies choose to partition their storage into very large volumes for convenience, and then subdivide the large volumes into separate project directories, which may then be allocated to project groups as needed.
- Share level: Frequently the most effective level of movement is at the share level, since this provides very granular control over the users and groups who may be affected, and the share point of the old server is available to the new NAS server as a source for copying the data.

Performing the Migration

As with the migration plans, there are two methods of actually moving the data from the old file server to the NAS B3000:

- Backup and restore
- Ethernet copy

IMPORTANT: Regardless of the method chosen, backing up and verifying the entire content of the server whose data is being moved is very important. There is always the possibility that mishaps can occur during the data transition. Even if not all data on the old server is being migrated to the NAS device, having a complete, verified backup of the old server's data is insurance against accidental deletion of directories and missed content.

Although the actual migration procedures of these two methods are different, some of the preparatory and completion procedures of each method are the same. These procedures for each of these migration methods are outlined below.

Backup and Restore

The following steps provide an outline of the necessary procedures when migrating to the NAS B3000 using backups. Procedural details are located within the appropriate topic-specific chapters of this administration guide.

1. Complete the initial system configuration.
   a. Complete the Rapid Startup procedures.
   b. For clustered deployments, complete the steps outlined in the Cluster Setup Tool.
2. Configure the NAS B3000 storage - *excluding* file shares.

   Configure the arrays, LUNs, pools, and virtual disks.

   IMPORTANT: When creating the virtual disks, verify that the Allocation Unit Size is set to the desired size. If the allocation unit size is not the same on the source volumes and the target virtual disks on the NAS device, there may be unintended growth in the file sizes. See the "Allocation Unit Size Issues" section earlier in this chapter for a discussion on the issues surrounding selecting an appropriate allocation unit size.

Do not create file shares at this time. The file structure is contained in the backup of the data and will be restored along with the data during the restoration process.

3. Create any local users or groups.
4. Install the backup software onto the NAS device.
5. Create the backups of the data being migrated.
6. Restore the data from the backup onto the target virtual disks of the NAS device.
7. Finalize the configuration of the NAS B3000.
   a. Re-create the file shares.
   b. Create any desired snapshot schedules.
   c. Build the permissions lists for the shares and files.
   d. Add any trust relationships. These trust relationships allow users from one domain to access resources in another domain.
   e. Install additional software, such anti-virus programs.

Ethernet Copy

If both the old file servers and the NAS B3000 can be attached to the same Ethernet network, data can be copied directly from the old servers on to the NAS device, without using backups. However, while this may be a convenient option, the actual copy process is slower than the restoration process from tape.

The procedural details of this type of migration are the same as when using tapes, with the following exception: when the storage of the NAS B3000 is configured, the file shares must also be created.

1. Complete the initial system configuration.
2. Configure the NAS B3000 storage - *including* file shares.
3. Create any local users or groups.
4. Create a complete system backup of the old file server.
5. Copy the data from the old file servers to the target folders on the NAS B3000.
6. Finalize the configuration of the NAS B3000.

Storage Capacity Expansion Issues

The NAS device is designed for expansion. Up to two additional external disk storage enclosures can be added to the MSA1000 for a total of 42 drives. In addition, up to nine MSA1000 storage enclosures can be accessed by the NAS B3000. Depending on the needs of each system deployment, many configuration options are available, including:

- Add new drives to an existing array and create a new logical drive or drives
- Add new drives, create a new array, and create a new logical drive or drives
- Add the new logical drive or drives to existing pool or pools
- Create a new pool or pools using the new logical drive or drives
- Use new pool space to expand existing virtual disks
- Use new pool space or new pools to create new virtual disks

These options give the administrator great flexibility in adding new storage space or effectively expanding existing space. When adding space to an existing pool, the virtual disks created in that pool can be expanded, or new virtual disks can be created to take advantage of the space. Use the procedures described in the previous sections for creating arrays, logical drives, pools, and virtual disks.

When adding space to the system, consider the following:

- Add drives in groups of three or four. Because new drives must be configured as new logical drives, for best performance add drives in sets of at least three, and preferably seven or more.
- The maximum number of storage units (logical drives) in a pool is eight. To have large pools from which to create virtual disks, make logical drives as large as possible.

To expand system capacity:

1. Physically install the new hard drives.
2. Use the ACU to add the new hard drives to an existing array or create a new array using the new drives.

   Existing logical drives automatically expand across the physical drives, including newly added ones.
3. Create a new logical drive to use the extra space in the expanded array.
4. Add the new LUN to an existing pool or create a new pool with the new LUN.
5. Create new virtual disks, as needed.
6. Create the necessary folders and file shares.

5

Physical Storage Management

For discussion purposes, storage in the *StorageWorks* NAS B3000 is divided into two categories: physical and virtual. Physical storage includes the physical hard drives, as well as the initial configuration of the hard drives into arrays and logical units (LUNs). Virtual storage includes the management and grouping of the LUNs into storage pools and virtual disks.

Complete conceptual information on managing physical and virtual storage is discussed in the "Storage Management Overview" and "Storage Management Planning" chapters.

This chapter discusses the procedural aspects of managing the physical storage. Procedural information on virtual storage is included in the "Virtual Storage Management" chapter.

Therefore, the storage topics discussed in this chapter include:

- Hard Drive Management
  - — Adding New Hard Drives
  - — Defining Hard Drive LED Indicators
  - — Replacing Failed Hard Drives
  - — Using Spare Drives
  - — Moving Hard Drives
  - — Moving Arrays

- Array and LUN Management
  - Compaq ACU Overview
  - Accessing the ACU
  - Entering Controller Settings
  - Creating a New Array
  - Creating a New Logical Drive
  - Configuring Selective Storage Presentation (SSP)
  - Expanding the Capacity of an Array
  - Migrating an Existing LUN to a New RAID Level

Hard Drive Management

Some of the administrative tasks for managing the physical hard drives include:

- Adding New Hard Drives
- Defining Hard Drive LED Indicators
- Replacing Failed Hard Drives
- Using Spare Drives
- Moving Hard Drives

Defining Hard Drive LED Indicators

The hard drive LEDs, located on each physical drive, are visible on the front of the server or on the front of the storage enclosure. They provide activity, online, and fault status for each corresponding drive when configured as a part of an array and connected to a powered-up controller. LED behavior can vary depending on the status of other drives in the array.

This section provides the following information about hard drive LEDs:

- An illustration detailing the location of each LED
- A table of the possible LED configurations and what each combination means

CAUTION: Read "Hot-Plug Drive Replacement Guidelines" in the *Compaq Servers Troubleshooting Guide* before removing a hard drive.

For additional information on troubleshooting hard drive problems, refer to "Hard Drive Problems" and "SCSI Device Problems" in the *Compaq Servers Troubleshooting Guide*.

Use the following illustration in conjunction with Table 5-1 to analyze the status of hot-plug hard drives.

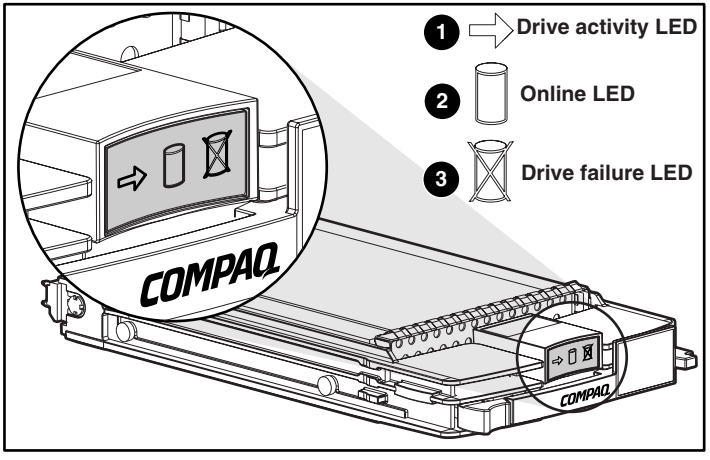


Figure 5-1: Hot-plug hard drive LED indicators

Table 5-1: Hard Drive LED Combinations

Activity	Online	Drive Failure	Indication
On	Off	Off	**Do not remove the drive. Removing a drive during this process causes data loss.** The drive is being accessed and is not configured as part of an array.
On	Flashing	Off	**Do not remove the drive. Removing a drive during this process causes data loss.** The drive is rebuilding or undergoing capacity expansion.
Flashing	Flashing	Flashing	**Do not remove the drive. Removing a drive during this process causes data loss.** The drive is part of an array being selected by the ACU. -Or- The Options *ROMPaq*™ is upgrading the drive.
Off	Off	Off	OK to replace the drive online if a predictive failure alert is received (see the "Predictive Failure Alert" section in *Compaq Servers Troubleshooting Guide* for details) and the drive is connected to an array controller. The drive is not configured as part of an array. -Or- If this drive is part of an array, then a powered-up controller is not accessing the drive. -Or- The drive is configured as an online spare.

continued

Table 5-1: Hard Drive LED Combinations *continued*

Activity	Online	Drive Failure	Indication
Off	Off	On	OK to replace the drive online. The drive has failed and has been placed offline.
Off	On	Off	OK to replace the drive online if a predictive failure alert is received (see the "Predictive Failure Alert" section in *Compaq Servers Troubleshooting Guide* for details), provided that the array is configured for fault tolerance and all other drives in the array are online. The drive is online and configured as part of an array.
On or flashing	On	Off	OK to replace the drive online if a predictive failure alert is received (see the "Predictive Failure Alert" section in *Compaq Servers Troubleshooting Guide* for details), provided that the array is configured for fault tolerance and all other drives in the array are online. The drive is online and being accessed.

Replacing Failed Hard Drives

The NAS B3000 is designed with many fault-tolerant features to prevent common problems. However, if a drive fails, it must be replaced. Because the operating system drives are set up in a RAID 1 array, the loss of one of the two drives does not result in any loss of system function. If the external drives are set up in RAID 0 arrays with no fault tolerance, the loss of a single drive will cause data loss. However, it is more likely that the external drives are set up in RAID arrays that offer fault tolerance, so the loss of a single drive in an array does not result in any loss of data. Regardless, failed drives must be replaced as soon as possible. Until a failed drive is replaced, the NAS device is operating in a non-fault-tolerant mode. If the other drive is lost before the failed one is replaced and rebuilt, the system will fail

NOTE: Refer to the maintenance and service guide for detailed procedures about hardware failures on the NAS device.

Failed drives can be replaced without the server being powered down. The drives in your server are hot-pluggable. To identify failed drives, look for one or more of the following:

- An amber LED is illuminated on a failed drive. This LED indicates that the storage enclosure is powered up and that the SCSI cable connecting the storage enclosure to the server is working.

  NOTE: The amber light may briefly illuminate when the drives are inserted. This illumination is normal and does not indicate a failure condition unless the LED remains illuminated.

- An amber LED is illuminated on the storage enclosure. This LED indicates that one or more drives in the storage enclosure has failed, a fan failure has occurred, or a high-temperature condition exists.
- A (POST) message lists failed drives when the NAS device is restarted. This message is dependent on the array controller detecting one or more "good" drives.
- The Array Diagnostics Utility (ADU), found on the SmartStart and Support Software CD, reports failed drives.
- The Compaq Insight Manager reports failed drives or prefailure conditions on one or more drives.

Follow these guidelines when replacing a failed drive:

- **Never remove more than one drive at a time (two drives if ADG is being used).** When a drive is being replaced, the controller uses data from the other drives in the array to reconstruct data on the replacement drive. If more than one drive is removed, (or two with RAID ADG) a complete data set is not available to reconstruct data on the replacement drive and permanent data loss could occur.
- **Never remove a working drive.** The amber Drive Failure indicator on the drive carrier indicates a drive that has been failed by the controller. Unless the drive is a member of a RAID ADG array, permanent data loss will occur if a working drive is removed while replacing a failed drive.
- **Never remove a drive while another drive is being rebuilt.** A drive's online indicator flashes green (once per second) while it is being rebuilt. A replaced drive is rebuilt from data stored on the other drives.

- **If the system has an online spare drive, wait for it to complete rebuilding before replacing the failed drive.** When a drive fails, the online spare becomes active and begins rebuilding as a replacement drive. After the online spare has completed Automatic Data Recovery (the Online indicators will be continuously lit), replace the failed drive with a new replacement drive. **Do not** replace the failed drive with the online spare. The system will automatically rebuild the replacement drive and reset the spare drive to an available state.

To replace a failed drive:

1. Determine the position of the failed drive.

   A lighted LED indicator means that the drive has failed. When identifying drives by drive number, refer to the following table showing how bay numbers correspond to SCSI ID numbers. It is imperative to identify the correct drive before starting the replacement procedure.

   NOTE: All Compaq utilities report drive information in terms of SCSI ID. Only the physical drive enclosure is labeled by bay number. Use Table 6-3 to properly identify the appropriate drive bay.

   IMPORTANT: Compaq utilities report drive state through the SCSI ID. Table 5-2 assists you in associating the appropriate drive bay to the corresponding SCSI ID.

Table 5-2: Storage Enclosure Drive Bay Configuration

Description														
Bay Number	1	2	3	4	5	6	7	8	9	10	11	12	13	14
SCSI ID	0	1	2	3	4	5	8	9	10	11	12	13	14	15

2. Remove the failed drive by unlatching and sliding it out of the drive bay about one inch.
3. Allow a few seconds for the drive to spin down before removing it completely.

CAUTION: Be sure to use a drive bay blank to cover open bays if you do not plan to insert a new drive within a few seconds. The drive bay blanks are necessary to maintain proper airflow for cooling. Failure to cover open bays can lead to thermal failure of your drives and loss of data.

4. Insert a new drive of the same type into the bay where the failed drive was located.

Compromised Fault Tolerance

If the fault tolerance of an array is compromised due to multiple concurrent drive failures, the condition of the logical drive or drives on that array is "failed," and unrecoverable errors are returned to the operating system. Data loss is probable. Inserting replacement drives at this time does not improve the condition of the logical drive or drives.

If this situation occurs, first try powering down the entire system and then powering up. Then remove power from both the server and storage enclosure. Reapply power to the storage enclosure, then the server, and then restart the system. In some cases, a drive with intermittent problems can work long enough for you to make copies of important files. If a 1779 POST message is displayed, press the **F2** key to re-enable the logical drive or drives. Remember, it is likely that data loss has occurred, and any data on a failed logical drive is suspect.

Fault tolerance can also be compromised due to non-drive issues. These issues include faulty SCSI and power cables, power supplies, facility power, or accidental unplugging of storage enclosure power. In such cases, the physical drives in the storage enclosures need not be replaced. However, data loss is possible.

In cases of actual drive failure, replace any drives that have failed to prevent further problems. Afterwards, the fault tolerance may again be compromised, power may need to be recycled, and the 1779 POST message may again be displayed. Press the **F2** key to re-enable the logical drive or drives. Then recreate your pools and virtual disks, and restore data from backup media.

Using Spare Drives

To increase the fault tolerance of the NAS device, Compaq recommends using at least one of the drives in the storage enclosures as an online spare. Using spares in combination with the recommended drive configuration methods achieves the highest level of protection. In case of a drive failure, if an online spare is assigned to an array and if the spare is available, it acts as an immediate replacement for the failed drive. Recovery operations start automatically to rebuild the information from the failed drive onto the spare drive, using the remaining drives and the parity or mirrored information.

CAUTION: Until the rebuild process is complete, a spare drive cannot prevent the failure of the entire array if another drive in the array fails. Additionally, it is possible that uncorrectable drive errors can prevent a successful rebuild operation.

A single online space can be assigned to multiple arrays, or multiple drives can be devoted to online spare duty for maximum redundancy. When using a single online spare drive, be sure to assign it to each array in the storage enclosure. The original online spare drive remains a part of the array until the replacement drive is installed.

See "Creating a New Array" later in this chapter for procedural information on assigning spares to arrays.

Moving Hard Drives

CAUTION: All data must be backed up before removing drives or changing configurations. Failure to do so could result in permanent loss of data. The system must be powered down.

Drives in the external storage enclosures can be moved, but should only be done after a complete and successful backup and when the server has been powered down and turned off. To move drives, the following conditions must be met:

- System is powered down (includes all system components).
- No drive failures are identified. The array must be in its original configuration.
- Capacity expansion or drive rebuild is not in progress.
- Controller firmware is the latest version (recommended).

When the above conditions are met, move the drives using the following procedure:

1. Remove one drive at a time by unlatching and sliding it out of the drive bay about one inch.

   IMPORTANT: Before removing a drive from the drive bay, be sure to allow a few seconds for the drive to completely spin down before handling it. If external storage enclosure has already been powered down, the drives should already have spun down.

2. Move the drive to the desired location in an external storage enclosure.
3. Repeat steps 1 through 2 for all of the drives that need to be moved.

   IMPORTANT: All drives in an array must be moved at the same time or data loss will occur.

4. Restore power to the external storage enclosure or enclosures, and then power up the server. As the system restarts, a 1724 POST message is displayed, indicating that the drive positions have changed and have been updated. If a 1785 POST message is displayed, immediately power down the system components to prevent data loss and return each drive to its original location. Then power up the server as usual.
5. If desired, run the ACU to view and confirm the new drive positions.

When moving drives, refer to Table 5-2, "Storage Enclosure Drive Bay Configuration."

CAUTION: All data must be backed up before removing drives or changing configurations. Failure to do so could result in permanent loss of data. The system must be powered down before removing drives.

Moving Arrays

When a company has multiple NAS devices, situations may arise in which an entire array needs to be moved from one server to another. Because the data on the servers is stored in virtual disks created from drive space pools that may contain space from multiple arrays, care must be taken when moving arrays. The following guidelines are provided:

- All drives with arrays and logical drives used in a pool must be moved at the same time.
- Use the ACU to identify which drives belong to the array being moved. In the ACU interface, highlighting the array causes the drive lights to flash on the member disks of the array.
- Move all drives in the array at the same time.
- Make sure that no failed drives are present or that no rebuild processes are in progress.
- Make sure that the positions of other drives on the system to which the array is being moved are not being changed at the same time.
- Make a full backup of all data on the server from which the array is being moved before starting the move process.
- To move the array, power down the system, and unplug power from the server. Then, remove power from the storage enclosure or enclosures and carefully remove the drives.

CAUTION: To avoid data loss, replace failed drives according to configuration guidelines in Table 5-2.

Array and LUN Management

NOTE: For consolidation purposes, detailed overview information of all storage issues is included in a separate chapter. The “Storage Management Overview” chapter introduces and discusses in detail arrays, LUNs, RAID levels, pools, virtual disks, and snapshots.

In addition, the “Storage Management Planning” chapter includes detailed planning information that guides the administrator through the decision making process of determining the best configuration of their storage.

The physical disks, arrays, and their corresponding logical units (LUNs) are managed using the Compaq Array Configuration Utility (ACU). Virtual Replicator then uses the LUNs to create storage pools, virtual disks, and snapshots.

This section provides instructions for using the ACU. VR procedures are discussed in the following chapter. The following topics are included in this section:

- Compaq ACU Overview
- Accessing the ACU
- Creating a New Array
- Creating a New Logical Drive
- Configuring Selective Storage Presentation (SSP)
- Expanding the Capacity of an Existing Array
- Migrating an Existing LUN to a New RAID Level or Stripe Size

Compaq ACU Overview

The ACU is graphical tool, incorporating wizard-style interfaces to create RAID arrays and logical drives from the physical drives installed in the storage subsystems. The drive arrays should be configured using the RAID level that meets the fault tolerance, cost effectiveness, and I/O performance needs of the environment using those arrays. For detailed planning discussions of recommended configuration striping methods and RAID levels, see the "Storage Management Planning" chapter.

The ACU can be used to grow an existing array by incorporating new drives into the array. The associated LUN and its data are automatically rewritten and re-striped over all of the drives now in the array. The new extra capacity in the array can be used for a variety of purposes, including reconfiguring associated LUNs or creating new LUNs and using them to grow the size of the array's pool.

The ACU can also completely reconfigure an existing LUN, including changing the RAID type and the stripe size. While these procedures are time consuming, they are not data destructive and can be performed online.

CAUTION: Existing logical drives must be deleted only after deleting the virtual disks and pools associated with these logical drives. See the "Virtual Storage Management" chapter for information on deleting virtual disks and pools.

The NAS device can support as many as nine MSA1000 storage subsystems, with 42 physical drives in each storage subsystem, for a total of approximately 27-TB of raw storage. Each MSA1000 storage subsystem is managed by a separate, embedded array controller and therefore must be managed separately.

Features of the ACU

- Graphical representation of drive array configurations with wizards that help optimize array configuration
- Online spare (hot spare) configuration
- Separate fault-tolerant configurations on a logical drive (LUN) basis
- Easy capacity expansion of arrays
- Online RAID level and stripe size migration

Features of the MSA1000 Smart Array Controllers

The MSA1000 Smart Array Controller is a drive array controller designed for installation in the MSA1000. The MSA1000 comes equipped with at least one MSA1000 Controller installed. In an NSPOF configuration, dual array controllers are present. The NAS server's Integrated Smart Array Controller protects the operating system drives in the server by using RAID 1 fault tolerance.

The MSA1000 manages the drives in the storage enclosures, using several high performance RAID configurations, such as Distributed Data Guarding (RAID 5) and Advanced Data Guarding (RAID ADG).

Key features and benefits of the MSA1000 Smart Array controllers include:

- Support for RAID 0, RAID 1, RAID 1+0, RAID 5, RAID ADG, and Selective Storage Presentation
- Fibre Channel support for connection to the server
- Support for 1-inch Compaq Ultra2 and Ultra3 Pluggable Universal Hard Disk Drives
- Online Capacity Expansion, Online RAID Migration, Online Stripe Size Migration
- Removable and upgradeable battery-backed cache with ECC memory (Array Accelerator)
- Performance monitoring through Compaq Insight Manager
- Pre-failure notification of hard disk drives
- Onboard rechargeable batteries that cache array accelerator data. This cached information is safe during equipment failure or power outage. This is particularly important for data that has been cached by a posted-write but has not yet been written to the hard drives. The batteries preserve data in the array accelerator for a minimum of four days.

IMPORTANT: The rechargeable batteries on a new Smart Array Controller can be discharged when the board is first installed. During server power-up with discharged array accelerator batteries, Power-On-Self-Test (POST) displays the code "1794," indicating that the array accelerator is disabled. This error message does not require action. The array accelerator is automatically enabled when batteries are charged to 90 percent of their capacity.

IMPORTANT: The internal circuitry can take up to 36 hours to fully charge the batteries. During this time, the array accelerator is disabled, but the Smart Array Controller properly functions, but without the performance advantage of the array accelerator.

Accessing the ACU

To access the ACU:

1. Log on to the NAS device as an administrator and go to the WebUI.
2. From the WebUI, navigate to **Disks, Array Configuration Utility**.

   A Terminal Services session is automatically opened, and prompts for user identification. Enter an administrator-level name and password to access the ACU.

   Each time the ACU is started, the utility checks the configuration of each MSA1000 and its controllers and associated physical hard drives, drive arrays and LUNs. This may take a minute or two.

   If the hard drives and the arrays are unconfigured or if the configuration is less than optimal, a configuration wizard guides the administrator through the configuration process of adding the drives to arrays or creating LUNs.

   NOTE: The automatic wizard can be bypassed to manually configure arrays by clicking the "Cancel All" selection.

3. After the Configuration Wizard is finished, or if it is bypassed, the main configuration screen of the ACU is displayed. All array and LUN configuration tasks can be performed in the ACU main configuration screen.

   In the **Controller Selection** drop-down box near the top of the screen, select the controller that needs to be configured.

CAUTION: Do not modify the settings for the Integrated Smart Array Controller in the Embedded Slot. Changes to the configuration of the embedded controller can corrupt the operating system on the server.

After a controller is selected, the screen display is refreshed to include information about the arrays and logical drives associated with the chosen controller.

If the selected controller is unconfigured, the screen will show only unassigned drives. When the ACU utility detects an unconfigured controller, a configuration wizard leads you through the controller configuration process.

If the selected controller has already been configured, arrays, logical drives, and unused space are displayed.

4. The ACU presents either a logical or a physical view of the drives, arrays, and LUNs. Control the presentation of the view by using the radio buttons at the bottom left of the screen.

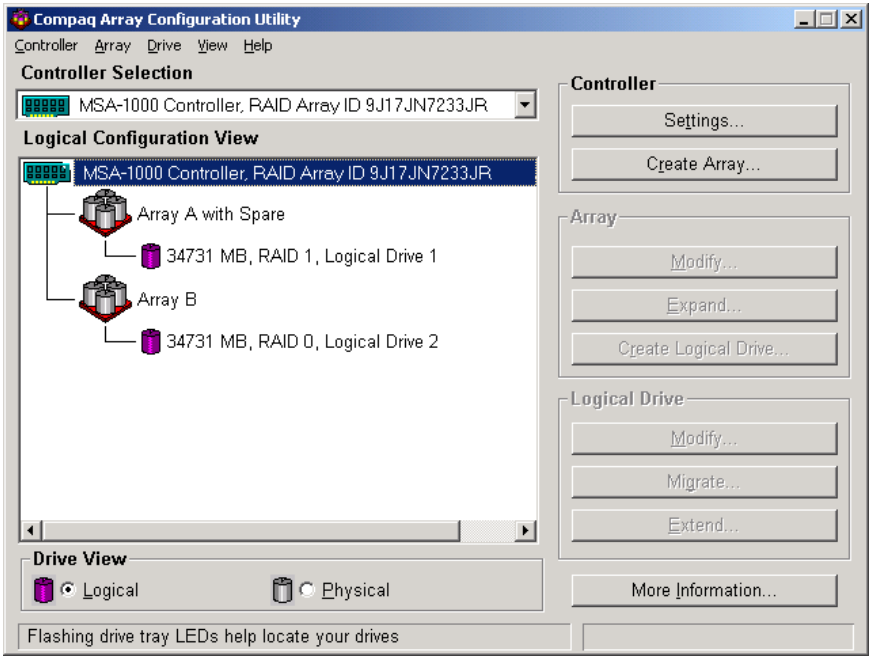


Figure 5-2: ACU Logical Drive view

Select either **Logical Drive View** or **Physical Drive View**. Figure 5-2and Figure 5-3 are examples of the two presentation methods.

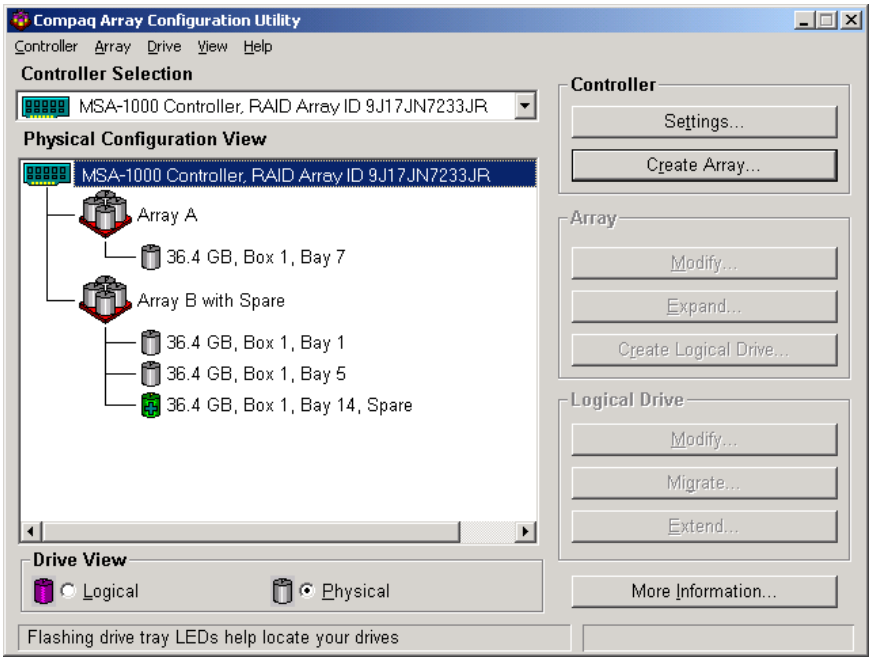


Figure 5-3: ACU Physical view

NOTE: Selecting an item—a controller, array, logical drive, or physical drive— in the Configuration View box will cause the hard drive tray LEDs to blink. Use this feature to identify a specific physical drive or to identify the drives in the storage enclosures that are attached to the controller.

5. Action buttons are displayed in the right portion of the dialog box. Some action buttons on the screen are highlighted and some appear gray. Appropriate buttons are available depending on the items selected to configure.

   Actions include:

   — **Controller Settings** — used to enter parameter settings for the arrays and LUNs associated with this controller.

   — **Create Array** — used to create new arrays from unassigned physical hard drives.

- **Modify Array** — used to make changes to an existing array. This option can be used to add or delete physical drives from an array and is data destructive.
- **Expand Array** — used to grow an array by adding unassigned physical hard drives to an existing array.
- **Create Logical Drive** — used to convert an array into a logical drive (LUN). It is during this process that the RAID level is assigned.
- **Modify Logical Drive** — used to change the Array Accelerator setting for an existing logical drive.
- **Migrate Logical Drive** — used to convert a LUN from one RAID configuration to a new RAID configuration.
- **Extend Logical Drive** — this option is not available for this operating system.

6. To see detailed information about a specific controller, array, or LUN, click **More Information** at the bottom right of the screen.

   Figure 5-4 is an example of the additional information that is displayed for an array.

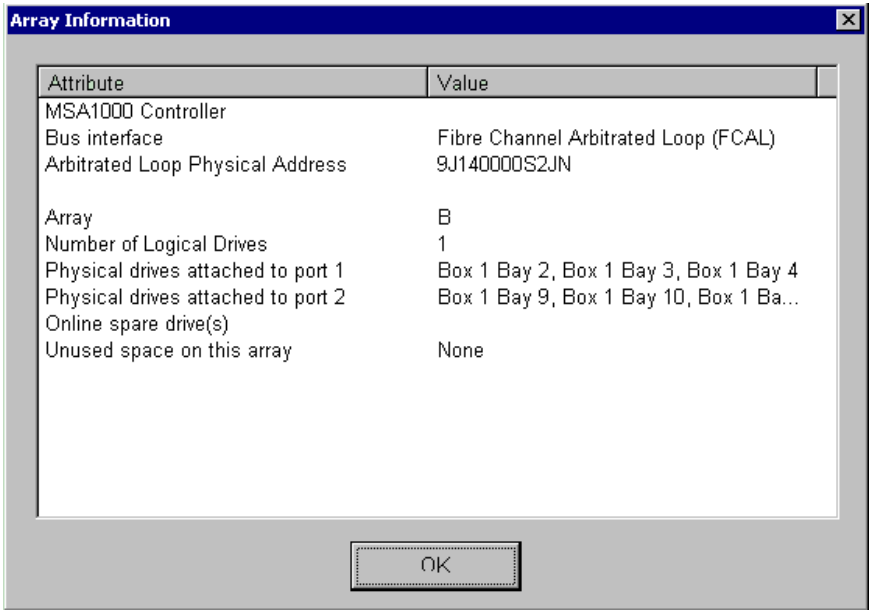


Figure 5-4: ACU More Information screen for an array

Entering Controller Settings

The controller settings determine how much importance to place on array expansion or rebuilding relative to normal I/O operations. Additionally, if the controller has a battery-backed cache, the ratio of read cache to write cache can be changed.

The default controller settings provided by the ACU-XE will be adequate for most environments. However, to change the controller settings:

1. Access the ACU and select the desired controller in the Controller Selection dropdown box.

CAUTION: Do not modify the settings for the Integrated Smart Array Controller in the embedded slot. Changes to the configuration of the embedded controller can corrupt the operating system on the server.

2. Click **Controller Settings**. The Controller Settings dialog box is displayed.

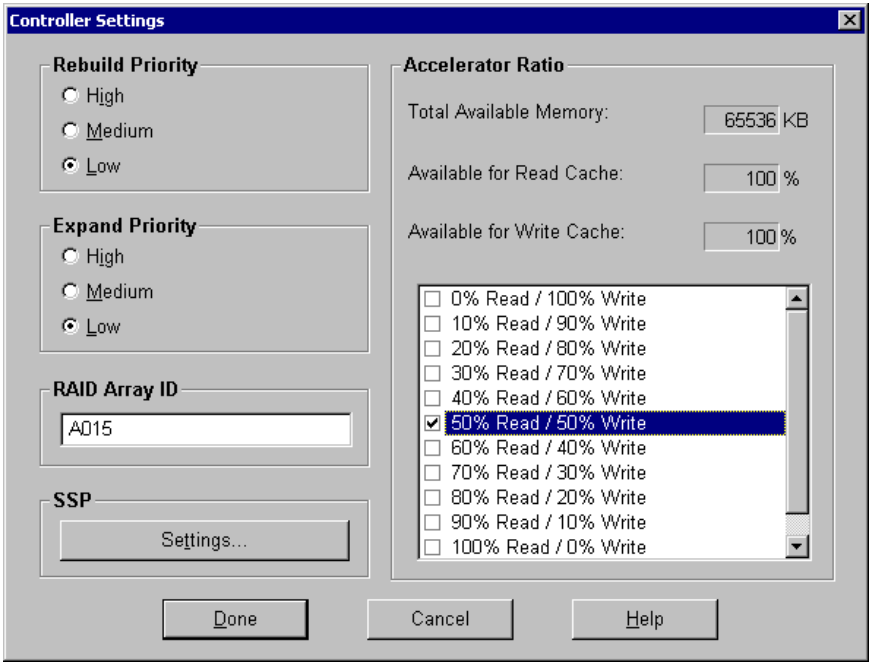


Figure 5-5: Controller Settings dialog box

3. Select the **Rebuild Priority**.

   The Rebuild Priority affects the amount of time the controller spends rebuilding data after a failed drive has been replaced.

   If the array rebuild is set to **low** priority, the rebuild will take place only when the array controller is not busy handling normal I/O requests. This setting has minimal effect on normal I/O operations. With a low rebuild priority, however, there is an increased risk that data will be lost if a physical drive fails while the rebuild is in progress.

   If the rebuild has **high** priority, the rebuild occurs at the expense of normal I/O operations. Although system performance is affected, this setting provides better data protection because the array is vulnerable to additional drive failures for a shorter time.

When the priority is set to **medium,** rebuild still has greater priority than I/O requests, but less than with the high setting.

4. Select the **Expand Priority**.

   The Expand Priority affects the amount of time the controller spends rewriting data and restriping the LUNs during an array expansion.

   If the expansion is set to **low** priority, the expansion will take place only when the array controller is not busy handling normal I/O requests. This setting has minimal effect on normal I/O operations. With a low expansion priority, however, there is an increased risk that data will be lost if a physical drive fails while the expansion is in progress.

   If the expansion has **high** priority, the expansion occurs at the expense of normal I/O operations. Although system performance is affected, this setting provides better data protection because the array is vulnerable to additional drive failures for a shorter time.

   When the priority is set to **medium,** expansion still has greater priority than I/O requests, but less than with the high setting.

5. If necessary, enter Selective Storage Presentation (SSP) settings to control access of specific LUNs to different hosts. See the "Configuring Selective Storage Presentation (SSP) section for detailed information on SSP.

6. Select the **Accelerator Read/Write Ratio**.

   The Accelerator Read/Write Ratio determines the amount of memory allocated to the read and write caches on the array accelerator. Some applications may perform better with a larger write cache while others may perform better with a larger read cache. This setting can only be changed if the controller has a battery-backed cache.

7. After all settings are entered, click **Done**. The ACU main configuration screen is displayed again.

Creating a New Array

Before creating any arrays, become familiar with the information in the "Storage Management Overview" chapter and use the information and recommendations in the "Storage Management Planning" chapter to develop a corporate storage management plan.

To create a new array:

1. Access the ACU as described previously. In the ACU utility main configuration screen, select the desired controller from the Controller Selection drop-down menu.

CAUTION: Do not modify the settings for the embedded Integrated Smart Array Controller Slot. Changes to the configuration of the embedded controller can corrupt the operating system on the server.

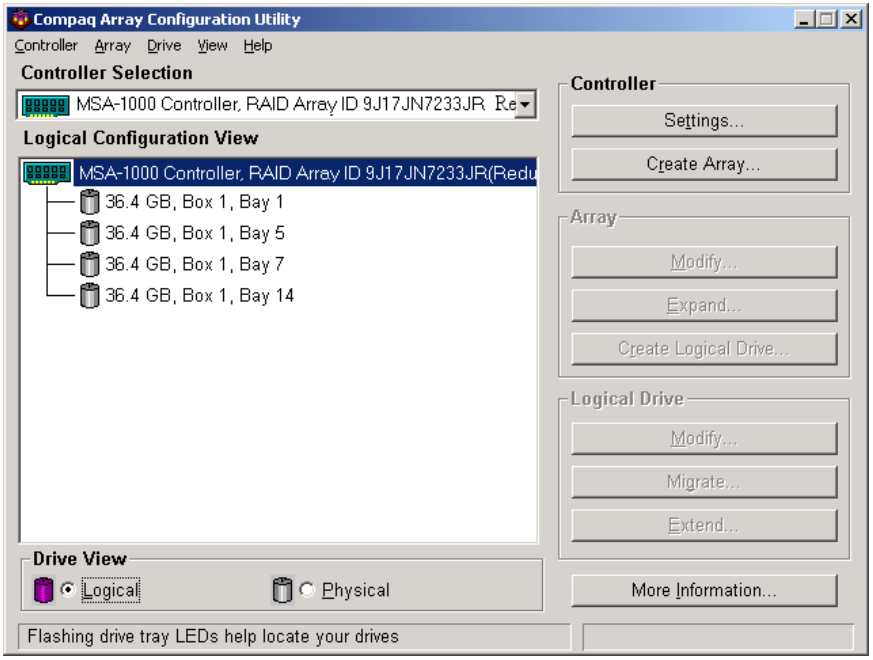


Figure 5-6: ACU Main configuration screen

2. Click **Create Array**. The Create Drive Array dialog box is displayed.

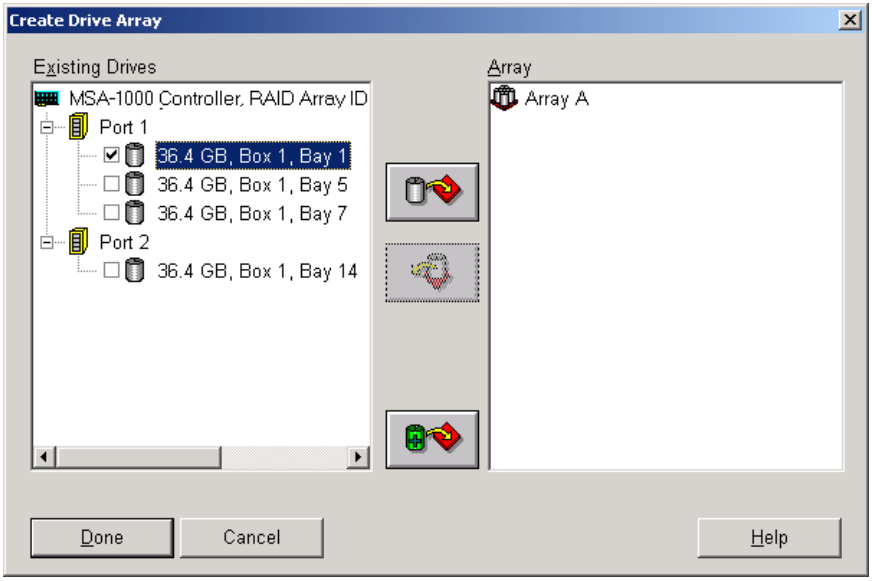


Figure 5-7: Create Drive Array screen

IMPORTANT: Always group physical drives of the same size and type. If drive sizes are mixed, some capacity of the larger drives is wasted. See the "Storage Management Planning" chapter for detailed information, examples, and consequences of mixing drive types.

3. Select all of the physical drives to include in the array by clicking on them in the **Existing Drives** box.
4. Add the drives to the array by clicking the icon showing the **right-pointing arrow** (**Assign Drives to Array**) option in the center of the screen. (When the cursor passes over this icon, the title for the button is displayed.)

   All selected drives are moved into the right pane on the interface, designating their inclusion in the array.
5. If desired, indicate a drive to use as a spare for this array.

   This online spare is used automatically and immediately when one of the other member drives in the array fails. Spares can be shared among arrays.

To assign a spare to this array, select the desired drive in the **Existing Drives** box and then click the **right-pointing arrow** (**Assign Spare to Array**) icon at the bottom center of the screen.

At this point, the Create Drive Array screen may look similar to the following figure.

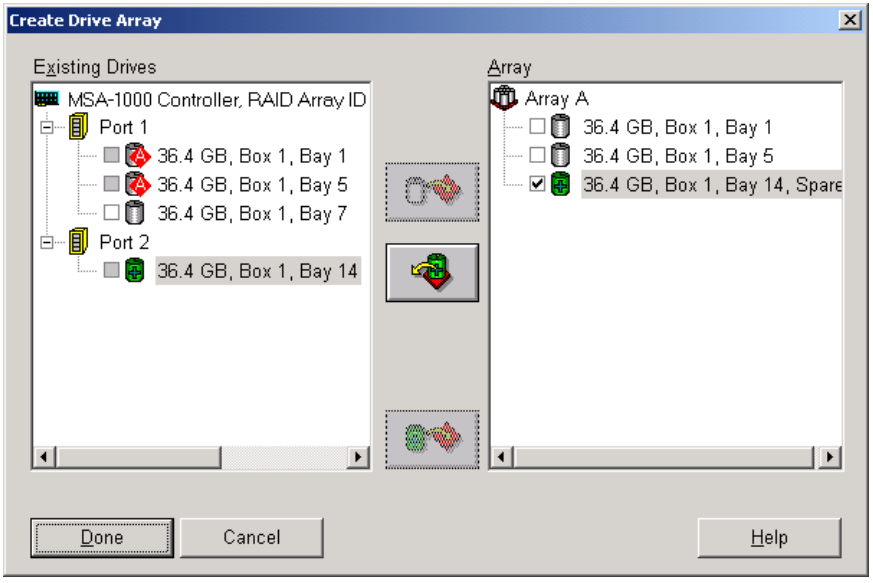


Figure 5-8: Example Array A

NOTE: The same spare drive can be assigned to multiple arrays. However, spare drives should have the same or greater capacity as the drives in the array.

6. Click **Done** to return to the ACU main configuration screen. The Configuration View is updated to show the new configuration. Array information is now displayed instead of the individual hard drive information.

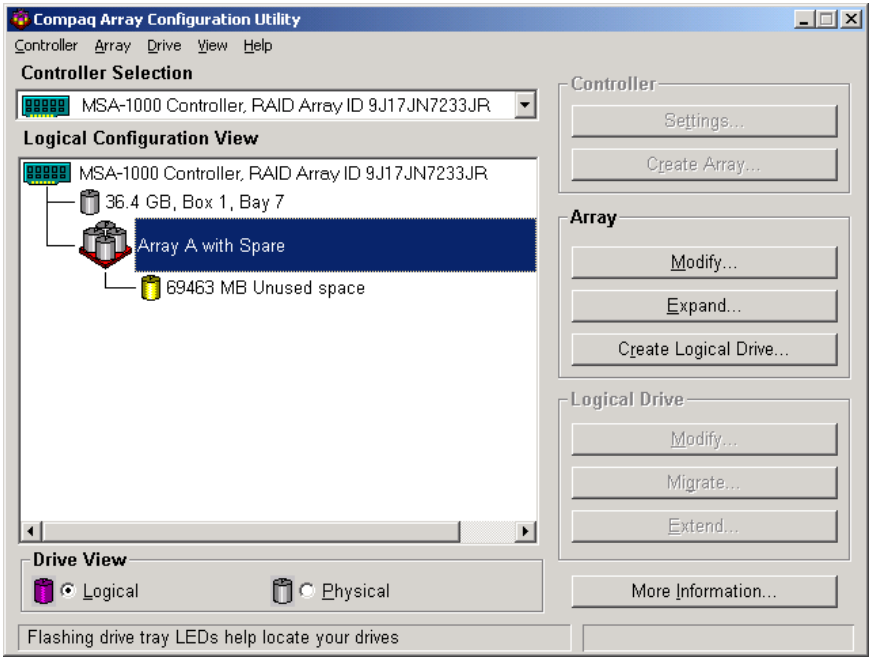


Figure 5-9: Example Array Logical Configuration view with one array

IMPORTANT: A logical drive (LUN) must be created for the arrays before exiting the ACU or the array setup will not be saved. Use the procedure in the following section to create a logical drive from the array.

7. Create additional arrays for this controller, using any remaining unused physical hard drives attached to this controller.
8. Create the logical drives (LUNs) for these arrays.

Creating Logical Drives (LUNs)

After the physical drives are gathered into arrays, they need to be converted into fault-tolerant LUNs. When creating a logical drive, the fault-tolerance (RAID level) is selected along with settings regarding the LUN size, array accelerator use, and the stripe size.

Although multiple LUNs can be created from one array, Compaq recommends creating one LUN from the array.

To create a new LUN:

1. Access the ACU, and in the ACU main configuration screen, select the desired controller and array.
2. Click **Create Logical Drive**. A screen similar to the following figure is displayed.

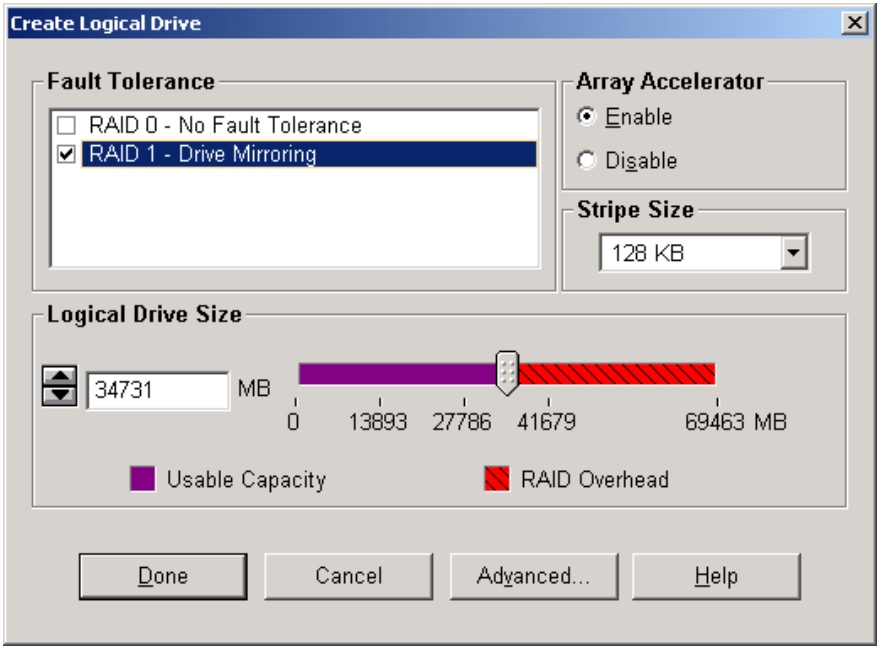


Figure 5-10: Create Logical Drive dialog box

3. In the Fault Tolerance box, indicate the desired level of fault tolerance for the LUN. Select the RAID type from the displayed list.

   NOTE: Only the applicable RAID types are displayed for the array. For example, in a two-drive array, only RAID 0 and RAID 1 are available

4. Select **Enable Array Accelerator**.
5. Set the **Stripe Size** to the desired value or accept the default.

   Stripe size refers to the amount of data stored on each physical drive in one stripe of a logical drive. Each RAID level has a default value plus a range of supported sizes. The default values provide optimum performance for that RAID level in most applications.

   To select a stripe size other than the default, click the down arrow next to the displayed default stripe size and select from those available.

Table 5-3: Optimum Stripe Sizes for Different Environments

Server Application Environment	Suggested Strip Size Change
Mixed read/write	Accept the default value.
Mainly sequential read (such as audio/video applications)	Larger stripe sizes work best.
Mainly write (such as image manipulation applications)	Smaller stripe sizes for RAID 5 and RAID ADG Larger stripe sizes for RAID 0, RAID 1, and RAID 1

6. Set the **Logical Drive Size**.

   To create a logical drive that uses the entire array, use the default values. The utility does not allow you to create a logical drive larger than the maximum size supported by the operating system.

   The Logical Drive Size area of the screen includes a scale marked with the amount of raw storage capacity in the array. The left side of the Logical Drive Size scale indicates the amount of space available for data. The right side of the scale indicates the amount of space required for storing parity or mirrored information, depending on the fault-tolerance method.

7. To set the **Maximum Boot Size**, click **Advanced**.

   Clicking the Advanced button displays the Advanced Features dialog box, which contains settings for the boot size for the logical drive.

   When the Maximum Boot Size option is disabled, the logical drive will use the default of 32 sectors per track. Enabling maximum boot size increases the number of sectors to the maximum of 63 in order to increase the number of blocks available during a BIOS call. Enabling maximum boot size may be necessary to be able to create large boot partitions for some operating systems.

   For example, enabling maximum boot size on a logical drive in Windows NT 4.0 allows you to create a bootable partition with a maximum size of 8 GB, rather than the 4 GB maximum size allowed when maximum boot size is disabled.

   Enabling maximum boot size may decrease performance of the logical drive.

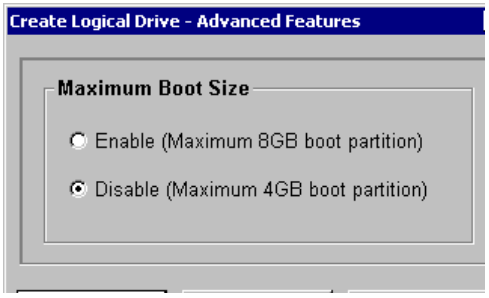


Figure 5-11: Advanced Features screen

8. Click **Done**.

   The Configuration View screen may now look like Figure 4-9.

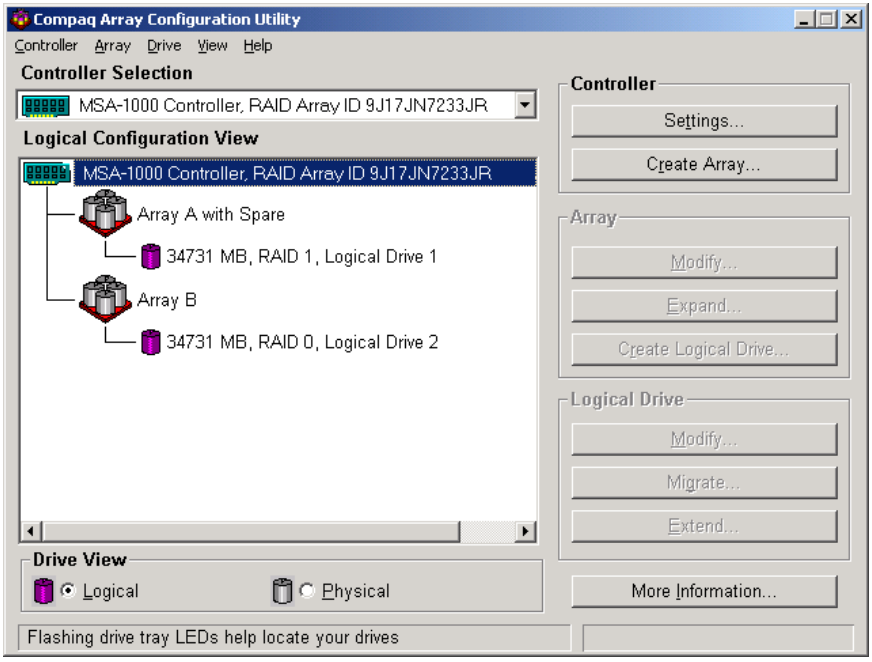


Figure 5-12: Example array - Configuration View screen with two arrays

9. If there are other arrays that need to be converted into LUNs, repeat steps 1 through 8 to create the LUNs for those arrays as well.

IMPORTANT: A logical drive (LUN) must be created for arrays before exiting the ACU or the array setup will not be saved.

10. Rescan the drives so that the newly created logical drives are visible to the operating system. To do this:
    a. From the NAS B3000 desktop, right-click the **My Computer** icon.
    b. Select **Manage** from the menu.
    c. Double-click **Device Manager**.
    d. Right-click **Disk Drives** and then select **Scan for hardware changes**.

11. After the arrays and logical drives are set up, the LUNs can be placed in to virtual storage pools from which virtual disks are created. Pools and virtual disks are detailed in the "Virtual Storage Management" chapter.

Configuring Selective Storage Presentation (SSP)

Selective Storage Presentation (SSP) is a function that allows the storage system to be shared by multiple hosts. By using SSP, the administrator selects which host or hosts can access a logical drive. By restricting logical drive access, the data will remain secure because other hosts will not be able to access the drive. SSP is currently supported only for fibre channel controllers.

By default, SSP is not set up for any of the controllers, so access to all of the LUNs is initially unrestricted.

SSP is enabled or disabled on a controller basis. Disabling SSP for a controller means that access to all logical drives on the controller is unrestricted. If SSP is enabled for the controller, access to the logical drives on the controller can be restricted.

To configure SSP:

1. From the ACU main configuration dialog box, select the desired controller and then click **Controller Settings**. The Controller Settings dialog box is displayed.

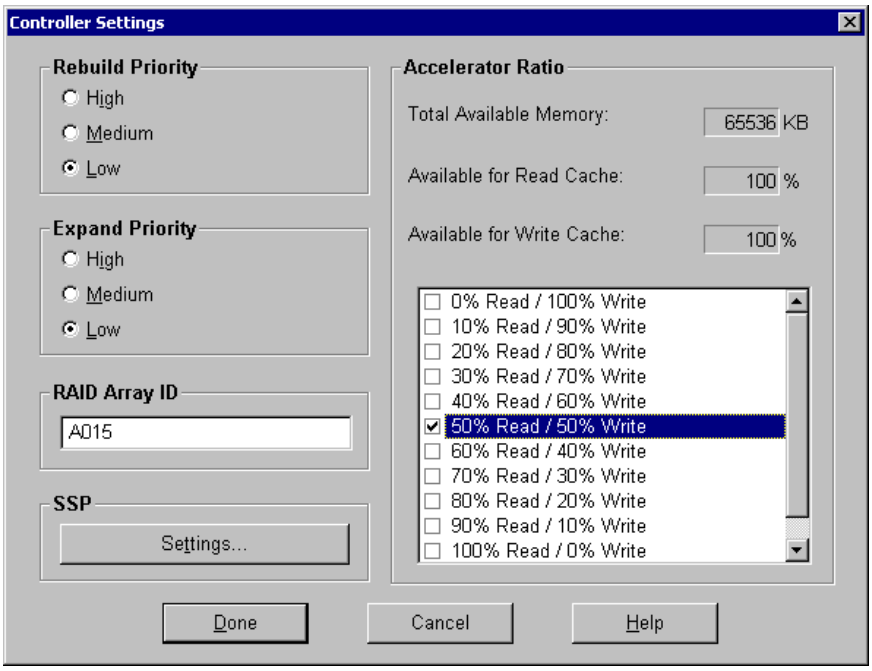


Figure 5-13: Controller Settings dialog box

2. Click **SSP Settings**. The Selective Storage Presentation (SSP) Settings dialog box is displayed.

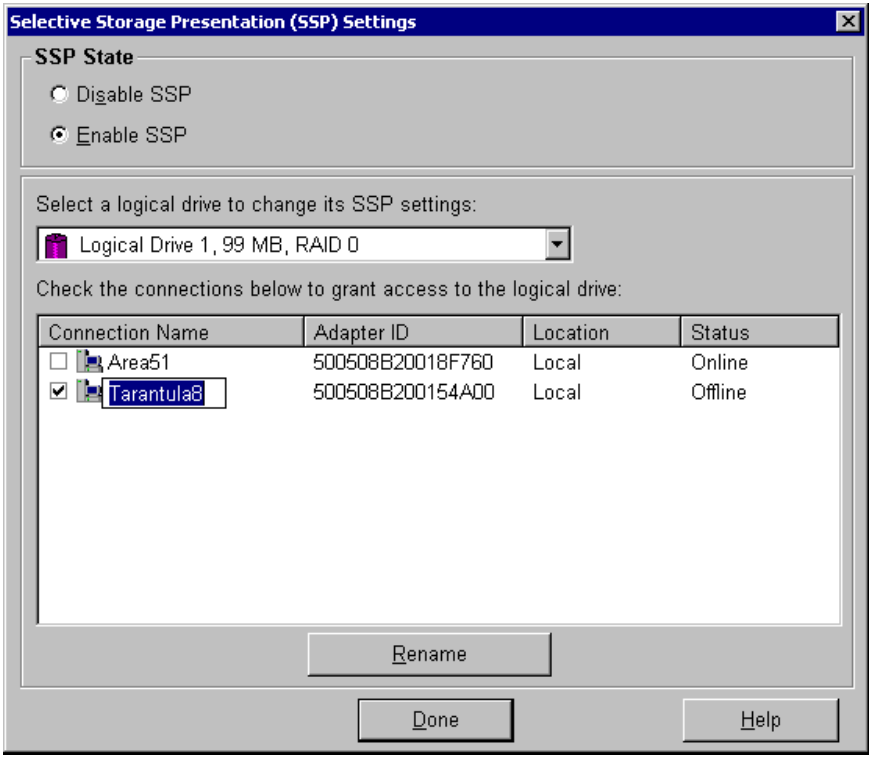


Figure 5-14: Selective Storage Presentation enable settings screen

3. Initially, SSP is disabled. To use SSP, select **Enable SSP**.

   After **Enable SSP** is selected, the Logical Drives drop-down box and the Connections box are populated.

   Enabling SSP allows access to selected LUNs to be restricted to specific hosts. Disabling SSP lets all host controllers access the selected logical drives.

4. Select a logical drive for which the access settings need to be changed from the Logical Drives drop-down box.

5. Select the connections in the window that need access to the logical drive. A checkmark in the box means the connection will have access to the logical drive.

WARNING: Logical drives should not be accessed by more than one server running an operating system that was not designed to share logical drives. Consult your operating system documentation for more information.

6. To rename a connection name, select the desired connection and click the **Rename** button. Then, edit the connection name. Renaming a connection will rename that connection for all logical drives on the controller.
7. Click **Done**.

Expanding the Capacity of an Existing Array

Capacity expansion increases the storage capacity of an existing array. The MSA1000 array expansion feature allows unused physical drives to be added to an array. During the expansion process, the controller will rearrange (re-stripe) the existing logical drives and their data so that they span all of the physical drives in the expanded array. The size of the existing LUNs remains constant and the data is preserved.

The new capacity in the array can then be used to migrate the RAID level of the LUNs of this array, to change the stripe size of LUNs of this array, or used to create new LUNs. If the purpose of expanding the array was to grow a pool, this new LUN can now be added to that pool. Adding units to a pool is discussed in the "Virtual Storage Management" chapter.

IMPORTANT: The expansion process takes about 15 minutes per GB or considerably longer if the controller does not have a battery-backed cache. While array expansion is taking place, no other expansion, or migration can occur on the same controller.

NOTE: During a hard drive expansion, migration, or extension process, the redundancy feature of the Controllers will be temporarily disabled. At the end of the expansion, migration or extension process, the redundancy feature of the Controllers will be automatically reinstated; no action is required by the user. This scenario is for expansion and migration only; the Controllers remain fully redundant during a drive rebuild process.

To grow an array:

1. If necessary, install new physical drives.
2. Back up all data on the array. Although array expansion is unlikely to cause data loss, this precaution will provide additional data protection.
3. From the ACU main configuration dialog box, click **Controller Settings** and verify that the **Expand Priority** setting is acceptable.
4. From the ACU main configuration dialog box, select the array to grow and then click **Expand Array**.

