Novell
NetWare® 6.5

SERVER DISKS AND STORAGE DEVICES
ADMINISTRATION GUIDE

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Contents

About This Guide

This guide contains conceptual information about server disks and storage devices. This guide is intended for network administrators and is divided into the following sections:

Documentation Conventions

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Documentation Updates

For the most recent version of the *NetWare 6.5 Storage Disks and Server Devices Administration Guide*, see the Novell Documentation Web site (http://www.novell.com/documentation/nw65/index.html).

Additional Documentation

For information on Novell$^{®}$ Storage Services$^{™}$ (NSS) File System, see the *Novell Storage Services File System Administration Guide for NetWare 6.5*.

For information on NetWare Traditional File System, see the *NetWare 6.5 Traditional File System Administration Guide*.

1 Overview of Server Disks and Storage Devices

Storage media for your NetWare® server can be attached directly as local hard drives or externally as storage-area-network (SAN) devices. The media can be server disks, single storage devices, arrays of storage devices, or virtual storage devices. In addition, the NetWare operating system manages remote storage devices such as tape drives and CD drives. It supports third-party solutions for near-line and offline storage.

This section discusses the following:

Key Concepts

This section discusses the following key concepts for preparing and using devices on your NetWare server:

Storage and File System Services

NetWare provides two file systems for your NetWare servers: Novell Storage Services™ (NSS) File System and NetWare Traditional File System (Traditional). NSS is the primary storage solution for NetWare and is the file system used for the NetWare system volume. During installation, NetWare creates an NSS system pool (sys) and volume (sys:) on your server's primary hard drive. You must create other NSS pools and volumes before you can use your system effectively. For information, see the *Novell Storage Services File System Administration Guide for NetWare 6.5*.

The NetWare Traditional File System is a legacy storage technology that precedes NetWare 6, when NSS became the primary file system for NetWare. It does not provide most of the

capabilities and conveniences afforded by NSS. Traditional volume is not used for the system volume in new installs. It is possible to keep an existing Traditional volume as the sys: volume if you upgrade from an older version. For information, see the *NetWare 6.5 Traditional File System Administration Guide*.

You can use the Traditional file system in combination with the NSS file system, if desired. However, if you are planning to implement Apple* File Protocol (AFP), Network File System (NFS), or Common Internet File System (CIFS) for your NetWare server, you must use the NSS file system, not the Traditional file system, for the system volume and for any data volumes that use these protocols.

For a comparison of NSS and Traditional file systems, see Appendix A, "Comparison of NSS and Traditional File System," on page 23.

Maximum Size of Logical or Physical Devices

NSS and Traditional file systems recognize logical or physical devices up to 2 TB in size. If you have a storage disk larger than 2 TB in size, use the storage device's management utility to carve the disk into smaller logical devices.

Device Identification

In NetWare, the NSS Media Manager assigns unique identifiers for all storage devices and individual segments on those devices. The identifier represents the same device in all NetWare utilities and console commands. For an explanation of the device numbering system, see "Partition Numbers and Device Names" on page 13.

Device Drivers

All storage devices require drivers. The NetWare Peripheral Architecture™ (NWPA) divides device drivers into two types:

- **Custom Device Module (CDM):** Drives the device itself.
- **Host Adapter Module (HAM):** Drives the adapter connected to the device.

For more information, see "Drivers for Host Adapters and Storage Devices" on page 15.

Device Configuration and Management

To configure and manage devices for use with NSS for NetWare, use one of the following management tools:

- Storage plug-in for iManager
- NSS Management Utility (NSSMU) for NetWare
- NSS server console commands

The NetWare install uses NSSMU to enable you to create pools and volumes during installation. After the install, you can use either tool.

To configure and manage devices for the Traditional file system, use the Novell Remote Manager for NetWare.

A legacy utility called Monitor provides important disk use and file statistics. You can use the Monitor utility to review disk usage and availability. You can also use it to review data block placement and redirection. For instructions, see "Monitor" in the *NetWare 6.5 Utilities Reference*.

