Novell Storage Services™ File System Administration Guide for Linux

Open Enterprise Server OES 2 SP3

March 2012

Novell

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About This Guide

This documentation describes how to use Novell Storage Services File System (NSS) to manage software RAIDs, pools, and volumes on a Novell Open Enterprise Server—Linux server.

For information about using NSS on NetWare 6.5 SP8, see the *NW 6.5 SP8: NSS File System Administration Guide*.

- Chapter 1, “Overview of NSS,” on page 25
- Chapter 2, “What’s New,” on page 31
- Chapter 3, “Installing and Configuring Novell Storage Services,” on page 39
- Chapter 4, “Upgrading the NSS Media Format,” on page 49
- Chapter 5, “Planning NSS Storage Solutions,” on page 55
- Chapter 6, “Using NSS in a Virtualization Environment,” on page 71
- Chapter 7, “Cross-Platform Issues for NSS,” on page 79
- Chapter 8, “Cluster-Enabling Shared NSS Devices and Pools with Novell Cluster Services,” on page 83
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- Chapter 10, “Managing Devices,” on page 115
- Chapter 11, “Migrating NSS Devices from NetWare 6.5 SP8 to OES 2 Linux,” on page 129
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Audience

This guide is intended for network administrators. Chapter 30, “Security Considerations,” on page 375 is intended for security administrators or anyone who is using NSS storage objects and is responsible for the security of the system.

Feedback

We want to hear your comments and suggestions about this manual and the other documentation included with this product. Please use the User Comment feature at the bottom of each page of the online documentation, or go to www.novell.com/documentation/feedback.html and enter your comments there.

Documentation Updates

For the most recent version of the *OES 2 SP3: Novell Storage Services File System Administration Guide* for Linux, see the latest Novell Open Enterprise Server 2 documentation (http://www.novell.com/documentation/oes2/index.html).

Additional Documentation

For information about planning and implementing storage solutions in Novell Open Enterprise Server 2, see the following:

- The “Storage and File Systems” section in the *OES 2 SP3: Planning and Implementation Guide* describes considerations for choosing a storage solution and system-wide caveats for implementing the different storage solutions.
- *OES 2 SP3: Storage and File Services Overview* describes typical requirements for system storage, and identifies the various storage products and services in Novell Open Enterprise Server 2 that address those requirements.
- *File System Primer* (http://wiki.novell.com/index.php/File_System_Primer) describes the variety of file systems available on Linux and which ones are the best to use for which workloads and data.

For more information about services referenced in this guide, see the following:

- The *OES 2 SP3: Novell Distributed File Services Administration Guide for Linux* describes how to configure and manage DFS services for NSS volumes on NetWare or Linux.

- The *OES 2 SP3: Dynamic Storage Technology Administration Guide* describes how to configure NSS volumes as shadow volumes by using Dynamic Storage Technology.
- Novell Archive and Version Services provides interval-based archiving for user data. See the *OES 2 SP3: Novell Archive and Version Services 2.1 Administration Guide for Linux*.
- The *OES 2 SP3: File Systems Management Guide* describes the Novell trustee model and how to configure file system trustees, trustee rights, and attributes for NSS volumes on Linux and NetWare, NetWare Core Protocol (NCP) volumes on Linux, and NetWare Traditional volumes on NetWare.
- The *OES 2 SP3: NCP Server for Linux Administration Guide* describes how to manage NCP connections for NSS volumes on Linux.
- The *OES 2 SP3: Novell Linux User Management Administration Guide* describes how to Linux-enable users for an OES 2 Linux server.
- The *NDK: Virtual File Services* (http://developer.novell.com/wiki/index.php/Virtual_File_Services_for_NetWare) describes the software APIs for creating software applications and scripts to manage NSS volumes and services on Linux and NetWare.
- The *NDK: Novell Storage Architecture Component (Media Manager and NWPA)* (http://developer.novell.com/wiki/index.php/Storage_Architecture_Components_%28Media_Manager_and_NWPA%29) describes software APIs for creating storage-related applications.
- Novell Storage Services Error Codes (http://www.novell.com/documentation/nwec/nwec/data/al3s3ui.html)
- The *SLES 10 SP3: Storage Administration Guide* describes storage services such as the EVMS volume manager, UUIDs, Linux multipath I/O for devices; and Linux software RAIDs 0, 1, 5, 6, and 10.
- Enterprise Volume Management System for Linux documentation:
  - *EVMS User Guide* (http://evms.sourceforge.net/user_guide)
  - *EVMS GUI Screen Shots* (http://evms.sourceforge.net/gui_screen/)

1 Overview of NSS

Novell Open Enterprise Server (OES) 2 SP3 provides Novell Storage Services (NSS) file system for the Linux operating system. This section describes benefits and key features of NSS.

- Section 1.1, “Introduction to NSS,” on page 25
- Section 1.2, “Benefits of NSS,” on page 25
- Section 1.3, “Understanding NSS,” on page 26
- Section 1.4, “NSS Features and Capabilities,” on page 28
- Section 1.5, “Comparison of NSS to Other File Systems,” on page 30
- Section 1.6, “What’s Next,” on page 30

1.1 Introduction to NSS

The NSS file system and services provide visibility, a trustee access control model, multiple simultaneous name space support, native Unicode, user and directory quotas, rich file attributes, multiple data stream support, event file lists, and a file salvage subsystem. These capabilities can help you effectively manage your shared file storage for any size of organization, scaling from small businesses to even the largest of organizations with hundreds of thousands of employees.

NSS volumes that were created on NetWare are cross-compatible between Linux and NetWare. This allows you to use a mixed-platform cluster with Novell Cluster Services while converting a cluster from NetWare to Linux. NSS volumes can fail over between Linux and NetWare, allowing for full data, trustee, and file system feature preservation when migrating data to Linux.

NSS devices and storage can be managed in the Web-based Novell iManager utility or with server-based management tools. NSS also supports third-party tools on both platforms for advanced data protection and management, virus scanning, and traditional archive and backup solutions.

1.2 Benefits of NSS

Files are at the heart of every company, large or small. Whether your network spans continents or a few cubicles, your files become the foundation of your business. No one can afford unreliable file service, especially when the files you manage are continually growing and requiring more and more storage space.

Businesses today demand more storage space and faster and easier access to data. To meet the demands, you need a file system that can scale to a growing business, is easily maintained, and is better protected against corruption. NSS provides a variety of features that can be combined to provide a robust and reliable solution for your business.

NSS provides the following benefits:

- A journaling file system that lets you create bigger volumes that activate (mount) quicker, store more data, and resist corruption better than non-journaling file systems.
- Encrypted volume support to meet the legal standard of making data inaccessible to software that circumvents normal access control, such as if the media were stolen.
- Access control and visibility management using the Novell trustee model.
- An unlimited number of NSS volumes, with up to 255 mounted concurrently.
- Lower memory requirements: 1 MB of RAM can activate an NSS volume.
- Pools of storage that span multiple devices and support dynamic resizing to grow the pool and volumes.
- Pool snapshots that capture point-in-time versions of files in the pool.
- Software RAID support, including RAID 0 (striping), RAID 1 (mirroring), and RAID 5 (Block-level striping with distributed parity), RAID 0+1 (mirroring RAID 0 devices), and RAID 5+1 (mirroring RAID 5 devices).
- Multiple server activation prevention (MSAP) to help protect pools from being concurrently activated by multiple servers that do not share a cluster relationship.
- Up to 4 billion (10E9) files in a single directory, so how you organize files is limited only by the application or file browser, not the file system.
- Faster access to data, regardless of file size or volume size.
- Directory space restrictions.
- User space restrictions.
- Salvage support for deleted volumes and files.
- Data compression.
- Novell Distributed File Services allows you to better manage storage growth by defining virtual file structures with junctions, moving volumes, and splitting volumes. For information, see the *OES 2 SP3: Novell Distributed File Services Administration Guide for Linux*.
- Novell Archive and Version Services allows you to archive interval-based versions of user files on NSS volumes, and to make them available to users for individual retrieval. For information, see the *OES 2 SP3: Novell Archive and Version Services 2.1 Administration Guide for Linux*.

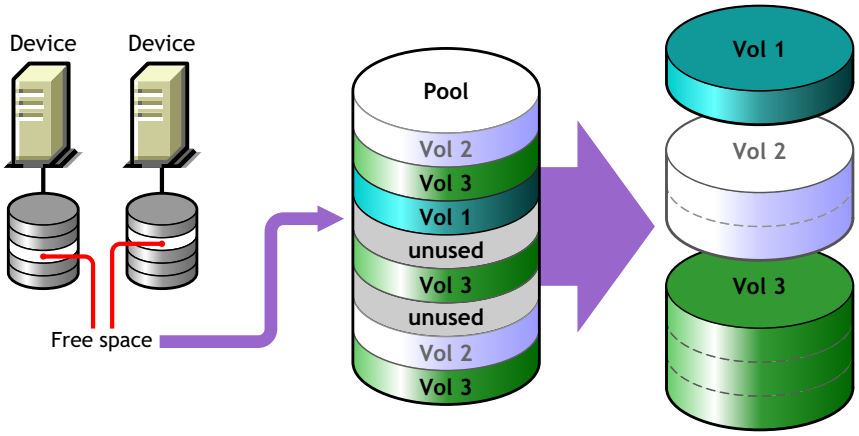
1.3 Understanding NSS

NSS is a 64-bit file system that can manage a virtually unlimited number of file objects. On each physical storage device, NSS abstracts physical NetWare partitions to make them appear as contiguous free space. NSS recognizes physical and logical devices up to 2 TB in size from which you can create any number of virtual storage resources, called pools. You can choose space from at least four logical devices of up to 2 TB each to create a pool with a maximum pool size of 8 TB. A pool can contain any number of volumes. If the pool spans devices by using space from them for the pool, the volumes automatically span the devices. A single volume can contain up to 8 trillion files and grow to 8 TB in size, depending on the size of the pool and space consumed by other volumes in the pool.

1.3.1 Storage Pools

On Linux, you can use NSS pools and volumes to store applications, files, and databases. You create storage pools by assigning areas of free space obtained from one or more of a server's storage devices. You can create one or more NSS volumes from the space in the storage pool. The following figure shows how NSS uses free space on multiple devices to create a storage pool.

Figure 1-1 *NSS Pool Architecture*



1.3.2 NSS Volumes

The logical volumes you create on NSS storage pools are called NSS volumes. You can specify a maximum storage quota for the volume, or allow the volume to grow dynamically to the size of its pool. You can add any number of volumes to a storage pool.

Because there is no limit to the number of volumes you can create, it is possible that the combined administrative size of all the volumes taken together is larger than the physical size of the storage pool itself. NSS refers to this process as "overbooking." If you overbook space in the pool, the individual administrative size of a volume cannot exceed the size of the storage pool.

NSS allocates space from the pools to the volumes only as needed. Typically, user consumption of a volume's available space ebbs and flows; it is unlikely that users concurrently consume volumes at 100% of their available capacity. Each volume consumes the space it needs as it needs it. By overbooking space, NSS provides a flexible and cost effective way to accommodate expanding storage needs.

For example, suppose you have a 300 GB storage pool. From this storage pool, you create two NSS volumes of 200 GB. You can define two 200 GB NSS volumes out of a storage pool of only 300 GB, if you feel comfortable that the NSS volumes will not both exceed 75 percent capacity (150 GB) and therefore, exceed the overall size of the storage pool. If one NSS volume does reach 150 GB, but the other volume stays under 100 GB, your overbooking plan worked.

Suppose you expect one of the volumes might exceed its share of the pool. You can overbook the pool by creating one NSS volume with a quota of 200 GB and a second NSS volume that can grow to the size of the pool. As the combined size nears the size of the pool, you can extend the size of the pool by adding another segment to it, allowing more space for the larger, expanding volume. Your overbooking plan works because you built in the opportunity to expand the pool and volume, according to your business needs.

1.4 NSS Features and Capabilities

NSS helps improve the scalability, flexibility, and availability of your storage devices. This section identifies specific NSS features that help you do the following:

- Use Less Memory and Gain More Speed
- Improve Storage Availability
- Prevent Unauthorized Access
- Protect Data from Corruption or Loss
- Maximize Available Space

1.4.1 Use Less Memory and Gain More Speed

NSS requires only about 1 MB of server memory to activate a volume, independent of the number of files it contains. With NSS, you can activate up to 256 NSS volumes (the system volume plus 255 other NSS volumes) concurrently per server, up to the available server memory.

Whenever you activate an NSS volume, it takes only seconds to mount a volume instead of minutes. NSS uses a journaling file system and does not need to scan the entire file system to create a directory entry table (DET) to load the volume. NSS loads a file's metadata into the memory only when you access the file.

NSS reads the file system journal only if a server goes down abnormally. Instead of slowly searching the volume for errors, NSS reads the journal to identify any incomplete transactions. It either completes the transaction or backs it out. This results in less server down time and is beneficial for applications such as mail services.

1.4.2 Improve Storage Availability

NSS provides the following features to improve I/O performance and provide fault-tolerant access to your data:

- Software RAID support for RAIDs 0, 1, 5, 10, and 15

  Uses software RAID devices to improve performance and availability. For information, see Chapter 13, "Managing NSS Software RAID Devices," on page 149.

- Shared-disk storage

  Makes devices shareable for use in a cluster. For information, see Section 10.7, "Sharing Devices," on page 123.

- Multiple name space support

  NSS provides full support for filenames in the Long, UNIX, DOS, and Macintosh name spaces. Long name space is the default. For information, see "Lookup Namespace" on page 225.

- Rich file metadata support

  NSS provides full support for all file attributes and multiple simultaneous data streams for DOS, Windows, UNIX, and Macintosh. For information, see Section 20.1, "Configuring File System Trustees, Trustee Rights, Inherited Rights Filters, and Attributes," on page 259.

1.4.3 Prevent Unauthorized Access

NSS includes the following features to help prevent access to data that circumvents normal access control:

- Encrypted Volume Support

  Encrypts data volumes, meeting U.S. Government security standards. For information, see "Managing Encrypted NSS Volumes" on page 251.

- Data shredding (up to 7 times) for deleted files

  Erases files completely, meeting U.S. Government security standards. For information, see Section 20.3, "Using Data Shredding to Prevent Access to Purged Files," on page 268.

- Multiple Server Access Prevention for pools

  Ensures data integrity by preventing unauthorized access to shared media in a storage area network. For information, see Section 15.12, "Preventing Pools from Activating on Multiple Servers," on page 187.

- Trustee model for access control on NSS volumes

  NSS uses the Novell Trustee model to greatly simplify access control management in the file system. It restricts visibility of data structures so that users only see subdirectories they have rights to see, not the whole tree like all other file systems.

  For information about the Novell Trustee model and NSS file system rights, see the *OES 2 SP3: File Systems Management Guide*.

  Some additional steps are necessary to configure access control for NSS on Linux. For information, see Section 5.5, "Access Control for NSS on Linux," on page 62.

1.4.4 Protect Data from Corruption or Loss

NSS includes the following features to ensure that the most current copy of your data is recoverable:

- Pool snapshots to provide point-in-time views of data

  Backs up files from snapshots of data so that all files, including open ones, are backed up. For information, see "Managing NSS Pool Snapshots" on page 203.

- Immediate data saves

  Writes data to the volume at regular intervals in order to reduce the seek time on the drive. For information, see Section 27.3, "Configuring or Tuning Group I/O," on page 352.

- Salvage file subsystem

  Recovers files, directories, and volumes that were deleted by applications or from the terminal/console commands. For information, see "Salvaging and Purging Deleted Volumes, Directories, and Files" on page 309.

1.4.5 Maximize Available Space

NSS includes the following features to help you maximize your available space:

- File compression

  Compresses inactive files, according to preset parameters, to conserve space in a volume. For information, see "Managing Compression on NSS Volumes" on page 275.

- Volume space restrictions

  Limits the amount of space a volume can consume in its pool. For information, see Section 22.2, "Managing NSS Volume Quotas," on page 295.

- Directory space restrictions

  Limits the amount of space a subdirectory can consume, regardless of broader volume and user constraints. For information, see Section 22.3, "Managing Directory Quotas," on page 296.

- User space restrictions

  Limits the amount of space a user's data can consume, regardless of broader directory or volume constraints. For information, see Section 22.4, "Managing User Space Quotas," on page 300.

1.5 Comparison of NSS to Other File Systems

Use the following table to find comparisons of NSS on Linux to NSS on NetWare and to NCP volumes on Linux POSIX file systems:

Comparison	NSS on NetWare	NSS on Linux	Linux POSIX File Systems plus NCP Server
Comparison of NSS on NetWare and NSS on Linux (page 473)	✓	✓	
Comparison of NSS on Linux and NCP Volumes on Linux POSIX File Systems (page 479)		✓	✓

1.6 What's Next

See Chapter 2, "What's New," on page 31 to learn about new and modified features in this release of NSS.

Review the following sections to help you plan your storage solution:

- For information about installing and configuring NSS on your server, see Chapter 3, "Installing and Configuring Novell Storage Services," on page 39.
- For guidelines and instructions about upgrading the media format of NSS volumes to use hard links, see Chapter 4, "Upgrading the NSS Media Format," on page 49.
- For guidelines and instructions about migrating NSS volumes from NetWare 6.5 SP8 servers to OES 2 Linux servers, see Chapter 11, "Migrating NSS Devices from NetWare 6.5 SP8 to OES 2 Linux," on page 129.
- For guidelines about setting up NSS volumes and services on a virtual server, see Chapter 6, "Using NSS in a Virtualization Environment," on page 71.
- For management tools overviews and quick references, see Chapter 9, "Management Tools for NSS," on page 87.
- For information to help you plan storage services to use the NSS file system and services, see Chapter 5, "Planning NSS Storage Solutions," on page 55.

2 What's New

This section describes enhancements and changes to the Novell Storage Services file system and services for Novell Open Enterprise Server 2 (OES 2).

- Section 2.1, "What's New (OES 2 SP3 July 2012 Patch)," on page 31
- Section 2.2, "What's New (OES 2 SP3 August 2011 Patch)," on page 31
- Section 2.3, "What's New (OES 2 SP3)," on page 31
- Section 2.4, "What's New (OES 2 SP2)," on page 32
- Section 2.5, "What's New for NSS (OES 2 SP1)," on page 33
- Section 2.6, "What's New for NSS (OES 2)," on page 34

2.1 What's New (OES 2 SP3 July 2012 Patch)

With the release of the July 2012 patches for OES 2 SP3, metamig can restore trustee information gathered by TRUSTEE.NLM. For more information, see "ROptions (Restore)" on page 430 in the Section B.3, "metamig," on page 429.

2.2 What's New (OES 2 SP3 August 2011 Patch)

With the release of the August 2011 patches for OES 2 SP3, the base platform has been upgraded to SLES 10 SP4.

SLES 10 SP4 support is enabled by updating OES 2 SP3 servers with the *move-to-sles10-sp4* patch. Novell encourages customers to update to this latest set of patches. For more information, see "Updating (Patching) an OES 2 SP3 Server" in the *OES 2 SP3: Installation Guide*.

SLES 10 SP4 is considered a lower-risk update that contains a set of consolidated bug fixes and support for newer hardware. It does not impact the kernel ABI or third-party certifications.

With the release of the August 2011 patches, OES 2 SP2 customers who upgrade to OES 2 SP3 via the *move-to* patch will receive the SLES 10 SP4 updates. New installations of OES 2 SP3, migrations to OES 2 SP3, and down-server upgrades to OES 2 SP3, should all be performed using SLES 10 SP4 media.

2.3 What's New (OES 2 SP3)

There are no new features for this release.

2.4 What's New (OES 2 SP2)

The features described in this section were added or modified for NSS in OES 2 SP 2 Linux release.

- Section 2.4.1, "NSS Management Enhancements," on page 32
- Section 2.4.2, "NSS Utility Enhancements," on page 32
- Section 2.4.3, "RAID 0+1 and RAID 5+1 Support," on page 32
- Section 2.4.4, "NSS Auditing Engine," on page 32

2.4.1 NSS Management Enhancements

NSSMU has improved response in multi-disk environments.

NSSMU and iManager can take an extremely long time to list devices and do various other things when the server has multiple devices. This is because of how information is read from EVMS.

To address this, the management code has been modified to support multiple devices. The NSS management pieces can now use a single request to get the needed information about multiple devices, thus avoiding multiple evms_open_engine() calls.

2.4.2 NSS Utility Enhancements

- The `attrib` and `rights` commands now have an option to work with link files.
- NSSComp includes an NSS compression screen.
- The NSS utility can now monitor compression statistics for a volume.
- A new `nssraid` utility is added to view the status of the NSS RAID 1 (mirror) devices.
- Additional options are now available in NSSCON for quitting, displaying the next line of information, etc.
- A new `quota` utility is included for setting user and directory quotas.
- A new NSS utility, `ncsinit` is included. `ncsinit` speeds up the process of initializing a disk and setting the device to a shared state.

2.4.3 RAID 0+1 and RAID 5+1 Support

Support for RAID 0+1 and RAID 5+1 has been added.

2.4.4 NSS Auditing Engine

OES 2 SP2 includes the NSS Auditing Engine, which is installed by default with NSS.

The auditing engine provides an interface for auditing client applications, such as Novell Sentinel and various third-party products to access. For information on using NSS Auditing Engine, see "NSS Auditing Engine".

2.5 What's New for NSS (OES 2 SP1)

In addition to bug fixes, the features or changes described in this section were made for NSS in OES 2 SP 1 Linux since the NSS release for OES 2 Linux.

- Section 2.5.1, "eDirectory 8.8.4," on page 33
- Section 2.5.2, "Long Is the Default Name Space for Mounting NSS Volumes on Linux," on page 33
- Section 2.5.3, "noatime and atime Options," on page 33
- Section 2.5.4, "PosixPermissionMask Option," on page 33
- Section 2.5.5, "Support for 64-Bit eDirectory, Novell CIFS, and Novell AFP," on page 33
- Section 2.5.6, "Support for Novell AFP for Linux," on page 34
- Section 2.5.7, "Support for Novell CIFS for Linux," on page 34
- Section 2.5.8, "Support for Novell Domain Services for Windows," on page 34
- Section 2.5.9, "UnplugAlways Option," on page 34

2.5.1 eDirectory 8.8.4

NSS supports eDirectory 8.8.4 in the OES 2 SP1 release.

2.5.2 Long Is the Default Name Space for Mounting NSS Volumes on Linux

Beginning with OES 2 SP1 Linux, the default name space that NSS uses when mounting NSS volumes on Linux has changed from UNIX to Long. This matches the name space handling of NSS volumes on NetWare. Using the Long name space as primary improves performance over using the UNIX name space, especially if you expect to store millions of files on the volume. To mount a volume with a different name space (that is, DOS, Macintosh, or UNIX), you must explicitly specify the name space to use.

2.5.3 noatime and atime Options

This NSS command option allows the administrator to control whether access times are updated when files and directories are read. Using `/noatime` is useful for backup, news servers, and mail servers where the extra disk activity associated with updating the access time is not desired. Avoiding the writes associated with updating the access time can result in measurable performance gains. For information, see Section A.22, "noatime and atime Commands," on page 407.

2.5.4 PosixPermissionMask Option

The `/PosixPermissionMask=`*`mask`* command option allows the administrator to control which POSIX permission bits can be set. This is useful if you need to modify the default setting to support a different value for the POSIX Other field that is required by Linux utitilites such as SSH. For information, see Section A.29, "POSIX Permission Mask Command," on page 412.

2.5.5 Support for 64-Bit eDirectory, Novell CIFS, and Novell AFP

Support was added for 64-bit eDirectory 8.8.4, Novell CIFS, and Novell AFP.

2.5.6 Support for Novell AFP for Linux

Novell AFP for Linux is available for accessing files on NSS volumes on OES 2 SP1 Linux. It works similarly to Novell AFP for NetWare. Linux-enabling users with Linux User Management is not required.

For information about installing and managing Novell AFP for Linux, see the *OES 2 SP3: Novell AFP For Linux Administration Guide*.

2.5.7 Support for Novell CIFS for Linux

Novell CIFS for Linux is available for accessing files on NSS volumes on OES 2 SP1 Linux. It works similarly to Novell CIFS for NetWare. Linux-enabling users with Linux User Management is not required.

For information about installing and managing Novell CIFS for Linux, see the *OES 2 SP3: Novell CIFS for Linux Administration Guide*.

2.5.8 Support for Novell Domain Services for Windows

Novell Domain Services for Windows is available for accessing files on NSS volumes with the Samba/CIFS protocol. For guidelines, see Section 5.6.4, "Novell Domain Services for Windows," on page 67.

For information about installing and managing Domain Services for Windows, see the *OES 2 SP3: Domain Services for Windows Administration Guide*.

2.5.9 UnplugAlways Option

The `/(No)UnplugAlways` command option allows NSS to unplug the device queue after queuing each read. It is enabled by default only for OES 2 SP1. This improves performance significantly on certain workloads. For information, see Section A.5.5, "UnplugAlways Command for the Read Queue," on page 392.

2.6 What's New for NSS (OES 2)

In addition to bug fixes, the features described in this section were added or modified for NSS in OES 2 Linux since the NSS release for Novell Open Enterprise Server 1 Linux.

- Section 2.6.1, "64-Bit Support," on page 35
- Section 2.6.2, "Archive and Version Services," on page 35
- Section 2.6.3, "Distributed File Services," on page 35
- Section 2.6.4, "Distributed File Services Plug-In," on page 35
- Section 2.6.5, "Encrypted Volumes," on page 36
- Section 2.6.6, "Enhanced Hard Links," on page 36
- Section 2.6.7, "Extended Attributes (XAttr)," on page 36
- Section 2.6.8, "Files and Folders Plug-in," on page 36
- Section 2.6.9, "Group I/O Management," on page 36
- Section 2.6.10, "High Memory Management," on page 37

- Section 2.6.11, “LAF Audit Log Messages,” on page 37
- Section 2.6.12, “Media Upgrade for Enhanced Hard Links Support,” on page 37
- Section 2.6.13, “Metadata Migration (METAMIG) Utility,” on page 37
- Section 2.6.14, “New Location for the NSS Configuration Files,” on page 37
- Section 2.6.15, “NOATIME and NODIRATIME Support,” on page 37
- Section 2.6.16, “Pool Snapshots,” on page 37
- Section 2.6.17, “Software RAIDs,” on page 38
- Section 2.6.18, “Storage Plug-In,” on page 38
- Section 2.6.19, “User Quotas,” on page 38
- Section 2.6.20, “User Quotas and Linux User Management,” on page 38
- Section 2.6.21, “User Quota Task in the Storage Plug-In,” on page 38

2.6.1 64-Bit Support

Selecting NSS as part of a 64-bit installation on OES 2 Linux installs 64-bit NSS.

2.6.2 Archive and Version Services

Novell Archive and Version Services is now supported for NSS volumes on OES 2 Linux. For information, see the *OES 2 SP3: Novell Archive and Version Services 2.1 Administration Guide for Linux*.

2.6.3 Distributed File Services

Novell Distributed File Services (DFS) is now supported for NSS volumes on OES 2 Linux. For information about using DFS, see the *OES 2 SP3: Novell Distributed File Services Administration Guide for Linux*.

2.6.4 Distributed File Services Plug-In

Novell Distributed File Services (DFS) can now be managed fully within the Distributed File Services plug-in for Novell iManager 2.7. The plug-in is included in the `nssmgmt.nlm` file. You can do the following with the new DFS plug-in:

- Create a DFS management context.
- Manage, monitor, and repair the Volume Location Database (VLDB) services, replica sites, and the VLDB.
- Create, modify, or delete DFS junctions for NSS volumes.
- Configure trustees, trustee rights, and inherited rights filters for junctions and junction target locations.
- Manage move volume or split volume jobs.

For information about DFS for NSS volumes, see the *OES 2 SP3: Novell Distributed File Services Administration Guide for Linux*.

2.6.5 Encrypted Volumes

Encrypted NSS volume support was added for OES 1 SP1 Linux. Previously, encrypted volumes were supported only on NetWare. For information, see Chapter 19, “Managing Encrypted NSS Volumes,” on page 251.

2.6.6 Enhanced Hard Links

Enhanced support for hard links is now available for NSS volumes on OES 2 Linux. For information about configuring and managing hard links for NSS volumes on Linux , see Chapter 24, “Managing Hard Links,” on page 321.

2.6.7 Extended Attributes (XAttr)

The Extended Attributes (XAttr) extension for NSS provides accessibility into many extended attributes for NSS on Linux. It allows you to read, back up, and restore extended attributes of files on NSS. For information, see Section A.10, “Extended Attributes (XAttr) Commands,” on page 397.

2.6.8 Files and Folders Plug-in

The Files and Folders plug-in (`filemanager.npm`) for Novell iManager 2.7 provides the following capabilities for NSS volumes and NCP (NetWare Core Protocol) volumes:

- Manage trustees, trustee rights, and inherited rights filters for files and directories
- View the inherited rights at every level in the file system tree for a given trustee of a selected file or directory
- View the effective rights for a given trustee of a selected file or directory
- Manage file attributes
- Configure directory quotas (only for NSS volumes where the volume’s Directory Quotas attribute is enabled)
- Browse directories and files
- Create directories
- Upload and download files
- Delete files
- Salvage and purge deleted files (only for NSS volumes where the volume’s Salvage attribute is enabled)

For an overview of these features for the Files and Folders plug-in, see Section 9.1.8, “Files and Folders Plug-In Quick Reference,” on page 101.

2.6.9 Group I/O Management

In OES 2 Linux, NSS performs group writes in three categories: journal, metadata, and user data. By setting policies for group writes, you can improve the performance of the file system for your particular environment. For information, see Section 27.3, “Configuring or Tuning Group I/O,” on page 352.

2.6.10 High Memory Management

NSS for Linux supports metadata caching in high memory for servers that are low-memory constrained. This can greatly improve metadata reads on 32-bit systems with large numbers of files. For information, see Section 27.2.3, “Configuring High Memory Cache,” on page 350.

2.6.11 LAF Audit Log Messages

NSS for OES 2 Linux supports Lightweight Auditing Format (LAF) for NSS trustee changes for NSS volumes on OES 2 Linux. When it is enabled, NSS reports events for adding or removing trustees and setting the inherited rights filter. For information, see Section 20.4, “Enabling or Disabling LAF Audit Log Messages for Trustee Events,” on page 269.

2.6.12 Media Upgrade for Enhanced Hard Links Support

Enhanced hard links support was added.A new metadata structure allows up to 65,535 hard links per file. A media upgrade is required to take advantage of this feature. For information about the media upgrade, see Chapter 4, “Upgrading the NSS Media Format,” on page 49.

For information about managing hard links, see Chapter 24, “Managing Hard Links,” on page 321.

2.6.13 Metadata Migration (METAMIG) Utility

The Metadata Migration (METAMIG, `metamig`) utility is available for OES 1 Linux and later. For information, see Section B.3, “metamig,” on page 429.

2.6.14 New Location for the NSS Configuration Files

In this release, NSS configuration files have moved from the `/opt/novell/nss/conf` directory to the `/etc/opt/novell/nss` directory.

2.6.15 NOATIME and NODIRATIME Support

NSS on OES 2 Linux supports the `O_NOATIME` option for the Linux `open(2)` command, and the `noatime` and `nodiratime` options for the `mount` and `nfsmount` command and the `/etc/fstab` file. All of these options have the same objective—that is, to prevent the access time from being updated unless the access involves a modification of a file’s or directory’s metadata or content. For information, see Section A.23, “noatime and nodiratime Support for Linux open, mount, nfsmount, and /etc/fstab,” on page 408.

2.6.16 Pool Snapshots

NSS now supports pool snapshots for NSS pools on OES 2 Linux. Pool snapshots were previously available only on NetWare. You can use NSSMU or the Storage plug-in for Novell iManager 2.7 to manage pool snapshots for Linux.

For information about creating, managing, or deleting snapshots on Linux , see Chapter 17, “Managing NSS Pool Snapshots,” on page 203.

2.6.17 Software RAIDs

NSS now supports software RAIDs 5 and 15 for devices on OES 1 SP1 Linux. Previously, software RAIDs 5 and 15 were supported only on NetWare. For information, see Chapter 13, "Managing NSS Software RAID Devices," on page 149.

2.6.18 Storage Plug-In

The Storage plug-in to Novell iManager 2.7 requires the `nssmgmt.npm` file and the `storagement.npm` file. For information, see Section 9.1.1, "Understanding Storage-Related Plug-Ins," on page 88.

2.6.19 User Quotas

NSS now supports user space quotas support for NSS volumes on OES 1 SP1 Linux. Previously, user quotas were supported only on NetWare. For information, see Section 22.4, "Managing User Space Quotas," on page 300.

2.6.20 User Quotas and Linux User Management

Changes in NCP Server for Linux now make it possible for the file ownership to be tracked for users of NSS volumes on Linux without requiring the user to be Linux-enabled with Linux User Management.

2.6.21 User Quota Task in the Storage Plug-In

The User Quota option in the Storage plug-in for iManager 2.7 now allows users to access information via iManager about their personal user quotas on NSS volumes. For information, see Section 22.4.2, "Viewing User Space Quotas," on page 301.

3 Installing and Configuring Novell Storage Services

This section describes how to install and configure Novell Storage Services on Novell Open Enterprise Server 2.

- Section 3.1, “Requirements for Installing NSS,” on page 39
- Section 3.2, “Installing and Configuring NSS on Linux,” on page 41
- Section 3.3, “Upgrading the Media Format for Hard Link Support,” on page 45
- Section 3.4, “Enabling Users for Linux Utilities and Services,” on page 45
- Section 3.5, “Updating NSS on OES 2 Linux,” on page 45
- Section 3.6, “Upgrading from OES 1 Linux to OES 2 Linux,” on page 46
- Section 3.7, “Updating the NSS Kernel Module (km_nss) for SUSE Linux Enterprise Server,” on page 47

3.1 Requirements for Installing NSS

Make sure your system and storage solution meets the requirements in this section.

- Section 3.1.1, “Device Requirements,” on page 39
- Section 3.1.2, “Requirements for NSS on Linux,” on page 40
- Section 3.1.3, “Requirements for Storage-Related iManager Plug-Ins,” on page 41

3.1.1 Device Requirements

The following requirements apply to devices for NSS on the latest release of OES 2 Linux:

- ❒ Devices can be up to 2 TB in size. For information, see Section 10.1.1, “Device Size Limit,” on page 115.
- ❒ At least 10 MB of free space is needed on the storage media for each NSS pool you plan to create.
- ❒ At least 12 MB of free space is needed on the storage media for each software RAID segment you plan to create.
- ❒ For information about devices to use in a virtual environment, see Chapter 6, “Using NSS in a Virtualization Environment,” on page 71.

3.1.2 Requirements for NSS on Linux

- "General Requirements" on page 40
- "EVMS Requirements" on page 40
- "Non-EVMS Volume Managers" on page 41

General Requirements

The following general requirements apply to NSS on Linux:

- ❒ A physical server or virtual server running OES 2 Linux.
- ❒ NSS is not installed by default. You can select it during the YaST install, or install it at any time from the *YaST > Open Enterprise Server > OES Install and Configuration*.

  For information about install options, see Section 3.2, "Installing and Configuring NSS on Linux," on page 41.
- ❒ The NSS file system is used only for data volumes on OES 2 Linux. The Linux operating system requires a Linux POSIX file system for its system volume, such as Ext3.
- ❒ After installing OES 2 Linux, install only approved updates. Refer to the *OES 2 SP3: Installation Guide* to install the approved updates.

  For information about updating the NSS Kernel Module, see Section 3.7, "Updating the NSS Kernel Module (km_nss) for SUSE Linux Enterprise Server," on page 47.
- ❒ A Novell eDirectory Read/Write replica must be available in the same tree as the server when you create an NSS pool or volume on Linux so that the Storage objects can be created in eDirectory; otherwise, NCP cannot map to the pool or volume.
- ❒ NSS Admin object must be placed under the default location, that is, the same place where the server object exists.

EVMS Requirements

The device where you want to create NSS volumes must be managed by EVMS in order to use the Storage plug-in to iManager or NSSMU to create and manage NSS partitions, pools, and volumes. Novell Cluster Services for Linux also requires EVMS.

IMPORTANT: If you move devices that contain NSS pools cross-platform (such as reassigning SAN-based devices from a NetWare server to an OES 2 Linux server), NSS recognizes the pools and automatically uses EVMS to manage the devices.

Updates to EVMS for OES 2 SP3 Linux, are received through the update channel for SUSE Linux Enterprise Server 10 SP4. Make sure that you install the latest patches for EVMS before you create pools and volumes for this server.

WARNING: NSS requires EVMS version 2.5.5-24.54.5 or later. This mandatory update is available in the SUSE Linux Enterprise Server 10 Support Pack 1 patch channel as of March 21, 2008. OES 2 SP3 Linux automatically installs or updates EVMS to EVMS version 2.5.5-24.72.1.

In some cases, reverting to EVMS versions earlier than 54.5 might result in data corruption. In the .46 and .49 versions, data corruption can occur if NSS pools and volumes are mounted when you install EVMS updates.

Linux uses Linux Volume Manager (LVM) as its default volume manager. Beginning with the Linux 2.6 kernel, any disk managed by the LVM2 cannot be managed by Enterprise Volume Management System (EVMS). Thus, disks where the boot partition (such as `/boot` for Grub) and system partition (such as for the swap and / (`root`) volumes) reside are typically unavailable to NSS.

To be able to create an NSS data volume on the same device as your boot partition or system partition, make sure to configure the device for EVMS during the install. For information, see "Installing with EVMS as the Volume Manager of the System Device" in the *OES 2 SP3: Installation Guide*.

When your data volumes are on non-system devices, do not configure devices during the install. Instead, leave the devices as unconfigured free space and do not assign a volume manager for them. After the install, create the volumes with NSSMU or the Storage plug-in to iManager.

Non-EVMS Volume Managers

NSS is not supported for devices managed by non-EVMS volume managers. For more information, see Chapter D, "Using NSS on Devices Managed by Non-EVMS Volume Managers," on page 463.

3.1.3 Requirements for Storage-Related iManager Plug-Ins

For information about installing and using the storage-related iManager plug-ins, see Section 9.1, "Novell iManager and Storage-Related Plug-Ins," on page 87.

3.2 Installing and Configuring NSS on Linux

This section describes only those steps in the install that are directly related to installing Novell Storage Services and its dependencies. For information about installing OES 2 services on Linux, see the *OES 2 SP3: Installation Guide*.

- Section 3.2.1, "Installing Linux with EVMS as the Volume Manager of the System Device," on page 41
- Section 3.2.2, "Selecting the NSS Pattern During the OES 2 Linux Install," on page 42
- Section 3.2.3, "Installing NSS on an Existing OES 2 Linux Server," on page 44
- Section 3.2.4, "Enabling or Disabling NSS on Linux," on page 44

3.2.1 Installing Linux with EVMS as the Volume Manager of the System Device

If you are installing OES 2 Linux on a system with a single device where you also plan to create NSS volumes, that device must be managed by the Enterprise Volume Management System (EVMS) volume manager instead of the default Linux Volume Manager 2 (LVM2) volume manager. The volume manager for the system device is configured in the Partitioning section of the Installation Settings page for the YaST install. For more information and instructions, see "Installing with EVMS as the Volume Manager of the System Device" in the *OES 2 SP3: Installation Guide*.

3.2.2 Selecting the NSS Pattern During the OES 2 Linux Install

1. In the YaST install, on the *Installations Settings* page, click *Software* to go to the *Software Selections and System Tasks* page.

   For information about the entire OES 2 Linux install process, see the *OES 2 SP3: Installation Guide*.

2. From the OES Services options, select *Novell Storage Services*. Selecting NSS as part of a 64-bit installation automatically installs NSS 64-bit support.

   The following additional OES 2 services are automatically selected:

   - Novell Backup / Storage Management Services

     SMS makes it possible to back up trustee and other extended attributes for data on NSS volumes. It is also used by Novell Distributed File Services for moving or splitting NSS volumes.

   - Novell eDirectory

     eDirectory supports authentication of users who connect to NSS volumes.

   - Novell Linux User Management

     LUM allows eDirectory users to be enabled for Linux services, such as access via Samba, FTP, and so on. The administrator user for the server is automatically Linux-enabled with LUM. Users must be Linux-enabled with LUM in order to access data on NSS volumes with Linux services or utilities such as SSH, or with Linux protocols such as Samba. The Linux services must also be LUM enabled.

     LUM is not required for NCP, Novell AFP, and Novell CIFS access.

     IMPORTANT: LUM is required even if the administrator user is the only LUM user on the server.