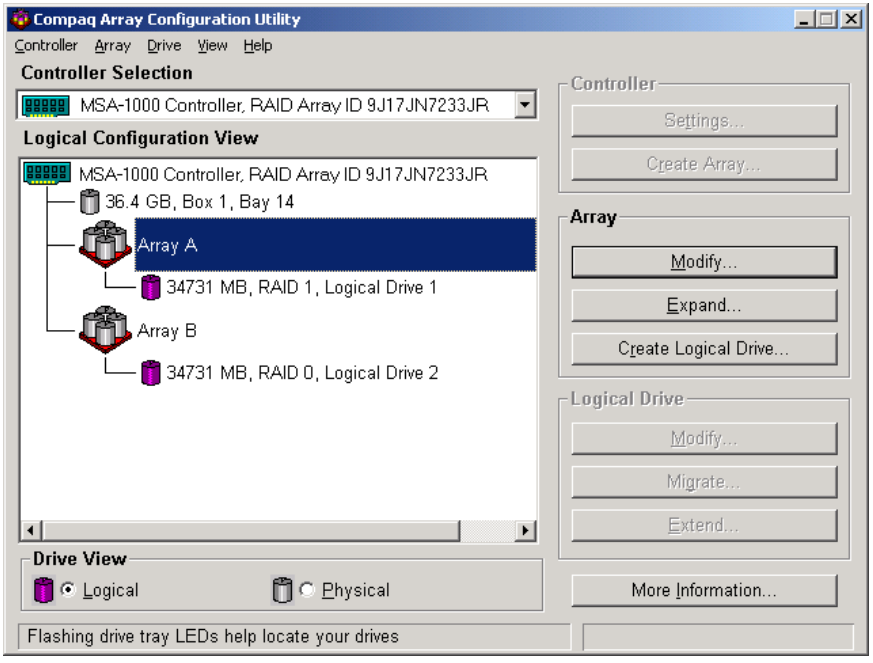


Figure 5-15: Array expansion example – Logical Configuration View screen

5. A sub-screen is displayed. Select the intended unassigned drives to add to the array.
6. Click the **right-pointing arrow** (**Assign Drives to Array**) in the center of the screen to add the drives to the array.

7. Click **Done** at the bottom of the screen. A screen similar to the following figure is displayed.

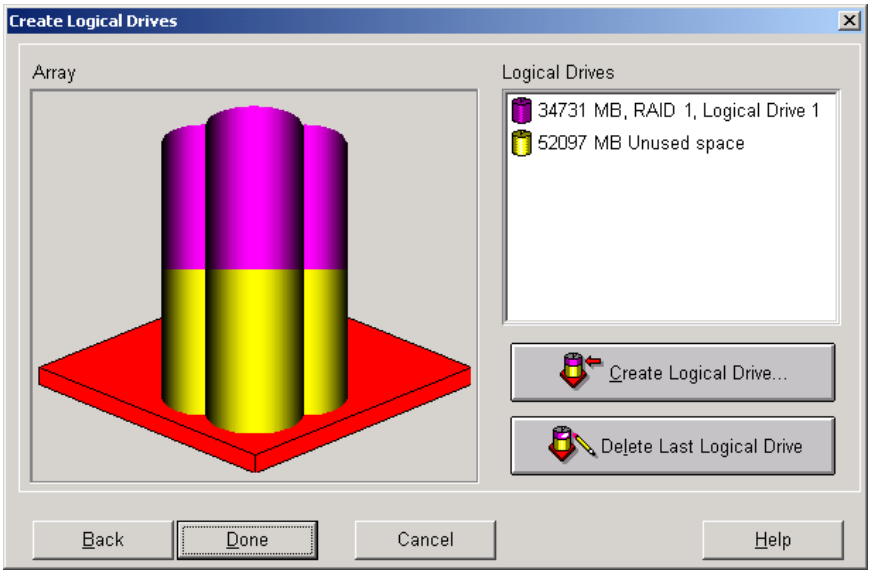


Figure 5-16: Expansion wizards - Logical Drive screen

8. To create a new LUN with the available capacity, click **Create Logical Drive**.
9. In the Create Logical Drive sub-screen, indicate the settings for the Fault Tolerance, Array Accelerator, Stripe Size, and Logical Drive size.

   To enable the Maximum Boot Size, click the Advanced button.
10. Click **Done**.
11. In the ACU Main Controller Configuration dialog box, save these settings.

    On the menu bar at the top of the screen, select **Controller**. Then, select the **Save Configuration** option. The settings for the new LUN are saved and the capacity expansion process starts.

CAUTION: In case of power loss, capacity expansion process information is temporarily stored in the Array Accelerator memory. To prevent the loss of data in the expanding logical drive, do not interchange MSA1000 Controllers or Array Accelerator boards during a capacity expansion process.

NOTE: If several arrays are to be expanded, the system will queue the requests, expanding one array at a time.

NOTE: The new LUN will not be accessible until the capacity expansion process has completed on the array.

Migrating an Existing LUN to a New RAID Level or Stripe Size

Use the Online RAID Level and Stripe Size Migration screen to reconfigure a currently configured logical drive to a new fault-tolerance (RAID) level or to change an existing logical drive's stripe size to a new stripe size (data block size).

Depending on the initial settings and the new RAID type and Stripe Size settings for the LUN, unused capacity may need to be available for the migration. Additional drives may need to be included in the array.

Both of these procedures can be done online without causing any data loss.

IMPORTANT: The migration process takes about 15 minutes per GB or considerably longer if the controller does not have a battery-backed cache. While migration is taking place, no other expansion or migration can occur on the same controller.

To migrate a logical drive to a different RAID level or stripe size:

1. Back up all data on the LUN. Although migration is unlikely to cause data loss, this precaution will provide additional data protection.
2. From the ACU Main Controller Configuration dialog box, select appropriate controller from the drop-down box, select the target logical drive, and click **Migrate Logical Drive**. A screen similar to the following is displayed.

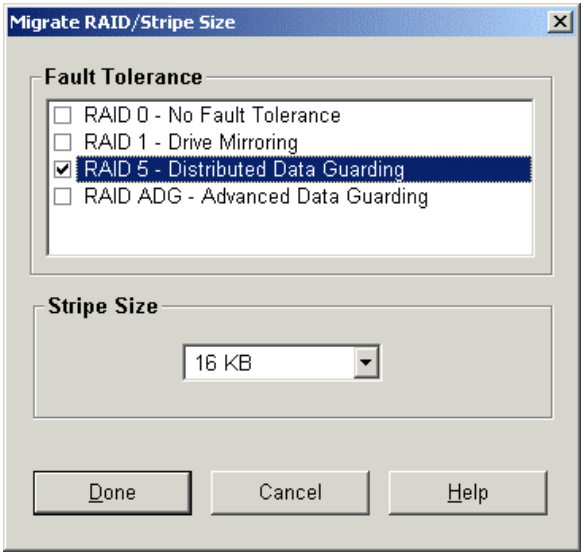


Figure 5-17: Migrate RAID/Stripe Size screen

3. To set the new level of fault tolerance, select the desired RAID type in the Fault Tolerance portion of the screen.
4. To set a new stripe size, either accept the default size for the selected RAID level, or set to another value.
5. Click **Done**.

6

Virtual Storage Management

Virtual storage elements of the *StorageWorks* NAS B3000 include storage pools, virtual disks, and snapshots. These virtual elements are created from the physical drive arrays and LUNs. For complete conceptual information on physical and virtual storage, see the "Storage Management Overview" chapter.

Because all storage overview and planning information is discussed in a separate chapter of this guide, this chapter is dedicated to the following virtual storage procedural tasks:

- Storage Management Wizard
- Pool Management
  - — Creating a New Pool
  - — Deleting a Pool
  - — Viewing Pool Properties
  - — Setting Pool Policies for a Specific Pool
  - — Adding Storage Units
  - — Bringing a Pool Online and Offline
  - — Moving Pools to Another Node
- Virtual Disk Management
  - — Creating a New Virtual disk
  - — Setting the Drive Letter of a Virtual disk
  - — Formatting a Virtual Disk

  - Deleting a Virtual Disk
  - Viewing Virtual Disk Properties
  - Growing a Virtual Disk
  - Backing Up (Creating a Scheduled Snapshot of) a Virtual Disk
- Snapshot Management
  - Creating a New Snapshot
  - Deleting a Snapshot
  - Viewing Snapshot Properties
  - Setting the Drive Letter for a Snapshot
  - Creating a Snapshot Schedule
  - Displaying and Deleting a Snapshot Schedule
  - Scheduling Snapshot Deletions
  - Restoring a Virtual Disk from a Snapshot
  - Enabling Incremental Backup Support
- Global Pool Policy Settings
- Namespace Recovery
- Drive Quotas
  - Enabling and Disabling Quota Management on a Virtual Disk
  - Creating New Quota Entries for a User or Group
  - Deleting Quota Entries for a User or Group
  - Modifying Quota Entries for a User or Group

Storage Management Wizard

The **Storage Management** wizard is one of three major wizards included in the Web-based user interface (WebUI) of the NAS device. This wizard contains some of the functionality of the detailed storage management screens and is designed to be intuitive and easy-to-use.

The functionality included in this wizard can also be performed through the **Virtual Replicator** menu option of the WebUI. Detailed information on storage management topics is included in later sections of this chapter.

To use the Storage Management wizard:

From the WebUI, select **Wizard Tasks**, and **Storage Management**. The Welcome screen of the wizard is displayed. Click **Next** to continue.

Figure 6-1: Storage Management wizard

The primary screen of the Storage Management wizard is an expandable selection box, listing all existing storage components. Depending on the components that have been set up, the following components may be listed:

- Nodes (for clustered deployments)
- Pools
- Virtual Disks
- Snapshots

Depending on the component that is selected, different options become available. This discussion is organized according to these storage components.

Node Wizard Tasks

Within the **Storage Management** wizard, if a node is selected to manage, one option is displayed:

Create New Pool

To create a new pool:

1. Click **Create New Pool**.

   The next screen of the wizard is displayed, listing the available storage units, their capacity, and type.

2. Select the Storage Unit (LUN) to use, indicate a pool name to assign, and specify the Segment Size. Then, click **Create**.

Pool Wizard Tasks

Within the **Storage Management** wizard, if a pool is selected to manage, two options are displayed:

- **Create virtual disk**
- **Delete this pool**

To create a new virtual disk:

1. Select **Create virtual disk**.

   The next screen of the wizard is displayed, listing the pool and the amount of free space that is available.

2. Enter the Name and size of the virtual disk, indicate whether to assign a drive letter, and specify the allocation unit size. Then, click **Create**.

To delete the pool:

1. Select **Delete this pool**.

   A verification box is displayed.

   NOTE: There is no additional warning prompt.

2. Confirm that the intended pool has been selected and then click **OK.**

Virtual Disk Wizard Tasks

Within the **Storage Management** wizard, if a virtual disk is selected to manage, two options are displayed:

- **Create snapshot**
- **Delete this virtual disk**

To create a snapshot:

1. Select **Create snapshot**.
2. Enter a name to assign the snapshot, a drive letter, and a label. Click **Create**.

To delete the virtual disk:

1. Select **Delete this virtual disk**.

   A verification box is displayed.

   NOTE: There is no additional warning prompt.

   Confirm that the intended virtual disk has been selected and then click **OK**.

Snapshot Wizard Tasks

Within the **Storage Management** wizard, if a snapshot is selected to manage, two options are displayed:

- **Delete this snapshot**
- **Restore virtual disk from this snapshot**

To delete this snapshot:

1. Select **Delete this snapshot**.

   A verification box is displayed.

   NOTE: There is no additional warning prompt.

   Confirm that the intended snapshot has been selected and then click **OK.**

To restore a virtual disk from a snapshot:

1. Select **Restore virtual disk from this snapshot**.

Pool Management (Details)

Virtual Replicator enables the grouping of LUNs into a single logical pool of drive space. The LUNs provide drive space for the pool in the same way that physical drives provide drive space for a RAID array.

Virtual Replicator is a utility for managing disk space logically and efficiently. VR combines logical drives into a pool of space, from which the administrator can create virtual disks of exactly the correct size needed by a particular department or application.

Pools are managed through the WebUI, with the **Virtual Replicator** menu option from the main menu. To create and manage storage pools, select the **Pools** option from the **Virtual Replicator** menu. The Manage Pools dialog box is displayed.

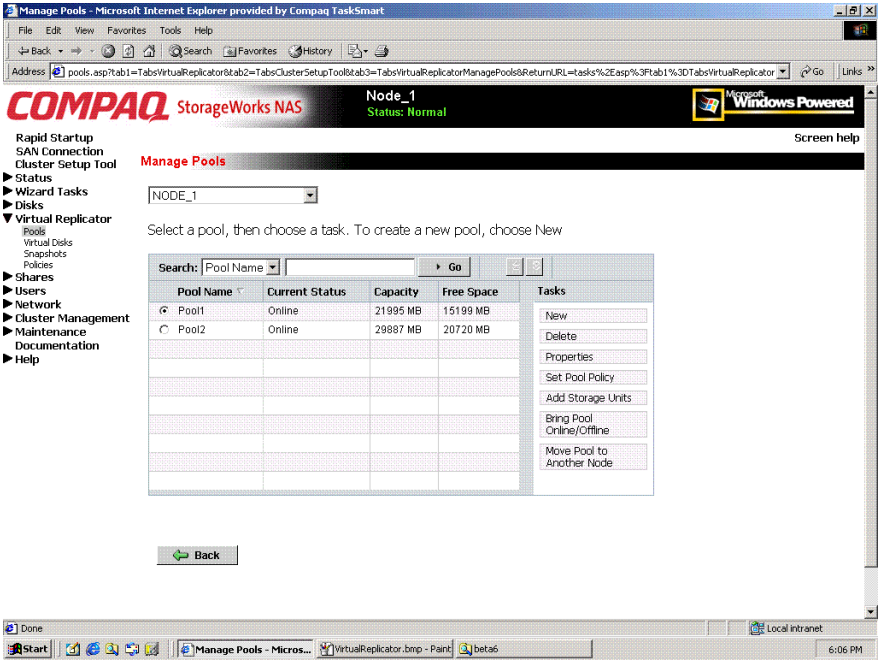


Figure 6-2: Manage Pools dialog box

NOTE: In a clustered environment, the drop-down box at the top of the Manage Pools dialog box can be used to switch from one node to another. This drop-down box is not displayed in a single-node deployment. In addition, the cluster options to Bring Pool Online/Offline and Move Pool to Another Node are not displayed.

All existing pools are displayed. Status and capacity information is displayed for each pool.

The **Manage Pools** dialog box allows the following tasks:

- Creating a new pool
- Deleting a pool
- Modifying pool properties
- Setting pool policies
- Adding storage units to a pool
- Bringing pools online or offline (clustered deployments only)
- Moving pools to another node (clustered deployments only)

Each of these tasks is discussed in the following sections.

Creating a New Pool

The process of creating a pool of disk space and dividing it into virtual disks is straightforward:

1. From the **Virtual Replicator**, **Pools** option, click **New**. The **Create New Pool** dialog box is displayed.

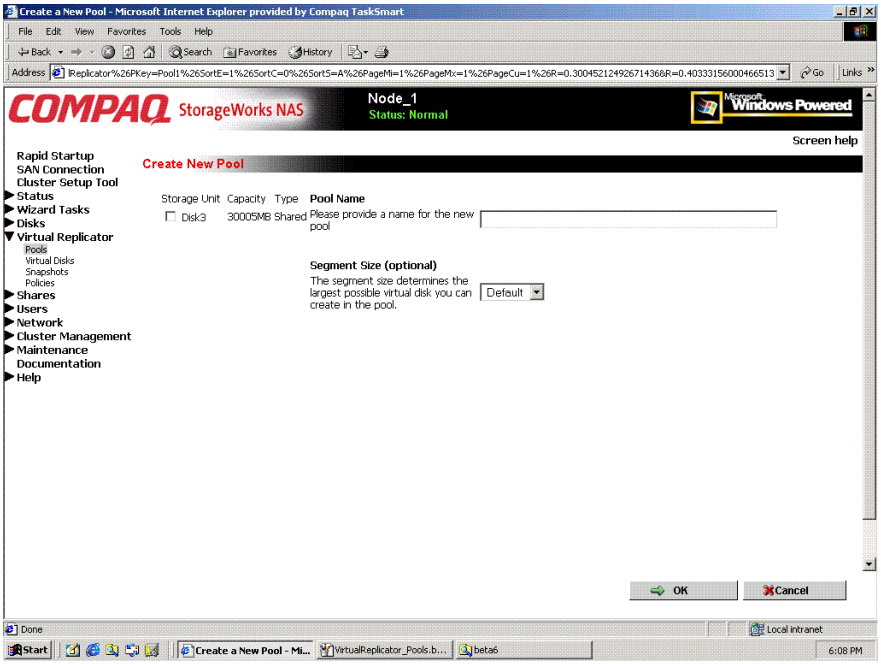


Figure 6-3: Create New Pool dialog box

2. Available LUNs are displayed. Select the units to include in the new pool, and enter a descriptive name for the new pool.

   NOTE: Default system settings allow up to eight logical drives as members of a pool. All LUNs must come from the same controller pair.

3. Select the desired segment size from the **Segment Size** drop-down box. Compaq recommends accepting the default size of 256 KB.

4. Click **OK**.

Deleting a Pool

To delete a pool:

1. From the **Manage Pools** dialog box, select the pool to delete from the displayed list and then click **Delete**.
2. A verification screen is displayed. To proceed with the deletion, click **OK**. The pool is deleted and the Manage Pools dialog box is displayed again.

Viewing Pool Properties

To view the properties of a pool, from the Manage Pools dialog box, select a pool from the displayed list and then click **Properties**. The Pool Properties screen is displayed. This interface is a summary display. To change any of these properties, use the appropriate action in the Manage Pools dialog box.

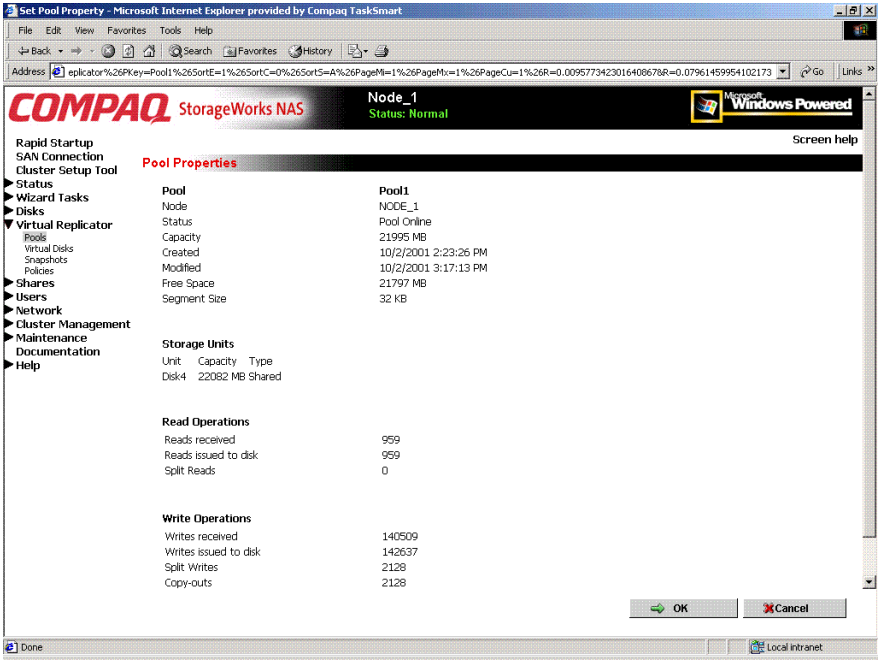


Figure 6-4: Pool Properties summary display

Setting Pool Policies for a Specific Pool

Virtual Replicator parameters are preset on the NAS device, with one primary set of parameters controlling all pools. Through this **Set Pool Policy** action, these parameters can be customized for a specific pool. The global set of parameters will continue to manage all pools that do not have customized policies.

Experienced users can modify these global and pool-specific policy settings. This section discusses setting pool-specific policy parameters. To change the global set of policy settings, see the "Global Pool Policy Settings" section later in this chapter.

CAUTION: Use caution when changing these parameters. Unwise choices can result in system inefficiencies, difficulties, and data loss.

To change the policy settings for a specific pool:

1. From the **Manage Pools** dialog box, select the target pool.
2. Click **Set Pool Policy**. An introductory **Manage policies** screen is displayed. Click **Next** to continue. An additional Manage policies dialog box is displayed.

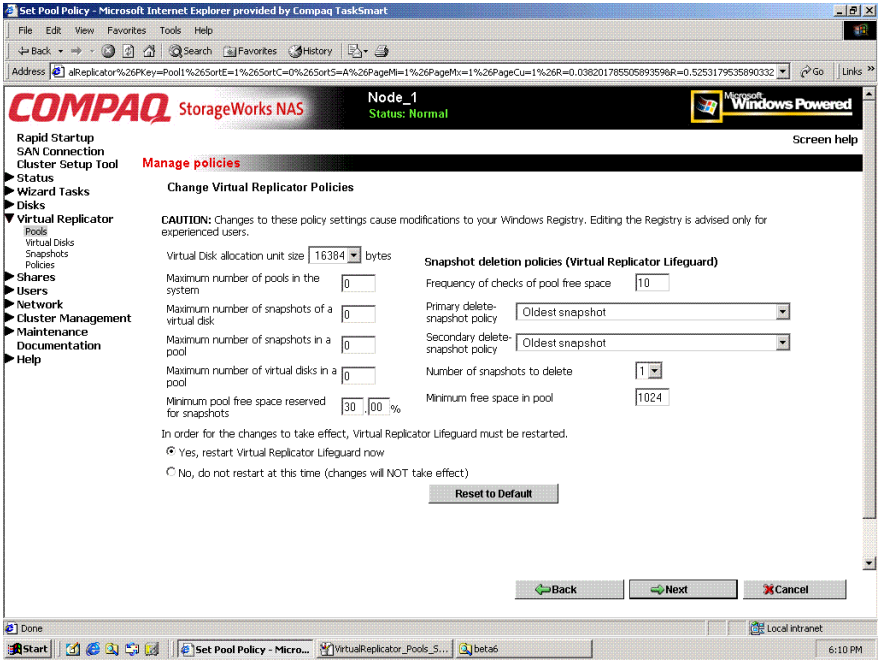


Figure 6-5: Manage Policies dialog box

3. Within this dialog box, enter the new parameter settings.

Default settings include:

Table 6-1: Pool Policy Default Settings

Policy	Default Setting
Virtual disk allocation unit size	16 KB
Maximum number of pools in system	
Maximum number of snapshots of a virtual disk	
Maximum number of snapshots in a pool	
Maximum number of virtual disks in a pool	8
Maximum pool free space reserved for snapshots	30%
Restart Lifeguard now or later	Now
Frequency of pool free space checks	10 seconds
Primary delete snapshot policy	Oldest snapshot first
Secondary delete snapshot policy	Oldest snapshot first
Number of snapshots to delete	1
Minimum free space in pool	1024 KB

4. After all settings are entered, click **Next** and then click **Finish**.

Adding Storage Units to a Pool

Two scenarios may occur when the size of a pool needs to be expanded:

- There are additional, unused LUNs available.
- There are not any additional, unused LUNs available.

  If no space is available, physical drives must be added, then the drives must be configured into a new array or perhaps an existing array could be expanded to include them. Then, a new LUN can be created and added to the existing pool.

  For information on creating and managing arrays and LUNs, see the following sections in the "Physical Storage Management" chapter: "Creating a New Array," "Expanding the Capacity of an Array," and Creating a New Logical Drive."

When the additional LUNs are available, to add them to an existing pool:

1. Select the desired pool in the **Manage Pools** dialog box. Then click **Add Storage Units**. The Add Storage Units dialog box is displayed.
2. All available LUNs are listed. Select the desired LUNs and then click **OK**.

   The Manage Pools dialog box is displayed again.

NOTE: Additional LUNs cannot be added if it violates any of the Pool Policy parameters.

IMPORTANT: All LUNs in a pool must be managed by the same controller pair.

Bringing a Pool Online and Offline

NOTE: This option is displayed only in a clustered environment. For information about operating the NAS device in a clustered environment, see the "Cluster Management" chapter.

For maintenance or other reasons, a pool may need to be taken offline.

Within the Manage Pools dialog box, the current status of each pool is displayed. Pool status will be either Online or Offline.

To toggle the status of a pool from Online to Offline or from Offline to Online:

1. Select the desired pool in the **Manage Pools** dialog box.
2. Click **Bring Pool Online/Offline**. A verification screen is displayed.
3. After confirming this is the correct pool, click **OK**. The Mange Pools dialog box is displayed again.

Moving Pools to another Node

NOTE: This option is displayed only in a clustered environment. For information about operating the NAS device in a clustered environment, see the "Cluster Management" chapter.

To change the ownership of a pool:

1. Select the desired pool in the **Manage Pools** dialog box, and then click **Move Pool to Another Node**. The **Move Pool** dialog box is displayed.

   The current node and the pool name of the selected pool are displayed.
2. Select the new node from the **Destination Node Name** box and then click **OK**. The Manage Pools dialog box is displayed again.

Virtual Disk Management (Details)

Virtual disks are managed through the WebUI, with the **Virtual Replicator** option. From the Virtual Replicator menu, select **Virtual Disks**. The Manage Virtual Disks dialog box is displayed. All existing virtual disks are displayed, including capacity information for each disk.

Figure 6-6 is an illustration of the Manage Virtual Disks dialog box.

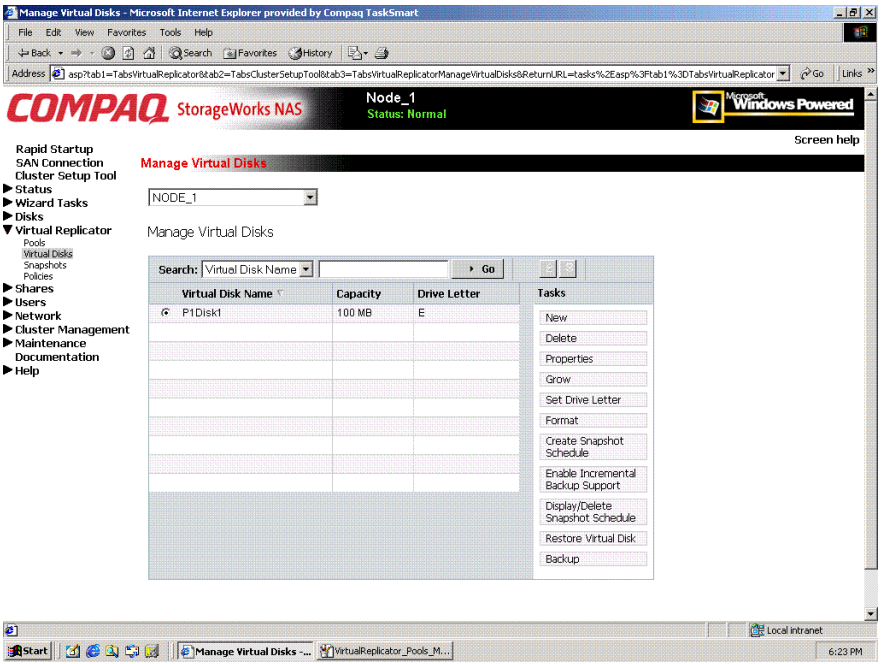


Figure 6-6: Manage Virtual Disks dialog box

NOTE: In a clustered environment, the drop-down box at the top of the Manage Virtual Disks dialog box can be used to switch from one node to another.

CAUTION: Virtual disks must be managed exclusively through the Virtual Replicator interface. Do not manage virtual disks or pools through any other interface. Use of other methods, such as Windows Disk Manager or Cluster Administrator could result in data loss.

The **Manage Virtual Disks** dialog box allows the following tasks:

- Creating a new virtual disk
- Setting the drive letter of a virtual disk
- Formatting a virtual disk
- Deleting a virtual disk
- Viewing virtual disk properties
- Growing a virtual disk
- Creating a snapshot schedule (see “Snapshot Management”)
- Enabling incremental backup support (see “Snapshot Management”)
- Displaying and deleting a snapshot schedule (“see “Snapshot Management”)
- Restoring a virtual disk (see “Snapshot Management”)
- Backing up (creating a snapshot of) a virtual disk

Each of these tasks is discussed in the following sections.

Creating a New Virtual Disk

To create a new virtual disk from a storage pool:

1. From the **Manage Virtual Disks** dialog box, click **New**. The Welcome screen of the New Virtual Disk wizard is displayed. Click **Next** to continue.

   The **Create a New Virtual Disk** dialog box is displayed. Figure 6-7 illustrates this dialog box.

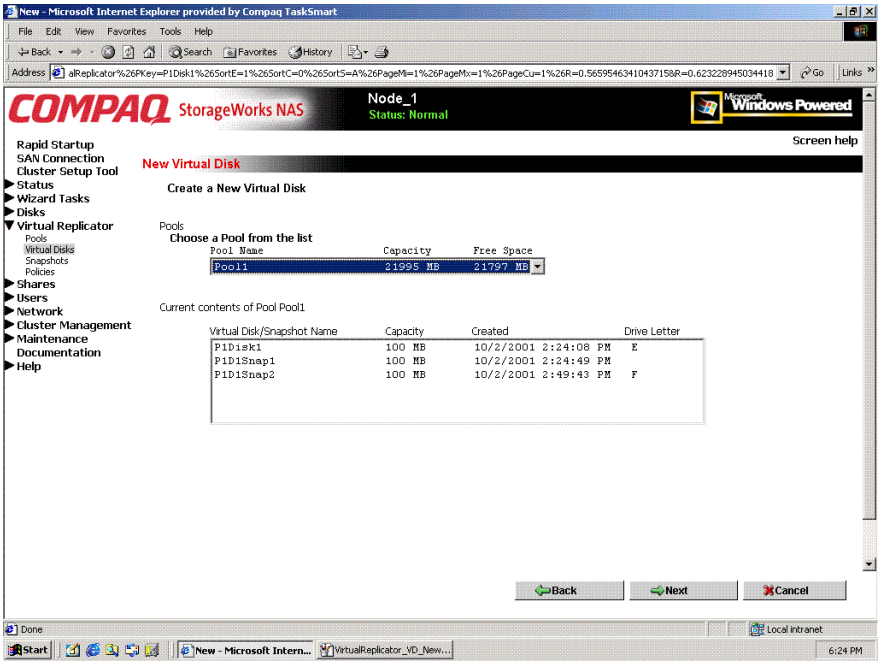


Figure 6-7: Create a New Virtual Disk dialog box

In the **Create a New Virtual Disk** dialog box, the following information is displayed:

- All existing pools, including total capacity and amount of free space
- For the selected pool, all existing virtual disks and snapshots, including total capacity of each, when they were created, and their drive letters

2. Select a pool from the list from which to create a virtual disk and then click **Next**. The **New Virtual Disk Step 1** dialog box is displayed.

   Figure 6-8 is an illustration of the New Virtual Disk Step 1 dialog box.

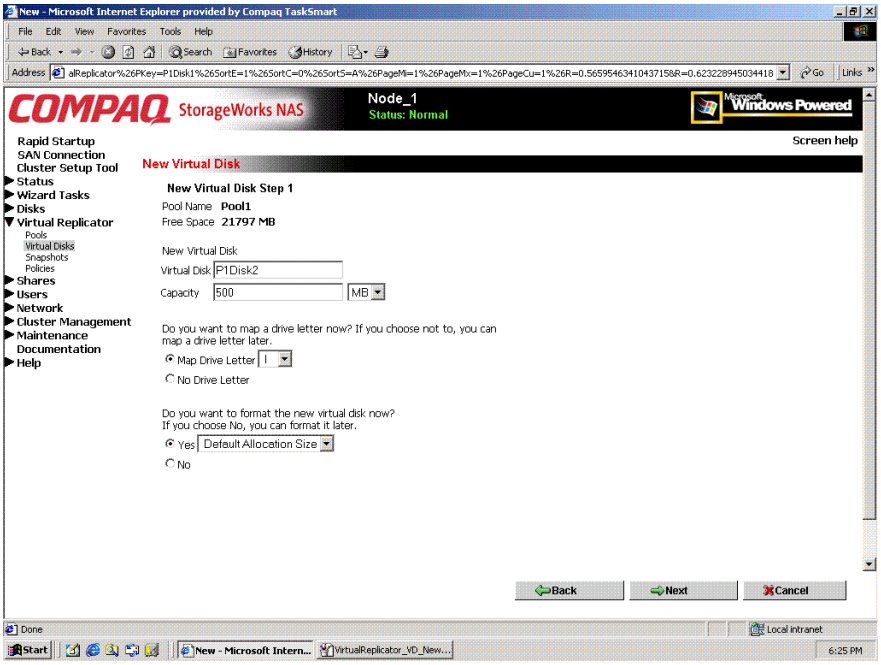


Figure 6-8: New Virtual Disk Step 1 dialog box

3. Enter a name for the new virtual disk and indicate its size.
4. Assign a drive letter (optional).

   The operating system does not recognize a virtual disk if it does not have a drive letter assigned. If a drive letter is not assigned at this time, it can be set later, using the **Set Drive Letter** option. See "Setting the Drive Letter of a Virtual Disk."

5. Format the new virtual disk and indicate the allocation size (optional). Compaq recommends using the default allocation size of 16 KB.

The operating system does not recognize a virtual disk if it is not formatted. If a drive is not formatted at this time, it can be formatted later, using the **Format** option. See "Formatting a Virtual Disk."

6. Click **Next**. A completion screen showing summary information about the new virtual disk is displayed. Click **Finish** to continue. The Manage Virtual Disks dialog box is displayed again.

Setting the Drive Letter of a Virtual Disk

To set or change the drive letter of a virtual disk:

1. From the **Mange Virtual Disks** dialog box, select the virtual disk to work with and then click **Set Drive Letter**. The **Set Drive Letter** dialog box is displayed.

   Current information about the selected virtual disk is displayed, including its current drive letter mapping.

2. In the **Drive Letter** drop-down box, expand the display and select a letter. Only available letters are displayed in the Drive Letter drop-down box.

3. Click **OK**.

   The selected letter is assigned to the virtual disk and the Manage Virtual Disks dialog box is displayed again.

Formatting a Virtual Disk

To format a virtual disk:

1. From the **Manage Virtual Disks** dialog box, select the virtual disk to format, and then click **Format**. The **Format Virtual Disk** dialog box is displayed.

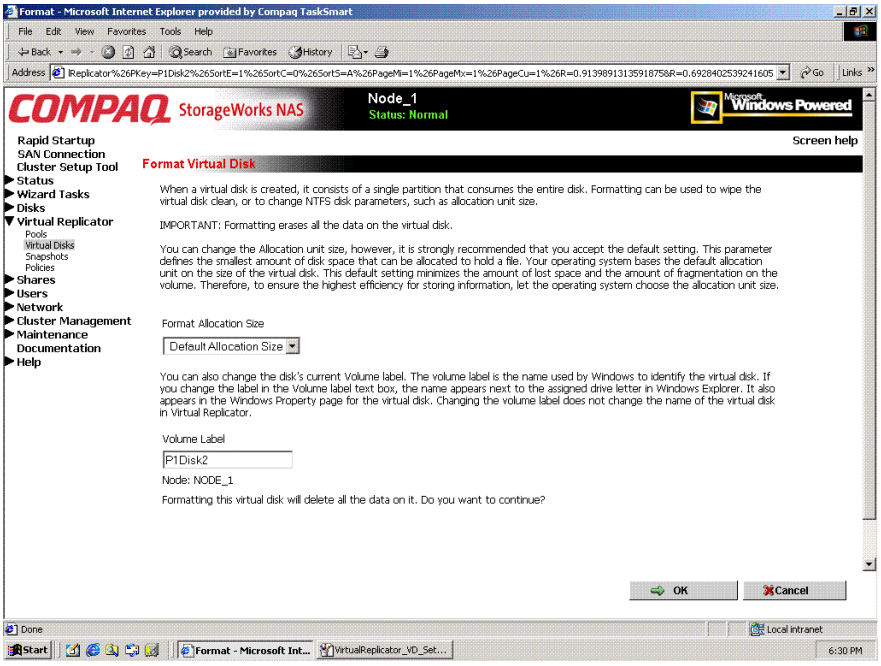


Figure 6-9: Format Virtual Disk dialog box

   Summary and descriptive information about formatting is displayed.

2. In the two data entry boxes, enter the allocation size and a label for the disk.

   IMPORTANT: No additional warning screen is displayed.

3. View the screen to verify that this is the correct virtual disk and the appropriate allocation size and labels are indicated. Click **OK**.

   The virtual disk is formatted and the Manage Virtual Disks dialog box is displayed again.

Deleting a Virtual Disk

When deleting virtual disks, it is important to remember the following:

- Virtual disks must be deleted using the Virtual Replicator before the underlying disk structure is deleted.
- Do not delete the LUNs before deleting the virtual disks, pools, and snapshots from VR.
- Delete all snapshots associated with a virtual disk before deleting the virtual disk.
- If the virtual disk contains data, back up the data. Deleting a virtual disk destroys all the data stored on the disk.
- Make sure no one is accessing the virtual disk. The disk cannot be deleted if any files on the disk are open.

To delete the virtual disk:

1. From the WebUI, navigate to **Virtual Replicator**, **Virtual Disks**.
2. In the **Manage Virtual Disks** dialog box, select the virtual disk to delete, and then click **Delete**.
3. A verification screen is displayed. After viewing the screen display to confirm that this is the correct virtual disk, click **OK**. All information on that virtual disk is erased, and the virtual disk is deleted. The Manage Virtual Disks dialog box is displayed again.

   NOTE: When deleting a virtual disk, make sure to delete any scheduled tasks for that disk. Otherwise, if the old virtual disk name is reused for another virtual disk, the old tasks will run on the new disk. Use the Windows Scheduled Tasks applet to delete scheduled tasks.

Viewing Virtual Disk Properties

To view the properties of a virtual disk, from the Manage Virtual Disks dialog box, select a virtual disk from the displayed list and then click **Properties**. The Virtual Disk Properties screen is displayed.

This interface is a summary display. To change any of these properties, use the appropriate action in the Manage Virtual Disks or the Manage Snapshots dialog boxes.

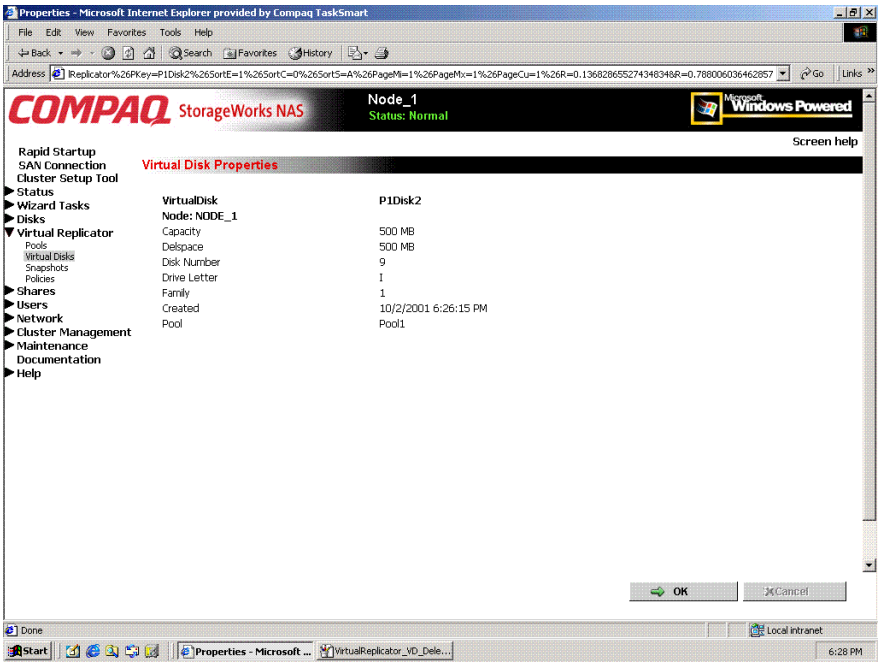


Figure 6-10: Virtual Disk Properties screen

Growing a Virtual Disk

Virtual Replicator can increase storage capacity without disrupting operations on the NAS device. The online volume growth feature directs the operating system to update the size of a virtual disk without requiring a system restart. With online volume growth, storage capacity can be easily increased as required by users and applications, with zero downtime.

The VR online volume growth feature operates only on basic and virtual disks formatted with the New Technology File System (NTFS). It does not work with dynamic drives, disks that are not virtual disks, or virtual disks that are not formatted with NTFS.

Preparing for Online Volume Growth of Basic or Virtual Disks

Before growing a volume:

- Make a reliable backup copy of the data.
- Plan for new storage. For example, adding capacity can increase the time required to perform backups.
- Make sure the pools have adequate free space. When the size of a virtual disk is increased, it consumes more space in the pool and reduces the amount of free space that can be used for snapshots.

NOTE: Online volume growth operates only on virtual disks formatted with New Technology File System (NTFS). If the file system is not NTFS, an error message is displayed instructing the administrator to cancel.

NOTE: The amount of free space shown is the amount of space available for use by virtual disks. The pool space reserved for snapshots is not included. Online volume growth does not grow the volume beyond the amount of free pool space available. If an attempt is made to grow the volume beyond the available space, an error occurs.

Adding Additional Storage Units to the Pool

Before growing a volume, additional storage units may need to be added to the pool.

CAUTION: Virtual Replicator does not support changing the size of a logical unit number (LUN) after it has been incorporated into a pool. An existing RAID array must be modified or a new RAID array must be added. Changing the size of the LUN results in data loss.

If additional LUNs were added, but they are not displayed in the user interface, use Windows Device Manager to rescan for the new drive.

The following procedure explains how to grow a virtual disk volume using the WebUI.

NOTE: Drive volume growth must not be performed at the same time as other major drive management operations.

Growing the Disk

To increase the capacity of a virtual disk:

1. Add the additional LUNs to the desired pool, using the procedures described in the "Pool Management" section.
2. From the **Manage Virtual Disks** dialog box, select the virtual disk to work with and click **Grow**. The Grow Virtual Disk dialog box is displayed. Information about the selected virtual disk is included in the screen display.
3. In the data entry box, enter the amount of additional capacity (MB) to add to the virtual disk.
4. Click **OK**. The disk is updated and the Manage Virtual Disks dialog box is displayed again.

Backing Up (Creating a Scheduled Snapshot of) a Virtual Disk

To create a scheduled snapshot of a virtual disk:

1. From the **Manage Virtual Disks** dialog box, select the virtual disk to back up and then click **Backup**. The Welcome screen of the **Virtual Disk** Backup wizard is displayed.
2. Click **Next** to continue. The **Snapshot Information** screen is displayed, including the name (and node, if applicable) of the selected virtual disk.

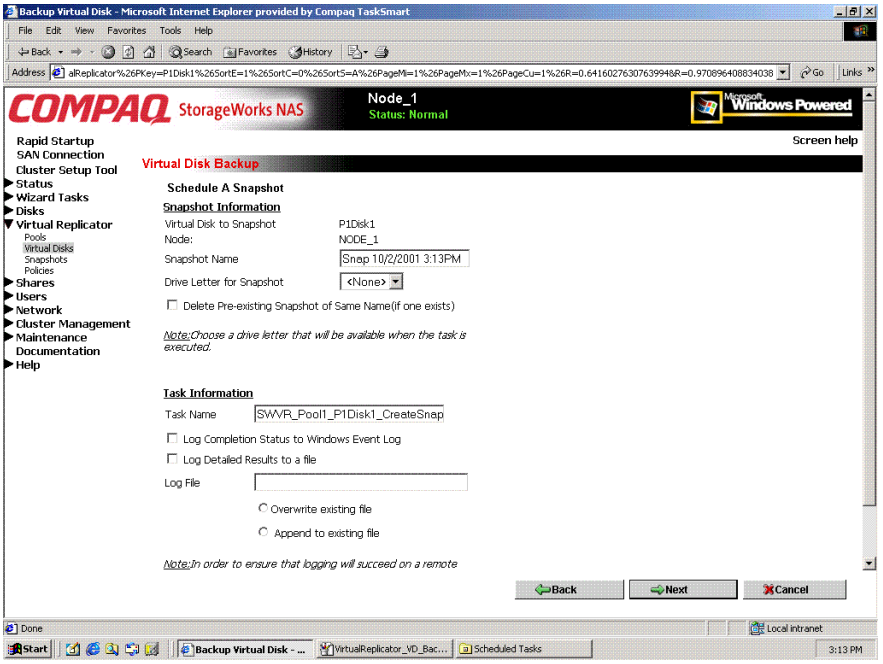


Figure 6-11: Schedule a Snapshot screen

3. Enter snapshot information, including:
   - A name for the snapshot
   - The drive letter to assign to the snapshot

- Indicate if the system should delete any existing snapshots with the same name. If this option is not checked and a snapshot with the same name already exists, the new snapshot will not be created.

4. Enter task information.

   The screen displays a default name for the task. Indicate whether the system will log the task into an audit file:

   - Completion status can be posted to the Windows Event Log. Compaq recommends posting to the log to confirm the task was begun and was completed.
   - Task details can be posted to a custom file. To post the details to a file, enter the filename and also indicate whether the system should append this information onto the end of the file or to overwrite information in the existing file.

5. Click **Next**. The **Schedule Information** screen is displayed.

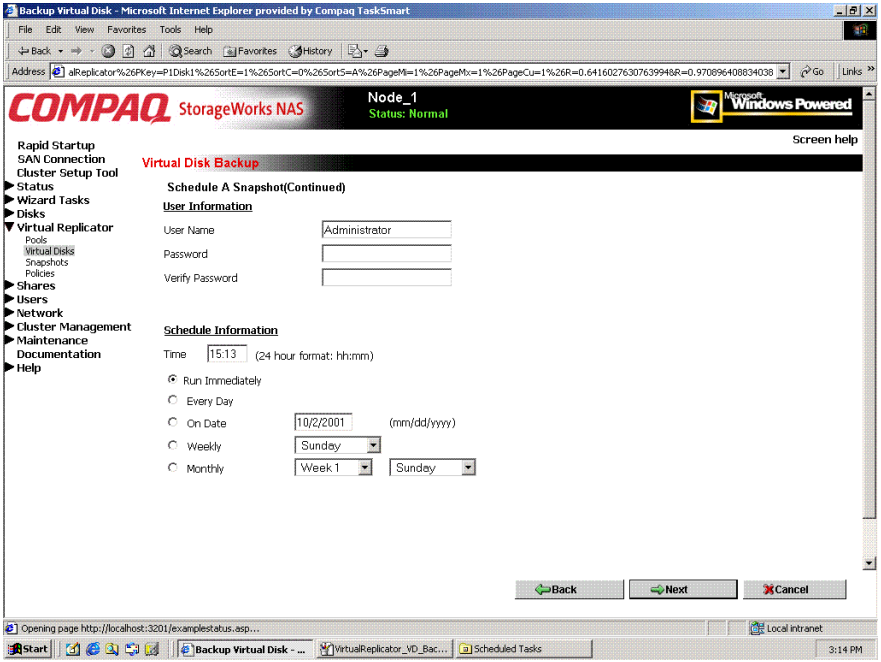


Figure 6-12: Schedule Information screen

6. Enter schedule information, including:
   - Time to create the snapshot (using a 24-hour clock)
   - When to create the snapshot. Options include:
     - Immediately
     - Daily
     - On a specific day
     - Weekly
     - Monthly.
7. Click **Next**. A summary screen is displayed. Figure 6-13 illustrates the Virtual Disk Backup summary screen.

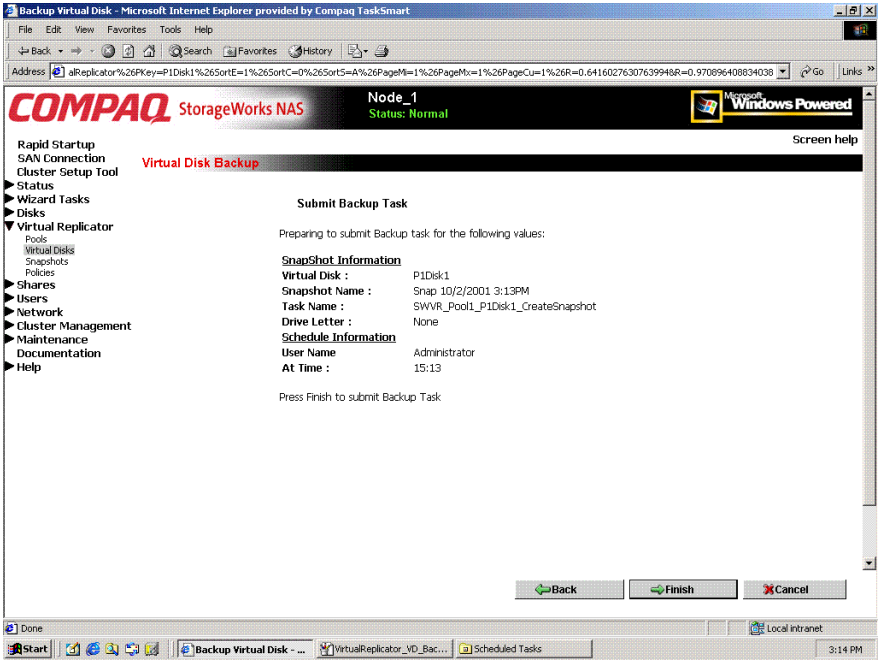


Figure 6-13: Virtual Disk Backup Summary screen

8. After verifying the accuracy of the schedule information, click **Finish**. The Manage Virtual Disks dialog box is displayed again.

Snapshot Management (Details)

Snapshots are managed through the WebUI, with the **Virtual Replicator** menu option. To create and manage snapshots, in the Virtual Replicator menu, select **Snapshots**.

The **Manage Snapshots** dialog box is displayed. All existing snapshots are displayed, including capacity and drive letter information for each snapshot.

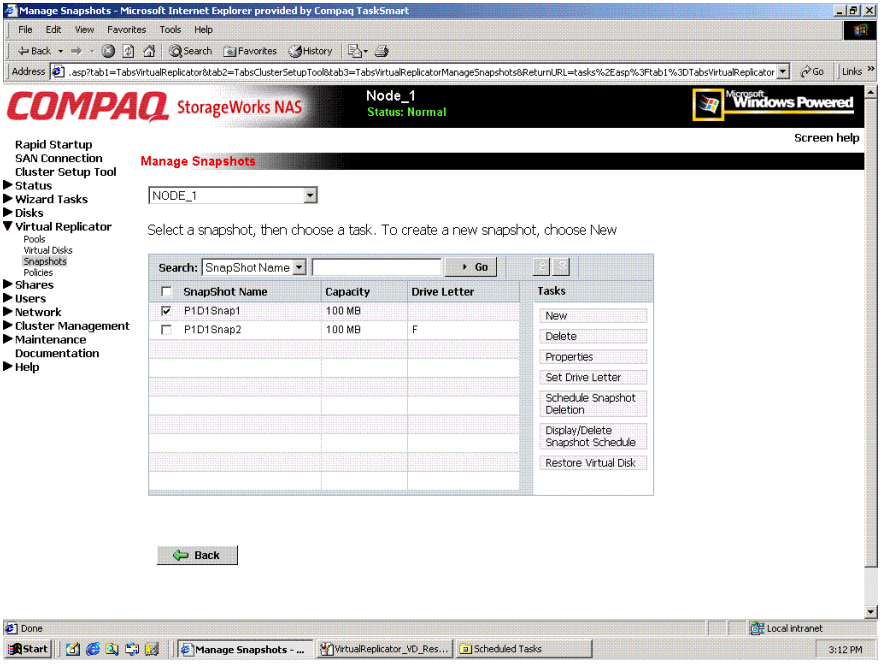


Figure 6-14: Manage Snapshots dialog box

NOTE: In a clustered environment, the drop-down box at the top of the Manage Snapshots dialog box can be used to switch from one node to another.

Snapshot tasks include:

- Creating a new snapshot
- Deleting a snapshot
- Viewing and Modifying snapshot properties
- Setting the drive letter for a snapshot
- Creating a Snapshot Schedule (managed through the Virtual Disks option)
- Displaying and deleting snapshot schedules (managed through the virtual Disks option and the Snapshots option)
- Scheduling snapshot deletions (managed through the Virtual Disks option)
- Restoring a virtual disk from a snapshot
- Enabling incremental backup support (managed through the Virtual Disks option)

Each of these tasks is discussed in the following sections.

Creating a New Snapshot

Snapshots are a routine maintenance tool for the administrator of the NAS device. Before creating a snapshot, the NAS device must have pools of space and one or more virtual disks established. Verify that there is adequate free pool space to support snapshots.

IMPORTANT: Snapshots are temporary in nature and are automatically deleted by the system if free pool space becomes critical. Snapshot data loss can occur. Snapshots are not a replacement for regular tape backups. See “Lifeguard Service” for more information.

After the pool or pools of space and one or more virtual disks are established, the process to create snapshots can begin.

1. From the **Manage Snapshots** dialog box, click **New**. The Welcome screen of the Create New Snapshot wizard is displayed. To continue, click **Next**. The next screen of the wizard is displayed.

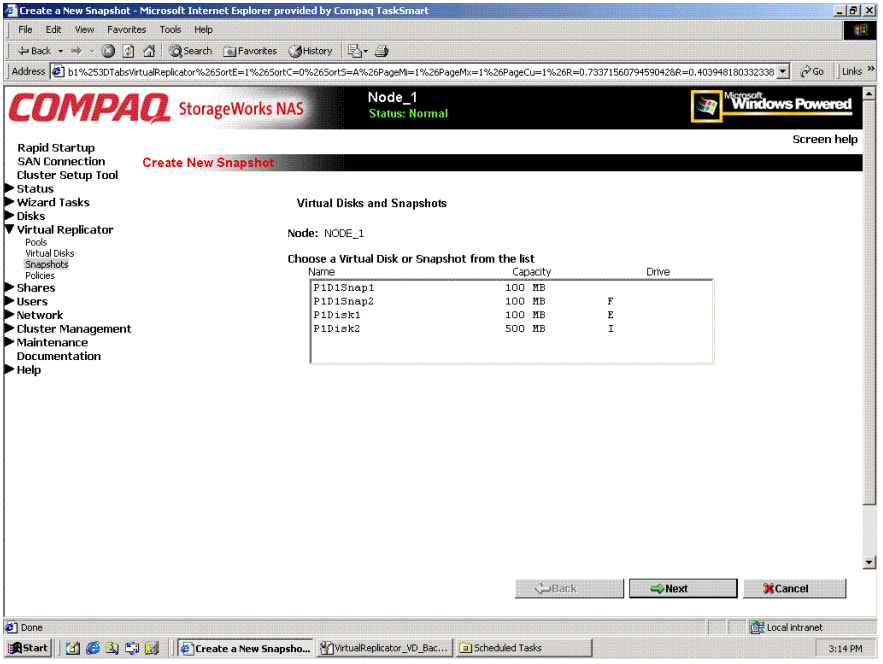


Figure 6-15: Virtual Disks and Snapshots screen

2. All existing virtual disks and snapshots are listed in the display box. Select the virtual disk or the snapshot to take a snapshot of, and then click **Next**. The New Snapshot information screen is displayed.

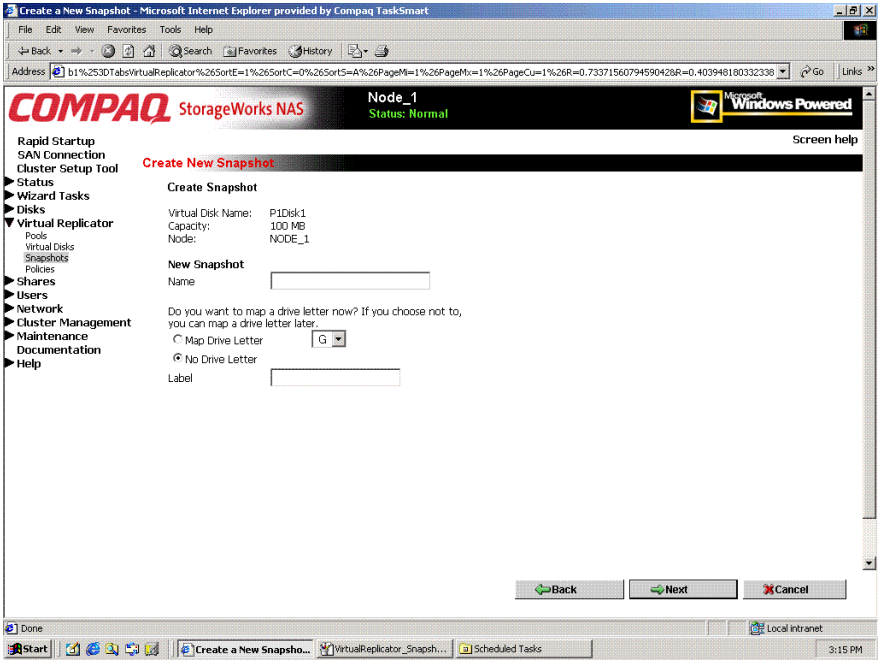


Figure 6-16: New Snapshot Information screen

3. The name and size of the selected item is displayed. Enter:

   - Snapshot name
   - Drive letter for the snapshot
   - Label for the drive letter of the snapshot.

   NOTE: Use appropriate snapshot and volume naming to identify each snapshot individually.

   NOTE: It is not necessary to assign a drive letter to the snapshot until access to the snapshot is needed. If one snapshot per virtual disk will be created, it is advisable to assign a drive letter at this time. If a drive letter is not set now, it can be set at a later time.

4. Click **Next**. A completion screen is displayed. Click **Finish**.

Deleting a Snapshot

To delete a snapshot:

1. From the **Manage Snapshots** dialog box, select the snapshot to delete from the displayed list. Then click **Delete**.
2. A confirmation screen is displayed. After verifying that the displayed snapshot is the one that needs to be deleted, click **OK**.

Viewing Snapshot Properties

To view snapshot properties, from the **Manage Snapshots** dialog box, select a snapshot from the displayed list and then click **Properties**. The Snapshot Properties screen is displayed.

This interface is a summary display. To change any of these properties, use the appropriate action in the Manage Snapshots or Manage Virtual Disks dialog boxes.

Figure 6-17: Snapshot Properties summary display

Setting the Drive Letter for a Snapshot

To set or change the drive letter for a snapshot:

1. From the **Manage Snapshots** dialog box, select the desired snapshot. Then, click **Set Drive Letter**. The Set Drive Letter dialog box is displayed.
2. Using the **Drive Letter** drop-down box, select a letter to assign to this snapshot, and then click **OK**. Only available, unused letters are displayed.

Figure 6-18: Set Drive Letter dialog box

Creating a Snapshot Schedule

A scheduled snapshot is a snapshot that that will be run at a specific date or time. These schedules can be recurring or a one time event. To create a snapshot schedule for a virtual disk:

1. From the **Manage Virtual Disks** dialog box, select the virtual disk to work with, and click **Create Snapshot Schedule**. The Welcome screen of the Schedule a Virtual Disk Snapshot wizard is displayed.

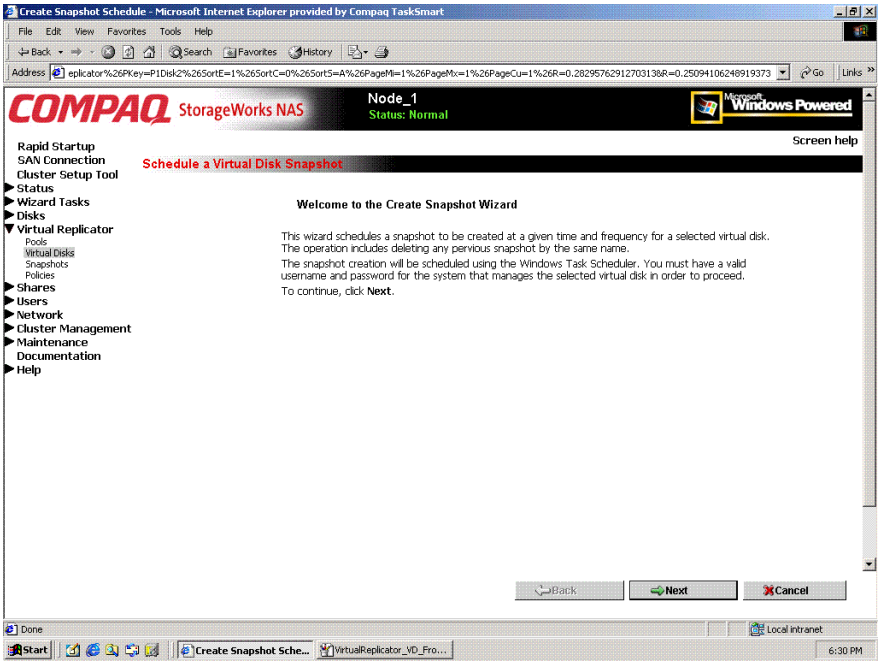


Figure 6-19: Snapshot Wizard Welcome screen

2. Click **Next**. The next screen of the wizard is displayed. The name and owner node (if applicable) of the selected virtual disk is displayed. In this screen, enter snapshot and task information.