File System Management for Directories and Files

Use one of the following management tools to manage directories and files on NSS and Traditional file systems:

- ◆ Novell NetStorage
- ◆ Novell Client™ for Windows* 2000/XP
- ◆ Novell Remote Manager for NetWare

For example, you can configure file system trustees, trustee rights, and attributes for directories and files. For information, see "Security: Granting Trustee Rights to Directories and Files" in the *NetWare 6.5 Traditional File System Administration Guide*. This information applies to both NSS and Traditional file systems.

Software RAID Devices

To increase data fault tolerance, on NSS file systems you can also create software RAIDs 1 (mirroring) and 5 (striping with parity). See "Configuring Software RAID Devices" in the *Novell Storage Services File System Administration Guide for NetWare 6.5*.

On Traditional file systems, you can create software RAID 1 (mirroring). See "Using Software RAID-1 Devices for Data Fault Tolerance" in the *NetWare 6.5 Traditional File System Administration Guide*.

Partitioning Disks

The maximum size of a logical or physical device recognized by NetWare is 2 TB. If a hard disk or storage device is larger than 2 TB, use the device's third-party disk management software to carve the device into smaller logical devices so that NetWare can recognize and use the device.

The standard IBM* disk-partitioning scheme allows four physical partitions.To comply with the four-partition limit, NetWare creates logical partitions within physical NetWare partitions. The logical partitions in a NetWare partition combine to appear as a single partition on the master boot record of the device. The logical parititions appear as partition objects to users and can be managed as if they were physical partitions.

NOTE: A NetWare disk partition is not related to a Novell eDirectory™ partition.

The entire NetWare partition is called the *physical partition*. Each NetWare partition contains a data area, where the file system resides. The logical sector 0 of a NetWare partition is the first sector of the data area available to file systems. This data area is referred to as a *logical partition*, as shown in Figure 1.

Figure 1   DOS and NetWare Partitions
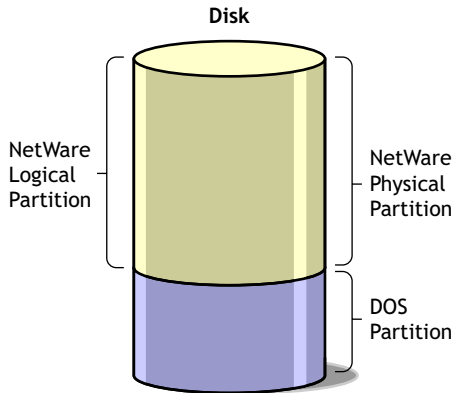
Both the NSS and Traditional file systems comply with the four-partition limit. Whenever you select free space on a device to create an NSS file system or a Traditional file system, the management tool automatically creates a logical partition, or *segment*, within a physical NetWare partition. Logical partition types include NSS partitions and Traditional partitions for your file systems and iSCSI partitions and SBD (Split Brain Detector) partitions for Novell Cluster Services.

At least one disk on each server includes one DOS partition and at least one NetWare partition for the system (sys:) volume, as shown in Figure 2. The DOS partition is the primary boot partition where the server.exe file is stored; you need only one boot partition per server. The system volume is where the NetWare operating system is installed. The NSS file system creates the sys: volume automatically when you install NetWare.

Figure 2   Partitioned Device
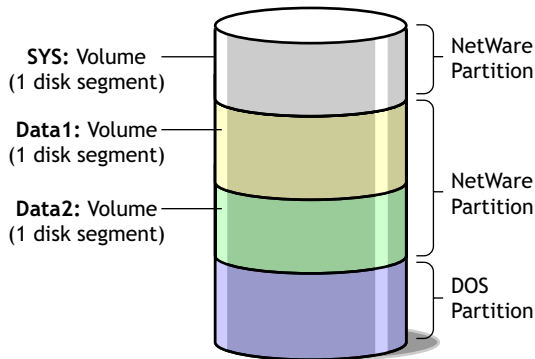
A hard disk can also contain other partitions such as a UNIX partition, as shown in Figure 3. The sys: volume can reside on the same or different disk than the DOS partition.