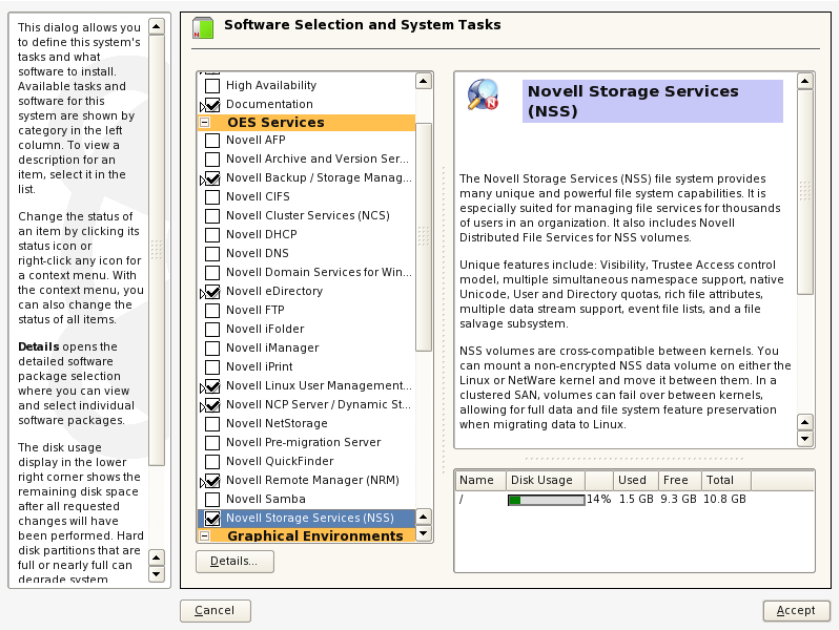
   - NCP Server / Dynamic Storage Technology

     NCP Server provides support to NSS for access control, shadow volumes, commands, and file access. It is required even if you are not using NCP clients to connect to the NSS volume.

   - Novell Remote Manager (NRM)

     Novell Remote Manager (NRM) is a browser-based management utility for monitoring server health, changing the configuration of your server, or performing diagnostic and debugging tasks.

     NRM provides the NCP Server management plug-in that allows you to create shadow volumes using NSS volumes on Linux. You can also use it to manage NCP connections to the NSS volumes.



3 Optionally select *Novell iManager* to be installed on the server.

You must install iManager somewhere in the same tree as the server. If you install iManager and NSS on the same server, the storage-related plug-ins are automatically installed.

If you install iManager on a different server, make sure you install the storage-related plug-ins that you need to manage NSS file system and services. For information about installing storage-related plug-ins on an existing server, see Section 9.1, "Novell iManager and Storage-Related Plug-Ins," on page 87.

4 Optionally select non-NCP file access services to be installed on the server.

NSS requires NCP Server to be installed and running on the server even if you select one or more of these alternate methods for user access.

- **Novell AFP:** Allows Macintosh users to connect to NSS volumes with the AFP (Apple Filing Protocol). Novell AFP is available beginning in OES 2 SP1 Linux. For information about configuring and managing AFP, see the *OES 2 SP3: Novell AFP For Linux Administration Guide*.
- **Novell CIFS:** Allows CIFS/Samba users to connect to NSS volumes with the CIFS/Samba protocol. Novell CIFS is available beginning in OES 2 SP1 Linux. For information about configuring and managing Novell CIFS, see the *OES 2 SP3: Novell CIFS for Linux Administration Guide*.
- **Novell Samba:** Allows CIFS/Samba users to connect to NSS volumes with the CIFS/Samba protocol. This service is based on Linux Samba and requires users to be Linux-enabled with Linux User Management. For information about configuring Samba during the install and configuring users for CIFS/Samba access after the install, see the *OES2 SP3: Samba Administration Guide*.

IMPORTANT: Novell Samba and Novell CIFS are different file access services that allow CIFS/Samba users to connect to NSS volumes. You can select only one of the two on a given server because of port contention issues.

---

5 Optionally select Novell Cluster Services to be installed on the server.

Install NCS if you plan to share NSS pools in a cluster. For information about installing NCS and configuring shared devices and pools using NCS, see the *OES 2 SP3: Novell Cluster Services 1.8.8 Administration Guide for Linux*.

6 Click *Accept* to return to the *Installation Settings* page.

Licensing dialog boxes might open where you are prompted to accept proprietary modules being installed.

7 Continue with the OES 2 Linux installation.

8 After the install, use the Software Updater (or other update methods) to install any NSS patches from the OES 2 Linux patch channel and any EVMS patches from the SUSE Linux Enterprise Server 10 SP4 patch channel.

3.2.3 Installing NSS on an Existing OES 2 Linux Server

If you did not install Novell Storage Services during the OES 2 Linux installation, you can install it later by using *YaST > Open Enterprise Server > OES Install and Configuration*.

1 Log in to the server as the `root` user.

2 In YaST, select *Open Enterprise Server > OES Install and Configuration*.

3 In the Selection window under *OES Services*, click *Novell Storage Services* and any other OES components that you want to install.

Follow the instruction for selecting NSS and its dependencies described in Section 3.2.2, "Selecting the NSS Pattern During the OES 2 Linux Install," on page 42.

4 Click *Accept* to begin the install, then click *Continue* to accept changed packages.

5 Follow the on-screen instructions to complete the install.

6 After the install, enter `rcnovell-smdrd restart` at the command prompt, or reboot the server before performing any backups, restores, or server consolidations on the NSS file system.

7 Use the Software Updater (or other update methods) to install patches from the OES 2 Linux patch channel and the SUSE Linux Enterprise Server 10 SP4 patch channel (such as for EVMS).

3.2.4 Enabling or Disabling NSS on Linux

When you install NSS during the initial install, NSS and its dependencies are automatically enabled in the Linux System Services (Runlevel) with Runlevels 2, 3, and 5. NSS is not automatically enabled if you post-install NSS on the server.

Although you can uninstall OES 2 Linux service RPMs through YaST, we do not recommend it because so many modules have interdependencies. Uninstalling services can leave the server in an undesirable state. If you no longer plan to use a server, we recommend disabling the service.

WARNING: NSS must be enabled to use any components or tools for the NSS file system.

To enable or disable NSS on Linux:

1 Log in to the server as the `root` user, then start YaST.

2 Click *System > System Services (Runlevel)*, then click *Expert Mode*.

3 Select novell-nss, then click *Set/Reset*.

4 Select one of the following options from the *Set/Reset* menu:

- *Disable the service*
- *Enable the service*

5 Click *Finish* to save and apply your changes, then exit the YaST Runlevel tool.

3.3 Upgrading the Media Format for Hard Link Support

The enhanced hard links support for NSS volumes requires a media format upgrade after you have installed or upgraded the operating system. For guidelines and media upgrade instructions, see Chapter 4, "Upgrading the NSS Media Format," on page 49.

3.4 Enabling Users for Linux Utilities and Services

On Linux, eDirectory users must also have a Linux identity in order to access NSS volumes via Linux services and utilities such as Samba, SSH, and FTP. OES 2 Linux provides the Linux User Management (LUM) technology that creates the local Linux user identity and stores the UID for the user in eDirectory. The Administrator user for the server is automatically Linux-enabled with LUM and added to a LUM administrator group for the server as part of the installation process. Before users of the NSS volumes can access NSS volumes on Linux with Linux services and utilities, you must enable both the service and the users with LUM.

For information, about how to enable users and Linux services with LUM, see the *OES 2 SP3: Novell Linux User Management Administration Guide*. For more information about why LUM is necessary for Linux services and utilities, see Section 5.5, "Access Control for NSS on Linux," on page 62.

3.5 Updating NSS on OES 2 Linux

You can get NSS patches in the OES 2 Linux update channel or from the Novell Download Web site (http://download.novell.com). For information about updating OES 2 Linux services, see "Updating (Patching) an OES 2 SP3 Server" in the *OES 2 SP3: Installation Guide*.

Consider the following issues when updating NSS on OES 2 Linux:

- Section 3.5.1, "Parameter Settings," on page 45
- Section 3.5.2, "Reboot Server or Restart jstcpd, adminusd, and volmnd," on page 46
- Section 3.5.3, "Storage-Related Plug-Ins," on page 46

3.5.1 Parameter Settings

When you update an OES 2 Linux server with a Support Pack or apply NSS patches, all NSS-related parameter settings remain the same as they were before the update or patch. For example, server-level, pool, and volume settings are not modified.

3.5.2 Reboot Server or Restart jstcpd, adminusd, and volmnd

If you do not reboot the server as part of the update or patch process, some NSS functions and tools might not work properly until you restart the `jstcpd`, `adminusd`, and `volmnd` daemons.

For example, NSSMU or the Novell Distributed File Services (DFS) volume location database might hang when you create a volume. DFS is delivered and updated as a part of the NSS package on OES 2 Linux (and later versions) servers. If the server is a VLDB replica site, the vldb might not work properly or cause hangs when creating new NSS volumes. For information, see "DFS may not function properly after upgrading NSS on OES 2 Linux and later." in the *OES 2 SP3: Novell Distributed File Services Administration Guide for Linux*.

To ensure that NSS and DFS is functioning properly after updating OES 2 Linux to a support pack or applying NSS patches:

1. Log in as the `root` user, then open a terminal console.
2. At the terminal console prompt, restart the following daemons in the order indicated:

   ```
   /opt/novell/nss/sbin/jstcpd
   /opt/novell/nss/sbin/adminusd
   /opt/novell/nss/sbin/volmnd
   ```

3. If the server is a VLDB replica site for a Novell Distributed File Services management context, restart the VLDB by entering

   ```
   vldb stop service
   ```

   ```
   vldb start service
   ```

3.5.3 Storage-Related Plug-Ins

The File Protocols plug-in for the Native File Access Protocols for NetWare service has been replaced in OES 2 SP1 by two plug-ins: Novell AFP (`afpmgmt.npm`) and Novell CIFS (`cifsmgmt.npm`). These plug-ins support AFP and CIFS services for NSS volumes on both Linux and NetWare.

The AFP and CIFS plug-ins also require the NSS Management (`nssmgmt.npm`) and Storage Management (`storagemgmt.npm`) plug-ins. Other storage-related plug-ins include Archive Versioning (`arkmgmt.npm`), Cluster Services (`ncsmgmt.npm`), Files and Folders Management (`fileman.npm`), Samba Management (`sambamgmt.npm`), and Distributed File Services (`dfsmgmt.npm`). All storage-related plug-ins share code in common with the Storage Management plug-in.

You must uninstall the existing storage-related plug-ins, then install the new plug-ins at the same time to make sure that the common code works for all plug-ins.

3.6 Upgrading from OES 1 Linux to OES 2 Linux

Consider the issues in this section when upgrading from OES 1 Linux (with the latest support packs and patches) to OES 2 Linux:

- Section 3.6.1, "Parameter Settings," on page 47
- Section 3.6.2, "Read Ahead Blocks Setting," on page 47

3.6.1 Parameter Settings

When you upgrade the server from OES 1 Linux to OES 2 Linux, all NSS-related parameter settings remain the same as they were before the upgrade. For example, server-level, pool, and volume settings are not modified. All future pools and volumes are created with the default settings for OES 2 Linux.

3.6.2 Read Ahead Blocks Setting

The Read Ahead Blocks parameter specifies the number of data blocks that NSS reads ahead for any open file on which read operations are ongoing in the specified server. Its default setting was changed from 2 blocks in OES 1 Linux to 16 blocks on OES 2 Linux and in a patch on OES 1 SP2 Linux. Volumes created after the patch was installed on OES 1 SP2 Linux have a default setting of 16; however, older volumes might be set to the original default, or to manual settings under 16. After upgrading to OES 2 Linux, if you experience read performance problems with an NSS volume, check the volume's Read Ahead Blocks parameter setting and change it to at least 16 blocks. A read-ahead value of 2 is too low in most OES 2 Linux environments.

On Linux, you can view or modify the Read Ahead Blocks value by using NSSMU as follows:

1. In NSSMU, select *Volumes* to view a list of volumes.
2. Select the volume, then press *Enter* to view its *Volume Properties* list.
3. Press the arrow keys to go to the *Read Ahead Count in Blocks* parameter, then press *Enter* to access the setting.
4. Type the new count value, then press *Enter*.

   Valid values are 0 to 1024 blocks, where a block is 4 KB. However, a count of 128 is the practical maximum value. Read-ahead block counts higher than 128 can starve other system components for memory or buffers, which can impair performance or cause the system to hang. As the number of concurrent connections to unique files increase, you should reduce the number of read-ahead blocks.
5. Press the arrow keys to go to *Apply*, then press *Enter* to save and apply the new setting.

You can also modify the value by using the Read Ahead Blocks switches in the NSS Console. For information, see Section A.31, "Read Ahead Blocks and Allocate Ahead Blocks Commands," on page 413.

3.7 Updating the NSS Kernel Module (km_nss) for SUSE Linux Enterprise Server

The NSS kernel module (`km_nss`) file is delivered in SUSE Linux Enterprise Server. The NSS kernel module is installed by default because it is part of the Linux kernel.

The NSS kernel module is delivered in Linux because of the following:

- The NSS kernel module provides NSS support for Linux utilities and commands.
- The NSS kernel module is open source to meet the GPL (GNU Public License) requirements.
- If you add a kernel patch for a third-party module, application, or service, the NSS source code must be in the kernel code in order to be recompiled with the patch. Otherwise, an OES 2 Linux deployment using NSS would break.

Although the basic NSS code for Linux is delivered in the Linux kernel, it is not usable without OES 2 services on the Linux server. NSS is a unique file system that is tightly integrated with identity management. The `root` user is the only local user who can see NSS volumes on a Linux server. NSS needs Novell eDirectory to authenticate non-`root` users for connections to the volume. In addition, OES 2 Linux provides Linux User Management, NetWare Core Protocol (NCP) Server, and volume and user space management tools that make NSS volumes usable on a Linux server.

Updates for the `km_nss` module are delivered in major releases of SUSE Linux Enterprise Server and as patches for the Linux kernel in the Software Updater. You can also download patches for the `km_nss` module from the *Novell SUSE Patch Support Database* (PSDB) (http://support.novell.com/linux/psdb/bydate.html).

4 Upgrading the NSS Media Format

An enhanced Novell Storage Services (NSS) media format is available that provides improved support for hard links. After you install or upgrade your operating system to Novell Open Enterprise Server 2, you can decide whether to upgrade the media format for your NSS volumes to use the new metadata structure; some restrictions apply.

- Section 4.1, “Guidelines for Upgrading the Media Format of NSS Volumes,” on page 49
- Section 4.2, “Upgrading the Media Format for Existing NSS Volumes,” on page 51
- Section 4.3, “Upgrading the Media Format Automatically for New NSS Volumes,” on page 53

4.1 Guidelines for Upgrading the Media Format of NSS Volumes

Before upgrading the media format of your NSS volumes, make sure you understand the following guidelines:

- Section 4.1.1, “Cross-Platform Support for the NSS Media Upgrade,” on page 49
- Section 4.1.2, “Which NSS Volumes to Upgrade,” on page 50
- Section 4.1.3, “Before Upgrading the Media Format,” on page 50
- Section 4.1.4, “After Upgrading the Media Format,” on page 51
- Section 4.1.5, “If You Do Not Upgrade the Media Format,” on page 51

4.1.1 Cross-Platform Support for the NSS Media Upgrade

The NSS media upgrade for enhanced hard links support is available for the following operating platforms (and later versions):

- Novell Open Enterprise Server 2 Linux and NetWare
- Novell Open Enterprise Server 1 SP1 NetWare
- NetWare 6.5 SP4

If the NSS volume is used in a cluster with Novell Cluster Services, all nodes in the cluster must be upgraded to a supported platform before you upgrade the media format for any shared volumes. After you upgrade the media format on an NSS volume, it cannot be mounted on an unsupported platform.

4.1.2 Which NSS Volumes to Upgrade

With a few exceptions as noted below, it is highly recommended that you upgrade the NSS volume to the new metadata structure after you upgrade the operating system to a supported platform.

Do not upgrade the media format of the NSS volume to the new metadata structure if any of the following conditions exist:

- You have not yet verified that your system is performing as expected after upgrading the operating system, and you might need to roll back to an earlier release.
- You plan to migrate one or more devices containing the NSS volume to an unsupported platform.
- You need to share this volume with a mixed cluster with Novell Cluster Services where there are some unsupported platforms in the mix. The cluster software prevents the media upgrade unless all operating systems in the cluster support the new media format.

4.1.3 Before Upgrading the Media Format

- "Opportunity to Roll Back Before the Media Upgrade" on page 50
- "Hard Link Behavior without a Media Upgrade" on page 50
- "Clusters and the Media Upgrade" on page 50

Opportunity to Roll Back Before the Media Upgrade

When you upgrade the operating system, NSS does not automatically upgrade the media format to use the new metadata structure. This allows you to the opportunity to roll back to the previous release if necessary. Before you upgrade the media format of NSS volumes to the new data structure, make sure the server is performing as expected.

WARNING: After the media format is upgraded to the new metadata structure, you cannot roll back to a previous release.

Hard Link Behavior without a Media Upgrade

Until you upgrade the media format for enhanced hard link support, any existing hard links on the NSS volume are visible, and they can be opened, closed, read, and written. However, you cannot create new hard links, and you cannot rename or delete existing hard links. Attempts to do so are rejected with an appropriate error.

Clusters and the Media Upgrade

If you attempt to upgrade the media format for a shared NSS volume on a cluster with Novell Cluster Services, the upgrade is refused until all servers on the system are configured with a supported operating system. Make sure to upgrade all cluster nodes to a supported platform before attempting to upgrade the shared volume.

4.1.4 After Upgrading the Media Format

After you upgrade the volume to use the media format with enhanced hard links, the following constraints apply for its use:

- The Hard Links attribute must be enabled for the upgraded NSS volume before you can create hard links.

  When you upgrade the NSS volume to use the new media format, if any old-style hard links are detected, the Hard Links attribute is automatically enabled. Otherwise, the volume is upgraded, but the attribute is disabled and must be enabled before you can create hard links. For information, see Section 24.3, "Enabling or Disabling the Hard Links Attribute," on page 326.
- The upgraded NSS volume cannot be rolled back to use the old media format.
- You cannot roll back the operating system to a previous version.
- You cannot migrate a device containing the upgraded volume to a system with an unsupported operating system.
- Only nodes that have a supported operating system can be added to a cluster where shared volumes use the upgraded media format.

4.1.5 If You Do Not Upgrade the Media Format

If you do not upgrade the media format for an NSS volume, the volume's format uses the same metadata structure as is used on earlier releases. Any existing hard links on your system's NSS volumes are visible, and they can be opened, closed, read, and written. However, until you upgrade the NSS volume to the new structure, you cannot create new hard links, and you cannot rename or delete existing hard links. Attempts to do so are rejected with an appropriate error.

If the non-upgraded NSS volume is shared in a mixed cluster with Novell Cluster Services, hard links can be created, renamed, or deleted by first mounting the volume on a node in the cluster with an operating system that is compatible with the old media format.

It is possible to move devices that contain non-upgraded NSS volumes cross-platform to servers with operating systems compatible with the old media format. For information about moving media cross-platform, see Section 11.2, "Moving Non-Clustered Devices From NetWare 6.5 SP8 Servers to OES 2 Linux Servers," on page 130.

4.2 Upgrading the Media Format for Existing NSS Volumes

- Section 4.2.1, "Upgrading the Media Format," on page 51
- Section 4.2.2, "Enabling Hard Links After the Media Upgrade," on page 52

4.2.1 Upgrading the Media Format

The media format upgrade process runs in the background. The elapsed time for the upgrade process varies according to the number of storage objects in the volume; the more objects a volume contains, the longer it takes. Volumes with a large number of objects can take a substantial time to upgrade.

The commands in this section perform the one-time upgrade for currently active NSS volumes. A message is sent to the logger screen when the process is successfully completed.

Issue the commands at the server console on NetWare as the administrator user, or in the NSS Console (`nsscon`) in a Linux terminal console as the `root` user.

nss /ZLSSUpgradeCurrentVolumeMediaFormat=*volumename*

Upgrades the specified active volume. If it is a shared volume, the clustering system vetoes the upgrade until all nodes in the cluster are running a supported operating system.

nss /ZLSSUpgradeCurrentVolumeMediaFormat=all

Upgrades all currently active volumes. If a shared volume is encountered, the clustering system vetoes the upgrade until all nodes in the cluster are running a supported operating system.

nss /ZLSSUpgradeCurrentVolumeMediaFormat=all /include=shared

Upgrades all currently active volumes that are part of a shared pool, but only if the clustering system permits it.

nss /ZLSSUpgradeCurrentVolumeMediaFormat=all /include=local

Upgrades all currently active volumes that are not part of a shared pool.

nss /ZLSSUpgradeCurrentVolumeMediaFormat=all /include=local,shared

Upgrades all currently active volumes whether they are shared or local. If a shared volume is encountered, the clustering system vetoes the upgrade until all nodes in the cluster are running a supported operating system.

4.2.2 Enabling Hard Links After the Media Upgrade

After the media is upgraded successfully, you must set the Hard Links attribute on volumes where you want to create hard links. The Hard Links attribute is automatically enabled if there are existing hard links on the volume. For information about using hard links on NSS volumes, see Chapter 24, "Managing Hard Links," on page 321.

IMPORTANT: Do not attempt to enable the Hard Links attribute until the upgrade process is complete.

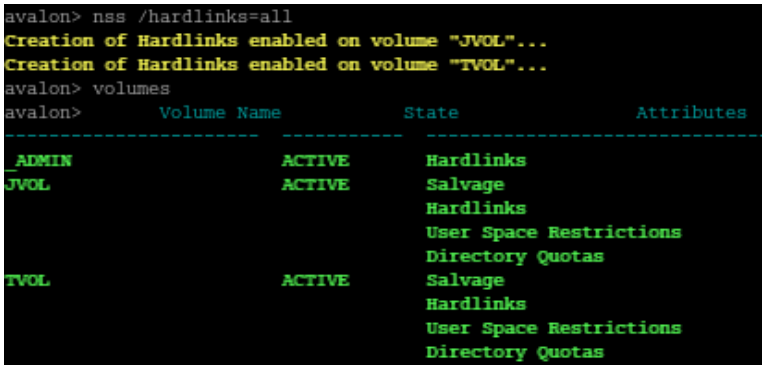
1 Issue the following commands at the server console on NetWare as the administrator user, or in the NSS Console (`nsscon`) in a Linux terminal console as the `root` user.

Command	Description
`nss /HardLinks=`*`volumename`*	Enables the Hard Links attribute for a specified volume. This enables hard links to be created on the volume.
`nss /HardLinks=all`	Enables the Hard Links attribute for all NSS volumes on the server. This enables hard links to be created on any volume on the server. Any given hard link can point only to a file on the same volume.

2 You can verify that the hard links attribute is set for the volume by entering the following command at the server console on NetWare, or at the NSS Console (nsscon) on Linux:

```
volumes
```

The Hard Links attribute appears in the Attributes column for volumes where it is enabled.



4.3 Upgrading the Media Format Automatically for New NSS Volumes

You can enable all future NSS volumes to be automatically created with the new media format. Make sure to use the commands on the servers where you plan to use hard links.

IMPORTANT: You must manually enable the Hard Links attribute on a volume before you are able to create hard links on it. For instructions, see Section 24.3, "Enabling or Disabling the Hard Links Attribute," on page 326.

Issue the following commands from the server console on NetWare, the NSS Console (`nsscon`) on Linux, or the `nssstart.cfg` file. If the command is issued from the command line, it persists until a server reboot. If the command is placed in the `nssstart.cfg` file, it persists across server reboots.

NOTE: Creates all new NSS volumes with the upgraded structure if the new volume is on a newly created pools (that is, pools created after enabling the `ZLSSUpgradeNewVolumeMediaFormat` flag).

---

nss /ZLSSUpgradeNewVolumeMediaFormat=all

Creates all new NSS volumes with the upgraded structure. This applies to volumes on both local and shared pools.

nss /ZLSSUpgradeNewVolumeMediaFormat=all /include=shared

Creates all new NSS volumes with the upgraded structure if the new volume is on a shared pool. However, the clustering system vetoes the upgrade until all nodes in the cluster are running a supported operating system.

nss /ZLSSUpgradeNewVolumeMediaFormat=all /include=local

Creates all new NSS volumes with the upgraded structure if the new volume is not on a shared pool.

nss /ZLSSUpgradeNewVolumeMediaFormat=all /include=local,shared

Creates all new NSS volumes with the upgraded structure whether the volume is local or shared. In a cluster, the clustering system vetoes the upgrade until all nodes in the cluster are running a supported operating system.

5 Planning NSS Storage Solutions

Consider what your storage needs are and how you can effectively manage and divide your storage space to best meet your needs. Use the information in this section to help plan your storage deployment by using the Novell Storage Services file system.

- Section 5.1, “Guidelines for NSS Storage,” on page 55
- Section 5.2, “Compatibility and Interoperability Issues for NSS,” on page 58
- Section 5.3, “Creating NSS Storage Objects in eDirectory,” on page 58
- Section 5.4, “Naming NSS Storage Objects,” on page 59
- Section 5.5, “Access Control for NSS on Linux,” on page 62
- Section 5.6, “File Access for Users,” on page 66
- Section 5.7, “Antivirus Support for NSS,” on page 69
- Section 5.8, “Backup Support for NSS,” on page 69
- Section 5.9, “NSS Support for Memory Mapped Files,” on page 69

5.1 Guidelines for NSS Storage

Use the guidelines in this section when planning your NSS storage solution:

- Section 5.1.1, “Devices,” on page 55
- Section 5.1.2, “Software RAID Devices,” on page 56
- Section 5.1.3, “Device Partitions,” on page 56
- Section 5.1.4, “NSS Pools and Volumes,” on page 56
- Section 5.1.5, “NSS Encrypted Volumes,” on page 57
- Section 5.1.6, “Storage Features,” on page 57

5.1.1 Devices

NSS recognizes devices up to 2 TB in size (where 1 TB = 2E40 bytes = 1,099,511,627,776 bytes). The restriction for NSS is the size that the device reports to the operating system. If you have physical, logical, or virtual devices larger than 2 TB in size, you must carve them into logical devices of less than 2 TB each by using the vendor-provided or other third-party disk-carving software. For more information, see Section 10.1.1, “Device Size Limit,” on page 115.

Storage devices can be local to the server, such as a system hard drive, or external to the server, such as with direct-attached storage or in a Fibre Channel or iSCSI storage area network (SAN). For information about common device types, see Section 10.1.2, “Device Types,” on page 116.

A local hard drive typically contains the operating system software and can optionally be used for applications and user data.

The Linux operating system is stored on the system device by using a Linux POSIX file system (such as Ext3). By default, the system device is managed by the Linux Volume Manager 2 (LVM2), but you can configure it to be managed by EVMS by modifying the default partitioning scheme at install time. For information, see " Installing with EVMS as the Volume Manager of the System Device " in the *OES 2 SP3: Installation Guide*.

NSS data pools and volumes are supported only on devices managed by EVMS.

If your system does not have sufficient power loss protection, we require using write-through cache management for SCSI devices to minimize the risk of losing data in the event of power failure. Write-Through cache management assures the file system that writes are being committed to disk as required. For information, see Section 10.10, "Enabling Write-Through Cache Management on SCSI Devices and RAID Controllers," on page 126.

Understanding how much free space you will need from each device helps you during the disk carving phase of the NSS configuration. For information about space availability, see Section 10.3, "Viewing a List of Devices on a Server," on page 119.

For Linux, only EVMS-managed devices show up in the NSSMU and the Storage plug-in to iManager. If you use LVM2 and EVMS to manage different devices on the server, EVMS might display free space on the LVM-managed devices that EVMS cannot actually manage. For information, see Section C.3, "Viewing Free Space Available to EVMS-Managed Devices," on page 455.

For additional information, see Section 10.1, "Understanding Devices," on page 115.

5.1.2 Software RAID Devices

NSS supports software RAIDs 0, 1, 5, 10, and 15. You can RAIDS 0, 1, and 5 in iManager or in NSSMU. RAIDs 10 and 15 can be created in NSSMU.

If you use hardware RAID devices, software RAID devices are unnecessary. You can use both hardware and software RAID devices on the same server.

To maximize the performance benefits of software RAID devices, partitions used for the RAID should come from different physical devices. For software RAID 1 devices, the mirrored partitions cannot share any disks in common.

For more information, see Section 13.1, "Understanding Software RAID Devices," on page 149 and Section 13.2, "Planning for a Software RAID Device," on page 151.

5.1.3 Device Partitions

NSS management tools automatically create and partitions for you on devices when you create and delete pools. For information, see Section 12.1, "Understanding Partitions," on page 141.

5.1.4 NSS Pools and Volumes

NSS is used for data storage on Linux. You can create NSS pools and volumes to store data on devices managed by EVMS. The operating system and applications are stored on Linux POSIX volumes.

For prerequisites for creating a pool, see Section 15.1, "Guidelines for Creating a Pool," on page 175.

When creating a pool, you can assign free space from multiple devices to create the maximum-sized pool of 8 TB. You can grow a pool dynamically by adding free space from the same device or different devices.

To mirror pools, each pool must use partitions from different devices; mirrored pools can have no devices in common.

Pools can contain multiple volumes, but a given volume belongs to only one pool.

Pools can be overbooked. If a pool contains multiple volumes, the cumulative administrative maximum sizes of all volumes can exceed the pool size by 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.

When creating a volume, assign it a fixed volume quota, or allow the volume to grow dynamically to the size of the pool. Any given volume's quota cannot exceed the size of the pool.

For guidelines for using volume attributes, see Section 18.1, "Understanding Volume Properties," on page 221.

For more guidelines for creating and managing NSS volumes, see Section 18.2, "Guidelines for NSS Volumes," on page 227.

5.1.5 NSS Encrypted Volumes

Encrypted Volume Support is available for data volumes. Create encrypted volumes only after you verify a successful system install or upgrade. For information, see "Understanding Encrypted Volume Support" on page 251.

5.1.6 Storage Features

Descriptions of the NSS storage features and guidelines for their use are located in sections that discuss the how to manage them. Table 5-1 identifies the features and provides links to the guidelines.

Table 5-1 *Guidelines for Using NSS Storage Features*

Storage Feature	Refer to
Pool snapshots	Section 17.1, "Understanding Pool Snapshots," on page 203 Section 17.2, "Guidelines for Using and Managing Pool Snapshots," on page 205 Section 7.1, "Cross-Platform Issues for NSS Pool Snapshots," on page 79
Compression	Section 21.1, "Understanding Compression," on page 275
Quotas	Section 22.1, "Understanding Space Quotas," on page 293
Salvage and purge	Section 23.1, "Understanding the NSS Salvage System," on page 309
Hard links	Section 24.1, "Understanding Hard Links," on page 321
Security	Chapter 20, "Securing Access to NSS Volumes, Directories, and Files," on page 259 Chapter 30, "Security Considerations," on page 375
Performance tuning	Chapter 27, "Tuning NSS Performance on Linux," on page 349

5.2 Compatibility and Interoperability Issues for NSS

Table 5-2 lists references for compatibility and interoperability issues for NSS.

Table 5-2 *Compatibility and Interoperability Issues for NSS*

Known Issues	Refer to
Virtualization environments	Chapter 6, "Using NSS in a Virtualization Environment," on page 71
Cross-platform issues	Chapter 7, "Cross-Platform Issues for NSS," on page 79
Clustering NSS pools and volumes	Chapter 8, "Cluster-Enabling Shared NSS Devices and Pools with Novell Cluster Services," on page 83

5.3 Creating NSS Storage Objects in eDirectory

When you use NSSMU or iManager to create an NSS pool or volume on a server, a Storage object is automatically created in Novell eDirectory. By default, the name of the Storage object is the server's name with an underscore and the object's name appended (for example, `myserver_sys`). A Storage object represents a logical or physical object on a server, whether it is a writable disk, a CD, or other storage medium.

IMPORTANT: An NSS volume must have a Storage object in eDirectory to be able to participate in Novell Distributed File Services.

For more information about Novell eDirectory, see "Object Classes and Properties" in the *Novell eDirectory 8.8 Administration Guide*.

5.4 Naming NSS Storage Objects

Storage object names must be unique on a server. If the server is part of a cluster, then all pools and volumes must have unique names across all servers in the cluster, whether they are in shared relationships or not.

- Section 5.4.1, "Case Insensitive Names," on page 59
- Section 5.4.2, "Number of Characters Allowed," on page 59
- Section 5.4.3, "Conventions for Valid Names of NSS Storage Objects," on page 60
- Section 5.4.4, "Other Naming Guidelines," on page 61

5.4.1 Case Insensitive Names

NSS storage object names are case insensitive. Names such as `AURORA`, `Aurora`, and `aurora` are the same. NSS saves pool and volume names in uppercase. NSS software RAID device names and labels are case sensitive. For example, if you enter `MyRaid` as the name, it is saved as `MyRaid` only.

IMPORTANT: Because Linux treats filenames as case sensitive, when using NSS volumes on Linux, make sure to mount the volume with the Long name space (ns=long) option so that file queries are case insensitive. For information, see Section 18.11, "Mounting NSS Volumes with Linux Commands," on page 237.

5.4.2 Number of Characters Allowed

For the NSS file system, the maximum length supported for a filename (the name and file extension) is 255 16-bit Unicode characters. The maximum length supported for the full path name (which includes the volume name, directories, filename, extension, and delimiters in the path) is 1023 16-bit Unicode characters. However, different tools, applications, and file systems place different limits on

filenames and path lengths, some of which can be more or less restrictive than these limits. While it is possible to create a full path that is longer than 1023 characters, most tools will have difficulty dealing with it.

Use the guidelines in Table 5-3 to determine the length requirements for names of NSS Storage objects.

Table 5-3 *Storage Object Name and Password Length*

NSS Storage Object	Minimum Number of Characters (16-bit Unicode Characters)	Maximum Number of Characters (16-bit Unicode Characters)
Device name for a physical or logical device	2	15
Device name for a software RAID 0 and RAID 5	1	128 (iManager) 15 (NSSMU) Longer names are truncated.
Device name for a software RAID 1, RAID 0+1, and RAID 5+1 **NOTE**: RAIDs 0+1 and 5+1 can be created only from NSSMU.	1	80 (iManager) 15 (NSSMU) Longer names are truncated.
Partition label	2	128
Pool name	2	15
Volume name	2	15
Encryption password for encrypted NSS volumes. Use standard ASCII characters	2 (a minimum of 6 is recommended)	16
Pathnames for files, including the server name, volume name, path delineators (such as colons, slashes, and dots), directory names, filename, and file extension	1	255

5.4.3 Conventions for Valid Names of NSS Storage Objects

Valid device, pool, and volume object names conform to the following naming conventions. We recommend that you also consider the character conventions for the software RAID names in order to have consistent naming policies on your system.

- Use only valid characters:

  ```
  ABCDEFGHIJKLMNOPQRSTUVWXYZ0123456789_!@#$%&()
  ```

  IMPORTANT: Special characters (non-alphanumeric) can create confusion or problems for some configuration files, command line utilities, applications, and scripts. For example, the ampersand (&), at (@), dollar sign ($), exclamation point (!), percent (%), and number sign (#) characters should be avoided for this reason. For more information, see Section 5.4.4, “Other Naming Guidelines,” on page 61

- Do not use spaces in the object name.

- Do not begin or end the object name with an underscore (_).
- Do not use multiple contiguous underscores (__) anywhere in the object name.

IMPORTANT: Novell Cluster services supports only alphanumeric characters and the underscore character in cluster resource names. Special characters (!@#$%&())are not supported. Because the pool name is automatically used in the pool cluster resource name, do not use special characters in pool names for pools that you plan to cluster enable.

5.4.4 Other Naming Guidelines

- In general, we recommend that you avoid using reserved names or words as names of Storage objects in order to avoid confusion.

  For example, the following case-insensitive names are reserved names:

  ALL
  AUX
  CLOCK
  COM1
  COM2
  COM3
  COM4
  CON
  LPT1
  LPT2
  LPT3
  NETQ
  NUL
  PIPE
  PRN

- Some characters on Linux, such as the ampersand (&), dollar sign ($), exclamation point (!), and number sign (#) characters, can cause problems in some configuration files, command line utilities, applications, and scripts. You might need to use different techniques in each case to make the name be accepted in the manner intended. Refer to the documentation for the specific consumer application or utility to find how to treat names that contain special characters in that environment.

  To avoid this extra effort, we recommend that you avoid using special characters in names of Storage objects.

- Because the "at sign" (@) character (also called "the at symbol") is an element of electronic mail addresses, such as `code@engineer.com`, it might cause confusion and possible problems in a Storage object name. A Web browser or other application could mistake it for an e-mail address.

  We recommend that you do not use the `@` character in Storage object names.

- The percent character (%) might cause problems if it is passed in a format string to an application routine that uses it to delineate parameters. For example, if a volume name that contains the percent character, such as `store%sales`, is passed to an `(s)printf` routine, the `(s)printf` routine might look for parameters that are not there and crash.

  We recommend that you do not use the percent character in Storage object names.

- If spaces are used in User or Group object names, you must enclose the object name in double quotation marks (") in order for it to be recognized in command line utilities, scripts, and applications.
- If special characters are used in User or Group object names and passwords, you might need to use different escape techniques in command line utilities (such as Bash on Linux) to make the name be accepted in the manner intended. Refer to the documentation for the specific command line utility to find how to escape special characters in that environment.

  For example, enclosing the name in double quotation marks and preceding the character with a backslash are common techniques for escaping special characters when parsing command lines.

  To avoid this extra effort, we recommend that you avoid using special characters in names of User and Group objects and in passwords.

5.5 Access Control for NSS on Linux

This section describes how Novell eDirectory, NCP (NetWare Core Protocol) Server, and Linux User Management (LUM) work with Novell Storage Services to provide access to NSS volumes on OES 2 Linux servers.

- Section 5.5.1, "Administrator User and Root User Roles for NSS," on page 62
- Section 5.5.2, "NSS File System Users," on page 64
- Section 5.5.3, "Novell Trustee Model," on page 65
- Section 5.5.4, "POSIX Permissions," on page 65
- Section 5.5.5, "How NSS Uses Novell Linux User Management," on page 65

5.5.1 Administrator User and Root User Roles for NSS

The Administrator user and the Linux `root` user are two very different concepts. It is important to understand the role of each in managing your NSS volume on OES 2 Linux servers.

- "Administrator User" on page 62
- "Root User" on page 63

Administrator User

The Administrator user is an eDirectory user who is given all file system trustee rights for the server, including the Supervisor right. The Administrator user account, or the Administrator equivalent user account, is given the following privileges:

- The user identity and credentials are defined in eDirectory.
- The user is assigned as a trustee of the NSS volume and given all file system trustee rights for that volume. You can also create a group for administrators with equivalent rights, and assign the user to that group.
- The username must be Linux-enabled with Linux User Management (LUM), which gives the user both an eDirectory GUID and a POSIX UID on the server.

NOTE: You might see the user with the same eDirectory GUID even after LUM disabling the user. This is because NCP server clears its cache periodically at the interval of 30 minutes.

During this time do not restart edirectory. Run `nsscon /ResetIDCache` after 30 minutes. For more information on ID Cache Commands, see Section A.5.3, "ID Cache Commands," on page 392.

- The user belongs to the Administrator group for the server that is Linux-enabled with LUM.

The Administrator user who installs NSS on OES 2 Linux is automatically given these privileges. Any other administrator, including the Tree Administrator user, who you want to be able to manage the NSS storage must be manually configured with the same privileges.

IMPORTANT: The Tree Administrator user is not automatically granted permissions to OES Linux servers installed in the tree.

For more information about Linux-enabled eDirectory users, see Section 5.5.2, "NSS File System Users," on page 64.

For a Linux server, the administrator logs in to iManager as the Administrator user (or Administrator equivalent user) to manage the NSS volume on Linux. The Administrator user can also use the iManager Files and Folders plug-in, NetStorage, and the Novell Client to manage file system trustee assignments, trustee rights, inherited rights masks, and file and directory attributes. These tools can also be used to purge and salvage files for volumes where the Salvage attribute is enabled.

Root User

The `root` user is a local Linux user who is the all-powerful connection when running on the Linux server. The `root` user is hardcoded internally in NSS to have all access rights to all files. In this way, the `root` user on Linux is similar to the Link Connection 0 user on NetWare.

The `root` user is not defined as a user in eDirectory, and the `root` user is not Linux-enabled with LUM. This allows you to log in to the server as the `root` user when eDirectory services are not available. The `root` user is the only local Linux user who is allowed to access NSS via the VFS layer without having an eDirectory GUID.

The `root` user logs in directly to the server to use NSS utilities (such as nsscon, nssmu, rights, attrib, metamig, ravsui, and raview) from the terminal console and to issue NSS command line commands from the NSS Console (NSSCON). The `root` user can also execute applicable Linux commands and utilities.

When accessing an NSS volume from the Linux environment, the `root` user observes some information differently, depending on whether the eDirectory user is Linux-enabled or not. Any native Linux commands that run from a terminal console on the NSS volume, such as the `ls` command, are sent via the VFS layer. If the users are not Linux-enabled, instead of seeing the local UID of the eDirectory user who owns the file, the `root` user sees all files as belonging to either the Nobody user (if it exists) or the `root` user.

IMPORTANT: NSS reports the Nobody UID or the `root` user UID for display purposes only; it does not change the true file ownership information stored as the user's eDirectory GUID in the metadata of the file system.

5.5.2 NSS File System Users

In addition to the `root` user and Administrator user, file system users fall into three categories:

- "eDirectory Users" on page 64
- "Linux-Enabled eDirectory Users" on page 64
- "Local Linux Users" on page 65

eDirectory Users

NSS uses the eDirectory GUID of a user to control access by using the Novell Trustee model. Users of the NSS volume and the Administrator user (or Administrator equivalent user) who manages the volume must be defined as users in Novell eDirectory. For information about managing users with eDirectory, see the *Novell eDirectory 8.8 Administration Guide*.

To grant access to eDirectory users, you must assign them to be trustees in the file system, grant them file system trustee rights, and set inherited rights filters. For more information about configuring trustees for NSS on Linux, see Section 20.1, "Configuring File System Trustees, Trustee Rights, Inherited Rights Filters, and Attributes," on page 259.

