Novell

NetWare® 6

NETWARE SERVER DISKS AND STORAGE DEVICES
ADMINISTRATION GUIDE

Novell®

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Server Disks and Storage Devices

With NetWare®, you can create up to four NetWare (or other) partitions on one hard disk. The primary storage and file system for NetWare is Novell® Storage Services™ (NSS). For information about the NSS file system, see Introducing Novell Storage Services in the *Novell Storage Services Administration Guide.*

After you create partitions on your storage devices, you can create volumes where you place your data files. There are two types of volumes you can create: traditional NetWare volumes and NSS logical volumes. For more information about NSS logical volumes see Create Logical Volumes in the *Novell Storage Services Administration Guide*.

To maintain and modify your storage and file system, you use your server console, ConsoleOne™, and MONITOR utilities. In ConsoleOne, you can create, modify, and purge partitions and volumes. MONITOR provides important disk use and file statistics. You can use MONITOR to review disk usage and availability. You can also use it to review data block placement and redirection. For instructions on using MONITOR, see MONITOR in *Utilities Reference*.

To optimize your server's storage devices, follow the general recommendations found in "Optimizing the File System Performance" on page 21.

Documentation Conventions

In this documentation, a greater-than symbol (>) is used to separate actions within a step and items in a cross-reference path.

Also, a trademark symbol (®, ™, etc.) denotes a Novell trademark. An asterisk (*) denotes a third-party trademark.

1 Overview of Server Disks and Storage Devices

Server hard disks and remote storage devices (such as tape drives and CD-ROM drives) are all managed by the NetWare® operating system.

Hard disks are divided into partitions, including one DOS partition and at least one NetWare partition per server. A hard disk can also contain other partitions, such as a UNIX* partition. For general information about disk partitions, see "Partitioning Disks" on page 10 and "Logical Partitions" on page 11.

All storage devices and individual disk partitions are identified by numbers assigned by the NetWare operating system Media Manager. The same number represents the same device in all NetWare utilities or console commands. For an explanation of the device numbering system, see "Device and Partition Numbering" on page 12.

All storage devices require drivers. The NetWare Peripheral Architecture™ (NWPA) divides device drivers into two types: a custom device module (CDM) that drives the device itself and a host adapter module (HAM) that drives the adapter the device is attached to. For more information, see "Drivers for Host Adapters and Storage Devices" on page 16.

To increase data fault tolerance, you can mirror partitions to partitions on other disks. For information about mirroring, see "Mirroring and Duplexing" on page 16. NetWare also includes a feature called Hot Fix™ which redirects any information stored on corrupted blocks to uncorrupted blocks. See "Redirecting Bad Blocks" on page 18.

Partitioning Disks

You can divide a NetWare server hard disk into units called disk partitions. You can also leave free (unassigned) space on a disk.

NOTE: A NetWare disk partition is not related to an NDS® partition.

One of the server's hard disks must contain a DOS partition. This is the primary boot partition where server.exe is stored. You need only one boot partition per server. You also need to keep a SYS: volume. The file system creates this volume automatically when you install NetWare.

A hard disk can contain as many as four partitions, including a DOS partition, multiple NetWare partitions, or non-NetWare partitions (such as Windows* NT* or UNIX). The disk can also contain free space assigned to the Novell Storage Services (NSS) file system.

A NetWare partition consists of a data area and can also contain a Hot Fix™ Redirection Area used for disk sector sparing (maintaining a spare sector per track in case another sector becomes defective). The logical sector 0 of a NetWare partition is the first sector of the data area available to applications, such as the traditional NetWare file system. This data area is referred to as a logical partition. See .

The following figures illustrate some of the ways hard disks can be partitioned.

Figure 1   NetWare and DOS Partitions on One Disk
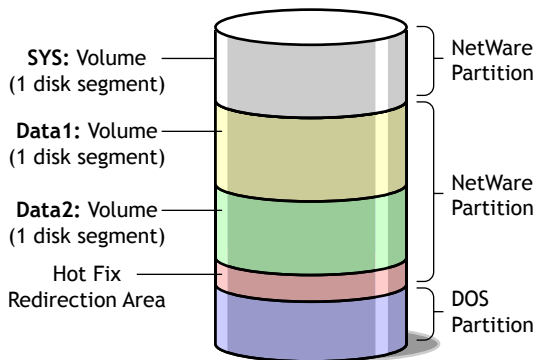
Figure 2   DOS Partition on First Disk, NetWare and Non-NetWare Partitions on Second Disk
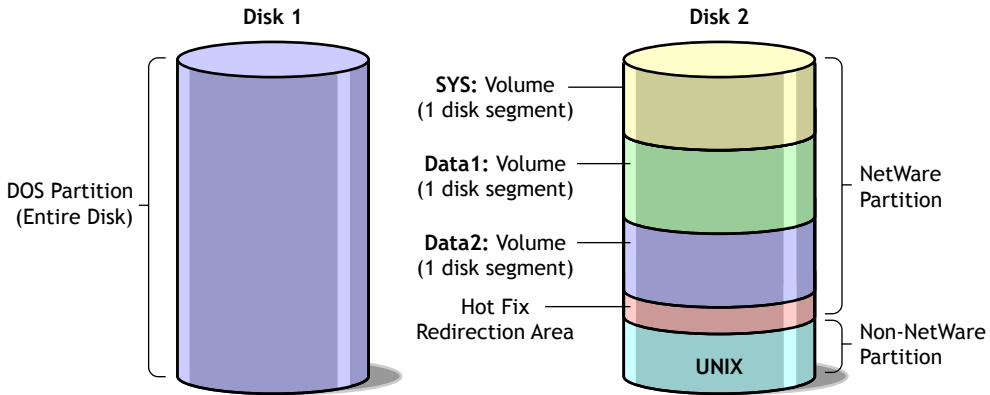
Figure 3   Disk with One NetWare Partition and Free Space Assigned to NSS
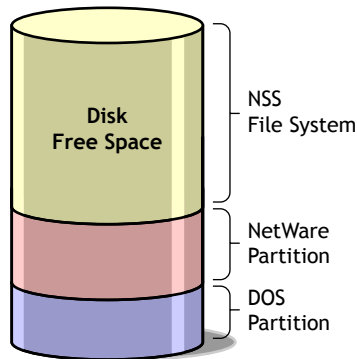
Logical Partitions

Server hard disks can contain up to four partitions. Each partition contains a data area, where the file system resides, and can contain another data area, called the Hot Fix/mirror object, which is used to manage mirroring and Hot Fix redirection.