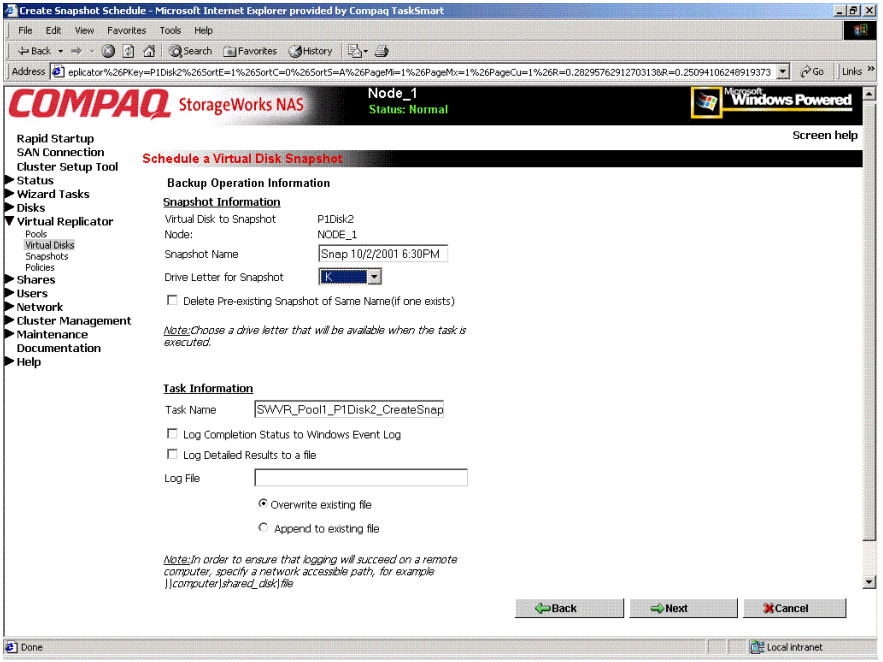


Figure 6-20: Snapshot and Task Information screen

3. Enter snapshot information, including:
   - A name for the snapshot
   - The letter to assign to the snapshot
   - Indicate if the system should delete any existing snapshots with the same name. If this option is not checked and a snapshot with the same name already exists, the new snapshot will not be created.

4. Enter task information.

   The screen displays a default name for the task. Indicate whether the system should log the task into an audit file:

   - Completion status can be posted to the Windows Event Log. Compaq recommends posting to the log to confirm the task was begun and was completed.
   - Task details can be posted to a custom file. To post the details to a file, enter the filename and also indicate whether the system should append this information onto the end of the file or overwrite information in an existing file.

5. Click **Next**. The **Schedule Information** screen is displayed.

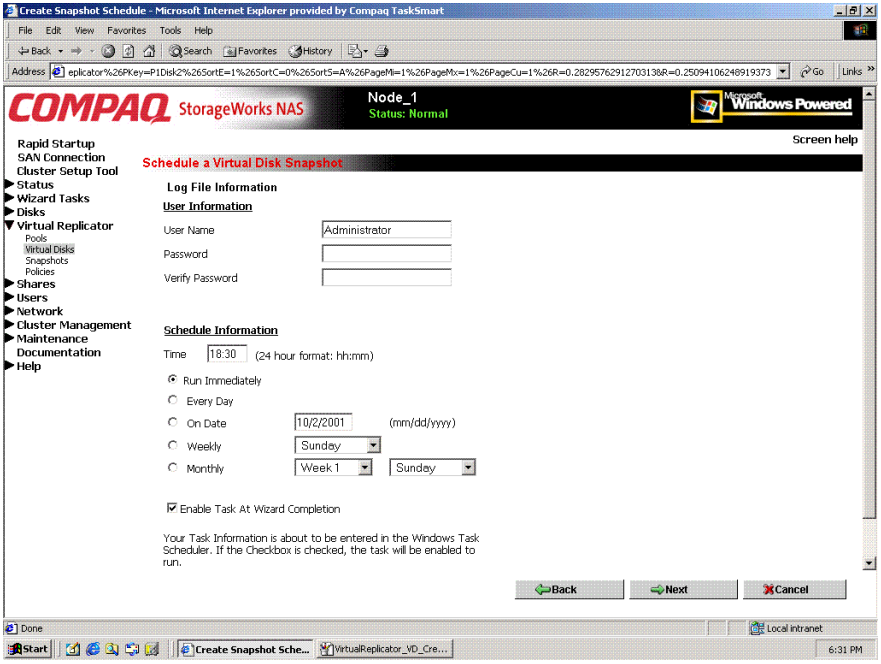


Figure 6-21: Schedule Information screen

6. Enter schedule information, including:
   - Time to create the snapshot (using a 24-hour clock)
   - When to create the snapshot

     Options include:

     — Immediately

     — Daily

     — On a specific date

     — Weekly

     — Monthly
   - Whether to enable this schedule at this time.

     To activate the snapshot schedule immediately, check the box. If Enable Task at Wizard Completion is not selected, this schedule will be stored, but will not be activated until you return to Windows Task Scheduler and enable the schedule.

     Click **Next**. A summary screen is displayed
7. After verifying the accuracy of the schedule information in the summary screen, click **Finish**. The Manage Virtual Disks dialog box is displayed again.

Displaying and Deleting a Snapshot Schedule

Snapshot schedules can be displayed and deleted from two places in the WebUI:

- Through the **Virtual Disks** menu option
- Through the **Manage Snapshots** menu option

Displaying and Deleting Snapshot Schedules through the Virtual Disks Menu

To view or delete snapshot schedules from the Virtual Disks menu option:

1. From the **Manage Virtual Disks** dialog box, select the virtual disk whose snapshots you want to see and then click **Display/Delete Snapshot Schedule**. The Display/Delete Snapshot Schedule dialog box is displayed.

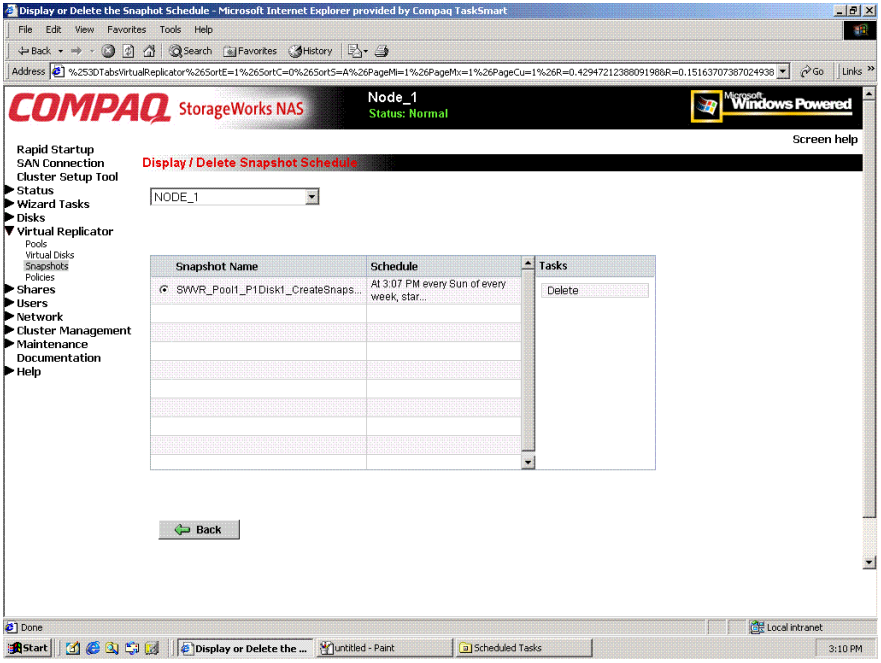


Figure 6-22: Display/Delete Snapshot Schedule dialog box

2. Select the desired schedules from the displayed list and then click **Delete**.
3. A confirmation screen is displayed. After verifying that the correct snapshot schedule was selected, click **OK**.

Displaying and Deleting Snapshot Schedules through the Manage Snapshot menu

To view and delete snapshot schedules from the Manage Snapshots menu option:

1. From the **Manage Snapshots** dialog box, select the snapshot whose schedule you want to view or delete and then click **Display/Delete Snapshot Schedule**. The Display/Delete Snapshot Schedule dialog box is displayed.
2. Select the schedule to delete and then click **Delete**.

   A confirmation screen is displayed. View the display to confirm that the desired schedule was selected.
3. To proceed with the deletion, click **OK**.

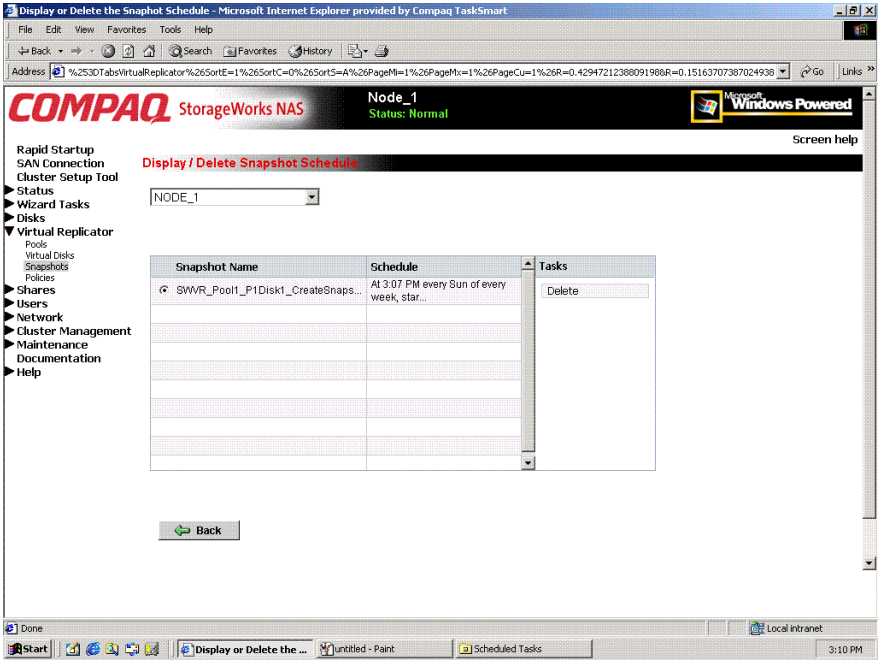


Figure 6-23: Display/Delete the Snapshot Schedule Wizard screen

Scheduling Snapshot Deletions

To schedule the deletion of a snapshot:

1. From the **Manage Snapshots** dialog box, select the snapshot to delete from the display list. Then click **Schedule Snapshot Deletion**.

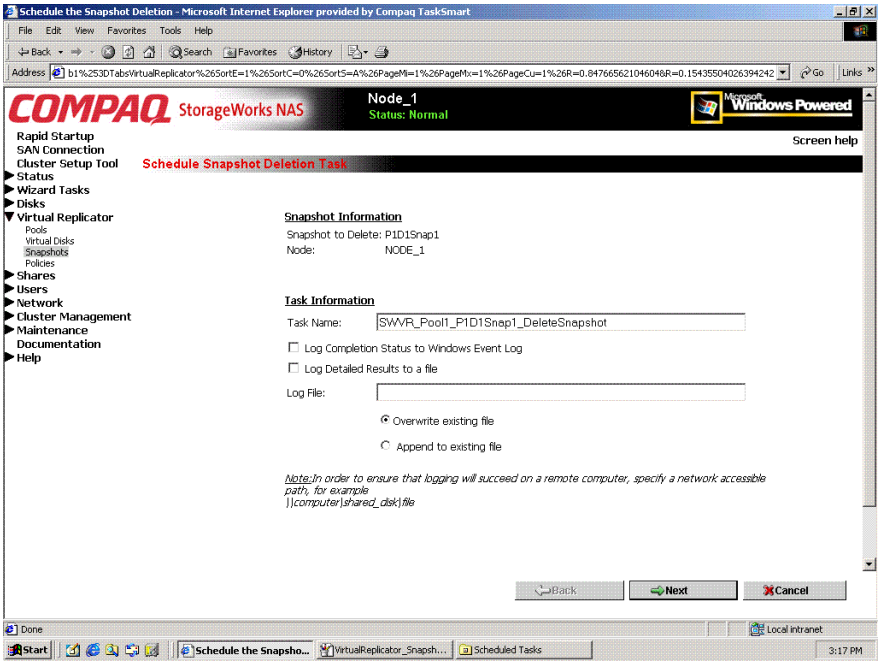


Figure 6-24: Schedule Snapshot Deletion Task dialog box

Snapshot information, including the snapshot name, is displayed.

2. Enter task information, including whether the system should log the task into an audit file:

   - Completion status can be posted to the Windows Event Log.
   - Task details can be posted to a custom file. To post the details to a custom file, enter the filename and indicate whether the system should append this information onto the end of the file or overwrite the existing file.

3. Click **Next**. The **Schedule Information** screen is displayed.

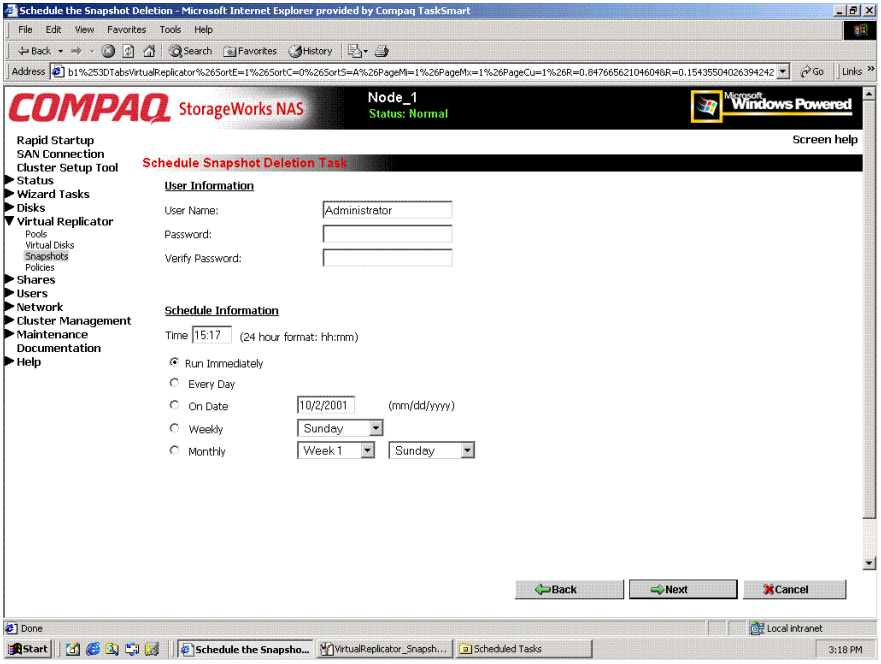


Figure 6-25: User Information and Schedule Information screen

4. Enter schedule information, including:
   - Time to delete the snapshot (using a 24-hour clock)
   - When to delete the snapshot

     Options include:

     — Immediately

     — Daily

     — On a specific day

     — Weekly

     — Monthly

5. Click **Next**. A completion screen is displayed. Click **Finish**.

Restoring a Virtual Disk from a Snapshot

Snapshots can be used to return a virtual disk back to a previous state. If the virtual disk or the data is corrupted, the snapshot may not be able to recover all necessary blocks and the disk must be restored using normal tape backup.

NOTE: Snapshots are not a replacement for normal tape backup.

This process is also called SnapBack. SnapBack uses the contents of a snapshot to restore the contents of a parent virtual disk. Snapshots can be used to recover data without performing a file copy to an intermediate location and consuming disk space in the process. The restoration is automatic and there is no need to map and remap drives, copy files, or delete snapshots or virtual disks. SnapBack performs all of these steps. During the operation, the drive letters of the virtual disk and snapshot are momentarily unavailable. As part of the process, the source snapshot is retained, but all snapshots that are older than the source for the SnapBack are deleted. Deleting earlier snapshots ensures the integrity of the data on the restored virtual disk.

CAUTION: When restoring a virtual disk from a snapshot, there must be sufficient free pool space; otherwise, a pool-full condition may occur and Lifeguard may delete the snapshot from which it is restoring. If the only snapshot is deleted, the virtual disk must be restored from tape backup. See “VR Lifeguard”

CAUTION: Before performing the SnapBack operation, verify that earlier snapshots, which will be deleted in the process, are not needed.

CAUTION: If the SnapBack operation is interrupted, the virtual disk will not be fully restored and will be in an unpredictable state. Compaq recommends restarting the SnapBack restore process as soon as possible.

IMPORTANT: The SnapBack process can be lengthy, depending on a variety of factors, such as the amount of data on the snapshot, the number of storage units in the pool, and hardware configuration.

The Restore From Snapshot Wizard schedules the recreation of a virtual disk from a snapshot. If specified, upon successful completion of the schedule, the previous virtual disk and snapshot are both deleted.

Virtual disks can be restored from a snapshot through two access points on the WebUI:

- Through the Virtual Disks menu
- Through the Snapshots menu

Each of these methods is discussed in the following sections of this chapter.

Preparing to Restore a Virtual Disk from a Snapshot

Before executing the restore:

1. Remove all shares associated with the virtual disk that is being restored.
2. Delete all snapshots of the virtual disk that is being recovered, except for the snapshot that will be used for the recovery. Additionally, to free up pool space, delete any unnecessary snapshots of other virtual disks in the same pool.
3. Make sure there is enough free pool space to accomplish the recovery and if necessary, add logical disks to increase pool free space.

   Typically, pool free space equivalent to the current size of the virtual disk that is being recovered is needed, plus the space currently used by the snapshot being used for the recovery. To determine the amount of space used by this snapshot, access the Snapshot Manager, and then click the virtual disk listing. Locate the snapshot name in the right pane. The amount of the space used by the snapshot is in the **Delspace** column.

Restoring a Virtual Disk from a Snapshot through the Snapshots Menu

To use the Snapshot menu to restore a virtual disk from a snapshot:

1. From the **Manage Snapshots** dialog box, select the desired snapshot. Then click **Restore Virtual Disk**. The Restore Virtual Disk from Snapshot screen is displayed.

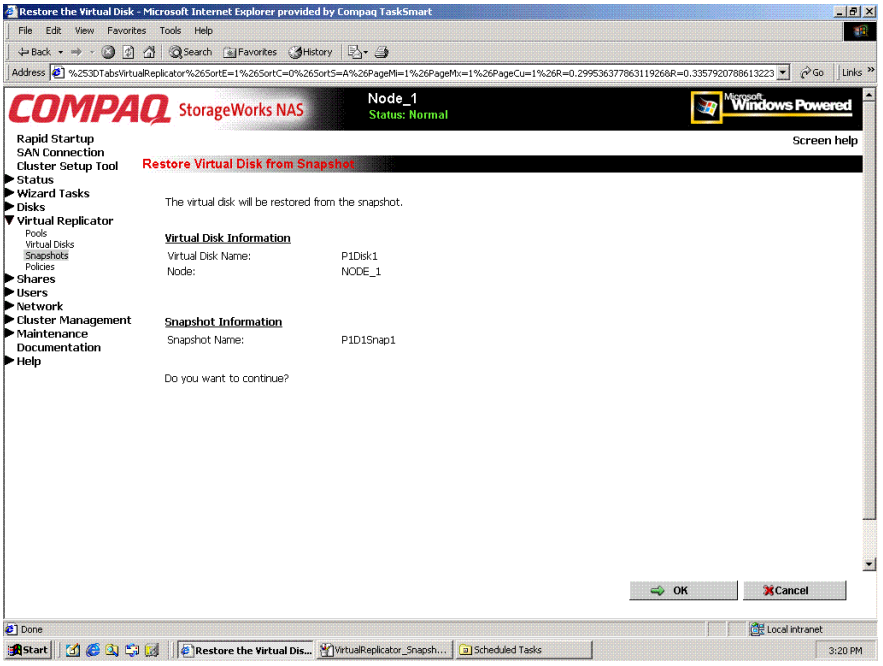


Figure 6-26: Restore Virtual Disk from Snapshot screen

2. Verify the accuracy of the data on the screen.

   NOTE: There is no additional warning prompt.

3. To proceed, click **OK**.

   The disk is restored, and the Manage Snapshots dialog box is displayed again.

Restoring a Virtual Disk from a Snapshot through the Virtual Disks Menu

To use the Virtual Disks menu to restore a virtual disk from a snapshot:

1. From the **Manage Virtual Disks** dialog box, select the desired virtual disk and then click **Restore Virtual Disk**.

   The Restore Virtual Disk from Snapshot screen is displayed.

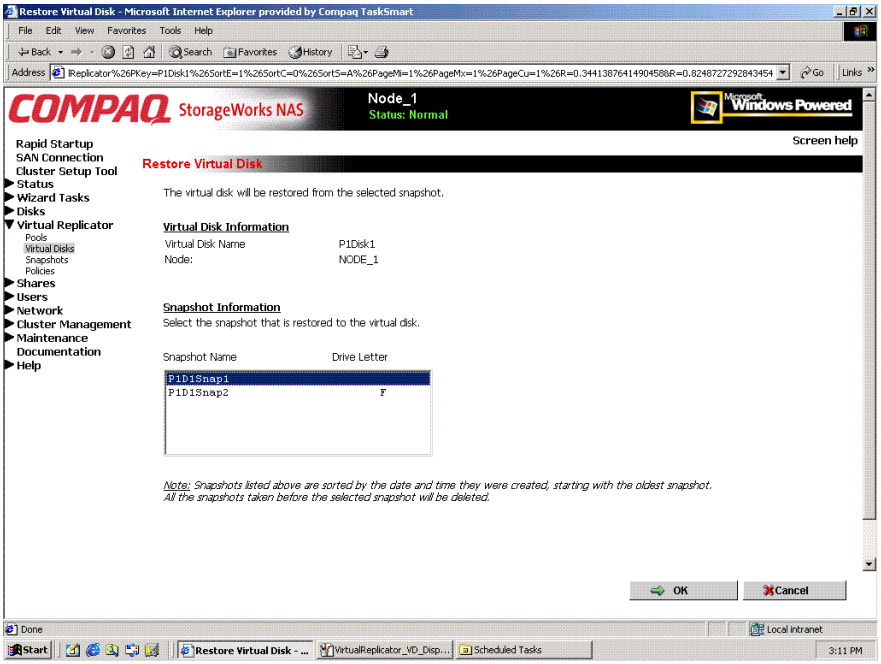


Figure 6-27: Restore Virtual Disk screen

2. In the snapshot box, select the snapshot to use.
3. Verify the accuracy of the data on the screen.

   NOTE: There is no additional warning prompt.

4. To proceed, click **OK**.

   The disk is restored, and the Manage Virtual Disks dialog box is displayed again.

Enabling Incremental Backup Support

Some backup utilities use an archive bit to indicate whether a file has been backed up. The Incremental Backup Support feature allows normal incremental backups by turning off the archive bits of the files on the virtual disk. The next snapshots that are taken will then have the archive bits correctly set for incremental backups.

1. From the **Manage Virtual Disks** dialog box, select the desired virtual disks, and click **Enable Incremental Backup Support**. The Welcome screen of the Enable Incremental Backup Support wizard is displayed.
2. Click **Next** to continue. The next screen of the wizard is displayed.

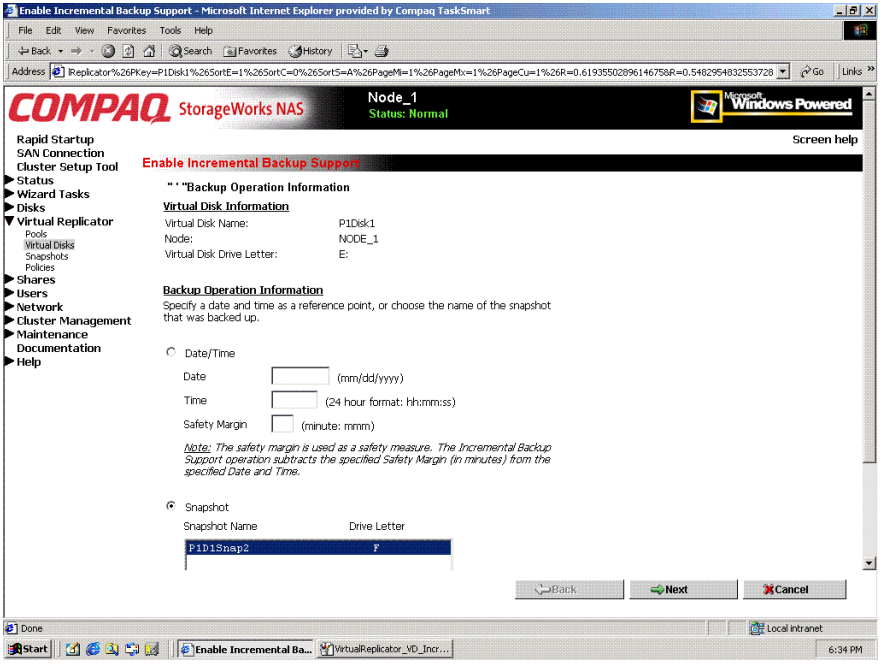


Figure 6-28: Backup Operation Information screen

3. Enter backup operation information. Select one of the following reference points:
   - Date and time
   - Snapshot name

4. Click **Next**. The **Log File Information** screen is displayed.

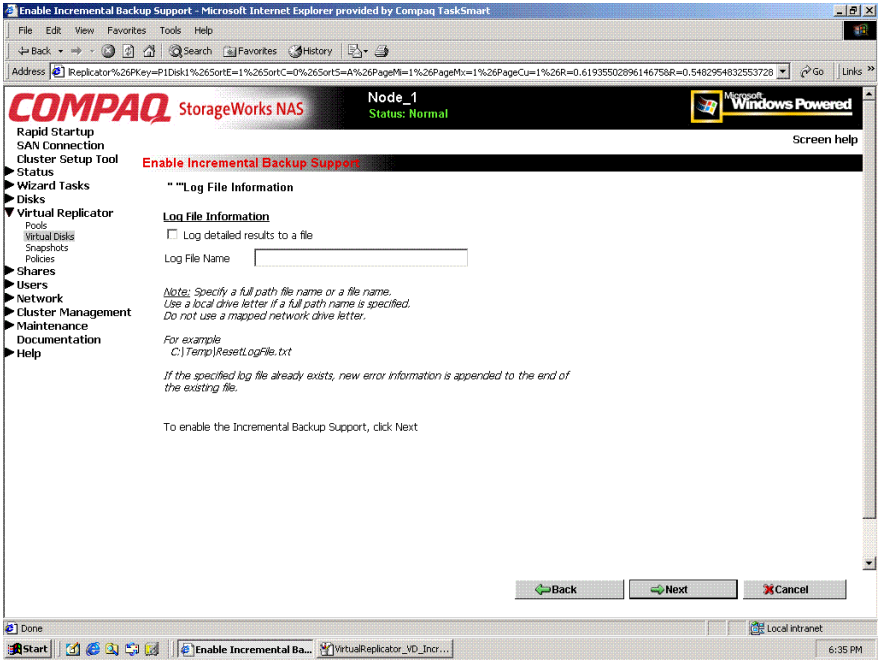


Figure 6-29: Log File Information Screen

5. To log results about the incremental backups, click **Log detailed results to a file**, and enter the file name.
6. Click **Next**. A confirmation screen is displayed.
7. After verifying the accuracy of the incremental backup information, click **Finish**.

Global Pool Policy Settings

Virtual Replicator parameters are preset on the NAS device, with one primary set of parameters controlling all pools. If a pool needs policy settings that are unique to it, the administrator can customize the policy settings for that individual pool. The global set of parameters continues to manage all pools that do not have customized policies.

This menu option allows the administrator to customize the global set of parameters. Only experienced users should modify these global and pool-specific policy settings.

CAUTION: Use caution when changing these parameters. Unwise choices can result in system inefficiencies, difficulties, and data loss.

This section discusses changing the global pool policies. To change the pool policies for a specific pool, see the "Setting Pool Policies for a Specific Pool" section earlier in this chapter.

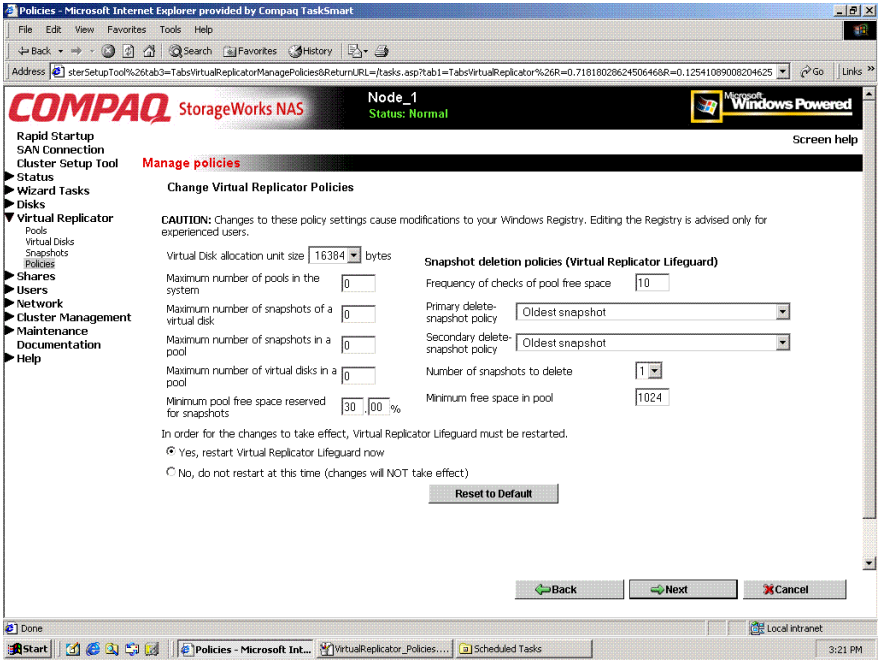


Figure 6-30: Manage Policies dialog box

1. From the **VR Main menu**, select **Policies**. An introductory **Manage policies** screen is displayed. Click **Next** to continue. The next Manage Policies dialog box is displayed.
2. In the **Manage policies** dialog box, enter the new parameter settings.

3. After all settings are entered, click **Next** and then click **Finish**.

Table 6-2: Pool Policy Default Settings (duplicated table)

Policy	Default Setting
Virtual disk allocation unit size	16 KB
Maximum number of pools in system	
Maximum number of snapshots of a virtual disk	
Maximum number of snapshots in a pool	
Maximum number of virtual disks in a pool	8
Maximum pool free space reserved for snapshots	30%
Restart Lifeguard now or later	Now
Frequency of pool free space checks	10 seconds
Primary delete snapshot policy	Oldest snapshot first
Secondary delete snapshot policy	Oldest snapshot first
Number of snapshots to delete	1
Minimum free space in pool	1024 KB

Namespace Recovery

Namespace Recovery is a utility that can be used whenever it may be necessary to re-detect the virtual storage configuration of the pools, virtual disks, and snapshots.

Figure 6-31 is an example of the Namespace Recovery screen.

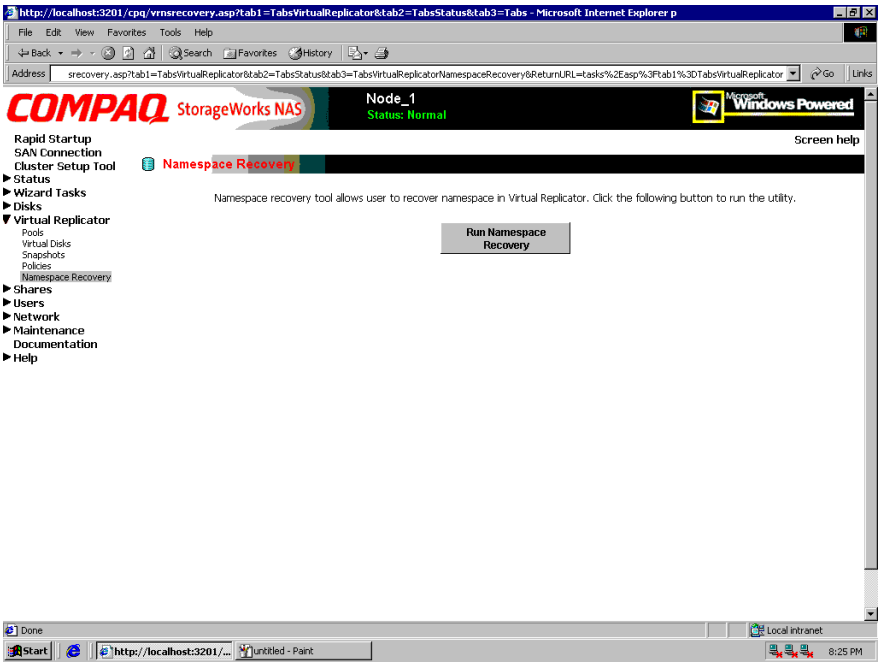


Figure 6-31: Namespace Recovery screen

Drive Quotas

Drive quotas let administrators control the allocation of drive space to individual users or groups of users. When quotas are enabled and properly configured, it is impossible for one person or group to consume all of the available space on a disk.

When quotas are enabled on a volume that already contains files, the system calculates the drive space used by all users on the volume. The quota limit and warning level are then applied to all current users. Administrators can then modify quotas as needed. By enabling and then disabling quotas, administrators take advantage of the auditing capabilities provided by quotas, without reducing server performance.

Usage quotas can be managed through two interfaces:

- Managing Quotas Using the Quota Management Wizard
- Managing Quotas (Details)

Managing Quotas Using the Quota Management Wizard

1. From the WebUI, select **Wizard Tasks**, and **User Management**. The Welcome screen of the wizard is displayed. Click **Next** to continue.
2. In primary menu of the User Management Wizard screen, select **User Quota**.
3. In the quota sub-screen, existing volumes and folders are displayed. Navigate to the desired folder and then select it.
4. A sub-screen of the wizard is displayed, listing several options:
   a. *To create new quota settings,* use the display box to navigate to the volume that needs a quota set up. Then, enter the quota information data fields. After all information is entered, click **Create New Quota Entry**.

      A user list is displayed. Select the user to monitor, and then click **Next**.

   b. *To delete a quota,* navigate to the desired user and click **Delete**.

   c. *To modify information for a quota,* use the display box to navigate to the desired volume or user. Enter the new quota information, and then click **Save Settings**.

Managing Quotas (Details)

Managing quotas includes:

- Enabling and disabling quota management on a virtual disk
- Creating new quota entries for a user or group
- Deleting quota entries for a user or group
- Modifying quota entries for a user or group

Each of these tasks is discussed in the following sections.

Quota management tasks are performed from the **Disks**, **Disk Quota** selection from the WebUI menu. Figure 6-34 is an illustration of the disk quota dialog box.

NOTE: If the volume is not formatted with the NTFS file system, or if you are not a member of the administrators group, the Disk Quota option is not displayed (accessible).

NOTE: For more information about quotas, refer to online help for NAS device quota help.

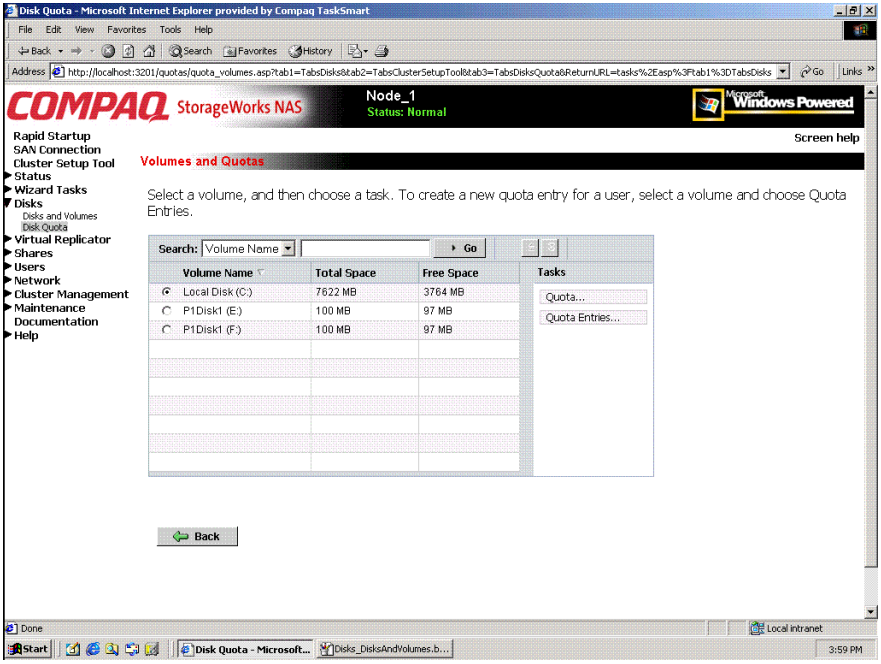


Figure 6-32: Disk Quota dialog box

Enabling and Disabling Quota Management on a Virtual Disk

To enable drive quotas:

1. From the WebUI, select **Disks**, **Disk Quota**. From the **Volumes and Quotas** dialog box, select a volume, and then click **Quota**. The **Default Quota** dialog box for the specified volume is displayed.

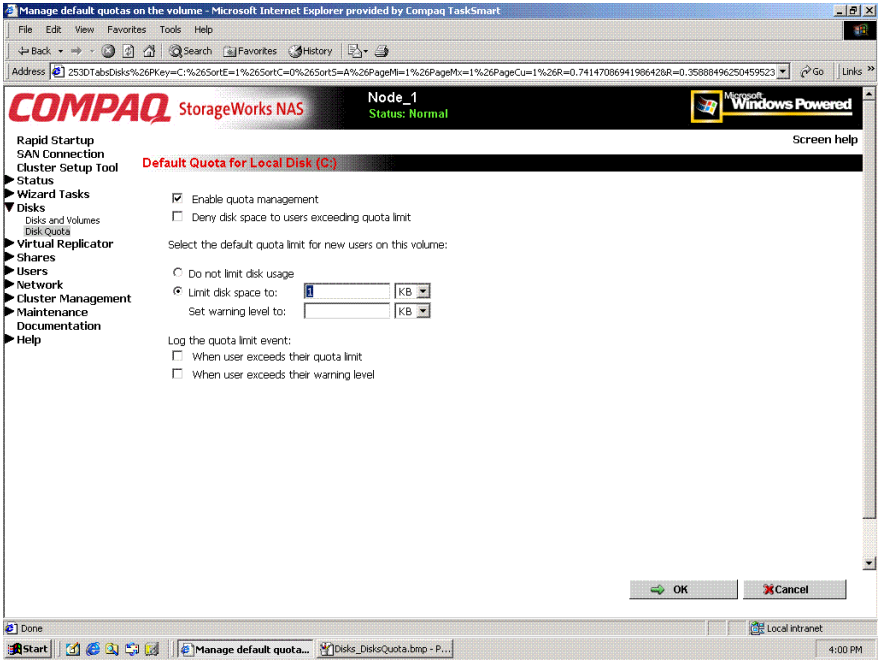


Figure 6-33: Default Quota Dialog box

2. To enable quotas on the selected disk, select **Enable quota management**. Compete the additional data fields on the screen, including disk space and warning level limits and auditing settings.
3. To disable quotas on the selected disk, de-select **Enable quota management**.
4. After completed all field entries, click **OK**. The Volume and Quotas dialog box is displayed again.

Creating New Quota Entries for a User or Group

To create new quotas for a user or group:

1. From the WebUI, select **Disks**, **Disk Quotas**. In the **Volumes and Quotas** dialog box, select a volume and then click **Quota Entries**. The **Quota Entries** dialog box is displayed.

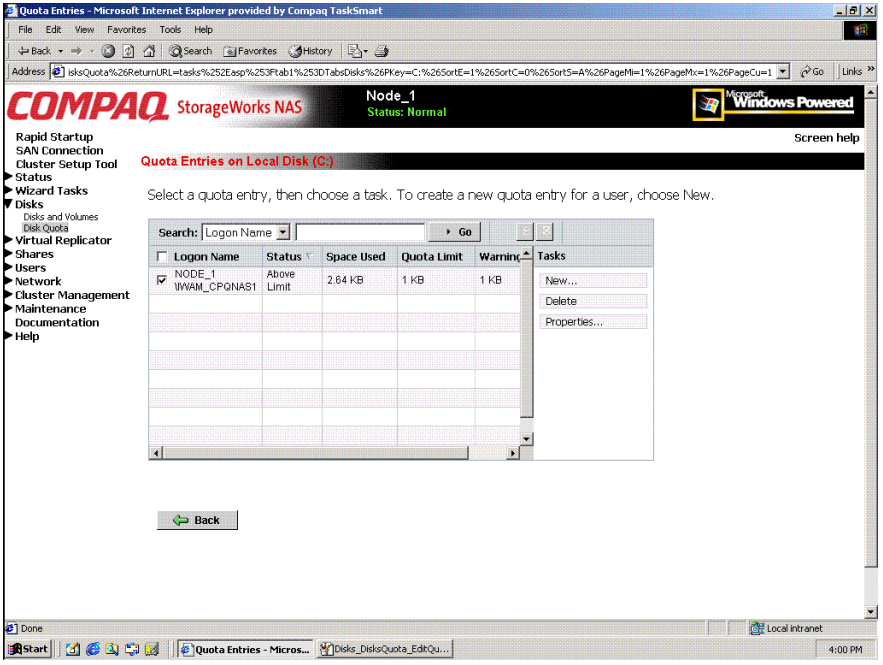


Figure 6-34: Quota Entries dialog box

2. All users and groups with established quotas are displayed. To create a new quota for a user or group, click **New**. The **New Quota Entry** dialog box is displayed.

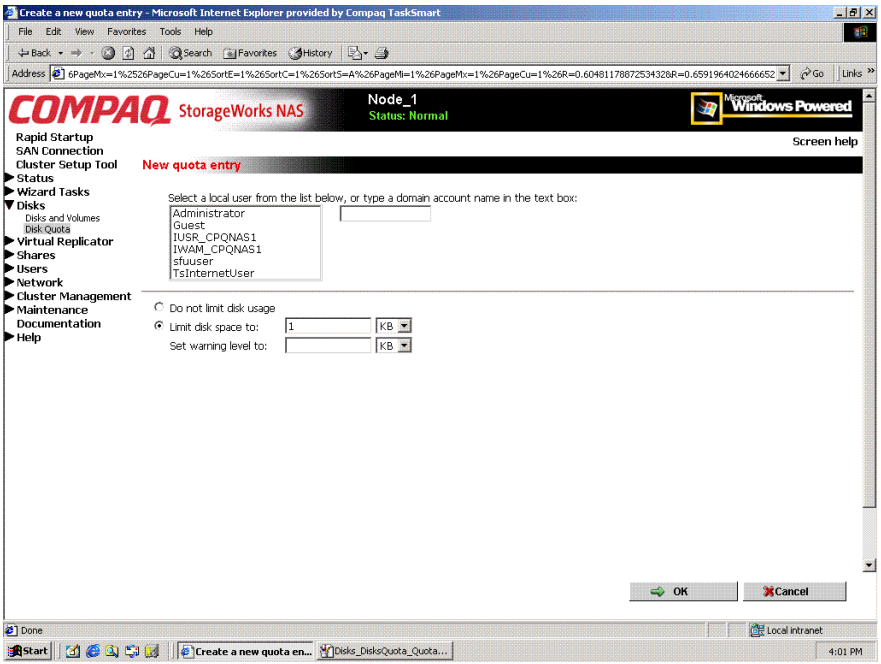


Figure 6-35: New Quota Entry dialog box

3. Indicate the user that the quota is for. For local users and groups, select the desired user from the Select a local user box. For users on the domain, enter the user's domain account name in the indicated box.
4. Enter a disk space limit.
5. Verify the accuracy of the field entries, and then click **OK**. The Quota Entries dialog box is displayed again.

Deleting Quota Entries for a User or Group

To delete quotas for a user or group:

1. From the WebUI, select **Disks**, **Disk Quotas**. In the Volumes and Quotas dialog box, select a volume and then click **Quota Entries**. The Quota Entries dialog box is displayed.
2. All users and groups with established quotas are displayed. To delete a quota for a user or group, click **Delete**. A verification dialog box is displayed.
3. Verify that this is the correct user, and then click **OK**. The Quota Entries dialog box is displayed again.

Modifying Quota Entries for a User or Group

Usage limit parameters for a user's quota can be changed. To modify these quota settings for a user:

1. From the WebUI, select **Disks**, **Disk Quotas**. In the Volumes and Quotas dialog box, select a volume and then click **Quota Entries**. The Quota Entries dialog box is displayed.
2. All users and groups with established quotas are displayed. To modify quota for a user or group, select a user, and then click **Properties**. The **Quota Entry** dialog box for that user is displayed.

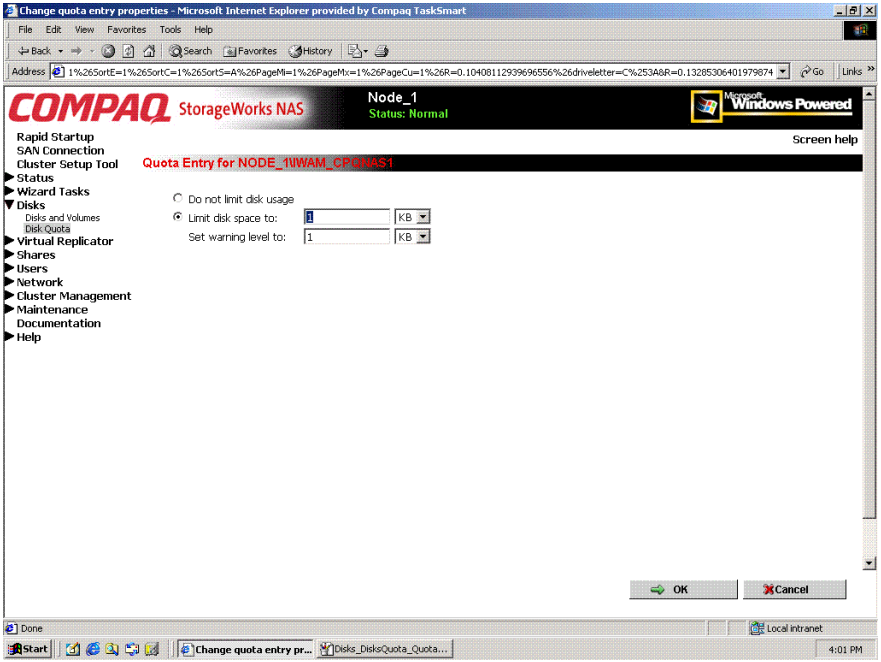


Figure 6-36: Quota Entry dialog box for a user

3. Enter the new disk limit information, and then click **OK**. The Quota Entries dialog box is displayed again.

7

User and Group Management

The *StorageWorks* NAS B3000 supports a variety of file sharing protocols for file access over a network, including: Common Internet File System (CIFS), Network File System (NFS), Novell Core Protocol (NCP), and AppleTalk (AFP). Access to shares requires a network logon (username and password). It follows that a fundamental part of managing shares involves managing the users and groups that have access.

There are two system environments for users and groups: workgroup and domain. Because users and groups in a domain environment are managed through standard Windows NT or Windows 2000 domain administration methods, this document discusses only local users and groups, which are stored and managed on the NAS device. For information on managing users and groups on a domain, refer to the domain documentation.

The following topics are addressed in this chapter:

- Domain Compared to Workgroup Environments
- User and Group Name Planning
  - — Managing User Names
  - — Managing Group Names
- Workgroup User and Group Management
  - — Managing Local Users and Groups using the Wizard
  - — Managing Local Users (Details)
  - — Managing Local Groups (Details)

Domain Compared to Workgroup Environments

NAS B3000 devices can be deployed in workgroup or domain environments. When in a domain environment, the server is a member of the domain. The domain controller is a repository of accounts and account access for the NAS B3000. Client machines are also members of the domain, and users log on to the domain through their Windows clients. The domain controller also administers user accounts and appropriate access levels to resources that are a part of the domain.

In a CIFS environment, when mapping a network drive or a client machine, a user sends a logon credential to the server. This credential includes the username, password, and if appropriate, domain information. Using the credential, the server authenticates and provides the corresponding access to the user.

When a NAS B3000 is deployed into a workgroup environment, all user and group account access permissions to file resources are stored locally on the server.

By contrast, when a NAS B3000 is deployed into a domain environment it uses the account database from the domain controller, with user and group accounts stored outside the server. The server integrates with the domain controller infrastructure.

NOTE: The NAS B3000 cannot act as a domain controller for other servers on the network. If user and group account information is stored locally, those accounts may be used only to authenticate logons to the NAS B3000, resulting in a workgroup configuration.

Administering users and groups in a domain environment is similar in a mechanical sense to administering them in a workgroup environment. If using an Active Directory domain controller, the Computer Management tool allows for adding, modifying, and removing users in the same context as in a workgroup environment. The concepts, however, are very different.

Additional information about planning for domain environments can be found at the Compaq *ActiveAnswers*™ website in the eBusiness Infrastructure solutions area:

www.compaq.com/ActiveAnswers/

The configuration of the domain controller is reflected on the NAS B3000 because it obtains user account information from the domain controller when deployed in a domain environment. As mentioned previously, the server cannot act as a domain controller itself.

User and Group Name Planning

Effective user and group management is dependent upon how well the user and group names are organized. Administrators typically create a small number of groups on the network and then assign users to the appropriate group or groups. File system and share permissions can then be applied at the group level, rather than at the user level. If the number of groups is small, assigning the appropriate permissions to selected group, or groups, is more efficient than assigning permissions to each user.

Although each organization has specific conventions, following general guidelines makes administration simpler and more efficient. Because CIFS is dependent on users and groups to grant appropriate access levels to file shares, CIFS administration benefits from a consistent user and group administration strategy.

Managing User Names

Usernames should reflect a logical relationship between the username and the person who uses the account. It is important that rules are established to ensure that usernames are:

- Systematic
- Easy to follow and implement
- Easy to remember

Using a combination of the user's first name, middle initial, and last name results in systematic usernames for every member of a particular organization. Common examples include:

- First initial followed by last name (jdoe for John Doe)
- First initial followed by middle initial and last name (jqpublic for John Q. Public)
- First name followed by last name, separated by a period (john.smith for John Smith)
- Last name followed by first initial (doej for Jane Doe)

Guidelines must be in place for instances when two users have the same initials or name. For example, a number can be added to the end of the username (jdoe1 and jdoe2).

Other conventions can be applied. Just ensure that conventions are both systematic and consistent.

Managing Group Names

Group management follows many of the same principles as user management.

It is recommended that group naming conventions be systematic and easy to understand. Make the group name convey some logical information about the function or purpose of the group. Table 7-1 provides examples of group names.

Table 7-1: Group Name Examples

Group Name	Description
Administrators	All designated administrators on the server
Users	All standard server users
Power users	All standard server users requiring advanced access levels

Using tags is a helpful convention that indicates the specific access that a particular user has to a network resource. For example, if there is a data share on the device, the network administrator can create a “Data Users ROnly” group and a “Data Users RWrite” group to contain users that have read-only or read-write access on the share, respectively.

Workgroup User and Group Management

In a workgroup environment, users and groups are managed through the WebUI of the NAS B3000. Within the **Users** option, there are three choices:

- Managing users and groups using the wizard
- Managing local users
- Managing local groups

User and group administrative tasks include adding, deleting, and modifying user and group information. Managing local users and managing local groups are discussed in the following paragraphs.

Managing Users and Groups Using the Wizard

The **User Management** wizard is one of three major wizards included in the WebUI. The wizard contains most of the functionality of managing users and groups as the **Users** menu option of the WebUI. The wizard provides the easiest interface for adding, modifying, and deleting users and groups. Because the wizard is so easy to use, little information is included in this document. Online help is available.

For detailed information on managing users and groups, see "Managing Local Users (Details)" and "Managing Local Groups (Details)," later in this chapter.

For detailed information on managing NFS user name mapping, see the "UNIX File System Management" chapter.

1. From the WebUI, select **Wizard Tasks**, **User Management**. The Welcome screen of the wizard is displayed. Click **Next** to continue.
2. The primary menu of the User Management wizard is displayed. From this screen, select one of the following areas to work:
    - Local User
    - Local Group
    - User Quota
    - NFS Mapping

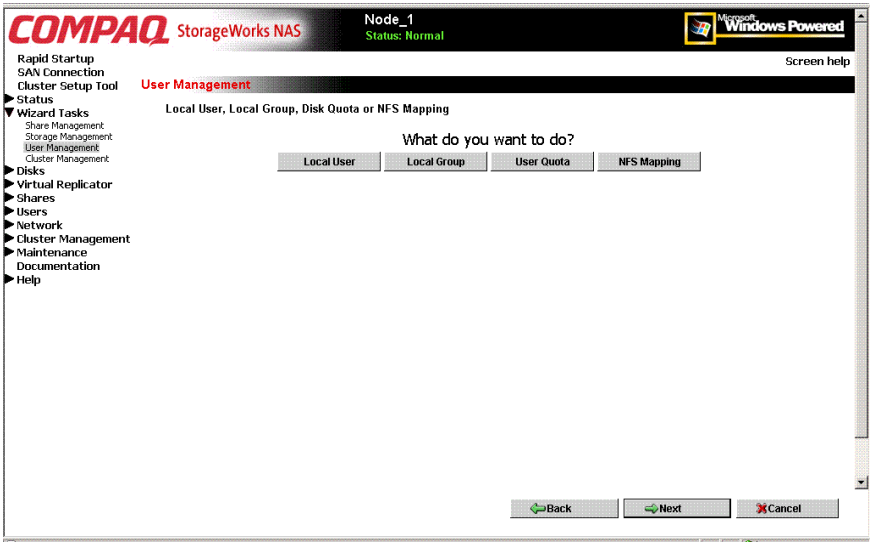


Figure 7-1: User Management wizard

Local Users

To manage user accounts through the wizard:

1. Click **Local User**. A sub-screen is displayed, with the following options:
   - Create
   - Delete
   - Modify
   - Set Password.
2. *To create a new user account,* enter the user data fields and then click **Create**.
3. *To delete a user account,* select a user from the displayed list and then click **Delete**.
4. *To modify information for a user,* select the user from the displayed list. User information is displayed. Enter the new values and then click **Modify**.
5. *To set the password for a user,* select the user from the displayed list. User information is displayed. Enter the new password and then click **Set Password**.

Local Groups

To manage local groups through the wizard:

1. Click **Local Group**. A sub-screen is displayed, with the following options:
   - Create
   - Delete
   - Modify
2. *To create a new group account,* enter the group information data fields and then click **Create**.
3. *To delete a group account,* select a group from the displayed list and then click **Delete**.
4. *To modify information for a group,* select the group from the displayed list, enter the new data, and then click **Modify**.

User Quota

To manage disk quotas for users and groups through the wizard:

NOTE: For detailed information on managing disk quotas, see the "Disk Quota" section of the "Virtual Storage Management" chapter.

1. Click **User Quota**.
2. Available volumes and folders are displayed. Navigate to the desired folder and then select it.

3. A sub-screen of the wizard is displayed, listing the following options:
   - Create new entry
   - Save settings
   - Delete
4. *To create quota settings,* use the display box to navigate to the volume that needs a quota set up. Then, select "Enable Quota Management" and enter the quota information data fields. After all information is entered, click **Create New Quota Entry**.

   A user list is displayed. Select the user to monitor, and then click **Next**.
5. *To delete a quota,* navigate to the desired user and click **Delete**.
6. *To modify information for a quota,* use the display box to navigate to the desired volume or user. Enter the new quota information, and then click **Save Settings**.

NFS Mapping

To set up NFS user name mapping through the wizard:

1. Click **NFS Mapping**. A sub-screen of the wizard is displayed, listing four tabs of information, including:
   - General
   - Simple mapping
   - Explicit user mapping
   - Explicit group mapping
2. *In the General tab*, indicate whether NIS or password and group files are being used.
3. *In the Simple Mapping tab*, indicate whether simple mapping will be used in addition to explicit mapping.
4. *In the Explicit User Mapping tab,* link the Windows user and the UNIX users.
5. *In the Explicit Group Mapping tab,* link the Windows group and the UNIX group.

Managing Local Users (Details)

Managing users includes the following tasks:

- Adding a new user
- Deleting a user
- Setting a user password
- Modifying user properties

In the WebUI, under **Users**, **Local Users** is the **Local Users on Server Appliance** dialog box. All workgroup user administration tasks are performed in the Local Users dialog box.

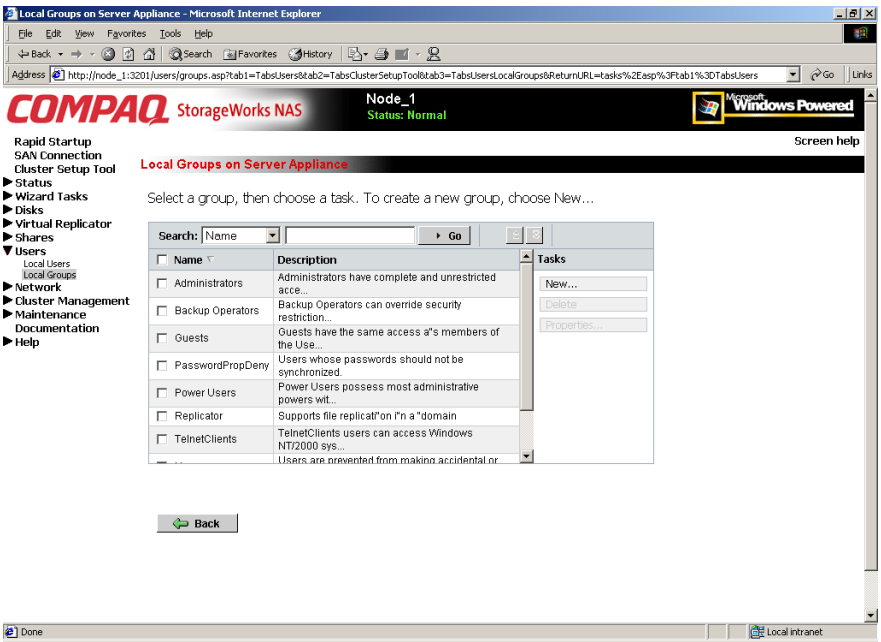


Figure 7-2: Local Users dialog box

All available options include: **New**, **Delete**, **Set a Password**, and **Properties**. When the Local Users dialog box is initially displayed, only the New option is available. After an existing user is selected, the additional actions are displayed. Each of these options is discussed in the following paragraphs.

Existing user records can be retrieved in one of two ways:

- By entering the user's **User Name** or **Full Name** in the **Search** fields to retrieve a specific user record. To redisplay the complete user list, space out the **Search** field.
- By selecting the user from the list of displayed users in the dialog box. The sort order of the display is controlled by clicking the **Name** field heading. The names are displayed in alpha-numeric order or reverse alpha-numeric order.

Adding a New User

To add a user:

1. From the **Local Users** dialog box, click **New**. The **Create New User** dialog box is displayed.

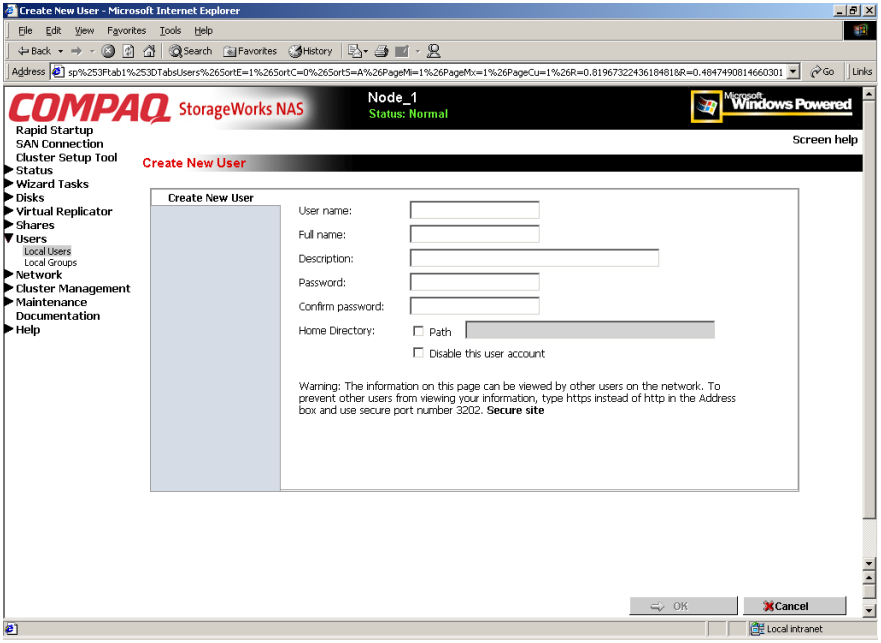


Figure 7-3: Create New User dialog box

2. Enter the user information and then click **OK**. The user is added and the **Local Users** dialog box is displayed again

Deleting a User

To delete a user:

1. In the **Local Users** dialog box, select the user to delete, and then click **Delete**.

   The **Delete User** dialog box is displayed, including a warning note about deleting users.