Figure 3   Partitioned Devices for Heterogeneous Use

Figure 3   Partitioned Devices for Heterogeneous Use
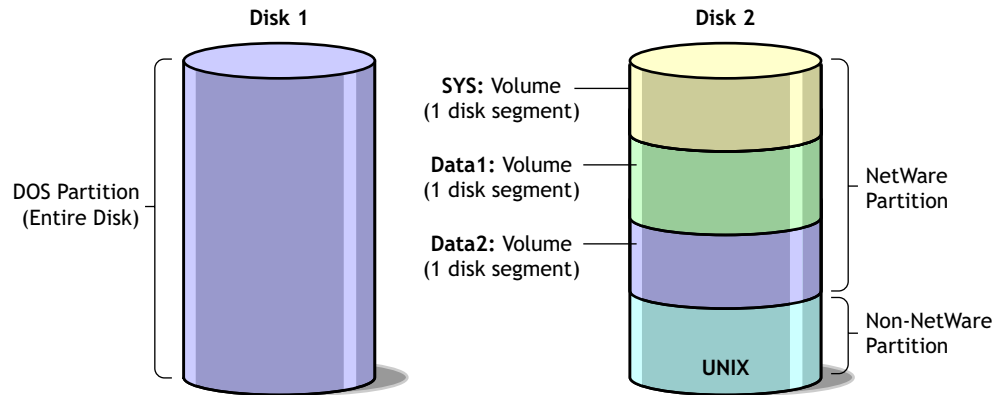
You can also leave free (unassigned) space on a disk, as shown in Figure 4.

Figure 4   Partitioned Device with Free Space
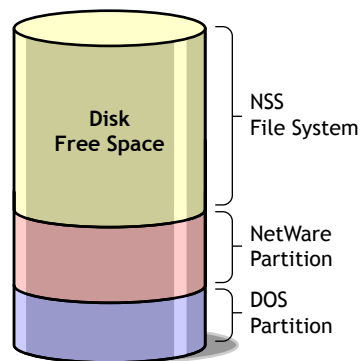
Partition Numbers and Device Names

In NetWare, the Media Manager assigns a unique object number to each storage device, disk partition, and logical partition. In addition, the Media Manager assigns device names to physical devices and adapters. These unique object numbers and device names are consistent across all NetWare utilities and console commands so that you can easily identify the objects and devices.

This section discusses the following topics:

Object Numbers

Object numbers are hexadecimal numbers assigned to devices, adapters, media, partitions, and divisions of a partition (such as the mirror object 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 Number Examples

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 System Console prompt, you would see a list of storage devices, such as the following (the first number in each line is the hexadecimal 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