The entire NetWare partition, including both the data area and the Hot Fix/ mirror object, is called the *physical partition*.

The data area of the partition is called the *logical partition*.

If you do not use Hot Fix and mirroring, the entire physical partition is the logical partition.

Figure 4   Logical and Physical Partitions on a Server Disk
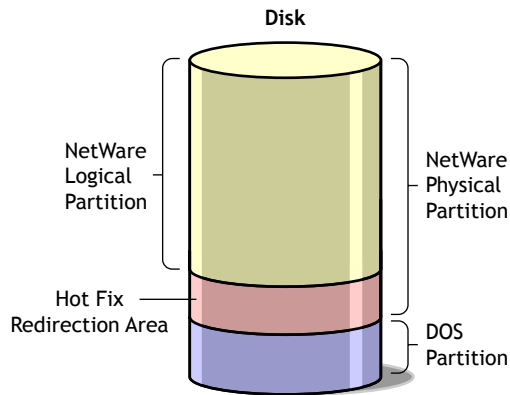
The logical partition contains four redundant copies of the volume definition table (VDT). Each table contains a list of all volume segments in that partition. A segment is the amount of space you obtain from a storage device. Four copies are maintained for fault tolerance. If a disk error occurs and one table is corrupted, the file system can detect and correct the error.

The rest of the logical partition can contain any number of volume segments.

Device and Partition Numbering

All storage devices, disk partitions, and logical partitions are identified by object numbers assigned by the NetWare operating system Media Manager.

In addition, the Media Manager assigns device names to physical devices and adapters called object numbers.

These object numbers and device names are consistent across all NetWare utilities and console commands so that you can easily identify the objects and devices.

Object Numbers

Object numbers are hexadecimal numbers assigned to devices, adapters, media, partitions, and divisions of a partition (such as the Hot Fix redirection area).

If you mirror partitions, each logical partition in the mirrored set has the same object number as the other partitions in the set.

Object numbers are not sequential or persistent. New numbers can be assigned when the server is restarted. But the same object number represents the same entity in any NetWare utility. For example, if you type LIST DEVICES at the server console prompt, you would see a list of storage devices, such as the following (the first number in each line is the Hexidecimal object number):

```
0x0001: [V312-A0-d4:0] iomega jaz 1GB rev:H.72

0x0003: [V025-A1-D1:0] WDC AC22100H

0x0002: [V025-A2-D2:0] NEC CD-ROM DRIVE:282 rev:3.07
```

Likewise, in MONITOR, if you select Available Options > Storage Devices, you would see a list of storage devices, partitions, and adapters similar to the following:

```
0x0001: [V312-A0-d4:0] iomega jaz 1GB rev:H.72

0x0000: [V025-A1] Novell IDE Host Adapter Module

0x0003: [V025-A1-D1:0] WDC AC22100H

0x0002: [V025-A2-D2:0] NEC CD-ROM DRIVE:282 rev:3.07

0x0006: DOS Partitioned Media

0x0008: NetWare Partition

0x000A: Non-Mirrored Partition
```

In the MONITOR example, object number 0x0001 represents an Iomega Jaz drive, just as it did in the LIST DEVICES display.

Note that a physical NetWare partition is identified as NetWare Partition and a logical partition is identified either as Non-Mirrored Partition or Mirrored Partition.

Mirroring messages use the logical partition object number to report that hard disks are being remirrored or unmirrored.

For instructions on using MONITOR, see MONITOR in the *Utilities Reference.*

Partition examples

The following are example partition entries with the device information:
Unpartitioned - D:0x1-1

- Unpartitioned indicates that the device is unpartitioned.

- D:0x is the device number.

- -1 is the chunk number. (A unique number that this is the first unpartitioned segment on device 1.)

NSS-P:0x15-1

- NSS-P:0x15-1 indicates that this is an unassigned NSS partition.

- P:0x15 is the partition ID.

- -1 is the chunk number (this will always be 1 because it consumes the entire partition).

Traditional P:0x15b-2

- Traditional indicates that this is a traditional volume with unassigned space.

- -P:0x1b is the partition number of the traditional partition ID.

- -2 is the chunk number indicating that this is the second piece of free space in this unused partition.

If the object ID number contains a "P," the partition does not have a mirror object ID. The selected object has an unmirrored physical partition ID.If the object ID number contains an "M," the partition is mirrored. The ID number following the "M" is the ID of the mirror group instead of an individual partition.For example, M:0x14-1 indicates that the partition exists on the group of partitions represented by the mirror ID 0x14. Traditional - M:0x1c-1 indicates that the traditional partition exists on the group of mirrored partitions represented by mirror ID 0x14.

Device Names

Devices such as hard disks and adapters are identified not only by a nonpersistent object number, see "Object Numbers" on page 13, but also by a permanent device name. When a hard disk fails, the failure message includes the device name so you can identify the disk or adapter.

To see a list of storage devices and their names, execute the LIST STORAGE ADAPTERS command at the server console prompt. The screen lists each device adapter, followed by a list of devices driven by that adapter. In the following example, the first line identifies an IDE disk adapter. The second line identifies a hard disk operated by that adapter:

```
[V025-A0] NOVELL IDE HOST ADAPTER MODULE

 [V025-A0-D1:0] QUANTUM FIREBALL_TM3840A
```

The bracketed letters and numbers at the beginning of each line are the device name. The device name identifies the adapter or device, as follows:

[V025-A0-D1:0]

Vendor Number
Adapter Number
Device Number
Logical Unit Number
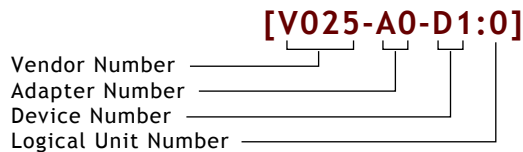
- ◆ **Vendor number**. A unique number specific to the device vendor.

- ◆ **Adapter number.** The instance of the adapter in the server. In the example, A0 identifies the first instance of an adapter installed in the server. Adapter numbers are unique. The second adapter installed in the server will have adapter number A1, even if the adapter is of the same type as adapter A0.