2. To delete the user, click **OK**. The user is deleted and the Local Users dialog box is displayed again.

Modifying a User Password

Follow these steps to modify a user's password:

1. In the **Local Users** dialog box, select the user whose password needs to be changed. Then, click **Set a Password**.

   The **Set Password** dialog box is displayed.

2. Enter the password and click **OK**. The Local Users dialog box is displayed again.

Modifying User Properties

To modify other user properties:

1. From the **Local Users** dialog box, select the user whose record needs to be modified. Then, click **Properties**.

   The General information page of the **Properties** dialog box is displayed. Figure 7-4 is an illustration of the user Properties dialog box.

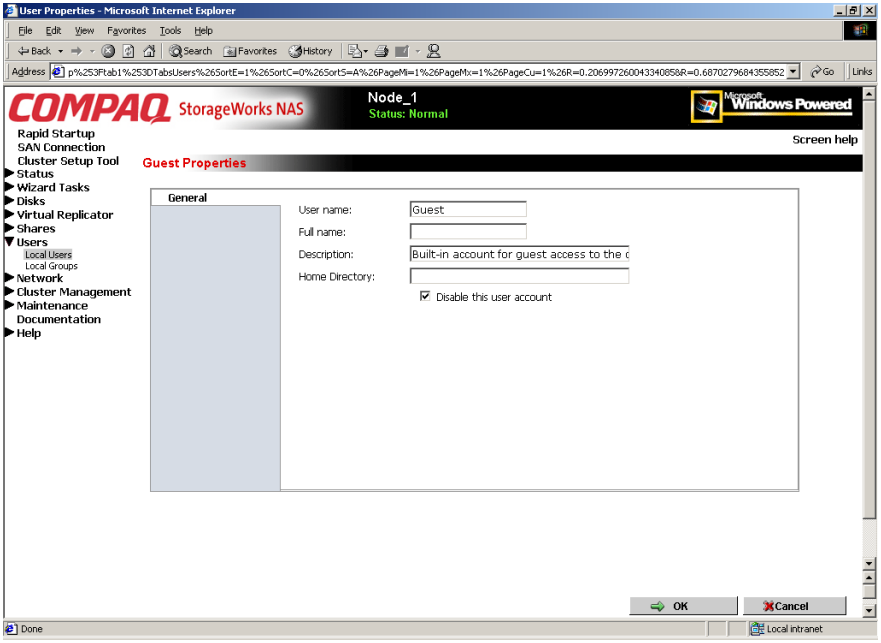


Figure 7-4: User Properties dialog box

2. The following information can be changed or set:
   - User name
   - Full name
   - Description
   - Home Directory
   - Disable this account
3. After completing the changes, click **OK**. The Local Users dialog box is displayed again.

Managing Local Groups (Details)

Managing groups includes the following tasks:

- Adding a new group
- Deleting a group
- Modifying group properties, including user memberships

Local groups in a workgroup environment are managed through the **Users** option in the WebUI.

In the WebUI, under **Users**, **Local Groups** is the **Local Groups on Server Appliance** dialog box. All workgroup group administration tasks are performed in the Local Groups on Server Appliance dialog box.

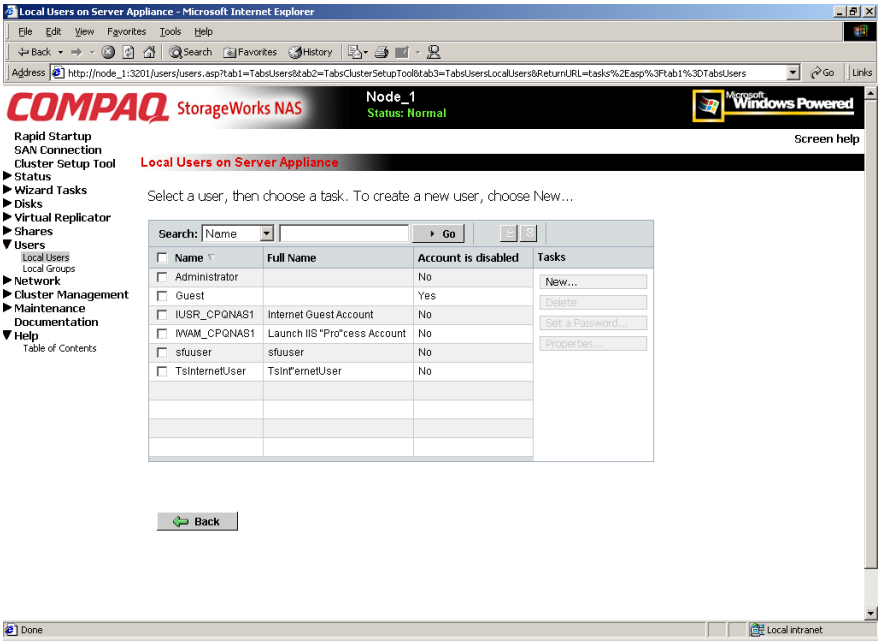


Figure 7-5: Local Groups dialog box

Adding a New Group

To add a group:

1. In the **Local Groups** dialog box, click **New**.

   The **Create New Group** dialog box is displayed.

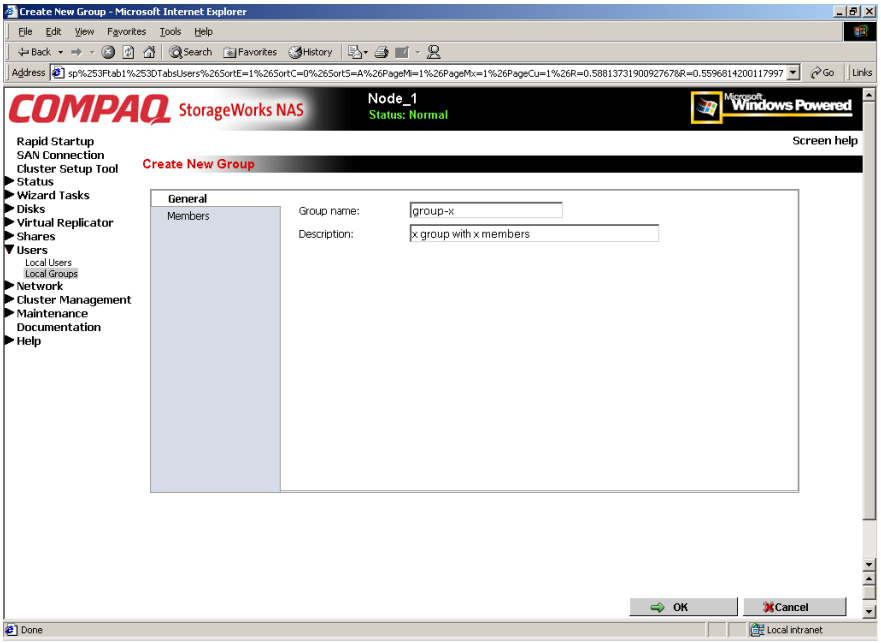


Figure 7-6: Create New Group dialog box, General tab

2. Enter the group name and description.
3. To indicate the user members of this group, click **Members**. See "Modifying Group Properties" for procedural instructions on entering group members.
4. After all group information is entered, click **OK**. The group is added, and the **Local Groups** dialog box is displayed again.

Deleting a Group

To delete a group:

1. From the **Local Groups** dialog box, select the group to delete, and then click **Delete**.
2. The **Delete Group** dialog box is displayed. Verify this is the intended group and then click **OK**. The **Local Groups** dialog box is displayed again.

Modifying Group Properties

To modify other group properties:

1. From the **Local Groups** dialog box, select the desired group and then click **Properties**. The **Properties** dialog box is displayed.

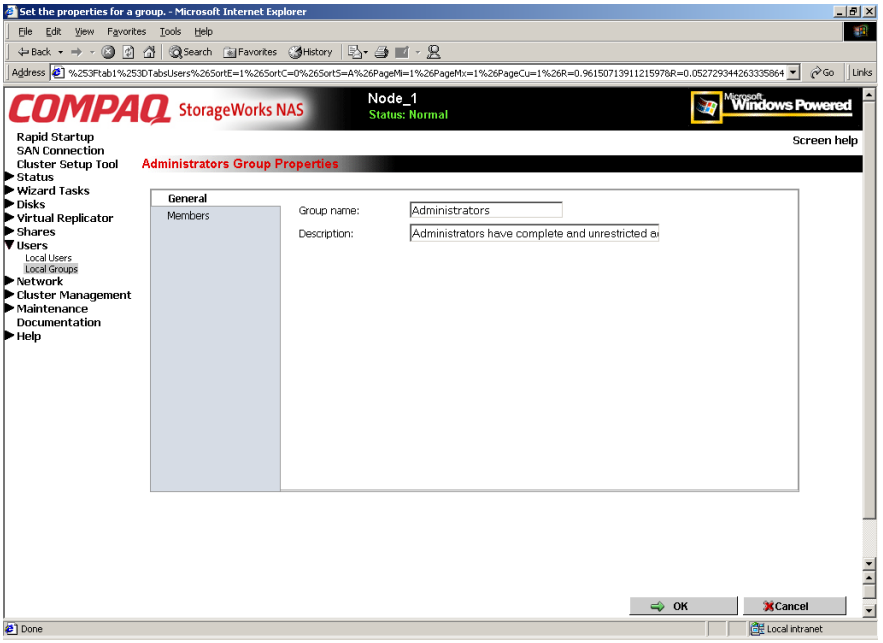


Figure 7-7: Group Properties dialog box, General tab

Within the Properties dialog box are two tabs:

- General tab
- Members tab

Each of these tabs is discussed in the following paragraphs.

2. Enter the desired changes in each of the tabs. Then, click **OK**. The Local Groups dialog box is displayed again.

General Tab

Within the General tab, basic group information can be changed, including:

- Group name
- Description

Members Tab

To indicate or change the members of a group, click the **Members** tab. Within this dialog box, users are added and removed from a group.

Two boxes are displayed: **Members** and **Add User or group**. Current members of that group are listed in the Members box. All users are listed in the Add user or group box.

- To add an existing local user to a group, select the desired user from the **Add Users** box and then click the **Add** button.
- To remove an existing local user from a group, select the desired user from the **Members** box, and then click the **Remove** button.
- To add user or group from a domain to this group, the scroll bar at the right of the screen may need to be used to scroll up the screen display. Enter the user or group name to include in the indicated format (`domain/user`).

Figure 7-8 is an example of the Members tab.

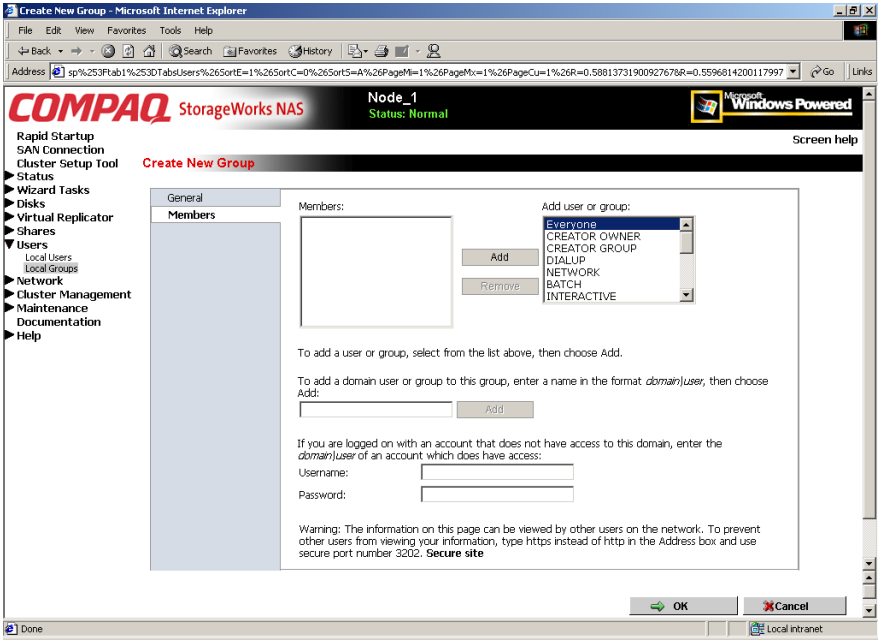


Figure 7-8: Group Properties dialog box, Members tab

8

Folder and Share Management

The *StorageWorks* NAS B3000 supports several file-sharing protocols, including CIFS, NFS, FTP, HTTP, NCP, and AFP. This chapter discusses overview information as well as procedural instructions for the set up and management of the file shares for the supported protocols. In addition, discussions on security at the file-level and at the share-level are included in this chapter.

Abbreviated information on creating NFS file shares is included in this chapter; for detailed information on setting up and managing NFS file shares, see the "UNIX File System Management" chapter.

NCP shares must be set up and managed through the Microsoft Management Console (MMC) user interface. For information on managing NCP file shares, see the "NCP File System Management" chapter.

More information about Windows file system security is available on the Microsoft Website:

www.microsoft.com/

IMPORTANT: The NAS B3000 can be deployed in a clustered as well as non-clustered configuration. This chapter discusses share setup for a non-clustered deployment. For information on managing file shares in a cluster, see the "Cluster Management" chapter.

The following topics are discussed in this chapter:

- Folder Management
  - Navigating to a Specific Volume or folder
  - Creating a New Folder
  - Deleting a Folder
  - Modifying Folder Properties
  - Creating a New Share for a Volume or Folder
  - Managing Shares for a Volume or Folder
  - Managing File-Level Permissions, Open Sessions, and Open Files
- Share Management
  - Defining Access Control Lists
  - Integrating Local File System Security into Windows Domain Environments
  - Comparing Administrative and Standard Shares
  - Planning for Compatibility between File-Sharing Protocols
  - Managing Shares Using the Shares Management Wizard
  - Managing Shares (Details)
- Protocol Settings

All procedures in this chapter are documented using the WebUI. In addition to this guide, the WebUI offers online help.

Folder Management

Volumes and folders on any system are used to organize data. Regardless of system size, systematic structuring and naming conventions of volumes and folders eases the administrative burden. Moving from volumes to folders to shares increases the level of granularity of the types of data stored in the unit and the level of security access allowed.

Although a variety of methods can be used to create and manage file folders on the NAS B3000, this document discusses using the NAS Web-based user interface (WebUI.)

Managing system volumes and file folders includes the following tasks:

- Navigating to a specific volume or folder
- Creating a new folder
- Deleting a folder
- Modifying folder properties
- Creating a new share for a volume or folder
- Managing shares for a volume or folder
- Managing file-level permissions

Navigating to a Specific Volume or Folder

When working with volumes and folders, the first task is to gain access to the desired volume or folder.

The steps are the same, whether navigating to a volume or a folder:

1. To navigate to a specific volume or folder, from the WebUI, select **Shares**, and then **Folders**. Initially, the **Volumes** dialog box is displayed.

   This initial dialog box displays all system volumes and snapshots.

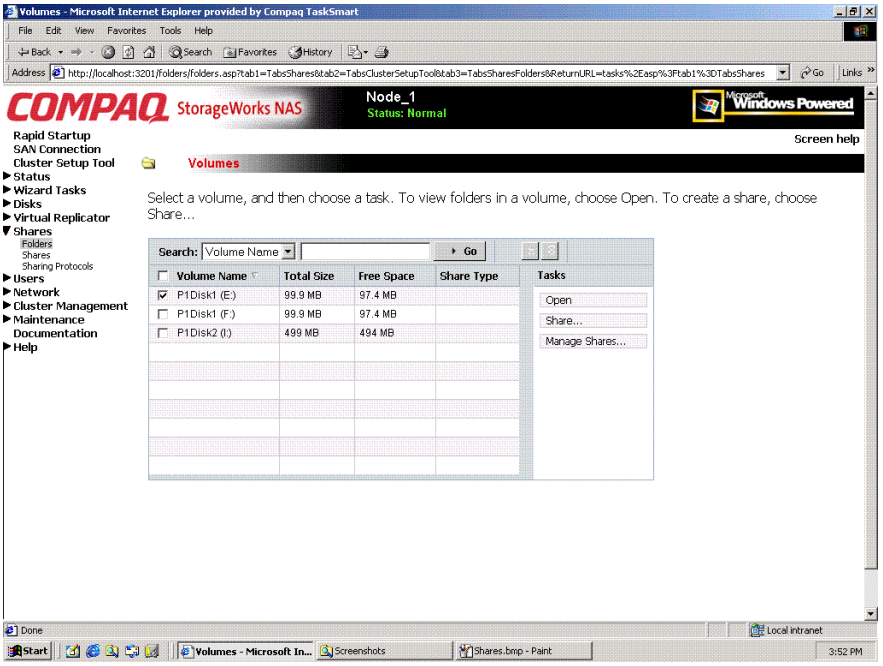


Figure 8-1: Volumes dialog box

2. From this dialog box, navigate to a specific folder by selecting the appropriate volume and then clicking **Open**. The **Folders** dialog box is displayed, with a list of all of the folders within that volume.

3. To navigate to a sub-folder, select the folder in which the sub-folder resides, and then click **Open**. Repeat this searching and opening process until the desired folder is opened. See Figure 8-2 for an example of **Folders** dialog box.

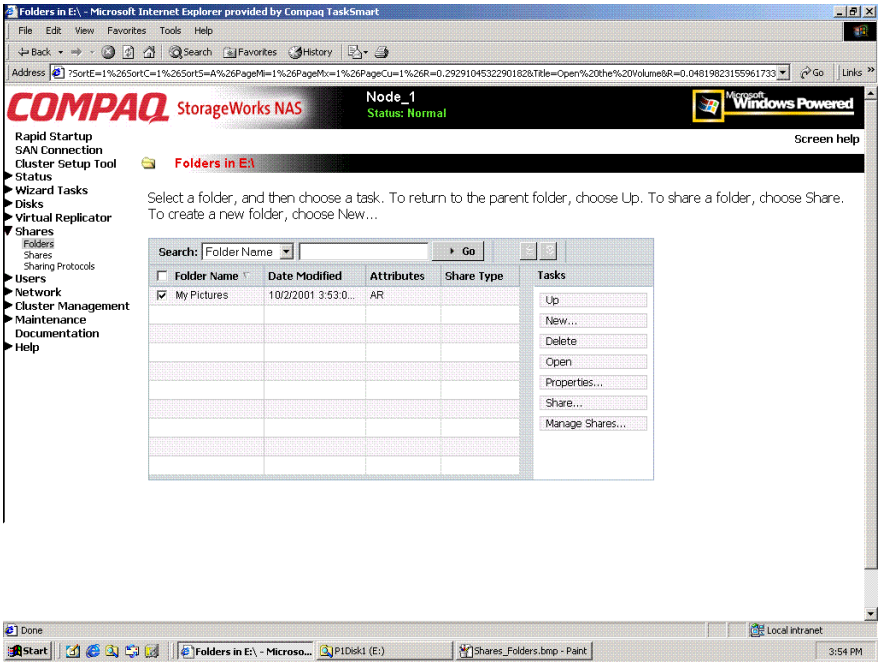


Figure 8-2: Folders dialog box

After accessing the desired folder, the following actions can be performed:

- Creating a new folder
- Deleting a folder
- Modifying folder properties
- Creating a new share for the volume or folder
- Managing shares for the volume or folder

Creating a New Folder

To create a new folder:

1. From the **Shares** directory, navigate to the **Folders** menu and then select **New**. The **Create New Folder** dialog box is displayed.

   Two tabs are displayed: **General** and **Compress**. Use these two tabs to enter the parameters for the new folder.

2. In the **General** tab, enter a name for the folder and specify the folder attributes.

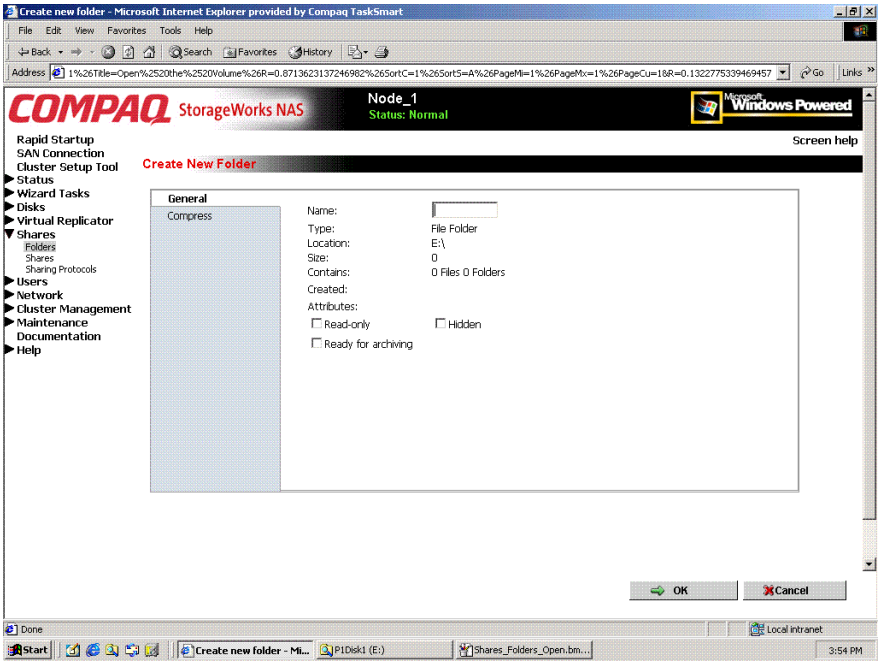


Figure 8-3: Create a New Folder dialog box, General tab

3. In the **Compress** tab, indicate whether and how this folder and its contents are to be compressed.

4. After all information for the new folder is entered, click **OK**.

Deleting a Folder

To delete a folder:

1. From the **Shares** directory, navigate to the folder to delete. Select the folder and then click **Delete**. The **Delete Folder** dialog box is displayed.

   Summary information about the deletion is displayed.

   IMPORTANT: View the summary information to confirm that this is the intended share.

2. Verify that the displayed folder is the folder to delete and then click **OK**.

   The folder and all of its sub-folders are deleted and the main dialog box is displayed again.

Modifying Folder Properties

To modify folder properties:

1. From the **Shares**, directory, navigate to the folder whose properties need to be edited. Then click **Properties**. The **Properties** dialog box is displayed.

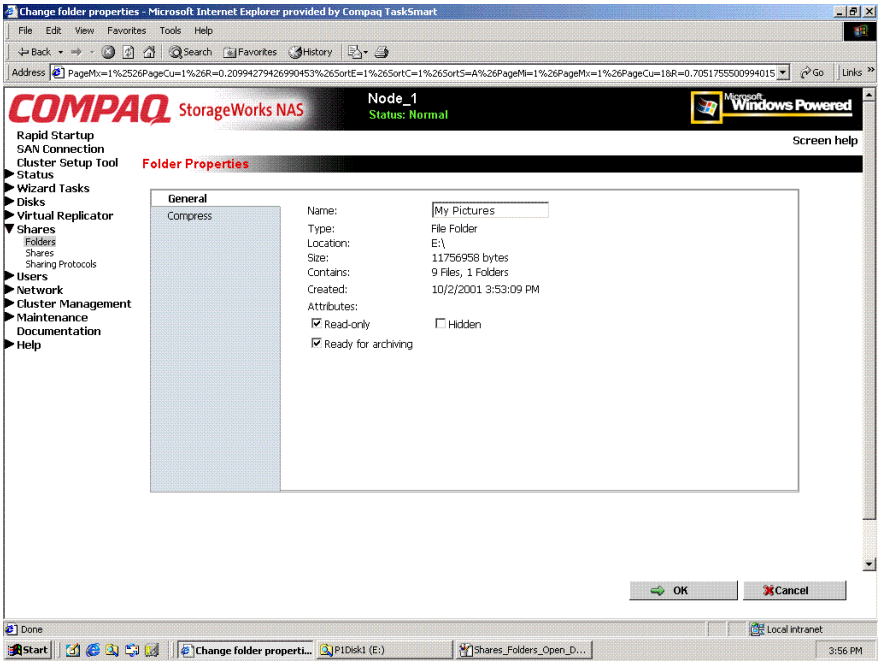


Figure 8-4: Folder Properties dialog box, General tab

2. In the **General** tab, enter the new information for the folder, which may include:
   - Folder Name
   - Folder Attributes
3. In the **Compress** tab, indicate whether and how this folder and its contents are to be compressed.
4. After all changes have been completed, click **OK**. The **Folders** dialog box is displayed again.

Creating a New Share for a Volume or Folder

Within the WebUI, there are two access points to the same screens used to create file shares:

- A share can be created for a folder while working with that folder *in the **Folders** screens*.
- A share can be created and, if necessary, new folders can be created, while working with file shares *in the **Shares** screens*.

This section discusses creating shares from the **Folders** menu, and is an overview of the procedures. Complete details on the process of creating shares are included in the discussion that documents creating shares through the **Shares** menu. See the "Managing Shares" section of this chapter for these details.

To create a new share for a specific volume or folder, *while in the **Folders** menu:*

1. Navigate to the desired volume or folder and click **Share**. The **Create New Share** dialog box is displayed.

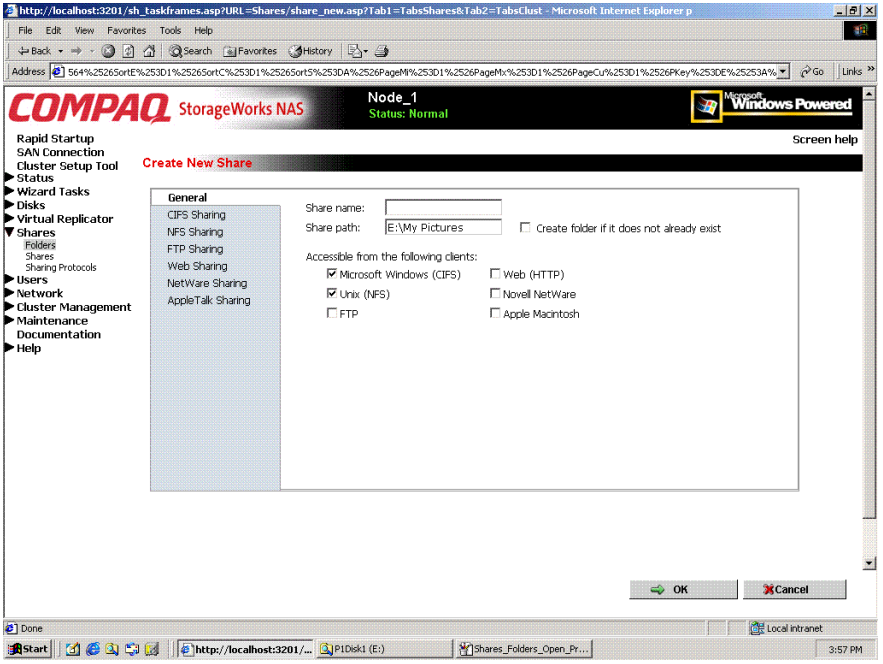


Figure 8-5: Create New Share dialog box, General tab

2. Enter the information for the share, including the name of the share, the allowed protocols, and corresponding permissions.

   NOTE: The Share Path is the path of the previously selected volume or folder. This field is automatically competed by the system.

3. Select the appropriate tab to enter protocol-specific information.

   See "Managing Shares" in the next section for detailed information about these entries.

4. After entering all share information, click **OK**.

Managing Shares for a Volume or Folder

Within the WebUI, there are two access points to the same screens used to manage file shares:

- While working with a folder *in the **Folders** dialog boxes,* the administrator can create, delete, and modify shares for that folder.
- While working with file shares *in the **Shares** dialog boxes,* the administrator can create, delete, and modify shares (and if necessary, create new folders).

NOTE: This section discusses managing shares from the **Folders** menu, and is an overview of the procedures. Complete details on the process of managing shares are included in the discussion that documents creating shares through the **Shares** menu. See the "Managing Shares" section later in this chapter for these details.

To create, delete, and manage shares for a particular volume or folder *while in the **Folders** menu:*

1. From the **Folders** directory, navigate to the target volume or folder and click **Manage Shares**. The **Shared Folders** dialog box is displayed.

   All associated shares for that folder or volume are listed.

2. To create a new share, click **New**. The **Create a New Share** dialog box is displayed.

   Because the screens are the same whether shares are managed through the Folders menu or the Shares menu, the procedures are only documented once. See "Creating a New Share" in the "Share Management" section for detailed procedural instructions on creating new file shares.

3. To delete a share, select the share to delete and click **Delete**. The **Delete Share** dialog box is displayed.

   Because the screens are the same whether shares are managed through the Folders menu or the Shares menu, the procedures are only documented once. See "Creating a New Share" in the "Share Management" section for detailed procedural instructions on deleting file shares

4. To modify share properties, select the share to modify, and click **Properties**. The **Share Properties** dialog box is displayed.

Because the screens are the same whether shares are managed through the Folders menu or the Shares menu, the procedures are only documented once. See "Creating a New Share" in the "Share Management" section for detailed procedural instructions on modifying shares.

Managing File-Level Permissions

The WebUI of the NAS B3000 provides security at the share level and is discussed later in this chapter. Security at the file level is managed using Windows Explorer available from the desktop of the NAS B3000. To access the NAS 3000 desktop from the WebUI, go to the Maintenance menu, and select Terminal Services.

File-level security includes settings for permissions, ownership, and auditing for individual files.

To enter file permissions:

1. Using Windows Explorer, navigate to the folder or file that needs to be changed and then right click the folder.
2. Select **Properties** and then select the **Security** tab. Figure 8-6 illustrates the properties available on the Security tab.

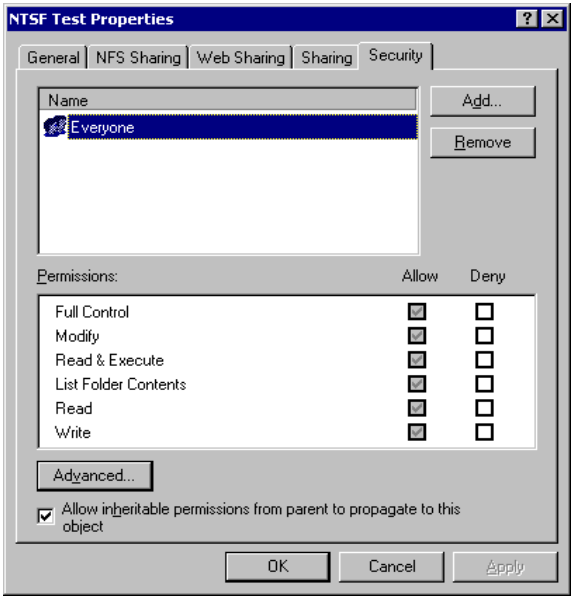


Figure 8-6: Security Properties dialog box for folder name NTSF Test

Several options are available in the Security tab dialog box:

- To add users and groups to the permissions list, click **Add**. Then follow the dialog box instructions.
- To remove users and groups from the permissions list, highlight the desired user or group and then click **Remove**.
- If the "Allow inheritable permissions from parent to propagate to this object" box at the bottom of the screen is checked, the file or directory inherits permissions from the parent directory. In this case, existing user and group permissions cannot be changed; however, additional users or groups can be added.
- The center section of the Security tab provides a listing of permission levels. When new users or groups are added to the permissions list, select the appropriate boxes to configure the common file access levels.

  NOTE: Selections can be made when the "Allow inheritable permissions from parent to propagate to this object" box is disabled.

- To modify ownership of files or to modify individual file access level permissions, click the **Advanced** button.

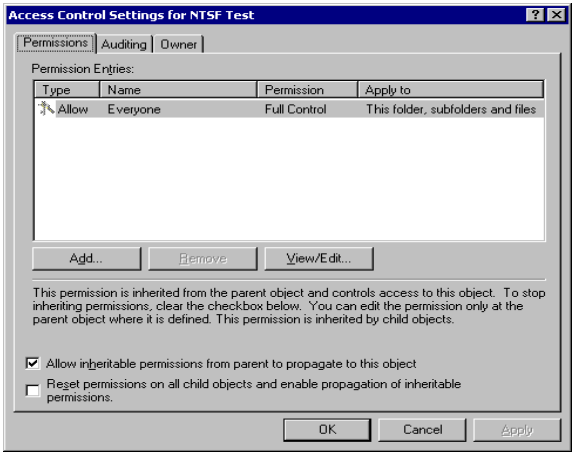


Figure 8-7: Access Control Settings dialog box for folder name NTSF Test, Permissions tab

To modify specific permissions assigned to a particular user or group for a selected file or folder in the **Advanced** screen:

1. Select the desired user or group.
3. Click **View/Edit**.
4. Check all the permissions that you want to enable, and clear the permissions that you want to disable. Enable or disable permissions by selecting the Allow box to enable permission or the Deny box to disable permission. If neither box is selected, permission is automatically disabled. Figure 8-8 illustrates the View/Edit screen and some of the permissions.

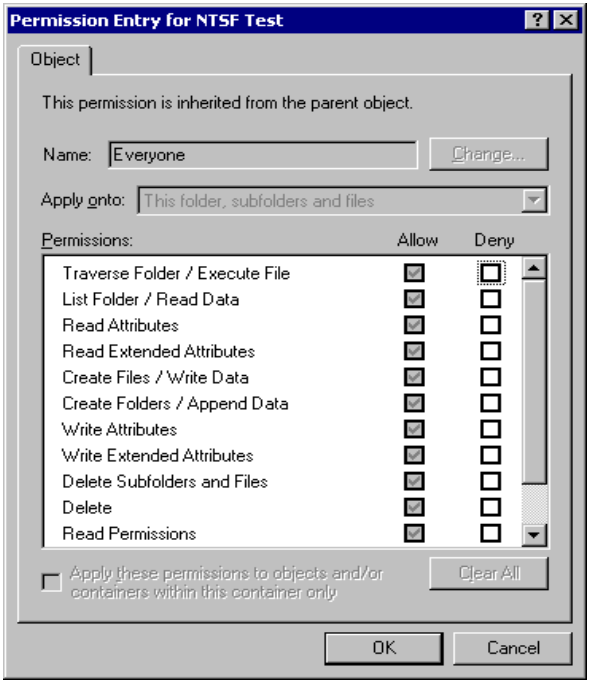


Figure 8-8: User or Group Permission Entry dialog box for folder name NTSF Test

Other functionality available in the Advanced Access Control Permissions tab is illustrated in Figure 8-8 and includes:

- Add a new user or group. Click **Add,** and then follow the dialog box instructions.
- Remove a user or group. Click **Remove.**
- Inherit permissions from the parent folder. Enable the "Allow inheritable permissions from parent to propagate to this object" box.
- Reset permissions. If the object being configured is a folder, check the "Reset permissions on all child objects and enable propagation of inheritable permissions" box, which allows all child folders and files to inherit the current folder permissions by default.

Another area of the Advanced Access Control is the Auditing tab. Auditing allows you to set rules for the auditing of access, or attempted access, to files or folders. Users or groups can be added, deleted, viewed, or modified through the advanced Access Control Settings Auditing tab. The Auditing tab dialog box is illustrated in Figure 8-9.

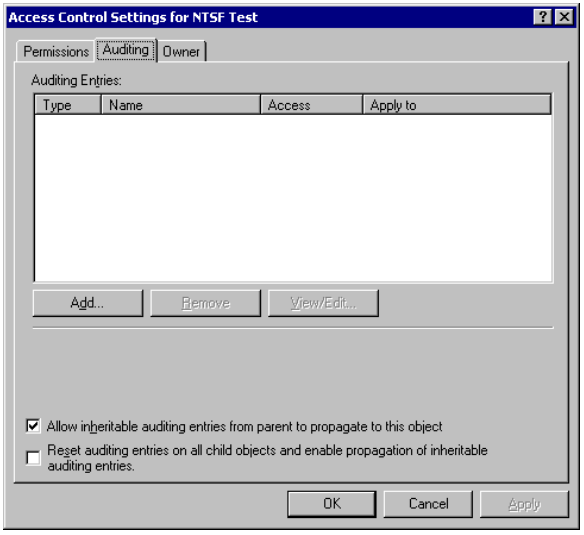


Figure 8-9: Access Control Settings, Auditing tab dialog box for folder name NTSF Test

Figure 8-10 illustrates the screen that is displayed when a user or group to be audited is added.

5. Select the appropriate domain or machine name from the "Look in:" drop-down list box at the top of the screen.

   NOTE: A list of users and groups from the desired domain can be viewed if the current user has permission to view the information on the domain.

6. Select the user or group.

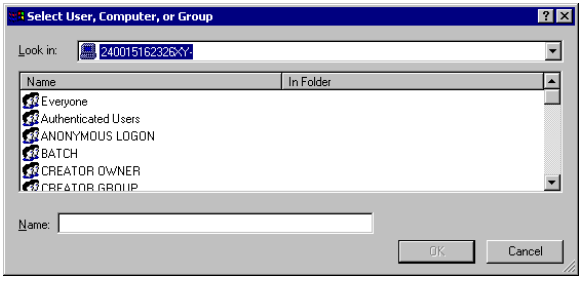


Figure 8-10: Select User, Computer, or Group dialog box

7. Click **OK.** Figure 8-11 illustrates the Auditing Entry screen that is displayed.

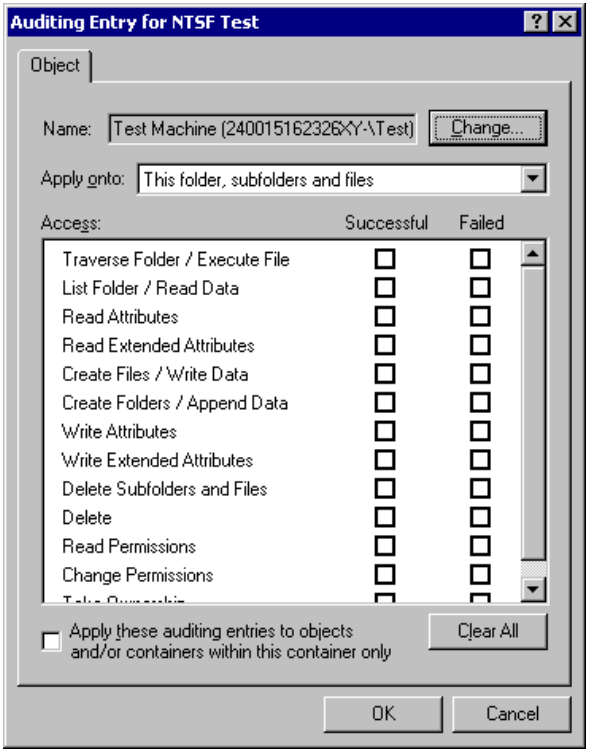


Figure 8-11: Auditing Entry dialog box for folder name NTSF Test

8. Select the desired Successful and Failed audits for the user or group as shown in Figure 8-11.
9. Click **OK**.

NOTE: Auditing must be enabled to configure this information. Use the local Computer Policy Editor to configure the audit policy on the NAS B3000.

The final tab in the advanced Advanced Access Control Settings security configuration is the Owner tab. This tab allows for taking ownership of files. Typically, administrators use this area to take ownership of files when the file ACL is incomplete or corrupt. By taking ownership, you gain access to the files and then manually apply the appropriate security configurations. Figure 8-12 illustrates the Owner tab.

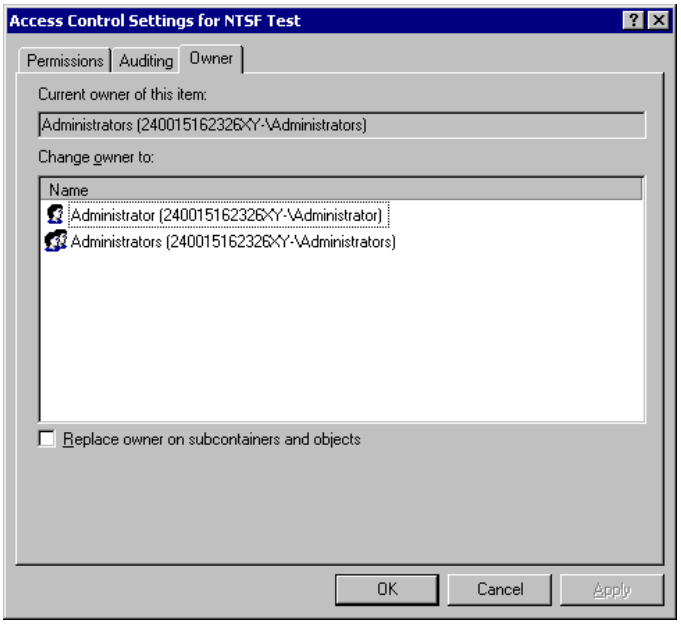


Figure 8-12: Access Control Settings, Owner tab dialog box for folder name NTSF Test

The current owner of the file or folder is listed at the top of the screen. To take ownership:

10. Select the appropriate user or group from the "Change owner to" list.
11. If it is also necessary to take ownership of subfolders and files, enable the "Replace owner on subcontainers and objects" box.
12. Click **OK** to execute the commands.

Share Management

There are several ways to set up and manage shares. The WebUI provides screens for setting up and managing shares. Additional methods include using a command line interface, Windows Explorer, or Microsoft Management Console (MMC). This guide demonstrates using the WebUI to set up and manage shares.

As previously mentioned, the file-sharing security model of the NAS device is based on the NTFS file-level security model. Share security seamlessly integrates with file security. In addition to discussing share management, this section discusses share security. See "Managing File-Level Security" earlier in this chapter for information on file security.

Shares management topics include:

- Defining Access Control Lists
- Integrating Local File System Security into Windows Domain Environments
- Comparing Administrative and Standard Shares
- Planning for Compatibility between CIFS and NFS
- Managing Shares Using the Shares Management Wizard
- Managing Shares (Details)

Defining Access Control Lists

The Access Control List (ACL) contains the information that dictates which users and groups have access to a share, as well as the type of access that is permitted. Each share on an NTFS file system has one ACL with multiple associated user permissions. For example, an ACL can define that User1 has read and write access to a share, User2 has read-only access, and User3 has no access to the share. The ACL also includes group access information that applies to every user in a configured group. ACLs are also referred to as permissions.

Integrating Local File System Security into Windows Domain Environments

ACLs include properties specific to users and groups from a particular workgroup server or domain environment. In a multidomain environment, user and group permissions from several domains can apply to files stored on the same device. Users and groups local to the NAS B3000 can be given access permissions to shares managed by the device. The domain name of the NAS B3000 supplies the context in which the user or group is understood. Permission configuration depends on the network and domain infrastructure where the server resides.

File-sharing protocols (except NFS) supply a user and group context for all connections over the network. (NFS supplies a machine-based context.) When new files are created by those users or machines, the appropriate ACLs are applied.

Configuration tools provide the ability to share permissions out to clients. These shared permissions are propagated into a file system ACL and when new files are created over the network, the user creating the file becomes the file owner. In cases where a specific subdirectory of a share has different permissions from the share itself, the NTFS permissions on the subdirectory apply instead. This method results in a hierarchical security model where the network protocol permissions and the file permissions work together to provide appropriate security for shares on the device.

NOTE: Share permissions and file-level permissions are implemented separately. It is possible for files on a file system to have different permissions from those applied to a share. When this situation occurs, the file-level permissions override the share permissions.

Comparing Administrative (Hidden) and Standard Shares

CIFS supports both administrative shares and standard shares. Administrative shares are shares with a last character of $. Administrative shares are not included in the list of shares when a client browses for available shares on a CIFS server. Standard shares are shares that do not end in a $ character. Standard shares are listed whenever a CIFS client browses for available shares on a CIFS server.

The NAS B3000 supports both administrative and standard CIFS shares. To create an administrative share, end the share name with the $ character when setting up the share. To create a standard share, do not type a $ character at the end of the share name.

Planning for Compatibility between File-Sharing Protocols

When planning for cross-platform share management on the NAS B3000, it is important to understand the different protocols and their associated constraints. Each additional protocol that is supported adds another level of constraints and complexity.

NFS Compatibility Issues

Of the file sharing protocols that are supported on the NAS B3000, NFS introduces the most constraints. When planning to manage CIFS and NFS shares, consider two specific requirements.

NOTE: Further information, including details about the NFS Service and the User Mapping service, is available in the "UNIX File System Management" chapter.

- **NFS service does not support spaces in the names for NFS file shares.**

  NFS translates any spaces in an export into an underscore character. Additional translations can be set up for files. See the Compaq "OEM Supplemental Help" chapter of the SFU help, found on the NAS B3000. This feature is designed to ensure the greatest level of compatibility with NFS clients, because some do not work with NFS exports that contain a space in the export name.

  If you plan to use the same name when sharing a folder through CIFS, and then exporting it through NFS, do not put spaces in the CIFS share name.

- **NFS service does not support exporting a child folder when its parent folder has already been exported.**

  An NFS client can access a child folder by selecting the parent folder and then navigating to the child folder. If strict cross-platform compatibility is an administration goal, CIFS must be managed in the same way. Do not share a folder through CIFS if the parent folder is already shared.

Managing Shares Using the Shares Management Wizard

The **Share Management** wizard is one of three major wizards included in the WebUI. The wizard contains most of the functionality of managing system shares as the **Shares** menu option of the WebUI. Although all share administration tasks are not included in the wizard, it provides the easiest to use interface for adding, modifying, and deleting shares. For detailed information on managing file shares, see "Managing Shares (Details)." For detailed information on managing NFS (UNIX) file shares, see the "UNIX File System Management" chapter.

To use the wizard:

1. From the WebUI, select **Wizard Tasks**, and then **Share Management**. The Welcome screen of the wizard is displayed. Click **Next** to continue.

   The primary menu of the Share Management Wizard is displayed. Figure 8-13 is an example of the Share Management Wizard screen.

2. From this screen, indicate the action to perform on system shares. Options include:

   - Create a new share
   - Delete an existing share
   - Modify share properties

   Each of these options is discussed in the following paragraphs.

Figure 8-13: Share Management wizard

Create a New Share

After selecting the create option, the system prompts with the following questions:

1. `Do you want to create a new pool for the new share?`

   When creating a new pool for this share, sub-screens will prompt for the Storage Unit to use, a Name for the pool, and the Segment Size to use.

2. `Do you want to create a new virtual disk for the new share?`

   When creating a new virtual disk for this share, sub-screens will prompt for the Pool to use, a Name for the virtual disk, disk size, disk drive letter to assign, and allocation size. In addition, the option is available for system to format the new virtual disk at this time.

3. Select the folder to use. To create a new sub-folder for this share, enter the folder name to use in the indicated space at the bottom of the dialog box.

4. Enter basic share settings, including share Name, Path, and access protocols to use.
5. In the final screen of the **Create a new share** option of the wizard, summary information is displayed. Verify the accuracy of the data.
6. To enter protocol-specific information about the share, click the **More Property** button.
7. After all settings are entered, click **Next**.

Delete an Existing Share

1. After selecting the delete option, the **List Shares** screen of the wizard is displayed.
2. Select the share to delete from the displayed list, and then click **Next**.
3. A verification screen is displayed. Confirm that this is the correct share, and then click **Yes**. The share is deleted, and the primary screen of the Share Management Wizard is displayed again.

Modify Existing Share Properties

To modify the properties of an existing share:

1. Select **Modify existing share properties**. In the **List Shares** screen, select the share to modify, and then click **Next**.
2. In the Show Share Property dialog box, enter the new information for the share.
3. Tabs are available in the Show Share Properties dialog box:
   - General — use to indicate the protocols that will access this share.
   - Protocol-specific — use to enter information that is unique to each sharing protocol.
4. After all changes are entered, click **Next**.

Managing Shares (Details)

In addition to the Share Management Wizard, shares can be managed through the **Shares** menu option of the WebUI. Tasks include:

- Creating a new share
- Deleting a share
- Modifying share properties

Each of these tasks is discussed in this section.

Creating a New Share

To create a new share:

1. From WebUI main menu, select the **Shares** directory and then select the **Shares** option. The Shares dialog box is displayed. From the **Shares** dialog box, click **New**. The **General** tab of the **Create a New Share** dialog box is displayed.

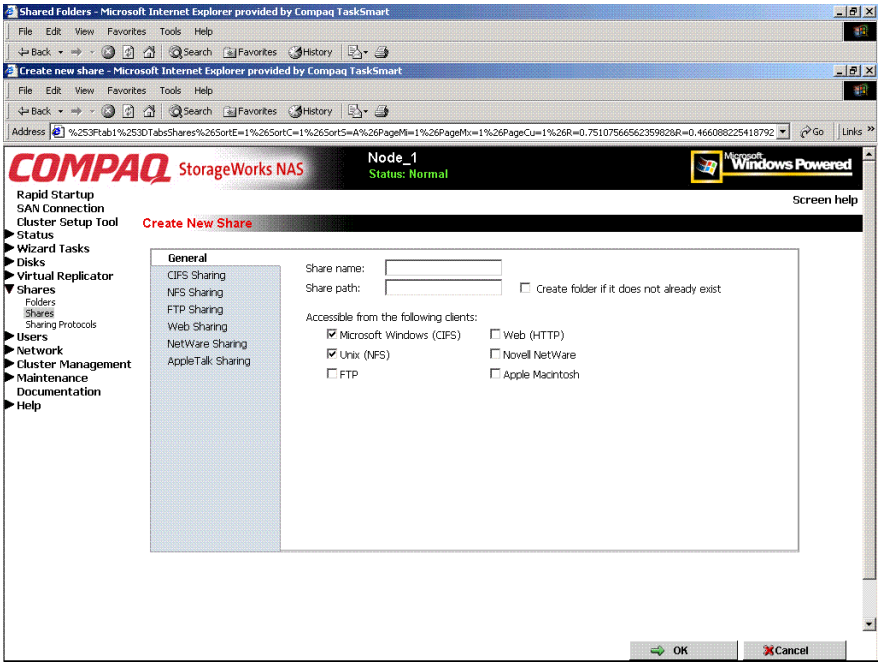


Figure 8-14: Create a New Share dialog box, General tab

2. Enter the following information:
   - Share name
   - Share path
   - Client protocol types

   To create a folder for the new share, check the indicated box and the system will create the folder at the same time it creates the share.

   Protocol-specific tabs are available to enter sharing and permissions information for each sharing type. See "Modifying Share Properties" for detailed information on these tabs.
3. After entering all share information, click **OK**.

Deleting a Share

IMPORTANT: Before deleting a share, warn all users to exit that share and confirm that no one is using the share.

To delete a share:

1. From the **Shares** menu, click **Delete**.
2. Verify that this is the correct share, and then click **OK**.

   NOTE: This option deletes only the share. The resource is not deleted.

Modifying Share Properties

To change share settings:

1. From the **Shares** menu, select the share to modify and then click **Properties**. The **General** tab of the **Share Properties** dialog box is displayed.

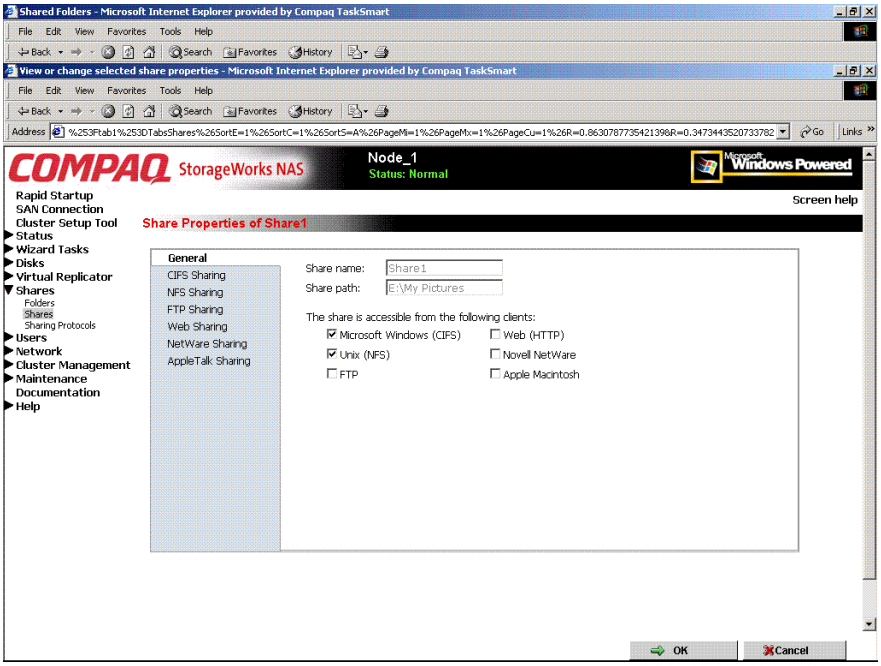


Figure 8-15: Share Properties dialog box, General tab

The name and path of the selected share is displayed.

2. To enter or change client protocol information, check the appropriate boxes and then click the corresponding tabs.

   - CIFS Sharing
   - NFS Sharing
   - FTP Sharing
   - Web Sharing (HTTP)
   - NetWare Sharing (NCP)
   - AppleTalk Sharing (AFP)

   Each of these tabs is discussed in the following paragraphs.

3. After all share information has been entered, click **OK**. The **Share** menu is displayed again.

CIFS Sharing

From the **CIFS Sharing** tab of the **Share Properties** dialog box:

1. Enter a descriptive **Comment**, and the **User limit** (optional).

   See Figure 8-16 for an example of the CIFS Sharing tab screen display.

2. If file caching on the client machines is allowed, click **Enable file caching on client computers accessing this share**.

   Select one of the following caching policies:

   - **Manual Caching for Documents**—The default setting. Recommended for folders containing user documents. Users must manually specify any files that they want available when working offline. To ensure proper file sharing, the server version of the file is always open.
   - **Automatic Caching for Documents**—Also recommended for folders containing user documents. In contrast to the default setting of Manual Caching, with this option, open files are automatically downloaded and made available when working offline. Older copies are automatically deleted to make room for newer, more recently accessed files. To ensure proper file sharing, the server version of the file is always open.
   - **Automatic Caching for Programs**—Recommended for folders with read-only data or run-from-the-network applications. File sharing is not ensured. Open files are automatically downloaded and made available when working offline. Older copies are automatically deleted to make room for newer, more recently accessed files.

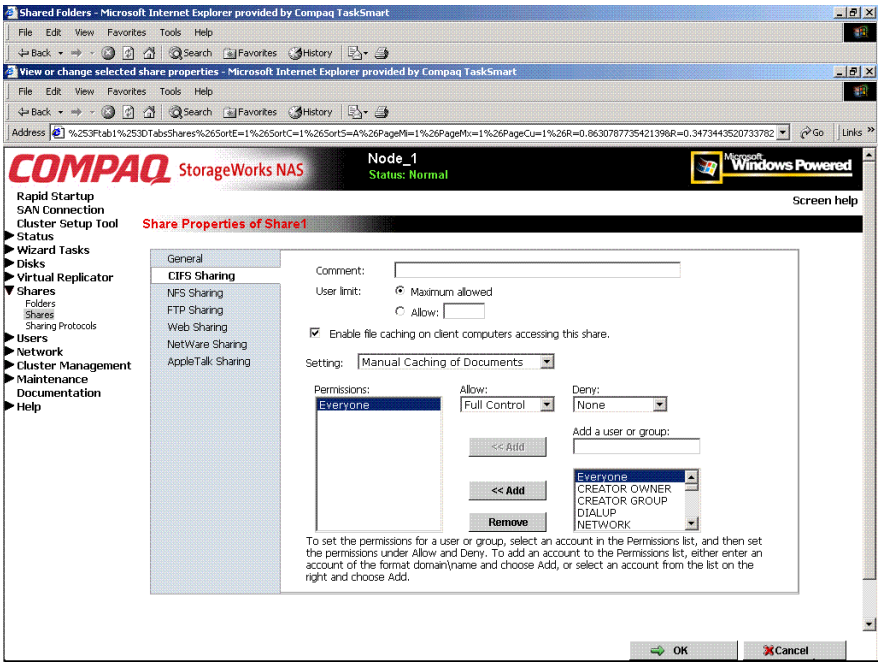


Figure 8-16: Share Properties dialog box, CIFS Sharing tab

3. Enter Permissions information:
   - The **Permissions** box lists the currently approved users for this share.
   - *To add a new user or group,* either select a user or group from the box at the bottom right of the screen or manually enter the user or group name in the **Add a user or group box** and then click **Add**. That user or group is added to the Permissions box.
   - *To remove access to a currently approved user or group,* select the user or group from the Permissions box and then click **Remove**.
   - *To indicate the type of access allowed for each user,* select the user and then expand the **Allow** and **Deny** drop-down boxes. Select the appropriate option.
4. After all CIFS Sharing information is entered, either click the next Sharing tab or click **OK**.

NFS Sharing

From the **NFS Sharing** tab of the **Create a New Share** dialog box:

1. Indicate the machines that will have access to this share.

   Select the machine to include in the **Select a client or client group** box or manually enter the NFS client computer name or IP address. Then click **Add**.

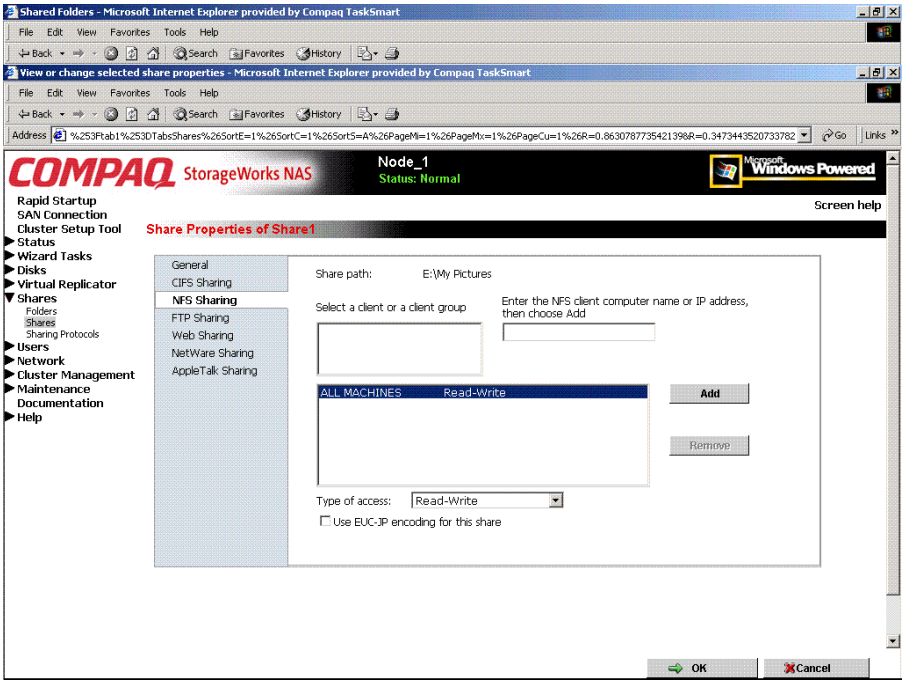


Figure 8-17: Share Properties dialog box, NFS Sharing tab

2. Indicate the permissions.

   Select the machine from the main user display box, and then select the appropriate access methods from the **Type of access** drop-down box at the bottom of the screen.

3. After all NFS sharing information is entered, either click the next Sharing tab or click **OK**.

FTP Sharing

From the **FTP Sharing** tab of the **Create a New Share** dialog box:

1. Select the read and write access permissions that are allowed, and indicate whether visits should be written to the FTP log.
2. Then, either click the next Sharing tab or click **OK**.

Web Sharing (HTTP)

From the **Web Sharing** tab of the **Create New Share** dialog box:

1. Select the read and write access permissions that are allowed, and indicate whether visits should be written to the HTTP log.
2. Then, either click the next Sharing tab or click **OK**.

NetWare Sharing (NCP)

NOTE: NCP shares can be set up only after Microsoft Services for NetWare (SFN) has been installed on the NAS B3000. Procedures for installing SFN are included in the "NetWare File System Management" chapter.