0x0006: DOS Partitioned Media

0x0008: NetWare Partition

0x000A: Non-Mirrored Partition
```

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.

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, which is a unique number indicating 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 0x1c.

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 System Console prompt. The console 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:

Figure 5   Device Name and Object Numbers
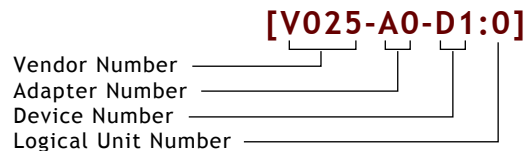
- ◆ **Vendor Number**. A unique number specific to the device vendor.

- ◆ **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 the List Devices command.

Fault tolerant systems such as mirrored devices 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 connected to the device.

◆ **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 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).

What's Next

To manage devices:

Task	Reference
To understand the differences between the NSS and Traditional file systems on NetWare	"Comparison of NSS and NetWare Traditional File Systems" in the *Novell Storage Services File System Administration Guide for NetWare 6.5*
To manage devices for the NSS file system	"Managing Devices" in the *Novell Storage Services File System Administration Guide for NetWare 6.5*
To manage devices for the Traditional file system	"Managing Disk Partitions" in the *NetWare 6.5 Novell Remote Manager Administration Guide for NetWare*

2 Managing Adapters and Devices

This section discusses the following:

Viewing a List of Adapters and Devices

In iManager

1 Log in to iManager, then click Storage Management > Devices.

2 Select the server you want to manage.

A list of devices on the selected server appears in the Devices list.

3 (Conditional) If multiple host bus adapters are available, select a device, then click Multipath.

A list of adapters appears in the Adapters list.

For details, see "Managing Devices" in the *Novell Storage Services File System Administration Guide for NetWare 6.5*.

At Your Server Console

Depending on what task you want to perform, use one of these methods:

- ◆ To see a list of server hardware devices: At the server console prompt, enter

  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.

TIP: You can enter the disk space information on a spreadsheet to create a graph of disk usage over time.

1 From the Monitor utility, select Available Options > Volumes.

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

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

   The scroll box at the right of the window indicates that the list of Volume parameters is scrollable. Or, use the arrow keys to scroll the list.

3 Scroll to Disk Space, then 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.

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 iManager, click Storage Management > 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 20.

After you install the new hard disk, you can use iManager Storage Management to configure the disk. For more information about configuring the disk, see "Managing Devices" in the *Novell Storage Services File System Administration Guide for NetWare 6.5*.

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 can reload data for the volumes affected by the disk failure.

1 If the bad disk was part of a software RAID 1 (mirror), 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 15.

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 iManager for NSS volumes, select the Storage Management > Volumes.

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 Storage Management > Software RAID.

6 Select the device, select a segment, then click Remove.

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

7 Remove the hard disk and install the replacement.

Use the instructions that came with the hard disk.

8 Turn on power, then 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 "Restore Options" in the *SBCON Administration Guide*.

After you install the new hard disk, use iManager to configure the disk. For more information about configuring the disk, see "Managing Devices" in the *Novell Storage Services File System Administration Guide for NetWare 6.5*.

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 select 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 is appended to the driver). These drivers must 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 15.

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 do not 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 system console prompt. The server loads the new driver immediately and unloads the old driver without dismounting volumes or otherwise interrupting service.

If you are not 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 cannot be replaced without first unloading the old driver and dismounting volumes.

Configuring and Monitoring Devices

To install and configure the server disk or storage media:

- ◆ For information about creating NSS storage pools and volumes, see the *Novell Storage Services File System Administration Guide for NetWare 6.5*.