Linux-Enabled eDirectory Users

Linux-enabled eDirectory users are users who are defined in eDirectory, granted file system trustee rights to the NSS volume, and Linux-enabled with Linux User Management. Linux-enabled eDirectory users have both a POSIX UID and an eDirectory GUID. You must Linux-enable users who need to access NSS volumes via Samba, NFS, third-party AFP solutions, or who need to use Linux utilities, commands, or services. NetStorage for Linux requires that users be Linux-enabled if NetStorage is configured to use OpenSSH for user access.

WARNING: When creating a LUM (Linux-Enabled eDirectory User) user consider the following:

- Do not assign the same UID as any local Linux users and the vice versa.
- Ensure that LUM user names do not conflict with any of the local Linux users name.

Assigning conflicting or duplicate UID's or LUM user names result in NSS access violations.

IMPORTANT: A Linux service or utility must also be enabled for LUM in order for users to access the file system with it.

For OES 2 Linux and later, it is no longer necessary to Linux-enable the users with LUM in order for user quotas (space restrictions) to be enforced. NCP Server for Linux has been modified to provide the GUID information that NSS needs for file ownership. NSS uses file ownership information to enforce user space restrictions based on a user's eDirectory username.

Users who create hard links must be Linux-enabled in order to use the `ln` command on the server. It is not necessary to Linux-enable users if they are only consumers of the hard link.

Beginning in OES 2 SP2 Linux, if users are Linux-enabled with LUM or not, the file creator, modifier, and deleter fields are recorded with the username of the user who performs the action. In prior releases of OES 2, the deleter field is recorded as the `root` user or Nobody user (if it exists) if the user is not LUM enabled.

NOTE: In OES 1 Linux, the modifier field and deleter field are reported as the `root` user or Nobody user for non-LUM-enabled users.

For information about installing and configuring Linux User Management and enabling users and groups for Linux, see the *OES 2 SP3: Novell Linux User Management Administration Guide*.

Local Linux Users

Local Linux users are users who are defined locally for the Linux server. The `root` user is the only local Linux user who can see and access the NSS volume.

5.5.3 Novell Trustee Model

NSS controls access to data based on the Novell Trustee model, which uses file system trustee assignments, trustee rights, and inherited rights filters to control file access. The trustee model depends on the secure directory services provided by eDirectory to manage the file system users. For example, eDirectory users must be authenticated by eDirectory to connect to the server, and NSS uses the effective file system rights of the user to control access to specific files or directories.

For information about the Novell Trustee model, see " Understanding File System Access Control Using Trustees " in the *OES 2 SP3: File Systems Management Guide*.

5.5.4 POSIX Permissions

For NSS volumes on Linux, the POSIX directory and file permissions are not used to determine access permission. Access control is based on the Novell trustee model and not on the POSIX permissions or access control lists (ACLs). NSS uses the POSIX permission fields to display Read Only, Read/Write, Execute, and Hidden attributes for directories and files. NSS does not use the Group ID field. Group ids associated with POSIX have no effect on files stored on NSS.

NSS does not allow the Linux system to set typical access control permissions in the POSIX fields. It interprets Linux `chmod` commands to apply the values as NSS directory and file attributes, according to the way NSS maps them to the User, Group, and Other permission fields.

By default, NSS sets the POSIX permissions fields for directories to 0777 (`drwxrwxrwx`). Some Linux services specify permissions needed to use the service. NSS provides the `nss /PosixPermissionMask=`*`mask`* option that allows you to change the default POSIX permissions, such as for the Group or Other fields.

For example, SSH requires that the POSIX permissions on home directories be set so that the Other field has no permissions. When you use NSS volumes as home directories, you must change the permission to 0770 on the home directories. You can use the `nss /PosixPermissionMask=0770` command in the NSS Console (`nsscon`) to modify the permissions.

For information and examples of how to interpret POSIX settings on your NSS volume on Linux, see "Viewing Key NSS Directory and File Attributes as Linux POSIX Permissions" in the *OES 2 SP3: File Systems Management Guide*.

5.5.5 How NSS Uses Novell Linux User Management

Novell Linux User Management is a directory-enabled application that simplifies and unifies the management of user profiles on Linux-based platforms.

IMPORTANT: LUM is not required for access via NCP, Novell AFP, and Novell CIFS.

Linux-enabled eDirectory users have both UIDs as local Linux users and GUIDs as eDirectory users. NSS needs the UID to execute protocols and services that communicate to NSS through the VFS layer only. NSS uses the GUID to enforce access to the files and directories based on the Novell Trustee model, which uses file system trustee assignments, trustee rights, and inherited rights filters.

With Linux protocols and services, the UID is passed to NSS via the VFS layer. There is no back-end XML call to exchange GUID information as there is with the NCP interface. NSS uses a LUM API to translate the UID to a GUID, and then caches the result for fast mapping on subsequent access by the same UID. With the GUID-UID mapping, NSS finds the GUID for the user who issues the command, then executes the command. Without LUM, NSS cannot identify a GUID for the UID it receives, and rejects the command with an error.

For information about installing and configuring LUM, enabling Linux services and utilities, and enabling users and groups for Linux, see the *OES 2 SP3: Novell Linux User Management Administration Guide*.

5.6 File Access for Users

NSS supports access via NCP and other protocols to eDirectory users and Linux-enabled eDirectory users.

IMPORTANT: NSS uses the Novell trustee model for file access. Users must be made file system trustees and granted trustee rights to data on the NSS volume that you want them to be able to access. Rights management can be done in multiple management tools, including iManager, Novell Remote Manager, the Novell Client and other NCP services, and command line commands. For information, see Section 20.1, “Configuring File System Trustees, Trustee Rights, Inherited Rights Filters, and Attributes,” on page 259.

- Section 5.6.1, “NCP,” on page 66
- Section 5.6.2, “Novell AFP,” on page 67
- Section 5.6.3, “Novell CIFS,” on page 67
- Section 5.6.4, “Novell Domain Services for Windows,” on page 67
- Section 5.6.5, “Samba,” on page 68
- Section 5.6.6, “SSH (Secure Shell),” on page 68
- Section 5.6.7, “Accessing Files with Linux Services, Utilities, and Protocols,” on page 68

5.6.1 NCP

NCP (NetWare Core Protocol) is the default protocol for accessing data on NSS volumes. NCP Server is required for NSS even if users access the volume via other protocols. Users access data on NSS volumes by using the Novell Client software on their Windows, Vista, or Linux workstations. This document refers collectively to those workstations as “Novell clients”.

IMPORTANT: NSS uses NCP Server by default and requires that NCP Server be running even if your users are accessing the volume via other protocols.

NCP Server for Linux is installed by selecting *NCP Server and Dynamic Storage Technology* from the *OES Services* menu in the YaST installation interface. For information about NCP Server for Linux, see the *OES 2 SP3: NCP Server for Linux Administration Guide*.

NCP Server works with Novell eDirectory, the Novell Client, and other NCP-based services such as NetStorage to authenticate and manage user sessions. When NCP Server is running, eDirectory users who have been granted file system trustee access can access an NSS volume with the Novell Client or NCP services. NSS cooperates with NCP Server to track file ownership and file system trustee assignments, trustee rights, and inherited rights based on the Novell trustee model.

The Linux file system interface uses UTF-8 encoding for all filenames. When accessing files with NCP, make sure to use the UTF-8 enabled NCP software that is available in the latest Novell Client.

If you are converting NSS volumes from NetWare to Linux, make sure you have resolved any UTF-8 problems before moving the volume to Linux. For information, see *Supporting Mixed Language Environments with Novell NetWare* (TID 10097059) (http://support.novell.com/docs/Tids/Solutions/10097059.html) in the Novell Support Knowledgebase.

For information about configuring and managing NCP Server, see the *OES 2 SP3: NCP Server for Linux Administration Guide*.

5.6.2 Novell AFP

NSS supports access to NSS volumes using the Novell AFP (Apple Filing Protocol). For OES 2 SP1 Linux and later, Novell AFP for Linux is installed by selecting *Novell AFP* from the OES Services menu in the YaST install interface.

For information about Novell AFP for Linux, see the *OES 2 SP3: Novell AFP For Linux Administration Guide*.

5.6.3 Novell CIFS

NSS supports access to NSS volumes using Novell CIFS. For OES 2 SP1 Linux and later, Novell CIFS for Linux is installed by selecting *Novell CIFS* from the OES Services menu in the YaST install interface.

For information about Novell CIFS for Linux, see the *OES 2 SP3: Novell CIFS for Linux Administration Guide*.

5.6.4 Novell Domain Services for Windows

NSS supports access to NSS volumes using Novell Domain Services for Windows (DSfW). DSfW configures Samba access for Samba/CIFS users. Administrators must export NSS volumes over Samba so that domain users (eDirectory users in the DSfW domain partition) can access NSS volumes over Samba/CIFS.

Samba/CIFS users under the domain are Linux-enabled with Linux User Management. The Domain Users group must be associated with the UNIX Workstation objects of the server (or servers if the volume is used in a cluster) where the volume is mounted in order to give the users access to the NSS volume via Samba/CIFS.

5.6.5 Samba

Because NSS controls access based on file system trustee rights, not by the POSIX permissions, Samba connections do not work until this trustee system has been configured for the Linux-enabled eDirectory users of the NSS file system. You cannot set up the ACLs and standard POSIX permissions for Samba access to an NSS volume. Instead, the Administrator user or Administrator user equivalent must set up users in eDirectory and make file system trustee assignments, grant trustee rights, and configure inherited rights masks on directories. The Samba service must also be enabled in LUM.

For information about configuring and managing Samba services for your OES 2 Linux server, see the *OES2 SP3: Samba Administration Guide*.

5.6.6 SSH (Secure Shell)

You can give users SSH (Secure Shell) access to NSS volumes by Linux-enabling users and the SSH utility in Linux User Management. For information, see the *OES 2 SP3: Novell Linux User Management Administration Guide*.

In addition, SSH requires that the POSIX permissions on home directories be set so that the Other field has no permissions. By default, NSS sets the POSIX permissions to 0777 and SSH is disabled in Linux User Management. If you use NSS volumes for home directories and you want users to have SSH access to them, you must modify the POSIX permissions on NSS volumes to 0770. You must also enable SSH with Linux User Management.

Add the following command in the `/etc/opt/novell/nss/nssstart.cfg` file to turn off all of the bits corresponding to the Other field:

```
/PosixPermissionMask=0770
```

The setting applies to all NSS volumes on the server. If the volume is shared in a cluster, make sure to add the command to the `nssstart.cfg` file on all nodes and to Linux-enable SSH on all nodes.

5.6.7 Accessing Files with Linux Services, Utilities, and Protocols

Only the `root` user and Linux-enabled eDirectory users who have been granted trustee access can see and access the NSS volume from a Linux interface. Users must be Linux-enabled with Linux User Management in order to use any of the standard Linux protocols, utilities, commands, services, or APIs for the NSS volume.

IMPORTANT: Any Linux service or utility that you want users to have access to must also be enabled in Linux User Management.

For information about installing and configuring Linux User Management, enabling users and groups for Linux, and enabling Linux services and utilities, see the *OES 2 SP3: Novell Linux User Management Administration Guide*.

5.7 Antivirus Support for NSS

For information about antivirus issues for NSS on Linux, see *Providing Anti-Virus Support for NSS on Linux* (http://developer.novell.com/wiki/index.php/Providing_Anti-Virus_Support_for_NSS_on_Linux).

For a current list of antivirus software vendors that support Novell Open Enterprise Server, see *Novell Open Enterprise Server Partner Support: Backup and Antivirus Support* (http://www.novell.com/products/openenterpriseserver/partners_communities.html). This list is updated quarterly.

The Apple Filing Protocol (AFP) support for NSS files on OES 2 SP1 Linux onwards is implemented via a technology that bypasses the real-time scanning employed by most OES 2 antivirus solutions. NSS files shared through an AFP connection might be protected by on-demand scanning on the OES 2 server or by real-time and on-demand scanning on the Apple client.

5.8 Backup Support for NSS

For information about OES 2 backup support for NSS, see Chapter 26, "Managing Backup and Restore for Data and Trustee Information," on page 345.

For a current list of backup software vendors that support Novell Open Enterprise Server, see *Novell Open Enterprise Server Partner Support: Backup and Antivirus Support* (http://www.novell.com/products/openenterpriseserver/partners_communities.html). This list is updated quarterly.

5.9 NSS Support for Memory Mapped Files

NSS has limited support for memory mapped files, primarily to support loading programs. NSS does not fully support memory mapped files especially if the application uses sparse files.

For example, the CopyCat application used by Netatalk uses sparse files for its database. Netatalk tries to create a CopyCat database as a sparse file called `.AppleDB` in the root of the volume by using memory mapped IO. This can cause the server to hang if you are using an NSS volume as the Netatalk share because of the limited support in NSS for this combination.

6 Using NSS in a Virtualization Environment

Use the information in this section to help you deploy Novell Storage Services file system and services in a virtualization environment.

For information about Xen virtualization, see *Virtualization with Xen* (http://www.novell.com/documentation/sles10/book_virtualization_xen/data/book_virtualization_xen.html).

- Section 6.1, “Guidelines for Using NSS in a Xen Virtualization Environment,” on page 71
- Section 6.2, “Installing OES 2 Linux on a Virtual Machine,” on page 75
- Section 6.3, “Initializing New Virtual Disks on the Guest Server,” on page 76
- Section 6.4, “What’s Next,” on page 77

6.1 Guidelines for Using NSS in a Xen Virtualization Environment

Consider the following guidelines when planning to use NSS in a virtualization environment:

- Section 6.1.1, “Host Server Issues,” on page 71
- Section 6.1.2, “Virtual Machine Issues,” on page 73
- Section 6.1.3, “Guest Server Issues,” on page 75

6.1.1 Host Server Issues

- “Running NSS on the Host Server Is Not Supported” on page 71
- “Using RAIDs” on page 72
- “Using Multipath Devices” on page 72

Running NSS on the Host Server Is Not Supported

NSS pools and volumes are not supported on the Xen host server in a Xen virtualization environment. You can install NSS on the guest servers from inside the guest server environment, just as you would if the guest servers were physical servers.

When you create a virtual machine, you must assign devices to it. If you plan to use the virtualization guest server as a node in a cluster and you need to be able to fail over cluster resources to different physical servers, you must assign SAN-based physical devices to the virtual machine. You create the NSS pools and volumes from within the guest server.

If you install Novell Cluster Services in the host server environment, the cluster resources use shared Linux POSIX volumes, and do not use shared NSS pools.

If you install Novell Cluster Services in the guest server environment, the guest server is a node in the cluster. The disk sharing is managed by Novell Cluster Services from within the guest server environment. You can use shared NSS pools as cluster resources that run on the guest server and on other nodes in that cluster.

For information about deployment scenarios using shared NSS pools in clusters in a virtualization environment, see "Configuring Novell Cluster Services in a Xen Virtualization Environment" in the *OES 2 SP3: Novell Cluster Services 1.8.8 Administration Guide for Linux*.

Using RAIDs

In a Xen virtualization environment, if you need to use RAIDs for device fault tolerance in a high-availability solution, we recommend that you use standard hardware RAID controllers. Hardware RAIDs provide better performance over using software RAIDs on the virtualization host server or guest server.

To get the best performance from a software RAID, create a RAID device on the Xen host and present that device to the guest VM. Each of the RAID's segments must be on different physical devices. It is best to present the entire physical RAID device or a physical partition of the RAID device to the guest VM, and to not present just a file-backed virtual device.

NSS is not supported to run in the virtualization host server environment, so NSS software RAIDs cannot be used there. Xen supports using Linux `mdadm` for software RAIDs on the host server.

If you attempt to create and manage a software RAID on the guest server in a production environment, make sure to present different physical devices to the guest VM that you want to use for the software RAID. Using segments from virtual devices that actually reside on the same physical device on the host server slows performance and provides no protection against failed hardware devices. The maximum number of disks that can be presented to the VM is 16 (`xvda` to `xvdp`). Xen provides a mechanism to dynamically add and remove drives from a VM.

Using NSS software RAIDs in a virtualization guest server environment has not been tested.

Using Multipath Devices

If it is available, use your storage vendor's multipath I/O management solution for the storage subsystem. In this case, the multiple paths are resolved as a single device that you can assign to a virtual machine.

Do not use multipath management tools in the guest environment.

If a storage device has multiple connection paths between the device and the host server that are not otherwise managed by third-party software, use Linux multipathing to resolve the paths into a single multipath device. When assigning the device to a VM, select the device by its multipath device node name (`/dev/mapper/mpathN`). The guest server operating system is not aware of the underlying multipath management being done on the host. The device appears to the guest server as any other physical block storage device. For information, see "Managing Multipath I/O for Devices" in the *SLES 10 SP3: Storage Administration Guide*.

6.1.2 Virtual Machine Issues

- "Assigning Physical Disks or Disk Partitions to the Virtual Machine" on page 73
- "Assigning File-Backed Disk Images for Virtual Devices" on page 73
- "Configuring I/O Scheduler for OES2 NSS on XEN Virtual Machine" on page 73

Assigning Physical Disks or Disk Partitions to the Virtual Machine

For the best performance on a Xen guest server, NSS pools and volumes should be created on block storage devices that are local SCSI devices, Fibre Channel devices, iSCSI devices, or partitions on those types of devices.

SATA or IDE disks have slower performance because special handling is required when working through the Xen driver to ensure that data writes are committed to the disk in the order intended before it reports back.

Assigning File-Backed Disk Images for Virtual Devices

Novell supports file-backed disk images on virtual machines, but does not recommend using them for important data because the volume can become corrupt after a power failure or other catastrophic failure. For example, file-backed volumes might be useful for training and sales demonstrations.

WARNING: Data corruption can occur if you use Xen file-backed disk images for NSS volumes on the guest server in the event of a power failure or other catastrophic failure.

Configuring I/O Scheduler for OES2 NSS on XEN Virtual Machine

OES 2 Linux kernel has four I/O schedulers available to choose from for custom configuration. They each offer a different combination of optimizations. The four Types of Linux I/O Schedulers are the following:

- NOOP Scheduler
- Deadline Scheduler
- Anticipatory Scheduler
- Completely Fair Queuing (CFQ) Scheduler

The NOOP scheduler is the simplest of all the I/O schedulers. It merges requests to improve throughput, but otherwise attempts no other performance optimization. All requests go into a single unprioritized first-in, first-out queue for execution. It is ideal for storage environments with extensive caching, and those with alternate scheduling mechanisms—a storage area network with multipath access through a switched interconnect, for instance, or virtual machines, where the hyperviser provides I/O backend. It's also a good choice for systems with solid-state storage, where there is no mechanical latency to be managed.

The Deadline scheduler applies a service deadline to each incoming request. This sets a cap on per-request latency and ensures good disk throughput. Service queues are prioritized by deadline expiration, making this a good choice for real-time applications, databases and other disk-intensive applications.

The Anticipatory scheduler does exactly as its name implies. It anticipates that a completed I/O request will be followed by additional requests for adjacent blocks. After completing a read or write, it waits a few milliseconds for subsequent nearby requests before moving on to the next queue item. Service queues are prioritized for proximity, following a strategy that can maximize disk throughput at the risk of a slight increase in latency.

The *Completely Fair Queuing (CFQ) scheduler* provides a good compromise between throughput and latency by treating all competing processes even-handedly. Each process is given a separate request queue and a dedicated time slice of disk access. CFQ provides the minimal worst-case latency on most reads and writes, making it suitable for a wide range of applications, particularly multi-user systems.

For OES 2 on XEN guest, the default is NOOP scheduler. To improve the I/O scheduler performance, change the default NOOP scheduler to CFQ. Perform the following steps to view and change the I/O scheduler after the OES 2 installation:

To view the current scheduler execute the following command:

```
cat /sys/block/{DEVICE-NAME}/queue/scheduler
```

To change the scheduler to CFQ execute the following command:

```
echo cfq > /sys/block/{DEVICE-NAME}/queue/scheduler
```

For example, your device name is sda. To view the scheduler enter the following command:

```
cat /sys/block/sda/queue/scheduler
```

and the output received is the following:

```
[noop] anticipatory deadline cfq
```

To change the current NOOP scheduler to CFQ, execute the following command:

```
echo cfq > /sys/block/sda/queue/scheduler
```

The optimization in OES 2 can also be achieved during the boot time at a global level. To achieve that, perform the following:

Add the elevator option to your kernel command in the GRUB boot loader configuration file (`/boot/grub/menu.lst`) and then reboot. For example,

```
kernel /vmlinuz-2.6.16.60-0.46.6-smp

root=/dev/disk/by-id/scsi-SATA_WDC_WD2500YS-23_WD-WCANY4424963-part3 vga=0x317

resume=/dev/sda2 splash=silent showopts elevator=cfq
```

or

Using YaST2, edit the optional kernel command line parameter under *System* > *Boot Loader* for the booting kernel image or any other kernel image listed and add `elevator=cfq`. For more information on editing and using the boot loader configuration, see Configuring the Boot Loader with YaST (http://www.novell.com/documentation/sles10/book_sle_reference/?page=/documentation/sles10/book_sle_reference/data/sec_boot_yast2_config.html).

6.1.3 Guest Server Issues

Consider the issues in this section for the OES 2 Linux server running in the Xen host environment:

- "Initializing Virtual Disks" on page 75
- "NSS Features that Are Not Supported in a Virtualization Environment" on page 75

Initializing Virtual Disks

The primary virtual disk (the first disk you assign to the virtual machine) is automatically recognized when you install the guest operating system. The other virtual devices must be initialized before any space is shown as available for creating a pool. Without initializing the devices, no space is shown as available for pool creation. For information, see Section 6.3, "Initializing New Virtual Disks on the Guest Server," on page 76.

NSS Features that Are Not Supported in a Virtualization Environment

Some NSS features are not supported in a Xen guest server environment.

Table 6-1 *NSS Feature Support in a Guest Server Environment*

NSS Feature	NSS on Linux
Data shredding	Not supported
Multipath I/O	Not applicable; not supported on Linux
Software RAIDs	Not tested

6.2 Installing OES 2 Linux on a Virtual Machine

When you install OES 2 Linux on a virtual machine, we recommend that you configure a virtual machine with multiple devices. Use the primary disk on the guest server as the system device with LVM2 (the YaST install default) as the volume manager. After the install, assign additional storage resources from the host to the virtual machine. The additional disks can use LVM2 or EVMS as needed. In this scenario, NSS volumes are created only on the data disks for the guest server, not on the system disk that you are using for the guest server's system device.

IMPORTANT: When you create the virtual machine, make sure to configure the size of the primary virtual disk according to the amount of space you need for the boot (`/boot`), `swap`, and root (`/`) volumes.

If you decide to use EVMS for the system device on the virtual machine, follow the install instructions in "Installing with EVMS as the Volume Manager of the System Device" in the *OES 2 SP3: Installation Guide*.

For information about creating a Xen virtual machine, see *SUSE Linux Enterprise Server 10 SP2: Virtualization with Xen (http://www.novell.com/documentation/sles10/xen_admin/data/bookinfo.html)*.

6.3 Initializing New Virtual Disks on the Guest Server

A new virtual disk can appear as an unformatted disk to the guest server if it does not have a partition table associated with it. You must initialize the device on the guest server just as you do for a blanked-out device on a physical server.

The primary virtual disk (the first disk you assign to the virtual machine) is automatically recognized when you install the guest operating system. After the install, use NSS tools to initialize additional blanked-out virtual devices where you plan to create NSS pools and volumes. On Linux, the NSS initialize function makes EVMS the volume manager of the device, and adds a NetWare Segment Manager.

You can initialize the disk by using the *Initialize Disk* function in NSSMU or in the Storage plug-in to iManager. For general instructions for initializing disks, see Section 10.6, "Initializing a Disk," on page 122.

To initialize devices for the guest server:

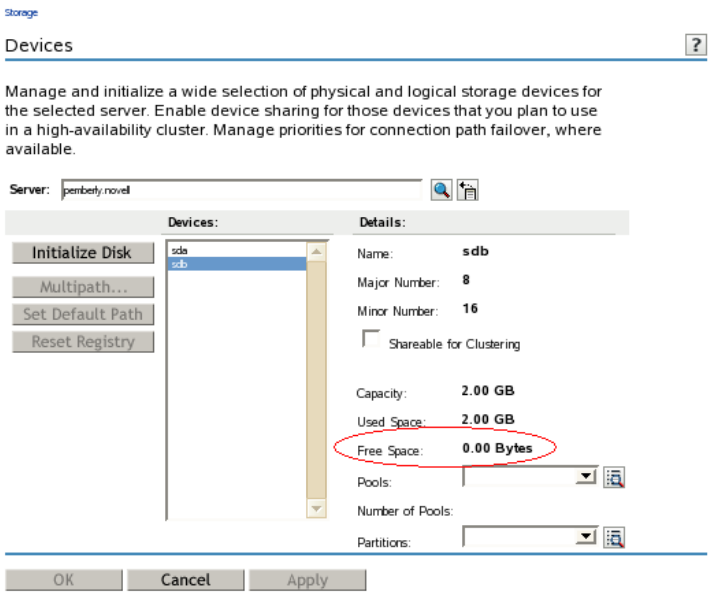
1. On the host, use the virtualization management tool to create and allocate virtual devices for the virtual machine.

   For information, see *SUSE Linux Enterprise Server 10 SP2: Virtualization with Xen (http://www.novell.com/documentation/sles10/xen_admin/data/bookinfo.html)*.
2. If the guest server is not running, boot the guest server now.
3. In iManager, click *Storage* > *Devices*.
4. Browse to locate and select the guest server to view a list of its devices.

   The virtual server has a Server object in the Novell eDirectory database, just like a physical server.
5. In the *Devices* list, select the newly added virtual device to view its details.
6. Verify that the device you selected is the new unformatted device, and not your system device or a formatted device.

   WARNING: Do not initialize the system disk.

   For example, for an unformatted device, the *Free Space* size is reported as 0.00 Bytes.

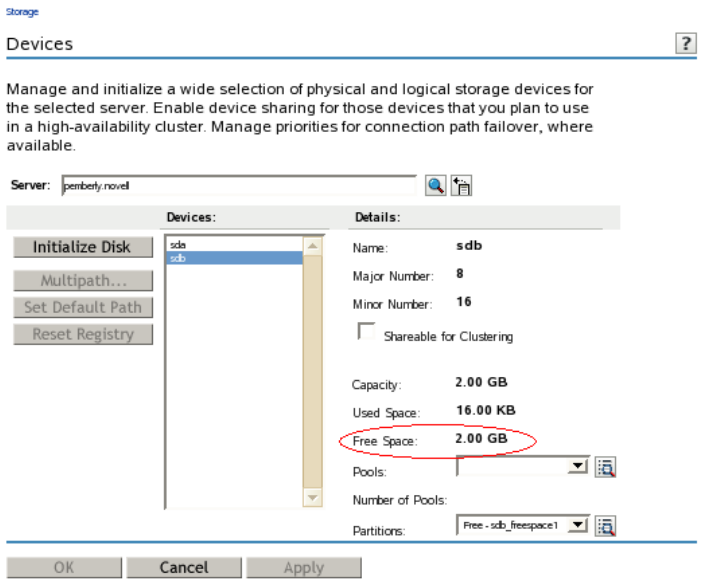


7 Click *Initialize*.

When the page refreshes, the device is initialized and available for further configuration with NSS pools and volumes.

8 Verify that the *Free Space* is now reported properly.

For example, after the device is initialized, the *Free Space* is reported to be the same as *Capacity*.



6.4 What's Next

To get started with virtualization, see *SUSE Linux Enterprise Server 10 SP2: Virtualization with Xen (http://www.novell.com/documentation/sles10/xen_admin/data/bookinfo.html)*

For information on setting up OES 2 Linux on a Xen-based virtual guest server, see "Installing, Upgrading, or Updating OES on a Xen-based VM" in the *OES 2 SP3: Installation Guide*.

7 Cross-Platform Issues for NSS

This section describes the cross-platform compatibility issues for the Novell Storage Services file system and services between NetWare and Novell Open Enterprise Server 2 Linux servers. You should understand these differences when working with NSS on Linux.

- Section 7.1, “Cross-Platform Issues for NSS Pool Snapshots,” on page 79
- Section 7.2, “Cross-Platform Issues for NSS Volumes,” on page 79
- Section 7.3, “Cross-Platform Issues for NSS Features,” on page 80
- Section 7.4, “Cross-Platform Issues for File Access,” on page 81
- Section 7.5, “Cross-Platform Issues for Management Tools,” on page 81

7.1 Cross-Platform Issues for NSS Pool Snapshots

Different pool snapshot technologies are used for NSS pools on NetWare and NSS pools on Linux. You can create pool snapshots on either platform, but you should not move them to another platform. Pool snapshots taken on NetWare do not work on Linux, and vice versa.

Consider these guidelines when working with NSS pool snapshots:

- The snapshots taken on a given platform are unusable if you move the pool's devices cross-platform. Before you move a pool with existing snapshots to a different platform, delete all existing snapshots for the pool.

  WARNING: You might not be able to open the original pool on the other platform if you do not delete the snapshots.

- NSS on Linux does not support using pool snapshots for clustered pools.
- Do not use the Pool Snapshot feature for a clustered pool in a mixed-platform cluster.
- You must remove any existing pool snapshots for a clustered pool on NetWare before you cluster migrate the pool cluster resource from a NetWare server to a Linux server in a mixed-platform cluster. (Mixed-platform clusters are supported only during a rolling cluster conversion.)

7.2 Cross-Platform Issues for NSS Volumes

OES 2 Linux requires a Linux POSIX file system volume for the operating system, such as Ext3. If you plan to move NSS pools and volumes cross-platform between NetWare and Linux servers, consider the following guidelines:

- You cannot install the Linux operating system on an NSS volume.

- You cannot install the NetWare operating system on a Linux POSIX file system volume or on an NSS volume on Linux.
- Use NSS on Linux only as data pools and volumes.
- You should not move an NSS system volume from NetWare to Linux unless you intend to use it as a data volume (or not at all) while it is mounted on the Linux server.

  At install time, OES 2 Linux sets up a sys: volume on a Linux POSIX file system with the Linux path of `/usr/novell/sys`, and creates an NCP volume for it in the `/etc/opt/novell/ncpserv.conf` file. The sys: volume contains the same login and public directories that exist on NetWare. These directories let Novell clients run commands for logging in, mapping drives, and so on, as well as providing the means for client commands to be run from login scripts.
- NSS volumes that were originally created on NetWare can be moved cross-platform from NetWare to Linux if both platforms support the same media format.
- If you use shared pools in a cluster, only pools that are originally created on NetWare can be migrated or failed back from Linux to NetWare. Mixed-platform clusters are supported only for rolling cluster conversions from NetWare to Linux.

7.3 Cross-Platform Issues for NSS Features

The following features of NSS on NetWare are not available for NSS on Linux. Use the native Linux alternatives where available.

- Section 7.3.1, "Multipath I/O to Devices," on page 80
- Section 7.3.2, "Removable Media," on page 80
- Section 7.3.3, "Transaction Tracking System," on page 80

7.3.1 Multipath I/O to Devices

The Media Manager solution for multipath I/O handling is not available for NSS on Linux. Use the Linux multipath I/O management tools. You should configure multipath I/O before using NSS management tools to create NSS software RAIDs, pools, or volumes on the devices. For information, see Chapter 14, "Managing Multipath I/O to Devices," on page 173.

7.3.2 Removable Media

Removable media such as CDs, DVDs, CD and DVD image files, and DOS partitions are typically mounted as file systems native to the Linux platform. Removable media and partitions are mounted by using Linux POSIX file systems options. For information, see "Some Other Supported File Systems" (http://www.novell.com/documentation/sles10/book_sle_reference/data/sec_filesystems_add.html) in the *SUSE Linux Enterprise Server 10 SP3 Installation and Administration Guide* (http://www.novell.com/documentation/sles10/book_sle_reference/data/book_sle_reference.html).

7.3.3 Transaction Tracking System

The NSS Transaction Tracking System (TTS) is not available for NSS on Linux.

7.4 Cross-Platform Issues for File Access

On Linux, users of the NSS volume must be Linux-enabled with Linux User Management if you want to give users access via any native Linux protocol or any Linux service or utility, such as Samba, FTP, or SSH. You must also LUM-enable the Linux service or utility. For information, see Section 5.5, "Access Control for NSS on Linux," on page 62.

7.5 Cross-Platform Issues for Management Tools

- Section 7.5.1, "Storage-Related Plug-Ins for Novell iManager 2.7," on page 81
- Section 7.5.2, "Interoperability of Protocols for the iManager Server and Target Server," on page 81
- Section 7.5.3, "Do Not Run EVMS Tools When Working in iManager or NSSMU," on page 82
- Section 7.5.4, "Management Tools for Pool Snapshots," on page 82
- Section 7.5.5, "Management Capabilities for Software RAIDs," on page 82

7.5.1 Storage-Related Plug-Ins for Novell iManager 2.7

The following storage-related plug-ins for OES 2 and later require Novell iManager 2.7 (or later):

Storage-Related Plug-In	NSS on Linux	NSS on NetWare
Archive and Versioning (Archive and Version Services)	Yes	Yes
Clustering (Novell Cluster Services)	Yes	Yes
Distributed File Services (Novell Distributed File Services)	Yes	Yes
Novell AFP	Yes (OES 2 SP1 Linux and later)	Yes
Novell CIFS	Yes (OES 2 SP1 Linux and later)	Yes
Novell NFS	No Use Linux NFSv3.	Yes
Files and Folders	Yes	Yes
Storage (NSS file system)	Yes	Yes

For more information about storage-related plug-ins, see Section 9.1.1, "Understanding Storage-Related Plug-Ins," on page 88.

7.5.2 Interoperability of Protocols for the iManager Server and Target Server

Table 9-3 in "Protocols for iManager Communications" on page 92 provides information about the protocols needed to use iManager to manage storage in a heterogeneous environment.

7.5.3 Do Not Run EVMS Tools When Working in iManager or NSSMU

Do not run the Enterprise Volume Management System (EVMS) management tools at the same time that iManager or NSSMU is running. Before you use `evmsgui`, close any instance of iManager or NSSMU, and vice versa.

7.5.4 Management Tools for Pool Snapshots

Pool snapshots for NSS on Linux can be managed in NSSMU or iManager.

7.5.5 Management Capabilities for Software RAIDs

NSSMU supports creating nested RAID 0+1 and 5+1 devices.

8 Cluster-Enabling Shared NSS Devices and Pools with Novell Cluster Services

Shared Novell Storage Services devices and pools can be used in a cluster environment by using Novell Cluster Services on your Novell Open Enterprise Server 2 (OES2) server. The NSS software is not clustered and must be installed and running on every server in the cluster.

- Section 8.1, "Cluster-Enabling NSS Pools and Volumes," on page 83
- Section 8.2, "Guidelines for Cluster-Enabling NSS," on page 83

8.1 Cluster-Enabling NSS Pools and Volumes

For information about installing Novell Cluster Services and cluster-enabling shared NSS devices and pools in the Novell Cluster Services clusters, see "Configuring Cluster Resources for Shared NSS Pools and Volumes" in the *OES 2 SP3: Novell Cluster Services 1.8.8 Administration Guide for Linux*.

8.2 Guidelines for Cluster-Enabling NSS

Novell Cluster Services must already be installed and configured on the server. Table 8-1 provides references for cluster-related tasks for NSS.

Table 8-1 *Clustering Guidelines for NSS*

NSS Feature	Description	Reference
Shared device	Enable the Shareable for Clustering parameter to support high-availability server clusters with Novell Cluster Services.	Section 10.7, "Sharing Devices," on page 123
Shared pools	Enable the pool for clustering when you create the pool. Devices contributing space to the pool must already be marked as shareable in order to be able to create a shared pool. Unshared pools can be created on shared devices. Pools created on NetWare can fail over to a Linux node in a mixed-node cluster, but only pools that were originally created on NetWare can fail back from Linux to NetWare.	Section 15.2, "Creating a Pool," on page 176
Multiple Server Activation Prevention (MSAP) for pools	MSAP prevents some accidental activations of a pool on more than one server at a time. MSAP is enabled by default.	Section 15.12, "Preventing Pools from Activating on Multiple Servers," on page 187

NSS Feature	Description	Reference
Pool snapshot	On Linux, NSS does not support using pool snapshots for clustered pools. You must remove any existing pool snapshots for a clustered pool on NetWare before you cluster migrate the pool cluster resource from a NetWare server to a Linux server during a rolling cluster conversion. **WARNING**: You might not be able to open the original pool on Linux if you do not delete the snapshots before you attempt to cluster migrate the pool cluster resource from NetWare to Linux.	"Cross-Platform Issues for NSS Pool Snapshots" on page 79
Shared volumes	You must create at least one shared volume in a cluster-enabled pool. We recommend using only one volume per pool in a cluster. Typically, all volumes are created when you initially set up the cluster resource and before you need to cluster migrate or fail over the resource to other servers in the cluster. The Server, Pool, Volume, Cluster Resource, and Cluster objects are recommended to be in the same context (such as ou=ncs,o=novell). If the objects are in different contexts, you might receive an eDirectory error when you attempt to modify the pool, create or modify the volumes, home directories, Distributed File Services junctions, or any other elements that are managed using eDirectory objects. To resolve the problem, you must cluster migrate the pool cluster resource back to the node where the pool was created in order to perform those management tasks.	Section 18.2.4, "Guidelines for NSS Volumes in a Mixed-Node Cluster," on page 228
Shared encrypted volume	When shared pools contain encrypted volumes, you must provide the encryption password the first time that a volume is mounted after a reboot. Thereafter, the nodes in the cluster share the key.	"Sharing Encrypted NSS Volumes in a Cluster" on page 254 "Using Encrypted Volumes in a Server Cluster" on page 257
Shadow volume pair using Dynamic Storage Technology	When a shared pool contains a volume that is part of a shadow volume pair, the other volume in the shadow pair can reside on the same pool or in a different pool on the same server. If it is on a different pool, both pools must be managed by the same cluster resource. In a cluster, shadow volumes can reside on and fail over only to nodes running OES 2 Linux.	*OES 2 SP3: Dynamic Storage Technology Administration Guide*

Cluster-Enabling an Existing NSS Pool and Its Volumes

Before you attempt to cluster-enable an existing pool and its volumes, the pool should be deactivated and its volumes should be dismounted.

Comment out (or remove) the volume's entry in the `/etc/fstab` file. The load and unload scripts that are created when you cluster-enable the pool will be responsible for mounting and dismounting the volume after the pool is cluster enabled. If you leave `/etc/fstab` as-is, the server will continue to try

and mount the NSS volume on reboot, but it will not succeed. For information about cluster-enabling an existing pool and its volumes, see "Cluster-Enabling an Existing NSS Pool and Its Volumes" in the Novell Cluster Services for Linux Administration Guide.

9 Management Tools for NSS

This section identifies the various tools for managing the Novell Storage Services file system.

- Section 9.1, “Novell iManager and Storage-Related Plug-Ins,” on page 87
- Section 9.2, “NSS Management Utility (NSSMU) Quick Reference,” on page 103
- Section 9.3, “NSS Commands and Utilities,” on page 106
- Section 9.4, “Novell NetStorage,” on page 107
- Section 9.5, “Novell Remote Manager,” on page 109
- Section 9.6, “Novell Client,” on page 111
- Section 9.7, “ConsoleOne,” on page 112
- Section 9.8, “Virtual File Services, APIs, and Scripts,” on page 113

NOTE: NSS also supports the use of third-party tools on both kernels for advanced data protection and management, virus scanning, and traditional archive and backup solutions.

9.1 Novell iManager and Storage-Related Plug-Ins

Novell iManager is a Web browser-based tool used for configuring, managing, and administering Novell eDirectory objects on your network. The Storage plug-in is the primary tool used to manage NSS devices, software RAIDs, pools, and volumes.

Novell iManager gives you the ability to assign specific tasks or responsibilities to user accounts and to present the user with only the tools (with the accompanying rights) necessary to perform those sets of tasks.

NOTE: The storage-related plug-ins do not support Mobile iManager.

This section describes the following:

- Section 9.1.1, “Understanding Storage-Related Plug-Ins,” on page 88
- Section 9.1.2, “Prerequisites for Using the Storage-Related Plug-Ins,” on page 91
- Section 9.1.3, “Downloading and Installing Plug-In Updates,” on page 94
- Section 9.1.4, “Accessing Novell iManager,” on page 94
- Section 9.1.5, “Accessing Roles and Tasks in iManager,” on page 94
- Section 9.1.6, “Selecting a Server to Manage,” on page 95
- Section 9.1.7, “Storage Plug-In Quick Reference,” on page 95
- Section 9.1.8, “Files and Folders Plug-In Quick Reference,” on page 101

9.1.1 Understanding Storage-Related Plug-Ins

Storage-related plug-ins share some management code in common. It is necessary to manage these plug-ins together when installing or updating any of the plug-ins.

- "Overview of the Storage-Related Plug-Ins for iManager" on page 88
- "Archive Versioning Management" on page 89
- "Cluster Services Management" on page 89
- "Distributed File Services Management" on page 89
- "Files and Folders Management" on page 89
- "File Protocols Management (AFP and CIFS)" on page 90
- "Samba Management" on page 90
- "NSS Management" on page 90
- "Storage Management" on page 90
- "Files for Storage-Related Plug-Ins" on page 90

Overview of the Storage-Related Plug-Ins for iManager

Table 9-1 identifies the storage-related plug-ins for Novell iManager 2.7.4 in OES 2 SP1 and later.