- ◆ **Device number.** The number of the disk or other device. For a SCSI disk, this is the target ID, usually set by a jumper on the hard disk. For an IDE disk, this number represents the bus from the IDE controller. IDE numbers range from D0 through D3, representing the primary, secondary, tertiary, or quaternary bus.

- ◆ **Logical unit number (LUN)**. The LUN identifies individual devices when more than one device is attached to one bus. For example, one IDE bus might be attached to two disks, a master and a slave. LUN 0 represents the master and LUN 1 represents the slave. However, because disk manufacturers rarely use the logical unit number to identify hard disks, the LUN almost always appears as 0.

The Device name represents the device in all Novell utilities and console commands, including MONITOR, LIST DEVICES, etc.

Fault tolerance systems such as Hot Fix use the Device name to report that data blocks on disks have relocated.

Drivers for Host Adapters and Storage Devices

All storage devices require drivers. The NetWare Peripheral Architecture (NWPA) divides device drivers into two kinds: a custom device module (CDM) that drives the device itself and a host adapter module (HAM) that drives the adapter has been attached to. The following are two types of drivers:

- Custom Device Module (CDM)

  CDMs drive storage devices, including autochangers, that are attached to the host adapter bus.

  CDMs are device-specific. For example, if there are three different types of storage devices attached to the host adapter (such as a CD-ROM drive, a SCSI hard drive, and an autochanger) then a specific CDM for each type of device must be installed.

- Host Adapter Module (HAM)

  A HAM is the driver component associated with the host adapter hardware. HAMs provide the functionality to route requests to the bus where a specified device is attached.

  HAMs are adapter-specific. For example, if a third-party adapter is installed in the server, a HAM developed specifically for that adapter must be installed.

Loading HAMs and CDMs is much like loading other device drivers, but instead of loading one .dsk file for both the adapter and device, you load one .ham file for the adapter and one .cdm file for each type of device attached to that adapter.

When you want to connect a new hardware device to the host bus adapter, you need to load only the appropriate CDM for that hardware device (in addition to the HAMs and CDMs already loaded, and assuming a compatible adapter is installed).

Mirroring and Duplexing

You can protect the data mirroring or duplexing disk partitions.

Mirroring stores the same data on separate disks on the same controller channel; duplexing stores the same data on separate disks on separate controller channels. Duplexing can also use two different drivers. Duplexing is the recommended method because two channels rarely fail simultaneously.

In the following illustration, several smaller disks are mirrored to partitions on one larger disk.
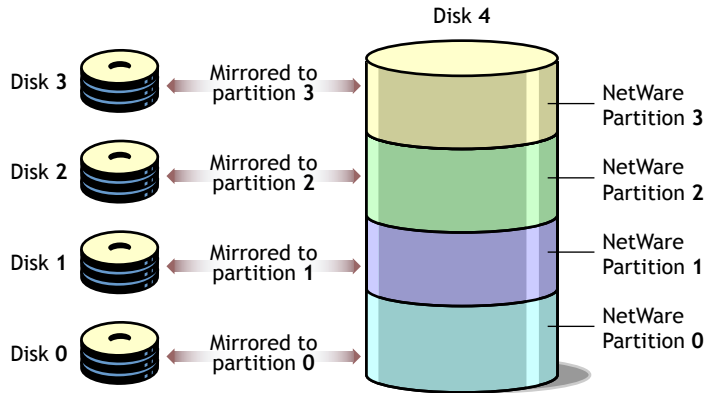
To mirror partitions you must enable Hot Fix. For information about Hot Fix, see "Redirecting Bad Blocks" on page 18.

With Hot Fix enabled, a section of the partition is set aside as the Hot Fix/ Mirror object, which holds data tables for both Hot Fix and mirroring. The tables store information about which data blocks are bad, which blocks have been redirected, which partitions are mirrored, and whether the partitions are synchronized or not.

Setting up Hot Fix is much easier when you create the partition. To add Hot Fix after you create a partition and add volumes, you must delete the volumes from the partition, add Hot Fix, then restore the volumes from a backup. When you restore volumes from a backup, make sure you have enough space on the partition to accommodate the volumes after you add Hot Fix to the data area.

The following are important concepts for mirroring partitions:

- Mirrored partitions must have the same partition type of mirror group as the group you assign it to. This means that NSS partitions can be mirrored only to other NSS partitions. The same criteria applies to traditional partitions.

- Mirrored partitions must be compatible in data area size. This means the new partition must be at least the same size or slightly larger than the other partitions in the group. The physical size (combined data and Hot Fix size) of the partition must be at least 100 KB, but no more than 120 MB larger than the data size of the existing partitions in the mirror group.(Note: The file system adjusts the Hot Fix size within the legal

ranges in order to make the data area identical to the other partitions in the group.)

 ◆ Mirrored partitions must have the same sharable status.

 ◆ Partitions you add to a mirror group cannot be part of any other mirror group. They must be standalone Mirror objects.

 ◆ The partitions you add must include the Mirror and Hot Fix options. You select these options when you create the partition; you cannot add the options later.

 ◆ When you select Hot Fix, mirroring is automatically selected. You cannot mirror partitions that do not have a Hot Fix Redirection Area.

 ◆ Although you can mirror one partition to as many as eight other partitions, mirroring two partitions is usually sufficient fault tolerance for most systems.

 ◆ If a mirrored disk fails and cannot be accessed by the server, you can unmirror the hard disks and salvage the volume from the functional disk. See "Recovering Data from an Out of Sync Disk" on page 37.

 ◆ If you want to remove a hot-plug mirrored disk without bringing down the server, you must unmirror the disk first. See "Unmirroring Partitions" on page 37.

For information about how to set up mirroring and duplexing, see "Mirroring and Duplexing Partitions" on page 37.

Redirecting Bad Blocks

Due to the constant reading and writing of data to disk, some disk storage blocks lose their capacity to store data. NetWare uses Hot Fix to prevent data being written to unreliable blocks.

The Hot Fix feature redirects the original block of data (still in memory) to the Hot Fix Redirection Area of the NetWare partition. Once the operating system records the address of the defective block in a section of the partition area, the server will not attempt to store data in the defective block.