- ◆ For information about creating Traditional volumes, see the *NetWare 6.5 Traditional File System 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 utility, select Available Options > Storage Devices.

For instructions, see "Monitor" in the *NetWare 6.5 Utilities Reference*.

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

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 selected 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, select either Activate or Deactivate, then 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.

A Comparison of NSS and Traditional File System

This section compares features and capabilities of the Novell® Storage Services™ (NSS) File System on NetWare® and the NetWare Traditional File System.

- "Features of NSS and Traditional File Systems on NetWare" on page 23
- "SET Parameters Shared by NSS and Traditional File Systems" on page 27
- "SET Parameters for the NSS File System" on page 28
- "SET Parameters for the Traditional File System" on page 29
- "Comparison of Directory and File Attributes" on page 30

Features of NSS and Traditional File Systems on NetWare

The following table describes key features of the NSS File System and the NetWare Traditional File System for NetWare 6.5 and Novell Open Enterprise Server NetWare:

Feature Description	NSS File System	NetWare Traditional File System
Management interfaces	Novell iManager NSSMU Novell Remote Manager (limited feature set)	Novell Remote Manager
Device and partition management	Novell iManager NSSMU	Novell Remote Manager
File system management for directories and files	Novell Client™ Novell NetStorage (via Web browser only, not WebDAV) Novell Remote Manager for NetWare Rights utility for NetWare	Novell Client Novell Remote Manager
Interface	64-bit	32-bit
File protocols	NCP™ NFAP (AFP, NFS, CIFS)	NCP
Character format	Unicode	ASCII double-byte
Maximum device size recognized (physical or logical)	2 TB	2 TB

Feature Description	NSS File System	NetWare Traditional File System
Minimum device size recognized (physical or logical)	10 MB	10 MB
Maximum partition size	2 TB	1 TB
Minimum partition size	10 MB	10 MB
Maximum number of partitions (logical or physical devices) per NSS pool or Traditional volume	No practical limit, but the combined size cannot exceed the maximum NSS pool size of 8 TB. A single partition must have more than 10 MB and up to 2 TB of available space to be recognized by NSS.	Up to 32 partitions, but the combined size cannot exceed the maximum Traditional volume size of 1 TB.
Maximum NSS pool or Traditional volume size	8 TB An NSS pool of 8 TB requires at least 4 segments of up to 2 TB each. You can combine any number of partitions of 10 MB to 2 TB in size, but the combined size cannot exceed 8 TB.	1 TB A Traditional volume of 1 TB requires 1 to 32 partitions of 10 MB to 1 TB in size, but the combined size cannot exceed 1 TB.
Minimum NSS pool or Traditional volume size	10 MB	10 MB
Maximum file size	Up to 8 TB per file, depending on the volume size and available space in the volume.	Up to 4 GB per file, depending on the volume size and available space in the volume.
Maximum number of files per volume	Up to 8 trillion, regardless of how many namespaces are loaded.	Up to 16 million files with 1 namespace. The practical limit is up to 4 million files with 3 namespaces.
Maximum number of files open concurrently	1 million	100 thousand
Maximum number of data volumes mounted concurrently per server	255 plus the sys: volume. You can mount NSS volumes beyond 256, but they are not visable or accessible through the normal Netware APIs.	255 plus the sys: volume.
Maximum size of a volume	Up to 8 TB, depending on the pool size and available space in the pool. If a pool contains multiple volumes, the cumulative administrative maximum sizes of all volumes can exceed the pool size, using the overbooking feature, although real total size is bound by physical limitations. Because space is allocated to volumes as needed, a volume might not reach its quota.	Up to 1 TB. The total size allocated for all volumes on the server cannot exceed the physical size of all devices combined, so overbooking is not possible. Unused space goes to waste if volumes grow unevenly.

Feature Description	NSS File System	NetWare Traditional File System
Time to mount a volume	Only a few seconds. NSS uses a journaling file system and does not need to scan the entire file system to create a directory entry table (DET) and to load a File Allocation Table (FAT).	Up to several minutes, depending on volume size. The mount process scans the entire file system to create a DET before loading the volume. The time to mount increases based on the number of files, the number of namespaces used, and the size of the files. The mount process also loads the volume's FAT. Volumes with a smaller block size require more server memory to mount and manage, and it takes longer to mount the volume.
Volume namespace	Accommodates all namespaces and requires less memory to mount than Traditional volumes.	Each namespace you add to a Traditional volume requires additional server memory. If you add namespace support to a volume and do not have enough memory, that volume cannot be mounted.