Table 9-1 *Storage-Related Plug-Ins for iManager*

Storage-Related Plug-In	NPM File	Role in iManager	Use to Manage
Archive Versioning Management	`arkmgmt.npm`	Archive Versioning	Novell Archive and Version Services
Cluster Services Management	`ncsmgmt.npm`	Clusters	Novell Cluster Services
Distributed File Services Management	`dfsmgmt.npm`	Distributed File Services	Novell Distributed File Services
Files and Folders Management	`fileman.npm`	Files and Folders	Novell Files and Folders
AFP Management	`afpmgmt.npm`	File Protocols > AFP	Novell AFP for Linux Novell AFP for NetWare
CIFS Management	`cifsmgmt.npm`	File Protocols > CIFS	Novell CIFS for Linux Novell CIFS for NetWare
Samba Management	`sambamgmt.npm`	File Protocols > Samba	Novell Samba
NSS Management	`nssmgmt.npm`	Storage	Novell Storage Services
Storage Management	`storagemgmt.npm`	No role. Required when using any combination of storage-related plug-ins	Contains common code for all storage-related plug-ins

IMPORTANT: The storage-related plug-ins share code in common in the `storagemgmt.npm` file. If you use more than one of these plug-ins, you should install, update, or remove them all at the same time to make sure the common code works for all plug-ins. If you remove only one of the plug-ins, it removes the common code and breaks the remaining installed plug-ins.

Archive Versioning Management

The Archive Versioning Management (`arkmgmt.npm`) file contains the Archive Versioning plug-in for Novell Archive and Version Services. This plug-in requires the NSS Storage Management plug-in and the Storage Management plug-in.

For information about using this plug-in, see the *OES 2 SP3: Novell Archive and Version Services 2.1 Administration Guide for Linux*.

Cluster Services Management

The Cluster Services Management (`ncsmgmt.npm`) file contains the Clustering plug-in for managing Novell Cluster Services. This plug-in requires the Storage Management plug-in. The NSS Storage Management plug-in is required for cluster-enabling NSS pools and volumes.

For information about using this plug-in, see *OES 2 SP3: Novell Cluster Services 1.8.8 Administration Guide for Linux*.

Distributed File Services Management

Use the Distributed File Services plug-in to manage Novell DFS for NSS volumes. The DFS plug-in also requires the NSS Storage Management and Storage Management plug-ins.

For information about using the DFS plug-in, see *OES 2 SP3: Novell Distributed File Services Administration Guide for Linux*.

Files and Folders Management

Provides a file tree view for managing and browsing files and Novell eDirectory objects.

When NCP Server is installed, this plug-in supports the Novell Trustee Model of access control for Novell Storage Services (NSS) volumes on Linux and NetWare and for NetWare Core Protocol volumes on Linux POSIX file systems. Use it to manage the file system trustees, trustee rights, and inherited rights filters for files and folders on NSS and NCP volumes. On Linux, install the NCP Server and Dynamic Storage Technology service. On NetWare, the NCP Server service is automatically installed.

For file systems that have Volume objects in eDirectory, this plug-in allows you to upload, download, and delete files and to create and delete directories. For NSS volumes, it provides additional features that allow you to manage file system attributes, to salvage and purge deleted files and folders, and to manage directory quotas.

File Protocols Management (AFP and CIFS)

Beginning in OES 2 SP1, the File Protocols plug-in for the Native File Access Protocols for NetWare services has been replaced by two plug-ins: Novell AFP (`afpmgmt.npm`) and Novell CIFS (`cifsmgmt.npm`). These plug-ins support AFP and CIFS services for NSS volumes on both Linux and NetWare.

The AFP and CIFS plug-ins also require the NSS Storage Management (`nssmgmt.npm`) and Storage Management (`storagemgmt.npm`) plug-ins.

IMPORTANT: Make sure to uninstall the existing File Protocols plug-in, NSS plug-in, and Storage Management plug-in before you upgrade to these new plug-ins.

For information about managing these services, see the following guides:

- *OES 2 SP3: Novell AFP For Linux Administration Guide*
- *OES 2 SP3: Novell CIFS for Linux Administration Guide*

Samba Management

Provides a Web interface for configuring your Samba server to to provide file and print services to clients that support the Microsoft SMB and CIFS protocols. This plug-in supports CIFS access to files on NSS volumes, NCP volumes, and Linux POSIX volumes.

NSS Management

The Novell Storage Services Management (`nssmgmt.npm`) plug-in allows you to manage NSS services (devices, software RAIDs, pools, and volumes) on NetWare 6.5 SP8, OES 1, and OES 2. Information about using this plug-in is the focus of this guide.

Storage Management

The Storage Management (`storagemgmt.npm`) file contains common code that is shared by the storage-related plug-ins. If you use more than one of these storage-related plug-ins, you should install, update, or remove the `storagemgmt.npm` file and all installed storage-related `.npm` files at the same time.

IMPORTANT: If you remove any one of the installed storage-related plug-ins, it removes the common code (`storagemgmt.npm`) file, which breaks the remaining installed plug-ins.

Files for Storage-Related Plug-Ins

The module files (see Table 9-1, “Storage-Related Plug-Ins for iManager,” on page 88) are located in the `/var/opt/novell/iManager/nps/portal/modules/` directory.

The Java JAR files are located in the `/var/opt/novell/iManager/nps/WEB-INF/lib/` directory.

The Tomcat TLD files are located in the `/var/opt/novell/iManager/nps/WEB-INF/` directory.

Table 9-2 Java and Tomcat Files for Storage-Related Plug-Ins

Storage-Related Plug-In	Java Files	Tomcat Files
Novell AFP	afpGadgets.jar afpManageLib.jar afpTags.jar	afp.tld
Archive and Version Services	arkGadgets.jar arkManageLib.jar	ark.tld
Novell CIFS	cifsGadgets.jar cifsManageLib.jar	cifs.tld
Novell Cluster Services	ncsGadgets.jar ncsManageLib.jar ncsTags.jar	ncs.tld
Novell Distributed File Services	dfsGadgets.jar dfsManageLib.jar nasGadgets.jar	dfs.tld
Novell Storage Services	nssGadgets.jar nssManageLib.jar	nss.tld
Storage Management (common to all)	nssAdminClient.jar nssGadgetLib.jar nssTags.jar	

9.1.2 Prerequisites for Using the Storage-Related Plug-Ins

The requirements in this section apply to the storage-related plug-ins for iManager 2.7 that are described in "Understanding Storage-Related Plug-Ins" on page 88.

- "EVMS" on page 91
- "Web Browser Language Setting" on page 92
- "Web Browser Character Encoding Setting" on page 92
- "Protocols for iManager Communications" on page 92

EVMS

NSS for Linux uses the Enterprise Volume Management Service (EVMS) version 2.5.5-24.54.5 or later to manage devices that contain NSS pools and volumes and Novell Cluster Services cluster resources. For information about upgrading EVMS, see "EVMS Requirements" on page 40.

NSS tools work transparently with EVMS to manage your devices, pools, and volumes.

IMPORTANT: You cannot run the EVMS graphical user interface (`evmsgui`), ncurses, or console commands at the same time that iManager or NSSMU is running. If you use EVMSGUI to manage NSS devices, close any instance of iManager or NSSMU, and vice versa.

NSS does not recognize devices that are being managed by non-EVMS volume managers such as LVM2. Only unconfigured devices or EVMS-managed devices with free unconfigured space are available to you when you create or expand NSS pools and software RAID devices.

For information about how to make EVMS the volume manager for your existing non-EVMS-managed devices, see Section C.4, "Making Devices Available to EVMS," on page 455.

Web Browser Language Setting

The iManager plug-in might not operate properly if the highest priority Language setting for your Web browser is set to a language other than one of iManager's supported languages. To avoid problems, in your Web browser, click *Tools* > *Options* > *Languages*, then set the first language preference in the list to a supported language.

Web Browser Character Encoding Setting

Supported language codes are Unicode (UTF-8) compliant. To avoid display problems, make sure the Character Encoding setting for the browser is set to Unicode (UTF-8) or ISO 8859-1 (Western, Western European, West European).

In a Mozilla browser, click *View* > *Character Encoding*, then select the supported character encoding setting.

In an Internet Explorer browser, click *View* > *Encoding*, then select the supported character encoding setting.

Protocols for iManager Communications

The storage-related plug-ins can be used to manage OES 2 Linux or NetWare 6.5 SP8 servers. Different communications protocols are required for connecting the various platforms.

Table 9-3 provides information about the protocols needed to use iManager to manage storage in a heterogeneous environment. A protocol annotated with an asterisk (*) is the default and is configured automatically on the servers. The protocols that you use must be loaded and running on both the iManager server and the target server that you want to manage.

For further clarification about WBEM, CIFS, and NCP, see the following sections:

- "WBEM" on page 93
- "CIFS (NetWare)" on page 94
- "NCP" on page 94

Table 9-3 *Interoperability of Protocols Used to Connect the iManager Server and Target Servers*

iManager Server Operating Platform	Protocol Used to Connect to the Target Server Based on Its Operating Platform (* indicates the default)			
	OES 1 Linux and Later	**OES 1 SP1 NetWare, NetWare 6.5 SP4, and Later**	**OES 1 NetWare and NetWare 6.5 SP3**	**NetWare 6.5 SP2**
OES 1 Linux and Later	* WBEM	* WBEM	WBEM (Start WBEM)	
	CIFS	CIFS	CIFS	CIFS (Field Patch 2B)
OES 1 SP1 NetWare, NetWare 6.5 SP4, and Later	* WBEM	* WBEM	WBEM (Start WBEM)	
		NCP	* NCP	* NCP
	CIFS	CIFS	CIFS	CIFS (Field Patch 2B)
OES 1 NetWare and NetWare 6.5 SP3	*WBEM	*WBEM	WBEM (Start WBEM)	
		NCP	* NCP	* NCP
	CIFS	CIFS	CIFS	CIFS (Field Patch 2B)
NetWare 6.5 SP2	Not available	* NCP	* NCP	* NCP

WBEM

Where WBEM is the default protocol, WBEM is loaded and runs automatically when you start the server. Otherwise, you must start WBEM to use the protocol.

For OES 2 Linux, the storage-related plug-ins for iManager require CIMOM connections for tasks that transmit sensitive information (such as a username and password) between iManager and the `_admin` volume on the OES 2 Linux server that you are managing. Typically, CIMOM is running, so this should be the normal condition when using the server. CIMOM connections use Secure HTTP (HTTPS) for transferring data, and this ensures that sensitive data is not exposed.

If CIMOM is not currently running when you click *OK* or *Finish* for the task that sends the sensitive information, you get an error message explaining that the connection is not secure and that CIMOM must be running before you can perform the task.

IMPORTANT: If you receive file protocol errors, it might be because WBEM is not running.

To check the status of WBEM on Linux:

1 As `root` in a console shell, enter

```
rcowcimomd status
```

To start WBEM on Linux:

1 As `root` in a console shell, enter

```
rcowcimomd start
```

For information about installing WBEM, see "Setting Up OpenWBEM" in the *OES 2 SP3: OpenWBEM Services Administration Guide*.

CIFS (NetWare)

Where it is available, CIFS must be configured before you can use it. An additional CIFS setup requirement for Field Patch 2B is noted where it is required. For information, see the *NW 6.5 SP8: AFP, CIFS, and NFS (NFAP) Administration Guide*.

NCP

NetWare Core Protocol (NCP) is the default protocol when the iManager server and target server are NetWare 6.5 SP3 or SP2.

9.1.3 Downloading and Installing Plug-In Updates

For information, see "Downloading and Installing Plug-Ins During Installation" in the *Novell iManager 2.7 Installation Guide*.

9.1.4 Accessing Novell iManager

1. Launch a Web browser.
2. Click *File* > *Open*, then enter

`https://server-IP-address/nps/iManager.html`

The URL is case sensitive. Replace *server-IP-address* with the actual server DNS name or IP address. For example:

`https://192.168.1.1/nps/iManager.html`

The iManager Login page opens.

3. Use your administrator username and password to log in to the eDirectory tree that contains the server you want to manage.

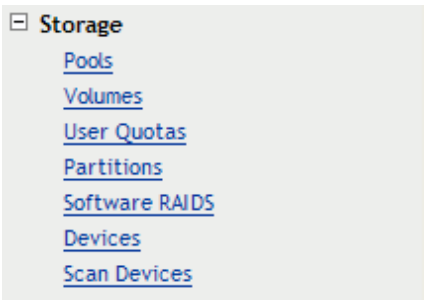
In Novell iManager, you can access only the roles and tasks you are authorized to manage. For full access to all available Novell iManager features, you must log in as Supervisor of the tree.

9.1.5 Accessing Roles and Tasks in iManager

1. Access iManager, then log in to the eDirectory tree where the server you want to manage resides.

For information, see Section 9.1.4, "Accessing Novell iManager," on page 94.

2. In *Roles and Tasks*, click the *Storage* role to expand its main tasks



As you work in the storage-related plug-ins, use the navigation links at the top of the page, referred to as "breadcrumbs," to return to pages you recently visited, or use the links in *Roles and Tasks*. If you use the *Refresh* and *Back* features of your Web browser to navigate, iManager returns you to the initial page you encountered after login.

3 To activate the options on the selected page, select a server to manage.

For information, see Section 9.1.6, "Selecting a Server to Manage," on page 95.

9.1.6 Selecting a Server to Manage

Before you can access the management options on a selected task page, you must select a server to manage that is in the same Novell eDirectory tree where you are currently logged in.

1 Use one of the following methods to select a server in the tree where you are logged in:

- Type the Novell eDirectory distinguished server name for the server you want to manage, then press *Tab* or click somewhere on the page outside of the *Server* field to enter your selection. For example:

  ```
  svr1.company
  ```

- Click the *Search* icon to open the eDirectory Object Selector. Browse or search the list to locate the server you want to manage, then click the server name.
- Click the *Object History* icon to select a server you have recently managed.

2 Wait for iManager to retrieve information about that server and display the appropriate information to the task page you are in.

It might take several seconds to retrieve the information, depending on the size and complexity of your storage solution.

9.1.7 Storage Plug-In Quick Reference

The Storage role comprises seven key tasks:

- "Pools" on page 96
- "Volumes" on page 97
- "User Quotas" on page 98
- "Partitions" on page 98
- "Software RAIDs" on page 99
- "Devices" on page 100
- "Scan for Devices (NetWare)" on page 101

Pools

You can create and manage storage pools to efficiently use all free space. You can also enable the Pool Snapshot feature to preserve point-in-time views of data pools and to support data backup and recovery. Snapshots are not supported for clustered pools.

Table 9-4 *Pool Management Tasks*

Task	Description	Reference
Pools	Displays a list of all pools on the selected server.	"Viewing Pools on a Server" on page 184
Details	Displays information about a selected pool.	"Viewing Pool Details" on page 184
New	Creates a new pool on the selected server.	"Creating a Pool" on page 176
Delete	Deletes a selected pool and all of its volumes and their data.	"Deleting a Pool" on page 183
Rename	Renames a selected pool.	"Renaming a Pool" on page 182
Activate	Mounts and activates a selected deactive or unmounted pool.	"Activating and Deactivating Pools" on page 180
Deactivate	Deactivates a selected active pool.	"Activating and Deactivating Pools" on page 180
Increase Size	Allows you to select one or more partitions from available devices in order to expand the size of a pool.	"Increasing the Size of a Pool" on page 181
Snapshot	Opens the Pool Snapshots page where you can create and manage pool snapshots. This option is disabled for online snapshot pools, because you cannot create a snapshot of a snapshot.	"Managing NSS Pool Snapshots" on page 203
Update eDirectory	Updates (replaces) the eDirectory object for a selected pool. Use only if a storage object is not recognized or has been lost.	"Updating eDirectory Pool Objects" on page 191
Deleted Volume	Displays a list of deleted volumes in a pool, and allows you to salvage or purge them. You can also pause and resume the autopurging of deleted volumes.	"Viewing, Salvaging, or Purging Deleted NSS Volumes in a Pool" on page 315
Offline	For a pool snapshot that is online as an active pool, takes it offline. This does not delete the pool snapshot.	"Viewing and Managing an Online Pool Snapshot" on page 216
Partitions	Displays a list of the partitions comprising the pool's storage space.	"Viewing Partition Information for a Pool" on page 185
Volumes	Lists all volumes on a selected pool.	"Viewing Volume Information for a Pool" on page 186
Devices	Displays a list of the devices that contribute space to a selected pool.	"Viewing Device Information for a Pool" on page 186

Volumes

You can create and manage NSS volumes, including their key attributes.

Table 9-5 *Volume Management Tasks*

Task	Description	Reference
Volumes	Displays a list of all volumes on the selected server.	"Managing NSS Volumes" on page 221
Details	Displays information about a selected volume.	"Viewing the Details of an NSS Volume" on page 232
New	Creates a new unencrypted volume. To create an encrypted NSS volume, use NSSMU.	"Creating Unencrypted NSS Volumes" on page 228
Delete	Deletes a selected volume and all of its contents.	"Deleting an NSS Volume" on page 247
Rename	Renames a selected volume.	"Renaming an NSS Volume" on page 238
Activate	Mounts and activates a deactive or unmounted volume.	"Activating and Deactivating an NSS Volume" on page 240
Deactivate	Deactivates an active volume.	"Activating and Deactivating an NSS Volume" on page 240
Mount	Mounts an unmounted volume. A volume must be mounted to view its details.	"Mounting and Dismounting an NSS Volume" on page 240
Dismount	Dismounts a mounted volume.	"Mounting and Dismounting an NSS Volume" on page 240
Move	Moves a selected NSS volume for the purpose of reorganizing and redistributing storage on the same server (or to other servers) in response to changing business needs.	For requirements, guidelines, and procedures for splitting volumes, see "Using DFS to Move NSS Volumes" in the *OES 2 SP3: Novell Distributed File Services Administration Guide for Linux*.
Split	Splits a selected NSS volume for the purpose of reorganizing and redistributing storage on the same server (or to other servers) in response to changing business needs.	For requirements, guidelines, and procedures for splitting volumes, see "Using DFS to Split NSS Volumes" in the *OES 2 SP3: Novell Distributed File Services Administration Guide for Linux*.
Properties	Displays a list of volume attributes, and allows you to set the attributes and name space to use for a volume. It also displays usage statistics for a volume.	"Viewing Properties of an NSS Volume" on page 232
User Quotas	Displays user quotas and space consumed for users of the volume. Administrators can view and manage user quotas. Users can view their own user space quotas.	"Configuring a User Space Quota" on page 304
Offline	Takes a selected snapshot volume offline, where it remains active in the background.	"Viewing and Managing an Online Pool Snapshot" on page 216

Task	Description	Reference
Update eDirectory	Updates (replaces) the eDirectory object. Use only if a storage object is not recognized or has been lost.	"Updating eDirectory Volume Objects" on page 231

User Quotas

The User Quotas task (see Table 9-6) allows managers to view and manage user space restrictions. It can be specified as an iManager role-based task for administrators. An individual user can log in to iManager under his or her own username to view the user's user space restrictions.

Table 9-6 *User Quotas Task*

Task	Description	Reference
User Quotas	For the Administrator user, displays quotas and allows the administrator user to manage user quotas for all users. For the user, displays the user's own space restrictions.	"Configuring a User Space Quota" on page 304

Partitions

NSS creates and deletes partitions for you when you work with software RAIDS and pools in iManager and NSSMU. To delete partitions manually, use the NSSMU Partitions page.

Table 9-7 *Partitions Tasks*

Task	Description	Reference
Partitions	Displays a list of all partitions on a selected server.	"Viewing a List of Partitions" on page 143
Details	Displays information about a selected partition.	"Viewing Details for a Partition" on page 145
Edit (NetWare)	Adds a label for a selected partition.	"Labeling a Partition" in the *NW 6.5 SP8: NSS File System Administration Guide*

Software RAIDs

You can create and manage software RAID 0, 1, and 5 devices to improve storage performance and reliability. You can use NSSMU to create a software RAID 0+1 or 5+1 device.

Table 9-8 *Software RAID Management Tasks*

Task	Description	Reference
Software RAIDs	Displays a list of software RAID devices on the selected server.	"Viewing a List of Software RAID Devices on a Server" on page 155
Details	Displays the details of a selected software RAID device.	"Viewing Details of a Software RAID Device" on page 156
New	Creates a new software RAID 0, 1, or 5 device for the selected server.	"Creating Software RAID Devices with iManager" on page 157
Rename	Renames a selected software RAID device.	"Renaming a Software RAID Device" on page 163
Increase Size	Expands an existing software RAID device by adding a partition to the RAID (up to the limit for that type of RAID). If there are no devices available, the button is disabled. Each partition you add must reside on a different device. You can add partitions that match the shared state of current member devices. They must be all local or all shared; you cannot mix them.	"Increasing the Size of a Software RAID Device" on page 163
Restripe	Completes a restriping process for a RAID 0 or RAID 5 device that has been paused.	"Restriping a Software RAID 0 or 5 Device" on page 165
Delete	Deletes the selected software RAID device and removes the RAID relationship between member partitions and the underlying storage structures. All data on the member partitions is lost.	"Deleting a Software RAID Device" on page 168
Pools	Lists pools on a selected software RAID devices.	"Viewing Pools on a Software RAID Device" on page 168
Partitions	Lists details about partitions (member segments) in the RAID. In some cases, you can also delete a partition to repair a RAID.	"Viewing Partitions on a Software RAID Device" on page 169

Devices

You can configure, mount, and maintain a wide selection of storage devices, including direct-attached-storage devices, network-attached storage devices, networked storage devices in a Fibre Channel or iSCSI storage area network (SAN), and hardware device arrays.

Table 9-9 *Device Management Tasks*

Task	Description	Reference
Devices	Displays a list of all local and external devices available on the selected server.	"Viewing a List of Devices on a Server" on page 119
Details	Displays information about a selected device.	"Viewing Details for a Device" on page 120
Initialize Disk	Initializes a selected device by erasing its partition table, effectively destroying all of its data. If devices are present but not showing up for creating pools and volumes, you should initialize the disk.	"Initializing a Disk" on page 122
Multipath (NetWare)	For network configurations with multiple paths between network devices and your NetWare server, opens the Multipath page where you can set the primary path and path failover priorities for fault tolerance of connections between host bus adapters and storage devices. You can also bring paths up and down.	"Managing Multipath I/O to Devices (NetWare)" in the *NW 6.5 SP8: NSS File System Administration Guide*
Set Default Path (NetWare)	Sets the connection to selected device to its user-defined default primary path.	"Setting the Primary Path for a Device to Its Default Path" in the *NW 6.5 SP8: NSS File System Administration Guide*
Reset Registry (NetWare)	Resets the multipath priority settings for a selected device in the server registry to its user-defined defaults.	"Resetting the Server Registry with Default Priority Settings for a Device" in the *NW 6.5 SP8: NSS File System Administration Guide*
Shareable for Clustering	Enables device sharing to support high-availability server clusters.	"Sharing Devices" on page 123
Pools	Displays a list of the pools on a device.	"Viewing Pools on a Device" on page 125
Partitions	Displays information about partitions that are configured on a device.	"Viewing Partitions on a Device" on page 124

Scan for Devices (NetWare)

You can scan for devices on a NetWare server that were not found automatically by the Media Manager.

Table 9-10 *Scan for Devices Task*

Task	Description	Reference
Scan	After you select a server to manage, scans for devices added since you booted the server.	"Scanning for Devices (NetWare)" in the in the *NW 6.5 SP8: NSS File System Administration Guide* For information about scanning for devices on Linux, see Section 10.5, "Scanning for Devices on Linux," on page 121.

9.1.8 Files and Folders Plug-In Quick Reference

The Files and Folders plug-in for iManager 2.7 provides the Files and Folders role for Linux and NetWare. It is also integrated in iManager as the *View Objects* option in the iManager toolbar. File browsing in iManager is available for file systems that have a Volume object defined in eDirectory, such as for NSS volumes on Linux and NetWare and for NCP volumes on Linux.

The Files and Folders Manager NPM file (`filemanager.npm`) is automatically installed in iManager. For information about manually installing NPM files for iManager, see the *Novell iManager 2.7 Installation Guide*.

Click the *Files and Folders* role to select tasks first, then search for the file or folder you want to manage. Click the *View Objects* icon to view the Tree, Browse, and Search view of a server's eDirectory objects in the left pane. In the Tree view, click a Volume object to see the hierarchical file system tree view of the volume's folders and files. Click the plus (+) or minus (-) icon next to a directory name to expand or collapse the view of its subdirectories. Locate the file or folder you want to manage, then specify the action you want to perform for it.

The Files and Folders plug-in for Novell iManager 2.7 provides the tasks described in this section. All of the tasks and actions that are available under the *Files and Folders* role are also available from the *View Objects* tree view.

- "Delete" on page 102
- "Deleted Files" on page 102
- "Download" on page 102
- "New Folder" on page 102
- "Properties" on page 102
- "Upload" on page 103

Delete

Deletes a file or folder on an NSS volume or an NCP volume (NCP share on a Linux POSIX file system). For information, see Section 25.2, "Deleting a File or Folder on an NSS Volume," on page 332.

Deleted Files

Salvages or purges deleted files on an NSS volume. Salvage and purge of deleted files and directories is available only for NSS volumes where the volume's Salvage attribute is enabled. Other NSS settings determine how long deleted files and directories are available.

For information about configuring salvage and purge behavior for NSS volumes, see Chapter 23, "Salvaging and Purging Deleted Volumes, Directories, and Files," on page 309.

For non-NSS volumes, the Deleted Files report is empty (no deleted files).

Download

Downloads a selected file from an NSS volume or NCP volume to a specified location on your local drive or mapped network drive. For information, see Section 25.4, "Downloading Files from an NSS Volume," on page 334.

New Folder

Creates a folder on an NSS volume or NCP volume. For information, see Section 25.1, "Creating a Folder on an NSS Volume," on page 331.

Properties

Adds, removes, or modifies file system trustees, trustee rights, inherited rights filters, and file system attributes for files and folders on NSS volumes and NCP volumes. See Table 9-11 for a complete list of tasks you can perform from the Properties page.

Table 9-11 *Properties Tasks*

Properties Tab	Task Description
Information	Displays or modifies a directory quota for the selected folder. Directory quotas management is available only for NSS volumes where the volume's Directory Quotas attribute is enabled. For information, see Section 22.3, "Managing Directory Quotas," on page 296. Displays information about a selected file or folder, such as: ◆ Current size ◆ Time stamps for when the file was created, modified, accessed, and archived Displays or modifies the owner of a selected file or folder. Displays or modifies the file system attributes for a file or folder. For information, see Section 20.1.3, "Configuring File or Folder Attributes," on page 260.
Rights	Displays, adds, or removes file system trustees for a selected file or directory. Displays, grants, or revokes file system trustee rights for trustees of the selected file or directory. Displays or modifies the inherited rights filter for a selected file or directory. For information, see Section 20.1, "Configuring File System Trustees, Trustee Rights, Inherited Rights Filters, and Attributes," on page 259.
Inherited Rights	Displays or modifies the inherited rights filters at every level of the path for a selected file or directory. For information, see "Configuring the Inherited Rights Filter for a File or Directory" on page 264. Displays the effective rights for the selected file or directory. For information, see Section 20.1.5, "Viewing Effective Rights for a Trustee," on page 265.

Upload

Uploads a specified file from your local drive or a mapped network drive to a specified location on an NSS volume or NCP volume. For information, see Section 25.3, "Uploading Files to an NSS Volume," on page 333.

9.2 NSS Management Utility (NSSMU) Quick Reference

The Novell Storage Services Management Utility (NSSMU) is a console-based utility for managing NSS storage media on a server. You can use NSSMU at any time as an alternative to the browser-based iManager Storage plug-in.

NSSMU is installed when you install NSS. The Linux install creates symlinks in the `/opt/novell/nss/sbin` folder for common NSS utilities, including NSSMU. Symlinks allow the path to NSSMU to become part of the `root` user's path, which allows you to run `nssmu` from a terminal console as the `root` user.

Table 9-12 identifies key functions available in NSSMU for Linux. This quick reference is also available in the `nssmu(8)` man page. To access the man page, enter the following at a terminal console prompt:

```
man 8 nssmu
```

Table 9-12 *Summary of Management Options in NSSMU for Linux*

Management Options	Description
Devices *F3* = Initialize EVMS-managed device (Do not initialize your system device.) *F9* = Refresh display *F5* = Select/deselect one or more devices for Initialize or Share actions *F6* = Share (shareable/not shareable for clustering) *Enter* = Show partitions *Esc* = Previous menu	Use this option to initialize and maintain physical storage devices and software RAID devices available to this server. Use the Software RAID Devices option to create, repair, or delete RAIDs. Initialize the selected device by erasing its partition table, effectively destroying all of its data. If devices are present but not showing up for creating pools and volumes, you should initialize the disk.
Partitions *Ins* = Create an NSS partition (disabled) *Del* = Delete an NSS partition *F3* = Mirror partition (that contains an existing pool) *F5* = Refresh details of the partition *F6* = Label *Enter* =Show volumes *Esc* = Previous menu	Use this option to display details about partitions. All types of partitions are displayed, including those for Linux file systems. The Create option is disabled. NSS partitions are automatically created for you as you define NSS pools or software RAIDs. You can delete a single partition at a time when repairing a failed software RAID partition. To delete all partitions for a software RAID, you should delete the RAID itself from the Software RAIDs page; otherwise, the RAID is not cleanly deleted. The Mirror option lets you specify 1 to 3 partitions to mirror an existing partition that contains an NSS pool. Effectively, you are creating a RAID1 mirror device for the pool. Each segment of the defined RAID is a complete mirror of the original pool and is the same size as the original partition. After you mirror the partition, manage the RAID from the Software RAIDs page.
Pools *Ins* = Create a pool *Del* = Delete a pool *F3* = Expand a pool (by adding space) *F4* = Update NDS/eDirectory *F5* = Refresh details of a pool *F6* = Rename a pool *F7* = Activate/deactivate a pool *s* = Display pool segments, segment size, and devices *F8* = More (list more options) *F9* = Show deleted volumes (then salvage, purge, or pause/resume autopurging) *Enter* = Show volumes for a pool *Esc* = Previous menu	Use this option to create, delete, rename, and expand NSS storage pools to efficiently use all free space in the available devices. After you create a pool, you can expand it by adding free space from the same or different device to increase its size. Select from the available free space to allocate it to the pool. Each device can contribute a different amount of space to the pool. Devices that contribute space must be in the same share state as the pool, that is, *Shared* or *Not Shared*. You can increase the size of a pool, but you cannot reduce it.

Management Options	Description
Volumes *Ins* = Create a new volume *Del* = Delete a volume *F2* = Rename mount point for the volume (new path with volume name) *F3* = Rename volume *F4* = Update NDS/eDirectory *F5* = Refresh details of the volume *F6* = View compression statistics *F7* = Dismount/mount a volume. If it is encrypted, the volume prompts for a password on the first mount after a system boot or reboot. *F8* = More (list more options) *F9* = Name Space - choose Long (default), UNIX, DOS, or Macintosh *Enter* = Set or view volume properties *Esc* = Previous menu	Use this option to create, delete, rename, activate/deactivate, and mount/dismount NSS volumes and to set their attributes. To store data in encrypted format, specify a password when you create the volume. This enables the Encryption attribute. The encryption setting persists for the life of the volume. The encryption password can be 2 to 16 standard ASCII characters, with a suggested minimum of 6. The password generates a 128-bit NICI key for encryption. On system reboot, specify the password when you activate the volume for the first time. On Linux, you can mount encrypted volumes only from NSSMU on the first time after a system reboot. Provide the password when needed. Until you provide a password for encrypted volumes, you cannot mount multiple encrypted volumes at a time.
RAID Devices *Ins* = Create a software RAID *Del* = Delete a software RAID device *F3* = Expand a RAID device (add partitions) *F4* = Rename a RAID device *F5* = Refresh details of the software RAID device *F6* = Restripe (resume restriping for paused RAID 0) *Enter* = Show segments (list member partitions for selected device) *Esc* = Previous menu *F8* = More (list more options) *Space*=Status Refresh	Use this option to create and manage NSS software RAID devices. A software RAID device emulates a hardware RAID device. RAID devices combine partitioned space on multiple physical devices into a single virtual device that you manage like any device. Each member device contributes an equal amount of space and only a single partition to the RAID.
Snapshot *Ins* = Create a pool snapshot *Del* = Delete a pool snapshot *F5* = Refresh display *F7* = Mount or dismount the pool snapshot as an active pool. The snapshot functions continue whether the snapshot is mounted or dismounted. *Esc* = Previous menu	Use this option to create, delete, mount, and dismount pool snapshots for NSS pools. Up to 15 snapshots of a pool are allowed to concurrently coexist. On Linux, snapshots are stored on a separate partition that you specify, not another pool. After it is created, the partition for the snapshot pool cannot be expanded.

9.3 NSS Commands and Utilities

Command line instructions and utilities are available to control most NSS functions.

- Section 9.3.1, “Command Consoles,” on page 106
- Section 9.3.2, “NSS Commands,” on page 106
- Section 9.3.3, “NSS Utilities,” on page 107

9.3.1 Command Consoles

NSS commands and utilities are issued from command line interfaces that are referred to as consoles in this guide. On Linux, all NSS commands and utilities are issued while logged in as the `root` user or a user with equivalent privileges.

- “Linux Terminal Console” on page 106
- “NSS Console” on page 106

Linux Terminal Console

NSS utilities for Linux are issued at the command prompt of a Linux terminal console.

If you are not running a graphical interface on the server, the terminal console is simply the command line prompt displayed when you log in to the server.

If you are using a graphical interface, you can open a terminal console by using one of these methods:

- Right-click on the Linux desktop, then select *Open Terminal* from the menu.
- From the Linux desktop, click the *Computer* menu, then select *Terminal (Command Line Terminal)* from the *Applications* menu.

NSS Console

The NSS Console (NSSCON, `nsscon(8)`) utility for Linux provides a command line interface in a console environment familiar to NetWare users. Use it to issue NSS commands and to monitor NSS activity through console messages. For more information, see Section B.5, “nsscon,” on page 433.

To start NSSCON, enter the following at a terminal console prompt:

```
nsscon
```

9.3.2 NSS Commands

To view a list of NSS commands and options, enter the following command at the NSSCON prompt on Linux:

```
nss /help
```

For information about NSS commands, see Appendix A, “NSS Commands,” on page 387.

9.3.3 NSS Utilities

The most well-known NSS utilities are the NSS Management Utility (`nssmu`) for managing storage and the NSS Console (`nsscon`) utility for issuing NSS commands on Linux. NSS provides other utilities to support more complex command line management tasks for NSS pools and volumes.

For information about NSS utilities, see Appendix B, "NSS Utilities," on page 423.

9.4 Novell NetStorage

Novell NetStorage provides a Web-based interface to access directories and files on your NSS volumes on NetWare. You can also manage file system trustees, file system trustee rights, and directory and file attributes for the NSS file system on NetWare.

- Section 9.4.1, "Prerequisites," on page 107
- Section 9.4.2, "Accessing NetStorage," on page 107
- Section 9.4.3, "Configuring File System Trustees, Trustee Rights, and Attributes," on page 108
- Section 9.4.4, "Purging and Salvaging Deleted Files," on page 108
- Section 9.4.5, "Browsing Directories and Files," on page 108
- Section 9.4.6, "Additional Information," on page 108

9.4.1 Prerequisites

For NSS on Linux, users must be Linux-enabled with Linux User Management in order to use NetStorage. For information about installing and configuring Linux User Management and enabling users and groups for Linux, see the *OES 2 SP3: Novell Linux User Management Administration Guide*.

9.4.2 Accessing NetStorage

In iManager

Beginning in OES 1 SP1, NetStorage is accessible from within iManager.

1. Log in to iManager in the eDirectory tree of the servers that you want to manage.

   For information, see Section 9.1.4, "Accessing Novell iManager," on page 94.
2. In *Roles and Tasks*, select *NetStorage*.

Direct URL

To avoid conflicts, the date and time on the workstation being used to access NetStorage should be reasonably close (within a few hours) to the date and time on the server running NetStorage.

1. Launch your Web browser and open it to the following location:

   `http://192.168.1.1/oneNet/NetStorage`

   Replace *192.168.1.1* with the actual DNS name or IP address of your NetStorage server or the IP address for Apache-based services. If Apache-based services use a port other than 80, you must also specify that port number with the URL.

For example, if the port number is 51080, the URL would be in the form

```
http://192.168.1.1:51080/oneNet/NetStorage
```

2 Log in with your administrator username and password to manage file system access for directories and files on NSS volumes.

NetStorage uses Novell eDirectory for authentication. You can also log in as any username with equivalent rights to the administrator. This limitation does not apply if you have created a Storage Location object using SSH (Secure Shell).

9.4.3 Configuring File System Trustees, Trustee Rights, and Attributes

Using NetStorage, you can set file system trustees, trustee rights, and attributes for directories and files on NSS volumes on your Linux or NetWare servers by using the *NetWare Info* tab and *NetWare Rights* tab in the *Properties* dialog box.

IMPORTANT: The label of Netware refers to the NetWare Core Protocol (NCP) that is used for trustee management. Use the option for NSS volumes and NCP on Linux.

For information about file system trustees, trustee rights, and attributes for directories and files on NSS Volumes, see the *OES 2 SP3: File Systems Management Guide*.

Directory or File Attributes

1 In NetStorage, select the file or directory, then click the *NetWare Info* tab to view or modify NSS directory or file attributes.

NSS File System Trustee Rights

1 In NetStorage, select the file or directory, then click the *NetWare Rights* tab to view or modify NSS file system trustee rights.

9.4.4 Purging and Salvaging Deleted Files

Using NetStorage, you can purge and possibly undelete (salvage) NSS files that were previously deleted. For information, see Section 23.6.1, “Using NetStorage,” on page 319.

9.4.5 Browsing Directories and Files

Administrators and users can use NetStorage to browse directories and files in an NSS volume.

9.4.6 Additional Information

For information, see:

- *OES 2 SP3: File Systems Management Guide*
- *OES 2 SP3: NetStorage Administration Guide*

9.5 Novell Remote Manager

Novell Remote Manager (NRM) is a browser-based management utility for monitoring server health, changing the configuration of your server, or performing diagnostic and debugging tasks.

NRM provides the NCP Server management plug-in that allows you to create shadow volumes using NSS volumes on Linux. You can also use it to manage NCP connections to the NSS volumes.

- Section 9.5.1, "Prerequisites for Using Novell Remote Manager," on page 109
- Section 9.5.2, "Novell Remote Manager for Linux," on page 110
- Section 9.5.3, "Accessing Novell Remote Manager," on page 110
- Section 9.5.4, "Starting, Stopping, or Restarting Novell Remote Manager on Linux," on page 111

9.5.1 Prerequisites for Using Novell Remote Manager

- "Prerequisites for Remote Administration" on page 109
- "Prerequisites for Administrator User Access on Linux Servers" on page 109

Prerequisites for Remote Administration

Your configuration must satisfy the following prerequisites:

- Make sure SSL 3.0 (where available) or SSL 2.0 is enabled in your Web browser.

  Novell Remote Manager requires an SSL connection between your Web browser and the target server where it is running. You must enable SSL services for your Web browser; otherwise, the browser displays an error when it tries to display the Novell Remote Manager Web pages.
- Ports 8008 (insecure) and 8009 (secure) are the default ports used for accessing Novell Remote Manager. If you change the port number, make sure you specify the same value for the port number when you log in.

Prerequisites for Administrator User Access on Linux Servers

You can log into Novell Remote Manager for Linux as the `root` user or equivalent for the OES Linux server you are managing.

You can alternately log in to Novell Remote Manager with your eDirectory credentials if you first enable Linux User Management (LUM) in your eDirectory tree and install and configure LUM on the target server. The Administrator user or equivalent must be Linux-enabled and at least one of the following conditions must be met:

- The Administrator user (or equivalent user) must be associated to the eDirectory group that has the Supervisor right for the Entry Rights property for the UNIX Workstation object in eDirectory.
- The Administrator user (or equivalent user) must have the Supervisor right for the Entry Rights property to the NCP object that represents the Linux server in the eDirectory tree.

To see if a user is Linux-enabled, go to iManager, select the User role, then select the user to see if the following is true:

- The user has a *Linux Profile* tab on the Modify User page in iManager.
- The user's eDirectory object is associated with the UNIX Workstation object that represents the Linux server.

For information about configuring Linux User Management and enabling users for Linux, see the *OES 2 SP3: Novell Linux User Management Administration Guide*.

9.5.2 Novell Remote Manager for Linux

Novell Remote Manager for Linux allows you to browse NSS volumes on your Linux servers. It requires that the NCP Server and NCP Server plug-in for Novell Remote Manager be installed and running.

Tasks

The NCP Server plug-in supports the following tasks:

- Managing connections to NSS volumes and viewing open files for a connection.

  For information, see "Managing Connections for NCP Volumes and NSS Volumes" in the *OES 2 SP3: NCP Server for Linux Administration Guide*.
- Creating or managing shadow volumes with NSS volumes as the primary and secondary storage areas.

  For information, see the *OES 2 SP3: Dynamic Storage Technology Administration Guide*.

Novell Remote Manager for Linux does not support the following tasks for NSS on Linux:

- Configuring directory quotas
- Salvaging and purging deleted files and directories
- Configuring file system trustees and attributes for directories and files
- Creating and managing partitions, pools, and volumes

Additional Information

For detailed information about Novell Remote Manager on Linux, see the *OES 2 SP3: Novell Remote Manager for Linux Administration Guide*.