From the **NetWare Sharing** tab, as illustrated in Figure 8-15, of the **Create a New Share** dialog box:

1. Enter a user limit.
2. Enter Permissions information.
   - The **Permissions** box lists the currently approved users for this share.
   - To add a new user or group, either select a user or group from the box at the bottom right of the screen or manually enter the user or group name in the **Add a user or group box**. Then click **Add**. That user or group is added to the Permissions box.
   - To remove access to a currently approved user or group, select the user or group from the Permissions box, and then click **Remove**.
   - To indicate the allowed access for each user, select the user and then expand the **Allow** and **Deny** drop-down boxes. Then, select the appropriate option.

3. After all NetWare Sharing information is entered, either click the next Sharing tab or click **OK**.

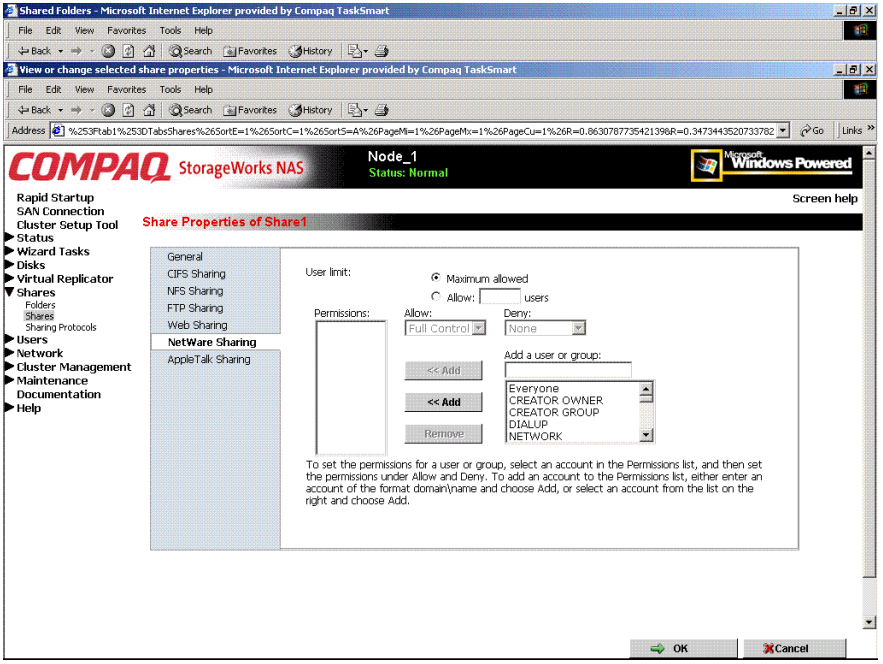


Figure 8-18: Share Properties dialog box, NetWare Sharing tab

AppleTalk Sharing (AFP)

From the **AppleTalk Sharing** tab of the **Create a New Share** dialog box:

1. Enter a user limit.
2. Enter password information.
3. Indicate whether the share has read-only permission or read-write permission.
4. After all AppleTalk Sharing information is entered, either click the next Sharing tab or click **OK**.

Protocol Parameter Settings

As previously mentioned, the NAS B3000 supports the following protocols:

- CIFS
- NFS
- FTP
- HTTP
- NCP (NetWare)
- AFP (AppleTalk)

This section discusses the parameter settings for each protocol type.

To access and enter protocol parameter settings:

1. From the **Shares** menu, select **Sharing Protocols**. The File Sharing Protocols dialog box is displayed.

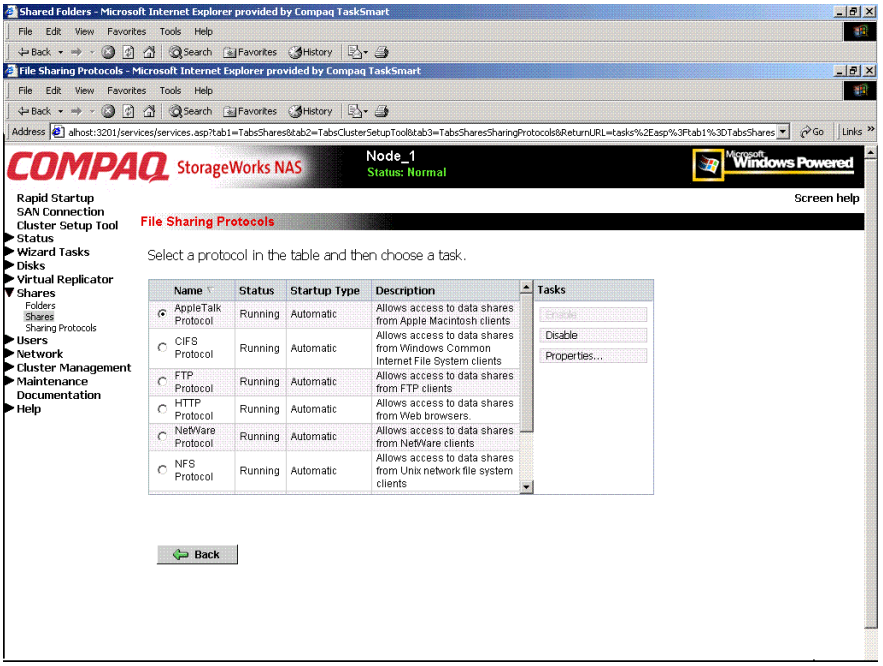


Figure 8-19: Sharing Protocols dialog box

2. Protocols and their statuses are listed. The following options are available:
   - Enabling a protocol
   - Disabling a protocol
   - Modifying Protocol Settings

Because enabling and disabling a protocol are self-explanatory, only modifying protocol-specific settings is described in this section.

CIFS Protocol Settings

There are no user-configurable settings for CIFS.

NFS Protocol Settings

NFS is the networking protocol for exporting UNIX file systems across a network. UNIX and NFS are discussed in the "UNIX File System Management" chapter.

Some of the NFS protocol settings include:

- Async/Sync Settings
- Locks
- Client Groups
- User and Group Maps

FTP Protocol Settings

Three tabs are presented in the FTP Protocol Properties dialog box: **Logging**, **Anonymous Access**, and **Messages**.

Within these tabs:

- **Logging** — Enable logging
- **Anonymous Access** — Enable anonymous access
- **Messages** — Enter a welcome and an exit message

HTTP Protocol Settings

The following parameters can be set for Web protocols:

- Indicate which IP addresses can be used to access data shares
- Indicate which port can be used to access data shares

NCP (NetWare) Protocol Settings

There are no user-configurable settings for NCP.

AFP (AppleTalk) Protocol Settings

Several parameters can be set for AFP shares, including:

- Welcome message
- Security settings
- Limits on number of sessions

9

UNIX File System Management

Microsoft Services for UNIX (SFU) is a comprehensive software package designed to provide complete UNIX environment integration into a Windows NT or Active Directory domain file server. SFU manages tasks on both Windows and UNIX platforms. Tasks include creating NFS exports from Windows and administering user name mappings. SFU also includes Telnet Server and Remote Shell for remote administration.

The following SFU components are included in the NAS B3000: Server for NFS, User Name Mapping, Telnet and Remote Shell Services, and Password Synchronization.

NOTE: SFU can be implemented in both a clustered and non-clustered environments. This chapter discusses SFU in a non-clustered deployment. For additional information that is specific to a cluster, see the “Cluster Management” chapter.

The following topics are described in this chapter:

- Network File System (NFS)
- Server for NFS
  - Authenticating User Access
  - Indicating the Computer to Use for NFS User Mapping Server
  - Logging Events
  - Installing NFS Authentication Software on the Domain Controller
- NFS File Shares
- NFS Protocol Properties Settings
- NFS Client Groups
  - Adding a New Client Group
  - Deleting a Client Group
  - Editing Client Group Information
- NFS User and Group Mappings
  - Types of Mappings
  - User Name Mapping Best Practices
  - Creating and Managing User and Group Mappings
  - Backing up and Restoring Mappings
- NFS File Sharing Tests
- Terminal Services, Telnet Server, and Remote Shell service
  - Using Terminal Services
  - Using Telnet Server
  - Using Remote Shell Service
- Password Synchronization

Network File System

Network File System (NFS) is a networking protocol for exporting UNIX file systems across a network.

There are two versions of NFS, Version 2 and Version 3. Version 3 supports additional file operations that Version 2 did not have.

In addition, NFS has the capacity to operate with two different network protocols, Transport Control Protocol (TCP) and User Datagram Protocol (UDP).

Traditionally, NFS operates with UDP for performance purposes, but it can also operate with TCP.

There are three key design goals of NFS:

1. Allow different UNIX machines to transparently export files across a network

   This feature works across different versions of UNIX and across different platforms. For example, a Linux machine can access files on a *Tru64*™ UNIX machine. Accessing these files is transparent to both the administrator and the users. The administrator and user do not notice any difference between accessing local files or files on the remote machine.

2. Make the administration as easy as possible

   The remote file system connects to the local machine in the same manner that a local file system does. The administrator is able to add a remote file system in the same manner as adding another hard drive or external storage.

3. Focus exclusively on file system operations

   The file system is used only for exporting file systems to remote machines. NFS supports only operations such as read, write, create, delete, and copy.

Server for NFS

Until recently, UNIX used only NFS to export files. UNIX-based platforms and Windows-based platforms were not able to share files. This restriction caused UNIX clients to require UNIX file servers and Windows clients to require Windows file servers. Windows and UNIX were separate environments, including the duplication of hardware, overhead, and effort. UNIX clients can now use Windows-based machines as file servers using Microsoft services For UNIX (SFU).

SFU enables UNIX clients to use Windows-based machines as file servers. The SFU NFS server supports NFS Version 2 and Version 3, and supports them both on the TCP and UDP network protocols.

SFU is more fully integrated into the operating system than other third-party NFS server packages. The administrative interface for NFS exports is similar to the Common Internet File System (CIFS) sharing interface used by Windows platforms.

Authenticating User Access

NFS export access is granted or denied to clients based on client name or IP address. The server determines whether a specific client machine has access to an NFS export. No user logon to the NFS server takes place when a file system is exported by the NFS server. Permission to read or write to the export is granted to specific client machines. For example, if client machine M1 is granted access to an export but client M2 is not, user jdoe can access the export from M1 but not from M2.

Permissions are granted on a per-export basis; each export has its own permissions, independent of other exports on the system. For example, file system *a* can be exported to allow only the Accounting department access, and file system *m* can be exported allowing only the Management department access. If a user in Management needs access to the Accounting information, the *a* export permissions can be modified to let that one user's client machine have access. This modification does not affect other client access to the same export, nor does it allow the Management user or client access to other exports.

After the client machine has permission to the export, the user logon affects file access. The client machine presents the UNIX user ID (UID) and group ID (GID) to the server. When the computer accesses a file, the user logon is compared against the typical UNIX permissions of user, group, and other, and typical UNIX access is applied.

NOTE: User credentials are not questioned or verified by the NFS server. The server accepts the presented credentials as valid and correct.

If the NFS server does not have a corresponding UID or GID, or if the administrator has set other conditions to filter out the user, a process called squashing takes effect. Squashing is the conversion of an unknown or filtered user to an anonymous user. This anonymous user has very restricted permissions on the system. Squashing helps administrators manage access to their exports by allowing them to restrict access to certain individuals or groups and to squash all others down to restricted (or no) access. Squashing enables the administrator to allow permissions instead of denying access to all the individuals who are not supposed to have access. See "User and Group Mappings" later in this chapter for specific information about creating and maintaining mappings.

Indicating the Computer to Use for the NFS User Mapping Server

During the processes of starting and installing the NAS B3000, the name *localhost* is assigned by default to the computer. It is assumed that the NAS B3000 is the computer that will be used for user name mapping.

If there are other mapping servers and a machine other than the localhost will store user name mappings, the name of that computer must be indicated, as detailed below:

NOTE: In a clustered environment, the mapping server needs to be the name of the cluster. This is changed automatically during the cluster setup procedures.

1. Use Terminal Services to access the **MMC**, click **File Sharing**, **Services for UNIX**. Click **Server for NFS**. Figure 9-1 is an example of the Server for NFS user interface.
2. In the **Computer name** box of the user mapping screen, type the name of the computer designated for user mapping and authentication.

3. *Localhost* is the computer name assigned by default on the NAS B3000. To control user mapping from a different computer, enter the name of that computer.

   NOTE: If a machine other than the localhost is to be used, make sure that the user name mapping service is installed and running on that machine.

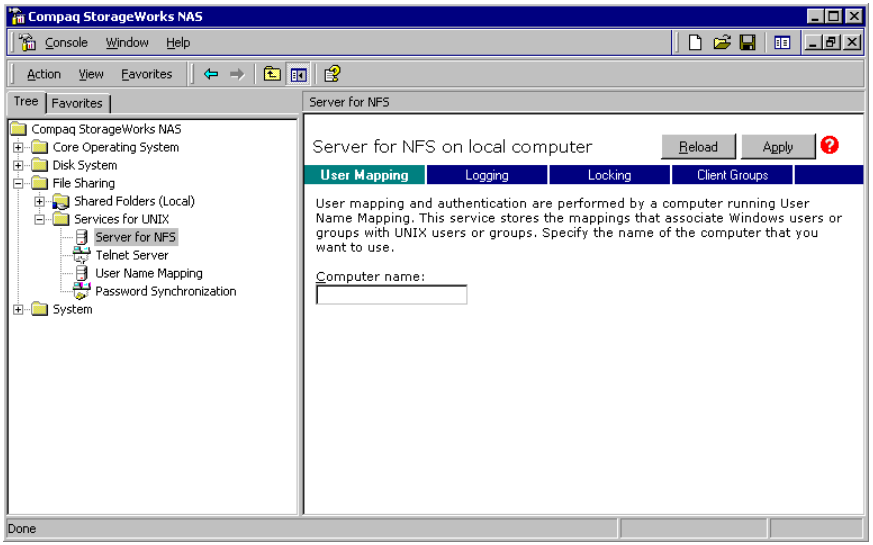


Figure 9-1: MMC Server for NFS screen, User Mapping tab

Logging Events

Various levels of auditing are available. Auditing sends SFU events to a file for later review and establishes log-setting behavior. Some behavior examples include events logged and log file size. See the online SFU help for more information.

1. From the **MMC**, click **File Sharing**, **Services for UNIX**, **Server for NFS**. Click the **Logging** tab
2. To log selected event types, click the check box for "Log events in this file" on the screen.
3. Enter a filename or use the default filename provided *(rootdrive\SFU\log\nfssvr.log)* and log file size (7-MB default). The default log file is created when the changes are applied.

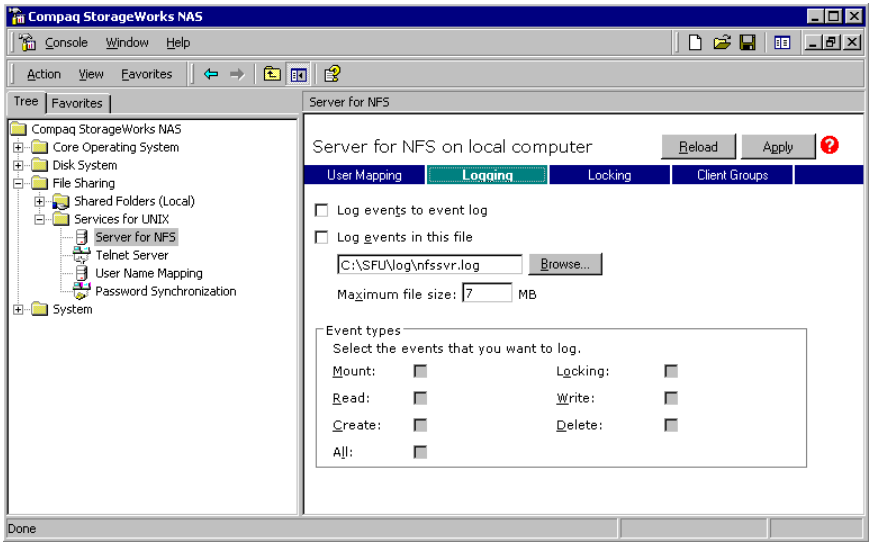


Figure 9-2: MMC Server for NFS screen, Logging tab

Installing NFS Authentication Software on the Domain Controllers

The NFS Authentication software must be installed on all Primary Domain Controllers (PDCs) and backup domain controllers (BDCs) that have Windows users mapped to UNIX users. For instructions on setting up user mappings, see "User and Group Mappings."

To install the Authentication software on the domain controllers:

1. Locate the *sfucustom.msi* file located in the SFU directory of the NAS B3000.
2. On the domain controller where the service is being installed:

   Using Windows Explorer:

   a. Open the shared directory containing *sfucustom.msi*.

   b. Double-click the file to open it. Windows Installer is opened.

   NOTE: If the domain controller being used does not have Windows Installer installed, locate the file *InstMSI.exe* on the SFU directory and run it. After this installation, the Windows Installer program starts when opening *sfucustom.msi*.

   c. Click **Next** when the Welcome screen is displayed.

   d. Enter the User name and Organization and click **Next**.

   e. Accept the license agreement and click **Next**.

   f. Select **Customized Installation** and click **Next**.

   g. Mark the selections to add **Authentication Tools for NFS** and de-select **Password Synchronization**. To de-select Password Synchronization, expand the drop-down box and select the red "X" next to Password Synchronization. (The entire feature will not be available.) The instructions for installing both Authentication Tools for NFS and Password Synchronization are found later in this chapter.

   h. Select the installation directory and click **Next**.

   i. Click **Finish** when installation is complete.

NFS File Shares

NFS file shares are created in the same manner as other file shares, however there are some unique settings. Procedures for creating and managing NFS file shares are documented in the same sections as creating file shares for other protocols. For single-node deployments, see the "Share Management" chapter and for clustered deployments, see the "Cluster Management" chapter.

IMPORTANT: File shares for clustered and non-clustered environments are managed through different interfaces. For clustered deployments, see the "Cluster Management" chapter.

NFS-specific information is extracted from the "Folder and Share Management" chapter and duplicated below.

Complete share management is performed through the **Shares** menu option of the WebUI. Tasks include:

- Creating a new share
- Deleting a share
- Modifying share properties

Each of these tasks is discussed in this section.

Creating a New Share

To create a new NFS file share:

1. From WebUI main menu, select the **Shares** directory and then select the **Shares** option. The Shares dialog box is displayed. From the **Shares** dialog box, click **New**. The **General** tab of the **Create a New Share** dialog box is displayed.

NOTE: By default, anonymous access is allowed on NFS shares. To disable anonymous access on an NFS share, use Terminal Services to go to the NAS B3000 desktop. Then, use Windows Explorer, right-click the file share, select Properties, and select NFS Sharing. De-select Allow Anonymous Access. Then, click OK.

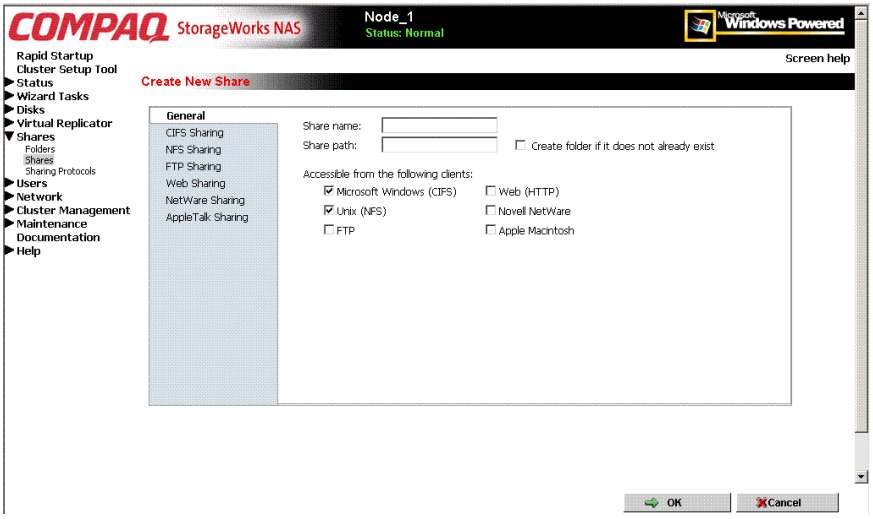


Figure 9-3: Create a New Share dialog box, General tab

2. In the **General** tab, enter the share name and path. Check the Unix (NFS) client protocol check box.

   IMPORTANT: NFS service does not support the use of spaces in the names for NFS file shares. NFS translates any spaces in an export into an underscore character. If you plan to use the same name when sharing a folder through CIFS, and then exporting it through NFS, do not put spaces in the CIFS share name.

   To create a folder for the share, check the indicated box and the system will create the folder at the same time it creates the share.

3. Select the **NFS Sharing** tab to enter NFS-specific information. See "Modifying Share Properties" for information on this tab.
4. After all share information is entered, click **OK**.

Deleting a Share

IMPORTANT: Before deleting a share, warn all users to exit that share and confirm that no one is using the share.

To delete a share:

1. From the **Shares** menu, select the share to be deleted, and then click **Delete**.
2. Verify that this is the correct share, and then click **OK**.

Modifying Share Properties

To change share settings:

1. From the **Shares** menu, select the share to modify and then click **Properties**. The **General** tab of the **Share Properties** dialog box is displayed.

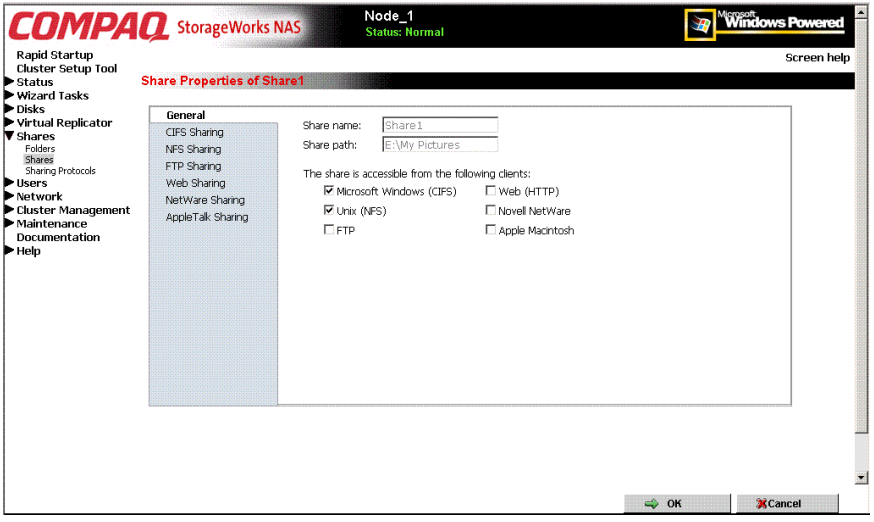


Figure 9-4: Share Properties dialog box, General tab

The name and path of the selected share is displayed.

2. To enter or change client protocol information, check the UNIX (NFS) client-type box and then click the **NFS Sharing** tab.

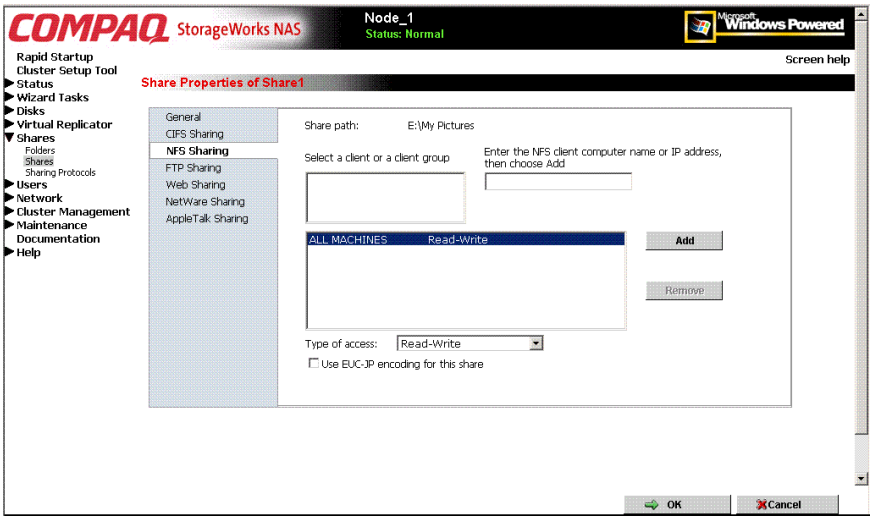


Figure 9-5: NFS Sharing tab

3. From the **NFS Sharing** tab of the **Share Properties** dialog box,
   a. Indicate the allowed clients.

      Select the machine to include in the **Select a client or client group** box or manually enter the NFS client computer name or IP address. Then click **Add**.

   b. Indicate the access permissions.

      Select the machine from the main user display box and then select the appropriate access method from the **Type of access** drop-down box.

4. After all NFS sharing information is entered, click **OK**.

NFS Protocol Properties Settings

Parameter settings for the NFS protocol are entered and maintained through the WebUI in the **NFS Properties** dialog box. To access the NFS Properties dialog box, select **Shares**, **Sharing Protocols**. Then, select the **NFS Protocol** radio button and click **Properties**.

The **NFS Properties** menu is displayed.

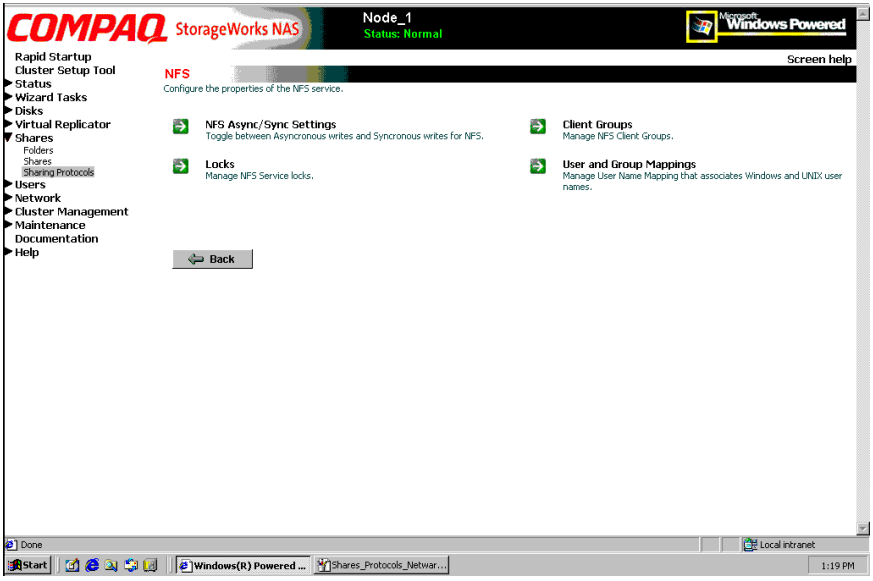


Figure 9-6: NFS Sharing Protocols menu

NFS properties include:

- Async/Sync Settings
- Locks
- Client Groups
- User and Group Mappings

Settings for Asynchronous/Synchronous writes and service Locks are discussed together in the following paragraphs of this chapter.

Client groups and user and group mappings are each discussed in separate sections later in this chapter.

NFS Async/Sync Settings

As mentioned in a previous section, there are two versions of NFS: Version 2 and Version 3. Version 3 supports additional file operations that Version 2 did not have, such as asynchronous file operations.

To indicate whether to use asynchronous or synchronous write settings:

1. From the WebUI, access the NFS Protocol Properties menu by selecting **Shares**, **Sharing Protocols**. Select **NFS Protocol** and then click **Properties**. The NFS Properties menu is displayed.
2. In the NFS Properties menu, select **NFS Async/Sync Settings**. The NFS Async/Sync Settings dialog box is displayed.
3. Select the desired write setting. The default setting is Synchronous writes.

   NOTE: Using synchronous writes allows for greater data integrity. Asynchronous writes will increase performance but will reduce data integrity as the data is cached before being written to disk.

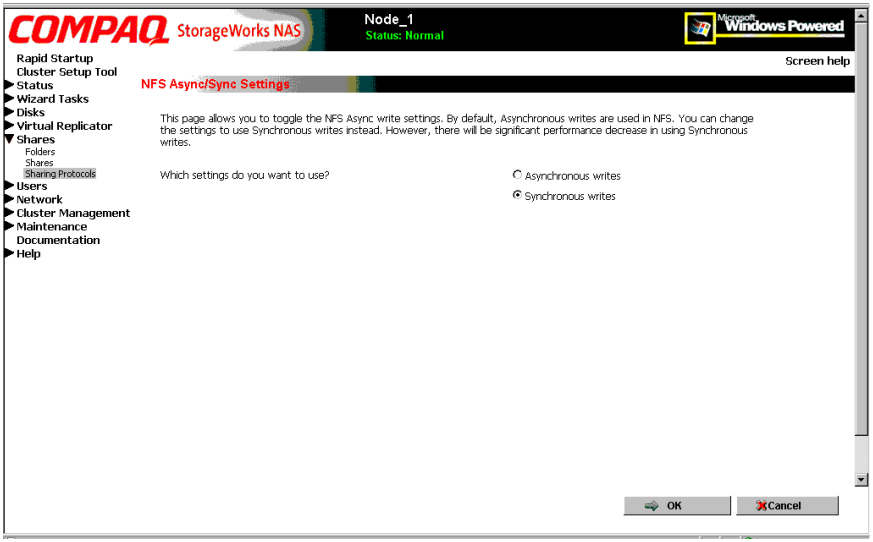


Figure 9-7: NFS Async/Sync Settings dialog box

NFS Locks

NFS supports the ability to lock files. File locking helps prevent two or more users from working with the same files at the same time.

NFS locking depends on the software application components to manage the locks. If an application does not lock a file or if a second application does not check for locks before writing to the file, nothing prevents the users from overwriting files.

To enter locking parameters:

1. From the WebUI, access the NFS Protocol Properties menu by selecting **Shares**, **Sharing Protocols**. Select **NFS Protocol** and then click **Properties**.

   The NFS Properties menu is displayed.

2. In the NFS Properties menu, select **Locks**. The NFS Locks dialog box is displayed. Figure 9-8 is an illustration of the NFS Locks dialog box.

   All clients that have locks on system files are listed in the **Current locks** box.

3. To manually clear locks that a client has on files, select the client from the displayed list, and then click **OK**.

4. To indicate the amount of time after a system failure that the locks are kept active, enter the number of seconds in the **Wait period** box.

   The NAS B3000 keeps the locks active for the specified number of seconds, while querying the client to see if it wants to keep the lock. If the client responds within this time frame, the lock is kept active. Otherwise, the lock is cleared.

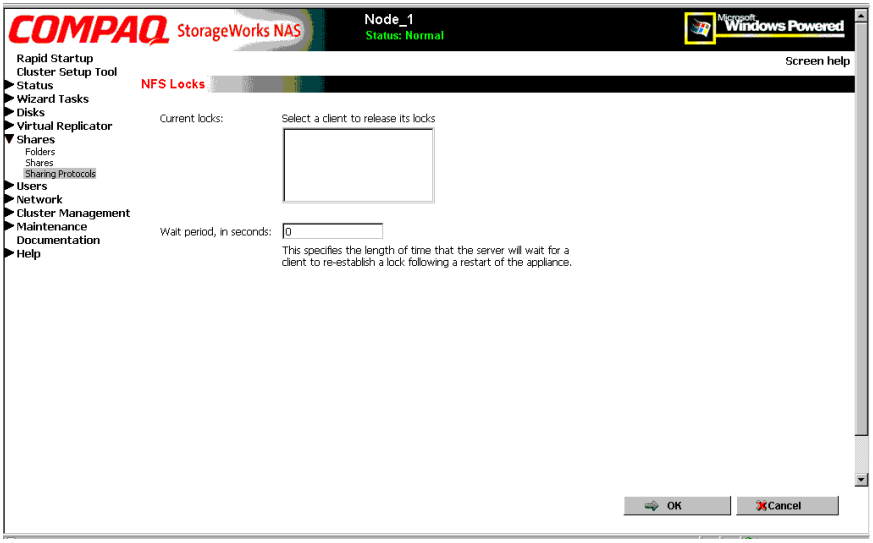


Figure 9-8: NFS Locks dialog box

NFS Client Groups

The client groups feature gives administrators a method of assigning access permissions to a set of clients. The administrator creates a client group, gives it a name, and then inserts clients into the group by client name or IP address. After the client group is created, the administrator adds or removes permissions for the entire group, instead of allowing or denying access for each individual client machine.

Proper planning includes control over the naming conventions of client groups and users. If the client group is given the same name as a client, the client is obscured from the view of the server. For example, assume that a client d4 exists. If a client group called d4 is created, permissions can no longer be assigned to just the client d4. Any reference to d4 now refers to client group d4.

To manage NFS client groups:

1. From the WebUI, access the NFS Protocol Properties dialog box by selecting **Shares**, **Sharing Protocols**. Select **NFS Protocol** and then click **Properties**. The **NFS Protocol Properties** menu is displayed.
2. In the NFS Protocol Properties menu, select **Client Groups**. The **NFS Client Groups** dialog box is displayed.

Figure 9-9: NFS Client Groups dialog box

The following tasks are available:

- Adding a new client group
- Deleting a client group
- Editing client group information

Adding a New Client Group

To add a new client group:

1. From the **NFS Client Groups** dialog box, click **New**. The **New NFS Client Group** dialog box is displayed.

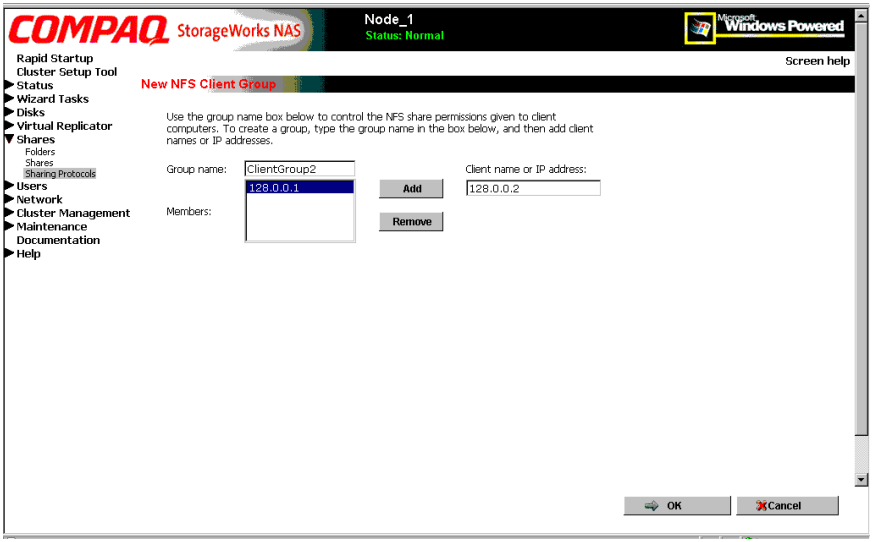


Figure 9-10: New NFS Client Group dialog box

2. Enter the name of the new group.
3. Enter the client name or their IP address.
4. Click **Add**. The system adds the client to the displayed list of members.
5. To remove a client from the group, select the client from the **Members** box and then click **Remove**.
6. After all clients have been added to the group, click **OK**. The NFS Client Groups dialog box is displayed again.

Deleting a client group

To delete a group:

1. From the **NFS Client Groups** dialog box, select the group to delete and click **Delete**.
2. A verification screen is displayed. Confirm that this is the correct group and then click **OK**.

   The NFS Client Groups dialog box is displayed again.

Editing Client Group Information

To modify the members of an existing client group:

1. From the **NFS Client Groups** dialog box, select the group to modify, and click **Edit**.

   The **Edit NFS Client Group** dialog box is displayed. Current members of the group are listed in the **Members** box.

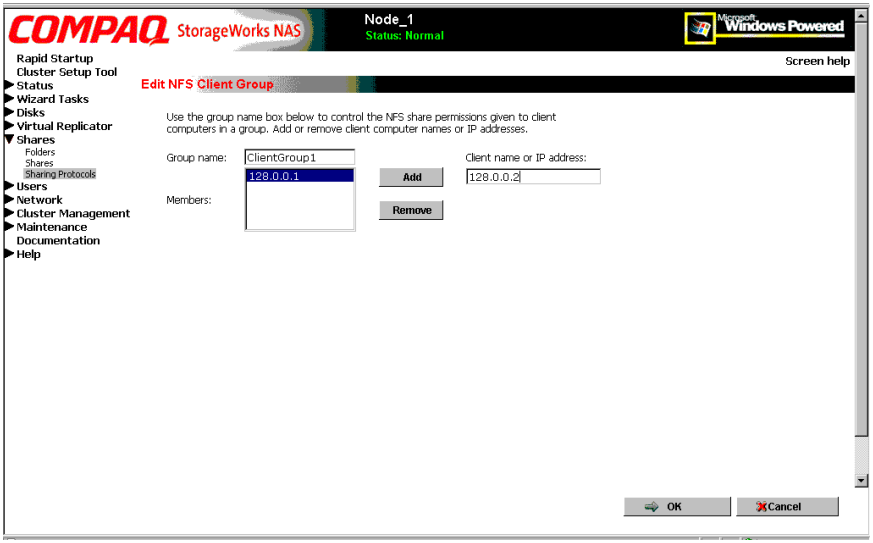


Figure 9-11: Edit NFS Client Groups dialog box

2. To add a client to the group, enter the client name or IP address in the **Client name** box, and then click **Add**. The client is automatically added to the Members list.
3. To delete a client from the group, select the client from the Members list, and then click **Remove**. The client is removed from the list.
4. After all additions and deletions are completed, click **OK**. The NFS Client Groups dialog box is displayed again.

NFS User and Group Mappings

When a fileserver exports files within a homogeneous environment, there are no problems with authentication. It is a simple matter of making a direct comparison to determine whether the user should be allowed access to the file, and what level of access to allow.

However, when a fileserver works in a heterogeneous environment, some method of translating user access is required. User mapping is the process of translating the user security rights from one environment to another.

User name mapping is the process of taking user and group identification from one environment and translating it into user identification in another environment. In the context of UNIX and NFS, user and group identification is a combination of a user ID (UID) and group ID (GID). In Windows environments, user identification is a Security ID (SID) (or Globally Unique Identifier (GUID) for Windows 2000).

The server grants or denies access to the export based on machine name or IP address. However, once the client machine has access to the export, user-level permissions are used to grant or deny access to user files and directories.

The NAS B3000 is capable of operating in a heterogeneous environment, meaning that it is able to work with both UNIX and Windows clients. Because the files are stored in the native Windows NT file system, the server has to map the UNIX users to Windows users to determine the user access level of the files.

NOTE: User mapping is not designed to address existing user database problems in the existing environment. All UIDs and GIDs must be unique across all NIS (Network Information Service) domains and all user names must be unique across all Windows NT domains.

The NAS B3000 supports mappings between one or more Windows domains and one or more NIS domains. The default setup supports multiple Windows NT domains to a single NIS domain. For information about users in multiple NIS domains, refer to the Compaq Supplemental Help section in the SFU online help.

Types of Mappings

There are three types of mappings. These mappings are listed below in order of the most complex with the greatest level of security to the least complex, easiest to manage, but with little security:

- Explicit mappings
- Simple mappings
- Squashed mappings

Explicit Mappings

Explicit mappings are created by the administrator to link Windows and UNIX users. They override simple mappings and are used to map users on the different systems that have unique names.

Simple Mappings

Simple mapping is a direct comparison of user names on the Windows system and the UNIX system. If the names match, it is assumed to be an authentic user, and appropriate share access is granted. Simple mapping is an option that the administrator must turn on if it is to be used.

Squashed Mappings

If the NFS server does not have a corresponding UID or GID or if the administrator has set other conditions to filter out the user, a process called squashing takes effect. Squashing is the conversion of an unmapped or filtered user to an anonymous user. This anonymous user has very restricted permissions on the system. Squashing helps administrators manage access to their exports by allowing them to restrict access to certain individuals or groups and to squash all others down to restricted (or no) access. Squashing enables the administrator to allow permissions instead of denying access to all the individuals who are not supposed to have access.

The default user is “Anonymous Logon,” but this default user can be changed. For more details on how to change the default squashing user, see the Compaq “OEM Supplemental Help” chapter of the SFU help, found on the NAS B3000.

Figure 9-12 is a diagram showing an example of how the mapping server works for an `ls -al` command.

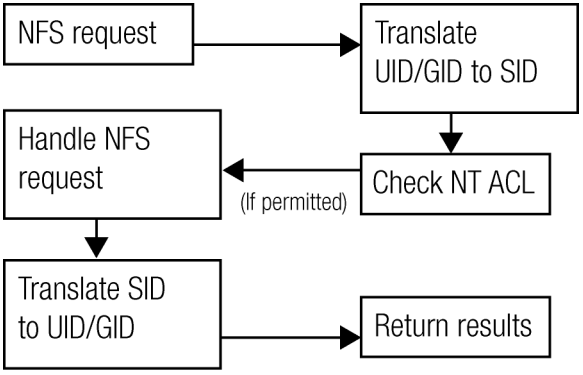


Figure 9-12: Mapping Server "ls –al" Command example

A double translation, as illustrated in Figure 9-12, is sometimes necessary because some commands return user ID information. For example, if the NFS request issued was an `ls -al` command, the return listing of files contains user information (the user and group that own the file). The `ls -al` command is a Unix command. It returns a long or full listing of all files. Because this information is contained in a Windows NT Access Control List (ACL), it is not UNIX ready. The ACL information has to be converted back to UNIX UIDs and GIDs for the UNIX systems to understand and display the user information.

This second translation is not done for commands that do not return user information. For example, if the NFS request were just to read data from or write data to a file, the second translation would not be performed because there is no returning user information.

User Name Mapping Best Practices

Below is a brief list of suggested practices:

- **Back up user and group mappings**

  To avoid loss of complex advanced mappings in the case of a system failure, back up the mappings whenever the mappings have been edited or new mappings have been added.

- **Map consistently**

  Groups that are mapped to each other should contain the same users and the members of the groups should be properly mapped to each other to ensure proper file access.

  Example using User1 and Group1:

  — Make sure that the Windows User1 is mapped to the corresponding UNIX User1.

  — Make sure that the Windows Group1 is mapped to the corresponding UNIX Group1.

  — Make sure that User1 is a member of Group1 on both Windows and UNIX.

- **Map properly**

  — Valid UNIX users should be mapped to valid Windows users.

  — Valid UNIX groups should be mapped to valid Windows groups.

  — Mapped Windows user must have the **Access this computer from the Network** privilege, or the mapping will be squashed.

  — The mapped Windows user must have an active password, or the mapping will be squashed.

Creating and Managing User and Group Mappings

To set up and manage user name mappings:

1. From the WebUI, select **Shares**, **Sharing Protocols**. Select **NFS Protocol** and then click **Properties**. The **NFS Properties** menu is displayed.
2. In the NFS Properties Menu, select **User and Group Mappings**. The User and Group Mappings dialog box is displayed.

   There are four tabs in the User and Group Mappings dialog box:

   - General information—sets the mapping information source, which is either NIS or password and group files
   - Simple Mapping—indicates whether simple mappings are being used
   - Explicit User Mapping—lists exceptional user mappings that will override the simple user mappings
   - Explicit Group Mapping—lists exceptional group mappings that will override the simple group mappings

   Each of these tabs is discussed in the following sections.
3. Enter mapping information on the appropriate tabs, then click **OK**.

NOTE: A wizard is available for entering user name mappings. The wizard is located in the **Users** menu option of the WebUI. See the "User and Group Management" chapter for brief information about the wizard.

General Information

The NAS B3000 stores the mapping data in an NTFS file system. The user name mapping server translates the UNIX users into Windows users so that the server can determine user access rights to the data.

Within this initial screen, indicate whether the source of mapping information is an NIS server or is a special file with password and group information.

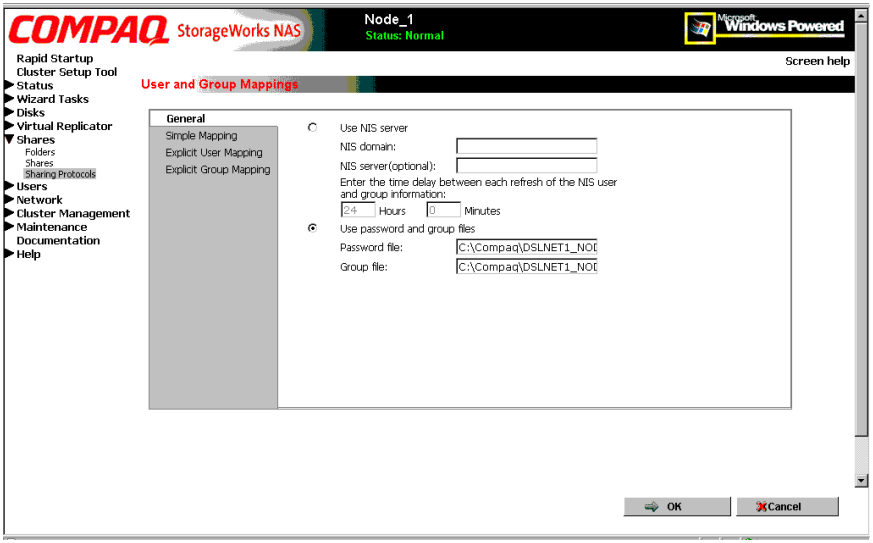


Figure 9-13: User and Group Mappings dialog box, General tab

From the **General** tab of the **User and Group Mappings** dialog box:

1. If an NIS server is being used:
   a. Select **Use NIS server**.
   b. Enter the NIS domain name.
   c. Enter the NIS server name. This field is optional. In the **Hours** and **Minutes** fields, indicate how often the system will connect to the NIS domain to update the user list.

2. If custom password and group files are being used:
   a. Select **User password and group files**.
   b. Enter the path and name of the password file.
   c. Enter the path and name of the group file.
3. After this basic information is entered, click **OK**.

Simple Mapping

Simple (or implicit) mapping is the first level of user name mapping. In simple mode, user and group names that match exactly in name are automatically equated.

While simple mappings are the most easily managed and are the most forthright type of map, security problems can arise. For example, if a UNIX user is coincidentally an exact match of a Windows user, the system will equate them and an inadvertent mapping will occur, granting a user inappropriate access.

To use simple mappings, the feature must be enabled. If this feature is turned off, the administrator must manually create an explicit map for each user.

To enable simple mapping, click the **Enable Simple Mapping** option and then enter the Windows domain name.

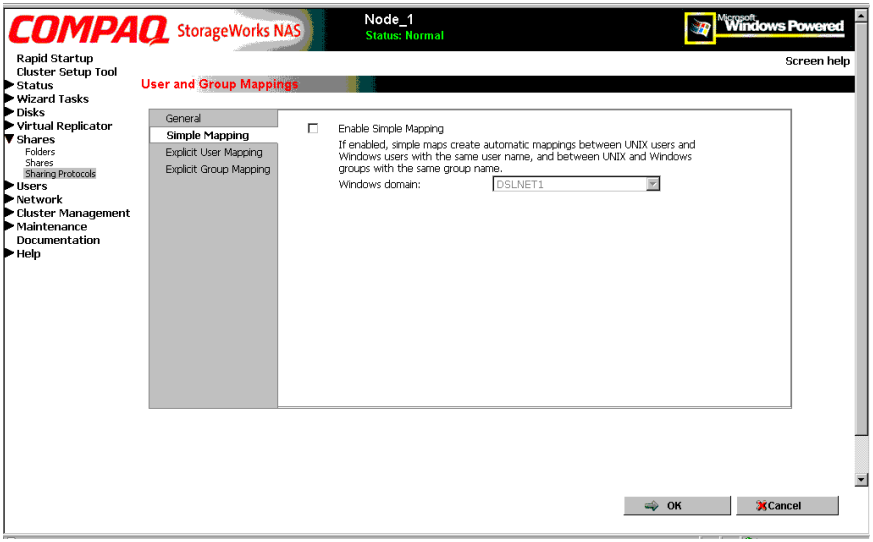


Figure 9-14: User and Group Mappings dialog box, Simple Mapping tab

IMPORTANT: Only one domain can have simple mappings. For information about how to set up simple mappings for multiple domains, see the Compaq "OEM Supplemental Help" chapter of the SFU help, found on the NAS B3000 console.

Explicit User Mapping

Explicit mappings allow the administrator to map any user or group manually to any other user and group. Advanced mappings override simple mappings, giving administrators the capability of using simple mapping for most users and then using advanced mappings for the users with unique names on the different systems. Alternatively, simple mapping can be disabled completely, relying solely on explicit mappings. Explicit mappings create the most secure mapping environment.

Security issues seen in simple mappings do not exist in explicit mappings. Explicit user mappings specifically correlate two users together, thus preventing the inadvertent mapping.

To enter explicit user mappings, select the **Explicit User Mapping** tab. Figure 9-15 is an example of the Explicit User Mapping tab.

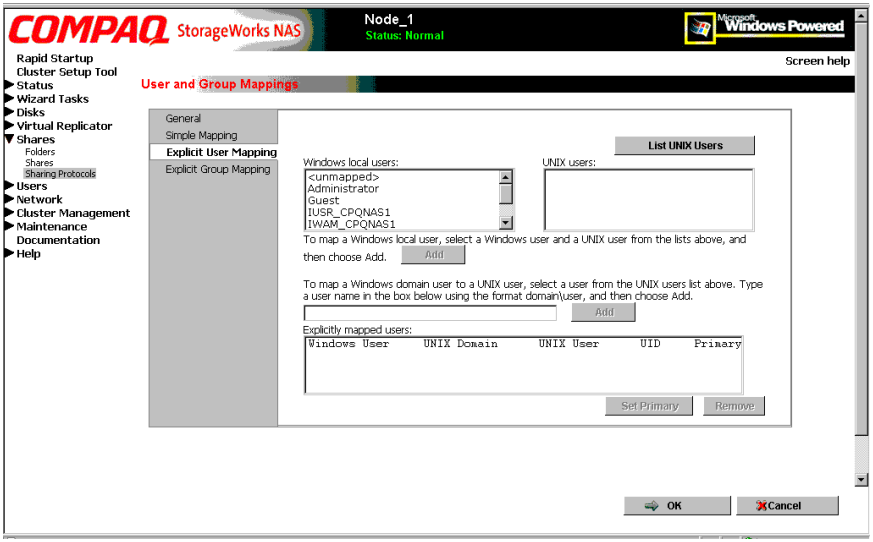


Figure 9-15: User and Group Mappings dialog box, Explicit User Mapping tab

To create explicit user mappings:

1. Click the **List UNIX Users** button to populate the **UNIX users** box.
2. To map a local Windows user to a UNIX user, highlight the Windows user in the **Windows local users** box and highlight the UNIX user that you want to map, and then click **Add**. The **Explicitly mapped users** box at the bottom of the screen is populated with the new mappings. Repeat this process until all desired users have been mapped.
3. To map a domain Windows user to a UNIX user, enter the domain and the user name in the box in the middle of the screen (use the `Domain\username` format) and highlight the UNIX user that you want to map, and then click **Add**. The map is added to the **Explicitly mapped users** box at the bottom of the screen. Repeat this process until all desired users have been mapped.
4. To map multiple Windows users to one UNIX user, one of the mapped Windows users must be set as the primary mapping. To indicate which user map is the primary mapping, highlight the desired map in the **Explicitly mapped users** box, and then click the **Set Primary** button.

5. To delete a map, highlight the map in the **Explicitly mapped users** box, and then click the **Remove** button.

6. After all entries are completed, click **OK** to activate the new entries.

Explicit Group Mapping

To enter explicit group mappings, select the **Explicit Group Mapping** tab. Figure 9-16 is an example of the Explicit Group Mapping tab.

Explicit mappings allow the administrator to map any user or group manually to any other user and group. Explicit mappings override simple mappings, giving administrators the capability of using simple mapping for most groups and then using explicit mappings to make changes to simple mappings. Simple mapping can be turned off for greater security.

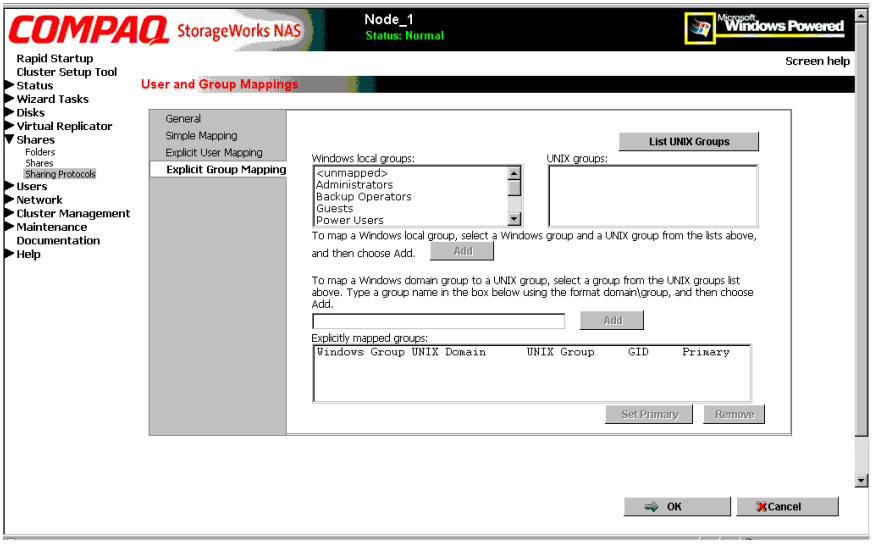


Figure 9-16: User and Group Mappings dialog box, Explicit Group Mapping tab

To create explicit group mappings:

1. Click the **List UNIX Groups** button to populate the **UNIX Groups** box.
2. To map a local Windows group to a UNIX group, highlight the Windows group in the **Windows local groups** box and highlight the UNIX group to map, and then click **Add**. The **Explicitly mapped groups** box at the bottom of the screen is populated with the new mappings. Repeat this process until all desired groups have been mapped.
3. To map a domain Windows group to a UNIX group, enter the domain and the group name in the box in the middle of the screen (use the `Domain\groupname` format) and highlight the UNIX group to map, and then click **Add**. The map is added to the **Explicitly mapped groups** box at the bottom of the screen. Repeat this process until all desired groups have been mapped.
4. To map multiple Windows groups to one UNIX group, one of the Windows groups must be set as the primary mapping. Therefore, to indicate which group map is the primary mapping, highlight the desired map in the **Explicitly mapped groups** box, and then click the **Set Primary** button.
5. To delete a map, highlight the map in the **Explicitly mapped groups** box and then click the **Remove** button.
6. After all entries are completed, click **OK** to activate the new entries.

Backing up and Restoring Mappings

The user name mapping server has the capability to save and retrieve mappings from files. This capability is useful for backing up mapping settings prior to making changes and for exporting the mapping file from one server to others, using the same mapping information.

The user name mapping server can save existing mappings to a file or load them from a file and populate the mapping server. This feature is found in the MMC under the Map Maintenance tab of the User Name Mapping screen, as shown in Figure 9-17.

To access the MMC, use Terminal Services. To open a Terminal Services session, from the WebUI, select **Maintenance**, **Terminal Services**.

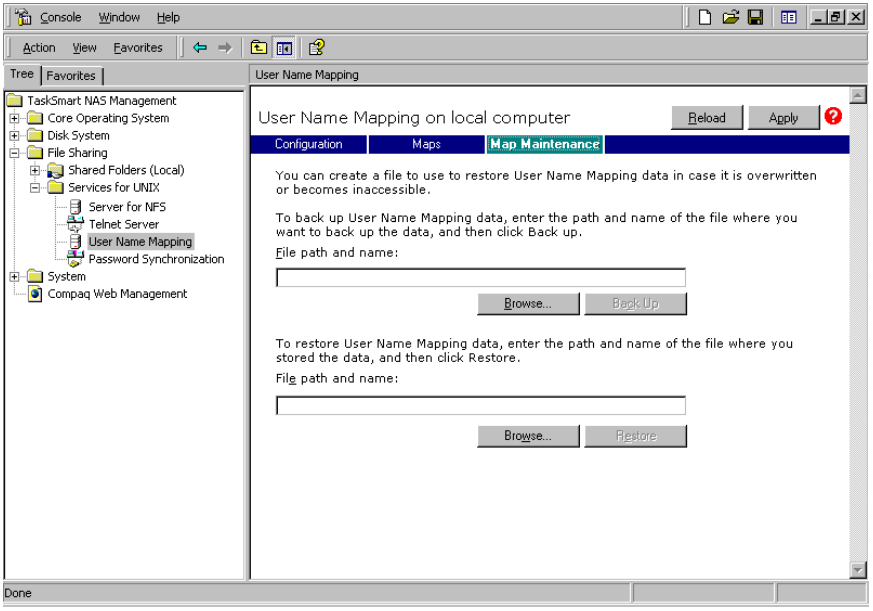


Figure 9-17: MMC User Name Mapping screen, Map Maintenance tab

Backing up User Mappings

1. Select the **Map Maintenance** tab from the **User Name Mapping** screen.
2. Type the path and name of the file to be used for backup in the **File path and name** field or click **Browse** to locate the file.

   NOTE: If the file is being created for the first time, follow these steps:

   1. Browse to the target directory.
   2. Right-click in the file-listing pane, select New, Text Document. Enter a name for the file and then press Enter.
   3. Double-click the new file to select it.

3. Click **Backup**.

Restoring User Mappings

This feature is particularly useful when backing up user mappings to address server failures. User mappings can then be restored from the file using the following procedures.

1. Select the **Map Maintenance** tab from the **User Name Mapping** screen.
2. Type the path and name of the file in the **File path and name** field or click **Browse** to locate the file.
3. After locating the file, click **Restore**.

NFS File Sharing Tests

Compaq recommends performing the following tests to verify that the setup of the shares, user mappings, and permissions grant the desired access to the NFS shares.

1. Create an NFS share.

   See "NFS File Shares" earlier in this chapter for information on creating shares.

2. Verify that the NFS share exists.

   Use Terminal Services to log in to the NAS B3000 and access the command line interface:

   `nfsshare <sharename>` (*sharename* represents the name of the share.)

3. Map a user.

   See "User and Group Mappings" in this chapter for instructions.

4. Verify that the mappings exist.

   Use Terminal Services to log in to the NAS B3000 and access the command line interface:

   ```
   mapadmin list -all
   ```

5. On the UNIX system, use the mapped user to create a file.

   a. As the root user, mount the share:

   ```
   mount -t nfs <nfs server IP address:/nfs share> /mount-point
   ```

   b. Log in as a mapped user.

   c. Change directories to the mount-point directory.

   d. Create the file as the mapped user (example: file1).

6. Verify the same permissions are set up for the user on both the UNIX side and the Windows side.
   a. List the permissions on the UNIX side:

      ```
      ls -l /mount-point/file1
      ```

      (Example screen display: `-r--r----- unixuser1 unixgroup1`

   b. List the permissions on the Windows side: (change to the nfs share directory)

      From a command line interface accessed from Terminal Services on the NAS B3000:

      ```
      cacls file1
      ```

      (Example display: DOMAIN1\Windowsuser1:R

      DOMAIN1\Windowsgroup1:R

   c. Compare and verify the permissions from UNIX and Windows.

Terminal Services, Telnet Service, and Remote Shell Service

In addition to the WebUI, three services are available for remote administration of Services for UNIX. These services let users connect to machines, log on, and obtain command prompts remotely. See Table 9-1 for a list of commonly used commands.

Using Terminal Services

Microsoft Terminal Services can be used to remotely access the NAS B3000 desktop. This provides the administrator flexibility to automate setups and other tasks. SFU file-exporting tasks and other SFU administrative tasks can be accomplished using Terminal Services to access the SFU user interface from the MMC or from a command prompt.

Terminal Services is included in the WebUI of the NAS B3000. To open a Terminal Services session, from the WebUI, select **Maintenance**, **Terminal Services**. See the "Remote Access Methods and Monitoring" chapter for information on setting up and using Terminal Services.

Using Telnet Service

Telnet is a UNIX command line utility. The Telnet service is included on the NAS B3000, but, by default, it is not activated. To use Telnet services, see the information in the "Remote Access Methods and Monitoring" chapter.

NOTE: Telnet is not cluster-aware.

Using Remote Shell Service

The Remote Shell is a UNIX method for allowing UNIX users to run commands remotely. It can be used in a fashion similar to Telnet or can be used to directly invoke a remote command. Remote Shell service is not activated by default. See the "Remote Access Methods and Monitoring" chapter for set up and use.

NOTE: Remote Shell service is not cluster-aware.

Table 9-1 describes some common SFU commands.