Hot Fix redirection can occur during a write request, a read request, or a read-after-write verification.

 ◆ Write redirection occurs when the disk reports an error during a write request. The system marks the block as bad and redirects the data to a different block.

- Read redirection occurs following a disk error during a read request.

  If the disk is mirrored, the system retrieves the data from the mirrored disk and redirects the data on the primary disk. If the disk isn't mirrored, the data is lost, and the block is marked as bad.

- Read-after-write-verify redirection occurs after data is written to disk. The data on disk is then read and compared to that in memory. If the two don't match, the system marks the block as bad and redirects the data to a different block.

By default, 2% of a disk's space is set aside as the Hot Fix Redirection Area. You can increase or decrease this amount when you create a partition.

If Hot Fix is enabled, it is always active unless the disk fails or the redirection area is full. You can view Hot Fix activity in MONITOR by selecting Storage Devices and then a Hot Fix partition.

Figure 5   Hot Fix
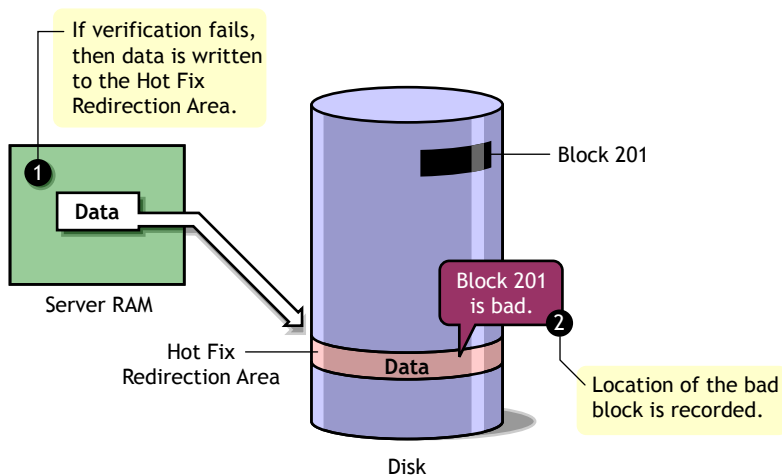
You can specify no Hot Fix Redirection Area when you create disk partitions. Having no Hot Fix Redirection Area saves partition space. Eliminating the Hot Fix Redirection Area might be recommended for large (Redundant Array of Inexpensive Devices (RAID) systems that provide their own means of fault tolerance.

However, if Hot Fix is not enabled, the partition will not have the fault tolerance. Data on corrupted sectors of the disk will not be redirected to the Hot Fix Redirection Area.

For instructions on how to specify no Hot Fix redirection area, see Creating a Partition in the *Novell Storage Services Administration Guide*.

2 Optimizing the File System Performance

NetWare® provides several methods for improving the performance of your file system. For a list of general guidelines for conserving disk space and improving disk performance, see "Optimizing Storage Disk Capacity" on page 21.

To improve disk reads and writes, see "Improving Disk Reads" on page 24 and "Improving Disk Writes" on page 26. You can also increase the speed of disk reads and writes by striping volume segments across multiple disks. Disk striping is called Redundant Array of Inexpensive Disks (RAID). For more information about RAID, see Stripe Data Across Storage Devices (RAID) in the *Novell Storage Services Administration Guide*.

The following is a list of suggestions for saving disk space:

- Compressing files. See File Compression in the *Traditional File Services Administration Guide*.

- Permanently deleting files. See Salvaging and Purging Files in the *Traditional File Services Administration Guide*.

Optimizing Storage Disk Capacity

There are several options for increasing the capacity of your storage disks. The following is a list of options you can use to improve your file system storage capacity:

- Enable block suballocation if you are using the traditional NetWare file system. This eliminates having unused data blocks on your volumes. This feature works only on traditional partitions and volumes. Block suballocation is enabled by default, but can be disabled when the volume

is created. If block suballocation has been disabled, enable it in ConsoleOne™ when you create a partition. For information about enabling block suballocation, see Creating a Partition in the *Novell Storage Services Administration Guide*. Once block suballocation is enabled, you cannot disable the feature without recreating the volume.

If you use block suballocation, set your file block size to 64 KB. The larger block size causes the system to transfer more data at one time so it improves performance.

Keep at least 1000 free blocks on each NetWare volume that has suballocation enabled. Free blocks are disk blocks that have no files stored in them. If the number of free blocks is low, the suballocation will increase server utilization.

To find the number of free blocks, in MONITOR select Available Options > Volumes. Select the name of the volume you want. Press Tab to expand the information window and note the value of the Free Blocks statistic. For instructions on using MONITOR, see MONITOR in *Utilities Reference.*

◆ You can save partition space and increase performance by eliminating the Hot Fix™ redirection area on a partition. However, once Hot Fix is eliminated from a partition, you cannot add it again without first deleting the volumes on the partition. Once Hot Fix is gone, the partition will no longer be fault tolerant, unless the hard disk itself provides a means of fault tolerance. Data on corrupted sectors of the disk won't be redirected to the Hot Fix redirection area. In addition, you will not be able to mirror the partition.

◆ Turn off Read-After-Write-Verify in MONITOR. For instructions on using MONITOR, see MONITOR in *Utilities Reference.*

Read-After-Write-Verify is almost always provided by the hard disk itself. Use the Read-After-Write-Verify feature in MONITOR only if your hardware does not provide this feature but does support software-controlled Read-After-Write-Verify.

See "Turning Off Read-After-Write Verification" on page 28.

◆ If you have a 16-bit disk adapter, make sure you increase the number of reserved buffers below 16 MB. Use the SET command or MONITOR to set the parameter Reserved Buffers Below 16 MB to its upper limit, 300. The parameter is found in MONITOR > Available Options > Server Parameters > Memory. Remember that too many reserved buffers can

prevent large volumes from mounting. As soon as possible, upgrade the system to a newer board that can access higher memory. For instructions on using the SETcommand, see SET in *Utilities Reference.* For instructions on using MONITOR, see MONITOR in *Utilities Reference.*

◆ Use a driver that supports scatter gather functionality.

◆ Provide at least one device large enough to hold a core dump of the server's memory. A core dump cannot span devices.