9.5.3 Accessing Novell Remote Manager

1. From your Web browser, enter one of the following:

   `http://server-ip-address:8008`

   `https://server-ip-address:8009`

   Replace *server-ip-address* with the IP address of the server you want to manage. If you have Domain Name Services (DNS) installed on your network for server name-to-IP address resolution, you can optionally use the server's DNS name instead of the IP address.
2. Determine the authenticity of the SSL certificate, then accept it if the certificate is valid.

3 When the Login page appears, do one of the following:

- **Linux:** Type the username and password of the `root` user for that server, or type the username and password of the Administrator user (or equivalent user) who is an eDirectory user and who has been Linux-enabled.
- **NetWare:** Type the username and password of the Administrator user or equivalent.

4 Click *OK* to log in to the target server and initiate your SSL session.

The management interface opens in your Web browser. After logging in, your SSL session for Novell Remote Manager remains open until you close all your browser windows at that workstation.

9.5.4 Starting, Stopping, or Restarting Novell Remote Manager on Linux

Novell Remote Manager on Linux is installed and runs by default. If it hangs, you can use the `/etc/init.d/novell-httpstkd` script to get status or to stop, start, or restart `httpstkd`. For the latest information about `httpstkd`, see "Starting or Stopping HTTPSTKD" in the *OES 2 SP3: Novell Remote Manager for Linux Administration Guide*.

1 Open a terminal console, then log in as the `root` user.

2 At the terminal console prompt, enter the command for the task you need to perform:

Task	Command
Status	`rcnovell-httpstkd status`
Start	`rcnovell-httpstkd start`
Stop	`rcnovell-httpstkd stop`
Restart	`rcnovell-httpstkd restart`

9.6 Novell Client

- Section 9.6.1, "Novell Client for Linux," on page 111
- Section 9.6.2, "Novell Client for Windows XP/2003 and Vista," on page 112

9.6.1 Novell Client for Linux

The Novell Client for Linux software allows users of Linux workstations to access and use all of the services available on servers running Novell eDirectory. The Novell Client brings the full power, ease of use, manageability, and security of eDirectory to Linux workstations. The Novell Client for Linux fully supports NetWare, OES, and eDirectory services and utilities on a Linux workstation, including security, file, and print services through Novell iPrint.

For information, see the *Novell Client 2.0 SP2 for Linux Administration Guide* .

9.6.2 Novell Client for Windows XP/2003 and Vista

In combination with NCP Server, the Novell Client for Windows XP/2003 and the Novell Client for Vista support the following:

- Management of file system trustees, trustee rights, and inherited rights filters for directories and files on NSS volumes
- Management of attributes for directories and files on NSS volumes
- Purge and salvage of deleted files on NSS volumes, if the volume is configured to support it by enabling the Salvage Files attribute for a volume
- Drive mapping for NSS volumes
- Login scripts for automatic drive mapping on login

For information, see the *Novell Client 4.91 SP5 for Windows XP/2003 Installation and Administration Guide* and the *Novell Client 2 SP1 for Windows Administration Guide* .

9.7 ConsoleOne

ConsoleOne is a Java application that runs on the server or a workstation. You can use ConsoleOne to manage trustees and attributes for directories and files in your NSS file system. For information about trustees and file and directory attributes for NSS, see the *OES 2 SP3: File Systems Management Guide*.

Loading ConsoleOne

To use ConsoleOne on a client workstation, you need to load ConsoleOne 1.3 or later, then copy the NSS `.jar` files from your server to your client workstation.

1. Copy these three NSS `.jar` files to your local `lib` directory:

   ```
   public\mgmt\consoleone\1.3\lib\nssadmin.jar
   public\mgmt\consoleone\1.3\lib\nssc1lib.jar
   public\mgmt\consoleone\1.3\lib\nssjavalib.jar
   ```

2. Copy these two `.jar` files to your local `resources` directory:

   ```
   public\mgmt\consoleone\1.3\resources\nssadminres.jar
   public\mgmt\consoleone\1.3\resources\nssc1libres.jar
   ```

3. Copy the following `.jar` file to your local `snap-ins` directory:

   ```
   public\mgmt\consoleone\1.3\snapins\nssadminreg.jar
   ```

Enabling the ConsoleOne Media Snap-In for Managing DFS

1. Open ConsoleOne.
2. Open the tree you want to work with.
3. Right-click the server object you want to manage.
4. Click *Properties*.

This opens the ConsoleOne interface, where you can access the Media snap-in for configuring DFS.

5 Select the *Media* snap-in.

Additional Information

For more information, see the *ConsoleOne 1.3.x User Guide*.

9.8 Virtual File Services, APIs, and Scripts

Virtual File Services (VFS) provides methods that allow you to manage services such as NSS by using standard file system functions. Using VFS and a scripting or GUI-based interface, you can view the status and statistics for your system and change the system parameters.

NSS provides a special administration volume, known as the `_admin` volume, that exists on each server. This volume uses no disk space and is created at startup time. Using VFS and the services provided by files that are created on the `_admin` volume, you can potentially control all server management functions.

For more information and instructions, see *NDK: Virtual File Services* (http://developer.novell.com/wiki/index.php/Virtual_File_Services_for_NetWare) in the Novell Developers Kit (NDK) documentation.

10 Managing Devices

Novell Storage Services file systems can be used on devices controlled by the Enterprise Volume Management System (EVMS). This section describes how to manage devices where you want to create or manage NSS storage objects.

- Section 10.1, “Understanding Devices,” on page 115
- Section 10.2, “Making Devices Available to EVMS,” on page 119
- Section 10.3, “Viewing a List of Devices on a Server,” on page 119
- Section 10.4, “Viewing Details for a Device,” on page 120
- Section 10.5, “Scanning for Devices on Linux,” on page 121
- Section 10.6, “Initializing a Disk,” on page 122
- Section 10.7, “Sharing Devices,” on page 123
- Section 10.8, “Viewing Partitions on a Device,” on page 124
- Section 10.9, “Viewing Pools on a Device,” on page 125
- Section 10.10, “Enabling Write-Through Cache Management on SCSI Devices and RAID Controllers,” on page 126
- Section 10.11, “What’s Next,” on page 127

10.1 Understanding Devices

A block storage device is the physical, logical, or virtual storage media available to a server. A device can be directly attached to the server or connected via storage networking protocols such as Fibre Channel and iSCSI.

- Section 10.1.1, “Device Size Limit,” on page 115
- Section 10.1.2, “Device Types,” on page 116
- Section 10.1.3, “Device Details,” on page 118

10.1.1 Device Size Limit

NSS can recognize physical, logical, or virtual devices up to 2 TB in size (where 1 TB = 2E40 bytes = 1,099,511,627,776 bytes). The restriction for NSS is the size that the device reports to the operating system. If the device’s size is larger than 2 TB, NSS cannot see the device. You must use the storage vendor’s or third-party disk carving tools to carve the device into logical devices (such as LUNs) that are each up to 2 TB in size.

Different manufacturers report device sizes differently. The actual device size varies with the hardware design and the applications and software drivers that manage the device. Many vendors report sizes using a definition where 1 TB = 10E12 bytes = 1,000,000,000,000 bytes. Space can also be

consumed by metadata that is added to manage the device. The location on the device where the metadata is stored can also vary by hardware manufacturer and software vendor. After you format the drive, yet another size might be reported. Third-party product documentation might state the maximum size limits of devices it supports before or after making accommodations for any management data or space lost to formatting. The size of devices you ultimately carve out for use with NSS depends on all these factors.

IMPORTANT: Make sure to refer to the documentation of the device manufacturer, application vendor, and software driver vendor for other limitations on the device size.

If you combine physical partitions or disks to represent a single device to the server, such as for RAIDs, the resulting device must be less than 2 TB in size in order for NSS to see it. For example, if you create a RAID device that is larger than 2 TB in size, NSS cannot recognize the device even if its member devices are each smaller than 2 TB. If the RAID size is larger than 2 TB, you must carve it into multiple LUNs or logical devices of up to 2 TB each in order for NSS to recognize them.

Do not expand devices beyond the 2 TB limit if they contain NSS pools and volumes. On Linux, devices larger than 2 TB are recognized by the Linux volume manager, but NSS cannot see them.

WARNING: Attempting to expand any of the devices that contribute space to an NSS pool beyond 2 TB in size can result in data loss on the associated NSS pool.

10.1.2 Device Types

The following are examples of common types of devices that are subject to the 2 TB maximum device size:

- "Server Disks" on page 116
- "Direct-Attached Storage Devices" on page 116
- "LUN Devices" on page 117
- "iSCSI Devices" on page 117
- "RAID Devices" on page 117
- "Multipath Devices" on page 118
- "Removable Media" on page 118
- "Virtual Disks" on page 118

Server Disks

Server disks include physical disks on the server or logical disks carved from the server disk.

Direct-Attached Storage Devices

Physical or logical disks can be directly attached to the server as individual devices or in a storage array.

LUN Devices

A LUN (logical unit number) can be either a physical or a logic disk drive. Refer to the iSCSI SAN or Fibre Channel SAN documentation for information about creating and managing LUNs for your SAN implementation.

A metaLUN is a controller-managed group of multiple LUNs or of multiple hardware RAIDs that are striped or concatenated together to be presented as a single LUN device to the server. Refer to the hardware manufacturer's documentation for information about creating metaLUNs.

iSCSI Devices

An iSCSI device is a remote target disk or tape drive on an iSCSI disk server that is made available across an IP network by iSCSI initiator software running on the server. After connecting to the disk server, you can view the devices in the *Devices* list and add NSS pools and volumes as you would with any device.

For information about managing and using iSCSI devices on OES 2 Linux, see "Mass Storage over IP Networks—iSCSI" (http://www.novell.com/documentation/sles10/book_sle_reference/data/cha_inst_system_iscsi.html) in the *SLES 10 SP3 Installation and Administration Guide* (http://www.novell.com/documentation/sles10/book_sle_reference/data/book_sle_reference.html). See also the Linux iSCSI Project (http://linux-iscsi.sourceforge.net/).

RAID Devices

A RAID (redundant array of independent disks) is a logical device that combines space from multiple devices by using special hardware, software, or both. Data is striped or replicated across all member devices to improve data reliability, increase I/O performance, or provide device fault tolerance. All RAID types require configuration using a RAID management tool made for the specific hardware or software used in the RAID.

- "Hardware RAID Devices" on page 117
- "Controller RAID Devices" on page 117
- "Software RAID Devices" on page 118

Hardware RAID Devices

In a hardware RAID, the RAID functionality and management are in firmware within the storage cabinet. Refer to the hardware manufacturer's documentation for information about creating hardware RAIDs.

Controller RAID Devices

Controller RAID devices are also known as *BIOS RAIDs*, *fakeRAIDs*, *hostRAID*, and *quasi-hardware RAIDs*.

In controller RAIDs, the functionality and management are in the HBA or controller BIOS/firmware. If the controller does not contain an on-board CPU resource to use for RAID management, the controller RAID consumes server CPU resources to manage the RAID.

Refer to the hardware manufacturer's documentation for information about configuring Controller RAID devices. For information about using Controller RAIDs with OES 2 Linux, see *TID 3626577: BIOS RAID Support* (http://www.novell.com/support/search.do?cmd=displayKC&docType=kc&externalId=3626577&sliceId=SAL_Public&dialogID=44924286&stateId=0%200%2044926638) in the Novell Support Knowledgebase.

Software RAID Devices

Software RAIDs are controlled by special software in the server's OS such as in the HBA driver or in upper level module such as NSS. Software RAIDs consume CPU resources to manage the RAID.

For information about creating and managing NSS software RAIDs on Linux, see Chapter 13, "Managing NSS Software RAID Devices," on page 149.

On Linux, you can optionally use Linux tools to create and manage Linux software RAIDs. Linux software RAIDs must be managed by the EVMS volume manager and have a Cluster Segment Manager or a NetWare Segment Manager on it in order to be visible to NSS. For information about using Linux tools to create Linux software RAIDs on OES 2 Linux, see "Managing Software RAIDs with EVMS" in the *SLES 10 SP3: Storage Administration Guide*.

Multipath Devices

If there are multiple connection paths between a device's hardware controller and the server, each path presents a given device to the server as a separate device. You must use a multipath management tool to resolve the multiple apparent devices to a single multipath device. Use the multipath device UUID or alias when you are creating NSS pools and volumes. Multipath tools also provide automatic path management for path failover, failback, and reconfiguration.

Use the Linux multipath I/O tools to create the multipath device. Afterwards, you must configure the multipath device to be managed by EVMS and add a Cluster Segment Manager or NetWare Segment Manager on it in order for it to be recognized by NSS. For information, see Chapter 14, "Managing Multipath I/O to Devices," on page 173 and the *SLES 10 SP3: Storage Administration Guide*.

Removable Media

Removable media devices include CDs, DVDs, or CD/DVD image files. On Linux, removable media are mounted as Linux POSIX file systems. Use Linux native tools to manage removable media on Linux.

Virtual Disks

In a Xen virtual environment, you use the Virtual Machine Manager in YaST to allocate storage devices from the host to the virtual machine. The devices that you want to use for the NSS file system on the guest operating system cannot exceed the 2 TB limit, even if the host operating system and guest operating system can handle larger devices. For information about storage considerations in virtual environment, see Chapter 6, "Using NSS in a Virtualization Environment," on page 71.

10.1.3 Device Details

The following table describes the type of information available for each device by viewing the Device Details page.

Table 10-1 *Explanation of Device Details*

Device Detail	Description
Name	The device name assigned by the device manager.
Major Number Minor Number	The device identity in major:minor format. Major and minor numbers are associated with the device special files in the `/dev` directory and are used by the operating system to determine the actual driver and device to be accessed by the user-level request for the special device file.
Shareable for Clustering	The attribute of a device that indicates whether the selected device can be shared by multiple computers in a cluster solution.
Capacity	The total available storage space of the selected device.
Used Space	The amount of space on the device that is currently in use by partitions, including NetWare partitions for NSS as well as native Linux partitions.
Free Space	The total amount of space on the device that is currently not in use.
Pools	The drop-down list shows all pools that exist on this device. To view a pool's details or to manage a pool, select the pool from the list, then click the *View Details* icon to go to the *Pools* page for that pool.
Number of Pools	The total number of pools that use this device.
Partitions	The drop-down list shows all partitions that exist on this device. To view a partition's details, select the partition from the list, then click the *View Details* icon to go to the Partition Information page for that partition.
Mirror Status	For a RAID1 device, this field shows its status: ◆ **In Sync:** The mirror group is fully synchronized. ◆ **Partial Sync:** The mirror group is only partially synchronized. ◆ **Not Mirrored:** The device is not mirrored (only one partition).

10.2 Making Devices Available to EVMS

You can view and manage devices for NSS on Linux with the Storage plug-in to iManager if they are managed by the Enterprise Volume Management System (EVMS). For information about making the devices where you want to use NSS available to EVMS, see Appendix C, "Using EVMS to Manage Devices with NSS Volumes," on page 451.

For information about management capabilities that are not available in NSS when the device is managed with a non-EVMS volume manager, see Section D.1, "FAQs About Using EVMS with NSS," on page 463.

10.3 Viewing a List of Devices on a Server

1. In iManager, click *Storage* > *Devices*.

   For instructions, see Section 9.1.5, "Accessing Roles and Tasks in iManager," on page 94.

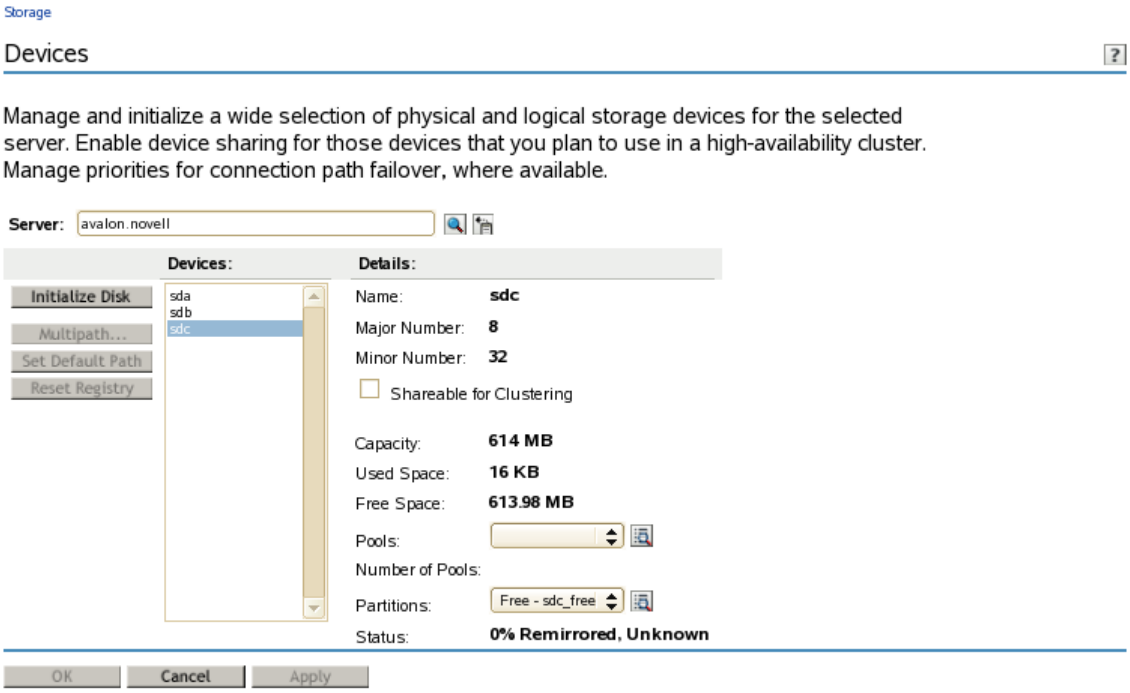
2. Select a server to manage.

   For instructions, see Section 9.1.6, "Selecting a Server to Manage," on page 95.

Depending on the number of devices, it can take a few seconds to display the list of devices. Avoid clicking again in the page until it refreshes and displays the *Devices* list.

3 Select a device to view its details.

For an overview of the subtasks available from this page, see "Devices" on page 100.



10.4 Viewing Details for a Device

The *Details* field in the *Devices* page displays information about each device in the *Devices* list.

To view a device's details:

1 In iManager, click *Storage* > *Devices*.

For instructions, see Section 9.1.5, "Accessing Roles and Tasks in iManager," on page 94.

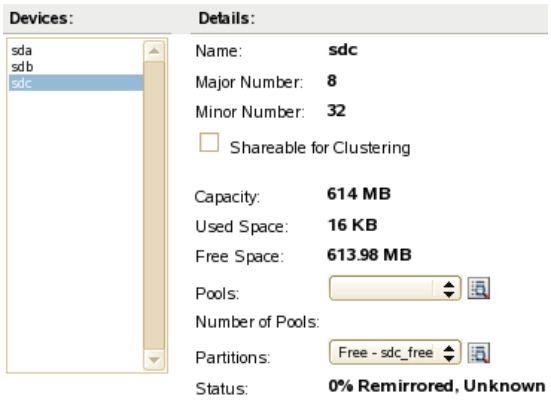
2 Select a server to manage.

For instructions, see Section 9.1.6, "Selecting a Server to Manage," on page 95.

When the page refreshes the devices are listed in the *Devices* list. Depending on the number of devices, this can take several seconds. Wait for the page to load before moving to the next step.

3 Select a device in the *Devices* list to view its details.

The page must refresh to display the details, which might take several seconds.



10.5 Scanning for Devices on Linux

If you add more disks to the SAN, you can use the `rescan-scsi-bus.sh` script to scan for the new devices on Linux without rebooting. For information, see "Scanning for New Devices without Rebooting" (http://www.novell.com/documentation/sles10/stor_admin/data/scandev.html) in the *SLES 10 SP3: Storage Administration Guide* (http://www.novell.com/documentation/sles10/stor_admin/data/bookinfo.html).

You can also use the following procedure to scan the devices and make them available without rebooting the system:

1 On the storage subsystem, use the vendor's tools to allocate the devices and update its access control settings to allow the Linux system access to the new storage. Refer to the vendor's documentation for details.

2 On the Linux system, use the HBA driver commands to scan the SAN to discover the new devices. The exact commands depend on the driver.

For example, for a QLogic 2300 HBA, the command is

```
echo scsi-qlascan >/proc/scsi/qla2xxx/<host number>
```

At this point, the newly added device is not known to the higher layers of the Linux kernel's SCSI subsystem and is not yet usable.

3 Scan all targets for a host to make its new device known to the middle layer of the Linux kernel's SCSI subsystem. At a terminal console prompt, enter

```
echo "- - -" >/sys/class/scsi_host/host<hostnumber>/scan
```

4 If the devices have multiple paths, run the Multipath tool to recognize the devices for Device Mapper Multipath I/O (DM-MPIO) configuration. At a terminal console prompt, enter

```
multipath
```

For information about configuring multipathing for devices on your Linux server, see "Managing Multipath I/O for Devices" in the *SLES 10 SP3: Storage Administration Guide*.

10.6 Initializing a Disk

If you can see a device listed in the *Devices* list, but the device is not available for creating pools and volumes, you probably need to initialize the disk.

On the *Devices* page, the *Initialize Disk* option initializes the selected device and completely removes all the partitions it contains. All the data stored on the device is lost. If the device contains a partition of an NSS pool, a Traditional volume, or a software RAID device, the *Initialize* process also deletes data on all of the partitions of the entire pool, volume, or device, even if they reside on separate devices.

WARNING: Do not initialize the device that contains a system volume (such as `/boot`, `swap`, and `/` (`root`)). Initializing the system volume destroys the operating system and all the data in it.

This option is disabled (dimmed) if the selected device contains any of the following:

- sys: volume
- DOS partition
- Software RAID 1 (mirrored) device

It can also be disabled if there is no space available based on each partition's size, or if you already have the maximum number of partitions allocated in a software RAID device.

NOTE: You can also use *ncsinit* utility to initialize and to set the device to a shared state. For more information, refer Section B.15, "ncsinit," on page 450.

To initialize a disk from iManager:

1. In iManager, click *Storage* > *Devices*.

   For instructions, see Section 9.1.5, "Accessing Roles and Tasks in iManager," on page 94.
2. Select a server to manage to view the *Devices* list.

   For instructions, see Section 9.1.6, "Selecting a Server to Manage," on page 95.

   A list of devices appears in the *Devices* list.
3. In the *Devices* list, select the device that you want to initialize (such as `sdd`).

   NOTE: You can select multiple devices for initialization.

   ---
4. Click *Initialize Disk*.

To initialize a disk from NSSMU:

1. In NSSMU, click *Devices*.

   A list of devices appears in the *Devices* list.
2. In the *Devices* list, select a device. Press *F5* to select the device.

   NOTE: You can select multiple devices for initialization.

   ---
3. Press F3, *Initialize Disk*.

If you encounter any error, refer to the log messages at `/var/log/messages`. The messages are preceded with NSSMU.

10.7 Sharing Devices

Devices that are shared in a Novell Cluster Services Cluster must be marked as shareable for clustering. This includes devices that you plan to use for shared software RAIDs, shared pools, and the cluster SBD (split-brain detector) partition.

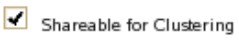
- Section 10.7.1, "Understanding Sharing," on page 123
- Section 10.7.2, "Planning for Device Sharing," on page 123
- Section 10.7.3, "Configuring the Device's Share State," on page 124

10.7.1 Understanding Sharing

Storage devices that exist in a storage area network (SAN) can be shared by multiple servers in a cluster using Novell Cluster Services. For information about clustering, see the *OES 2 SP3: Novell Cluster Services 1.8.8 Administration Guide for Linux*.

IMPORTANT: The system hardware does not specify that disk drives come up automatically as *Shareable for Clustering* or *Not Shareable for Clustering*. You must manually set this value for each device, according to the configuration of your storage system.

Making a device shareable enables device sharing for those devices in high-availability clusters that you want to be part of a shared-disk storage solution. If the *Shareable for Clustering* option is enabled (selected), the selected storage device can be shared by multiple computers in a cluster.



WARNING: Marking a device as shareable for clustering sets all of the pools on this device to shareable. If any of these pools span multiple devices, you must make sure that each device is set to the same share state as this one, or the device can become unusable.

If a device is a member of a software RAID device, marking the device as shareable for clustering automatically sets all the other member devices of the RAID as shareable for clustering.

10.7.2 Planning for Device Sharing

By default, devices are not shared. Use the following guidelines when planning whether to share devices:

- The device that contains the operating system cannot be marked as *Shareable for Clustering*.
- You cannot mix space from shared and unshared devices to create a pool. If a pool spans multiple storage devices, all of the member devices in that pool must be marked as *Shareable for Clustering*, or all marked as *Not Shareable for Clustering*.
- You cannot mix space from shared and unshared devices to create a software RAID. All devices that contribute space to the RAID must be marked as *Shareable for Clustering*, or all marked as *Not Shareable for Clustering*.
- Do not mark a device as *Shareable for Clustering* if it is not capable of being shared, such as when the device contributes space to the system pool (`sys`), to an unshared software RAID, or to an unshared pool.

10.7.3 Configuring the Device's Share State

To configure the device's share state from iManager:

1. In iManager, click *Storage* > *Devices*.

   For instructions, see Section 9.1.5, "Accessing Roles and Tasks in iManager," on page 94.

2. Select the server that you want to manage to view a list of its devices.

   For instructions, see Section 9.1.6, "Selecting a Server to Manage," on page 95.

3. In the *Devices* list, select a device to view information about it.

4. Depending on the current state of the device, do one of the following:

   - To set a device's share state to On, select the *Shareable for Clustering* check box, then click *Apply* or click *OK*.
   - To set a device's share state to Off, deselect the *Shareable for Clustering* check box, then click *Apply* or click *OK*.

   If you click *Apply*, iManager saves the change and remains on the device page. If you click *OK*, iManager saves the change and takes you to the main Storage page. If you do not click *Apply* or *OK*, the change is not implemented.

To configure the device's share state from NSSMU:

1. In NSSMU, click *Devices*.

   A list of devices appears in the *Devices* list.

2. In the *Devices* list, select a device. Press *F5* to select the device.

   NOTE: You can select multiple devices at a time.

3. Press *F6* to share the device.

NOTE: If you have selected shared devices, you are prompted to make your shared devices unshared.

If you encounter any error, refer to the log messages at `/var/log/messages`. The messages are preceded with NSSMU.

10.8 Viewing Partitions on a Device

NSS abstracts all partition creation and deletion in iManager; there are no actions to perform on partitions. For information about partitions, see "Managing Partitions" on page 141.

1. In iManager, click *Storage* > *Devices*.

   For instructions, see Section 9.1.5, "Accessing Roles and Tasks in iManager," on page 94.

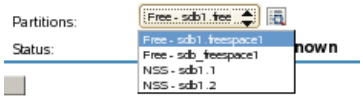
2. Select a server to manage.

   For instructions, see Section 9.1.6, "Selecting a Server to Manage," on page 95.

   A list of devices appears in the *Devices* list.

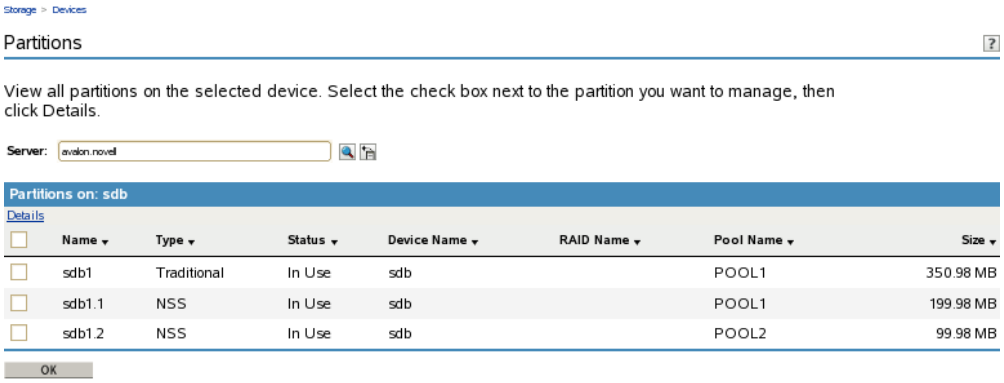
3. In the *Devices* list, select a device.

4. In the *Details* area, click the arrow on the *Partitions* drop-down list to expand it.

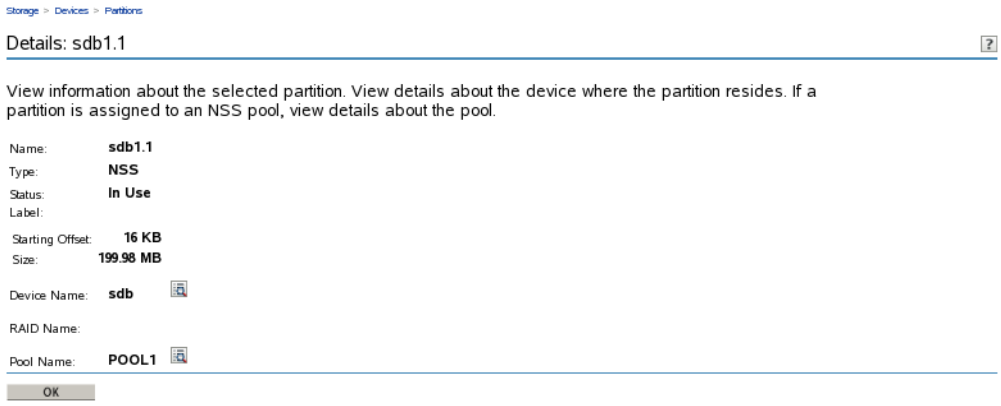


5 Select a partition, then click *View Details*.

This opens the *Partitions* page. It displays a list of all the partitions that currently exist on the selected device.



6 To view details about a partition, select the check box next to it in the *Partitions* list, then click *Details* to view its details.



10.9 Viewing Pools on a Device

1 In iManager, click *Storage* > *Devices*.

For instructions, see Section 9.1.5, “Accessing Roles and Tasks in iManager,” on page 94.

2 Select the server that you want to manage.

For instructions, see Section 9.1.6, “Selecting a Server to Manage,” on page 95.

3 In the *Devices* list, select a device.

4 In the *Details* area, click the arrow on the *Pools* drop-down list to expand it.

5 Select a pool, then click *View Details*.

This opens the *Pools* page where you can view the details of the pool and manage it.

For information about pool management, see "Managing NSS Pools" on page 175.

10.10 Enabling Write-Through Cache Management on SCSI Devices and RAID Controllers

Any journal based file system (including NSS) requires that when writes occur, they must be committed to disk in order to prevent corruption in event of a power failure.

Using write-back cache management can improve performance by allowing data to be held in cache rather than being written to disk. However, write-back cache management introduces the risk of losing data if the power fails. Many array controllers have an on-board battery backup, which can reduce the risk of data loss when using write-back, but it might not eliminate the risk. It is up to you to determine if the power backup is sufficient for power loss scenarios in your production environment.

If your system does not have sufficient power loss protection, we require using write-through cache management for SCSI devices to minimize the risk of losing data in the event of power failure. Write-Through cache management assures the file system that writes are being committed to disk as required.

If the server uses a RAID controller, enable Write-Through (disable Write-Back) cache management when configuring the RAID device by using the controller's BIOS setup routine or configuration utility.

To enable Write-Through cache management for local devices:

1 Log in to the server as `root`.

2 If the `scsi-config` utility is not already installed, install it using the `xscsi` RPM.

The `xscsi` RPM, which contains the `scsi-config` command, is not installed by default.

2a In YaST, open the *Various Linux Tools* section.

2b Install the `xscsi` RPM package, then close YaST.

The `xscsi` package installs the `scsi-config` utility in `/user/bin/scsi-config`.

3 Enable Write-Through (disable Write-Back) cache management for each SCSI device by performing the following for each device where you plan to use NSS volumes:

3a At a terminal console prompt, enter

```
scsi-config
```

3b In the window that opens, browse to select drive you want to manage, then click *Continue*.

3c Click *Cache Control Page*.

3d Enable Write-Through cache management mode by deselecting the *Write cache enabled* check box.

Write-Through cache management is enabled by default, so the *Write cache enabled* check box should be deselected. If the *Write cache enabled* check box is selected, Write-Back cache management mode is enabled and you deselect the box to disable Write-Back cache management.

3e Click *Quit* > *Save Changes*.

3f When prompted to confirm the change, click *Go Ahead and Save* > *Quit*.

3g To verify the setting, at a terminal console prompt, enter

```
scsiinfo -c /dev/sdx
```

Replace `/dev/sdx` with the device you are checking.

A value of 0 for *Write Cache* means that the drive is in Write-Through cache management mode.

10.11 What's Next

If your server provides multiple I/O paths between the server and its storage devices, configure the primary path and path priorities for I/O failover for each device. For information, see Chapter 14, "Managing Multipath I/O to Devices," on page 173. When you are done, continue with creating software RAIDs and pools.

To configure software RAID devices, see Chapter 13, "Managing NSS Software RAID Devices," on page 149.

To create pools of storage on the devices, see Chapter 15, "Managing NSS Pools," on page 175.

11 Migrating NSS Devices from NetWare 6.5 SP8 to OES 2 Linux

This section describes the issues involved in migrating Novell Storage Services devices from NetWare servers to Novell Open Enterprise Server 2 Linux servers.

IMPORTANT: For a general discussion of migration issues in OES 2, see "Migrating and Consolidating Existing Servers and Data" in the *OES 2 SP3: Planning and Implementation Guide*.

- Section 11.1, "Guidelines for Moving Devices from NetWare 6.5 SP8 to OES 2 Linux," on page 129
- Section 11.2, "Moving Non-Clustered Devices From NetWare 6.5 SP8 Servers to OES 2 Linux Servers," on page 130
- Section 11.3, "Moving Non-Clustered Devices From NetWare 6.0 to OES 2 Linux," on page 135
- Section 11.4, "Moving Clustered Devices with NSS Volumes From NetWare to Linux," on page 138

11.1 Guidelines for Moving Devices from NetWare 6.5 SP8 to OES 2 Linux

You can move devices containing NSS volumes between NetWare 6.5 SP8 servers and OES 2 Linux servers. When you move an unshared device to a different server, you must decommission its volumes in eDirectory for the current server, then recommission them for the new server.

For shared NSS pools and volumes, Novell Cluster Services provides this service automatically during a rolling cluster conversion from NetWare 6.5 SP8 to OES 2 Linux. For information about converting shared pool cluster resources and service resources, see the *OES 2 SP3: Novell Cluster Services NetWare to Linux Conversion Guide*.

- Section 11.1.1, "Media Format," on page 129
- Section 11.1.2, "Pool Snapshots," on page 130
- Section 11.1.3, "Cross-Platform Issues," on page 130

11.1.1 Media Format

The NSS media upgrade for enhanced hard links support is available for the following operating platforms (and later versions):

- Novell Open Enterprise Server 2 Linux and NetWare
- Novell Open Enterprise Server 1 SP1 NetWare
- NetWare 6.5 SP4

The media upgrade is not available on OES 1 Linux, NetWare 6.5 SP3, and earlier versions. You cannot move a device that has been upgraded to the new media format to a platform that does not support it. For information about the media format upgrade, see Chapter 4, "Upgrading the NSS Media Format," on page 49.

11.1.2 Pool Snapshots

Different pool snapshot technologies are used for NSS pools on NetWare and NSS pools on Linux. You can create pool snapshots on either platform, but the snapshots are unusable if you move the devices cross-platform and are invalid if you move the volume back.

WARNING: Before moving a device cross-platform make sure to delete any existing pool snapshots for all pools on it. You might not be able to see the original pools on the Linux platform if you do not delete the snapshots before moving the device.

11.1.3 Cross-Platform Issues

For information about differences to expect when using NSS on Linux, see Chapter 7, "Cross-Platform Issues for NSS," on page 79.

11.2 Moving Non-Clustered Devices From NetWare 6.5 SP8 Servers to OES 2 Linux Servers

This section describes how to move devices cross-platform from a NetWare 6.5 SP8 server to an OES 2 SP1 (or later) Linux server. NSS supports moves of devices containing NSS volumes between any servers that support a compatible media format. For information, see Section 11.1, "Guidelines for Moving Devices from NetWare 6.5 SP8 to OES 2 Linux," on page 129.

IMPORTANT: Similar handling is necessary when moving devices with NSS pools between any two OES servers (NetWare to Linux, NetWare to NetWare, or Linux to Linux).

To preserve the NSS pool and volumes on the device when you move it, you must modify the volumes' Storage objects in eDirectory. You decommission the volume by removing its related Storage object from eDirectory for the original server. You recommission the volume by creating a new Storage object in eDirectory for the destination server. When moving clustered devices cross-platform for a cluster conversion from NetWare to OES 2 Linux, Novell Cluster Services automatically manages the Storage object updates to eDirectory.

NOTE: The *decommission* and *recommission* terminology is used only to illustrate the process; it does not represent a particular technology or tool.

- Section 11.2.1, "Prerequisites," on page 131
- Section 11.2.2, "Setting Up File Access For Users on the OES 2 Linux Server," on page 131
- Section 11.2.3, "Decommissioning Each NSS Pool and Its Volumes on the Original Server," on page 132
- Section 11.2.4, "Recommissioning Each NSS Pool and Its Volumes on the Destination Server," on page 133
- Section 11.2.5, "Using Scripts to Decommission and Recommission NSS Volumes," on page 134

11.2.1 Prerequisites

The prerequisites in this section apply to moving multiple devices from a NetWare 6.5 SP8 server to an OES 2 SP1 (or later) Linux server.

IMPORTANT: When moving a non-clustered device, you must also move any other devices that contribute segments to the NSS pools on the device you are moving.

Compatibility Issues for Using NSS Volumes Cross-Platform

Before you begin, make sure you understand the Section 7.2, "Cross-Platform Issues for NSS Volumes," on page 79.

Original NetWare Server

You can move NetWare 6.5 SP4 (or later) NSS media to an OES 2 Linux server if the operating platform can support the NSS media format. NetWare 6.5 SP3, OES 1 SP2 Linux, and earlier servers do not support the new media format.

For information, see Section 4.1, "Guidelines for Upgrading the Media Format of NSS Volumes," on page 49.

Destination OES 2 Linux Server

- NSS and other needed OES 2 services must be installed on the OES 2 SP1 (or later) Linux server where you want to move the NSS volume. For information, see Section 3.2, "Installing and Configuring NSS on Linux," on page 41.
- EVMS must be installed and running on the destination server.

11.2.2 Setting Up File Access For Users on the OES 2 Linux Server

Before or after you move an NSS volume from NetWare to Linux, you need to set up file access for users on the OES 2 Linux server.

Set Up Users in eDirectory

The original server and the destination server can be in the same or different eDirectory trees.

If the destination server is in the same tree as the original server, the file system trustees and trustee rights continue to work after the move.

If the destination server is in a different tree, use eDirectory to enable or reassign affected users for access in the destination tree. For information, see the *Novell eDirectory 8.8 Administration Guide*.

Set Up Protocols and Services

To provide access for users on the OES 2 SP1 (or later) Linux server, do one or more of the following, depending on your network environment:

- **NCP Server and Services:** Install and configure NCP Server to allow the users to access the volume with the Novell Client or other NCP services. For information, see the *OES 2 SP3: NCP Server for Linux Administration Guide*.
- **Novell AFP for Linux:** Install and configure Novell AFP to allow the users to access the volume with the Apple Filing Protocol. For information, see the *OES 2 SP3: Novell AFP For Linux Administration Guide*.
- **Novell CIFS for Linux:** Install and configure Novell CIFS to allow the users to access the volume with CIFS. For information, see the *OES 2 SP3: Novell CIFS for Linux Administration Guide*.
- **Linux Protocols and Services:** Install and configure other protocols, such as Novell Samba or Linux NFS, to allow the users to access the volume with the non-NCP protocols. Using these Linux services requires that the users be Linux enabled to execute Linux commands and services on the volume.

  For information about installing Novell Samba, see *OES2 SP3: Samba Administration Guide*.

  For information about configuring Linux NFSv3, see Section 18.16, "Exporting and Importing NSS Volumes for NFS Access," on page 242.

  For information about enabling users and the Linux service with Linux User Management (LUM), see the *OES 2 SP3: Novell Linux User Management Administration Guide*.

For guidelines about users and access, see Section 5.5, "Access Control for NSS on Linux," on page 62.

11.2.3 Decommissioning Each NSS Pool and Its Volumes on the Original Server

For each NSS pool, decommission the pool and its volumes from the original server.

1. If you use native Linux protocols or Linux services (such as SSH and FTP) for user access on the destination OES 2 SP1 (or later) Linux server, you must Linux-enable the current users of the volumes before you move the devices.

   IMPORTANT: If you do not use native Linux protocols or services for user access, this step is not necessary.

   Use one of the following methods to Linux-enable users of the volumes on the device:

   - To enable multiple users at once, use the `nambulkadd` command.

     User IDs are automatically refreshed after the enabling process ends.
   - To enable a single user at a time, use iManager.

   For information, see the *OES 2 SP3: Novell Linux User Management Administration Guide*.
2. Deactivate the pool on the device.
   - **2a** In iManager, click *Roles and Tasks*.
   - **2b** Click *Storage* > *Pools*.
   - **2c** Browse to select the original server where the NSS pool resides.
   - **2d** Select the pool you want to decommission, then click *Deactivate*.