Table 9-1: Command Line Interface Command Prompts

Command	Function
nfsstat /?	Learn about viewing statistics by NFS operation type
showmount /?	View the format of the command to display NFS export settings on NFS servers
showmount -a	View users who are connected and what they currently have mounted
showmount -e	View exports from the server and their export permissions
rpcinfo /?	Learn how to display Remote Procedure Call (RPC) settings and statistics.
mapadmin /?	View how to add, delete, or change user name mappings
tnadmin /?	View how to change Telnet Server settings
nfsshare /?	Learn how to display, add, and remove exported shares

Password Synchronization

Password synchronization is an optional service that automatically synchronizes Windows passwords with UNIX passwords across multiple machines or environments. This service is included on the NAS B3000, but is not activated.

NOTE: Password Synchronization is not cluster aware. Password synchronization may not occur during cluster failover conditions.

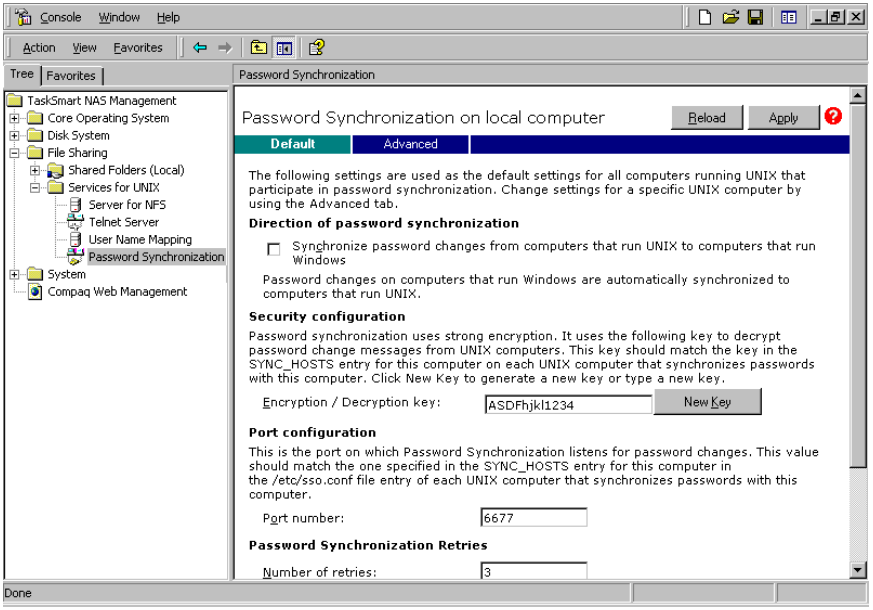


Figure 9-18: MMC Password Synchronization screen

Password synchronization ensures that the machines contain identical and most current user password database. When the user or administrator changes a password, the new password is updated across all target machines.

Without password synchronization, the user could have different passwords on different machines. If the administrator or user changed the password, the change would affect only that single machine.

Password Synchronization Best Practices

- Install Password Synchronization on all domain controllers to ensure consistent synchronization of the Domain and the UNIX passwords.
- Ensure consistent password policies.

If you are providing Windows-to-UNIX password synchronization, make sure the Windows password policy is as restrictive in all areas as the UNIX policy. Failure to ensure that password policies are consistent may result in synchronization failure when a user changes a password on the less restrictive system and the change is rejected by the more restrictive system.

- Avoid synchronizing administrator passwords.

  Do not synchronize passwords for members of the Windows Administrator groups or the passwords of UNIX Superuser or Root accounts.

  — When Password Synchronization is installed, members of the local Administrators or Domain Administrators group are added to the PasswordPropDeny group, which prevents their passwords from being synchronized. If you add a user to either the Administrators or Domain Admins group, be sure to add the user to the PasswordPropDeny group.

  — The `sync_users` statement in the *sso.conf file* on UNIX systems prevents the passwords of Superusers from being synchronized.

Password Synchronization Requirements

The work environment **must** meet the following criteria for the password synchronization service to function:

- The password policies must be the same on Windows NT and UNIX.
- User and group names must match exactly in spelling. No advanced mapping component exists to correct for any mistakes or differences.
- The UNIX system must be using CRYPT to encrypt its password database. If the UNIX machine is using anything else, such as MD5, the password synchronization service does not work.
- The password synchronization service must be installed on the primary and backup domain controllers. Click the **Advanced** button to select settings other than default.

Implementing Password Synchronization

The password synchronization service is a service residing on the NFS server. The service does not have to be on the same server as the NFS server, but the service is included on each NAS B3000 device. The password synchronization service detects updates on the Windows NT side and transmits the changes to the target UNIX machines, as specified in the service configuration.

To access the password synchronization module on the NAS device, use Terminal Services to access the **MMC**. From the MMC, select **File Sharing**, **Services for UNIX**, and **Password Synchronization**.

Configuring Advanced Settings

To configure advanced settings for password synchronization, use the following procedures:

1. Type the name or IP address of the UNIX computer in the Computer Name box.
2. Click **Add** and then click **Configure.** The password synchronization settings dialog box for the specific computer is displayed.

   This dialog box allows the user to perform steps such as supplying new encryption keys or changing password synchronization port numbers.

Figure 9-19: MMC Password Synchronization screen, Advanced Settings dialog box

Installing Password Synchronization

The password synchronization service must be installed on all primary domain controllers (PDCs) and backup domain controllers (BDCs) located in a domain, to support the service. The PDCs contain the primary copy of the user passwords.

Password synchronization should be installed by itself. Core SFU components are not needed to install the service on a domain controller.

NOTE: This procedure does not install SFU.

IMPORTANT: Before installing password synchronization, be sure to close all applications and notify users connected that the server is rebooting.

To install Password Synchronization without NFS Authentication Tools on a domain controller:

1. Allow the `C:\WINNT\bin\SFU` directory of the NAS B3000 to be shared:

   ```
   net share SFU=C:\WINNT\bin\SFU
   ```

2. On the domain controller, connect to the share:

   ```
   net use Z: \\NAS_machine_name\SFU
   ```

3. Change directories from the domain controller to the root of the connected share of the NAS B3000:

   ```
   cd /d Z:\
   ```

4. Run the installation program on the domain controller:

   ```
   OemSetup.msi ADDLOCAL=PasswdSync SFUDIR=C:\SFU
   OEMINSTALL=TRUE SOURCELIST=Z:\ /l*v %temp%\sfusetup.log /q
   ```

5. Restart the domain controller. The domain controller must be restarted manually after installing the password synchronization. If the domain controller is not restarted, password synchronization will not run correctly.

6. Run the Administration User Interface on the domain controller and set up password synchronization:

   Click **Start**, **Programs**, **Windows Services for UNIX**, **Services for UNIX Administration**.

To install Password Synchronization and NFS Authentication Tools on the domain controller:

1. Allow the `C:\WINNT\bin\SFU` directory of the NAS B3000 to be shared:

   ```
   net share SFU=C:\WINNT\bin\SFU
   ```

2. On the domain controller, connect to the share:

   ```
   net use Z: \\NAS_machine_name\SFU
   ```

3. Change directories from the domain controller to the root of the connected share of the NAS B3000:

   ```
   cd /D Z:\
   ```

4. Run the installation program on the domain controller in the following order:

   ```
   OemSetup.msi ADDLOCAL=NFSServerAuth SFUDIR=C:\SFU
   OEMINSTALL=TRUE SOURCELIST=Z:\ /l*v %temp%\sfusetup.log /q
   ```

```
OemSetup.msi ADDLOCAL=PasswdSync SFUDIR=C:\SFU
OEMINSTALL=TRUE SOURCELIST=Z:\ /l*v %temp%\sfusetup.log /q
```

5. Restart the domain controller. The domain controller must be restarted manually after installing the password synchronization. If the domain controller is not restarted, password synchronization will not run correctly.

Customizing Password Synchronization

Use **Default** to select password synchronization settings. Select different settings for each UNIX host in the Hosts tab.

- **Direction of Password Synchronization—**This option must remain unchecked. Password changes on Windows NT/2000 are always propagated to UNIX computers. Synchronize password changes from UNIX machines to Windows NT/2000.
- **Security configuration—**Password synchronization uses strong encryption for propagating passwords.
- **Encryption key—**Password synchronization comes with a default Encryption Key (displayed). Enter an encryption key of your own, regenerate the key, or do both.
- **Port configuration—**This port is where the password synchronization service checks for password changes. UNIX machines must be configured to use the defined port number.
- **Password Sync Retries—**Select Password Sync Retries to determine how Password Synchronization failures are handled.
- **Logging—**Significant password synchronization events are logged to the event log. Select the option to allow or deny extensive logging.

10

NetWare File System Management

File and Print Services for NetWare is one part of the Microsoft software package Services for NetWare. The most common use of the NetWare network operating system is as a file and print server. Customers using NetWare as the platform to host their file and print services have become accustomed to its interface from both a user and an administrator point of view and have built up an investment in NetWare file and print services. File and Print Services for NetWare helps customers preserve their NetWare skill set while consolidating the number of platforms. This reduces hardware costs and simplifies file and print server administration by making the NAS B3000 emulate a NetWare file and print server. FPNW eases the addition of the NAS B3000 into a mixed infrastructure by providing a NetWare user interface (UI) to a Windows 2000-based server; administrators and users see their same, familiar NetWare UI. Additionally, the same logon for clients is maintained without a need for any client configuration changes.

This service also provides the ability to create Novell volumes, which are actually NTFS shares, from which users can map drives to and access resources. Novell Login scripts are supported on the NAS B3000 or through an existing NDS (Novell Directory Services) account.

IMPORTANT: IPX\SPX protocol is required on the Novell servers.

Topics included in this chapter include:

- Installing Services for NetWare
- Managing File and Print Services for NetWare
- Creating and Managing NetWare Users
- Creating and Managing NetWare Volumes (Shares)

Installing Services for NetWare

The installation of File and Print Services for NetWare (FPNW) on the NAS B3000 allows for a smooth integration with existing Novell servers. FPNW allows a Windows 2000-based server to emulate a NetWare file and print server to users, clients, and administrators. This emulation allows authentication from Novell clients, the use of Novel logon scripts, the creation of Novell volumes (shares), the use of Novell file attributes, and many other Novell features.

Additional information on Microsoft Directory Synchronization Services and the File Migration Utility can be found at:

http://www.microsoft.com/WINDOWS2000/guide/server/solutions/NetWare.asp

IMPORTANT: The printing capabilities of File and Print Services for NetWare are not supported on the NAS B3000.

To install Services for NetWare:

1. From the desktop of the NAS B3000, click **Start**, navigate to **Settings-Network and Dial-up Connections**, click **Local Area Connection**, and then click **Properties**.
2. Click **Install**. The Select Network Component Type dialog box is displayed.

   Figure 10-1 is an example of the Select Network Component Type dialog box.

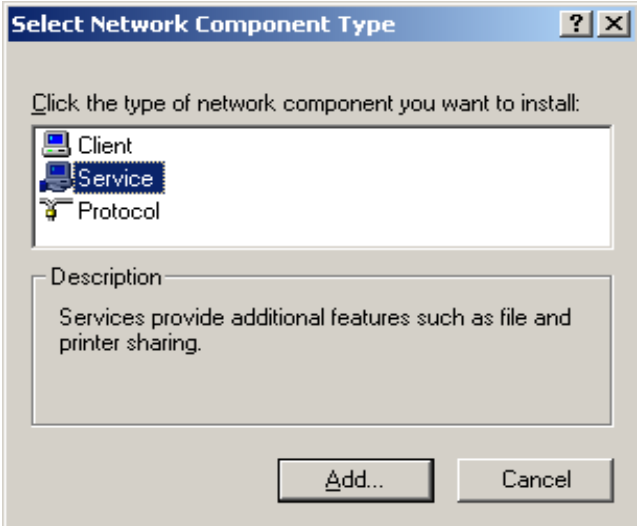


Figure 10-1: Local Area Connection Properties page, Install option

3. Select **Service** and click **Add**.
4. Click the **Have Disk** icon and navigate to the location of Services for NetWare.

   Services for NetWare is located in the path: c:\compaq\SFN\FPNW\.
5. Select the NETSFNTSRV file and click **OK**.

   File and Print Services for NetWare should now appear as an option to install.
6. Select **File and Print Services for NetWare** and click **OK**.

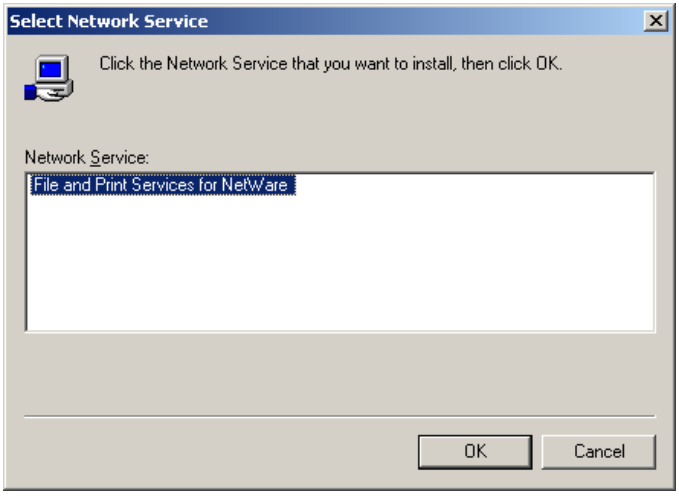


Figure 10-2: Installing File and Print Services for NetWare

Managing File and Print Services for NetWare

To access FPNW:

1. From the desktop of the NAS B3000, click **Start**, **Settings**, **Control Panel**, and then double-click **FPNW**.

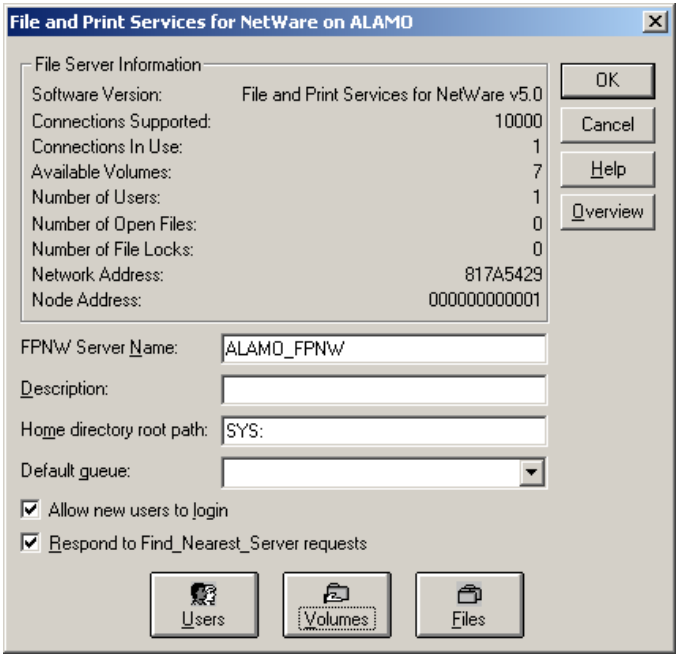


Figure 10-3: File and Print Services for NetWare screen

2. Enter an **FPNW Server Name** and **Description**.

   This name must be different from the server name used by Windows or LAN Manager–based clients to refer to the server. If you are changing an existing name, the new name will not be effective until you stop and restart File and Print Services for NetWare. For example, in the diagram below, the Windows server name is Alamo and the FPNW server name is Alamo_FPNW.

3. Indicate a **Home directory root path**.

   This path is relative to where the Sysvol volume has been installed. This will be the root location for user's individual home directories. If the directory specified does not already exist, it must first be created.

4. Use the **Users** button to:

   See connected users, disconnect users, send broadcast messages to all users connected to the server, and to send a message to a specific user.

5. Click the **Volumes** button to:

   See users connected to specific volume and to disconnect users from a specific volume.

6. Click the **Files** button to:

   See open files and close open files.

Creating and Managing NetWare Users

To use Services for NetWare, the Novell clients must be entered as local users on the NAS B3000.

Adding Local NetWare Users

1. From the NAS B3000 desktop, click the **NAS Management Console** icon, click **Core Operating System**, and then click **Local Users and Groups**.
2. Right-click the **Users** folder and then click **New User**.

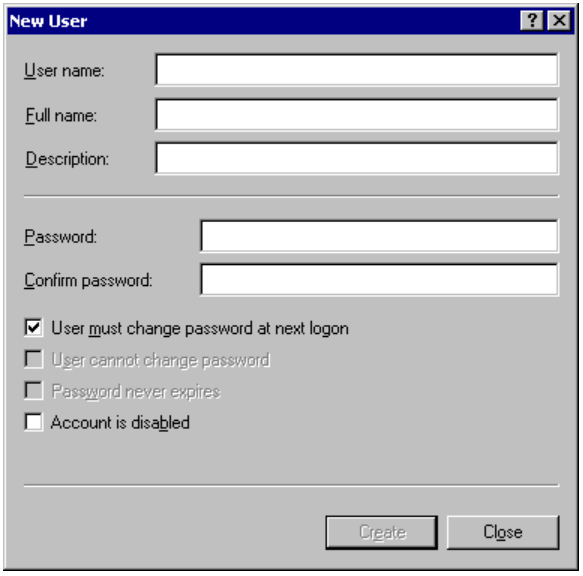


Figure 10-4: MMC New User dialog box

3. Enter the user information, including the user's User name, Full name, Description, and Password. Then, click **Create**.
4. Repeat these steps until all NetWare users have been entered.

Enabling Local NetWare User Accounts

1. In the **Users** folder (M**MC**, **Core Operating System**, **Local Users and Groups**), right-click an NCP client listed in the right-pane of the screen and then click **Properties**.
2. Select the **NetWare Services** tab.

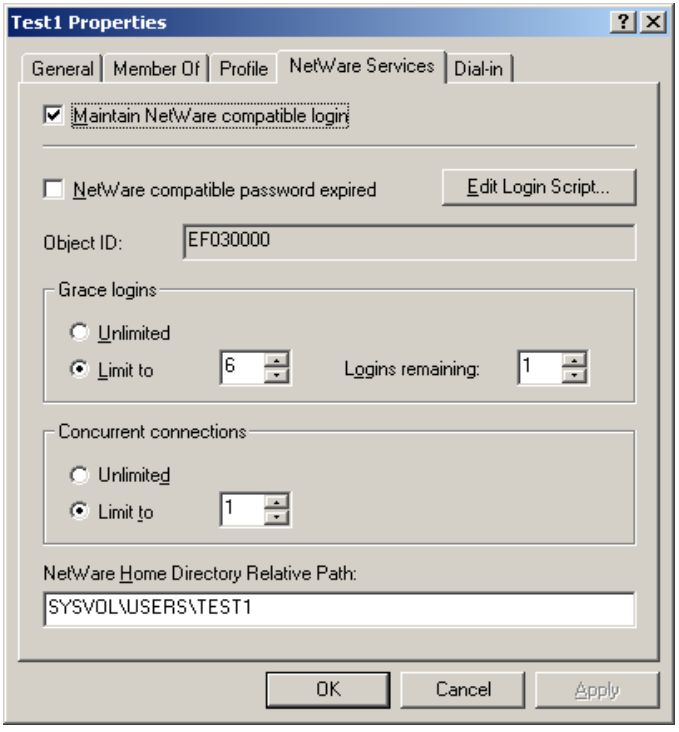


Figure 10-5: NetWare Services tab

3. Select **Maintain NetWare compatible login**.
4. Set other NetWare options for the user and click **OK**.

NOTE: The installation of *File and Print Services for NetWare* will also create a supervisor account, which is used to manage FPNW. The supervisor account is required if the NAS B3000 was added as a bindery object into NDS.

Managing NCP Volumes (Shares)

As with all protocols, before the file shares can be set up, the pools and virtual disks that will contain the data to be shared must be established. Creating storage pools and virtual disks is discussed in the "Virtual Storage Management" chapter.

NCP file shares are created in the same manner as other file shares; however, there are some unique settings. NCP shares can be created and managed through two user interfaces:

- WebUI
- MMC

Procedural instructions for using each of these interfaces are included in the following sections.

Creating and Managing NCP File Shares Using the WebUI

Complete information on managing all types of file shares in documented in the "Shares Management" chapter of this guide. The following information is specific to NCP share management and is extracted from the "Shares Management" chapter and duplicated below.

NOTE: NCP shares can be created only after Microsoft Services for NetWare is installed. See the previous section "Installing Services for NetWare" for instructions on installing SFN.

In addition to the Share Management Wizard of the WebUI, shares can be managed through the **Shares** menu option of the WebUI. Tasks include:

- Creating a new share
- Deleting a share
- Modifying share properties

Each of these tasks is discussed in this section.

Creating a New NCP Share

To create a new share:

1. From WebUI main menu, select the **Shares** directory and then select the **Shares** option. The Shares dialog box is displayed. From the **Shares** dialog box, click **New**. The **General** tab of the **Create a New Share** dialog box is displayed.

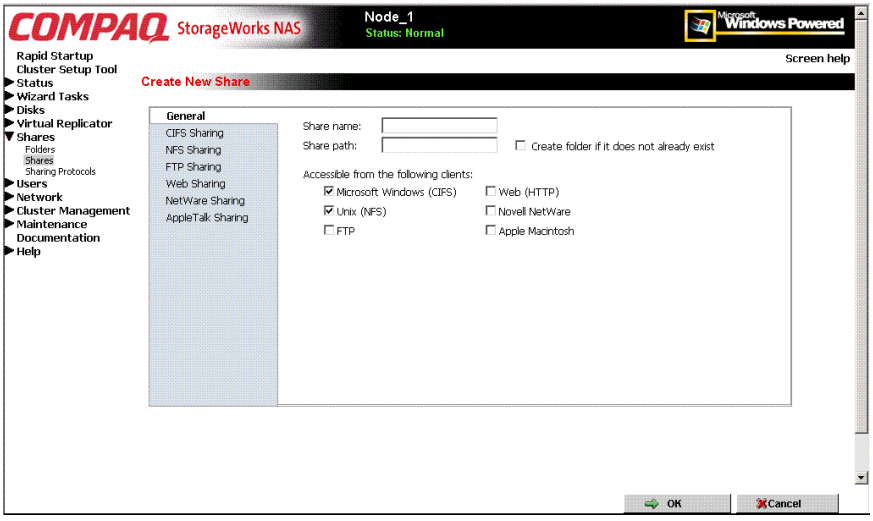


Figure 10-6: Create a New Share dialog box, General tab

2. In the **General** tab, enter the share name and path. Check the Novell NetWare client protocol checkbox.

   To create a folder for the share, check the indicated box and the system will create the folder at the same time it creates the share.

3. Select the **NetWare Sharing** tab to enter NCP-specific information. See "Modifying Share Properties" for information on this tab.

4. After all share information is entered, click **OK**.

Deleting an NCP Share

IMPORTANT: Before deleting a share, warn all users to exit that share and confirm that no one is using the share.

To delete a share:

1. From the **Shares** menu, click **Delete**.
2. Verify that this is the correct share and click **OK**.

Modifying NCP Share Properties

To change share settings:

1. From the **Shares** menu, select the share to modify and then click **Properties**. The **General** tab of the **Share Properties** dialog box is displayed.

   The name and path of the selected share is displayed.

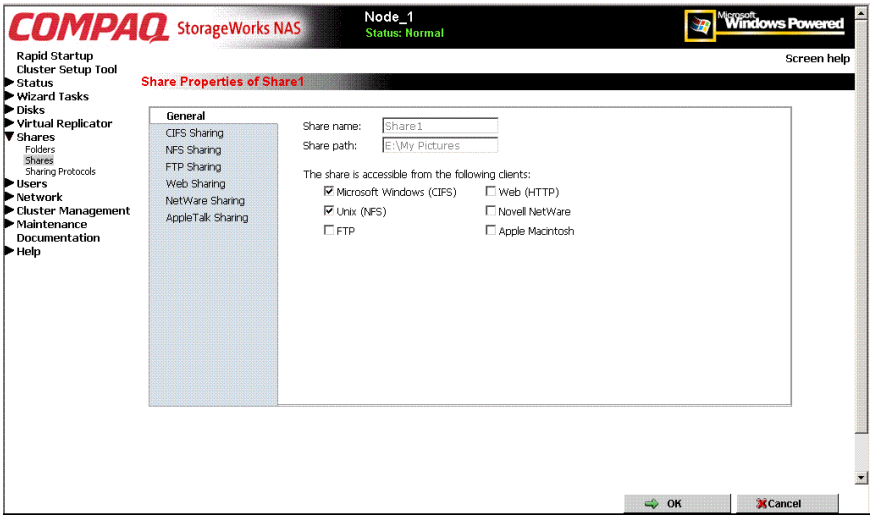


Figure 10-7: Share Properties dialog box, General tab

2. To enter or change client protocol information, check the **Novell NetWare** client-type box and then click the **NetWare Sharing (NCP)** tab.

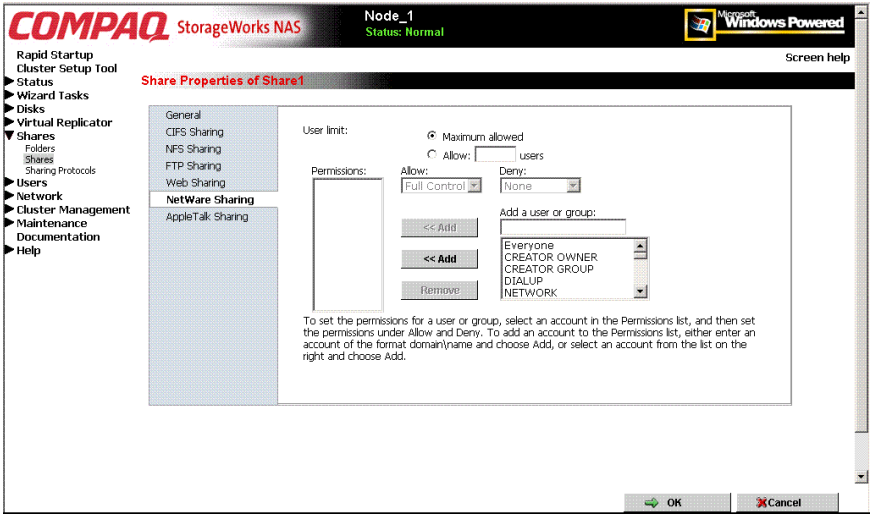


Figure 10-8: Share Properties dialog box, NetWare Sharing tab

3. From the **NetWare Sharing** tab of the **Share Properties** dialog box:
   a. Enter a user limit.
   b. Enter Permissions information.

      The **Permissions** box lists the currently approved users for this share.

      To add a new user or group, either select a user or group from the box at the bottom right of the screen or manually enter the user or group name in the **Add a user or group box**. Then click **Add**. That user or group is added to the Permissions box.

      To remove access to a currently approved user or group, select the user or group from the Permissions box, and then click **Remove**.

      To indicate the allowed access for each user, select the user and then expand the **Allow** and **Deny** drop-down boxes. Then, select the appropriate option.
4. After all NetWare Sharing information has been entered, click **OK**. The **Share** menu is redisplayed.

Creating and Managing NCP Shares using the MMC

In addition to the WebUI available on the NAS B3000, shares can be managed through the Microsoft Management Console (MMC). Tasks include:

- Creating a new share
- Modifying share properties

Each of these tasks is discussed in this section.

Creating a New NCP Share using the MMC

To create a new file share:

1. From the NAS B3000 desktop, click the **Microsoft Management Console** icon, click **File Sharing, Shared Folders**, and then **Shares**.
2. Right-click **Shares**, and then click **New File Share**. The Create Shared Folder dialog box is displayed.

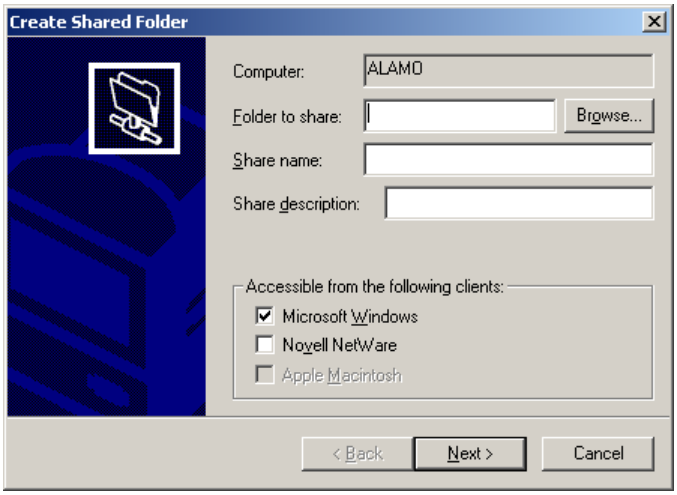


Figure 10-9: Create Shared Folder dialog box

3. In **Folder to Share**, type the path of the directory to be shared.
4. In **Share Name**, type the name of the share. Users will see this name.

5. In **Share Description**, type a description for the share.
6. Select the **Novell NetWare** checkbox and then click **Next**. The dialog box illustrated in Figure 10-10 is displayed.

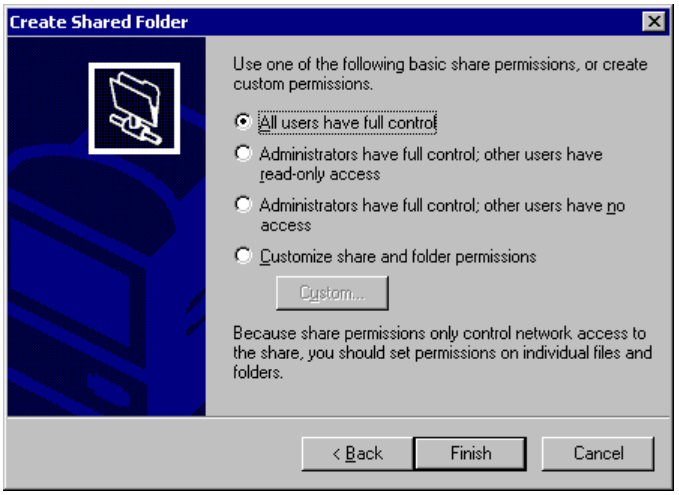


Figure 10-10: NetWare Basic Share Permissions dialog box

7. Select the appropriate permissions level.

   If a custom permissions level is desired, select the **Customize share and folder permissions** radio button and then click **Custom**. The Customize Permissions dialog box is displayed. Figure 10-11 is an illustration of the Customize Permissions dialog box.

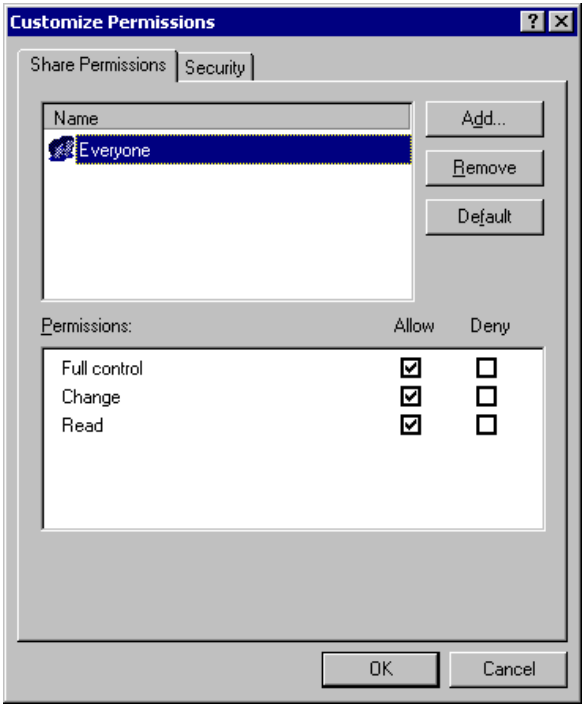


Figure 10-11: Customize Permissions dialog box, Share Permissions tab

8. In the Share Permissions tab, enter choose the appropriate permissions level for each user or group that is configured to have access to that share.
9. To enter file system permissions, select the **Security** tab. The following dialog box is displayed.

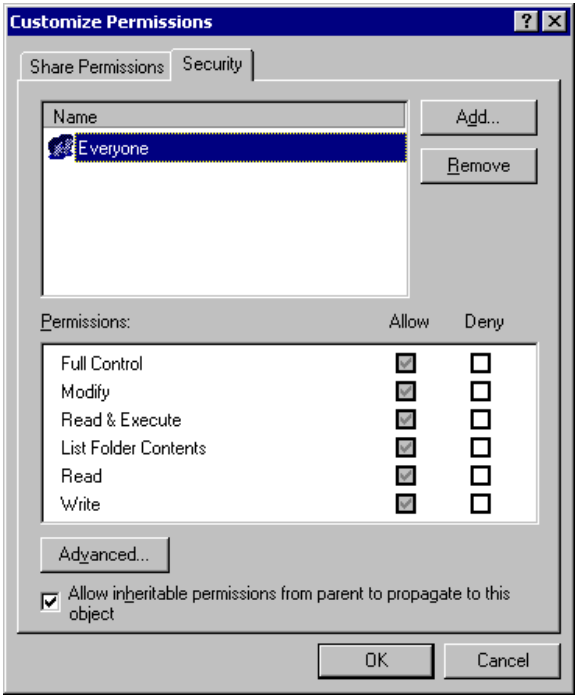


Figure 10-12: Customize Permissions dialog box, Security tab

10. In the Security tab of the Permissions dialog box, enter the file system security properties that apply to the share folder on the server.
11. After the permissions have been entered, click **OK** to return to the Create Shared Folder screens. Click **Finish** to create the share.
12. To create additional shares, click **Yes** at the "Create another shared folder" prompt, otherwise, click **No** to exit.

Modifying NCP Share Properties using the MMC

To change share settings through the MMC:

1. From the NAS B3000 desktop, select the **Microsoft Management Console** icon and then select **File Sharing, Shared Folders**, and **Shares**.
2. In the details pane, right-click the desired share and then click **Properties**.
3. Click the **Share Permissions** tab.
4. *To grant permissions to an additional group or user,* click **Add**, select the group or user, and then click **Add**. After any additional groups or users have been added, click **OK**.
5. *To change the permissions granted to the group or user,* select the desired group or user and then select **Allow** or **Deny** for each item.
6. *To remove permissions for the group or user*, select the desired group or user and them click **Remove**.

NOTES:

1. Permissions can be set on a shared volume regardless of its type of file system.
2. Share permissions are effective only when the share is accessed over the network.
3. The group of permissions you set for the share applies equally to all files and subdirectories in the volume.
4. Permissions on an NTFS share operate in addition to NTFS permissions set on the directory itself. Share permissions specify the maximum access allowed.

11

Cluster Management

One important feature of the *StorageWorks* NAS B3000 is that it can operate as a single node or as a cluster. This chapter discusses cluster management issues. Some of these topics are discussed or mentioned elsewhere in this guide. The discussion in this chapter is more detailed than other references and addresses the unique administration procedures for operating in a clustered environment.

When the cluster option is selected during the Rapid Startup setup program, after its completion, Rapid Startup activates the Cluster Setup Tool (CST). The CST guides the administrator through the processes of setting up a cluster.

This chapter discusses:

- Cluster Overview
- Cluster Terms and Components
  - — Nodes
  - — Resource Groups
  - — Resources
  - — Virtual Servers
  - — Failover
  - — Quorum Disk
- Cluster Concepts
  - — Sequence of Events for Cluster Resources
  - — Hierarchy of Cluster Resource Components

- Cluster Planning
  - Storage Planning
  - Network Planning
  - Protocol Planning
- Cluster Setup
- Cluster-Specific System Parameter Settings
- Basic Cluster Administration Procedures
  - Failing Over and Failing Back
  - Restarting One of the Cluster Nodes
  - Shutting Down One of the Cluster Nodes
  - Powering Down both of the Cluster Nodes
  - Powering Up both of the Cluster Nodes
- Cluster Groups and Resources, including File Shares
  - Group Overview
  - Resource Overview
  - File-Share Resource Planning Issues
  - Using the Cluster Management Wizard
  - Managing Cluster Groups (Details)
  - Managing Cluster Resources (Details)
- SecurePath Configuration in a Clustered Deployment

Cluster Overview

As introduced in the Quick Start Guide, two server heads (nodes) can be connected to each other and deployed as a no single point of failure (NSPOF) dual-redundant cluster. The nodes are connected by a crossover cable and are each connected to network switches or hubs. This connection allows communication between the nodes to track the state of each cluster node. Each node sends out periodic messages to the other node; these messages are called heartbeats. If a node stops sending messages, the cluster service will fail over any resources that the node owns to the other node. For example, if the node that owns the Quorum disk is shut down for any reason, its heartbeat will stop. The other node detects the lack of the heartbeat and takes over ownership of the Quorum disk and the cluster.

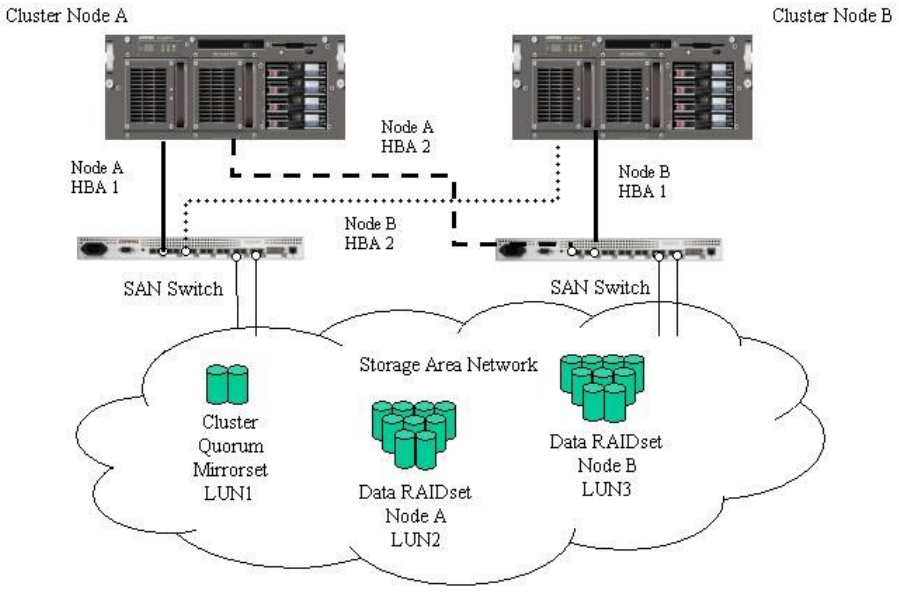


Figure 11-1: NAS B3000 cluster diagram

Cluster Terms and Components

This section provides brief definitions of clustering terms. This information provides basic knowledge of clusters and the terminology used throughout this document.

Nodes

The most basic parts of a cluster are the server heads. A server node is any individual computer in a cluster or a member of the cluster. If the NAS device is a member of a cluster, then the server heads are referred to as nodes.

Resources

Hardware and software components that are managed by the cluster service are called cluster resources. Cluster resources have three defining characteristics:

- They can be brought online and taken offline.
- They can be managed in a cluster.
- They can be owned by only one node at a time.

Examples of cluster resources are IP addresses, network names, storage pools, and file shares.

Virtual Servers

A virtual server is a cluster group that consists of a static IP Address resource and a Network Name resource. Several virtual servers can be created. By assigning ownership of the virtual servers to the different server nodes, the processing load on the NAS devices can be distributed between the two nodes.

The creation of a virtual server allows resources dependant on the virtual server to fail over and fail back between the cluster nodes. File Share and SCE Pool resources are assigned to the virtual server to ensure non-disruptive service of file shares to the clients.

Failover

Failover of cluster groups and resources happens:

- when a node hosting the group becomes inactive. A shutdown of cluster service or a loss of power can cause a failover.
- when all of the resources within the group are dependent on one resource and that resource fails.
- when an administrator forces a failover.

A resource and all of its dependencies must be located in the same group so that if a resource fails over, all of its dependent resources fail over.

When a resource is failed over, the cluster service performs certain procedures. First, all of the resources are taken offline in an order defined by the resource dependencies. Secondly, the cluster service attempts to transfer the group to the next node on the preferred owners list. If the transfer is successful, the resources are brought online in accordance with the resource dependency structure.

The system failover policy defines how the cluster detects and responds to the failure of individual resources in the group. After a failover occurs and the cluster is brought back to its original state, failback can occur automatically based on the policy. After a previously failed node comes online, the cluster service can fail back the groups to the original host. The failback policy must be set before the failover occurs so that failback works as intended.

Quorum Disk

Each cluster must have a shared disk called the Quorum disk. This physical disk in the common cluster disk array plays a critical role in cluster operations. The Quorum disk offers a means of persistent storage. The disk must provide physical storage that can be accessed by any node in the cluster. If a node has control of the quorum resource upon startup, it can initiate the cluster. In addition, if the node can communicate with the node that owns the quorum resource, it can join or remain in the cluster.

The Quorum disk maintains data integrity by:

- storing the most current version of the cluster database.
- guaranteeing that only one set of active communicating nodes is allowed to operate as a cluster.

Cluster Concepts

Microsoft cluster concepts are rather straight-forward when explained through a diagram. Figure 11-2 illustrates a typical cluster configuration with the corresponding storage elements. The diagram progresses from the physical disks to the file shares, showing the relationship between both the cluster elements and the physical devices underlying them.

Sequence of Events for Cluster Resources

The sequence of events in the diagram includes:

1. Physical disks are combined into RAID arrays and LUNs.
2. The LUNs are placed into pools.
3. Virtual disks are formed out of the pools, formatted, and assigned a drive letter.
4. Directories and folders are created on assigned drives.
5. Cluster components (virtual servers, file shares) are created, organized in groups, and placed within the folders.

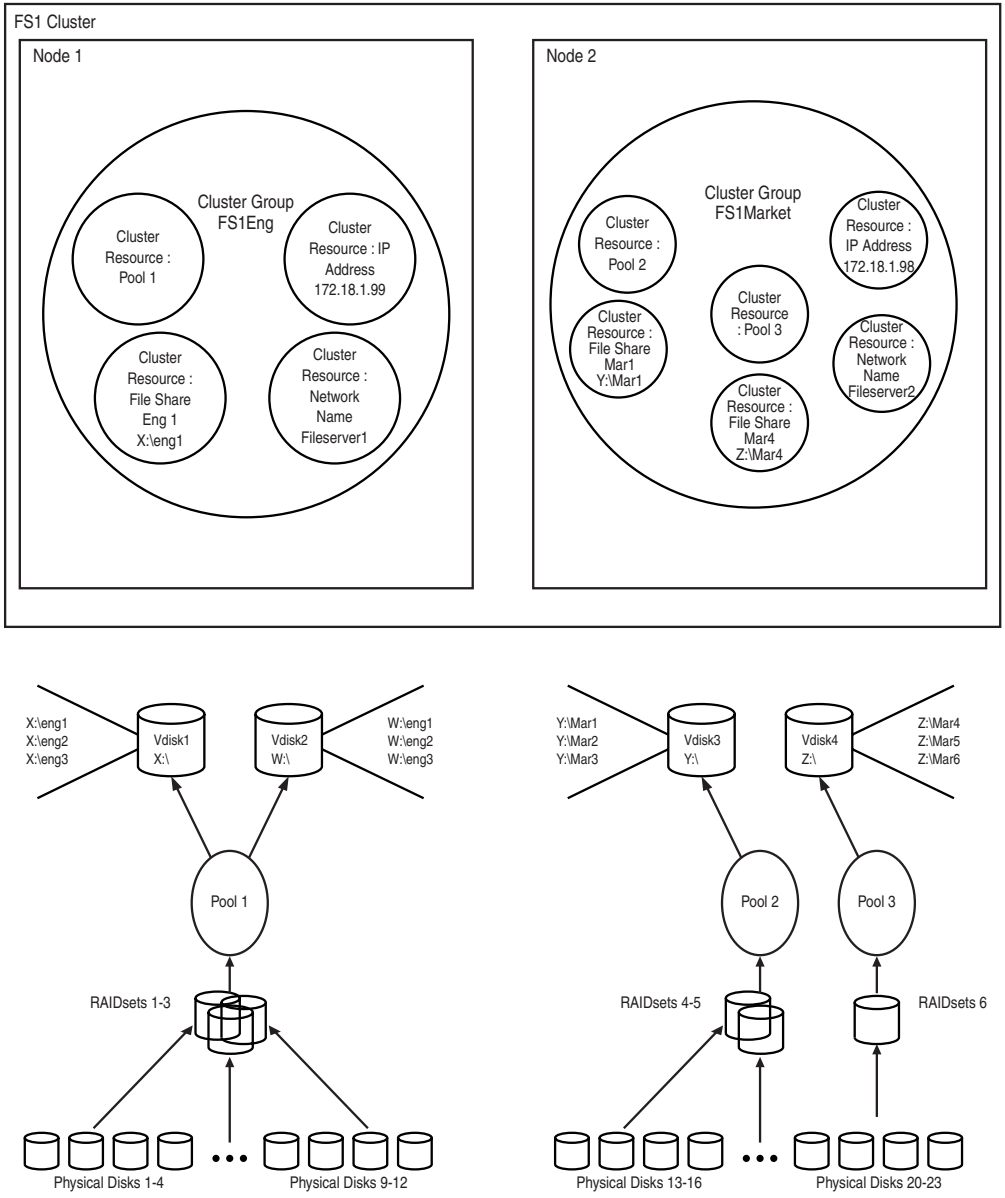


Figure 11-2: Cluster Concepts diagram

Hierarchy of Cluster Resource Components

The cluster components are referred to as resources and are placed together in groups. Groups are the basic unit of failover between nodes. Resources do not failover individually, rather they failover with the group in which they are contained.

In Figure 11-2 it is depicted as follows:

- **Pool** resources are placed in a group and relate to the VR pool that is created as part of the storage elements. It should be noted that when a pool is created through Virtual Replicator, a cluster pool resource is automatically created for the pool.
- **File Share** resources are placed in a group and relate to the actual directory on the drive on which the share is being created.
- An **IP Address** resource is formed in the group and relates to the IP address by which the group's virtual server is identified on the network.
- A **Network Name** resource is formed in the group and relates to the name published on the network by which the group is identified.
- A **Virtual Server** is a group containing an IP Address resource and a Network Name resource. File share and pool resources assigned to this virtual server group can transition from one node to the other during failover conditions.
- The **Group** is owned by one of the nodes of the cluster, but may transition to the other node during failover conditions.

The diagram illustrates a cluster containing two nodes. Each node has ownership of one group. Contained within each group is a singular file share that is known on the network by the associated Network Name and IP address. In the specific case of Node1, file share Eng1 relates to X:\Eng1. This file share is known on the network as \\Fileserver1\Eng1 with an IP address of 172.18.1.99. X:\Eng1 relates to the actual virtual disk X: containing a directory Eng1. The virtual disk X: is created from pool1.

For cluster resources to function properly, two very important requirements should be adhered to:

- Dependencies between resources of a group must be established. Dependencies determine the order of startup when a group comes online. In the above case, the following order should be maintained:

  — Pool — File Share

  — Pool — NFS File Share

  — IP Address — Network Name

  Failure to indicate the dependencies of a resource properly may result in the file share attempting to come online prior to the pool being available, resulting in a failed file share.

- Groups should have a Network Name resource and an IP Address resource. These resources are used by the network to give each group a virtual name. Without this virtual reference to the group, the only way to address a share that is created as a clustered resource is by node name. Physical node names do not transition during a failover, whereas virtual names do.

  For example, if from a client a network share map F: was established and assigned to \\Node1\Eng1 instead of \\Fileserver1\Eng1, when Node1 fails and Node2 assumes ownership, the map will be come invalid because the reference in the map is to \\Node1. If the map were created to the virtual name and Node1 were to fail, the map would still exist when the group associated with Eng1 failed over to Node2.

  The previous diagram is an example and is not intended to imply limitations of a single group or node. Groups can contain multiple pools and file shares and nodes can have multiple groups, as shown by the group owned by Node2.

Cluster Planning

Clustering the NAS B3000 greatly enhances the availability of file service by enabling file shares to fail over to a second NAS B3000 device, if problems arise. Clients see only a brief interruption of service as the file share resource transitions from one server node to the other.

Requirements for taking advantage of clustering include:

- Storage planning
- Network planning
- Protocol planning

Storage Planning

For clustering, an additional storage unit (LUN) must be designated for the cluster and configured as a mirrorset. This LUN is used for the Quorum disk. The Quorum disk is the shared storage used by the cluster nodes to coordinate the internal cluster state.

One or more RAID arrays are dedicated to each cluster node for data storage. Each cluster node will assume ownership of at least one VR pool. That owner node will serve all virtual disks and shares within that pool, until a failover condition occurs. When a failover occurs, the pool, virtual disk, and all associated shares will transition over to the remaining node and will remain there until the other node is returned to service. Some types of shares are not cluster-aware and will not be available during a failover condition. See the “Protocol Planning” section for additional information.

In both non-clustered and clustered deployments of the NAS B3000, virtual storage such as pools, virtual disks, and snapshots are managed through the Virtual Replicator. For clustered environments, the process of creating and managing these resources is the same, but VR prepares them for use in a clustered environment.

To prepare a VR resource for use in a cluster, VR automatically creates a cluster group for each pool as the pool is created. In addition, VR creates an SCE (Storage and Clusters Extension) resource for each pool. This SCE pool resource is required for VR to successfully work in a cluster environment.

CAUTION: Do not rename or delete a SCE pool resource. Renaming can cause the loss or corruption of data.

For organizational purposes, the SCE pool resource can be moved to another group. See "Managing Cluster Resources (Details)" for information on moving resources.

Network Planning

Clusters require more sophisticated networking arrangements than a stand-alone NAS device. For example, because a cluster must be deployed into a domain environment, workgroups are not supported. A Windows NT domain or Active Directory domain must be in place to contain the cluster names, virtual server names, and user and group information. A cluster cannot be deployed into a non-domain environment.

All cluster deployments have at least six network addresses and network names:

- The cluster name and IP address
- Node A's name and IP address
- Node B's name and IP address
- At least one virtual server name and IP address for Node A
- At least one virtual server name and IP address for Node B
- Remote Insight Lights Out Edition board name and IP address
- Cluster Interconnect static IP addresses for Node A and Node B.

Virtual names and addresses are the only identification used by clients on the network. Because the names and addresses are virtual, their ownership can transition from one node to the other during a failover, preserving access to the shares on the virtual disks.

In addition, a cluster will use at least two network connections on each node:

- The cluster interconnect or "heartbeat" crossover cable connects to the first network port on each cluster node.
- The client network subnet connects to a second network port on each cluster node. The cluster node names and virtual server names will have IP addresses residing on these subnets.

IMPORTANT: If the share is to remain available during a failover, each cluster node must be connected to the same network subnet. It is impossible for a cluster node to serve the data to a network to which it is not connected.

Protocol Planning

The NAS B3000 supports many file sharing protocols, including sharing protocols for Windows, UNIX, Linux, Novell, Macintosh, Web, and FTP clients. However, not all of these protocols can take advantage of clustering. If a protocol does not support clustering, the share will not be available to the clients until the owner cluster node is brought back online.

Compaq recommends placing cluster-aware and non-cluster-aware protocols on different file shares.

Use the information in Table 11-1 to determine whether it is advantageous to use clustering.

Table 11-1: Sharing Protocol Cluster Support

Protocol	Client Variant	Cluster-Aware
CIFS	Windows NT	Yes
	Windows 2000	
	Windows 95	
	Windows 98	
	Windows ME	
NFS	UNIX	Yes
	Linux	
HTTP	Web	No
FTP	Many	Yes
NCP	Novell	No
AppleTalk	Apple	No

Cluster Setup

The Cluster Setup Tool (CST) guides the administrator through the processes of setting up a clustered NAS B3000.

The process of clustering two NAS B3000 devices includes several steps, sometimes performed on each node and sometimes only on one node. The Cluster Setup Tool is a guided checklist that includes all procedures. Suggestions and guidance are also included in the Cluster Setup Tool. Some of the procedures are automated.

If the "cluster" checkbox is selected during the Rapid Startup Utility, the CST is automatically activated as the Rapid Startup procedures are completed. If necessary, the CST can also be accessed as a menu option on the WebUI.

IMPORTANT: If a NAS B3000 is initially deployed as a single-node system, there is no smooth transition from the non-clustered setup to a clustered setup without a complete system backup and restore.

The main processes of setting up clustered NAS devices include:

- Running the Rapid Startup utility on each node of the cluster
- Running the CST
  - — Configure the NAS devices
  - — Confirm the availability of the Quorum disk
  - — Create LUNs
  - — Install Microsoft Cluster Service (MSCS)
  - — Configure SecurePath
  - — Un-install and re-install Virtual Replicator (VR)
  - — Upgrade Services for UNIX (SFU)
- Entering cluster-specific parameter settings, optional
- Setting up NFS user name mapping (if applicable)
- Setting up cluster groups and resources, including file shares (can be done as part of the CST)

Cluster-Specific System Parameter Settings

The NAS B3000 comes with pre-set cluster parameter settings, which should be sufficient for most deployments. If necessary, administrators with advanced cluster knowledge can change these settings. Changes to system parameters must be performed with great caution.

To modify system settings about the cluster:

From the WebUI, select **Cluster Management**, **Settings**. Several sub-screens are available, including:

- Networks
- Network Interfaces
- Nodes
- Resource Types

Each of these types of settings is discussed in the following paragraphs.

Networks Settings

Use this option to enter parameters for the system heartbeat, LAN, and other cluster networks.

NOTE: Because they affect the state of the cluster, changes to cluster network settings must be done with great caution. Any changes must be performed after the cluster has been completely set up.

1. From the **Cluster Management**, **Settings** dialog box, select **Networks**. The Networks dialog box is displayed.
2. Select the network to modify and then click **Modify**. The **Modify Network** dialog box is displayed. See Figure 11-3 for an example of the Networks dialog box.

3. For each network, modify and indicate the following:
   - Network name and description
   - Network role (public, private, or mixed)

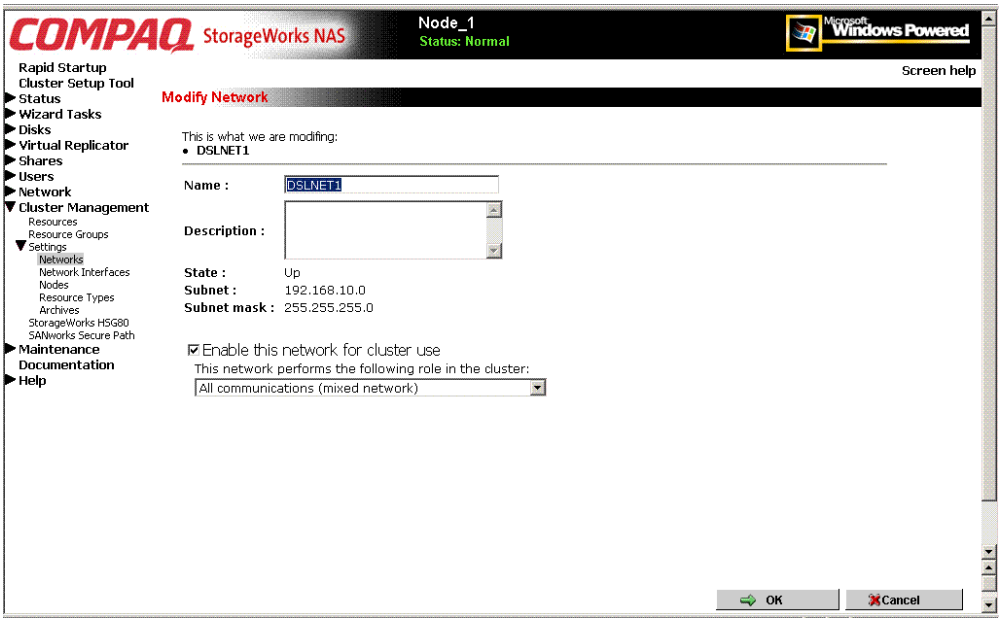


Figure 11-3: Cluster Settings - Networks dialog box

4. After all settings have been entered, click **OK**. The Networks dialog box is displayed again.

Network Interface Settings

To modify parameters about the network interfaces:

1. From the **Cluster Management**, **Settings** dialog box, select **Network Interfaces**. The Network Interface dialog box is displayed.
2. All interfaces are listed. Select the interface to modify, and then click **Modify**.

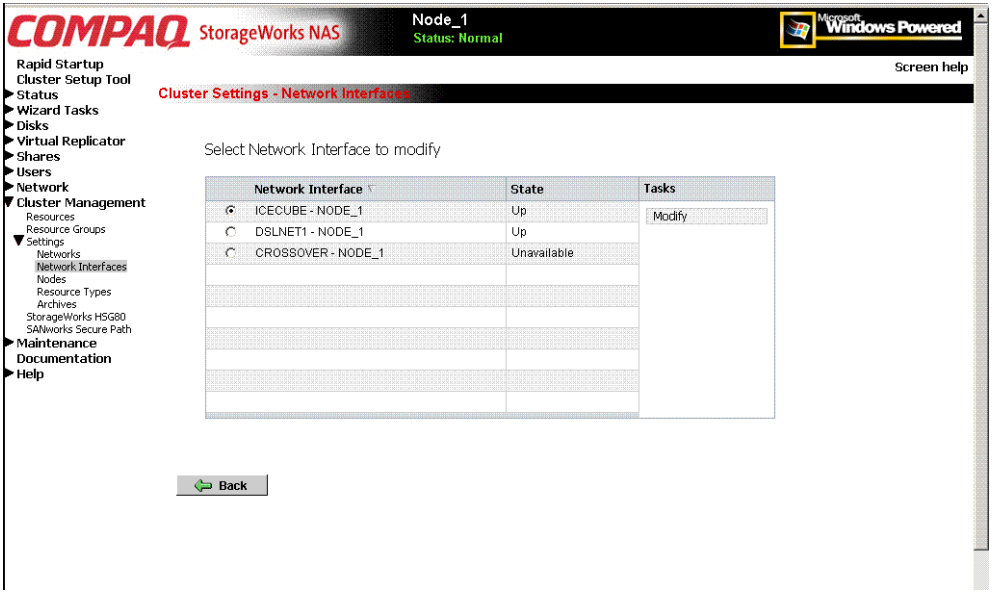


Figure 11-4: Cluster Settings - Network Interfaces dialog box

Node Settings

The following functions can be executed on each node: modify the node description, pause or resume a node, and evict a node.

To perform one of these tasks on a node:

1. From the **Cluster Management**, **Settings** dialog box, select **Nodes**.

   The **Nodes** dialog box is displayed.

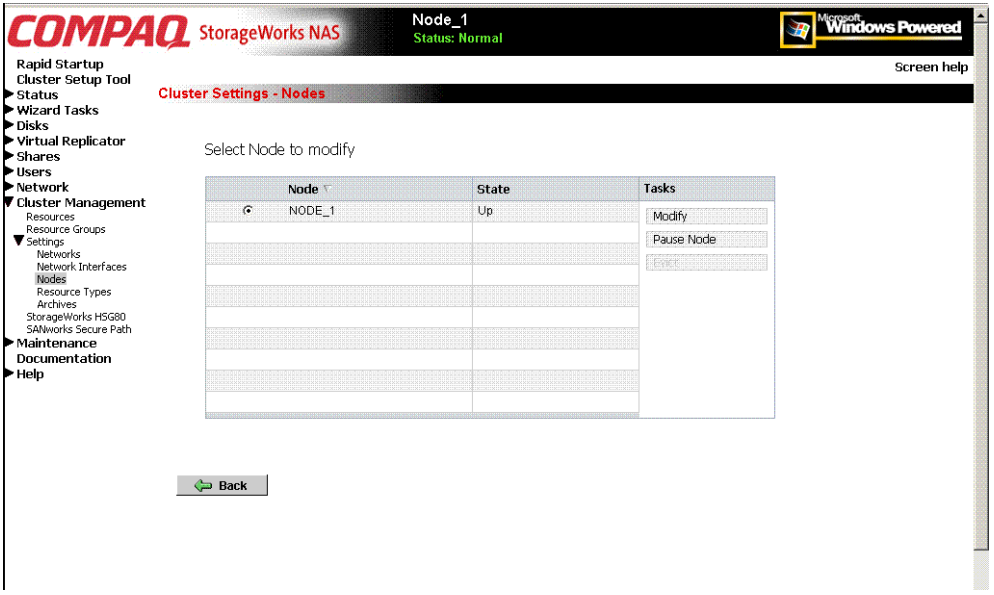


Figure 11-5: Cluster Settings - Nodes dialog box

2. All nodes are listed. Select the node to work with, and then click the appropriate **Task** button.

   a. *To modify the node description,* click the **Modify** button.

   b. *To pause or resume the node,* click the **Pause Node** or **Resume Node** button.

   c. *To evict a node,* click the **Evict** button.