◆ If a volume is comprised of two or more segments, each segment should be on a different disk. If the volume is made of more than one segment on one disk, the volume spans between the two segments, slowing performance.

◆ If you use file compression, make sure you enable the option at a time when there is little server activity.

For example, make sure that the Deleted Files Compression Option parameter is *not* set to 2, which would cause compression whenever a file is deleted but not purged. Make sure that users have not flagged their directories IC, which enables immediate compression. Use the SET command to make sure that compression is scheduled to start and stop at the appropriate times.

◆ You can enable fault tolerance protection by mirroring or duplexing the SYS volume, because it contains the core NetWare files. See "Mirroring and Duplexing Partitions" on page 37.

◆ Keep 10% free space in any NetWare volume, except SYS where there should be 20% free space.

WARNING: Do not fill up your SYS volume. This could damage your entire file system. The Transaction Tracking System, which protects NDS®, will shut down compromising the NDS replicas on the server.

To keep enough free space on volumes, try the following suggestions:

  ◆ Use MONITOR to check each volume's disk space regularly.

  ◆ Use the Volume Low Warning Threshold parameter to specify when you will be warned that a volume is running out of disk space. Set the parameter in MONITOR. For instructions on using MONITOR, see MONITOR in *Utilities Reference.*

  ◆ Move any user files or print queues to another volume.

  ◆ Don't store replicas on servers with low disk space.

- CD-ROM drives can create large index files. Don't use or mount the CD-ROM unless you have enough space.

- Limit the size of auditing files. (Auditing works only on traditional NetWare partitions.)

Improving Disk Reads

On a server that is read-intensive, the following procedures can improve the speed of disk reads.

- "Changing Concurrent Disk and Directory Writes for Faster Reads" on page 24.

- "Changing the Turbo File Allocation Table (FAT) Wait Time for Faster Reads" on page 25.

For instructions on using MONITOR, see MONITOR in *Utilities Reference.*.

Changing Concurrent Disk and Directory Writes for Faster Reads

Use this procedure if your server is slow to respond to read requests.

NOTE: This procedure requires that you decrease the values of the Maximum Concurrent Disk Cache Writes parameter and the Maximum Concurrent Directory Cache Writes parameter. Although decreasing these values increases the speed of read requests, it might decrease the speed and efficiency of write requests.

1 From the MONITOR Available Options, select Server Parameters > File Caching.

NOTE: You can also set file caching parameters with the SET command in MONITOR.

2 Decrease the value of Maximum Concurrent Disk Cache Writes.

If the parameter is currently set to the default value of 50, try setting the value to 10.

3 Press ESC to return to the list of categories and then select Directory Caching.

A list of Directory Caching parameters appears in the upper window.

4 Decrease the value of Maximum Concurrent Directory Cache Writes.

If the parameter is currently set to the default value of 10, try setting the value to 5.

5 Increase the value of Directory Cache Buffer Non Referenced Delay.

This parameter specifies how long a directory entry must be cached before it can be overwritten. Increasing this value causes the system to allocate more directory cache buffers and thus speeds up directory access.

If the parameter is currently set to the default value of 5.5 seconds, try setting the value to 60 seconds.

6 Press Esc until you return to Available Options.

Changing the Turbo File Allocation Table (FAT) Wait Time for Faster Reads

When a program randomly accesses a file that contains more than 64 file allocation table (FAT) entries, the file system builds a turbo FAT index for the file so that the information in the file can be accessed quickly.

The Turbo FAT Re-Use Wait Time parameter specifies how long a turbo FAT index remains in memory after the indexed file is closed. When the turbo FAT index is in memory, files can be opened and information accessed faster.

If network users frequently access files larger than 64 blocks, use this procedure to increase the time the index is kept in memory.

1 From the MONITOR Available Options, select Server Parameters > File System. For instructions on using MONITOR, see MONITOR in *Utilities Reference.*.

A list of File System Parameters displays in the upper window.

NOTE: You can also set file system parameters with the SET command in MONITOR.

2 Scroll down the File System Parameters list to Turbo FAT Re-Use Wait Time.

The scroll thumb to the right indicates that you can use the arrow keys to scroll the list.

3 Increase the value of FAT Re-Use Wait Time.

You must specify the value in seconds.

If the parameter is currently set to the default value of 329.5 seconds (5 minutes 29.6 seconds), try setting the value to 600 seconds (10 minutes). The changed value is now persistent.

4 Press Esc until you return to Available Options.

Improving Disk Writes

For a write-intensive server, the following procedures can improve the speed of disk writes.

Increasing the Number of Concurrent Writes

You can increase the speed and efficiency of disk cache writes by increasing the number of write requests that can be executed at one time.

To determine whether you need to increase the number of concurrent writes, first compare the number of dirty cache buffers to the total number of cache buffers. These statistics are found on the General Information screen in MONITOR. Dirty cache buffers contain data that has not yet been written to disk.

The ratio of dirty cache buffers to total cache buffers is an indicator of the efficiency of disk cache writes. If the number of dirty cache buffers is greater than 70 % of total cache buffers, increase the number of concurrent write requests.

For an explanation of file caching, see Setting the Cache Buffers in the *Novell Storage Services Administration Guide*.

NOTE: Increasing the number of concurrent disk cache writes slows disk cache reads. You might want to balance the speed of disk writes and reads to meet the needs of users. If your server's processing load is write-intensive, you can favor disk writes. If it is read-intensive, favor disk reads.

1 From the MONITOR Available Options, select Server Parameters > File Caching. For instructions on using MONITOR, see MONITOR in *Utilities Reference.*

   NOTE: You can also set file caching parameters with the SET command in MONITOR.

2 Increase the value of Maximum Concurrent Disk Cache Writes.

   If the parameter is currently at the default value of 50, try increasing it to 100. The changed value is now persistent.

3 Press Esc until you return to Available Options.

Changing Disk and Directory Caching for Faster Writes

Use this procedure if network users frequently make many small write requests and the server is slow to respond to the requests.

1 From the MONITOR Available Options, select Server Parameters > File Caching. For instructions on using MONITOR, see MONITOR in *Utilities Reference.*

NOTE: You can also set file caching parameters with the SET command in MONITOR.

2 Increase the value of Dirty Disk Cache Delay Time.

This parameter specifies how long the system waits before writing a not-completely-dirty cache buffer to disk.