3 Remove the eDirectory Storage objects for the NSS pool and each of its volumes.

3a In iManager, click *Roles and Tasks*.

3b Click *eDirectory Administration* > *Delete Object*.

3c Specify the name and context of the object or objects you want to delete.

3d Click *OK*.

4 Repeat Step 2 and Step 3 for each pool on the devices you plan to move.

5 If you are using DFS in the tree where the original server is located, run the `vldb repair` command.

On the primary VLDB server, at the command prompt, enter

```
vldb repair
```

This removes a GUID entry from the VLDB for each of the decommissioned volumes.

6 Remove or reallocate the devices from the original server. Depending on your storage configuration, this might require a server shutdown.

11.2.4 Recommissioning Each NSS Pool and Its Volumes on the Destination Server

For each NSS pool, recommission the pool and its volumes on the destination server.

1 Relocate or reassign the devices to the destination server.

2 Reboot the destination server to mount the devices.

3 If a pool on the devices you moved is not automatically activated, activate the pool.

3a In iManager, click *Roles and Tasks*.

3b Click *Storage* > *Pools*.

3c Browse to select the destination server.

3d Select the pool, then click *Activate*.

4 Create the eDirectory Storage objects for the NSS pool and each of its volumes.

4a In iManager, click *Roles and Tasks*.

4b Click *Storage* > *Pools*.

4c Browse to select the destination server.

4d Select the pool, then click *Update eDirectory*.

4e In the lower right, select *View Volume Details* to view all volumes on the selected pool.

iManager opens to the Volumes page with the server and pool preselected.

4f For each volume in the selected pool, select the volume, then click *Update eDirectory*.

4g Repeat Step 4d through Step 4f for each NSS pool and its volumes.

5 Allow the eDirectory tree to stabilize.

This can take several minutes.

6 Run the `vldb repair` command.

At the server command prompt on the primary VLDB server, enter

```
vldb repair
```

This adds a GUID entry to the VLDB for each of the recommissioned volumes.

11.2.5 Using Scripts to Decommission and Recommission NSS Volumes

Scripts are available to automate the process of decommissioning and recommissioning NSS volumes that are not cluster-enabled, see Decommissioning Script and Recommissioning Script for moving NSS devices cross-platform (http://www.novell.com/documentation/oes/script/decom_recom.zip). This `decom_recom.zip` file contains two Perl scripts:

- **decom.pl:** The decommissioning script deactivates the specified pool, removes eDirectory Storage objects for a specified NSS pool and each of its volumes on the original server, then it repairs the VLDB, if it exists, to remove the volumes' information from the VLDB. You provide the pool name, and the script automatically gets the list of volumes on the pool.
- **recom.pl:** The recommissioning script activates the specified pool, creates eDirectory Storage objects for a specified NSS pool and each of its volumes on the destination server, then it repairs the VLDB, if it exists, to add the volumes' information to the VLDB. You provide the pool name, and the script automatically gets the list of volumes on the pool.

The scripts support moving NSS volumes on OES 1 NetWare or NetWare 6.5 SP8 to OES 2 Linux. You can modify the scripts to move volumes between any two non-clustered OES servers:

- NetWare to Linux
- Linux to NetWare
- NetWare to NetWare
- Linux to Linux

Decommissioning NSS Pools on the Original Server with decom.pl

For each NSS pool, decommission the pool and its volumes from the original server.

1. If you use non-NCP protocols or Linux services for user access on the destination OES 2 Linux server, you must Linux-enable the current users of the volumes before you move the devices.

   IMPORTANT: If you use only NCP Server and NCP services for user access, this step is not necessary.

   Use one of the following methods to Linux-enable users of the volumes on the device:

   - To enable multiple users at once, use the `nambulkadd` command.

     User IDs are automatically refreshed after the enabling process ends.

   - To enable a single user at a time, use iManager.

   For information, see the *OES 2 SP3: Novell Linux User Management Administration Guide*.

2. For each NSS pool on the device you are moving, run the `decom.pl` script and specify the name of the pool to decommission.
3. Remove or reallocate the devices from the original server. Depending on your storage configuration, this might require a server shutdown.

Recommissioning NSS Pools on the Destination Server with recom.pl

For each NSS pool, recommission the pool and its volumes on the destination server.

1. Relocate or reassign the devices to the destination server.
2. Reboot the destination server to mount the devices.
3. For each NSS pool on the device you moved, run the `recom.pl` script and specify the name of the pool to recommission.

11.3 Moving Non-Clustered Devices From NetWare 6.0 to OES 2 Linux

NSS supports moving the devices containing NSS volumes from a NetWare 6.0 server to an OES 2 SP1 (or later) Linux server. For information, see Section 11.1, "Guidelines for Moving Devices from NetWare 6.5 SP8 to OES 2 Linux," on page 129.

To preserve the NSS pool and volumes on the device when you move it, you must modify the volumes' Storage objects in eDirectory. You "decommission" the volume by removing its related Storage object from eDirectory for the original server. You "recommission" the volume by creating a new Storage object in eDirectory for the destination server. When moving clustered devices cross-platform, while converting the cluster from NetWare to Linux, Novell Cluster Services automatically manages the Storage object updates to eDirectory.

NOTE: The "decommission" and "recommission" terminology is used only to illustrate the process; it does not represent a particular technology or tool.

IMPORTANT: Similar handling is necessary when moving devices with NSS pools between any two OES servers (NetWare to Linux, NetWare to NetWare, or Linux to Linux).

This section describes how to move devices cross platform from a NetWare 6.0 server to an OES 2 SP1 (or later) Linux or later server:

- Section 11.3.1, "Prerequisites," on page 135
- Section 11.3.2, "Setting Up File Access For Users on the OES 2 Linux Server," on page 136
- Section 11.3.3, "Decommissioning Each NSS Pool and Its Volumes on the Original Server," on page 137
- Section 11.3.4, "Recommissioning Each NSS Pool and Its Volumes on the OES Linux Server," on page 137

11.3.1 Prerequisites

The prerequisites in this section apply to moving multiple devices from a NetWare 6.0 server to an OES 2 SP1 (or later) Linux server.

IMPORTANT: When moving a non-clustered device, you must also move any other devices that contribute segments to the NSS pools on the device you are moving.

Compatibility Issues for Using NSS Volumes Cross-Platform

Before you begin, make sure you understand Section 7.2, “Cross-Platform Issues for NSS Volumes,” on page 79.

Destination OES 2 Linux Server

NSS must be installed on an EVMS-managed device on the destination server. For information, see “Installing with EVMS as the Volume Manager of the System Device” in the *OES 2 SP3: Installation Guide*.

11.3.2 Setting Up File Access For Users on the OES 2 Linux Server

Before or after you move an NSS volume from NetWare 6.0 to OES 2 SP1 (or later) Linux, you need to set up file access for users on the OES 2 SP1 (or later) Linux server.

Set Up Users in eDirectory

The original server and the destination server can be in the same or different eDirectory trees.

If the destination server is in the same tree as the original server, the file system trustees and trustee rights continue to work after the move.

If the destination server is in a different tree, use eDirectory to enable or reassign affected users for access in the destination tree. For information, see the *Novell eDirectory 8.8 Administration Guide*.

Set Up Protocols and Services

To provide access for users on the OES 2 SP1 (or later) Linux server, do one or more of the following, depending on your network environment:

- **NCP Server and Services:** Install and configure NCP Server to allow the users to access the volume with the Novell Client or other NCP services. For information, see the *OES 2 SP3: NCP Server for Linux Administration Guide*.
- **Novell AFP for Linux:** Install and configure Novell AFP to allow the users to access the volume with the Apple Filing Protocol. For information, see the *OES 2 SP3: Novell AFP For Linux Administration Guide*.
- **Novell CIFS for Linux:** Install and configure Novell CIFS to allow the users to access the volume with CIFS. For information, see the *OES 2 SP3: Novell CIFS for Linux Administration Guide*.
- **Linux Protocols and Services:** Install and configure other protocols, such as Novell Samba or Linux NFS, to allow the users to access the volume with the non-NCP protocols. Using these Linux services requires that the users be Linux enabled to execute Linux commands and services on the volume.

  For information about installing Novell Samba, see *OES2 SP3: Samba Administration Guide*.

  For information about configuring Linux NFSv3, see Section 18.16, “Exporting and Importing NSS Volumes for NFS Access,” on page 242.

  For information about enabling users and the Linux service with Linux User Management (LUM), see the *OES 2 SP3: Novell Linux User Management Administration Guide*.

For guidelines about users and access, see Section 5.5, “Access Control for NSS on Linux,” on page 62.

11.3.3 Decommissioning Each NSS Pool and Its Volumes on the Original Server

For each NSS pool, decommission the pool and its volumes from the original server.

1. On the NetWare 6.0 server, if the device you want to move contains any mirrored partitions, you must first break the mirror (remove all but 1 segment) before upgrading.
2. If you use non-NCP protocols or Linux services for user access on the destination OES 2 Linux server, you must Linux-enable the current users of the volumes before you move the devices.

   IMPORTANT: If you use only NCP Server and NCP services for user access, this step is not necessary.

   Use one of the following methods to Linux-enable users of the volumes on the device:

   - To enable multiple users at once, use the `nambulkadd` command.

     User IDs are automatically refreshed after the enabling process ends.
   - To enable a single user at a time, use iManager.

   For information, see the *OES 2 SP3: Novell Linux User Management Administration Guide*.
3. Deactivate the pool: At a server console, enter

   ```
   nss /pooldeactivate=pool
   ```
4. Remove the eDirectory Storage objects for the NSS pool and each of its volumes.
   - **4a** In iManager, click *Roles and Tasks*.
   - **4b** Click *eDirectory Administration* > *Delete Object*.
   - **4c** Specify the name and context of the object or objects you want to delete.
   - **4d** Click *OK*.
5. Repeat Step 2 and Step 3 for each pool on the devices you plan to move.
6. If you are using DFS in the tree where the original server is located, run the `vldb repair` command.

   At the command prompt on the primary VLDB server, enter

   ```
   vldb repair
   ```

   The VLDB Repair removes a GUID entry from the VLDB for each of the decommissioned volumes.
7. Remove or reallocate the devices from the original server. Depending on your storage configuration, this might require a server shutdown.

11.3.4 Recommissioning Each NSS Pool and Its Volumes on the OES Linux Server

For each NSS pool, recommission the pool and its volumes on the destination server.

1. Relocate or reassign the devices to the destination server.
2. Reboot the destination server to mount the devices.
3. If a pool on the devices you moved is not automatically activated, activate the pool. At a server console, enter

```
nsscon
nss /poolactivate=pool
```

4 Create the eDirectory Storage objects for the NSS pool and each of its volumes.

   4a In iManager, click *Roles and Tasks* .

   4b Click *Storage* > *Pools*.

   4c Browse to select the destination server.

   4d Select the pool, then click *Update eDirectory*.

   4e In the lower right, select *View Volume Details* to view all volumes on the selected pool.

   iManager opens to the Volumes page with the server and pool preselected.

   4f For each volume in the selected pool, select the volume, then click *Update eDirectory*.

   4g Repeat Step 4d through Step 4f for each NSS pool and its volumes.

5 Allow the eDirectory tree to stabilize.

   This can take several minutes.

6 Run the `vldb repair` command.

   On the primary VLDB server, at the command prompt, enter

   ```
   vldb repair
   ```

   The VLDB Repair adds a GUID entry for each of the recommissioned volumes to the VLDB.

7 Make sure the devices are up and working as expected on the Linux System.

8 For each device, you can optionally upgrade the format for its partitions (or segments, as specified in EVMSGUI) on the device, or leave the partitions in the old format.

   Upgrading the partitions on the device to the NetWare 6.5 and later partition format is strongly recommended, but it is not necessary unless you want to mirror a partition on the device. Before you can create the mirror, you must upgrade the partition format of the partitions on the device you moved.

   8a At a server console, open the EVMSGUI by entering

   ```
   evmsgui
   ```

   8b Right-click the segment, then select *Upgrade*.

   8c Repeat Step 8b for every partition on the device that was moved to the OES 2 Linux server.

   8d Click *Save* to save the changes.

9 If you want to mirror the upgraded partition from Step 8, see Section 13.7, “Mirroring an Existing Pool with NSSMU,” on page 160.

11.4 Moving Clustered Devices with NSS Volumes From NetWare to Linux

You can use a shared NSS data pool and volume in a mixed cluster configuration by using Novell Cluster Services for Linux if all nodes in the cluster support the same NSS media format.

For information about upgrading to the latest media format, see Section 4.1, “Guidelines for Upgrading the Media Format of NSS Volumes,” on page 49.

For information about converting clusters from NetWare to OES 2 SP1 (or later) Linux, see the *OES 2 SP3: Novell Cluster Services NetWare to Linux Conversion Guide*.

12 Managing Partitions

Novell Storage Services automatically manages partitions used under the software RAID devices and NSS pools, whether you create RAIDs and pools in the Storage plug-in for iManager or the NSS Management Utility.

- Section 12.1, “Understanding Partitions,” on page 141
- Section 12.2, “Viewing a List of Partitions,” on page 143
- Section 12.3, “Viewing Details for a Partition,” on page 145
- Section 12.4, “Deleting an NSS Partition,” on page 146
- Section 12.5, “Adding Other Types of File System Partitions,” on page 147

12.1 Understanding Partitions

- Section 12.1.1, “NSS Partitions,” on page 141
- Section 12.1.2, “Understanding Types of Partitions,” on page 141
- Section 12.1.3, “Understanding Partition Details,” on page 142

12.1.1 NSS Partitions

A partition is a logical division of a physical hard drive. NSS abstracts all partition creation and deletion in iManager and NSSMU through the *Pools* page and the *Software RAIDs* page. When you create NSS pools or NSS software RAID devices, NSS automatically creates the NSS partitions on the devices you specify. You can view and label these NSS partitions from the *Partitions* page.

Partitions are automatically managed by NSS whenever you create pools. You do not manage NSS partitions directly.

On Linux, the tools use the Enterprise Volume Management System (EVMS) to manage devices and partitions. EVMS discovers and mounts the partition in the `/dev/evms/` directory.

IMPORTANT: If you create and mount pools from the command line, you must modify your mount point to the partition’s location under `/dev/evms/`.

12.1.2 Understanding Types of Partitions

The following table describes the variety of partition types that iManager can report for an OES 2 Linux system.

The Partitions function in iManager and NSSMU is intended simply as a reporting tool so that you can see the types of partitions that are being virtualized by higher-level storage entities such as pools or software RAID devices. Generally, you cannot create or modify partitions with iManager or

NSSMU tools. NSS partitions are created for you automatically when you create a pool. There might be multiple NSS partitions that are aggregated and managed underneath the single pool of space. Similarly, the tools automatically create a Virtual Device when you create a software RAID device.

IMPORTANT: You cannot create any of the reported partition types in iManager; you can only view and label NSS partitions from the Partitions page.

Table 12-1 *Explanation of Partition Types*

Partition Type	Description
Cluster Service	A partition used to monitor cluster connectivity and services; it appears only in shared devices in the cluster.
DOS	A conventional DOS partition.
Ext3	The partition type for Linux Extended File System 3.
iSCSI	A partition in a target disk server in an iSCSI storage area network; it appears as an iSCSI device to file servers with iSCSI initiator software.
NSS	The primary partition type for NSS file systems.
Reiser	The partition type for Linux Reiser file systems.
System Configuration	A vendor-specific partition for maintaining metadata about the server configuration.
Unknown	An partition type that is unknown to the current operating system.
Virtual Device	A partition that serves as a partition in a software RAID 0 or RAID 5 device.

12.1.3 Understanding Partition Details

You can view the following information about partitions:

Table 12-2 *Explanation of Partition Details*

Partition Detail	Description
Partition ID	The partition name assigned by the device manager.
Partition Name	The physical descriptive name of the partition that corresponds to the device's physical descriptive name, followed by the type of partition it is.
Type	The abbreviated name of the partition type.
Status	Specifies if a partition is In Use or Available.
Label	The partition name assigned by the administrator.
Starting Offset	Amount of space on the disk that precedes the beginning of the selected partition.
Size	The storage capacity of this partition.
Device Name	The physical descriptive name of the device where the partition exists. For software RAIDs, the description might include RAID 0, RAID 1, or RAID 5.
Device ID	The device name assigned by the device manager.
Pool Name	For NSS partitions, specifies the name of the pool that uses the partition.

12.2 Viewing a List of Partitions

The Partitions page in the Storage plug-in to iManager and in NSSMU is a reporting tool that allows you to view a list of partitions. You can view the types of partitions that are being virtualized by higher-level storage entities such as NSS pools or software RAID devices.

In iManager, you can use the Partitions page, or access information about partitions through a related task.

- Section 12.2.1, "Viewing Partitions on the Server," on page 143
- Section 12.2.2, "Viewing Partitions on a Device," on page 144
- Section 12.2.3, "Viewing Partitions in a Software RAID Device," on page 144
- Section 12.2.4, "Viewing Partitions in an NSS Pool," on page 145

12.2.1 Viewing Partitions on the Server

The Partitions page in iManager reports the partitions that it finds on a selected server, and displays information about them.

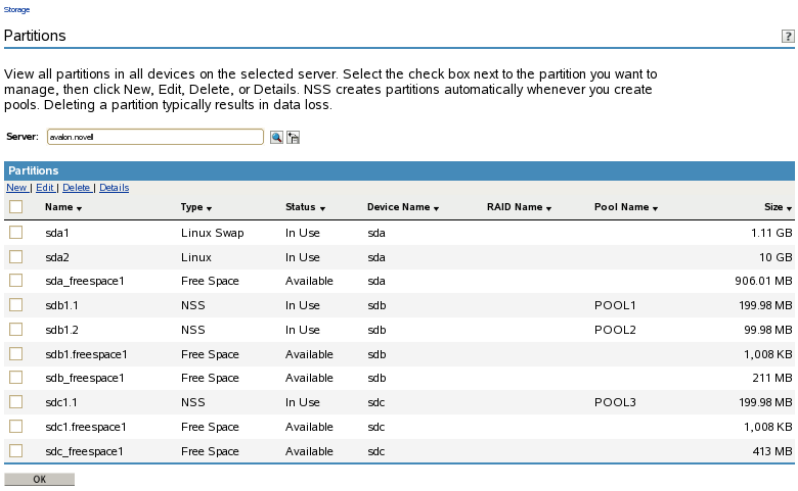
1. In iManager, click *Storage* > *Partitions*.

   For instructions, see Section 9.1.5, "Accessing Roles and Tasks in iManager," on page 94.
2. Select the server that you want to manage.

   For instructions, see Section 9.1.6, "Selecting a Server to Manage," on page 95.

3 View the list of partitions on the device.

For information about the partition types, see Section 12.1, “Understanding Partitions,” on page 141.



12.2.2 Viewing Partitions on a Device

1 In iManager, click *Storage* > *Devices*.

For instructions, see Section 9.1.5, “Accessing Roles and Tasks in iManager,” on page 94.

2 Select the server that you want to manage.

For instructions, see Section 9.1.6, “Selecting a Server to Manage,” on page 95.

3 In the *Devices* list, select a device.

4 In the *Details* area, click the arrow on the *Partitions* drop-down list to expand it.

5 Select a partition, then click the *View Details* icon.

The *Partitions* page displays a list of all the partitions that currently exist on the selected device.

12.2.3 Viewing Partitions in a Software RAID Device

1 In iManager, click *Storage* > *Software RAIDs*.

For instructions, see Section 9.1.5, “Accessing Roles and Tasks in iManager,” on page 94.

2 Select the server that you want to manage.

For instructions, see Section 9.1.6, “Selecting a Server to Manage,” on page 95.

3 In the *Software RAIDs* list, select a device.

Wait for the page to refresh before continuing.

4 In the *Details* area, click the arrow on the *Partitions* drop-down list to expand it.

5 To view details about partitions, click the *View Partition Details* icon.

This opens the *Partitions* page. It displays a list of all the partitions that currently exist on the selected device.

6 Select a partition from the *Partitions* list, then click *Details* to view more information.

12.2.4 Viewing Partitions in an NSS Pool

Although NSS abstracts the partitions underlying the pool structure, you can view information about those partitions.

1. In iManager, click *Storage* > *Pools*.

   For instructions, see Section 9.1.5, "Accessing Roles and Tasks in iManager," on page 94.
2. Select the server that you want to manage.

   For instructions, see Section 9.1.6, "Selecting a Server to Manage," on page 95.
3. In the *Pools* list, select the pool you want to manage.

   Wait for the page to refresh and display the details. The pool must be active to see partition details.
4. If the pool is deactive, make sure the pool is selected, then click *Activate*.

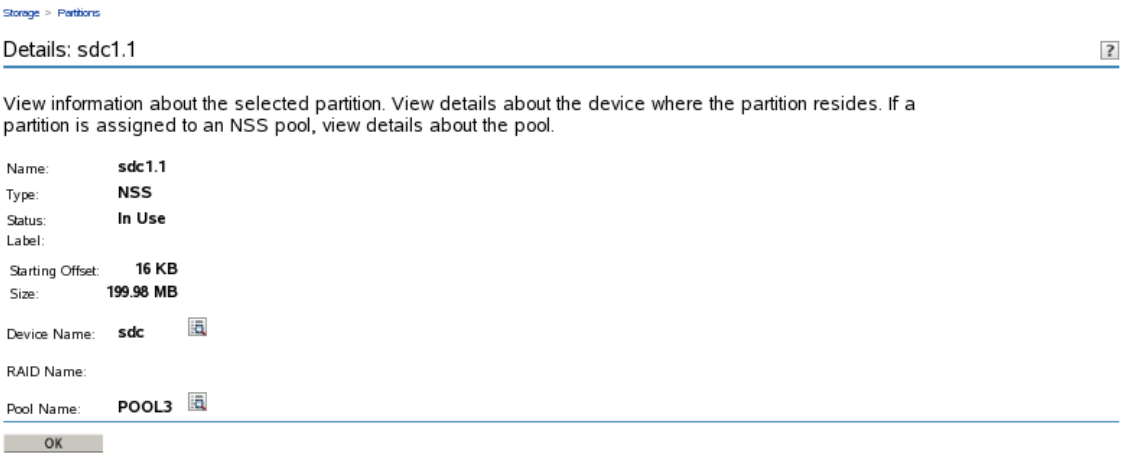
   After the page refreshes, the *Partitions* drop-down list is available.
5. Click on the arrow next to the *Partitions* drop-down list to expand the list.
6. To view details about the partitions, click the *View Partition Details* icon.

   A *Partitions* page opens where you can view details about the pool's partitions.
7. Select a partition from the *Partitions* list, then click *Details* to view more information.

12.3 Viewing Details for a Partition

1. In iManager, go to the *Storage* > *Partitions* page, then select a server.
2. in the list of Partitions, select a partition.
3. Click *Details* to view its *Partition Details* page.

   For information about the details, see Section 12.1.3, "Understanding Partition Details," on page 142.



4. Click the *View Details* icon next to the *Device Name* to go to the Devices page.

   The device is preselected and its details are displayed automatically on the right.
5. Click the *View Details* icon next to the *Pool Name* to go to the Pools page.

   The pool is preselected and its details are displayed automatically on the right.

12.4 Deleting an NSS Partition

Deleting a partition results in data loss. We recommend that you delete the storage structure that uses the parttion instead of deleting the partition itself.

- Section 12.4.1, "Deleting Partitions in a Pool," on page 146
- Section 12.4.2, "Deleting Partitions in an NSS Software RAID Device," on page 146

12.4.1 Deleting Partitions in a Pool

You cannot shrink the size of a pool by deleting its partitions. Use the Pools page in iManager or NSSMU to delete the pool. For information, see Section 15.6, "Deleting a Pool," on page 183.

12.4.2 Deleting Partitions in an NSS Software RAID Device

You can delete all of the partitions in a software RAID device by deleting the software RAID. For information, see Section 13.15, "Deleting a Software RAID Device," on page 168.

For NSS software RAIDs that provide fault-tolerance, there is limited support for deleting individual partitions used in the RAID.

NSS Software RAID	Delete a Partition (Yes/No)	Guidelines
RAID 0	No	Delete the RAID to remove its partitions.
RAID 1 (mirror)	Yes	Delete the RAID, or delete all but one partition.
RAID 5	Yes	Delete the RAID, or delete only one failed partition at a time to repair and restore the RAID. See also Section 13.14, "Replacing a Failed Segment in a Software RAID," on page 166.

For NSS software RAID devices, use the Software RAIDs page in iManager or NSSMU to access and delete its partitions.

- "Using iManager to Delete a Partition in a Software RAID" on page 146
- "Using NSSMU to Delete a Partition in a Software RAID" on page 147

Using iManager to Delete a Partition in a Software RAID

The Storage plug-in to iManager does not allow you to delete partitions from the Partitions page because it is designed to abstract all partition management. To delete a single partition in a software RAID 1 or RAID 5 device:

1. In iManager, click *Storage* > *Software RAIDs*.

   For instructions, see Section 9.1.5, "Accessing Roles and Tasks in iManager," on page 94.
2. Select the server that you want to manage.

   For instructions, see Section 9.1.6, "Selecting a Server to Manage," on page 95.
3. In the *Software RAIDs* list, select the software RAID 1 or RAID 5 device you want to manage.

   Wait for the page to refresh and display the details.

4 Click the *View Partition Details* icon to open the *Partitions* page for the selected software RAID.

5 Select a partition, then click *Delete* to delete the partition and its contents.

Using NSSMU to Delete a Partition in a Software RAID

NSSMU allows you to delete any NSS partition directly from the Partitions page.

1 In NSSMU, select *Partitions*.

2 Select the partition you want to delete.

3 Click *Delete* to delete the partition and its contents, then click *OK* to confirm deletion.

12.5 Adding Other Types of File System Partitions

NSS and Linux POSIX file systems can co-exist on a device that is managed by EVMS. Use NSSMU or the iManager Storage plug-in to manage NSS pools and volumes on OES 2 Linux. Use the EVMS GUI (evmsgui) management tool to create Linux POSIX file systems on the device. For more information, see Section C.2, "Using Linux POSIX File Systems and NSS Pools and Volumes on the Same Device," on page 453.

Do not use YaST or LVM2 management tools to create or manage NSS pools and volumes on EVMS-managed devices. During the partition creation process, the YaST partitioner modifies the `/etc/fstab` configuration file to incorrectly identify NSS pools as Ext2 partitions instead of NSS partitions. This can make your system unbootable.

For example, a command like this is added to the `/etc/fstab` file for each NSS pool:

`/dev/evms/poolname /nss/.pools/poolname ext2 defaults 1 2`

where *poolname* is the name of the pool.

Instead of `ext2`, the partition type should be `nss`:

`/dev/evms/poolname /nss/.pools/poolname nss defaults 1 2`

To work around this problem when using the YaST partitioner, after you create a Linux POSIX file system and before you reboot your system, edit the `/etc/fstab` file to remove or comment out the lines that identify NSS partitions as Ext2 partitions.

To recover your system if you reboot your server before editing the `/etc/fstab` file:

1 Boot your OES 2 Linux server in Single User mode.

2 Mount the root (`/`) file system with the `remount` and read/write (`rw`) options by entering the following at a terminal console prompt:

```
mount -n -o remount,rw /
```

3 Edit the `/etc/fstab` file to do the following, then save the file:

- If a line wrongly identifies an NSS partition as an Ext2 partition, correct the entry by changing `ext2` to `nss`.
- If a line wrongly identifies an NSS partition as an Ext2 partition, and if the entry duplicates a correct entry for the NSS partition, then remove or comment out the line that wrongly identifies the NSS partition as an Ext2 partition.

4 Reboot the server to apply the changes.

13 Managing NSS Software RAID Devices

RAID devices help provide data fault tolerance for storage devices. In some RAID configurations, the read/write performance is also improved. The Novell Storage Services (NSS) File System supports software RAIDs 0, 1, 5, 0+1, and 5+1.

This section describes the following:

- Section 13.1, “Understanding Software RAID Devices,” on page 149
- Section 13.2, “Planning for a Software RAID Device,” on page 151
- Section 13.3, “Viewing a List of Software RAID Devices on a Server,” on page 155
- Section 13.4, “Viewing Details of a Software RAID Device,” on page 156
- Section 13.5, “Creating Software RAID Devices with iManager,” on page 157
- Section 13.6, “Creating Software RAID Devices with NSSMU,” on page 160
- Section 13.7, “Mirroring an Existing Pool with NSSMU,” on page 160
- Section 13.8, “Creating a RAID 1 Mirror to Duplicate Data,” on page 161
- Section 13.9, “Creating a Software RAID 0+1 with NSSMU,” on page 162
- Section 13.10, “Creating a Software RAID 5+1 with NSSMU,” on page 162
- Section 13.11, “Renaming a Software RAID Device,” on page 163
- Section 13.12, “Increasing the Size of a Software RAID Device,” on page 163
- Section 13.13, “Restriping a Software RAID 0 or 5 Device,” on page 165
- Section 13.14, “Replacing a Failed Segment in a Software RAID,” on page 166
- Section 13.15, “Deleting a Software RAID Device,” on page 168
- Section 13.16, “Viewing Pools on a Software RAID Device,” on page 168
- Section 13.17, “Viewing Partitions on a Software RAID Device,” on page 169
- Section 13.18, “Deleting Partitions on a Software RAID Device,” on page 170
- Section 13.19, “Managing Software RAID Devices with NSSMU,” on page 170

13.1 Understanding Software RAID Devices

A software RAID is a configuration for storage devices that emulates a hardware RAID device. A software RAID combines partitioned space from multiple physical devices into a single virtual device that you manage like any device. Each member device contributes an equal amount of space to the RAID. You can create partitions, pools, and volumes on a RAID device, just as you would with any physical storage device. Unlike hardware RAID devices, software RAIDs use standard host adapters and do not require any special RAID hardware.

The following table describes the software RAID devices supported by NSS:

Table 13-1 *RAID Characteristics*

Type of RAID	Number of Segments	Purpose	Advantages	Disadvantages
RAID 0	2 to 14	Data striping	Improves I/O performance for both reads and writes, which occur concurrently in parallel to its member devices.	Does not provide data redundancy for data fault tolerance. If a single disk fails, the data cannot be recovered. You must re-create the RAID 0 and restore its volumes from a backup copy before you can use it again.
RAID 1	2 to 4	Data mirroring	Provides full data redundancy for failover and instant recovery. Improves read performance. Equivalent write performance is possible with a duplex connection, which provides a separate channel for each member disk.	To achieve the best I/O performance, it requires separate channels for each member disk; otherwise, write performance decreases slightly. Each mirror must be on a separate device; it can share no disks in common. Can be a member of only one pool.
RAID 5	3 to 14	Data striping with parity	Provides limited data recovery for one member disk at a time. If a single drive in the RAID fails, its volumes and pools remain active, but with degraded performance because the RAID must use parity to reconstruct the missing data. You must remove the failed segment, replace the disk, add the new segment, and restripe the data to reconstruct the data on the replacement drive. Improves read performance if all drives are present and working properly. If a drive fails, read performance is reduced because of parity reads and data reconstruction.	Read responses are the same only if data happens to be in cache when called; otherwise it is slightly reduced for parity checking. I/O performance for writes is reduced because it takes time to calculate and write parity to disk. The more writes to the drive, the greater is the burden to CPU. If multiple disks fail, the data cannot be recovered. You must re-create the RAID 5 and restore its volumes from a backup copy before you can use it again.
RAID 0+1	2 to 4 RAID 0 devices	Mirroring RAID 0 devices	Provides full data redundancy for failover and instant recovery. Improves I/O performance for both reads and writes, but is slower than an unmirrored RAID 0 device.	Requires separate channels for each member disk to achieve best I/O performance. RAID 0 devices that you mirror can share no disks in common. If a single disk fails, you must re-create the RAID 0 and remirror the entire device. The data is restored through mirroring.

Type of RAID	Number of Segments	Purpose	Advantages	Disadvantages
RAID 5+1	2 to 4 RAID 5 devices	Mirroring RAID 5 devices	Provides full data redundancy for failover and instant recovery. If a single data disk fails, the RAID 5 device remains up and mirrored. Its performance is degraded until you replace the failed disk. It can handle multiple disk failures, depending on the number of failures and which disks fail.	Requires separate channels for each member disk to achieve best I/O performance. RAID 5 devices that you mirror can share no disks in common. If multiple data disks fail concurrently on the same segment, you must remove the damaged segment from the mirror, re-create the RAID 5, and then mirror the RAID 5. The data synchronizes with the mirrors.

13.2 Planning for a Software RAID Device

Before you create your software RAID device, you must evaluate your storage requirements and determine which RAID solution best fits your performance and fault tolerance needs.

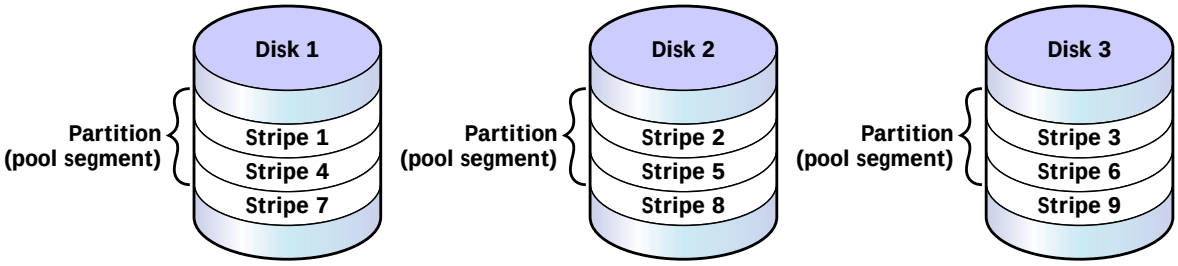
- Section 13.2.1, “General Guidelines for Software RAID Devices,” on page 151
- Section 13.2.2, “Guidelines for Software RAID 1 Devices,” on page 152
- Section 13.2.3, “Drive Restrictions for NSS Software RAID 0 and 1 Devices,” on page 153
- Section 13.2.4, “Choosing a Software RAID Solution,” on page 153
- Section 13.2.5, “Determining the Partition Size,” on page 154
- Section 13.2.6, “Determining the Number of Partitions,” on page 154
- Section 13.2.7, “Determining the Stripe Size for RAID 0 and RAID 5,” on page 155

13.2.1 General Guidelines for Software RAID Devices

To set up a RAID device, you allocate free space from any of your physical storage devices. NSS transparently presents the allocated free space as virtual partitions that represent NSS-managed physical partition areas on the participating drives. These partitions are the basic elements of a software RAID device. How you allocate each of the partitions to pools depends on the nature of the pools (shared or not shared for clustering) and the type of RAID device it is.

As an example, the RAID 0 device, illustrated in the following figure, consists of three RAID partitions. It stripes data across three physical drives. The stripes are written and read in the order designated.

Figure 13-1 *Striping Data on a Software RAID 0 Device*



Consider the following general guidelines when creating a software RAID device:

- Each partition in the RAID configuration should come from a different device. NSS lets you obtain RAID partitions from the same device, but this severely impedes the performance of your file system.
- Do not use space from a drive that contains your system partition (such as the root (`/`) or `/boot` partitions on Linux).
- You can use any combination of IDE or SCSI devices in a software RAID device. Make sure these devices have similar performance characteristics; otherwise, your performance might decrease.
- In a clustered solution using Novell Cluster Services, for software RAIDs 0 or 5 on shared disks:
  - You can have only one pool associated with that RAID device.
  - You must create an NSS pool and volume on that RAID device from the same server node before the pool can be migrated to other nodes in the cluster.

13.2.2 Guidelines for Software RAID 1 Devices

The following is a list of requirements for mirroring partitions with software RAID 1 devices:

- Mirrored partitions must have the same partition type: NSS partitions to NSS partitions and Traditional partitions to Traditional partitions.
- Mirrored partitions should be set up on devices that have similar performance thresholds.
- You can mirror only partitions, each from its own NetWare partition. If a storage pool spans multiple devices, each of the individual partitions that make up that pool can be mirrored independently. All of the pool's partitions must be mirrored in order for the data in that pool to be fault tolerant.
- You cannot combine mirror groups (existing groups with multiple mirrored partitions). A mirror group is expanded by adding a partition from your free space but not by adding an existing mirror group to the current group.
- All of the devices that participate in a mirror must be marked a shared or not shared for clustering for each mirror group.
- Avoid setting up multiple mirror groups on a single device. Such configuration heavily degrades the performance of the file system.
- To mirror software RAID 0 devices, the member devices must have no drives in common.

13.2.3 Drive Restrictions for NSS Software RAID 0 and 1 Devices

When you create or expand an NSS software RAID device on Linux, do not use space from the drive that contains your boot partition or system partition. In a worst-case scenario, you might need to reinitialize a drive if the partition in the RAID failed.

WARNING: Reinitializing a drive destroys its contents.

If your boot and system partitions are on drives managed by LVM, the drives are not eligible to contribute space to the software RAID.

If the boot and system partitions are on drives managed by EVMS, the drives might appear in the list of available devices if they contain enough space. Do not specify space from those drives as segments for the NSS software RAID device you are creating or expanding.

13.2.4 Choosing a Software RAID Solution

When choosing a software RAID solution, determine whether you need to address file system performance, data fault tolerance, or both. The following table highlights the key data fault tolerance, performance, and configuration issues associated with each RAID type.

Table 13-2 *RAID Performance Characteristics*

Requirement	RAID 0	RAID 1	RAID 5	RAID 0+1	RAID 5+1
NSS on Linux	Yes, for data volumes only	Yes, for data volumes only	Yes, for data volumes only	Yes, for data volumes only	Yes, for data volumes only
Data fault-tolerance	No	Redundancy	Parity	Redundancy	Redundancy and parity
Read I/O performance	Best improved (parallel reads)	Improved if parallel channels to each mirror	Improved, if all segments are present and working properly	Improved, with RAID 0 read advantage	Improved if parallel channels to each mirror, with RAID 5 read advantage
Write I/O performance	Best improved (parallel writes)	Same if parallel channels; otherwise, slightly decreased	Somewhat decreased by parity calculation	Slightly improved, depending on channel configuration	Somewhat decreased, depending on channel configuration and parity calculations
Valid names	1 to 116 characters (iManager) 1 to 15 characters (NSSMU)	1 to 80 characters (iManager) 1 to 15 characters (NSSMU)	1 to 116 characters (iManager) 1 to 15 characters (NSSMU)	2 to 80 characters (iManager) 1 to 15 characters (NSSMU)	2 to 80 characters (iManager) 1 to 15 characters (NSSMU)
Number of segments	2 to 14	2 to 4	3 to 14	Mirror 2 to 4 software RAID 0 devices	Mirror 2 to 4 software RAID 5 devices

Requirement	RAID 0	RAID 1	RAID 5	RAID 0+1	RAID 5+1
Maximum segment size	1 TB, if 2 segments	2 TB for each mirror	0.66 TB, if 3 segments	2 TB for each mirror	0.66 TB, if 3 segments
Maximum RAID size (total for combined segments)	2 TB	2 TB	2 TB	2 TB	2 TB
Minimum segment size	12 MB	12 MB	12 MB	12 MB	12 MB

13.2.5 Determining the Partition Size

The space that a member device contributes to a software RAID is called a partition or segment. Each physical device should contribute only one partition to the RAID; otherwise, it negates the benefits of the RAID. A software RAID device can contain only one partition per device. All member partitions in a software RAID device must be the same size.

The size of physical and logical devices used for NSS and Traditional file systems cannot exceed 2 TB (1 TB = 2E40 bytes). For example, when using two segments to create a RAID 0, the maximum partition size of each member segment is 1 TB. For a RAID 1, each segment is a mirror, so the maximum size of each segment is 2 TB.

The capacity of the RAID device depends on the RAID type and the number of member partitions:

- **RAID 0:** Capacity equals the number of partitions times the partition size.
- **RAID 1:** Capacity equals one partition size.
- **RAID 5:** Capacity equals the number of partitions minus one, times the partition size.
- **RAID 0+1:** Capacity equals one partition size of space taken from the RAID 0; it is not limited to the partition size of partitions in the RAID 0 itself.
- **RAID 5+1:** Capacity equals one partition size of space taken from the RAID 5; it is not limited to the partition size of partitions in the RAID 5 itself.

13.2.6 Determining the Number of Partitions

Each software RAID device comprises multiple partitions. You must specify at least the minimum number of partitions to create the type of RAID you choose. The maximum number of partitions is limited by the maximum number supported by that RAID type and the maximum device size (2 TB) that can be seen by NSS and Traditional file systems.

After you set up the software RAID device, you can increase its size by adding segments. In iManager, click *Storage* > *Software RAIDs* > *Increase Size*, and then add segments up to the maximum number of segments for each type of RAID, or until you reach the maximum device size of 2 TB.

You cannot remove segments in a RAID device to decrease its size. In general, to reduce the size of a RAID device: Back up its data, delete the RAID, re-create the RAID with a smaller segment size or fewer segments, and then restore its data from the backup copy.

For some RAIDs, you can replace a failed partition by removing the segment from the RAID, replacing the failed disk, and then adding a segment to the RAID to replace the failed one. For information, see Section 13.14, “Replacing a Failed Segment in a Software RAID,” on page 166.

13.2.7 Determining the Stripe Size for RAID 0 and RAID 5

In RAID 0 and RAID 5 configurations, NSS writes data to each member device in turn. The maximum amount of data (in KB) committed to each write to a partition is called a stripe. Striping is unrelated to file block sizes that you might set on your storage device.

Set the stripe size in increments of powers of two, between 4 KB and 256 KB (4, 16, 32, 64, 128, 256). The default stripe size is 64 KB.