Minimum server memory required to activate a volume	Requires only 1 MB of available RAM to activate a single volume of any size and any number of files. Loads a file's metadata into memory only as you access the file.	Loads the DET into memory at the time of the mount. The amount of memory required increases with volume size and number of files. For a maximum volume size and number of objects, the memory required can be up to 1 GB just to activate the volume.
File access time	Same for each file, regardless of its location on the volume.	Depends on the file's location on the volume.
File save time	Offers the Flush Files Immediately attribute for NSS volumes to write files to disk on save instead of waiting for the next disk write cycle. This helps prevent possible data loss between disk write cycles and helps ensure data integrity.	Caches file in memory until the next disk write cycle.
File compression	Yes	Yes
Volume encryption	Yes	No
Error correction and data recovery time on system failure	Journaling file system logs changes. On system failure, replays the most recent transactions to confirm validity, then repairs errors or rolls back to the original condition, typically in 15 to 60 seconds, unless the volume is corrupted. If the volume is corrupted, repair can take up to several hours, depending on the volume size.	Must verify the entire volume contents with vrepair.nlm, which can take several hours, depending on the volume size.

Feature Description	NSS File System	NetWare Traditional File System
Software RAID support	RAID 0 (striping) RAID 1 (mirroring) RAID 5 (striping with parity) RAID 10 (mirroring RAID 0 devices) RAID 15 (mirroring RAID 5 devices)	RAID 0 (striping) RAID 1 (mirroring) RAID 10 (mirroring RAID 0 devices)
Data shredding	Yes, up to 7 times	No
Transaction Tracking System™ (TTS™)	Yes Requires exclusive use per server. To use TTS, first disable TTS for all Traditional volumes, and then enable TTS for your NSS volumes.	Yes Requires exclusive use per server. Use for Traditional or for NSS, but not for both on the same server. TTS is enabled by default.
Directory quotas and User space quotas	Yes	Yes, enabled by default
File snapshot attribute (make a temporary snapshot copy of an open file for backup)	Yes; allows backup of open files without deactivating the volume.	No
Pool snapshot (retain point-in-time version of a pool using block-level copy on write)	Yes; allows backup of block-level changes, without deactivating the volume. Uses a brief freeze-release process to capture information for last remaining open files.	No
Backup support	Reviews a journaled list of files modified since the previous backup.	Does not have a modified file list. It must scan the entire file system to identify files modified since the previous backup.
Backup systems support	TSA, TSA600 for files over 2 GB, SMS, and Enhanced SBackup	TSA, SMS, and Enhanced SBackup
Device maintenance support	Activate and deactivate devices by pool.	Activate and deactivate devices by Traditional volume.
CD and DVD device recognition	Default process with full support for ISO 9660 and Macintosh HFS formats. Use CDs and DVDs as read-only NSS volumes.	CDs and DVDs cannot be Traditional volumes in NetWare 6.5.
Operating system version detection	Default process	Manual process
DOS FAT compatible	Yes	No
Ability to access DOS partitions on the NetWare server	Load dosfat.nss to treat as a standard NSS volume.	No
Block suballocation	Unnecessary; superseded by technology.	Yes

Feature Description	NSS File System	NetWare Traditional File System
Auditing	Unnecessary; superseded by technology.	Yes
File name locks	Unnecessary; superseded by technology.	Yes
Data migration	Yes	Yes

SET Parameters Shared by NSS and Traditional File Systems

The SET parameters for the Common File System are shared by NSS and Traditional file systems. The following are the default settings in NetWare 6.5 for the Common File System SET parameters.

IMPORTANT: When modifying Common File System SET parameters, ensure that your planned settings satisfy the requirements for both your NSS and Traditional volumes on NetWare.

Common File System SET Parameters	Default Value
Maximum Transactions	10000
Maximum Concurrent Directory Cache Writes	75
Minimum File Delete Wait Time	1 minute 5.9 seconds
Immediate Purge Of Deleted Files	Off
Compression Daily Check Stop Hour	6
Compression Daily Check Starting Hour	0
Minimum Compression Percentage Gain	20
Enable File Compression	On
Maximum Concurrent Compressions	2
Convert Compressed To Uncompressed Option	1
Decompress Percent Disk Space Free To Allow Commit	10
Decompress Free Space Warning Interval	31 minutes 18.5 seconds
Deleted Files Compression Option	1
Days Untouched Before Compression	14

SET Parameters for the NSS File System

The following are the default settings in NetWare 6.5 for the NSS file system SET parameters.

Common File System SET Parameters for NSS and Traditional File Systems	Default Value
NSS Auto Locks HFS CD-ROM Disc in device	Off
NSS Auto Update CDHFS Volume Objects To NDS	Off
Mount ISO 9660 multi disc set as one CD9660 volume	Off