If the value is low, the system writes to disk more frequently, but writes fewer requests each time. If the value is high, the system waits longer before writing to disk, but executes more write requests with each operation. A higher value provides greater efficiency in writing to disk.

If the parameter is currently at the default value of 3.3 seconds, try increasing the value to 7 seconds.

3 Press Esc to return to the list of parameter categories and then select Directory Caching.

A list of Directory Caching Parameters appears in the upper window.

The scroll thumb to the right indicates that you can use the arrow keys to scroll the list.

4 Increase the value of Dirty Directory Cache Delay Time.

This parameter specifies how long the system keeps a directory table write request in memory before writing it to disk.

IMPORTANT: Increasing the parameter provides slightly faster performance, but can increase the chance of directory tables becoming corrupted.

If the parameter is currently at the default value of 0.5 second, try increasing the value to 2 seconds.

5 Increase the value of Maximum Concurrent Directory Cache Writes.

This parameter determines how many write requests from directory cache buffers are executed at one time. Increasing this value increases the efficiency of directory cache write requests.

NOTE: Increasing the number of concurrent directory cache writes decreases the speed of directory cache reads. Balance the speed of writes and reads to meet the needs or your users.

If the parameter is currently at the default value of 10, try increasing the value to 25. The changed value is now persistent.

6 Press Esc until you return to Available Options.

Turning Off Read-After-Write Verification

Read-After-Write Verify is almost always provided by the hard disk. If your hard disk provides read-after-write verification, you might want to disable the software version of read-after-write verification in order to nearly double the speed of disk writes.

WARNING: Turning off read-after-write verification can increase the risk of data corruption on the server's hard disk. You should use the following procedure only if your disks provide read-after-write verification and are reliable or if your disk subsystem provides data fault tolerance through mirroring or appropriate RAID level.

Prerequisites

❑ Hard disks that provide their own means of read-after-write verification.

Procedure

1 From the MONITOR Available Options, select Storage Devices.

A list of Registered Storage Objects appears. The device information associated with a highlighted storage device appears in the upper window. You can verify the type of storage device in the Device Type field.

2 Select the desired hard disk from the list.

The Drive Status window appears. The Read After Write Verification field indicates whether the feature is turned On or Off.

3 Press Enter to access the Read After Write Verification options.

4 To change Read After Write Status, select Disable Verify.

5 Press Esc to return to Available Options.

NOTE: You can also disable read-after-write verification by setting the Enable Disk Read After Write Verify SET parameter to OFF. However, this setting affects only those disks loaded after the parameter value is changed. It does not change the setting for currently loaded disks.

3 **File System Management**

It is important to monitor disk space regularly and keep a log to track disk usage over time. For instructions on checking disk space, see Viewing Storage Objects in the *Novell Storage Services Administration Guide*.

Adding a hard disk to the server requires both installing and partitioning the disk, as well as loading disk drivers.

- ◆ For information about adding conventional hard disks and loading disk drivers, see "Adding a Hard Disk to the NetWare Server" on page 32.

- ◆ NetWare® partitions can be created on any hard drive and can coexist with other partitions such as DOS or UNIX. For information about creating and deleting traditional NetWare partitions, see Creating a Partition in the *Novell Storage Services Administration Guide*.

  Disk space not assigned to NetWare partitions can be used for the Novell® Storage Services™ (NSS) file system. For information about creating NSS partitions, storage groups, and volumes, see Setting Up and Configuring Novell Storage Services in the *Novell Storage Services Administration Guide*.

To determine the operating status of your disk subsystem and to activate or deactivate a storage device, see "Activating and Deactivating a Hard Disk" on page 36.

To increase the fault tolerance of your server, you can mirror the data from a NetWare partition on one disk to NetWare partitions on other disks. When you mirror partitions over different disk channels or host bus adapters, this is called *duplexing*. The process for mirroring and duplexing is the same. To mirror and unmirror partitions or to recover data from mirrored partitions, see "Mirroring and Duplexing Partitions" on page 37.

Removable media devices can be mounted and locked or unlocked using MONITOR, See "Managing Removable Media Devices" on page 38.

View a List of Adapters and Devices

◆ To see a list of server hardware devices, type the following at the server console prompt:

   LIST DEVICES

◆ To see a list of storage adapters and the devices they drive, at the server console prompt enter:

   LIST STORAGE ADAPTERS

   The screen lists each adapter, followed by a list of devices driven by that adapter.

◆ To see a list of CDMs bound to a particular device, at the server console prompt enter:

   LIST STORAGE DEVICE BINDINGS *object_number*

   Find the object number by executing the LIST DEVICES command; the object number is the first number on each line in the list. Do not enter the 0x000prefix.

   For example, this command lists CDMs for device 0x0001:

   LIST STORAGE DEVICE BINDINGS 1

Checking Available Disk Space

You should monitor available disk space regularly and keep a log so you can track disk usage over time. This information helps you make the best use of your disk space management options, such as adding a new hard disk, compressing files, and migrating data to an offline system such as an optical disc library.

HINT: You might want to enter the disk space information on a spreadsheet to create a graph of disk usage over time.

1 From the MONITOR Available Options, select Volumes.

   A list of mounted volumes appears. Volume information is displayed for the highlighted volume in the upper screen.

2 Press Tab to expand and activate the Volume Information window.

   The scroll thumb at the right of the window indicates that the list of Volume parameters is scrollable.

3 Scroll to Disk Space and note the available disk space for the volume and record it in a log.

4 Press Tab to return to the list of Mounted Volumes. Check additional volumes as necessary.

5 Press Esc until you return to Available Options.

6 Repeat this procedure weekly for each volume.

Checking for Disk Errors

MONITOR indicates how many data blocks have been redirected by Hot Fix™ because of bad sectors on the disk. Review Hot Fix statistics regularly to detect disk problems before they cause loss of data.

IMPORTANT: When the number of available Hot Fix redirection blocks is 10 or fewer, NetWare broadcasts warning messages. If you receive these messages, the Hot Fix redirection area is nearly full and the disk is in danger of failing. Take immediate corrective action.

Follow this procedure to review the Hot Fix statistics in MONITOR.