To maximize performance of the RAID, set the stripe size to correspond with your typical data write requirements. In general, use smaller stripe sizes for data servers and medium-to-large sizes for file servers. For most implementations, 64 KB provides the best performance.

13.3 Viewing a List of Software RAID Devices on a Server

Use the Software RAIDs task in the iManager Storage plug-in to create and manage your software RAID devices.

1. In iManager, click *Storage* > *Software RAIDs*.

   For instructions, see Section 9.1.5, “Accessing Roles and Tasks in iManager,” on page 94.

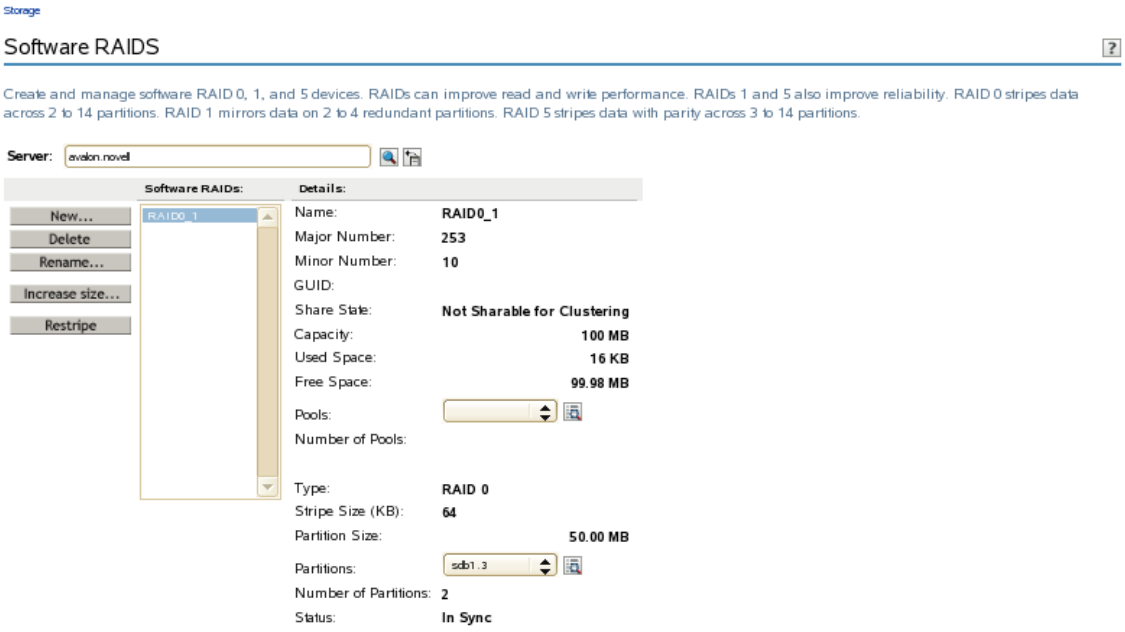
2. Select a server in the Novell eDirectory tree where you are logged in.

   For instructions, see Section 9.1.6, “Selecting a Server to Manage,” on page 95.

   A list of software RAID devices appears in the *Software RAIDs* list. Depending on the number of devices, this can take a few seconds. Avoid clicking again in the page until it refreshes and displays the *Software RAIDs* list.

3. Select a RAID device from the *Software RAIDs* list to view its details.

   For an overview of the subtasks available from this page, see “Software RAIDs” on page 99.



13.4 Viewing Details of a Software RAID Device

You can view the following information about a selected software RAID device:

Table 13-3 *Explanation of Details for a Software RAID Device*

Software RAID Device Detail	Description
Name	The administrator-specified descriptive name for the RAID. In iManager, if you do not specify a name for the device at create time, a name is autogenerated in the format of RAID <type> Device <number>.
Major Number Minor Number	The device identity in major:minor format. Major and minor numbers are associated with the device special files in the `/dev` directory and are used by the operating system to determine the actual driver and device to be accessed by the user-level request for the special device file.
GUID	The Global Unique Identifier number that NSS assigns to the storage object. This number is necessary so your file system can locate the specific device.
Share State	*Shareable for Clustering* or *Not Shareable for Clustering*. The share state can be modified on the Devices page. If you assign partitions to a software RAID device, all the devices for those member partitions must either be marked as *Shareable for Clustering*, or all marked as *Not Shareable for Clustering*.
Capacity	The total storage capacity of the device that is reserved for data storage. For a RAID 0, the storage capacity is equal to the sum of its partitions. For RAID 1, the storage capacity is equal to a single partition size; the duplicate partitions are mirrors. For RAID 5, the storage capacity is equal to the sum of its partitions minus one partition for parity.
Used Space	The amount of space on the device that is currently in use by NSS partitions.
Free Space	The total amount of space on the device that is currently not in use.
Pools	The drop-down list shows all pools that exist on this device. To view a pool's details or to manage a pool, select the pool from the list, then click the *View Details* icon to go to the *Pools* page for that pool.
Number of Pools	The total number of pools that use this device.
Type	The type of RAID (such as RAID 0, RAID 1, RAID 5).
Stripe Size	The maximum size (in KB) of a data write, as configured for a RAID 0 or RAID 5 device.
Partition Size	The size (in MB) of partitioned space per drive.
Partitions	Lists the member partitions of the selected software RAID device in a drop-down list. To view a partition's details, select the partition in the drop-down list, then click the *View Details* icon.
Number of Partitions	The total number of partitions in the selected software RAID device.

Software RAID Device Detail	Description
Status	Shows the status of a RAID 1 (mirrored) device's partitions: ◆ **In Sync:** The mirror group is fully synchronized. ◆ **Out of Sync:** The mirror group is only partially synchronized, and the percent mirroring in progress. ◆ **Not Mirrored:** The device is not mirrored (only one partition).

Viewing Details in iManager

1 In iManager, click *Storage* > *Software RAIDs*.

For instructions, see Section 9.1.5, "Accessing Roles and Tasks in iManager," on page 94.

2 Select a server in the eDirectory tree where you are logged in.

For instructions, see Section 9.1.6, "Selecting a Server to Manage," on page 95.

This opens the *Software RAIDs Management* page.

The *Software RAIDs* list displays the virtual RAID devices on the selected server. The list might include any RAID O, RAID 1, or RAID 5 devices that you created. It does not list any hardware RAID devices in this list.

3 Select a virtual storage device in the *Software RAIDs* list to view information about that device, then wait for the page to refresh.

Viewing Details in NSSMU

1 In NSSMU, select *Software RAIDs*.

2 Select the RAID device you want to manage and wait for the information to be displayed.

13.5 Creating Software RAID Devices with iManager

1 In iManager, click *Storage* > *Software RAIDs*.

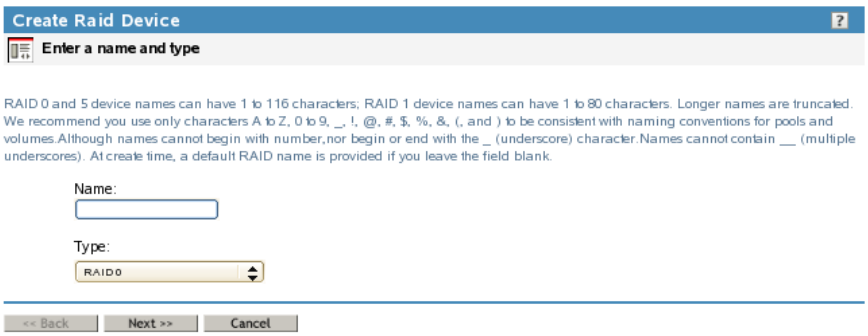
For instructions, see Section 9.1.5, "Accessing Roles and Tasks in iManager," on page 94.

2 Select a server in the eDirectory tree where you are logged in.

For instructions, see Section 9.1.6, "Selecting a Server to Manage," on page 95.

3 Click New.

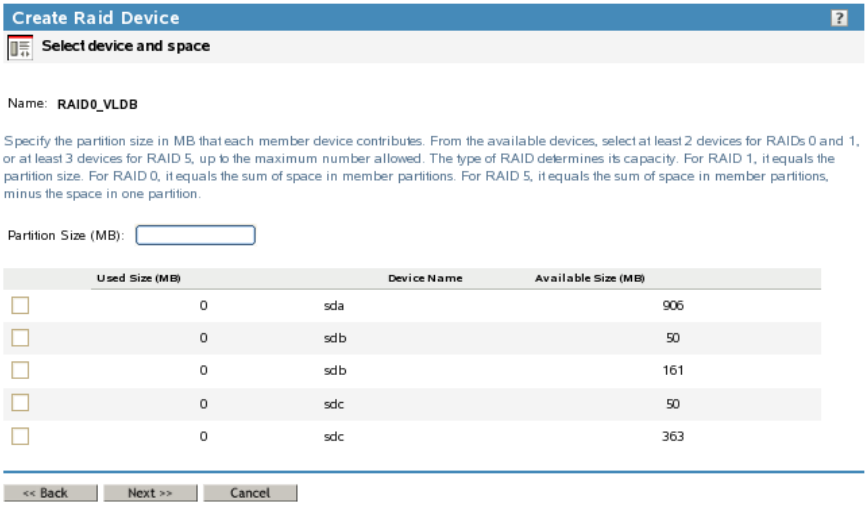
This opens a Wizard that steps you through the process.



4 **Device Type and Name:** Specify the type of RAID device you want to create, type a name for the RAID device, then click *Next*.

If you leave the Name field blank, NSS creates a unique name for the device in the form of RAID <type> Device <sequential_number>. For information about choosing names, see Section 5.4, "Naming NSS Storage Objects," on page 59.

This opens the *Devices and Space* page.



5 **Devices and Space:** Select devices and the amount of space to use from each, then click *Next*.

5a In the *Partition Size* field, type the amount of space in MB to use from each physical device.

NSS identifies devices that have enough free space to meet the partition-size requirements and are eligible for inclusion in the RAID. For information, see "Determining the Partition Size" on page 154.

If the amount you specify exceeds the amount of free space available on a minimum number of physical devices, the RAID creation fails and returns an error message.

5b Select the check box next to each of the storage devices you want to obtain space from.

You can obtain space from multiple devices. Select only devices that have enough space available to meet your needs. Each segment must be more than 12 MB. The combined space from all segments must be less than 2 TB.

If a device's available space is smaller than the specified partition size, it is disabled (dimmed) so that you cannot select it.

IMPORTANT: Unallocated partitions (that is, partitions that are not mirrored and do not contain pools or other file systems), are deleted in order to present the unused space as free space for use by the RAID. No data loss occurs by this action.

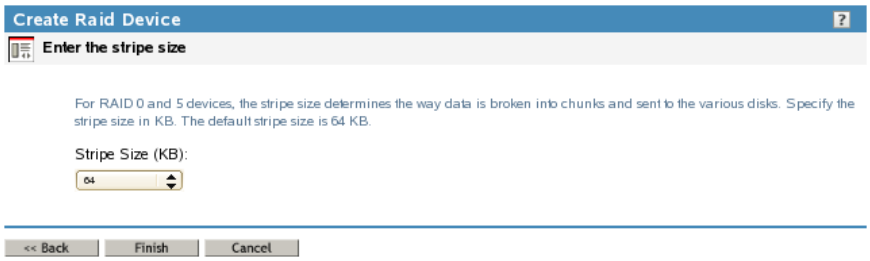
A single physical device can offer multiple free space areas in the list. After you select a device, all other free space on that device is disabled for that RAID. Each device should contribute only one partition to the RAID; otherwise, it defeats the purpose of improved performance and data protection that a RAID affords.

If the server has both local and shared devices, the partitions of a RAID can reside only on shared devices or only on local devices. If you select the check box next to a local storage device, the shared devices are dimmed so that you cannot select them. If you select the box next to a shared storage device, the local devices are dimmed.

Only devices that have free space appear in the list. If no devices are listed, there is no space available to create a software RAID device. Cancel the Wizard, add more devices to the server or free up space on existing devices, then return to the *Software RAIDs* page to create a RAID device.

5c If this is a RAID 0 or 5, click *Next* to go to the Stripe Size page. Otherwise, skip ahead to Step 7.

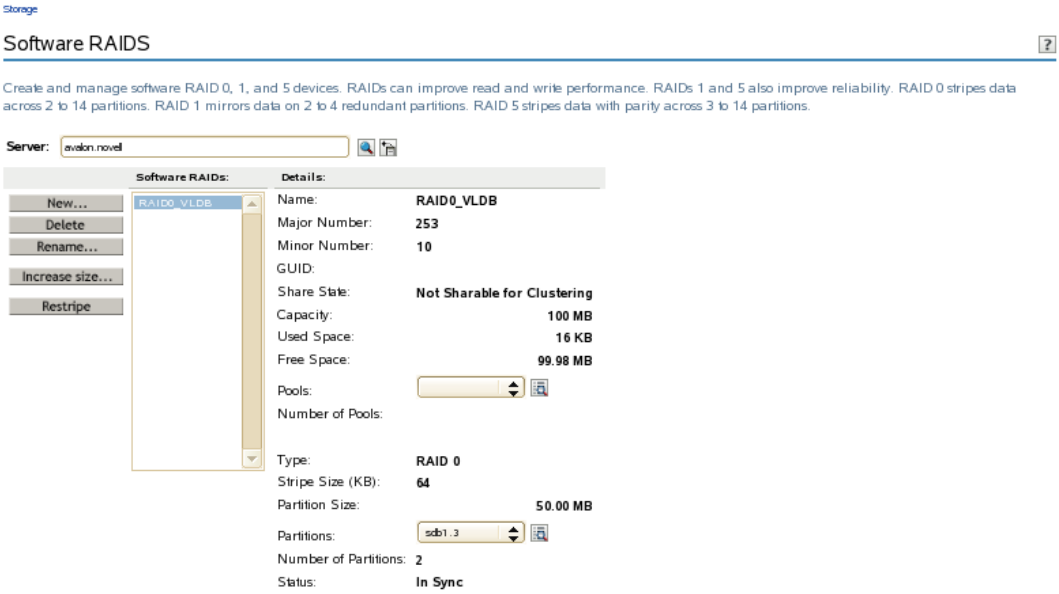
This opens the Stripe Size page.



6 Stripe Size: If this is a RAID 0 or 5 device, set the stripe size. For information, see "Determining the Stripe Size for RAID 0 and RAID 5" on page 155.

7 Click *Finish*. (Or click *Cancel* at any time to back out of the process.)

NSS creates the software RAID device, then opens to the Software RAIDs task. Your newly created RAID device appears in the *Software RAID Devices* list. The name you provided for the RAID appears in the Description field. This is the device name displayed when the RAID is listed in the NSSMU Software RAIDs page.



After you create the RAID, manage it as you would a physical device in terms of using it for pools and volumes. For information on configuring an NSS file system on your RAID, see Chapter 15, "Managing NSS Pools," on page 175.

13.6 Creating Software RAID Devices with NSSMU

1. In NSSMU, select *RAID Devices* from the NSSMU main menu.
2. Press Insert (Ins) to create a new device.
3. Select the RAID type (0, 1, or 5), then press Enter.
4. (Conditional) If this is a RAID 0 or 5 device, specify the stripe size, then press Enter.

   The default stripe size is 64 KB, which typically provides the best performance for devices with NSS volumes.
5. Use the arrow keys to select the partitions that you want to contribute space to the RAID.

   If no partitions appear, it is an indication that either there are no partitions large enough or there are no free partitions. Each segment must be more than 12 MB. The combined space from all segments must be less than 2 TB.

   IMPORTANT: Unallocated partitions (that is, partitions that are not mirrored and do not contain pools or other file systems), are deleted in order to present the unused space as free space for use by the RAID. No data loss occurs by this action.

   After space is selected from a device, other free space associated with that device might not appear. This prevents you from adding more than one segment from a single physical device, and consequently, helps ensure the optimum performance of your file system.

   The following table lists the number of segments that you can include in a RAID device:

RAID Type	Number of Segments
RAID 0	Minimum of 2 and a maximum of 14
RAID 1	Maximum of 4
RAID 5	Minimum of 3 and a maximum of 14; one segment is used for parity

6. Specify the amount of space to use, then press Enter.

   The segment is created and added to the *Segments Included* in the RAID window.

13.7 Mirroring an Existing Pool with NSSMU

1. Before you begin, review the Section 13.2.2, “Guidelines for Software RAID 1 Devices,” on page 152.
2. In NSSMU, select *Partitions* from the NSSMU main menu.
3. From the list of existing partitions, select the NSS partition for the pool you want to mirror.
4. Press *F3* to create the RAID 1 device and mirror the partition where the pool resides.
5. From the available devices, select up to three additional devices that you want to use as a segment, then press Enter.

   On the page where you select the second partition, you have to press the space bar to select the partition for the second mirror. When it is truly selected, the asterisk next to it stays there even if you move up and down in the list. Then press F3 to mirror. The message pops up to confirm creating the mirror.

The space assigned is the same size as the existing partition. The segments must reside on different devices. If no partitions appear, it is an indication that either there are no partitions large enough or no free space exists on other devices.

6 To confirm the RAID 1 device, select *RAID Devices* from the NSSMU *Main* menu. The RAID 1 device ID appears in the *RAID Devices* window.

7 Select the RAID device, then view its details to make sure that synchronization has begun.

The remirroring status shows a percentage is greater than 0. It is fully synchronized at 100%

If you are mirroring a shared partition (that is, if it contains a cluster-enabled pool), the synchronization to the mirror does not begin automatically. Continue with Step 8a.

8 If you are mirroring a shared partition (that is, if it contains a cluster-enabled pool), start the remirroring manually by doing the following:

8a Use one of the following methods to initiate mirroring for the newly created mirror:

- At the server console of a cluster node, enter the following to migrate the cluster resource to another node:

  ```
  cluster migrate cluster_resource destination_node_name
  ```

  Migrating the pool causes load scripts to be executed and causes the mirroring to start on the new node.

- At the server console of the cluster node where the pool is currently active, enter

  ```
  dmsetup message raid_device_name 0 remirror=on
  ```

  WARNING: Issue this command only on the node where the pool is currently active. Issuing the command on multiple nodes can corrupt the mirror.

8b Verify that the remirroring has begun by opening NSSMU on the node where the pool is currently active, open the RAID page, then select the RAID device.

The remirroring status shows a percentage is greater than 0. It is fully synchronized at 100%.

13.8 Creating a RAID 1 Mirror to Duplicate Data

You can create a RAID 1 mirror to duplicate data on a new device, such as to duplicate data on a new storage array.

1 Set up the RAID 1 mirror between the initial storage element and new storage element.

For information, see Section 13.5, “Creating Software RAID Devices with iManager,” on page 157.

2 Let the RAID create a duplicate of the data on the mirror.

3 (Optional) If you want to retain the data on the initial storage element and use the element elsewhere, remove the disk it is on from the server.

WARNING: If you leave the disk attached to the server while deleting the element from the RAID, its data is destroyed.

4 Use NSSMU or iManager to delete the initial storage element from the mirror, leaving only the new storage element active on the server as a single-element mirror.

The RAID 1 group remains in Media Manager and uses only 1 KB of memory. The new array performs normally, without performance degradation and without consuming additional resources.

WARNING: Leave the RAID 1 group active because deleting the RAID 1 group deletes all of its member partitions and destroys the data on them.

In iManager and from the command line, the new array reports that it is Not Mirrored. In NSSMU, the new array reports that it is In-Sync and 100% remirrored, even though there is only a single element.

13.9 Creating a Software RAID 0+1 with NSSMU

In NSS, you can mirror your software RAID 0 devices to create a nested RAID 0+1 device. Use NSSMU to mirror the partition used by the pool on a RAID 0 device. The following procedure describes how to create the RAID 0+1 in NSSMU. You can also create the RAID 0 devices first in iManager, but you must use NSSMU to be able to select them for a mirror.

1. In NSSMU, create a software RAID 0 device with 2 to 14 segments.

   For information, see Section 13.6, “Creating Software RAID Devices with NSSMU,” on page 160.

2. Repeat Step 1 one to three times to create 2 to 4 RAID 0 devices.

   The RAID 0 devices you use to create the mirror must have no drives in common. Each drive you use to create the RAIDs can belong to only one of the RAID 0 devices.

3. In NSSMU, create a pool on one of the RAID 0 devices.
   - **3a** In NSSMU, select *Pools* from the NSSMU main menu.
   - **3b** Press *Insert* (Ins) to create a pool.
   - **3c** From the list of available devices, select one of the RAID 0 devices.
   - **3d** Assign all of the available space to the pool, then press Enter.
4. Create a RAID 1 device to mirror the pool.
   - **4a** In NSSMU, select *Partitions* from the NSSMU main menu.
   - **4b** Select the NSS partition for the pool you want to mirror.
   - **4c** Press F3 to create the RAID 1 device and mirror the partition.
   - **4d** From the available devices, select up to three remaining RAID 0 devices you created above.
   - **4e** Press *F3* to initialize and create the RAID 1 (mirror) device.

     After the RAID device is created, the device ID appears in the *RAID Devices* window. This window is viewed from the RAID Devices NSSMU main menu. The RAID is a RAID 0+1.

13.10 Creating a Software RAID 5+1 with NSSMU

In NSS, you can mirror your software RAID 5 devices for your server to create a nested RAID 5+1 device. Use NSSMU to mirror the partition used by the pool on a RAID 5 device. The following procedure describes how to create the RAID 5+1 in NSSMU. You can also create the RAID 5 devices and NSS pool for the RAID 5 devices in the Storage plug-in for iManager, and then switch to NSSMU to mirror the pool’s partition.

1. In NSSMU, create a software RAID 5 device with 3 to 14 segments.

For information, see Section 13.6, “Creating Software RAID Devices with NSSMU,” on page 160.

2 Repeat Step 1 one to three times to create 2 to 4 RAID 5 devices.

The RAID 5 devices you use to create the mirror must have no drives in common. Each drive you use to create the RAIDs can belong to only one of the RAID 5 devices.

3 In NSSMU, create a pool on one of the RAID 5 devices.

3a In NSSMU, select *Pools* from the NSSMU main menu.

3b Press Insert (Ins) to create a pool.

3c From the list of available devices, select one of the RAID 5 devices.

3d Assign all of the available space to the pool, then press Enter.

4 Create a RAID 1 device to mirror the pool.

4a In NSSMU, select *Partitions* from the NSSMU main menu.

4b Select the NSS partition for the pool you want to mirror.

4c Press F3 to create the RAID 1 device and mirror the partition.

4d From the available devices, select one of the remaining RAID 5 devices you created above.

NOTE: You can select up to three devices.

4e Press F3 to initialize and create the RAID 1 (mirror) device.

After the RAID device is created, the device ID appears in the *RAID Devices* window. This window is viewed from the RAID Devices NSSMU main menu. The RAID is a RAID 5+1.

13.11 Renaming a Software RAID Device

1 In iManager, click *Storage* > *Software RAIDs*.

For instructions, see Section 9.1.5, “Accessing Roles and Tasks in iManager,” on page 94.

2 Select a server in the eDirectory tree where you are logged in.

For instructions, see Section 9.1.6, “Selecting a Server to Manage,” on page 95.

3 Click *Rename*.

This opens a dialog box where you can enter the new name.

4 Type the new name.

Do not leave the field blank when you are renaming because a default RAID name is not generated for a rename procedure. For information about choosing names, see Section 5.4, “Naming NSS Storage Objects,” on page 59.

5 Click *Finish*. (Or click *Cancel* at any time to back out of the process.)

NSS renames the software RAID device, then opens to the Software RAIDs Page. The details for the renamed software RAID device are displayed on the page, with the new name in the Description field.

13.12 Increasing the Size of a Software RAID Device

You can increase the capacity of an existing software RAID 0, 1 or 5 device by adding partitions, up to the maximum number for the type of RAID. You cannot modify the size of an individual partition after the device is created.

IMPORTANT: If the software RAID device is shared in a cluster, connect to the node where the RAID is currently active to manage the RAID and increase the size of the RAID.

To add partitions to an existing software RAID:

1. In iManager, click *Storage* > *Software RAIDs*.

   For instructions, see Section 9.1.5, "Accessing Roles and Tasks in iManager," on page 94.

2. Select a server in the eDirectory tree where you are logged in.

   For instructions, see Section 9.1.6, "Selecting a Server to Manage," on page 95.

3. Make sure that there is no I/O for the volumes on the RAID device by deactivating the volume.

   3a Click *Volumes*.

   3b Select the volumes in the RAID device you want to expand.

   3c Click *Dismount*.

4. Select a device in the *Software RAID Device*s list.

   If the device contains the maximum number of partitions, the *Increase Size* option is dimmed. You cannot expand the RAID. Do not proceed.

5. Click *Increase Size*.

   This opens the Expand a RAID Wizard to let you choose from available free space on devices that are not already members in the RAID and that contain enough free space to meet the RAID's current partition size.

6. Do one of the following:

   - If there are no devices available, you cannot expand the RAID. Click *Cancel*.

     A device must be the same size or larger than the segment size being used in the RAID. You might need to add or initialize a new device, then try again.

   - Select the check box next to each of the storage devices you want to obtain space from.

     The partition size is predetermined by the existing RAID. The partition you choose must be the same size as other partitions comprising the device.

     Stripe size is fixed at its current value for the duration of the expansion. If you want to change the stripe size, restripe after the expansion.

     You can choose multiple partitions up to the maximum for the type of RAID it is. For information, see "Determining the Number of Partitions" on page 154 and "Determining the Partition Size" on page 154.

7. Click *Finish*.

   After you add a partition, the RAID's data is restriped across both existing and new partitions. During the restriping, the RAID's capacity does not include the added partition. While restriping, the new device is considered a failed device until it is completely resynchronized. After the restriping is complete, the RAID's capacity includes the added partition.

   While expanding a RAID 5 device, if one of the drives goes down (either one of the existing segments or the newly added segment), the pool deactivates. If you remove any device from a RAID 5 other than the one that was just added for restripe, it considers that as a two-disk error, and deactivates the RAID and the pool.

Remirroring and Restriping Temporarily Impacts System Performance

For software RAID 1 devices, the additional mirror begins to collect data immediately. Performance is slightly impacted, but data is available.

For software RAID 0 or RAID 5 devices, the system automatically begins restriping the disks to accommodate the partition you just added. This severely impacts performance until the striping is complete. The capacity of the RAID is not updated until the restriping is done. If the restriping process is interrupted before it completes, it begins automatically on system reboot.

13.13 Restriping a Software RAID 0 or 5 Device

In general, there are three reasons for restriping of software RAID 0 and 5 devices:

- **Partition Replacement:** If a partition fails, you must replace it. Restriping can recover the data in a single lost partition in a RAID 5 by using parity. However, the data must be restriped from a backup tape if a partition fails in a RAID 0.
- **RAID Expansion:** If you expand a RAID 1 or 5 device, the RAID restripes the data across all members.
- **RAID Stripe Size:** If you increase or decrease the stripe size of a RAID 1 or 5 device, the RAID restripes the data across all members. This happens infrequently, unless you are measuring performance with different striping sizes to determine which best fits your operational needs.

If the restriping process is interrupted, the RAID recognizes that when the system reboots, and automatically continues the restriping process. You can also use iManager to pause and resume a restriping process.

When expanding a RAID 5, if the newly added drive goes down during the restripe, the restriping continues without the new partition and puts the RAID in a degraded state with one partition missing. If the same partition comes back online, it finishes the restripe. If the partition has completely failed, after the degraded restriping is complete, you can add a new replacement partition, and the RAID restripes to fix it.

To manually resume or pause the Restripe process:

1. In iManager, click *Storage* > *Software RAIDs*.

   For instructions, see Section 9.1.5, “Accessing Roles and Tasks in iManager,” on page 94.
2. Select a server in the eDirectory tree where you are logged in.

   For instructions, see Section 9.1.6, “Selecting a Server to Manage,” on page 95.
3. Make sure that there is no I/O for the volumes on the RAID device by deactivating the volume.
   - **3a** Click *Volumes*.
   - **3b** Select the volumes in the RAID device you want to expand.
   - **3c** Click *Dismount*.
4. Select a device in the *Software RAIDs* list.

   Wait for the page to refresh before continuing.
5. Click *Restripe*.

   The restriping process begins or pauses immediately. Restriping severely degrades I/O performance until the restriping is complete.

13.14 Replacing a Failed Segment in a Software RAID

For some RAIDs, you can replace a failed segment by removing the segment from the RAID, replacing the failed disk, and then adding a segment to the RAID to replace the failed one. The following table provides recommended actions for each RAID type.

Table 13-4 *Recommended Actions on Segment Failure in a Software RAID*

Software RAID	Remove Segments	Recommended Action
RAID 0	Not allowed	If one or more disks in a RAID 0 fails, all data is lost on that device. You must re-create the RAID and restore its data from a backup copy.
RAID 1	All but one mirrored segment	The last segment of a RAID 1 device is the primary device that contains the data. You can use the NSSMU *Partitions* option to remove mirrored segments to free up the related space on those segments, but the data on the last remaining segment is no longer mirrored. If a disk fails in one of the segments, all of its data is lost on that segment. The remaining mirrors continue to operate normally. Remove the segment, replace the failed disk, and then add the segment as an element in the mirror. The data is synchronized over time until it is fully mirrored on the new segment.
RAID 5	One data segment at a time	You can temporarily remove one segment at a time in a RAID 5 device to replace a failed data disk. For example, you can replace a single failed data disk while the system is still operational. Use the NSSMU *Partitions* option to remove the failed segment, replace the failed disk, add a segment to the RAID 5, and then restripe the RAID. The parity is used during restriping to restore the missing data. Read and write performance is degraded on the failed segment until the data is recovered because of parity-related reads and calculations. If multiple data segments fail concurrently, all data is lost on that device. You must delete the RAID 5 and re-create it with good disks. Recover its data from a backup copy. For example, if a second segment fails before the restriping is completed for the first drive replacement, this is considered a two-drive failure. You must recover data from a backup copy.
RAID 0+1	All but one mirrored segment; cannot remove disks from the underlying RAID 0	The last segment of a RAID 0+1 is a RAID 0 device that contains the original data. If one or more disk fails in one of the mirrored segments, all data is lost on that segment. The remaining mirrors continue to operate normally. Remove the failed RAID 0 from the RAID 0+1. Delete the RAID 0, replace the failed disks, re-create the RAID 0, and then add the RAID 0 segment as an element in the mirror. The data is synchronized over time until it is fully mirrored on the repaired RAID 0 segment.

Software RAID	Remove Segments	Recommended Action
RAID 5+1	All but one mirrored segment; can safely remove one segment at a time per segment	The last segment of a RAID 5+1 is a RAID 5 device that contains the original data. If a single data segment fails in a RAID 5 that is an element in a RAID 5+1, repair the RAID 5 while it is operational, as you would with any RAID 5. If multiple disks in a mirrored segment fail concurrently, all data is lost on that segment. The remaining mirrors continue to operate normally. Remove the failed RAID 5 from the RAID 5+1. Delete the RAID 5, replace the failed disks, re-create the RAID 5, and then add the repaired RAID 5 as a segment in the RAID 5+1. The data is synchronized over time until it is fully mirrored on the repaired RAID 5 segment.

A Segment Fails in a RAID 0

If a segment fails in a RAID 0, you must delete the software RAID 0 device, create a new RAID 0 device, then copy your data to the RAID from backup media. For information, see Section 13.15, "Deleting a Software RAID Device," on page 168.

A Segment Fails in a RAID 1

1. From the command console, enter `nssmu`.
2. From the NSSMU main menu, select *Software RAIDs*.
3. Remove the bad segment.
   - **3a** Select the software RAID 1 device that you want to manage.
   - **3b** Press Enter to show its member segments. The bad segment should show a status of Bad - Unavailable Partition.
   - **3c** Select the bad segment, then press *Delete*.
4. Expand the RAID with a replacement segment.
   - **4a** Select the software RAID 1 device that you want to manage.
   - **4b** Press *F3* to increase the size of the RAID.
   - **4c** From the list of available devices, select the device you want to use for the new segment. The segment size defaults to the size of existing partitions in the RAID 1.
   - **4d** Select *OK* twice.
5. The data begins mirroring automatically and continues until the segment is 100% mirrored.

A Single Data Segment Fails in a RAID 5

To replace a single failed data segment in a software RAID 5:

1. From the command console, enter `nssmu`.
2. From the NSSMU main menu, select *Software RAIDs*.

3 Remove the bad segment.

   3a Select the software RAID 5 device that you want to manage.

   3b Press *Enter* to show its member segments. The bad segment should show a status of Bad - Unavailable Partition.

   3c Select the bad segment, then press *Delete*.

4 Expand the RAID with a replacement segment.

   4a Select the software RAID 5 device that you want to manage.

   4b Press *F3* to increase the size of the RAID.

   4c From the list of available devices, select the device you want to use for the new segment. The partition size defaults to the size of existing partitions in the RAID 5.

   4d Select *OK* twice.

5 The restriping should begin automatically. If it does not, from the *Software RAIDs* page, select the RAID 5 device, then press *F6* to restripe.

Multiple Segments Fail in a RAID 5

If two or more segments fail concurrently in a RAID 5 or if the parity partition fails, you must delete the software RAID 5 device, create a new RAID 5 device, then copy your data to the RAID from backup media. For information, see Section 13.15, “Deleting a Software RAID Device,” on page 168.

13.15 Deleting a Software RAID Device

If you delete a software RAID device, it ends the RAID relationship, and it destroys the NSS file structure on member partitions. All data is lost. Make sure to back up your data or move it to another location before deleting the software RAID device.

1 In iManager, click *Storage* > *Software RAIDs*.

   For instructions, see Section 9.1.5, “Accessing Roles and Tasks in iManager,” on page 94.

2 Select a server in the eDirectory tree where you are logged in.

   For instructions, see Section 9.1.6, “Selecting a Server to Manage,” on page 95.

3 Make sure that there is no I/O for the volumes on the RAID device by deactivating the volume.

   3a Click *Volumes*.

   3b Select the volumes in the RAID device you want to delete.

   3c Click *Dismount*.

4 Select a device in the *Software RAIDs* list.

5 Click *Delete*.

13.16 Viewing Pools on a Software RAID Device

1 In iManager, click *Storage* > *Software RAIDs*.

   For instructions, see Section 9.1.5, “Accessing Roles and Tasks in iManager,” on page 94.

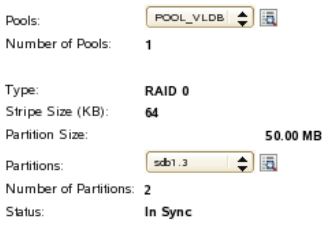
2 Select a server to manage.

   For instructions, see Section 9.1.6, “Selecting a Server to Manage,” on page 95.

A list of devices appears in the *Software RAIDs* list.

3 In the *Software RAIDs* list, select a RAID device.

4 In the *Details* area, click the arrow on the *Pools* drop-down list to expand it.



5 Select a pool, then click *View Details*.

This opens the *Pools* page where you can view the details of the pool and manage it. See Section 15.2, "Creating a Pool," on page 176 for a sample *Pools* page.

For information about pool management, see "Managing NSS Pools" on page 175.

13.17 Viewing Partitions on a Software RAID Device

1 In iManager, click *Storage* > *Software RAIDs*.

For instructions, see Section 9.1.5, "Accessing Roles and Tasks in iManager," on page 94.

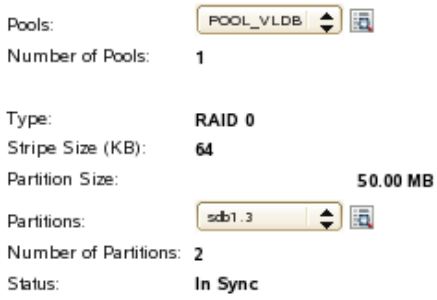
2 Select a server to manage.

For instructions, see Section 9.1.6, "Selecting a Server to Manage," on page 95.

3 In the *Software RAIDs* list, select a device.

Wait for the page to refresh before continuing.

4 In the *Details* area, click the arrow on the *Partitions* drop-down list to expand it.



5 To view information about partitions, click the *Partitions View Details* icon.

This opens the *Partitions* page. It displays a list of all the partitions that currently exist on the selected device.

6 Select a partition from the *Partitions* list, then click *Details* to view its details.

13.18 Deleting Partitions on a Software RAID Device

You can delete all but one partition of a RAID 1 (mirror) and only one partition at a time for a RAID 5. To delete a RAID 1 partition, you must delete its RAID.

1. In iManager, click *Storage* > *Software RAIDs*.

   For instructions, see Section 9.1.5, "Accessing Roles and Tasks in iManager," on page 94.

2. Select a server to manage.

   For instructions, see Section 9.1.6, "Selecting a Server to Manage," on page 95.

3. Make sure that there is no I/O for the volumes on the RAID device by deactivating the volume.

   3a Click *Volumes*.

   3b Select the volumes in the RAID device pool.

   3c Click *Dismount*.

4. In the *Software RAIDs* list, select a device.

   Wait for the page to refresh before continuing.

5. Click the *Partitions View Details* icon.

   This opens the *Partition* page. It displays a list of all the partitions that currently exist on the selected device.

6. Select a partition from the *Partitions* list, click *Delete*, then click *OK*.

13.19 Managing Software RAID Devices with NSSMU

The following table lists the keystrokes that enable you to view, expand, restripe, create, and delete a RAID device:

Table 13-5 *Software RAID Management Tasks in NSSMU*

Keystroke	Description
Enter	Shows the RAID partitions associated with the selected RAID device.
F3	Expands a RAID device by adding more partitions from another storage device. You should not place more than one RAID partition on a disk; this severely impedes the performance of your file system.
F4	Rename a selected RAID device.
F6	Restripes or remirrors a RAID device. Make sure all partitions have been added to your RAID device before restriping a device. The file system performance might slow down during the restriping/ remirroring process.
F8	Show pools (list pools on selected RAID 0 or 5; for RAID 1, its single member pool appears in device details)
Ins	Creates a software RAID (0, 1, or 5)
Del	Deletes an entire RAID device. When you delete a RAID device, all partitions, volumes, and pools associated with that device are also deleted.
F5	Refreshes the display.

14 Managing Multipath I/O to Devices

Novell Storage Services for Linux does not provide multipath I/O (MPIO) support. This section describes how to use Linux tools to configure and manage multipathing for devices, and how to configure Linux multipathed devices for use with EVMS and NSS.

- Section 14.1, “Understanding Multipath I/O on Linux,” on page 173
- Section 14.2, “NSS Errors When Linux Multipath Is Not Configured,” on page 174
- Section 14.3, “Configuring Multipath on Linux,” on page 174

14.1 Understanding Multipath I/O on Linux

Multipath I/O software resolves multiple paths to a device into a single device and manages the traffic flow across the paths transparently for file systems on the devices. NSS on Linux does not provide an EVMS-based software solution for managing multiple paths like the Media Manager multipath solution on NetWare. Instead, you can use Linux multipath I/O tools to configure and manage multiple paths for devices where you want to create NSS software RAIDs, pools, and volumes. You can also use solutions from the storage array vendor or third-party vendor.

Devices have multiple connection paths when you implement hardware configurations such as the following:

- The server has multiple host bus adapters for connection to external devices.
- The external storage device has multiple interconnects for connection to one or more host bus adapters.
- A server with multiple host bus adapters is connected to a storage device through intermediate devices, such as a Fibre Channel SAN switch.

In a Linux host, when there are multiple paths to a storage controller, each path appears as a separate block device, which results in multiple block devices for single LUN. The Device Mapper Multipath utility detects multiple paths with the same LUN WWID, and creates a new multipath device with that WWID.

For example, a host with two HBAs attached to a storage controller with two ports via a single unzoned Fibre Channel switch sees four block devices:

```
/dev/sdb
/dev/sdc
/dev/sdd
/dev/sde
```

Device Mapper Multipath creates a single block device, `/dev/mpath/mpath1` that reroutes I/O through those four underlying block devices.

14.2 NSS Errors When Linux Multipath Is Not Configured

If you have not started multipathing before you attempt to configure NSS pools or volumes, NSS cannot resolve the multiple paths and attempts the command on all the paths. You get the following error:

```
Error 21621: zERR_MSAP_POOL_ALREADY_IN_USE.
```

After you have configured Linux multipathing for a device, the multipath device appears in NSSMU or iManager.

14.3 Configuring Multipath on Linux

For detailed information about configuring and managing multipath I/O for devices on Linux, see "Managing Multipath I/O for Devices" in the *SLES 10 SP3: Storage Administration Guide*.

For information about using Linux multipath solutions with clustered pool resources on Novell Cluster Services, see "Multipath I/O Configuration Requirements" in the *OES 2 SP3: Novell Cluster Services 1.8.8 Administration Guide for Linux*.

15 Managing NSS Pools

Novell Storage Services uses storage pools to efficiently acquire and use all free space available on devices. A pool is an area of storage that consists of space, called a partition, obtained from one or more of the storage devices available on a server. The amount of space that each storage device contributes can differ for each member device.

Use the iManager Storage plug-in to configure and manage NSS pools. For information about iManager, see Section 9.1, “Novell iManager and Storage-Related Plug-Ins,” on page 87.

You can also use the console-based NSS Management Utility to configure and manage NSS pools. For information, see Section 9.2, “NSS Management Utility (NSSMU) Quick Reference,” on page 103.