NSS Auto Locks CD-ROM Disc in device	Off
NSS Auto Update CD9660 Volume Objects To NDS	Off
Emulate Classic NetWare Directory Quotas	Off
NSS Work To Do Count	50
NSS Maximum Cache Balance Buffers Per Session	1024
NSS Cache Balance Timer	30
NSS Cache Balance Percent	60
NSS Cache Balance Enable	On
NSS Buffer Flush Timer	1
NSS Minimum OS Cache Buffers	256
NSS Minimum Cache Buffers	256
NSS File Flush Timer	10
NSS Closed File Cache Size	50000
NSS Open File Hash Shift	16
NSS Auth Cache Size	1024
NSS ASCII Name Cache Enable	On
NSS Name Cache Enable	On
NSS Name Cache Size	2111
NSS Low Volume Space Alerts	On
NSS Low Volume Space Warning Reset Threshold	15
NSS Low Volume Space Warning Threshold	10

SET Parameters for the Traditional File System

The following are the default settings in NetWare 6.5 for the Traditional file system SET parameters.

SET Parameters for the Traditional File System	Default Value
Volume Log File State	1
Volume TTS Log File State	1
Volume Log File Overflow Size	4194304
Volume TTS Log File Overflow Size	4194304
Auto TTS Backout Flag	On
TTS Abort Dump Flag	Off
TTS Unwritten Cache Wait Time	1 minute 5.9 seconds
TTS Backout File Truncation Wait Time	59 minutes 19.2 sec
Dirty Directory Cache Delay Time	0.5 seconds
Directory Cache Allocation Wait Time	2.2 seconds
Directory Cache Buffer Nonreferenced Delay	5.5 seconds
Maximum Directory Cache Buffers	2000
Minimum Directory Cache Buffers	500
Maximum Number Of Internal Directory Handles	100
Maximum Number Of Directory Handles	20
Maximum Record Locks Per Connection	500
Maximum File Locks Per Connection	2500
Maximum Record Locks	20000
Maximum File Locks	200000
Read Ahead Enabled	On
Read Ahead LRU Sitting Time Threshold	10 seconds
Minimum File Cache Buffers	20
Maximum Concurrent Disk Cache Writes	750
Dirty Disk Cache Delay Time	3.3 seconds
Minimum File Cache Report Threshold	20
Automatically Repair Bad Volumes	On
File Delete Wait Time	5 minutes 29.6 seconds

SET Parameters for the Traditional File System	Default Value
Allow Deletion Of Active Directories	On
Maximum Percent of Volume Space allowed for Extended Attributes	10
Maximum Extended Attributes per File or Path	16
Purge Files On Dismount	Off
Fast Volume Mounts	On
Maximum Percent Of Volume Used By Directory	13
Maximum Subdirectory Tree Depth	25
Volume Low Warn All Users	On
Volume Low Warning Reset Threshold	256
Volume Low Warning Threshold	256
Turbo FAT Re-Use Wait Time	5 minutes 29.6 seconds
Allow Unowned Files To Be Extended	On
Auto Mount Mirrored Volume Containing Inactive Device	Off

Comparison of Directory and File Attributes

Attribute Code	Description	Applies to Files	Applies to Directories	NSS	Traditional
A	Archive Needed identifies files that have been modified since the last backup. This attribute is assigned automatically.	Yes	No	Yes	Yes
Ci	Copy Inhibit prevents Macintosh users from copying a file. This attribute overrides Read and File Scan trustee rights.	Yes	No	Yes	Yes
Dc	Do Not Compress keeps data from being compressed. This attribute overrides settings for automatic compression of files not accessed within a specified number of days.	Yes	No	Yes	Yes
Di	Delete Inhibit means that the directory or file cannot be deleted. This attribute overrides the Erase trustee right.	Yes	Yes	Yes	Yes
Dm	Do Not Migrate prevents directories and files from being migrated from the server's server disk to another storage medium.	Yes	Yes	Yes	No migration support
Ds	Do Not Suballocate prevents data from being suballocated.	Yes	No	Not needed	Yes
H	The Hidden attribute hides directories and files so they cannot be listed using the DIR command.	Yes	Yes	Yes	Yes

Attribute Code	Description	Applies to Files	Applies to Directories	NSS	Traditional
I	Index allows large files to be accessed quickly by indexing files with more than 64 File Allocation Table (FAT) entries. This attribute is set automatically.	Yes	No	Not needed	yes
Ic	Immediate Compress sets data to be compressed as soon as a file is closed. If applied to a directory, every file in the directory is compressed as each file is closed.	Yes	Yes	Yes	Yes
N	Normal indicates the Read/Write attribute is assigned and the Shareable attribute is not. This is the default attribute assignment for all new files.	Yes	Yes	Yes	Yes
P	Purge flags a directory or file to be erased from the system as soon as it is deleted. Purged directories and files cannot be recovered.	Yes	Yes	Yes	Yes
Ri	Rename Inhibit prevents the directory or file name from being modified.	Yes	Yes	Yes	Yes
Ro	Read Only prevents a file from being modified. This attribute automatically sets Delete Inhibit and Rename Inhibit.	Yes	No	Yes	Yes
Rw	Read/Write allows you to write to a file. All files are created with this attribute.	Yes	No	Yes	Yes
Sh	Shareable allows more than one user to access the file at the same time. This attribute is usually used with Read Only.	Yes	No	Yes	Yes
Sy	System hides the directory or file so it does not appear in a file manager or directory listing. System is normally used with operating system files, such as Linux or NetWare system files.	Yes	Yes	Yes	Yes
T	Transactional allows a file to be tracked and protected by the Transaction Tracking System (TTS).	Yes	No	Explicit	Implicit and explicit