NOTE: Some hard disks perform their own redirection automatically, independent of the NetWare Hot Fix mechanism. The MONITOR statistics reflect only Hot Fix redirection.

1 Load MONITOR at the server console prompt.

For instructions on using MONITOR, see MONITOR in the *Utilities Reference*.

2 Select Storage Devices, then select a Hot Fix partition.

3 Press Tab to expand the information window.

The window displays several Hot Fix statistics.

The following statistics indicate how much data redirection is taking place:

Total Hot Fix Blocks Available: The total number of blocks within the Hot Fix redirection area, whether used or not.

Used Hot Fix Blocks: The number of blocks holding redirected data.

Number of Available Hot Fix Blocks: Remaining unused blocks in the Hot Fix redirection Area.

System Hot Fix Blocks: The number of blocks in the Hot Fix redirection area set aside for Hot Fix and Mirroring tables. These blocks are used to manage both Hot Fix and mirroring.

The number of available Hot Fix blocks equals the total number of Hot Fix blocks, minus the used and system Hot Fix blocks.

4 Note the number of used Hot Fix blocks and compare it to the total number of blocks and the number of available blocks.

If the number of redirected blocks is zero or very low, and if it has not changed since you last reviewed the statistics, you do not need to take corrective action.

If the number of redirected blocks has increased substantially since you last reviewed the statistics, or if the number is over half the total number of redirection area blocks, back up the data on the hard disk and troubleshoot the disk, controller, and host bus adapter.

If the number of redirected blocks has increased slightly since you last reviewed the statistics, monitor the server closely and be prepared to troubleshoot the hardware if necessary.

Adding and Replacing Hard Disks

The following procedures explain how to add or replace conventional hard disks in the NetWare server and how to load or replace disk drivers.

Adding a Hard Disk to the NetWare Server

Prerequisites

❑ All users logged out of the server

❑ Access to the documentation that came with the hard disk

❑ Access to the documentation that came with the computer

Procedure

Use the following procedure to install an additional hard disk in a functioning NetWare server.

1 Follow the instructions that came with your hard disk to install the disk and associated hardware, such as a disk adapter and cable. If necessary, configure the computer to recognize the new disk

Refer to the documentation that came with the computer for more information about configuration methods and requirements.

2 Start the server.

3 From ConsoleOne™, click Media > Devices > Scan for Devices.

You must load a driver if you have installed a new disk adapter along with the hard disk. For instructions on loading drivers, see "Loading Disk Drivers" on page 34.

After you install the new hard disk you can use ConsoleOne to configure the disk. For more information about configuring the disk, see Setting Up and Configuring Novell Storage Services in the *Novell Storage Services Administration Guide*.

Replacing a Hard Disk

If a hard disk becomes unreliable or unusable, follow this procedure to remove the disk from the network.

If you have been backing up your data consistently and verifying its integrity, you will be able to reload data for the volumes affected by the disk failure.

1 If the bad disk was mirrored, check the sys$log.err file to see which disk in the mirrored set failed.

The error log contains a message stating that a device has been deactivated due to a device error. It includes the device name, which is a series of letters and numbers within brackets. See "Device Names" on page 14.

2 If possible, make a backup copy of the data on the hard disk.

Make sure the backup copy contains uncorrupted versions of all files and directories on the hard disk.

3 From ConsoleOne, click Media Traditional Volumes or Logical Volumes depending on which volumes you have on the disk.

4 Select a volume that is on the disk you are replacing, click Dismount.

Repeat this step for all volumes on the disk.

5 Click Media > Partitions.

6 Select a partition that is on the disk you are replacing, click Mirror.

7 Select a partition, click Remove.

This removes the partition from the mirror group. Repeat steps 6 and 7 for each partition that is on the disk you are replacing.

8 Remove the hard disk and install the replacement.

Use the instructions that came with the hard disk.

9 Turn on power and restart the server.

If the failed disk contained the only copy of the server operating system, refer to your backup software to determine whether you can restore NetWare and the file system from a backup or whether you must reinstall NetWare.

If you use Storage Management Services (SMS) as your backup application, you must reinstall NetWare, then restore files from a backup. See Restoring Data from a Server in the *Storage Management Services Administration Guide.*

After you install the new hard disk you can use ConsoleOne to configure the disk. For more information about configuring the disk, see Setting Up and Configuring Novell Storage Services in the Novell Storage Services Administration Guide.

Loading Disk Drivers

If you add or replace a hard disk adapter on your NetWare server, you must load the corresponding disk driver.

Loading a disk driver enables communication between the disk controller and the server's CPU.

Load the disk driver once for each disk adapter you want to support.

Follow the instructions that accompany the driver. Most NetWare disk drivers have a help file that appears on the screen as you highlight the driver. Refer to these descriptions to determine which driver to load.

IMPORTANT: Some drivers do not have a description file (a configuration file that's appended to the driver). These drivers have to be loaded manually at the system console. To load these drivers, follow the screen prompts or press F1 for help.

For general information about .cdm and .ham modules, see "Drivers for Host Adapters and Storage Devices" on page 16.

Replacing Disk Drivers

The conventional way to replace a disk driver is to unload the driver, thus dismounting all the volumes, then load the new driver and remount the volumes. If you are following this process, be sure you replace a driver only when users won't need to access the volumes.

You can replace one instance of a driver that has been loaded multiple times by using the REMOVE STORAGE ADAPTER command at the server console.

NetWare also supports hot replace disk drivers that can be replaced without dismounting volumes or otherwise interrupting the server's operation. If you are replacing such a driver, simply load the new driver at the server console prompt. The server loads the new driver immediately and unloads the old driver without dismounting volumes or otherwise interrupting service.

If you aren't sure whether your disk driver is a hot replace driver, try loading the new driver without unloading the existing driver. You will receive an error message if the driver can't be replaced without first unloading the old driver and dismounting volumes.

Creating NetWare Partitions

NetWare partitions can be created on any hard drive and can coexist with other partitions such as DOS, Windows* NT* UNIX*. Disk space not assigned to NetWare partitions can be used for the Novell Storage Services file system.

When there is a DOS partition on the drive, it should always be the *first* partition. The NetWare partition should always be the *last* partition on the drive.

You can have as many as four partitions on the same drive, including multiple NetWare partitions.