Resource Types

To modify settings for the different resource types:

1. From the **Cluster Management**, **Settings** dialog box, select **Resource Types**. The **Resource Types** dialog box is displayed.
2. All types of resources are displayed. Select the type of resource to modify and then click **Modify**.

   The **Modify Resource Types** dialog box is displayed.

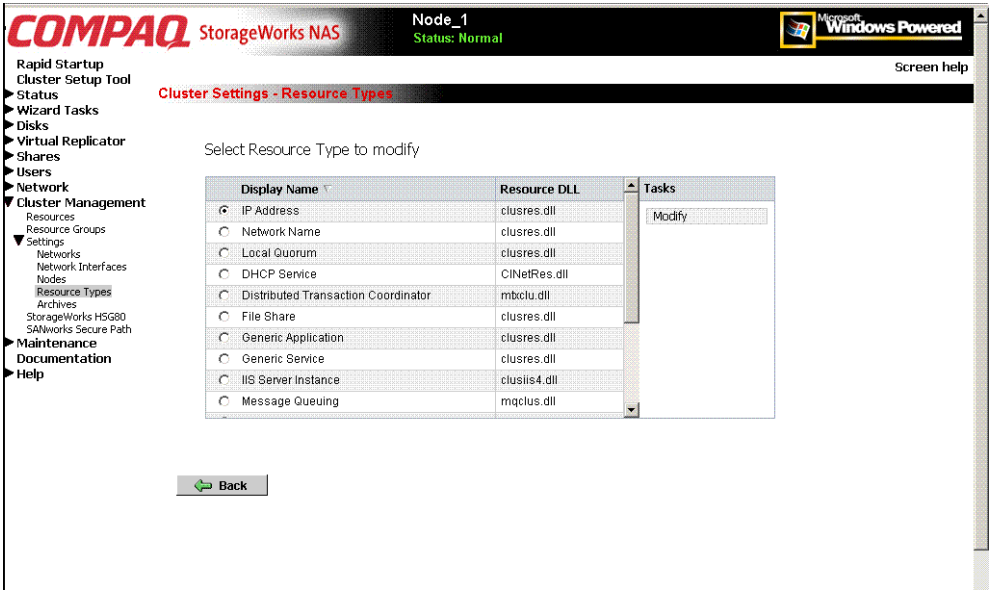


Figure 11-6: Cluster Settings - Resource Types dialog box

3. Select the resource type to modify, and then click **Modify**. The Modify Resource Type dialog box is displayed.
4. For each resource type, modify the following settings:
   - Resource name
   - Resource description
   - "Looks Alive" polling interval
   - "Is alive" polling interval
5. After all settings have been entered for this resource type, click **OK**. The Resource Types dialog box is displayed again.

Basic Cluster Administration Procedures

- Failing over and failing back
- Restarting one cluster node
- Shutting down one cluster node
- Powering down both cluster nodes
- Powering up both cluster nodes

Failing Over and Failing Back

As previously mentioned, when a node goes offline, all of the resources dependent on that node are automatically failed over to the other node. Processing continues, but in a reduced manner because all operations must be processed on the remaining node.

Because operating environments differ, the administrator must indicate whether the system will automatically fail the resources (organized by resource groups) back to their original node or will leave the resources failed over, waiting for the resources to be moved back manually. See "Managing Cluster Resource Groups (Details)" for information on allowing or preventing failback and moving these resources from one node to another.

IMPORTANT: If the NAS B3000 is not set to automatically fail back the resources to their designated owner, the resources must be moved back manually each time a failover occurs. See "Managing Cluster Resource Groups (Details)" for information on overriding this default setting.

Restarting One Cluster Node

IMPORTANT: Restarting a cluster node should be done only after confirming that the other node in the cluster is functioning normally. Adequate warning should be given to users connected to resources of the node being restarted.

The physical process of restarting one of the nodes of a cluster is the same as restarting a NAS device in single node environment. However, additional caution is needed.

Restarting a cluster node causes all file shares served by that node to fail over to the other node in the cluster. Until the failover process completes, any currently executing read and write operations will fail. The other node will be placed under a heavier load by the extra work until the restarted node comes up.

Shutting Down One Cluster Node

IMPORTANT: Shutting down a cluster node must be done only after confirming that the other node in the cluster is functioning normally. Adequate warning should be given to users connected to resources of the node being restarted.

Shutting down a cluster node causes file shares served by that node to fail over to the other node. This will cause any currently executing client read and write operations to fail until the cluster failover process completes. The other node will be placed under a heavier load by the extra work until the second node is powered up and rejoins the cluster.

Powering Down both Cluster Nodes

The power down process for the NAS B3000 cluster is similar to the process for a single node, but with the cluster, extra care must be taken with the storage subsystem and the sequence of the shutdown.

The power-down process is divided into two main steps:

1. Shutting down the cluster nodes
2. Removing power from the cluster nodes

The sequence of these steps is critical. The devices **must** be shut down before the storage subsystem. Improperly shutting down the nodes and the storage subsystem causes corruption and loss of data.

IMPORTANT: Before powering down the cluster nodes, follow the proper shutdown procedure as previously illustrated. See ”Shutting Down One Cluster Node.”

IMPORTANT: The cluster nodes should never be powered on when the storage subsystem is not available.

Powering Up both Cluster Nodes

The power up process for the NAS B3000 cluster is more complex than it is for a single node because extra care must be taken with the storage subsystem.

The power up process can be divided into three segments of the process:

1. Supplying power
2. Verifying the storage subsystem
3. Powering up the cluster nodes

The sequence of these three steps is critical. The devices **must** be restarted after the storage subsystem has been restarted. Improperly restarting the nodes and the storage subsystem causes corruption and loss of data.

IMPORTANT: Do not power up the cluster nodes without first powering up the storage subsystem, and verifying it is operating normally.

To power up the cluster nodes:

1. After power has been supplied and the storage subsystem is confirmed to be operating normally, power up a single node by pressing the power button on the front of the device. Wait for the node to come completely up before powering up the second node.

   If both nodes are powered up at the same time, the first node that completes the sequence will gain ownership of the cluster quorum and will control the cluster database. Designate a particular node as the usual cluster quorum owner by always powering up that node first and letting it completely restart before powering up the second cluster node.

2. Power up the second cluster node by pressing the power button on the front of the device.

   As each node starts, the monitor displays the logon dialog. Background processes will start the cluster service and form the cluster.

Cluster Groups and Resources, including File Shares

Management tasks for a cluster include creating and managing cluster resources and cluster groups. As mentioned previously, cluster resources are created and then assigned to logical, organizational groups. Ownership of these groups should be assigned in a balanced arrangement between the server nodes, distributing the processing load between the two nodes.

Cluster resources include administrative types of resources as well as file shares. The following paragraphs include overview and planning issues for cluster groups, cluster resources, and clustered file shares.

Creating and managing these resources and groups can be managed through the intuitive wizard interface of the WebUI as well as through the topic-specific management screens of the WebUI. These procedural instructions are discussed later is this chapter.

Cluster Group Overview

A default cluster group is automatically created when the cluster is first created. This default cluster group contains an Internet Protocol (IP) Address resource, a Network Name resource, and the Quorum disk resource. When the new cluster is created, the (IP) address and the cluster name that were specified during setup are set up as the IP address and network name of this default cluster group.

CAUTION: Do not delete or rename the Cluster Group or IP Address. Doing so will result in losing the cluster and will require reinstallation of the cluster.

When creating groups, the administrator's first priority is to gain an understanding of how to manage the groups and their resources. Administrators may choose to create a resource group and a virtual server (IP Address resource and Network Name resource) for each node that will contain all resources owned by that node, or the administrator may choose to create a resource group and virtual server for each pool created in Virtual Replicator (VR). See the "Virtual Storage Management" chapter for detailed information on VR resources. Additionally, the administrator should try to balance the load of the groups and their resources on the cluster between the two nodes.

Node Based Cluster Groups

Creating only one resource group and one virtual server for each node facilitates group and resource administration. This setup allows administrators to include all file share resources under one group. Clients access all of the resources owned by one node through a virtual server name.

In node based cluster groups, each group has its own network name and IP address. The administrator decides on which node to place each pool resource. This configuration provides a very coarse level of granularity. All resources within a group must remain on the same node. Only two IP addresses and network names are required. This configuration creates less overhead for resource and network administration. A possible disadvantage of this approach is that the resource groups can potentially grow large when many file shares are created.

Pool Based Cluster Groups

Alternatively, creating one resource group and one virtual server for each pool (SCE Pool resource) that is created in VR allows administrators to dedicate groups to specific departments. For example, an administrator can create the following resource groups:

- Finance
- Marketing

The administrator can then provide each department with a unique IP address and network name. If one of the resource groups becomes unavailable, the other group is still available. This configuration provides administrators with more granular control of the resource groups. In this type of configuration, every time a new VR pool is created a new virtual server must be created.

For each group, a network name and IP address must be created. Each group contains a single pool, network name, IP address, and any file share resources. The administrator chooses which node owns each pool. However, the more groups that are created, the more network names and IP addresses the administrator has to manage. Remembering where a certain resource is located requires more administrative overhead and forces clients to map more drive letters.

Load Balancing

The creation of separate cluster groups for each virtual server provides more flexibility in balancing the processing load on the cluster between the two nodes. Each cluster group can be assigned to a cluster node with the preferred owner parameter. For example, if there are two cluster groups, the cluster could be set up to have the first cluster group owned by node A and the second cluster group owned by node B. This allows the network load to be handled by both devices simultaneously. If only one cluster group exists, it can only be owned by one node and the other node would not serve any network traffic.

Cluster Resource Overview

Hardware and software components that are managed by the cluster service are called cluster resources.

Resources represent individual system components. These resources are then organized into groups and managed as a group.

Some resources are created automatically by the system and other resources must be set up manually.

Resource Types:

- IP Address resource
- Cluster name resource
- Cluster Quorum disk resource
- SCE pool resources (automatically created by VR)
- Virtual server name resources
- CIFS file share resources
- NFS file share resources

File-Share Resource Planning Issues

CIFS and NFS are cluster-aware protocols that support the Active/Active cluster model, allowing resources to be spread out and processed on both nodes at the same time. For example, some NFS file share resources can be assigned to a group owned by a virtual server for NodeA and additional NFS file share resources can be assigned to a group owned by a virtual server for NodeB.

Configuring the file shares as cluster resources provides for high availability of file shares. Because the resources are placed into groups, ownership of the files can easily move from one node to the other, as circumstances require. If the cluster node owning the group of file shares should be shut down or fail, the other node in the cluster will begin sharing the directories until the original owner node is brought back on-line. At that time, ownership of the group and its resources can be brought back to the original owner node.

Sequential Planning

1. Create at least one virtual server for each node in the cluster.

   A virtual server is a resource group consisting of an IP Address resource and a Network Name resource. Ownership of these virtual servers should be assigned to the different server nodes. In addition to providing load-balancing capabilities, the virtual server allows for the transition of group resources in failover situations.

2. Create at least one resource group for each virtual server in the cluster.

   Cluster resource groups are used to balance the processing load on the servers. Distribute ownership of the groups between the virtual servers.

3. For NFS environments, configure the NFS server.

   NFS-specific procedures include entering audit and file lock information as well as setting up client groups and user name mappings. These procedures are not unique to a clustered deployment and are detailed in the “UNIX File System Management” chapter. Changes to NFS setup information are automatically replicated to all nodes in a cluster.

4. Create the file share resources.

   In a clustered environment, file shares are created as a type of cluster resource. Creating cluster resources and file shares is documented later in this chapter.

5. Assign ownership of the file share resources to the resource groups.

   Divide ownership of the file share resource between the resource groups, which are in turn distributed between the virtual servers, for effective load balancing.

   Make sure that the pool resource for this file share is also included in this group.

   Make sure that the resources are dependent on the virtual servers and pools from which the virtual disk and file share was created.

NFS Cluster-Specific Issues

In addition to the user name mapping best practices outlined in the "UNIX File System Management" chapter, there are additional recommendations.

For convenience, all suggestions are listed below:

- **Back up user and group mappings**

  To avoid loss of complex advanced mappings in the case of a system failure, back up the mappings whenever the mappings have been edited or new mappings have been added.

- **Map consistently**

  Groups that are mapped to each other should contain the same users and the members of the groups should be properly mapped to each other to ensure proper file access.

- **Map properly**
  - — Valid UNIX users should be mapped to valid Windows users.
  - — Valid UNIX groups should be mapped to valid Windows groups.
  - — Mapped Windows user must have the **Access this computer from the Network** privilege, or the mapping will be squashed.
  - — The mapped Windows user must have an active password, or the mapping will be squashed.

- **In a clustered deployment, create user name mappings using domain user accounts.**

  Because the security identifiers of local accounts are recognized only by the local server, other nodes in the cluster will not be able to resolve those accounts during a failover. Do not create mappings using local user and group accounts.

- **In a clustered deployment, administer user name mapping on a computer that belongs to a trusted domain.**

  If NFS administration tasks are performed on a computer that belongs to a domain that is not trusted by the domain of the cluster, the changes are not properly replicated among the nodes in the cluster.

- **In a clustered deployment, if PCNFS password and group files are being used to provide user and group information, these files must be located on each node of the system.**

  These password and group files on each server node must be updated periodically to maintain consistency and prevent users or groups from being inadvertently squashed.

Using the Cluster Management Wizard

To access the Cluster Management Wizard:

1. Go to the WebUI and select **Wizard Tasks**, **Cluster Management**. A Welcome screen is displayed. Click **Next** to continue.
2. The next screen of the wizard is displayed, listing the resources that have already been set up. Expand the display to see the nested resources and select the resource to work with.
3. Task options are now displayed in the right portion of the screen. Options include:
   - Modify
   - Delete
   - Create New Group
   - Create New Resource

   Each of these options is discussed in the following paragraphs.

   Depending on the resource type that was selected, the available options will differ. For example, if a resource has other resources dependent upon it, the Delete option is not displayed and the resource cannot be deleted.

Modify

To modify settings for a resource or resource group:

1. After selecting the desired resource or resource group, move the cursor to the field setting that needs to be changed. Enter the new value and then click **Modify**.
2. *For resource groups*, the following fields can be changed: name and description.
3. *For resources*, depending on the type of resource that is chosen, the following fields may be changed: name, description, IP Address, Subnet mask, and Network type.

Delete

To delete a resource or resource group, after selecting the desired resource or resource group, click **Delete**.

If the **Delete** option is not available, the selected resource has other resources dependent upon it. In order to protect the integrity of the files and the data, a resource or group cannot be deleted if it has other resources dependent upon it. After all subordinate resources are deleted, the owner resource or resource group can be deleted.

Create New Group

To create a new Resource Group:

1. Click **Create New Group**.
2. Enter a group Name and Description.
3. Click **Create**.

   The group is created and is immediately available.

Create New Resource

To create a new cluster resource:

1. Click **Create New Resource**. Enter a resource Name and Description.
2. Specify a Resource Type

   Possible resource types include:

   - IP Address
   - Network Name
   - File Share
   - NS File Share
   - Generic Application
   - Generic Service

Depending on the Resource Type that was selected, different sub-screens are displayed, including:

- Possible owners
- Dependencies
- IP Address information
- File share information

3. After all information for the resource is completed, click **Create**.

Managing Cluster Resource Groups (Details)

Cluster groups can be managed through the **Cluster Management Wizard** and through the Cluster Groups dialog box. The wizard is the recommended method and is very intuitive and easy to use.

This section discusses the Cluster Resource Groups dialog boxes because these dialog boxes contain complete Group functionality. Some auxiliary options are not included in the Wizard.

To manage cluster resource groups, from the WebUI, select **Cluster Management**, **Resource Groups**. The Resource Groups dialog box is displayed.

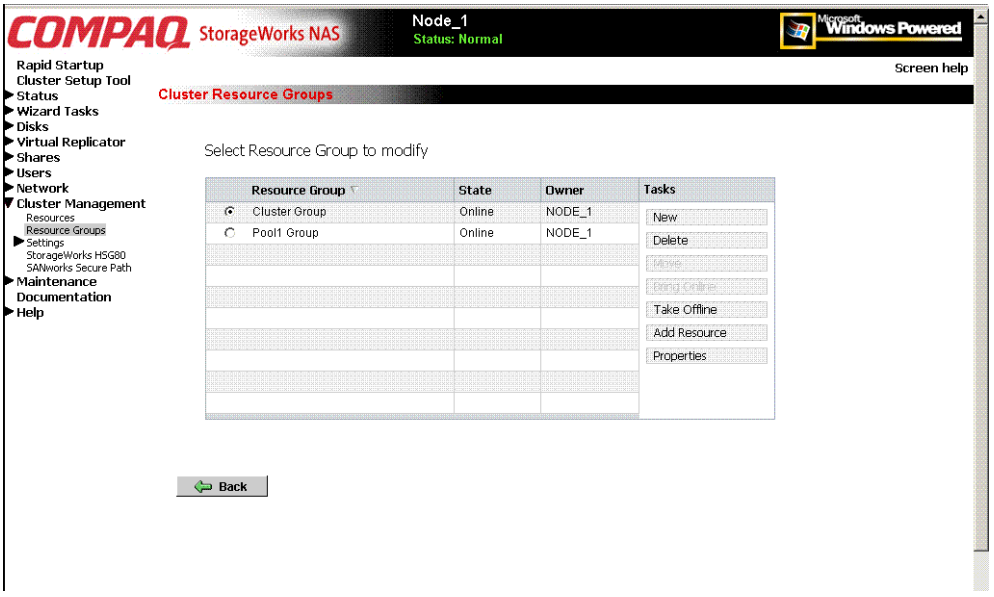


Figure 11-7: Cluster Resource Groups dialog box

Options include:

- Creating a new resource group
- Deleting a resource group
- Moving a resource group from one node to another node
- Bringing a resource group online and taking a resource group offline
- Adding a new resource to a group
- Modifying resource group properties

Creating a New Resource Group

To create a new resource group:

1. From the **Resource** dialog box, click **New**. The Create New Resource Group dialog box is displayed.

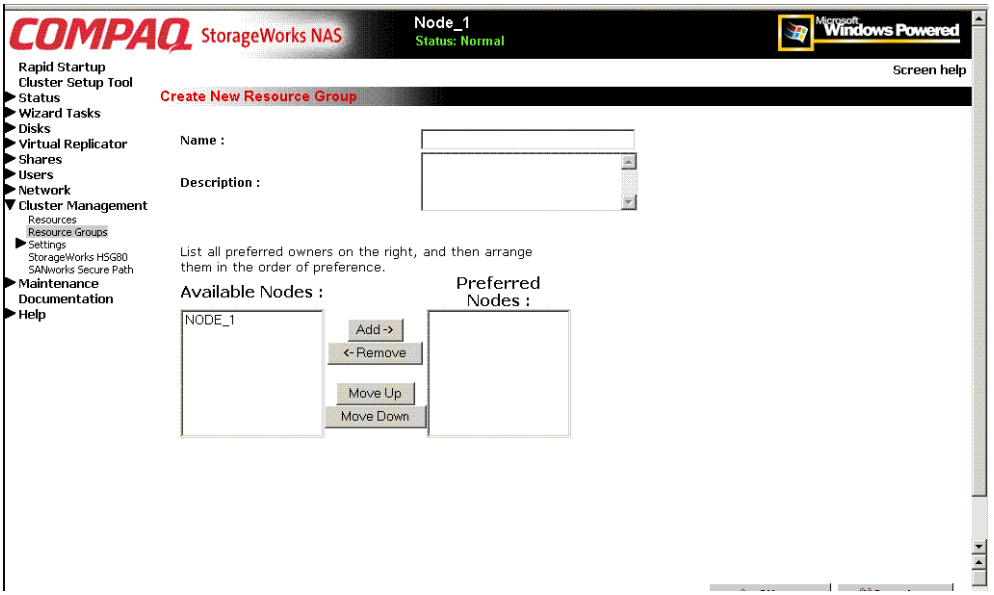


Figure 11-8: Create New Resource Group dialog box

2. Enter a Name and Description for the group.

3. Add the nodes that can own this group. Available nodes are listed in the **Available Nodes** box. Select the nodes and then click **Add**. They are now listed in the **Preferred Nodes** box.
4. Indicate the preferred owner of the group by selecting the nodes in the **Preferred Nodes** box and then clicking the **Move Up** and **Move Down** buttons to arrange them in preferred order.

Deleting a resource group

CAUTION: Do not delete or rename the Cluster Group or IP Address; doing so will result in losing the cluster and will require reinstallation of the cluster.

IMPORTANT: Do not delete storage pool resources. To delete a pool, use Virtual Replicator. VR will automatically delete the SCE pool resource at the same time it deletes the pool.

To delete a resource group, first delete all of the resources in that group. Then, from the **Resource Group** dialog box, select the group to delete and then click **Delete**. A warning screen is displayed. Verify that the intended group is selected and then click **OK**.

Moving a Resource Group from One Node to Another Node

To move a resource group from one node to another, from the **Resource Groups** dialog box, select the group to move, and then click **Move**. A confirmation screen is displayed. Confirm that this is the node to move, and then click **OK**.

Bringing a Resource Group Online and Taking a Resource Group Offline

To toggle the state of a cluster from online to offline or from offline back to online, from the **Resource Groups** dialog box, select the desired group and then click **Bring Online** or **Take Offline**, respectively. A confirmation screen is displayed. Confirm the accuracy of the display and then click **OK**.

Adding a New Resource to a Group

To add a new resource to a group, from the **Resource Groups** dialog box, select the group to add the resource to, and then click **Add Resource**. The Welcome screen of the **Create Resource** wizard is displayed. See "Creating a New Resource," later in this chapter for information on creating resources.

Modifying resource group properties

To modify resource group properties:

1. From the **Resource Groups** dialog box, select the group to modify and then click **Properties**.

   The Resource Group Properties dialog box is displayed.

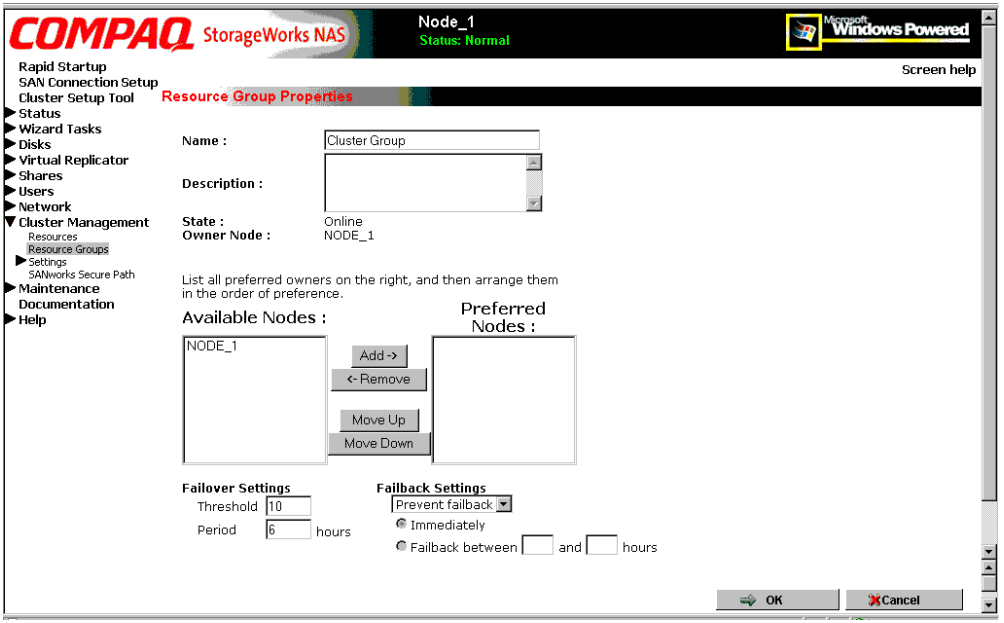


Figure 11-9: Resource Group Properties dialog box

2. As needed, change the group:
   - Name
   - Description
   - Preferred nodes
3. Enter failover settings.

   Enter values in the **Threshold** and **Period** fields to indicate how many times (Threshold) in a period of time (Period) the group is allowed to fail over before the group is automatically taken offline by the system.
4. Enter failback settings.

   In the case of a node failure, the group will automatically fail over to the available node. Use the **Failback Settings** drop-down box and radio buttons to indicate how the system will move the group back to the preferred node when it becomes available.
   - To control the failback manually, select **Prevent Failback** in the Failback Settings drop-down box.
   - To fail back the group automatically to the preferred node when it becomes available, select **Allow Failback**.

     If **Allow Failback** is selected, indicate when the system is to execute the fail back.
     - — To failback as soon as the preferred node becomes available, click **Immediately**.
     - — To indicate a preferred time of day for the failback, enter values in the **Failback between** fields. The numbers correspond to the local time of the cluster group. Use a 24-hour clock. To failback the following day, enter a higher number in the first of the two fields. For example, to authorize failback between 11:00 pm and 3:00 am, enter 23 and 3.

Managing Cluster Resources (Details)

To manage cluster resources without using the Wizard, select **Cluster Management**, **Resources**. The Cluster Resource dialog box is displayed.

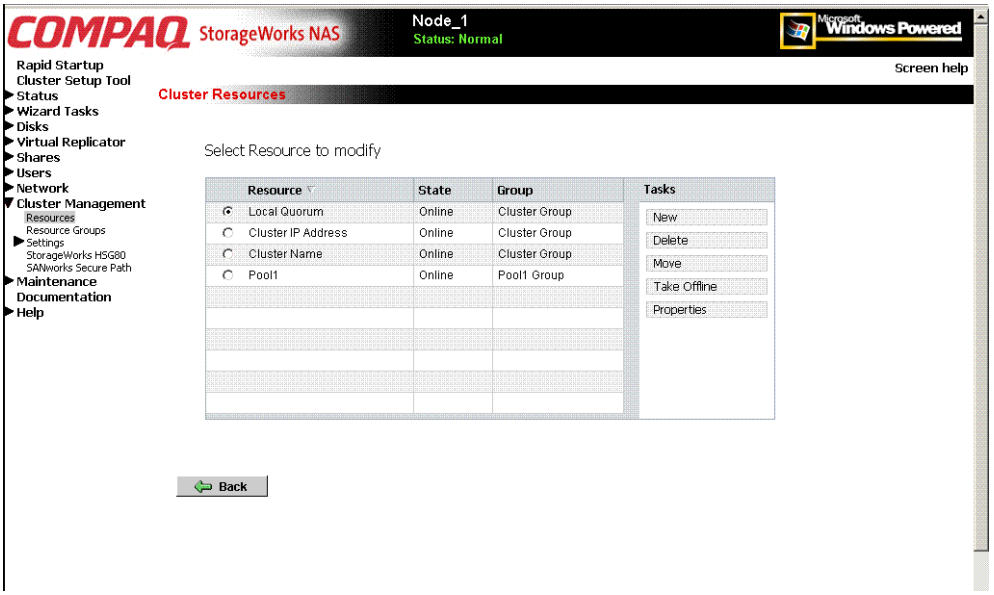


Figure 11-10: Cluster Resources dialog box

Options include:

- Creating a new resource
- Deleting a resource
- Moving a resource
- Bringing a resource online
- Modifying resource properties

Creating a New Resource

Many cluster resources are automatically created by the system, such as the Quorum disk resource and the SCE Pool resources. Manually created resources include:

- Virtual servers
- Cluster aware file shares, including CIFS and NFS

To create a new resource:

1. From the **Resource** dialog box, click **New**.

   The Welcome screen of the Create Resource wizard is displayed.

2. Click **Next** to continue.

   A general information screen is displayed. Depending on the type of resource being created, different sub-screens are displayed. Sub-screens include:

   - General information screen
   - Possible owners screen
   - Dependencies screen
   - Resource-type specific screen

   Each screen is detailed on the following pages.

3. After completing all sub-screens, click **OK**.

General information screen

This preliminary screen is displayed for all resource types. It contains basic information indicating the resource name and description, as well as identifies what type of resource it is. Figure 11-11 is an example of the general information screen.

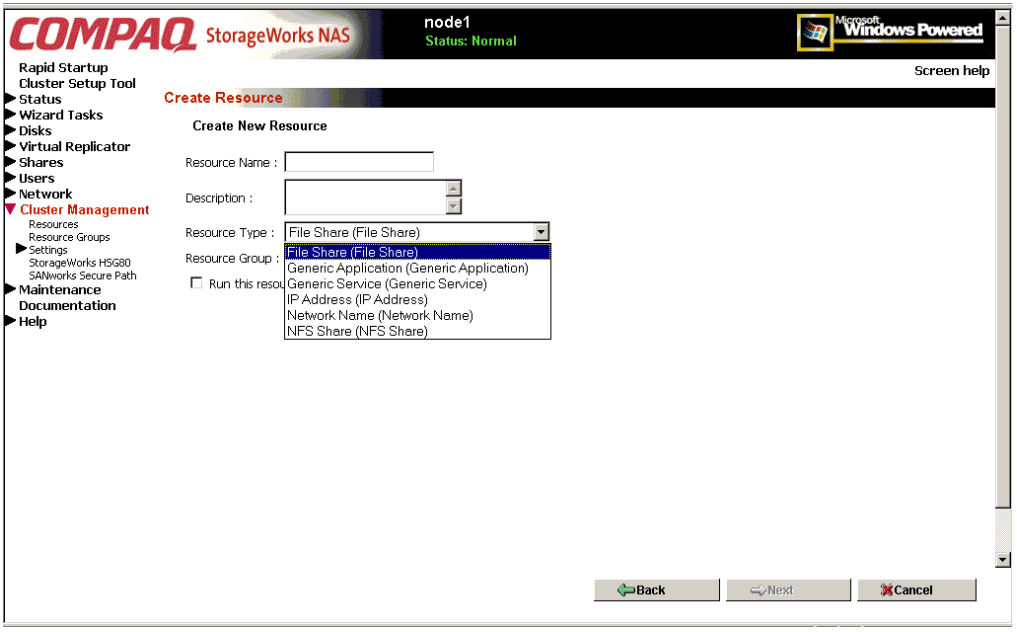


Figure 11-11: Create New Resource dialog box, General Information screen (expanded Resource Type drop-down box)

1. In the preliminary screen for creating a cluster resource, enter the basic information about this resource, including:

   IMPORTANT: Do not create resources for storage pools. Virtual Replicator automatically creates the pool resources.

   - Name and description
   - Resource Type

     To see the available types, expand the **Resource Type** drop-down menu. Resource-type choices include:

     — IP Address (for virtual servers)

     — Network Name (for virtual servers)

     — File Share (for CIFS file shares)

     — NFS File Share

     — Generic Application

     — Generic Service
   - Resource Group

     To see the available groups to assign this resource to, expand the **Resource Group** drop-down box.
   - To run this resource in a separate Resource Monitor, select the box at the bottom of the screen.

   NOTE: Depending on the type of resource selected, different sub-screens are displayed.

2. After all basic information is entered for the resource, click **Next**. The next information screen is displayed.

Possible owners screen

In the Possible Owners screen, indicate the nodes that are allowed to own this resource and then click **Next**.

> **IMPORTANT:** For the resource to fail over properly, both nodes must be listed as possible owners.

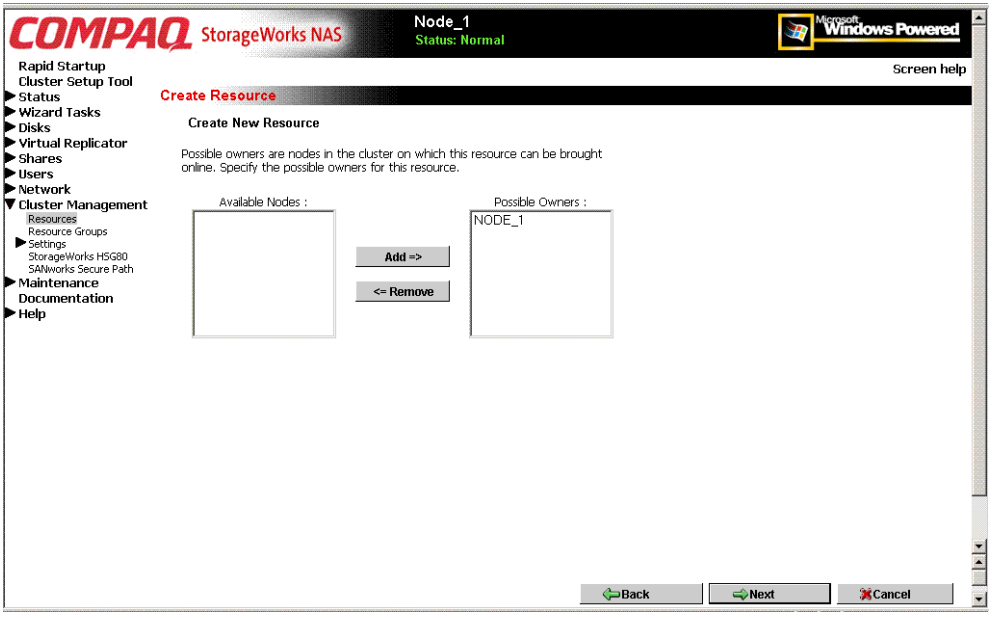


Figure 11-12: Create New Resource dialog box, Possible Owners screen

Dependencies screen

In the Dependencies screen, indicate the resources that must be brought up before this resource.

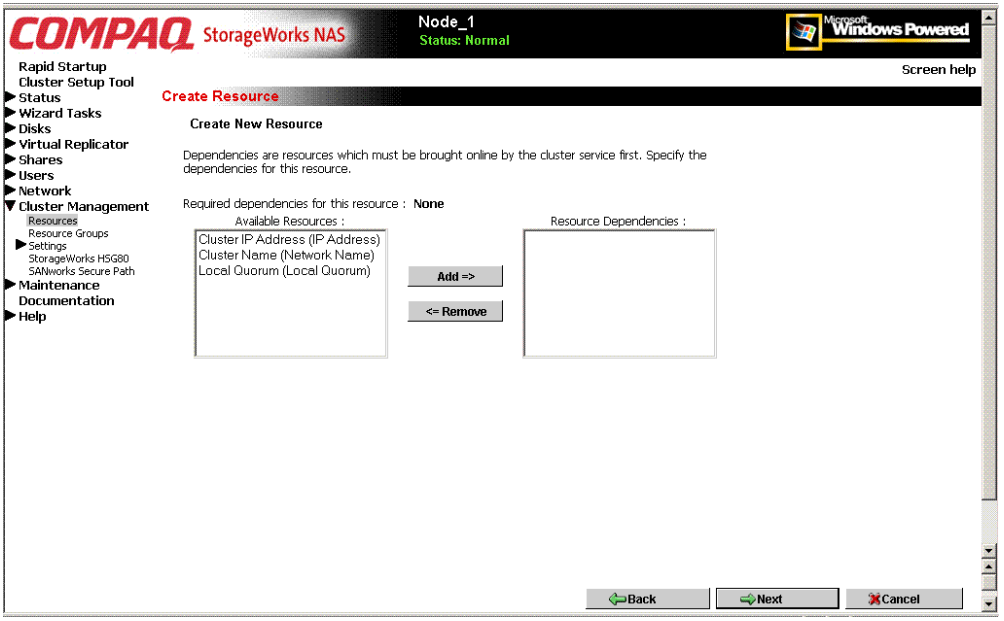


Figure 11-13: Create New Resource dialog box, Dependencies screen

Dependencies between the resources of a group must be established. When a group comes online, the dependencies determine the startup order. For example, file share is usually dependent on the SCE Pool resource on which it resides and the Network Name resource (virtual server) is usually dependent on the IP Address resource (Node).

After completing the Dependencies screen, a screen is displayed that is specific to the type of resource being created.

Separate sections are included on the following pages for the unique screens of the following resource types:

- IP address
- Network Name
- File Share
- NFS Share

IP Address resource-type screen

If an IP Address type of resource is being created, the screen illustrated in Figure 11-14 is displayed.

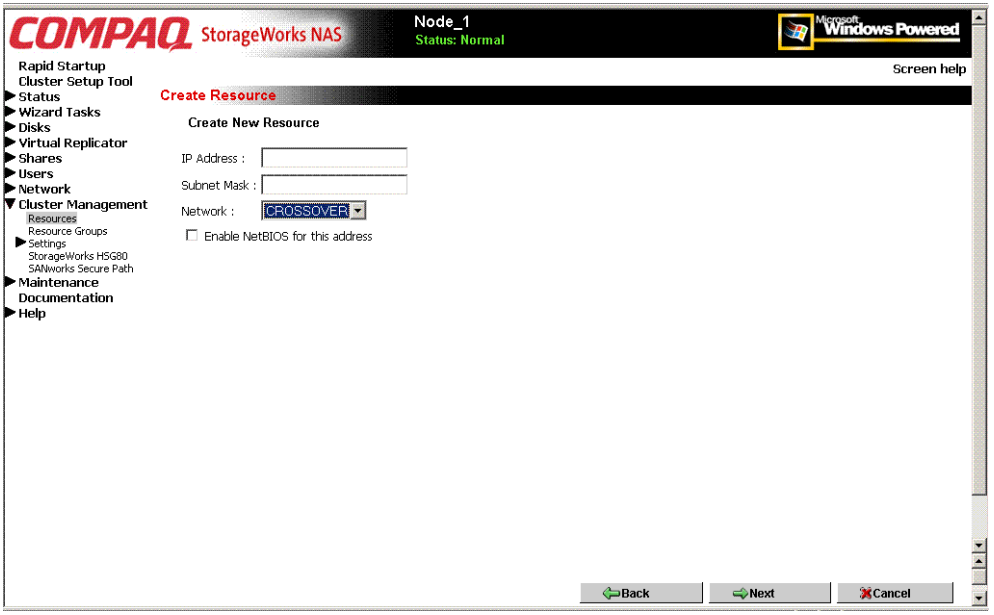


Figure 11-14: Create New Resource dialog box, IP Address screen

Enter the information for the IP Address resource, including:

- IP Address
- Subnet Mask
- Network
- To enable NetBIOS for this address, check the option at the bottom of the screen.

Network Name resource-type screen

If a Network Name type of resource is being created, the screen illustrated in Figure 11-15 is displayed.

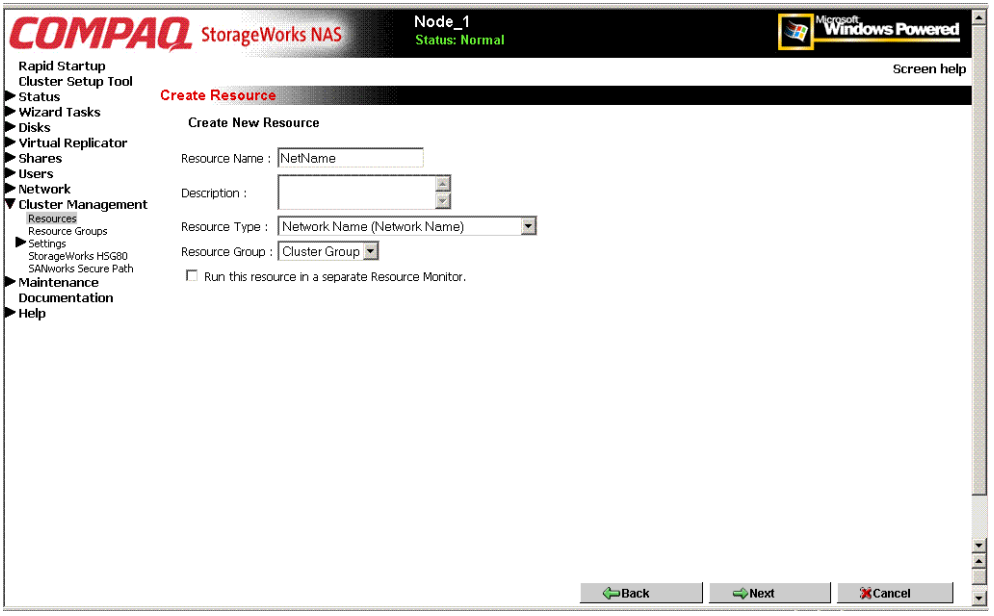


Figure 11-15: Create New Resource dialog box, Network Name screen

CIFS file share resource-type screen

If File Share type of resource is being used to create CIFS file shares in a clustered environment, the following screen is displayed.

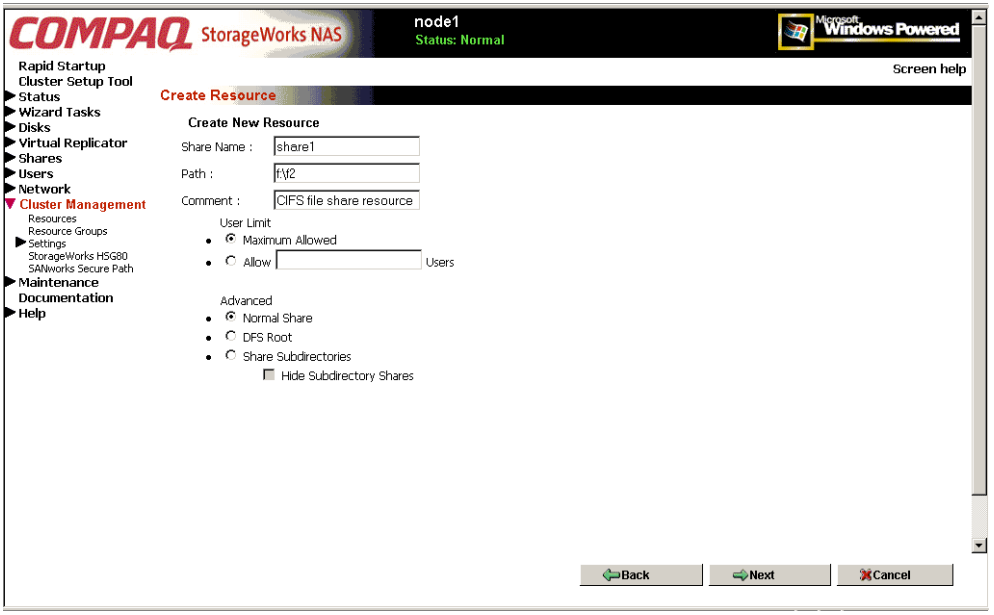


Figure 11-16: Create New Resource dialog box, CIFS-specific share screen

1. Enter a descriptive **Comment** and the **User limit**.
2. Select one of the **Advanced** sharing options.
   - Normal Share—normal sharing rules apply
   - DFS Root—only the selected directory is shared
   - Share Subdirectories—the parent directory is not shared, only the sub-directories are shared.
   - Hide Subdirectory Shares
3. After entering all information for the CIFS share, click **Next**. A summary screen is displayed. View the screen display, confirm its accuracy, and click **Finish**.

NFS share resource-type screen

If an NFS file share is being created, the screen illustrated in Figure 11-17 is displayed.

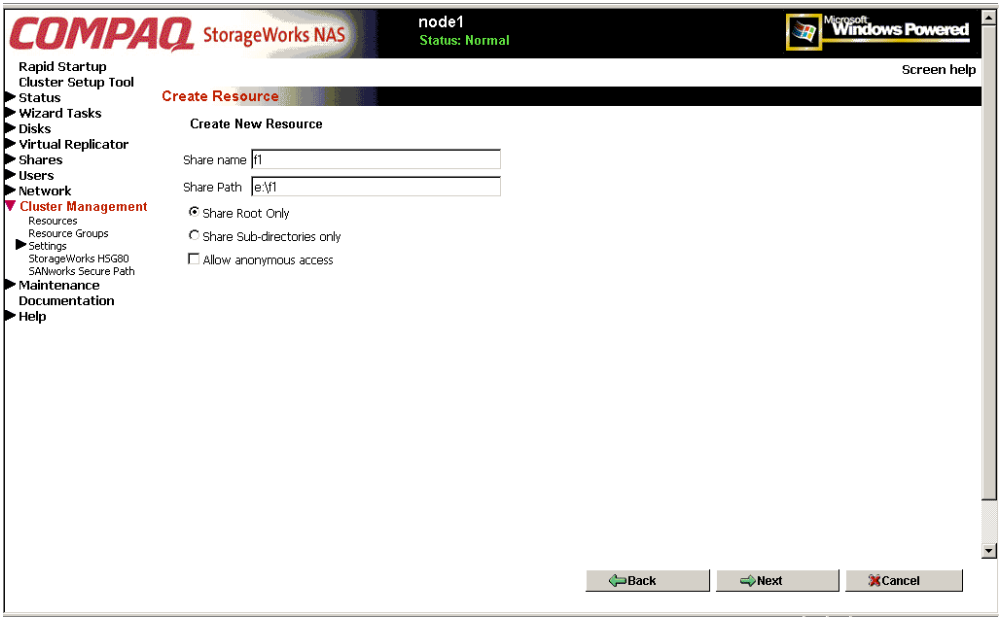


Figure 11-17: Create New Resource dialog box, NFS-specific share screen

1. Indicate the sharing options:
   - Share Root Only—Only the selected directory is shared.
   - Share Sub-Directories Only—Only the sub-directories are shared. The parent directory is not shared.
2. Indicate whether to permit anonymous access. If this box is checked, anonymous, unmapped, squashed users can access the share. Only check this box on the file share that was created for the squashed users.

3. After all fields are completed, click **Next**. A summary screen is displayed. View the screen display to confirm its accuracy.
4. Click **Finish** to create the share.

Deleting a resource

To delete a cluster resource, first delete any resources that are dependent on it. Then, select the desired resource from the Resource dialog box and then click **Delete**. A warning screen is displayed. View the screen display, confirm that this is the resource to delete, and then click **OK**.

IMPORTANT: Do not delete or rename the Cluster Group or IP Address; doing so will result in losing the cluster and will require reinstallation of the cluster.

IMPORTANT: Do not delete storage pool resources. To delete a pool, use Virtual Replicator. Virtual Replicator will automatically delete the SCE pool resource at the same time it deletes the storage pool.

Moving a resource

Depending on the environmental standards that are established for managing and organizing storage, cluster resources may need to be moved from one group to another to properly organize them.

After creating new pools, administrators will commonly move the SCE pool resource from the default cluster group to the appropriate group for their organization.

IMPORTANT: After moving an SCE pool resource from the default-assigned group to a user-defined group, the empty default-assigned cluster group must be deleted.

To move a cluster resource from one group to another group:

1. From the **Resource** dialog box, select the resource to move and then click **Move**. The Move Resource dialog box is displayed.

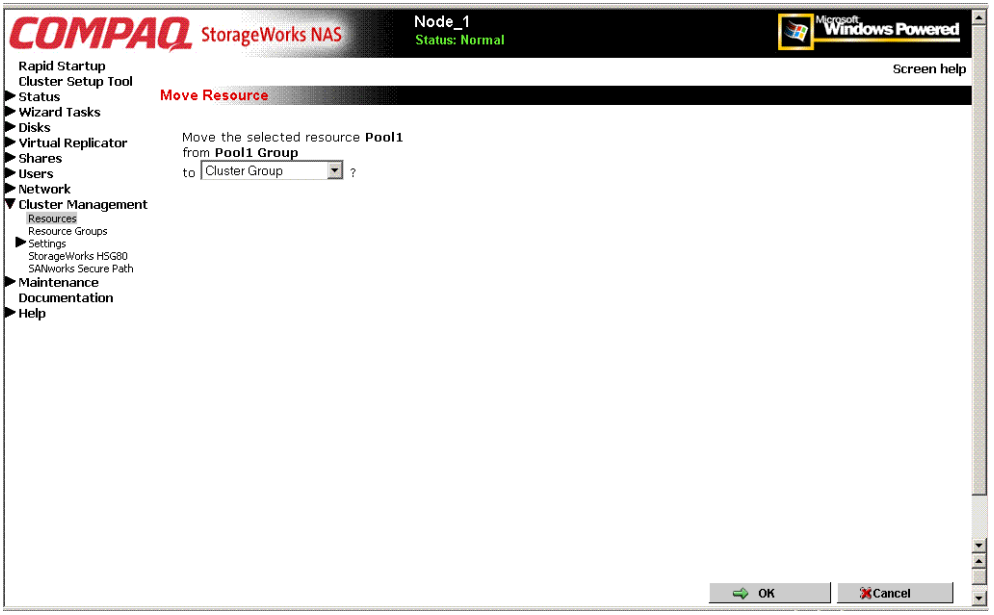


Figure 11-18: Move Resource dialog box

2. In the group drop-down box, select the target group to receive this resource, and then click **OK**.

Bringing a resource online

To bring all resources in a group online, go to the Cluster Management **Resource Groups** menu. See "Resource Groups" for procedural information.

To bring a specific resource online, from the **Resources** dialog box, select the desired resource and then click **Bring Online**. In the confirmation screen, click **OK**.

Modifying Resource Properties

To modify resource information:

1. From the Cluster **Resource** dialog box, select the resource to modify and then click **Properties**. Several tabbed screens are displayed to enter or change resource property settings:
   - General information
   - Possible owner
   - Dependencies
   - Advanced
   - Parameters
   - Share Permissions

   NOTE: Depending on the type of the selected resource, the available tabbed screens will differ.

   Each tab is discussed in the following paragraphs.
2. Enter the corrections in the available option tabs and click **OK**.

General tab

The following basic information about a resource can be changed in this tab:

- Resource description
- Whether to run this resource in a separate resource monitor

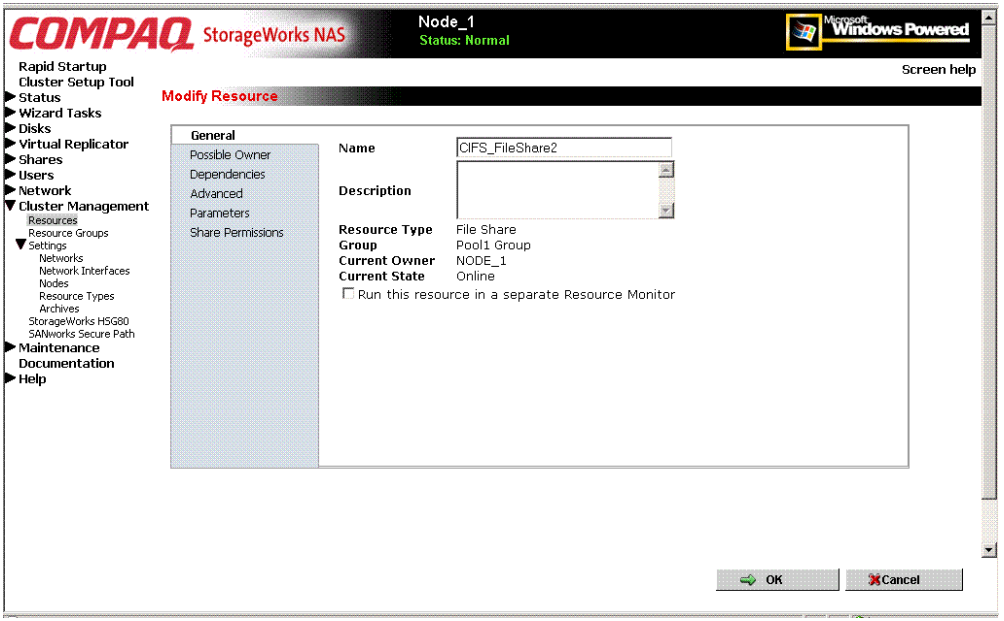


Figure 11-19: Modify Resource Properties dialog box, General tab

NOTE: The Parameters tab and the Share Permissions tab are only displayed for file share types of resources.

Possible Owner tab

In the Possible Owner tab, indicate the nodes that are allowed to own this resource. For ensured availability and improved fault-tolerance, add both nodes of the cluster as possible owners.

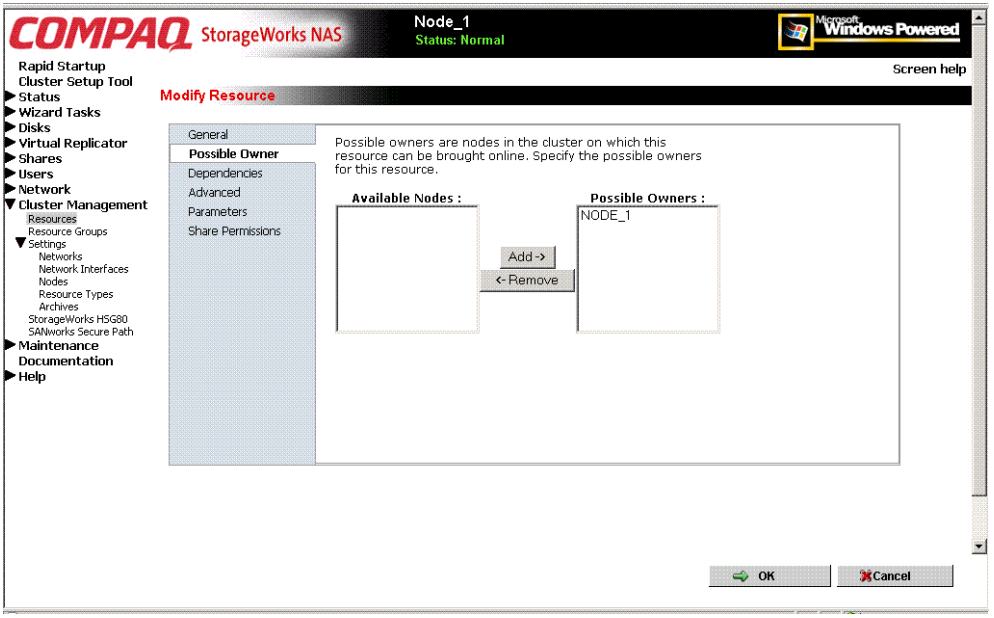


Figure 11-20: Modify Resource Properties dialog box, Possible Owners tab

IMPORTANT: Both nodes must be listed as possible owners, or resources will not fail over properly.

Dependencies tab

In the Dependencies tab, indicate which resources must be brought online prior to this resource.

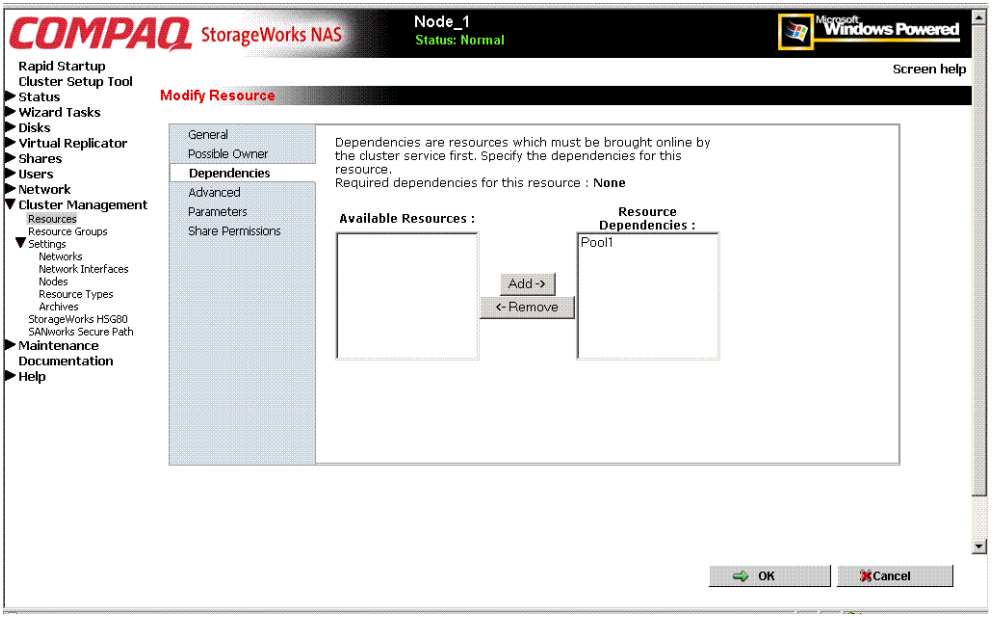


Figure 11-21: Modify Resource Properties dialog box, Dependencies tab

Dependencies between the resources of a group must be established. When a group comes online, the dependencies determine the startup order. For example, file share must be dependent on the SCE Pool resource on which it resides and the Network Name resource (virtual server) must be dependent on the IP Address resource (Node).

Advanced tab

In the Advanced tab, the following settings can be modified:

- What cluster service should do when this resource fails
- "Looks Alive" poll interval
- Is "Alive poll" interval
- Timeout

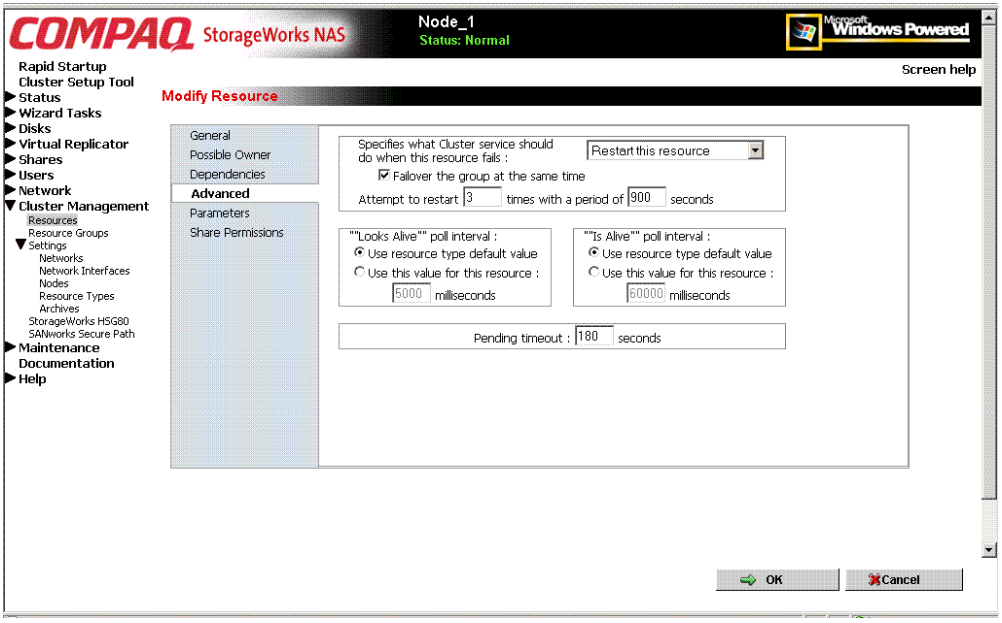


Figure 11-22: Modify Resource dialog box, Advanced tab

Parameters tab

NOTE: The information contained in the Parameters tab will be slightly different, depending on the resource type. Figure 11-23 is an example screen display for a CIFS file share.

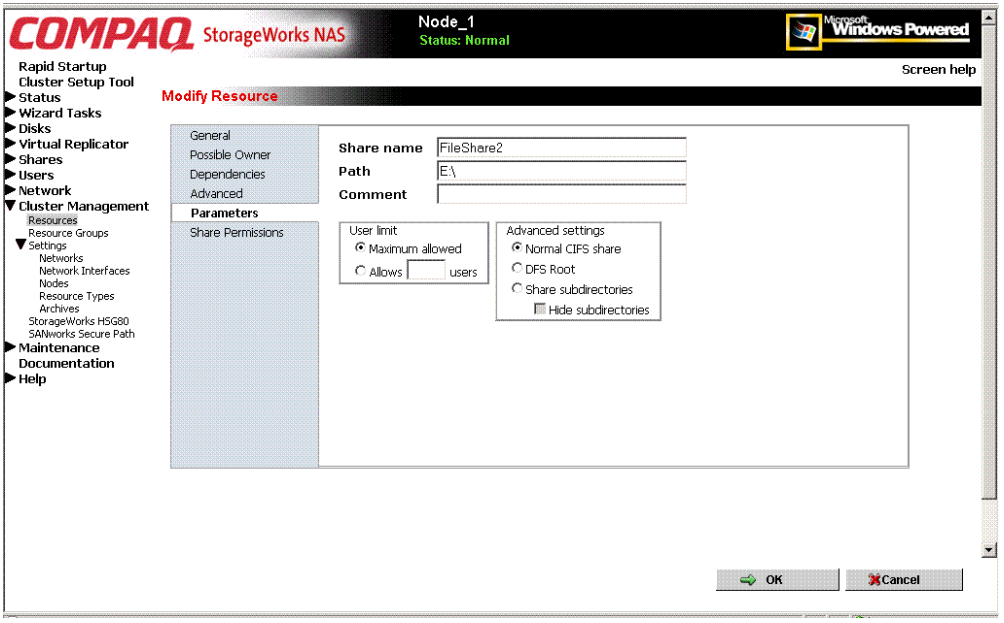


Figure 11-23: Modify Resource Properties dialog box, Parameters tab

1. Enter a descriptive **Comment** and the **User limit**.
2. Select one of the **Advanced** sharing options:
   - Normal Share—normal sharing rules apply
   - DFS Root—only the selected directory is shared
   - Share Subdirectories—the parent directory is not shared, only the sub-directories are shared.
   - Hide Subdirectory Shares
3. After entering all information for the CIFS share, click **Next**.