X	The Execute attribute indicates program files such as .exe or .com.	Yes	No	Yes	Yes

B   Documentation Updates

This section contains information about documentation content changes made to the *NetWare 6.5 Server Disks and Storage Devices Administration Guide* since the initial release of NetWare® 6.5. If you are an existing user, review the change entries to readily identify modified content. If you are a new user, simply read the guide in its current state.

Refer to the publication date, which appears on the front cover and the Legal Notices page, to determine the release date of this guide. For the most recent version of the *NetWare 6.5 Server Disks and Storage Devices Administration Guide*, see Novell documentation (http://www.novell.com/documentation/lg/nw65/sdiskenu/data/front.html)

In this section, content changes appear in chronological order, according to the publication date. Within a dated entry, changes are grouped and sequenced, according to where they appear in the document itself. Each change entry provides a link to the related topic and a brief description of the change.

This document was updated on the following dates:

- "May 14, 2004" on page 33
- "July 2, 2004" on page 34
- "February 28, 2004" on page 34

May 14, 2004

Updates were made to the following sections. The changes are explained below.

- "Comparison of NSS and Traditional File Systems" on page 33
- "Appendix B: Documentation Updates" on page 34

Comparison of NSS and Traditional File Systems

The following changes were made to this section:

Location	Change
Comparison of NSS and Traditional File Systems	NSS was first released in NetWare 5.1, and became the primary storage system in NetWare 6. If you have Traditional volumes, you can still use them with NetWare 6.5 and earlier, or you can upgrade Traditional devices to NSS. For information on converting Traditional volumes to NSS, see "Upgrading NetWare 5 Volumes to NetWare 6.x NSS Volumes Using Volume Copy Upgrade" in the *Novell Storage Services File System Administration Guide for NetWare 6.5*.
Character format	NSS uses Unicode; Traditional uses ASCII double-byte code.

Location	Change
Time to mount a volume	NSS uses a journaling file system and does not need to scan the entire file system to create a directory entry table (DET) and to load a File Allocation Table (FAT).
Minimum server memory required to activate a volume	NSS requires only 1 MB available RAM to activate a single volume of any size and any number of files. Loads a file's metadata into memory only as you access the file. Traditional loads the DET into memory at the time of the mount. The amount of memory required increases with volume size and number of files. For a maximum volume size and number of objects, the memory required can be up to 1 GB just to activate the volume.
File save time	NSS offers the Flush Files Immediately attribute for NSS volumes to write files to disk on save instead of waiting for the next disk write cycle. This helps prevent possible data loss between disk write cycles.
File compression	Yes for both NSS and Traditional.
Volume encryption	Yes for NSS; no for Traditional.
Software RAID support	NSS supports software RAIDs 0, 1, 5 and RAID 10 pools. Traditional supports software RAIDs 0 and 1, RAID 10 Traditional volumes.
Device maintenance support	NSS activates and deactivates devices by pool. Traditional activates and deactivates devices by Traditional volume.
CD and DVD device recognition	Default process with full support for ISO9660 and Macintosh* HFS formats. Use CDs and DVDs as read-only NSS volumes. CDs and DVDs cannot be Traditional volumes in NetWare 6.5.
DOS FAT compatible	NSS is compatible; NSS is not compatible.
Time to repair corrupted volume	NSS takes from a few seconds to several hours, depending on the volume size. Traditional takes up to several hours, depending on the volume size.

Appendix B: Documentation Updates

The Documentation Updates section is new in this release.

July 2, 2004

Links were updated.

February 28, 2004

Updates were made to the following sections. The changes are explained below.

- "Overview of Server Disks and Storage Devices" on page 35
- "Optimizing Device Performance" on page 35

Overview of Server Disks and Storage Devices

Editorial changes were made to this section.

Optimizing Device Performance

This section was moved to "Optimizing Disk and Cache Performance for Traditional Volumes" in the *NetWare 6.5 Traditional File System Administration Guide*.

Managing Adapters and Devices

This section was updated to describe how to perform tasks in Novell Remote Manager instead of the legacy utility Monitor.

Comparison of NSS and Traditional File Systems

The following changes were made to this section:

Location	Change
SET Parameters Shared by NSS and Traditional File Systems (page 27)	This section is new.
SET Parameters for the NSS File System (page 28)	This section is new.
SET Parameters for the Traditional File System (page 29)	This section is new.
Comparison of Directory and File Attributes (page 30)	This section is new.