If you have partitions from previous versions of NetWare that you are no longer using, you can delete them and create a new NetWare partition. (See "Deleting NetWare Partitions" on page 36 for more information.)

WARNING: When creating a disk partition, never specify a partition size larger than the actual size of the disk. If you specify a larger size, NetWare will eventually try to use the excess disk space. When it determines there is no corresponding disk location, it deactivates the volume stored on the disk.

For instructions on creating partitions, see Creating a Partition in the *Novell Storage Services Administration Guide.*

Deleting NetWare Partitions

This section explains how to delete traditional NetWare partitions. For information about deleting NSS partitions, storage groups, and volumes, see Setting Up and Configuring Novell Storage Services in the *Novell Storage Services Administration Guide.*

NOTE: The partition table displays partitions such as OS/2*, UNIX, and XENIX* as Unknown Partition Type #. Don't delete these unknown partition types unless you know what is on them.

Some machine vendors such as COMPAQ* create a small partition that setup and configuration utilities can be run from. Don't delete this partition.

For instructions on deleting partitions, see Deleting a Partition in the *Novell Storage Services Administration Guide.*

Activating and Deactivating a Hard Disk

Use this procedure to determine the operating status of your disk subsystem components and to activate or deactivate a storage device. (When you deactivate a disk, its volumes are dismounted.)

1 From the MONITOR Available Options, select Storage Devices.

For instructions on using MONITOR, see MONITOR in *Utilities Reference.*

A list of Registered Storage Objects appears. The device information associated with a highlighted storage device appears in the upper window. You can verify the type of storage device in the Device Type field.

NOTE: Storage devices are listed in hierarchical order to reflect each object's dependencies. In descending order, each object is indented to indicate that it is a

child to the object above it. In ascending order, parent objects appear immediately above the highlighted object.

2 Select the appropriate hard disk from the list.

The Drive Status window appears. The Operating Status field indicates whether the device is activated or deactivated.

3 Press Enter to access the Operating Status options.

4 To change the operating status of the disk, highlight either Activate or Deactivate and press Enter.

If you attempt to deactivate a disk that has mounted volumes, you receive a confirmation prompt. If you confirm that you want to deactivate the disk, the volumes are dismounted.

5 Press Esc until you return to Available Options.

Mirroring and Duplexing Partitions

The process for mirroring and duplexing is the same. The term mirroring is used in all menus to refer to both mirroring and duplexing.

Mirroring Partitions

For instructions on mirroring partitions, see Creating a Partition in the *Novell Storage Services Administration Guide.*

Unmirroring Partitions

You must unmirror mirrored partitions before you can delete a partition or conduct surface tests on a disk.

For instructions on unmirroring partitions, see Deleting a Partition in the *Novell Storage Services Administration Guide.*

Recovering Data from an Out of Sync Disk

Once a hard disk is unmirrored, its status is listed as either Not Mirrored or Out of Sync on the Disk Partition Mirroring Status list.

When a hard disk is listed as Out of Sync, the operating system does not recognize any volume information on it. Use this procedure to recover data from an Out of Sync partition.

1 From ConsoleOne, open the tree you want.

2 Right-click on the server object and select Properties.

3 Click Media > Partitions.

4 Select a Partition that contains the data you want to recover, click Mirror > Resync.

This initiates the resynchronization process for the mirror group that contains the partition you selected.

Managing Removable Media Devices

Mounting a Removable Media Device

Use this procedure to mount a removable media device, such as a CD-ROM drive.

Before you mount a CD-ROM volume, make sure you have enough space or else consider making it read-only. The associated indexing files create substantial overhead.

1 From the MONITOR Available Options, select Storage Devices.

For instructions on using MONITOR, see MONITOR in *Utilities Reference.*

A list of Registered Storage Objects appears. The device information associated with a highlighted storage device appears in the upper window. Use the Device Type field to verify the type of storage device.

NOTE: Storage devices are listed in hierarchical order to reflect each object's dependencies. In descending order, each object is indented to indicate that it is a child to the object above it. In ascending order, parent objects appear immediately above the highlighted object.

2 Select the appropriate CD-ROM or other removable media device from the list.

The Drive Status window appears. The Removable Drive Mount Status field indicates whether the device is mounted or dismounted.

3 To change the mount status of the device, select the Removable Drive Mount Status field.

The Change Mount Status window appears.

4 Select Mount Drive.

5 Press Esc until you return to Available Options.

Dismounting a Removable Media Device

Use this procedure to dismount a removable media device, such as a CD-ROM device.

1 From the MONITOR Available Options, select Storage Devices.

For instructions on using MONITOR, see MONITOR in *Utilities Reference.*

A list of Registered Storage Objects appears. The device information associated with a highlighted storage device appears in the upper window. Check the Device Type field to verify the type of storage device.

NOTE: Storage devices are listed in hierarchical order to reflect each object's dependencies. In descending order, each object is indented to indicate that it is a child to the object above it. In ascending order, parent objects appear immediately above the highlighted object.

2 Select the appropriate CD-ROM or other removable media device from the list.

The Drive Status window appears. The Removable Drive Mount Status field indicates whether the device is mounted or dismounted.

3 To change the mount status of the device, select Removable Drive Mount Status field.

The Change Mount Status window appears.

4 Select Dismount Drive.

5 Press Esc until you return to Available Options.

Locking and Unlocking a Removable Media Device

Use this procedure to lock or unlock a removable media device, such as a CD-ROM device. (When a removable media device is locked, the media can be ejected only by using a software switch.)

1 From the MONITOR. Available Options, select Storage Devices.

For instructions on using MONITOR, see MONITOR in *Utilities Reference.*

A list of Registered Storage Objects appears. The device information associated with a highlighted storage device appears in the upper window. Check the Device Type field to verify the type of storage device.

NOTE: Storage devices are listed in hierarchical order to reflect each object's dependencies. In descending order, each object is indented to indicate that it is a child to the object above it. In ascending order, parent objects appear immediately above the highlighted object.

2 Select the appropriate CD-ROM or other removable media device from the list.

The Drive Status window appears. The Change Lock Status field indicates whether the device is locked or not locked.

3 To change the lock status of the device, select the Removable Drive Lock Status field.

The Change Lock Status window appears.

4 Select either Lock Drive or Unlock Drive.

5 Press Esc until you return to Available Options.