Share Permissions tab

NOTE: The information contained in the Parameters tab will be slightly different, depending on the resource type. Figure 11-24 is an example screen display for a CIFS file share.

In the Share Permissions tab, use the **Add** and the **Remove** buttons to indicate which users have access to this share. Then, use the **Allow** and the **Deny** drop-down boxes to control the types of access granted.

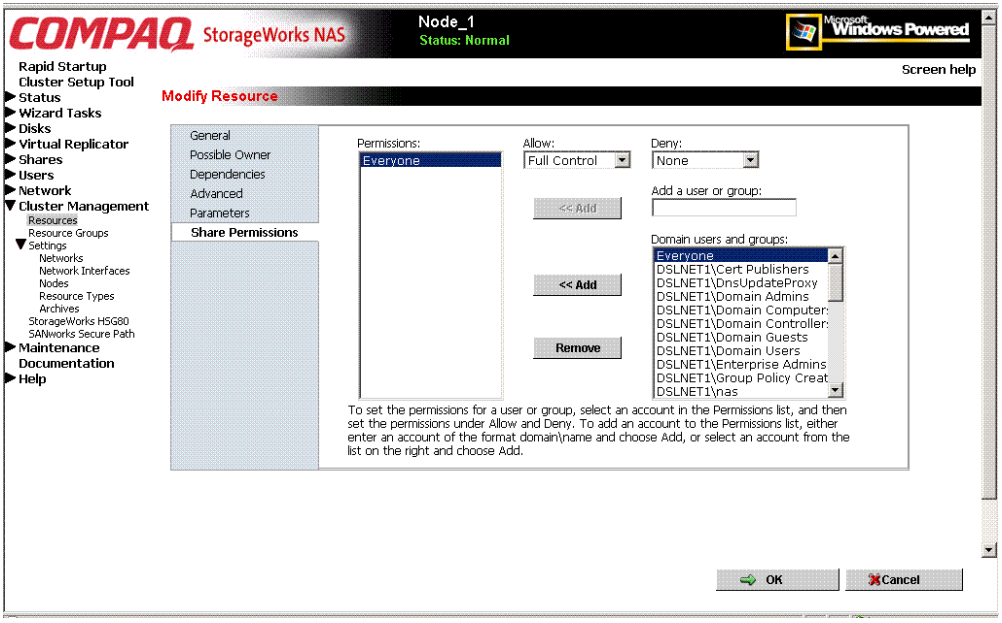


Figure 11-24: Modify Resource Properties dialog box, Share Permissions tab

SecurePath Configuration in a Clustered Deployment

This section provides the additional information and procedures for setting up SecurePath for in a cluster. For basic overview, setup, and use of SecurePath, see the "Setup Completion and Basic Administrative Procedures" chapter.

SecurePath comes pre-installed on the NAS devices. However, configuration of the Graphical User Interface (GUI) is necessary to manage the paths.

To configure SecurePath:

1. Start the **SecurePath Agent Configuration Utility** on NodeA by selecting **Start**, **Programs**, **SecurePath**, **SecurePathCFG**.
2. Click **Password**. The Password dialog box is displayed.

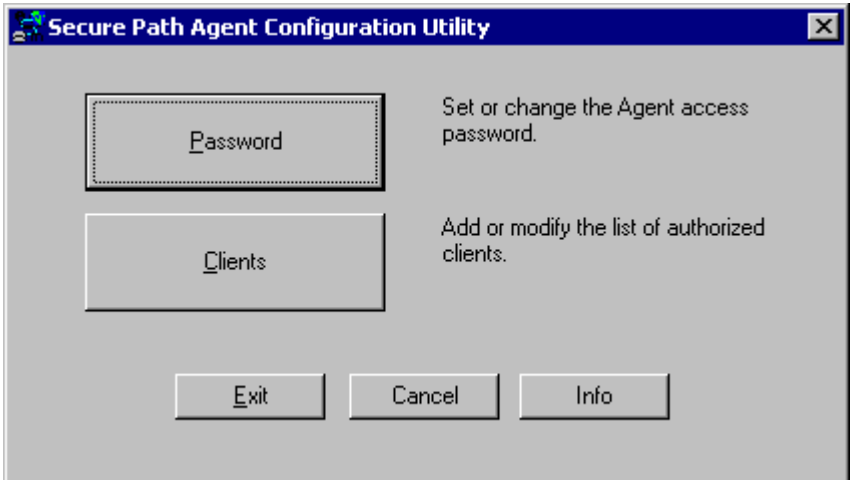


Figure 11-25: SecurePath Agent Configuration Utility dialog box

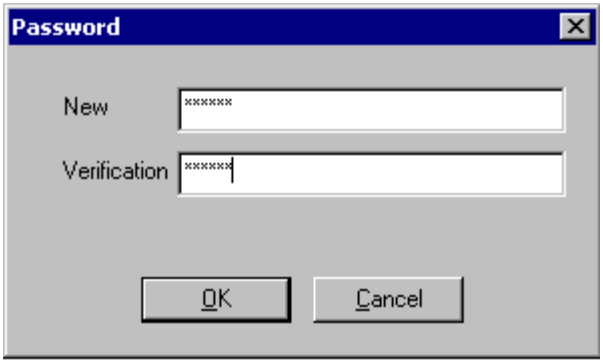


Figure 11-26: SecurePath Agent Configuration Utility Password dialog box

3. Set the password as something easy to remember, such as `compaq`. When repeating this step for NodeB, use the same password. Then, click **OK**. At the **Password Validation Successful** dialog box, click **OK**. The SecurePath Agent Configuration Utility dialog box is displayed again.
4. Click **Clients**. The **Client Access Configuration** dialog box is displayed.
5. For this example, in the Client Access Configuration dialog box, select **cpqnas**, and then click **Delete client**. This step clears any default client entries.

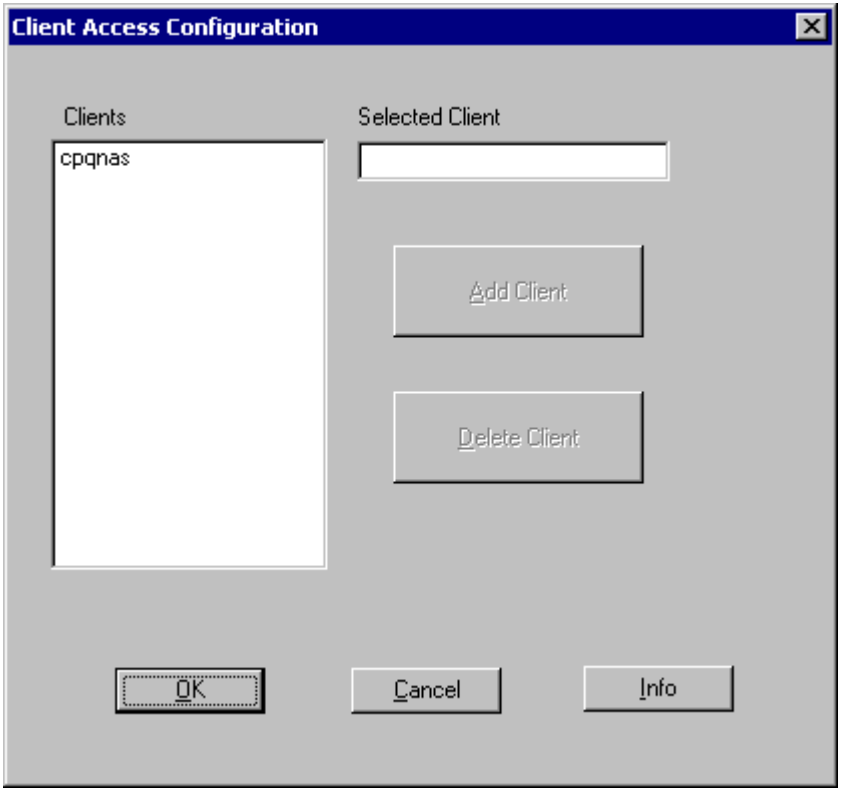


Figure 11-27: Client Access Configuration dialog box

6. Add both NodeA and NodeB:
   a. In the Selected Client field, enter the hostname of NodeA. Click **Add Client**.
   b. In the Selected Client field, enter the hostname of NodeB. Click **Add Client**.
   c. Click **OK**.
   d. The SecurePath Agent Configuration Utility dialog box is displayed again. Click **Exit System**.
7. From NodeB, repeat steps 1 through 6, using the same password as NodeA.

8. Restart the Secure Path Agents service on both nodes. To restart the service:
   a. From the **MMC**, select **Core Operating System**, and **Services**.
   b. Right-click **SecurePath Agents**, and then click **Restart**.
9. Start SecurePath Manager on NodeA. To open the manager, click **Start**, **Programs**, **SecurePath**, **SPM**.
10. Click **New**. The SecurePath Login dialog box is cleared.

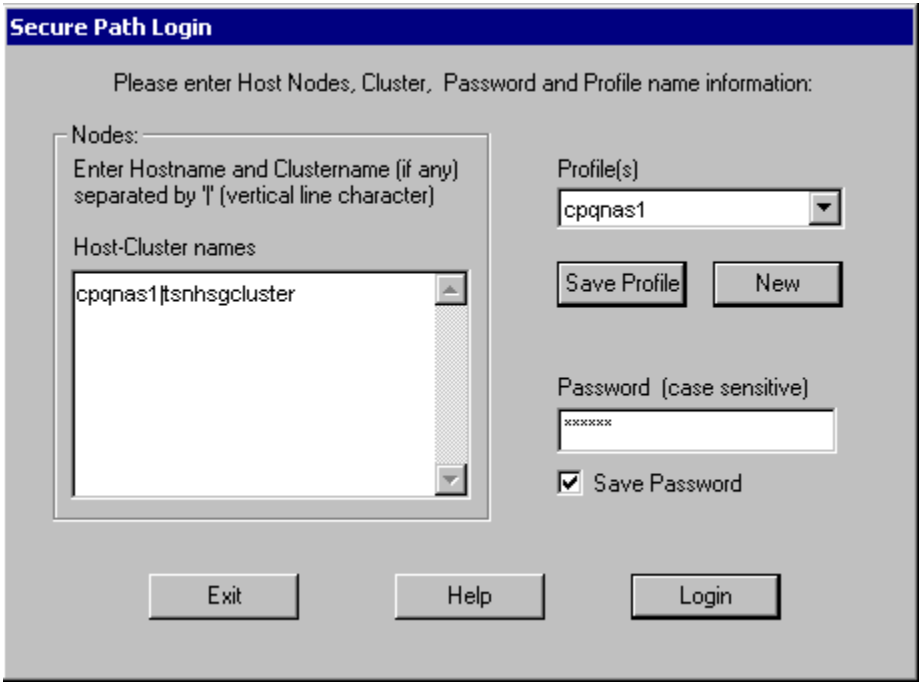


Figure 11-28: SecurePath Login dialog box

11. In the **SecurePath Login** dialog box, enter the following:
   a. In the **Profiles** drop-down box, enter the hostname of NodeA.
   b. In the **Host-Cluster names** box, enter:

      `XXXX|YYYY`

      (*XXXX* = the hostname of NodeA, *YYYY* = the name of the cluster)

c. In the **Password** box, enter the password chosen earlier.

d. Select **Save Password**.

e. Click **Save Profile**.

12. Click **Login** to log onto the SecurePath Manager for NodeA.

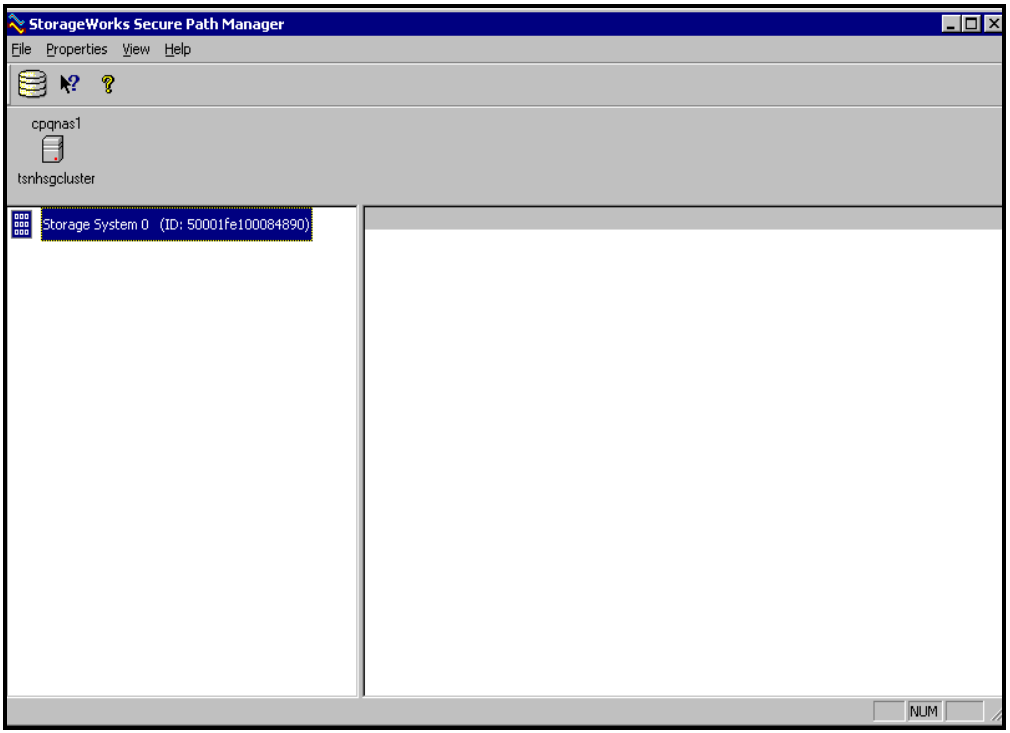


Figure 11-29: SecurePath Manager dialog box

13. Start **SecurePath Manager** on NodeB.

14. Click **New**. The SecurePath Login dialog box is cleared.

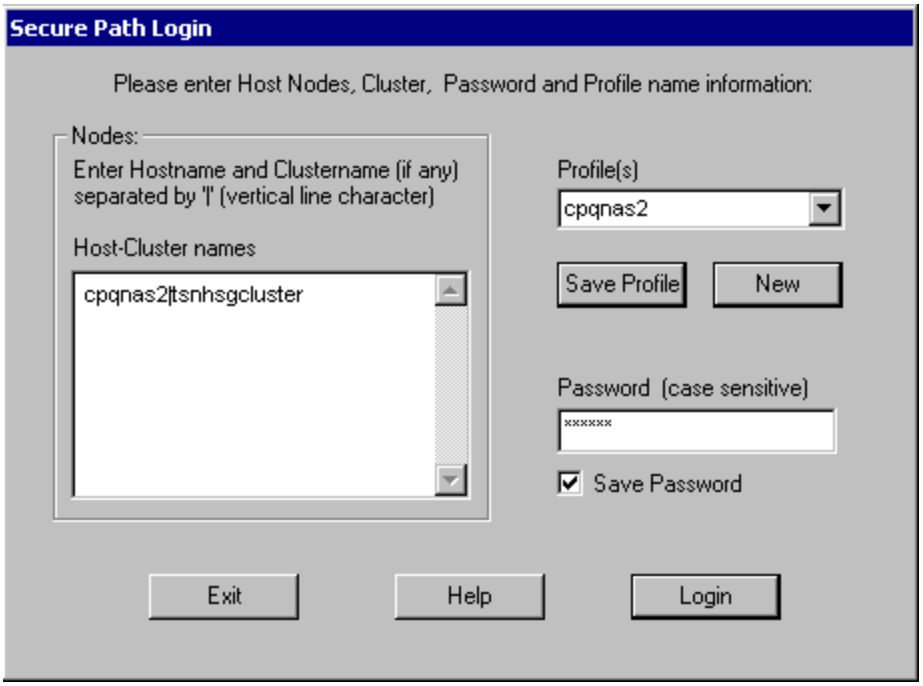


Figure 11-30: SecurePath Login dialog box on Node B

15. In the **SecurePath Login** dialog box:
    a. In the **Profiles** drop-down box, enter the hostname of NodeB.
    b. For **Host-Cluster names**, enter:

       `XXXX|YYYY`

       (*XXXX* = hostname of NodeB, *YYYY* = the name of the cluster)
    c. For **Password**, enter the password chosen earlier.
    d. Select **Save Password**.
    e. Click **Save Profile**.

16. Click **Login** to log into the *StorageWorks* SecurePath Manager for NodeB.

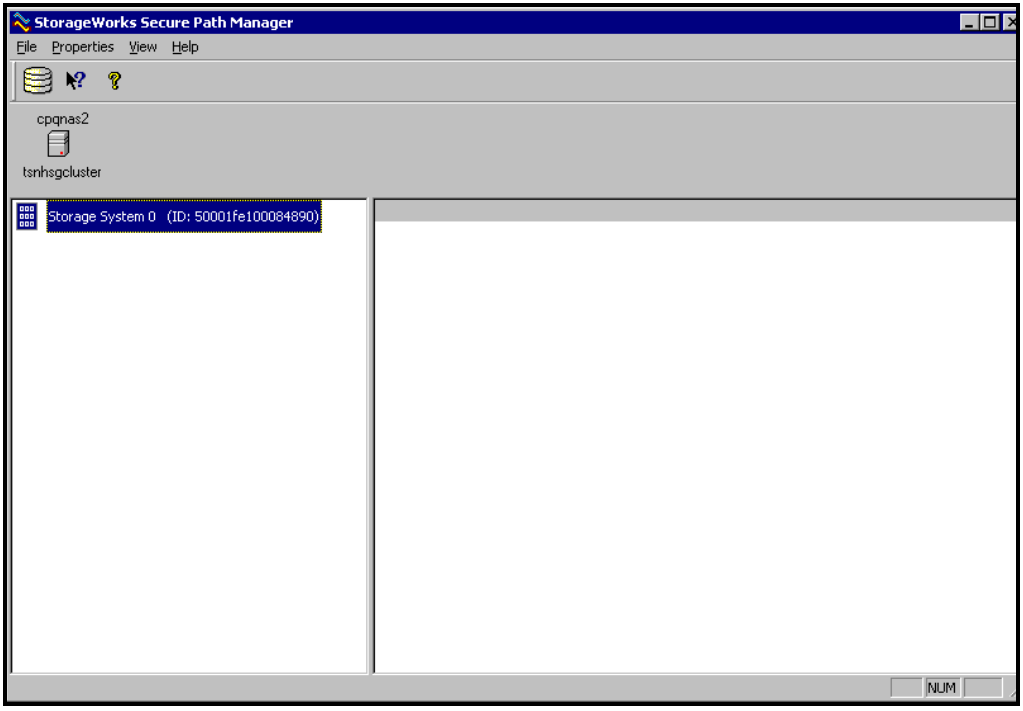


Figure 11-31: SecurePath Manager dialog box for Node B

17. Exit SecurePath Manager on both NodeA and NodeB.
18. Start **SecurePath Manage**r on NodeA.
19. Click **New**. The SecurePath Login dialog box is cleared.

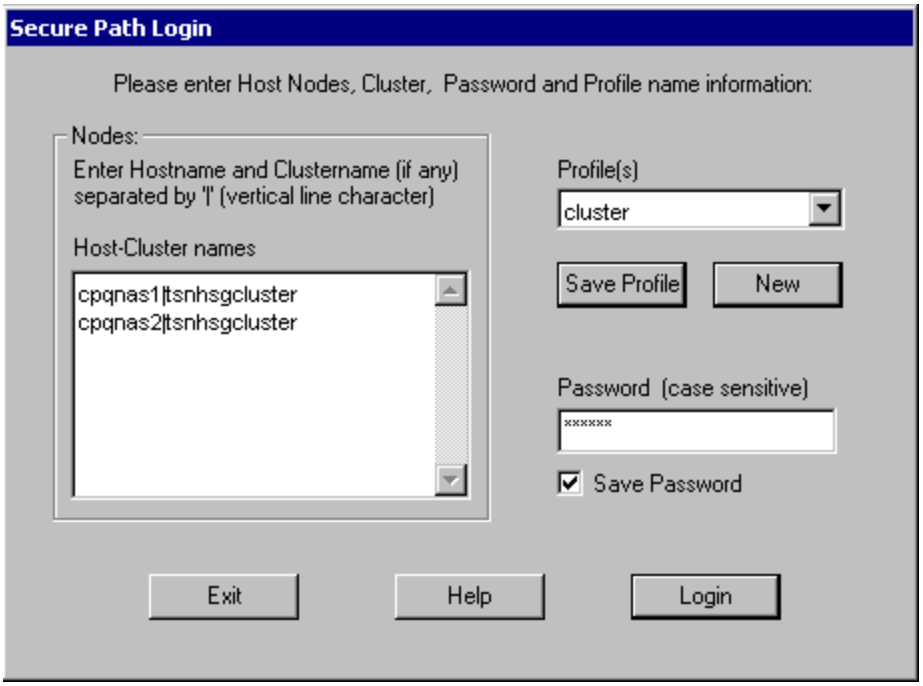


Figure 11-32: SecurePath Login dialog box

20. In the **SecurePath Login** dialog box:
    a. In the **Profiles** drop-down box, enter `cluster`.
    b. In the **Host-Cluster names** box, enter:

       `XXXX|YYYY`

       `ZZZZ|YYYY`

       (*XXXX* = the hostname of NodeA, *YYYY* = the name of the cluster, *ZZZZ* = the hostname of NodeB)
    c. In the **Password** box, enter the password chosen earlier.
    d. Select **Save Password**.
    e. Click **Save Profile**.

21. Click **Login** to log into the SecurePath Manager for NodeA and NodeB.

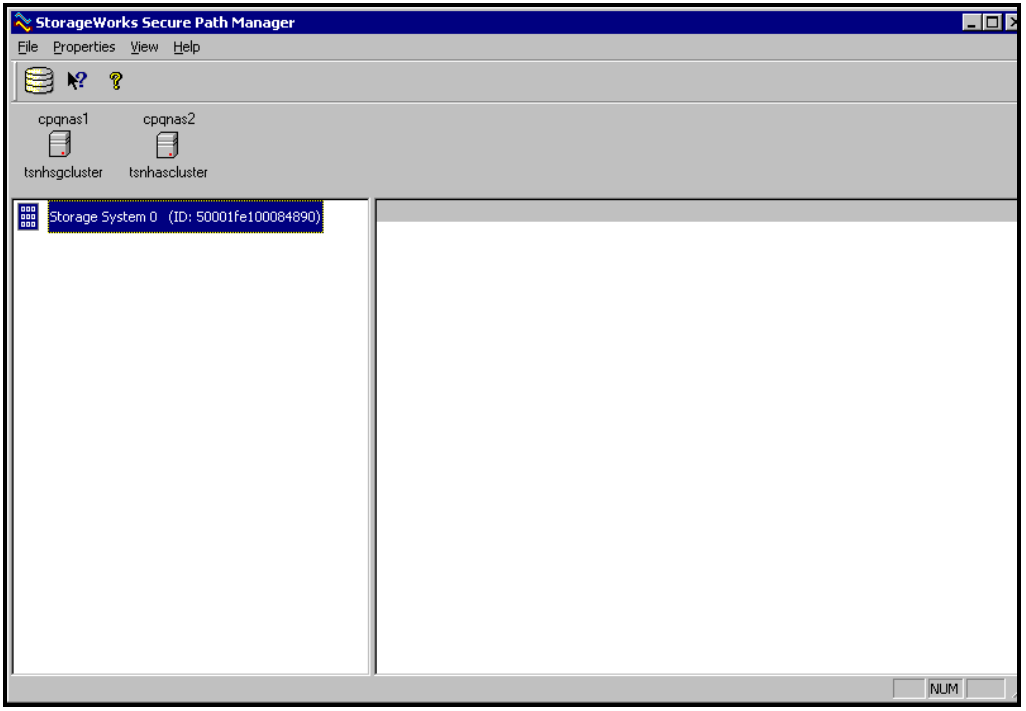


Figure 11-33: SecurePath Manager dialog box for Node A and Node B

22. Start **SecurePath Manager** on NodeB.
23. Click **New**. The SecurePath Login dialog box is cleared.
24. In the **SecurePath Login** dialog box:
    a. In the **Profiles** drop-down box, enter cluster.
    b. In the **Host Cluster names** box enter:

       `XXXX|YYYY`

       `ZZZZ|YYYY`

       (XXXX = hostname of NodeA, YYYY = cluster name, ZZZZ = hostname of NodeB)

    c. In the **Password** box, enter the password chosen earlier.
    d. Select **Save Password.**
    e. Click **Save Profile**.
25. Click **Login**. This procedure logs into the SecurePath Manager for NodeA and NodeB.

    IMPORTANT: If the SecurePath Manger screen is not displayed, an error was made while executing the steps in this section. Return to step 1 of this section to begin the configuration process again.

26. Exit SecurePath Manager for both NodeA and NodeB.

12

Remote Access Methods and Monitoring

The *StorageWorks* NAS B3000 comes from the factory with full remote manageability. Several methods of remote access are provided. These options let the administrator use an interface with which they are already familiar, including:

- Web-based user interface
- Terminal services
- Remote Insight Lights-Out Edition board
  - — Features
  - — Remote Insight Lights-Out Edition Board Configuration
  - — Using the Remote Insight Lights-Out Edition Board to Access the NAS B3000
- Telnet Server
  - — Enabling Telnet Server
  - — Configuring Telnet Server
- Remote Shell Daemon
- Compaq Insight Manager
  - — Compaq Insight Manager Console
  - — Compaq Insight Manager Agent Web Interface
- Enterprise management applications
  - — HP OpenView
  - — Tivoli NetView (AIX)

Web-Based User Interface

The NAS B3000 includes a Web-based user interface (WebUI) for the administrator to remotely manage the machine. Of all of the remote access methods, the WebUI is the most intuitive and easiest to learn and use.

The WebUI permits complete system management, including system configuration, cluster management, user and group management, shares management, UNIX file system management, and storage management.

In addition, the WebUI includes wizards to guide the administrator while performing repetitive tasks, such as creating a share.

To access the WebUI:

1. Launch a Web browser.
2. In the URL field, enter:

   http://<your NAS B3000 machine name or IP address>:3201/

Extensive procedural online help is included in the WebUI.

Terminal Services

The NAS B3000 supports Terminal Services, with a license for two concurrently running open sessions. Terminal Services provides the same capabilities as being physically present at the server console.

Use Terminal Services to access:

- The NAS B3000 desktop
- The NAS B3000 Microsoft Management Console (MMC)
- A command line interface
- Backup software
- Antivirus programs
- SecurePath
- Telnet Server
- Remote Shell

To access Terminal Services from the WebUI, select **Maintenance**, **Terminal Services**. For additional procedural information on Terminal Services, see the "Setup Completion and Basic Administrative Procedures" chapter.

Remote Insight Lights-Out Edition Board

The following information provides an overview of the Remote Insight Lights-Out Edition board capabilities. For further information, refer to the *Compaq Remote Insight Lights-Out Edition Installation and Users Guide* on the Documentation CD.

The Remote Insight Lights-Out Edition board is a PCI-based, single-board computer that uses a Web interface to provide remote management for the server.

Regardless of the state of the host operating system or the host CPU, complete capability for the server is available. A built-in processor, combined with a standard external power supply, makes the Remote Insight Lights-Out Edition board independent of the host server and its operating system. The Remote Insight Lights-Out Edition board provides remote access, sends alerts, and performs other management functions, even if the host server operating system is not responding or the server has lost power.

Features

The Remote Insight Lights-Out Edition board provides the following features:

- Hardware-based graphical remote console access

IMPORTANT: The remote client console must have a direct browser connection to the Remote Insight Lights-Out Edition board without passing through a proxy server or firewall.

- Remote restart
- Server failure alerting
- Integration with Compaq Insight Manager
- Local Area Network (LAN) access through onboard NIC
- Browser support for Internet Explorer 4.01 or later
- Reset and failure sequence replay
- Auto configuration of IP address through domain name system (DNS) or Dynamic Host Configuration Protocol (DHCP)
- Virtual power button

Security Features

- SSL encryption for login and network traffic
- User administration allows capability to define 12 user profiles
- Event generation for invalid login attempts
- Logging of user action in the Event Log

Manage Users Feature

The Manage Users feature lets those with supervisory access to add and delete users or to modify an existing user's configuration. Manage Users also lets the administrator modify:

- User name
- Logon name
- Password
- Simple network management protocol (SNMP) trap IP address
- Receive host OS-generated SNMP traps
- Supervisor access
- Logon access
- Remote console access
- Remote server reset access

Manage Alerts feature

The Manage Alerts feature allows the user to send test alerts, to clear pending alerts, and to specify which type of alert messages to receive.

- Select alert types received
- Generate a global test alert
- Generate an individual test alert
- Clear pending alerts
- Enable alerts

Refer to the *Remote Insight Lights-Out Edition Board User Guide* for more information about the Remote Insight Lights-Out Edition board features and functionality.

Remote Insight Lights-Out Edition Board Configuration

The Remote Insight Lights-Out Edition board on the NAS B3000 is initially configured through the Rapid Startup Utility. SNMP is enabled and the Compaq Insight Management Agents are preinstalled.

The Remote Insight Lights-Out Edition board comes with factory default settings, which the administrator can change. Administrators may want to add users, change SNMP trap destinations, or change networking settings. Refer to the *Remote Insight Lights-Out Edition Installation and User Guide* for information about changing these settings.

There are several methods for performing Remote Insight Lights-Out Edition board configuration changes:

- Web interface
- Remote Insight Lights-Out Edition board configuration utility access by pressing **F8** during a system restart.

- Initial Remote Insight Lights-Out Edition board access using the default DNS name

  The Remote Insight Lights-Out Edition board is preconfigured by the Rapid Startup Utility, using the following default settings:

  — **User Name**: *Administrator*

  — **Password**: (last four digits of the serial number)

  — **DNS Name**: *RIBXXXXXXXXXXXX* (The 12 Xs are the MAC address of the Remote Insight Lights-Out Edition board.)

  — **IP Address**: The IP address entered during system setup

- System utilities access by pressing **F10** during a system restart:

  1. Select System Configuration.
  2. Select Configure Hardware.
  3. Select Review or Modify Hardware Settings.
  4. Select View or Edit Details.
  5. Select Remote Insight Lights-Out Edition board.
  6. Change DNS name, network settings, or users.
  7. Press **F10** to save changes before exiting.

- Remote Insight Lights-Out Edition board configuration service

  — The Compaq NAS B3000 comes equipped with a Remote Insight Lights-Out Edition board configuration service. The service is a Windows-powered OS service supplied by Compaq. It configures the network setting for the Remote Insight Lights-Out Edition board.

  — The Remote Insight Lights-Out Edition board is configured by the Rapid Startup Utility or the Offline Configuration Utilities (OCU).

Using the Remote Insight Lights-Out Edition Board to Access the NAS B3000

Using the Web interface of a client machine is the recommended procedure for remotely accessing the server:

1. In the URL field of the Web browser, enter the IP address of the Remote Insight Lights-Out Edition board.
2. Supply an administrator-level user name and password.

   The NAS B3000 desktop is displayed.

Telnet Server

Telnet Server is a utility that lets users connect to machines, log on, and obtain a command prompt remotely. Telnet Server is preinstalled on the NAS B3000, but must be activated prior to use.

NOTE: Telnet Server is non-clusterable.

IMPORTANT: For security reasons, the Telnet Server must be restarted each time the server is restarted.

Enabling Telnet Server

To enable Telnet Server, use Terminal Services to access a command line interface and enter the following command:

```
net start tlntsvr
```

Configuring Telnet Server

To enter Telnet parameter settings, access the Telnet Server user interface. Use Terminal Services to go to the MMC. Then select **File Sharing**, **Services for UNIX**, **Telnet Server**.

In the Telnet Server UI, indicate the following:

- Authentication information
- Auditing information
- Server Settings
- Sessions information

Each of these topics is discussed in the following paragraphs.

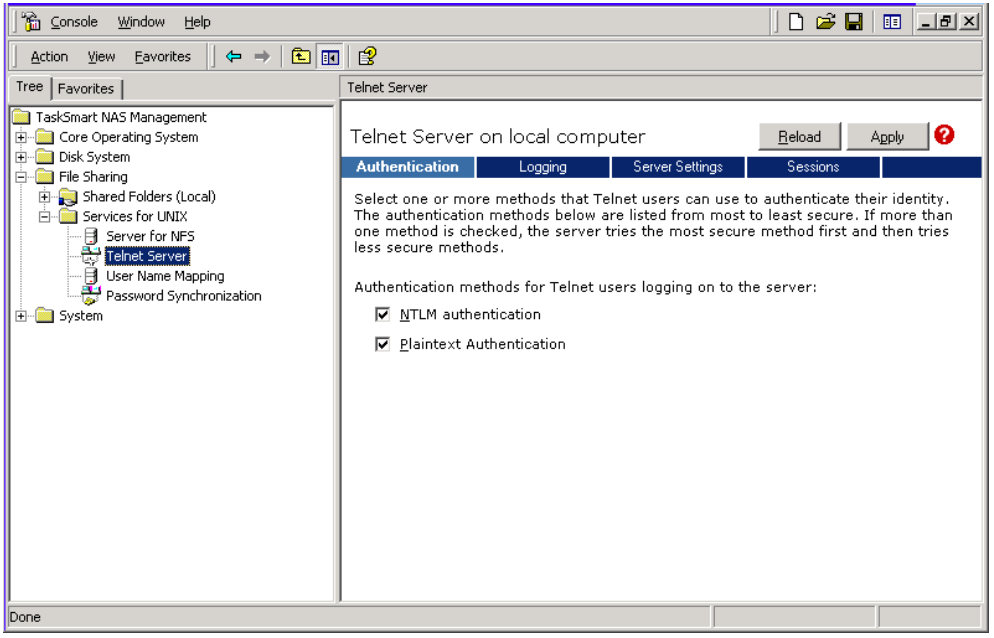


Figure 12-1: Telnet Server interface screen

Authentication Information

The Authentication tab is used to select user authentication methods allowed by the Telnet Server. The administrator determines what method of authentication is appropriate based on work environment.

Auditing Information

Telnet Server can log various events. The Logging tab allows the administrator to enable logging and select the events that should be logged. Note that errors and significant events are always logged to the Windows event list as well.

Server Settings

Use the Server Settings tab to change Telnet Server parameters. These parameters determine how the NAS B3000 Telnet Server operates. For example, one parameter is the number of simultaneous Telnet Server connections that the server allows.

Sessions Information

The sessions screen provides the ability to view or terminate active sessions.

Remote Shell Daemon

The remote shell, commonly referred to as "rsh" in UNIX, is a method for allowing users to access a command prompt or to run a command on another machine. It can be used in a fashion similar to Telnet Server or can be used to directly invoke a remote command.

Be default, the Remote Shell is not automatically started on the NAS B3000. The administrator will need to start this service by entering the following command:

```
net start rshsvc
```

NOTE: For security reasons, each time the B3000 is restarted, the Remote Shell service will have to be restarted.

In the following example, the remote shell will run the ls -al command on <server name> and returns the results to the screen

```
rsh <server name> ls -al
```

NOTE: An *.RHOSTS* file must be created to allow client access to the server. See the SFU help topic "Rshsvc" on how to create the *.RHOSTS* file.

Currently, SFU implements only the remote command functionality of rsh. If a command line is needed, use Telnet Server.

For more information regarding the setup and use of remote shell or the remote shell service, refer to the online help documentation.

Compaq Insight Manager

The NAS B3000 is equipped with the latest Compaq Insight Management Agents for Servers, allowing easy manageability of the server through Compaq Insight Manager, HP OpenView, and Tivoli NetView.

Compaq Insight Manager is a comprehensive management tool that monitors and controls the operation of Compaq servers and clients. Compaq Insight Manager Version 4.70 or higher is needed to successfully manage the NAS B3000. Compaq Insight Manager consists of two components:

- Windows-based console application
- Server- or client-based management data collection agents

Management agents monitor over 1,000 management parameters. Key subsystems make health, configuration, and performance data available to the agent software. The agents act upon that data by initiating alarms in the event of faults. The agents also provide updated management information, such as network interface or storage subsystem performance statistics.

NOTE: The NAS B3000 also supports Compaq Insight Manager XE.

Compaq Insight Manager Console

System monitoring applications such as Compaq Insight Manager allow the administrator to accomplish normal administrative tasks from any remote location with a Web browser. To manage the NAS B3000 using the Compaq Insight Manager console:

1. From the **Setup** menu, access **Discover IP devices**. Then click **New.**
2. Enter the IP address range of the device and then click **Add.**
3. Click **Close** when finished.
4. Click **Find Devices** and select the device to view.
5. Click **Add/Update All Devices**.
6. Double-click the server to show a device information window. The window allows the user to view management data collected by the Compaq agents.

Figure 12-2 is an example of the device information window.

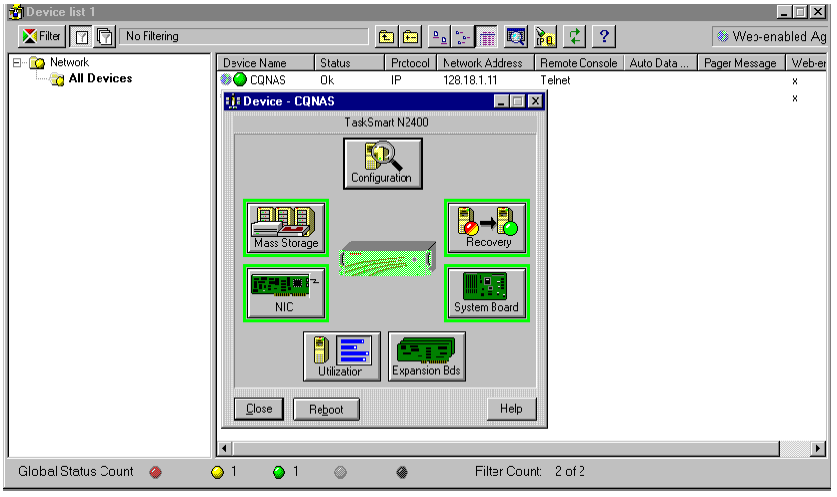


Figure 12-2: Device Information window

For more information about using Compaq Insight Manager, refer to the Compaq Management CD.

Compaq Insight Manager Agent Web Interface

There are two options for accessing the Compaq Insight Manager Agent Web interface.

- From the Compaq Insight Manager console, right-click the device name and select **View Web Data.** The agent Web interface of the server launches in a browser within Compaq Insight Manager.
- Open a Web browser. Enter the server's IP address, using port 2301. An example IP address is http://122.18.1.14:2301. The default logon account is "anonymous." Click the account name to log on as an administrator. The user name and password are both administrator, lowercase. Once logged on as an administrator, the user can change the password.

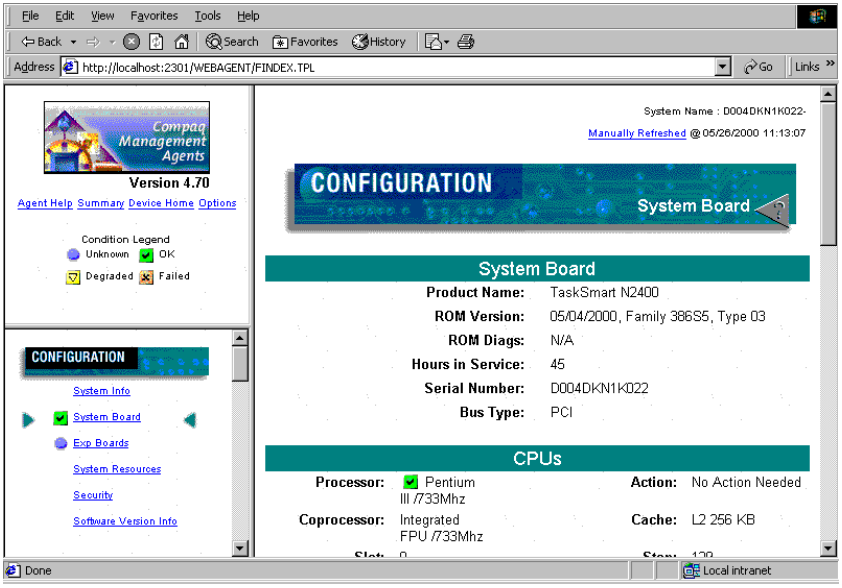


Figure 12-3: Compaq Insight Manager Agent Web interface

For more information about Compaq Insight Manager, see the Compaq Management CD.

Enterprise Management Applications

The following enterprise management applications are installed onto the client machine:

- HP OpenView
- Tivoli NetView

HP OpenView (Windows-Based Operating System)

The NAS B3000 can be managed using HP OpenView by following these steps:

1. Install Compaq Insight Manager for HP OpenView Version 2.0 or higher onto the client machine.
2. Modify *CPQCONFIG.DAT* in HP OpenView.

Compaq Insight Manager for HP OpenView, Version 2.0

Compaq Insight Manager for HP OpenView integrates Compaq hardware management and event notification into the HP OpenView Network Node Manager (NNM) network management console.

Depending on the version of Compaq Insight Manager for HP OpenView being used, an addition to the *CPQCONFIG.DAT* may be needed to manage the NAS B3000 from HP OpenView. Because HP OpenView works with different platforms, the location of the *CPQCONFIG.DAT* file varies. Locate the file, add the following line to the file, and save it:

```
Server : ntsrvr : 1.3.6.1.4.1.232.11.2.7.2.1.4.0 string
"StorageWorks NAS B3000";
```

This command string allows HP OpenView to identify the NAS B3000.

Compaq Insight Manager for HP OpenView introduces an integrated browser launch from the NNM console to the home page of the Web-enabled Compaq Management Agents, as shown in Figure 12-4. The interface is used to collect in-depth information about installed Compaq hardware.

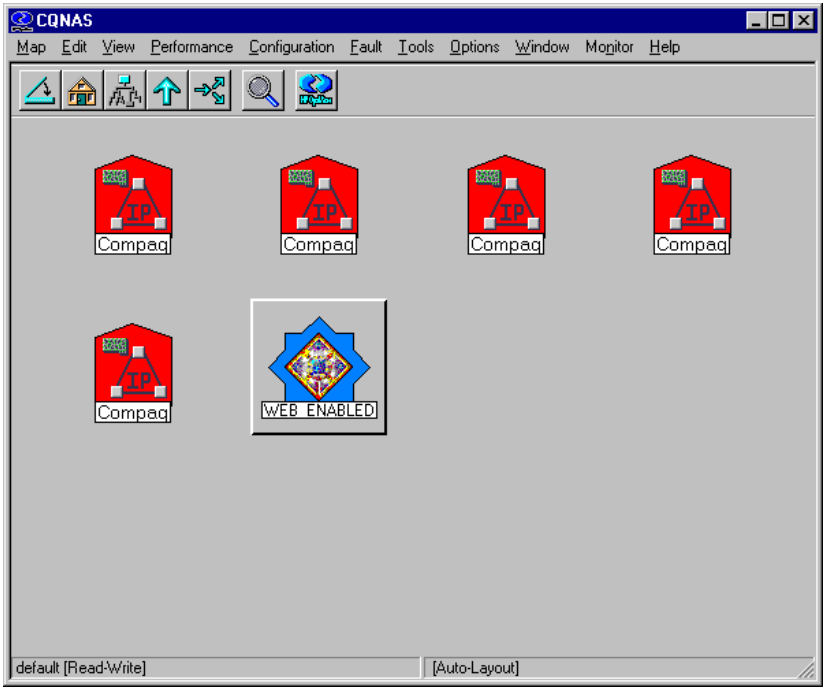


Figure 12-4: Web Enabled interface

The information collected includes system status, system health, prefailure monitors, performance and environmental data, event alarms, and Windows-based OS statistics. Compaq Insight Manager for HP OpenView can be obtained from the Compaq website:

http://www.compaq.com/products/servers

Tivoli NetView (AIX)

The NAS B3000 can be managed using Tivoli NetView (AIX). Two steps are required to be able to manage the NAS B3000 through Tivoli NetView.

1. Install Compaq Insight Manager for Tivoli NetView Version 2.0 or later onto the client machine.
2. Modify *CPQCONFIG.DAT* in Tivoli NetView.

Compaq Insight Manager for Tivoli NetView (AIX), Version 2.0

Compaq Insight Manager for Tivoli NetView integrates Compaq hardware management and event notification into the Tivoli NetView network management console. This release introduces an integrated browser launch from the NetView console to the home page of the Web-enabled Compaq Management Agents, which is used to collect in-depth information about Compaq hardware. The information collected includes system status, system health, prefailure monitors, performance and environmental data, event alarms, and Windows-based OS statistics. Compaq Insight Manager for Tivoli NetView can be obtained from the Compaq website:

http://www.compaq.com/products/servers

Depending on the version of Compaq Insight Manager for Tivoli NetView being used, an addition to the *CPQCONFIG.DAT* may be needed to manage the NAS B3000 from Tivoli NetView. Often the location of the *CPQCONFIG.DAT* file varies. Locate the file and add the following line to the file and save it:

```
Server : ntsrvr : 1.3.6.1.4.1.232.11.2.7.2.1.4.0 string
"StorageWorks NAS B3000";
```

This command string allows Tivoli NetView to identify the NAS B3000.

Installing the Management Software on the Client Machine

If a remote machine needs to have remote access to the NAS B3000, it must first have the management software loaded onto it. The following directions provide instruction on loading the Compaq Insight manager console onto the client machines.

Compaq Insight Manager:

1. Insert the Compaq Management CD Version 4.70 or later into the management console of the client machine.
2. From the Compaq Management CD window, click **Compaq Insight Manager.**
3. Select **Compaq Insight Manager** and follow the installation directions.

Compaq Insight Manager for HP OpenView (Windows 2000 Operating System)

For detailed instructions on downloading and installing Compaq Insight Manager for HP OpenView (Windows 2000 operating system), visit the following website:

http://www.compaq.com/products/servers/management/nt-ov-dl.html

For detailed instructions on downloading and installing Compaq Insight Manager for HP OpenView (HPUX) visit the management area website:

http://www.compaq.com/products/servers/

Compaq Insight Manager for Tivoli NetView

For detailed instructions on downloading and installing Compaq Insight Manager for Tivoli NetView (AIX) visit the management area of the Compaq website:

http://www.compaq.com/products/servers/

A

Backup Utility Management

This appendix is a backup guide for *StorageWorks* NAS devices. This document guides the reader through the process of determining which backup and restore solution is best suited to the NAS device and their business environment.

As a source and a destination for departmental, workgroup, and enterprise data, the NAS B3000 becomes an integral part of company computing environments. Therefore, efficient backup and reliable restore capabilities are a priority.

This appendix provides pointers for setting up and maintaining reliable backups, including:

- Sizing considerations
- Backup solutions
- Best practices

Sizing Considerations

Sizing considerations guide an administrator in selecting or scaling the solution to fit specific business requirements. Considerations include:

- Sizing factors
- Sizing tools

Sizing Factors

Factors to consider include:

- Speed of backup and restoration
  - How much data must be backed up?
  - How long will it take to complete a backup?
  - Is a full backup needed or will a partial backup suffice?
- Cost
  - What equipment will be required to implement this backup?
  - What software vendor will best meet organizational needs?
- Safety of data
  - How often is this information backed up?

For more information about which hardware and software products are certified by Compaq, access the Compaq StorageWorks Enterprise Backup Solution Hardware/Software Compatibility Matrix at

www.compaq.com/products/storageworks/ebs/EBScompatmatrix.html

Sizing Tools

There are many factors to consider when choosing a backup solution for your environment. These factors include performance, capacity, reliability, automation, and cost issues. To help understand the factors that affect performance and purchasing decisions, Compaq has developed a performance sizing tool. This tool addresses the factors involved in selecting a backup solution for a specific environment.

The award-winning sizer is a Windows-based tool that helps maximize business benefits by optimizing the solution.

This sizing tool displays:

- Product information
- A complete backup schedule for your environment
- Tape library solutions supporting performance and business requirements.

The sizing guide can be accessed from the Compaq Storage website:

www.compaq.com/products/storageworks/ebs/ebstoolsbackupsizing.html

Information about backup products is available on the Compaq website:

www.compaq.com

Backup Solutions

There are three main considerations when developing a backup solution:

- System environments
- Hardware options
- Software options

System Environments

In many departmental and workgroup situations, it is common to connect a tape backup device directly to the NAS device, using a SCSI connection. In this scenario, the server has exclusive use of the tape device. Compaq has several tape solutions with wide industry acceptance available for use with the NAS B3000.

In enterprise situations, multiple servers commonly share a large tape library device through a storage area network (SAN) using Fibre-Channel connections.

The NAS device is deployed into one of the following environments:

- SCSI direct connect
- Fibre channel

SCSI Direct-Connect Environments

The NAS device may be directly connected to a large tape library using an optional SCSI tape controller. The optional High Voltage Differential (HVD) or Low Voltage Differential (LVD) controllers have two SCSI busses, each capable of supporting up to two DLT 7000 (35/70-GB) devices, for a total of four tape drive devices.

Fibre-Channel Environments

If your company is already sharing tape libraries, or planning this approach, you need to ascertain which of the following fibre channel environments is being used for the SAN:

- Fibre-Channel Arbitrated Loop (FC-AL)
- Switched Fibre Channel

Fibre-Channel Loop

Fibre channel loop environments connect servers, such as the NAS B3000, to backup devices using a fibre channel hub and a fibre-channel-to-SCSI bridge, called a fibre channel tape controller. The fibre channel loop host bus adapter (HBA) controller is inserted into an open PCI slot in the server, and a fiber link connects the controller to the fiber hub. Other servers can also be connected to the hub in the same way. A separate fiber link connects the hub to the fibre channel tape controller. Finally, an HVD or LVD SE SCSI cable connects the tape controller to the actual SCSI tape device or devices.

Switched Fibre-Channel

Fibre channel switched environments are similar to loop environments, except that a different HBA controller is used, and a fibre switch replaces the fibre hub used in the loop environments. Switched environments can be made more reliable than loop environments.

Fibre channel environments use a host bus adapter (HBA) to connect a cluster node to a fiber switch. The NAS B3000 requires two HBAs and two fibre SAN switches. This configuration creates a multi-path fault-tolerant infrastructure. Switched fabric environments are scalable in performance and capacity because the architecture provides a dedicated data path between two devices in a switch. Switched fabric environments also provide good performance because they contain many dedicated 100 MB/s data paths without sharing bandwidth.

As with the SCSI-connected environments, verify that the chosen backup software vendor supports the specific hardware environment.

Hardware Options

Selecting the correct type device and connection type ensures a reliable backup of data that is well-suited to the particular computing environment. Compaq recommends several tape solutions for use with the NAS B3000.

For a full list of qualified tape solutions, refer to the Compaq Website:

www.Compaq.com

Additional backup recommendations and information is available in the Backup whitepapers, also available at the Compaq Website.

Before purchasing a tape device, ensure that the backup software supports the preferred device. Most backup software supports a wide range of backup devices, and Compaq has done extensive testing and certification on many popular backup software packages. The administrator should confirm specific choices by consulting the software vendor's website. Vendors usually post a hardware compatibility guide for each version of the backup software application.

Software Options

After choosing the tape hardware devices, the next step is to select the backup software. If backup software is already being used on other servers, the same software may be used to reduce the complexity and setup time of the backup solution.

Before purchasing backup software, verify that it is supported on the chosen backup device. Most backup software supports all types of backup devices and Compaq has done extensive testing and certification on many popular backup packages. The administrator must confirm the specific choice by consulting the software vendor's website. Vendors usually post a hardware compatibility guide for each version of the backup software application.

Important capabilities to look for in backup software include the following:

- Autochanger support
- Tape media management database
- File history database with extensive search capabilities

- Ability to define backup groups and schedules
- Ability to take advantage of multiple tape devices concurrently, to reduce backup window
- Capabilities to analyze, summarize, and report status automatically
- Options for sharing tape drives in a shared library environment
- Options to enable backup of open and locked files
- Options to back up system state and system databases
- Options to interact with software from a remote console application
- Options for disaster recovery

Best Practices

After deciding on a backup solution, establish procedures that will enhance the reliability and effectiveness of the backups. The following sections describe general recommendations for performing a backup. Keep company-specific needs and environment in mind when implementing these suggestions.

Regular and Reliable Backups

The NAS B3000 has a range of high-availability features, including:

- RAID 1 (mirroring) for the operating system drives
- RAID 3/5 for the data drives
- Redundant power supplies and fans
- Redundant HBAs for multiple paths to data
- Snapshots

Despite these features, the only way to reliably safeguard data against accidental loss, intentional tampering, or hardware failures is with regularly scheduled backup and offsite storage of backup media.

It is recommended that data disks be configured in RAID arrays. This configuration makes data loss due to disk failure unlikely. Two drives in the same array must fail at the same time for data loss to occur. Nevertheless, it can happen and backups prevent an inconvenience from becoming a tragedy.

Automated Tape Libraries

Automated tape libraries improve performance, capacity, and reliability of tape backup operations and should be used whenever possible. Libraries must be enabled by additional licensing, installation of library control modules, and configuration steps. Some of the benefits of tape libraries include:

- Enhanced performance by the automated, instantaneous handling of tapes, requiring no lag time for an administrator to arrive and manually change the tape
- Improved capacity because tape libraries include storage slots for additional tape cartridges. Enough media can be loaded so that operations can continue overnight, over the weekend, or all week, without intervention or tape changes
- Increased reliability because tapes are handled less and the human element of forgetfulness in changing tapes is eliminated

Multiple Backup Devices

To take advantage of multiple backup devices, the server must be configured correctly. Generally, backing up multiple disks requires multiple tape drives. If the NAS device has 500 GB of disk space and this space is arranged as a single virtual disk, it is not possible to directly take advantage of multiple tape drives. If possible, make multiple smaller virtual disks. This procedure lets the administrator back up the multiple devices in parallel, sending the data from one or two disks to each tape in parallel. This type of configuration greatly reduces the time required for backup and makes the most efficient use of the tape backup device.

If it is necessary to use a single, large virtual disk, the administrator configures several backup groups to contain the various directory trees at the root of the virtual disk, so that more than one tape device can work in parallel.

Also, note how the virtual disks are constructed when setting up backup jobs. To increase the performance of the backups, schedule the back up of virtual disks so disks that share a common set of physical drives are scheduled at different times. The underlying physical disks can devote more time to each of the backup jobs, rather than having two backup jobs competing for disk I/O.

Backup Schedules

An automatic, periodic backup is much more reliable than occasional backups that occur only when someone remembers to execute them. The specific needs of the organization will determine what type of schedule to implement.

A weekly or biweekly full backup is the basis of any good backup schedule. Add to that baseline daily incremental or differential backups to capture any daily changes that occur between full backups. Depending on the rate of data change, and the capacity and performance of the backup devices, adjust the backup schedule to fit the environment of the organization. Incremental backups capture changes to the data that have occurred since the last backup. Differential backups capture all the changes that have occurred since the last full backup.

If the backup devices do not have sufficient capacity for a complete, full backup, distribute the backups so they occur throughout the backup cycle. This strategy can meet the backup needs of the organization until a larger tape backup device or library can be installed. For example, instead of doing a full backup of disks C:, X:, Y:, and Z: on Friday, back up C: on Monday, X: on Tuesday, Y: on Wednesday, and Z: on Thursday. Schedule incremental or differential backups on the same distributed schedule.

NOTE: The suggested scenarios for backup times are based on a hypothetical company situation.

Media Rotation

Most backup software solutions are equipped to label and track media usage accurately. Take advantage of these capabilities to maintain different media pools for full backups and incremental/differential backups, as well as archive media. The retention time on each of these types of backup is different. For example, using differential backups on the same tape for full backups causes the tape space to be wasted, after the retention time for the differential data has passed. Keep separate pools to avoid this problem.

Offsite Storage

Set up a regular process for moving important long-term media, such as backups and archives, offsite for safekeeping. This ensures that the administrator can recover the data in the event of a complete facility destruction where the NAS device resides. As an alternative to a commercial offsite storage facility, if the company has multiple buildings, the offsite media can be stored in another building. This alternative provides some protection in the event of a building fire where the NAS device is located.

When employing offsite storage, strike a balance between safety and convenience by deciding how long to keep the media onsite. After the media has been moved offsite, restores will take much longer because the media is not readily available.

A periodic audit of the offsite facility ensures that the media is being stored in secure, environmentally acceptable conditions, and that it can be located and returned to the facility in a timely manner.

Server Setup Information Archival

After the administrator has established a regular backup schedule, it is necessary to document the setup attributes of the NAS device. There is always the possibility of the complete loss of the server in cases of fire, flood, or weather disasters. To maximize the ability to recover from server disasters and to minimize the time required for recovery, keep current copies of the following information in a safe location:

- Server name
- Quorum disk and system state backup (cluster deployments)
- IP addresses
- Gateways
- DNS servers
- NIS servers
- User mapping database
- Storage setup
  - — Drive arrays (LUNs owned by the cluster nodes)
  - — Connections (cluster deployments)
  - — Virtual Replicator pool names, sizes and member storage units (LUNs)
  - — Virtual disk names and sizes
  - — Snapshot names and schedules
  - — Share names, paths, and access permission settings

This information greatly increases the ability to quickly and accurately recover from catastrophic failures such as fires, weather disasters, theft, and complete hardware failure.

Snapshots and Quick Online Restores

The Virtual Replicator aggregates disk RAID arrays into large pools of storage from which virtual disks are created. VR also enables the snapshot capability for the NAS device. Snapshots are temporary, online copies of the virtual disks. When a snapshot is made, an identical copy of the original source disk is created without any additional disk space being utilized. Snapshots can be completed in a few seconds, because disk space is used only when the original files change.

Snapshots can be used as the source of data for a backup. There are some applications that must be stopped before backups are made. A backup requires that the file system is recorded in a consistent state, where no changes occur during the backup. Because snapshots are created in a matter of seconds and maintain a consistent view of the file system from that point on, snapshots can drastically reduce the amount of time applications must be paused or shut down during backup operations. The NAS device facilitates automatically creating snapshots at any given time, and can even be set up to create a snapshot, execute a backup, and delete the snapshot upon successful completion of the backup job.

Though snapshots should never be considered a replacement for regular data backup to removable media, they can be a highly convenient feature for immediate, tapeless recoveries. If a file is accidentally deleted or corrupted, it can be recovered quickly by accessing the snapshot, selecting the file or directory, and copying it back to its original location on the virtual disk.

To use the snapshot capability for a quick online restore, take a snapshot on a regular basis or before the source disk is altered. This ensures a backup of all the original files, applications, and configurations.

IMPORTANT: Snapshots should be considered an additional convenience for restores, not a replacement for tape backup. In the event of disk failures, snapshots can be lost along with the original virtual disk data. Snapshots will be automatically deleted without warning by the Virtual Replicator to regain space when disk space is low.

Readiness Testing

Completing regular backups is important, but is only the first step in the backup process. To verify the integrity of those backups, the administrator must conduct periodic testing to confirm the ability to recover files and directories. Regularly testing the recoverability of random files or directories ensures that the backup solution is working as planned.

Disaster Recovery

Disasters that cause the loss of an entire server or server operating system drives require a complete restoration of the server. The specific procedure for recovering from a disaster depends on your environment, the backup software and the optional disaster recovery modules that may have been installed.

In general, it is necessary to complete the following steps to fully recover from a disaster:

NOTE: These steps illustrate the recovery procedures in a non-clustered deployment.

- Use the QuickRestore process to reinstall the NAS B3000 system image.
- Configure the arrays, logical drives, pools, and virtual disks as they were at the time of the disaster.
- Reinstall the backup application.
- Add the NAS B3000 into the appropriate domain.
- Re-establish user accounts if the NAS B3000 is a part of a workgroup.

  If the files were retained, re-establish user rights to drives, files, and directories.

  NOTE: Being a part of a domain negates this requirement.
- Recover the backup application file and media history databases.
- Recover data from backup applications.
- Recover the system state.
- Re-create file shares.

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