This section describes how to configure and manage NSS pools by completing the following tasks:

- Section 15.1, “Guidelines for Creating a Pool,” on page 175
- Section 15.2, “Creating a Pool,” on page 176
- Section 15.3, “Activating and Deactivating Pools,” on page 180
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- Section 15.5, “Renaming a Pool,” on page 182
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- Section 15.8, “Viewing Pool Details,” on page 184
- Section 15.9, “Viewing Partition Information for a Pool,” on page 185
- Section 15.10, “Viewing Volume Information for a Pool,” on page 186
- Section 15.11, “Viewing Device Information for a Pool,” on page 186
- Section 15.12, “Preventing Pools from Activating on Multiple Servers,” on page 187
- Section 15.13, “Updating eDirectory Pool Objects,” on page 191
- Section 15.14, “Updating eDirectory for Shared Pool,” on page 191
- Section 15.15, “What’s Next,” on page 192

15.1 Guidelines for Creating a Pool

Devices must be initialized before any space is shown as available for creating a pool. Without initializing the devices, no space will be shown available for pool creation. For instructions, see Section 10.6, “Initializing a Disk,” on page 122.

Novell NCP Server must be installed, configured, and running. For information, see Section 5.6.1, “NCP,” on page 66.

Novell CIFS must be installed, configured, and running before you can use the CIFS option when cluster-enabling an NSS pool. For information, see Section 5.6.3, “Novell CIFS,” on page 67.

Novell AFP must be installed, configured, and running before you can use the AFP option when cluster-enabling an NSS pool. For information, see Section 5.6.2, “Novell AFP,” on page 67.

15.2 Creating a Pool

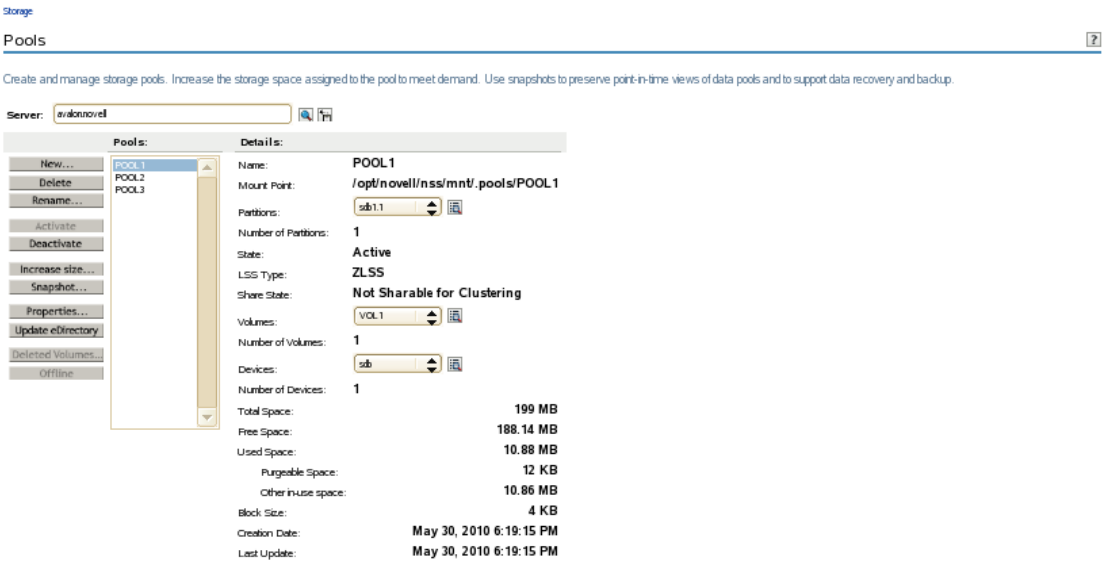
1. In iManager, click *Storage* > *Pools*.

   For instructions, see Section 9.1.5, “Accessing Roles and Tasks in iManager,” on page 94.

2. Select a server to manage.

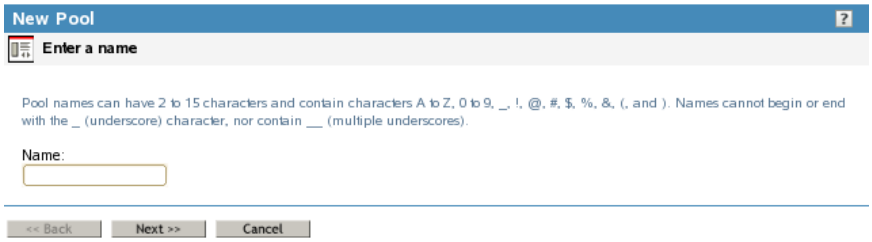
   For instructions, see Section 9.1.6, “Selecting a Server to Manage,” on page 95.

   A list of pools appears in the *Pools* list.



3. To create a new pool, click *New*.

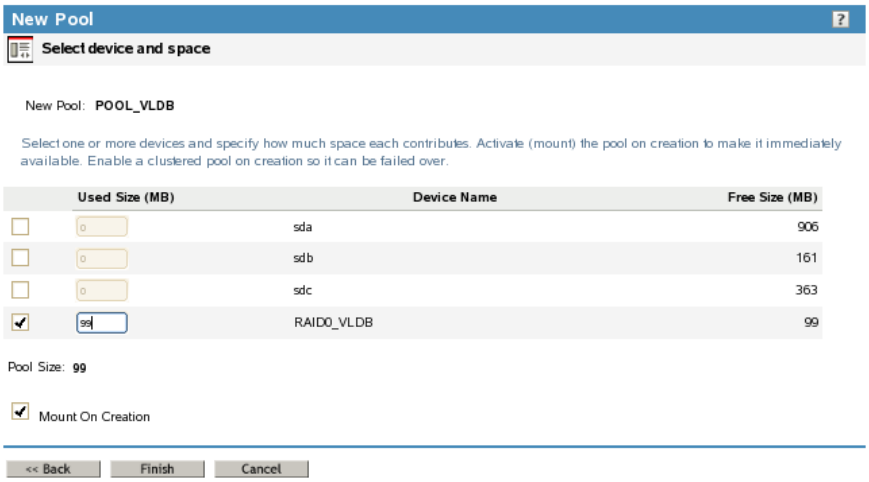
   The New Pool Wizard opens to guide you through the process.



4 Specify a name for the new storage pool, then click *Next*.

For guidelines about naming pools, see Section 5.4, "Naming NSS Storage Objects," on page 59.

In the following example, the device is not shared, so the *Cluster Enable on Creation* check box is not displayed.



5 Specify device parameters and the space to use, then click *Next*.

5a Select the check box next to one or more of the available devices you want to use in the pool.

5b In *Used Size*, specify the amount of space in megabytes (MB) to add to the pool from each device you selected, up to the amount of free space available for that device.

To update the *Total Pool Size* as you enter the device's *Used Size*, click anywhere within the Wizard dialog box. If any entry exceeds a device's available space, the pool expansion fails and returns an error message.

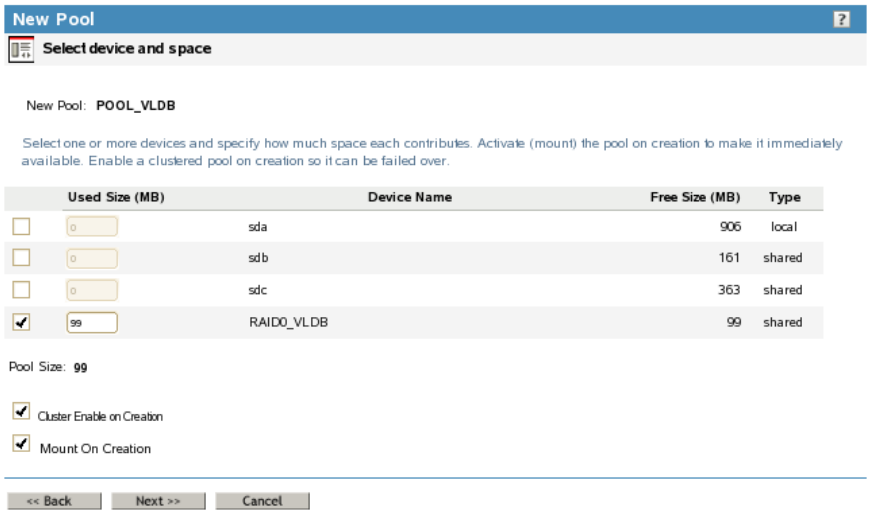
The pool itself can be up to 8 TB. NSS recognizes devices up to 2 terabytes (TB) in size, so the free space available on any given device is 2 TB or less. To create an 8 TB pool, you would use least four segments of free space of up to 2 TB each.

You can obtain space from one or more of the devices listed. Only devices that have free space appear in the list. If no devices are listed, it might be because you need to initialize a recently added device, or it might be that there is no space available on any devices. Cancel the Wizard, add more devices to the server or free up space on existing devices, then return to the *Pools* page to increase the size of this pool.

5c Select *Activate on Creation* (*Mount on Creation* for Linux) to activate (mount) the device automatically after it is created.

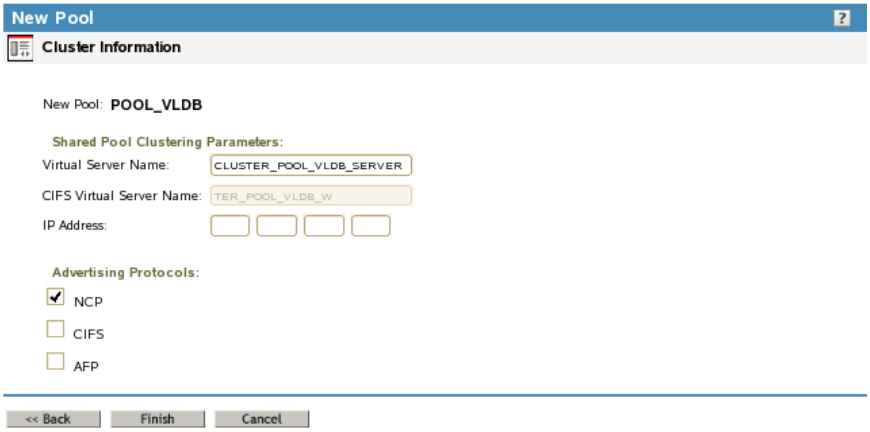
This parameter is automatically enabled. Deselect the check box to turn it off.

5d If the selected device is shareable, the *Cluster Enable on Creation* check box is automatically selected so the pool can be shared in a cluster configuration. Deselect the check box if you do not want to cluster-enable this pool for sharing.



5e If the pool is cluster-enabled, click *Next* to specify its cluster parameters. Otherwise, skip ahead to Step 7.

6 If the *Cluster Enable on Creation* check box is selected, an additional page appears that allows you to specify the cluster information.



Specify the following shared pool clustering parameters:

- **Virtual Server Name:** The name assigned to the virtual server that represents the shared pool in the cluster.

  When you cluster-enable a pool, a virtual Server object is automatically created in Novell eDirectory and given the name of the Cluster object plus the name of the cluster-enabled pool. For example, if the cluster name is `cluster1` and the cluster-enabled pool name is `pool1`, then the default virtual server name will be `cluster1_pool1_server`. You can edit the field to change the default virtual server name.

- **CIFS Virtual Server Name:** The name assigned to the virtual server for handling CIFS (Common Internet File System) requests. This is the name of the server as it appears in a Windows system.

- **IP Address:** The IP address that you want to assign the virtual server.

Each cluster-enabled NSS pool requires its own IP address. The IP address is used to provide access and failover capability to the cluster-enabled pool (virtual server). The IP address you assign to the pool remains assigned to the pool regardless of which server in the cluster is accessing the pool.

IMPORTANT: The IP address for the virtual server must be in the same IP subnet as the server nodes in the cluster where you plan to use it.

To specify an IP address, tab between the different entries; no dot is required in the fields. For example, if the IP address is `192.168.1.1`, type the following:

```
192 168 1 1
```

- **Advertising Protocols:** Protocols that give users native file access to data.

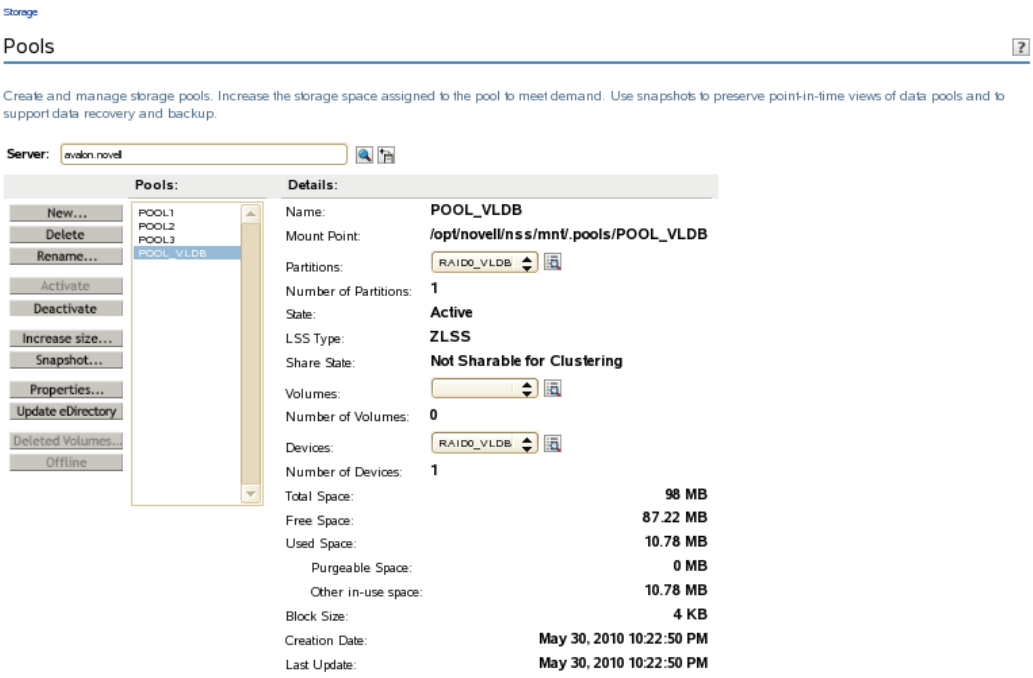
  Specify one or more advertising protocols by selecting the check boxes of the protocols you want to enable for data requests to this shared pool.

  NOTE: For OES 2 Linux and earlier, Novell CIFS and Novell AFP are not available. CIFS and AFP check boxes can be selected, but CIFS and AFP functionality does not apply to Linux. Selecting the check boxes has no effect.

  - NetWare Core Protocol (NCP) is the Novell networking protocol used by the Novell Client. It is selected by default. Selecting NCP causes commands to be added to the pool-resource load and unload scripts to activate the NCP protocol on the cluster. This lets you ensure that the cluster-enabled pool you are creating is highly available to Novell clients.
  - CIFS is the Windows networking protocol. Selecting CIFS causes commands to be added to the pool-resource load and unload scripts to activate the CIFS protocol on the cluster. This lets you ensure that the cluster-enabled pool you are creating is highly available to CIFS/Samba clients.
  - Apple Filing Protocol (AFP) is the Macintosh networking protocol. Selecting AFP causes commands to be added to the pool-resource load and unload scripts to activate the AFP protocol on the cluster. This lets you ensure that the cluster-enabled pool you are creating is highly available to AFP clients.

7 Click *Finish*.

For NSS on Linux, the create time might take longer than expected. Typically, the pool creation takes less than a minute, and the volume creation takes less than 10 seconds. However, if you have a large tree or the server does not hold an eDirectory replica, the create time can take up to 3 minutes.



8 Create a volume on the pool. For information, see Section 18.3, “Creating Unencrypted NSS Volumes,” on page 228 or Section 19.3, “Creating an Encrypted Volume,” on page 254.

15.3 Activating and Deactivating Pools

You might need to temporarily restrict user access to an pool. Instead of bringing down the server, you only need to deactivate the specific pool.

The *Activate* option on the *Pools* page makes the selected pools and all the volumes in them available for user access. The *Deactivate* option on the *Pools* page takes the selected pools and all the volumes in them temporarily unavailable to users. It does not destroy volumes in the pools, nor does it destroy the data contained in the volumes.

To change the state of a pool:

1 In iManager, *Storage* > *Pools*.

For instructions, see Section 9.1.5, “Accessing Roles and Tasks in iManager,” on page 94.

2 Select a server to manage.

For instructions, see Section 9.1.6, “Selecting a Server to Manage,” on page 95.

3 In the *Pools* list, select the pool that you want to activate or deactivate.

Wait for the page to refresh. It displays the pool’s details and enables management options. The State field shows whether the device is Active or Deactive.

4 Depending on the pool's current state, to change the state of the pool:

- Click *Actions* > *Activate*.
- Click *Deactivate* > *Actions*.

15.4 Increasing the Size of a Pool

Using the *Increase Size* option on the *Pools* page expands the storage capacity of a selected pool by adding new partitions. You can increase the size of your storage pools, but you cannot reduce their size.

1 In iManager, click *Storage* > *Pools*.

For instructions, see Section 9.1.5, "Accessing Roles and Tasks in iManager," on page 94.

2 Select a server to manage.

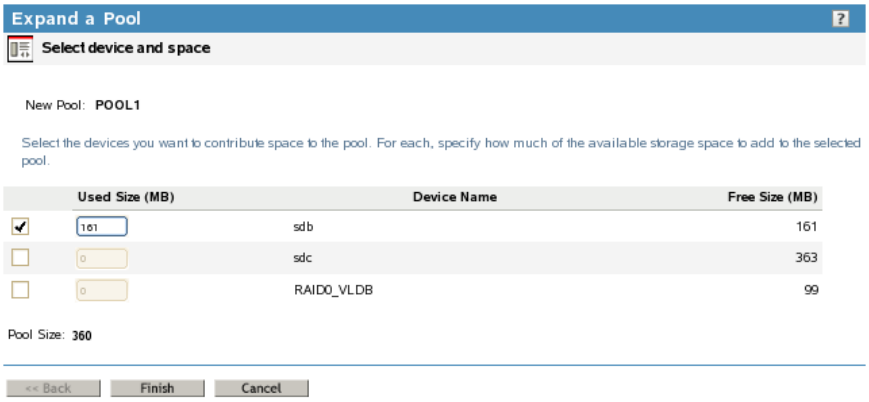
For instructions, see Section 9.1.6, "Selecting a Server to Manage," on page 95.

3 In the *Pools* list, select the pool that you want to expand.

Wait for the page to refresh. It displays the pools's details and enables management options.

4 Click *Increase Size*.

This opens an *Expand a Pool* Wizard that guides you through the process of adding partitions from available devices.



5 Select the devices you want to use and the amount of space to use from each device.

In the *Used Space* field, type the amount of space in megabytes (MB) to add, up to the amount of free space available for that device. If any entry exceeds a device's available space, the pool expansion fails and returns an error message.

Software RAID 1 (mirrored) devices can contain only one pool per device. If you select a RAID 1 device to add a partition to your pool, NSS automatically allocates all of the available space to the pool.

The *Total Pool Size* is the sum of the partitions you define plus the current pool size. Initially, the *Total Pool Size* field displays the current size of the pool. To update the *Total Pool Size* as you enter values in the *Used Size* field, click anywhere within the Wizard dialog box.

You can obtain space from one or more of the devices listed. Only devices that have free space appear in the list. If no devices are listed, there is no space available to increase the size of the pool. Cancel the Wizard, add more devices to the server or free up space on existing devices, then return to the *Pools* page to increase the size of this pool.

6 Click *Finish*, or click *Cancel* at any time to back out of the process.

15.5 Renaming a Pool

The *Rename* option on the *Pools* page lets you to modify the name of the selected pool. For example, you might want to assign a pool name that relates to a department name change. The pool must be in the active state when you rename the pool so that eDirectory can be updated.

For an NSS pool on Linux, EVMS must unload and reload the pool in order to rename it. Depending on the pool's load-time behavior and share state, the pool might be in a deactive state after the rename and require administrator action to reload the pool and its volumes. Because the volumes are temporarily unavailable, it is best to perform a pool rename on Linux during a period of little or no user activity. See Table 15-1 to determine what actions to take after renaming a pool on Linux:

Table 15-1 *Actions Required after Renaming an NSS Pool on Linux*

Pool Share State	Pool Load-Time State	Pool State After a Rename	Action Required
Unshared	Autoloaded	Active with volumes dismounted	Mount the pool's volumes
Unshared	Not autoloaded	Deactive	Activate the pool, then mount its volumes
Shared	Load and unload is controlled by Novell Cluster Services. Before you rename a cluster-enabled pool, make sure to offline the pool resource, activate the pool by using iManager or NSSMU instead of using the load script, then you can rename the pool by using iManager or NSSMU.	Deactive	Online the pool resource to activate the pool and its volumes. Novell Cluster Services automatically updates the pool resource load and unload scripts to reflect the name change. Also, NSS automatically changes the Pool Resource object name in eDirectory.

Because renaming involves changing information in the Pool object in eDirectory, you must also make sure that a shared pool resource is loaded on the original server in the cluster where it was created.

1 In iManager, click *Storage* > *Pools*.

For instructions, see Section 9.1.5, "Accessing Roles and Tasks in iManager," on page 94.

2 Select a server to manage.

For instructions, see Section 9.1.6, "Selecting a Server to Manage," on page 95.

3 In the *Pools* list, select the pool that you want to rename.

Wait for the page to refresh and display the details.

4 If the pool is deactive, activate it by clicking Activate.

Wait for the page to refresh and display the details.

5 Click *Rename*.

This opens the *Rename a Pool* Wizard that guides you through the process.

6 Specify a name, then click *Finish*.

If the name is valid and unique, the pool is successfully renamed.

If not, you receive an error, and you must repeat the process. For information about valid pool names, see Section 5.4, "Naming NSS Storage Objects," on page 59.

7 If the *Pools* page does not automatically update to show the new name for the pool, in *Roles and Tasks*, click *Pools* to refresh the current page.

8 Activate the pool if it is deactive, then mount the pools's volumes.

15.6 Deleting a Pool

You might need to delete an NSS pool to create more free space for other pools. The *Delete* option on the *Pools* page removes one or more selected pools from the server, including all member partitions and the data on them. Deleting a pool removes the ownership of the space it occupied, freeing the space for reassignment. If the pools you want to delete are active, deactivate them before you delete them.

WARNING: Deleting a pool destroys all the volumes and data in it. These volumes cannot be restored.

If the pool is created on RAID1 device, deleting the pool will also delete the RAID1 device.

15.6.1 Prerequisites for Deleting a Pool

If the pool is shared in a Novell Cluster Services cluster, you must offline the cluster resource before you attempt to delete the clustered pool or its cluster resource.

If the pool has pool snapshots, you must delete the pool snapshots before you delete the pool. For information, see Section 17.10, "Deleting a Pool Snapshot," on page 218.

15.6.2 Procedure

1 In iManager, click *Storage* > *Pools*.

For instructions, see Section 9.1.5, "Accessing Roles and Tasks in iManager," on page 94.

2 Select a server to manage.

For instructions, see Section 9.1.6, "Selecting a Server to Manage," on page 95.

3 In the *Pools* list, select one or more pools that you want to delete.

Wait for the page to refresh. It displays the pools's details and enables its management options.

4 Click *Delete*.

5 Click *Yes* to confirm the deletion, or click *No* to cancel the deletion.

WARNING: If you click *Yes*, the pool and all the volumes and data on it are immediately destroyed.

15.7 Viewing Pools on a Server

1 In iManager, click *Storage* > *Pools*.

For instructions, see Section 9.1.5, “Accessing Roles and Tasks in iManager,” on page 94.

2 Select a server to manage.

For instructions, see Section 9.1.6, “Selecting a Server to Manage,” on page 95.

When the page refreshes, a list of pools appears in the *Pools* list. Depending on the number of pools, this can take a few seconds. Avoid clicking again in the page until it refreshes and displays the *Pools* list.

3 If the pool is not in the list, you might need supply the pool name.

For Linux, EVMS discovers and mounts pools at system startup. If you later create and mount a pool from the command line, EVMS does not find the pool and that pool does not show up in the list. You must repeat this process if you dismount the manually created pool at any time. Alternately, you can continue to manage the pool from the command line.

To help EVMS discover a pool not in the list:

3a Click *Mount*.

3b Type the pool name, then click *OK*.

There is no search function to find the pool; you must supply the pool name.

15.8 Viewing Pool Details

The *Pool Details* area of the *Pools* page displays information about a selected pool in the *Pools* list, as described in the following table:

Table 15-2 *Explanation of Pool Details*

Device Detail	Description
Name	The descriptive pool name assigned by the administrator.
Mount Point	On your Linux system, this is the mount location for the NSS pool. The default mount location is `/opt/novell/nss/mnt/.pools/poolname`, where *poolname* is the name of the selected pool.
Partitions	A list of all of the partitions that are part of the selected pool. To view information about any of the partitions, select the partition in the drop-down list, then click the *View Details* icon.
Number of Partitions	The total number of partitions currently assigned to the selected pool.
State	The current state of the selected pool, as Active or Deactive. Active pools are available to the users; deactive pools are not available to users.
LSS Type	The type of Loadable Storage System, such as ZLSS, CDDVD, or DOSFAT.
Share State	Shows whether the selected pool is on a device that is marked as *Shareable for Clustering* or as *Not Shareable for Clustering*. The system pool cannot reside on a device that is shareable for clustering. Use the Devices page to set this device attribute.

Device Detail	Description
Volumes	A list of all existing volumes residing in the selected pool. To view information about any of the volumes or to manage any of the volumes, select the volume in the drop-down list, then click the *View Details* icon. You can also select a pool, then click *Volumes* in *Roles and Tasks*.
Number of Volumes	The total number of volumes residing in the selected pool.
Devices	A list of the descriptive device names of all logical devices contributing space in the selected pool.
Number of Devices	The total number of devices currently assigned to the selected pool.
Total Space	The total amount of space assigned to the selected pool.
Free Space	The total amount of space that is currently not in use on the selected pool.
Used Space	The total amount of space that is in use on the selected pool. ◆ **Purgeable Space:** The total amount of space in the selected pool that is currently in use as a salvage area or partitioned space that is not yet otherwise assigned. ◆ **Other In-Use Space:** The total amount of space in the selected pool that is currently in use and cannot be easily deleted without destroying data.
Block Size	The maximum amount of data committed to a single write. Possible sizes include 4, 8, 16, 32, or 64 KB. The default setting for NSS is 4 KB.
Creation Date	The time stamp (date and time) that the pool was created.
Last Update	The time stamp (date and time) that the pool was last modified by a management action.

Procedure

1. In iManager, click *Storage* > *Pools*.

   For instructions, see Section 9.1.5, "Accessing Roles and Tasks in iManager," on page 94.
2. Select a server to manage.

   For instructions, see Section 9.1.6, "Selecting a Server to Manage," on page 95.
3. In the *Pools* list, select a pool to view its details.

   Wait for the page to refresh and display the pool's details.
4. The pool must be active to display its details. If the *Details* area is empty, select the pool, then click *Activate*.

   When the page refreshes, you can view the pool's details.

15.9 Viewing Partition Information for a Pool

Although NSS abstracts the partitions underlying the pool structure, you can view information about those partitions.

1. In iManager, click *Storage* > *Pools*.

   For instructions, see Section 9.1.5, "Accessing Roles and Tasks in iManager," on page 94.

2 Select a server to manage.

   For instructions, see Section 9.1.6, “Selecting a Server to Manage,” on page 95.

3 In the *Pools* list, select the pool you want to manage.

   Wait for the page to refresh and display the details. The pool must be active to see partition details.

4 If the pool is deactive, make sure the pool is selected, then click *Activate*.

   After the page refreshes, the *Partitions* drop-down list is available.

5 Click on the arrow next to the *Partitions* drop-down list to expand the list.

6 To view details about a partition, select the partition, then click *View Details*.

   A *Partition Information* page opens where you can view details about the partition.

15.10 Viewing Volume Information for a Pool

1 In iManager, click *Storage* > *Pools*.

   For instructions, see Section 9.1.5, “Accessing Roles and Tasks in iManager,” on page 94.

2 Select a server to manage.

   For instructions, see Section 9.1.6, “Selecting a Server to Manage,” on page 95.

3 In the *Pools* list, select a pool.

   Wait for the page to refresh and display the details in the *Details* area.

4 To view the volumes in the pool, use one of these methods:

   - In the *Details* area, click the arrow on the *Volumes* drop-down list.

     To view details for a volume in the list, select the volume, then click *View Details*. The *Volumes* page opens with the server and volume preselected.

   - Click *Storage* > *Volumes*.

     The *Volumes* page opens with the server preselected. To view details for a volume in the *Volumes* list, select the volume, then wait for the page to refresh.

For information about Volume management, see “Managing NSS Volumes” on page 221.

15.11 Viewing Device Information for a Pool

1 In iManager, click *Storage* > *Pools*.

   For instructions, see Section 9.1.5, “Accessing Roles and Tasks in iManager,” on page 94.

2 Select a server to manage.

   For instructions, see Section 9.1.6, “Selecting a Server to Manage,” on page 95.

   When the page refreshes, a list of pools appears in the *Pools* list.

3 In the *Pools* list, select a pool.

   Wait for the page to refresh and display the pool’s details in the *Details* area.

4 To view the list, in the *Details* area, click the arrow on the *Devices* drop-down list.

5 (Optional) Select the device, then click *View Details* to view its details.

The *Devices* page opens with the server and device preselected. Wait for the page to refresh to view the device's details.

For information about device management, see "Managing Devices" on page 115.

15.12 Preventing Pools from Activating on Multiple Servers

Multiple Server Activation Prevention (MSAP) prevents some accidental activations of a pool on more than one server at a time. You should never purposely attempt to activate a pool on two servers at the same time.

- Section 15.12.1, "Understanding MSAP," on page 187
- Section 15.12.2, "Enabling or Disabling MSAP for All NSS Pools," on page 188
- Section 15.12.3, "Enabling or Disabling MSAP for a Given NSS Pool," on page 188
- Section 15.12.4, "Rebuilding the MSAP Block for a Given NSS Pool," on page 189
- Section 15.12.5, "Determining If MSAP Is Enabled or Disabled on NSS Pools," on page 190
- Section 15.12.6, "Managing MSAP with XML or APIs," on page 190
- Section 15.12.7, "Additional Information," on page 190

15.12.1 Understanding MSAP

MSAP is enabled by default for all pools on the server. When enabled, it helps prevent some accidental activations of a pool on more than one server at a time. It does not catch all multiple activations. MSAP is not meant as a replacement of clustering software that controls shared pools.

MSAP protects pools on systems that do not have clustering installed but are attached to a shared disk by accident. For example, a pool might not be marked with the Shareable for Clustering attribute, but it exists on shared disks seen by multiple servers.

Pool MSAP also protects against dangerous conflicts that can occur if you disable the Shareable for Clustering flag in order to force an activation of a shared pool, or if you use `override=shared` when activating a pool. If MSAP detects a conflict, it deactivates the pool before massive corruption occurs.

If you unload Novell Cluster Services NLM software, or if you are not running it, pool MSAP provides an extra level of protection. The clustering software watches pools that are marked with the Shareable for Clustering attribute; MSAP detects conflicting connection from multiple servers and prevents corruption of pools even on devices that are marked as Not Shareable for Clustering.

In some cases, the MSAP software causes pools to take up to 30 seconds to activate. This delay might occur on the next pool activation after the Server ID or the Cluster ID changes for a given server pool. The Server ID changes if the registry is corrupted. The Cluster ID changes if the Cluster eDirectory object ID is lost.

If MSAP is enabled, all active NSS pools are read every 14 seconds. If your storage media are not shared between multiple servers such as in a SAN, you can clear the zpool_feature_msap bit. You should not clear this bit if your pools are on physically shared storage media.

If a pool can be accessed by older servers not running the Support Pack with the MSAP software, then multiple pool activations can still occur.

IMPORTANT: MSAP does not protect against partition conflicts for pools. It does not prevent multiple servers from creating a pool in the same partition.

15.12.2 Enabling or Disabling MSAP for All NSS Pools

By default, MSAP is enabled for all pools on the server when the server is booted.

To manually enable or disable MSAP for all pools on the server, issue the following MSAP console commands in the NSS Console (`nsscon`) on Linux.

nss /msapserver

Enables MSAP for all the pools on the server. By default, MSAP is enabled for every pool on the server.

nss /nomsapserver

Disables MSAP for all the pools on the server. This command remains in effect only until the server is next rebooted.

IMPORTANT: We recommend that you never disable MSAP.

15.12.3 Enabling or Disabling MSAP for a Given NSS Pool

Use the procedures in this section to enable or disable MSAP for a given pool.

The `/PoolMSAP` option enables MSAP for a given pool on the server. Use the command when the pool is activated. MSAP is enabled the next time the pool is activated.

The `/NoPoolMSAP` option disables MSAP for a given pool. Use the command when the pool is activated. MSAP is disabled the next time the pool is activated.

IMPORTANT: We recommend that you never disable MSAP.

1. Open a terminal console, then log in as the `root` user.
2. If the pool is not active, activate it now.
   - **2a** Start NSSMU by entering the following at the terminal console prompt:

     ```
     nssmu
     ```
   - **2b** Go to the *Pools* page.
   - **2c** Select the pool, then activate it by pressing *F7*.
   - **2d** Exit NSSMU.
3. Enable or disable MSAP for a given pool.
   - **3a** Start the NSS Console by entering the following at the terminal console prompt:

     ```
     nsscon
     ```
   - **3b** At the `nsscon` prompt, do one of the following:
     - **Enable MSAP:** Enter

       ```
       nss /poolmsap=poolname
       ```

- **Disable MSAP:** Enter

  `nss /nopoolmsap=poolname`

3c Close the NSS Console by entering

`exit`

4 Deactivate the pool, then activate it again.

4a Start NSSMU by entering the following at the terminal console prompt:

`nssmu`

4b Go to the *Pools* page.

4c Select the pool, then deactivate it by pressing *F7*.

4d Select the pool, then activate it by pressing *F7* again.

4e Exit NSSMU.

MSAP is now enabled or disabled, depending on your action in Step 3.

5 Verify that MSAP is enabled or disabled for the given pool.

5a Start the NSS Console by entering the following at the terminal console prompt:

`nsscon`

5b At the `nsscon` prompt, enter

`nss /pools`

5c Review the messages to determine if the pool was successfully enabled or disabled as follows:

- **MSAP Enabled:** The *Multi-Use Detect* message is displayed for the pool.
- **MSAP Disabled:** The *Multi-Use Detect* message is not displayed for the pool.

5d Close the NSS Console by entering

`exit`

15.12.4 Rebuilding the MSAP Block for a Given NSS Pool

If the MSAP block for a pool becomes corrupt, it prevents a pool from going into the Maintenance state. Use the `/MSAPRebuild` option to rebuild a pool's corrupt MSAP block. Before issuing the command to rebuild, you must deactivate the pool. Rebuilding an MSAP block does not give the rebuilder ownership of the pool.

1 Open a terminal console, then log in as the `root` user.

2 Deactivate the pool.

2a Start NSSMU by entering the following at the terminal console prompt:

`nssmu`

2b Go to the *Pools* page.

2c Select the pool, then deactivate it by pressing *F7*.

2d Exit NSSMU.

3 Rebuild the MSAP block for the pool.

3a Start the NSS Console by entering the following at the terminal console prompt:

```
nsscon
```

3b At the `nsscon` prompt, enter

```
nss /msaprebuild=poolname
```

3c Close the NSS Console by entering

```
exit
```

4 Activate the pool.

4a Start NSSMU by entering the following at the terminal console prompt:

```
nssmu
```

4b Go to the *Pools* page.

4c Select the pool, then activate it by pressing *F7*.

4d Exit NSSMU.

The pool should now be able to be placed in Maintenance mode.

15.12.5 Determining If MSAP Is Enabled or Disabled on NSS Pools

The `nss /pools` command displays the message *Multi-Use Detect* for NSS pools that have MSAP enabled.

1 At the NSS Console (nsscon) prompt, enter

```
nss /pools
```

2 For each pool, review the messages to determine whether MSAP is enabled or disabled as follows:

- **MSAP Enabled:** The *Multi-Use Detect* message is displayed for the pool.
- **MSAP Disabled:** The *Multi-Use Detect* message is not displayed for the pool.

15.12.6 Managing MSAP with XML or APIs

The `_admin\manage_nss\pool\poolname\zlss\msap.xml` file contains MSAP statistics for the pool. One file exists for each pool.

The MSAP attribute is displayed in the Enabled Attributes (<enabledAttributes>) tag of the `poolinfo.xml` management file.

For `manage.cmd`, the pool operation `getPoolInfo` returns the MSAP tag (<msap>) in the Supported Attributes tag (<supportedAttributes>) and the Enabled Attributes tag (<enabledAttributes>).

For APIs, the pool feature zpool_feature_msap can be viewed and controlled using the `zGetInfo` and `zModifyInfo` commands.

15.12.7 Additional Information

For more information about the MSAP commands used in this section, see Section A.21, “Multiple Server Activation Prevention (MSAP) Commands,” on page 406.

15.13 Updating eDirectory Pool Objects

On the *Pools* page, the Update eDirectory option adds or updates the Novell eDirectory pool object at the same context level as the server. NSS searches for the object. If the pool object exists, NSS prompts you with two options: Delete and replace the existing object, or Retain the existing object. If the pool object does not exist, NSS adds the object to the same context level where the server exists. Update eDirectory after you have modified a pool's parameters or renamed it.

To update eDirectory from iManager, perform the following steps:

1. In iManager, click *Storage* > *Pools*.

   For instructions, see Section 9.1.5, "Accessing Roles and Tasks in iManager," on page 94.
2. Select a server to manage.

   For instructions, see Section 9.1.6, "Selecting a Server to Manage," on page 95.
3. In the *Pools* list, select the pool you want to update.

   Wait for the page to refresh. It displays the pools's details and enables its management options.
4. Click *Update eDirectory*.

To update eDirectory from NSSMU, perform the following steps:

1. Go to NSSMU.
2. Select the pool you want to update.
3. Press *F4* to perform NDS update.

NOTE: When doing an NDS Update on a non-replica server, the operation might fail because of the eDirectory synchronization issue on non-replica servers.

When eDirectory synchronization is completed, the object creation also succeeds.

15.14 Updating eDirectory for Shared Pool

To update eDirectory for Shared Pool from iManager, perform the following steps:

1. Make the cluster resource offline.
   - **1a** In iManager, click *Clusters* > *Cluster Manager*.
   - **1b** Select the resource that you want to bring offline and click *Offline*.
2. Delete the cluster resource.
   - **2a** In iManager, click *Clusters* > *Cluster Options*.
   - **2b** Select the cluster where your resource is available.
   - **2c** Select the resource that you have brought offline in Step 1 and click *delete*.
3. Activate the Pool.
   - **3a** In iManager, click *Storage* > *Pools*.
   - **3b** Select the server where the pool exists.
   - **3c** Select the pool from the pools list that you want to activate.
   - **3d** Click *Activate*.

4 Update the eDirectory.

4a Select the pool and click on *Update eDirectory*.

IMPORTANT: Updating a pool's eDirectory object might delete the pool's existing volumes' eDirectory objects.

4b (Conditional) If the pool's existing volumes' eDirectory objects are not available, update the eDirectory objects for existing volumes.

5 Cluster enable the pool. For more information, see "Cluster-Enabling an Existing NSS Pool and Its Volumes" in the *OES 2 SP3: Novell Cluster Services 1.8.8 Administration Guide for Linux*.

6 Bring the cluster resource online.

6a In iManager, click *Clusters* > *Cluster Manager*.

6b Select the pool and click *Online*.

To update eDirectory for Shared Pool from command prompt, perform the following steps:

1 Make the cluster resource offline.

Run the command, `cluster offline` <*resource name*>.

2 Delete the cluster resource from iManager. For more information, see Step 2 on page 191.

3 Activate the Pool.

3a Go to NSSMU.

3b Select the pool you want to activate.

3c Press *F7*.

4 Update the eDirectory.

4a Press *F4* to NDS Update the pool.

IMPORTANT: Updating a pool's eDirectory object might delete the pool's existing volumes' eDirectory objects.

4b (Conditional) If the pool's existing volumes' eDirectory objects are not available, update the eDirectory objects for existing volumes.

5 Cluster enable the Pool. For more information, see "Cluster-Enabling an Existing NSS Pool and Its Volumes" in the *OES 2 SP3: Novell Cluster Services 1.8.8 Administration Guide for Linux*.

6 Bring the cluster resource online.

Run the command, `cluster online` <*resource name*>.

15.15 What's Next

You can now create volumes in the NSS pools you created. For information, see Chapter 18, "Managing NSS Volumes," on page 221.

16 Verifying and Rebuilding NSS Pools and Volumes

This section describes how to verify and rebuild Novell Storage Services pools to restore the consistency of a pool's metadata structure, and thus, the metadata structure of its volumes.

- Section 16.1, "When to Use Verify and Rebuild," on page 193
- Section 16.2, "Verifying and Rebuilding an NSS Pool and Its Volumes," on page 195
- Section 16.3, "ReZIDing Volumes in an NSS Pool," on page 200

16.1 When to Use Verify and Rebuild

NSS allows you to temporarily deactivate individual storage pools to fix volume problems instead of bringing down the server. However, when you deactivate a storage pool, users do not have access to any of the volumes in that pool. All of the volumes on the pool are part of the verify or rebuild process.

WARNING: After rebuilding an NSS pool, previously deleted volumes can not be salvaged.

The purpose of the Pool Verify and Pool Rebuild utilities is to make sure you have a valid metadata structure for a pool. Use the utilities only when you have problems with the pool's metadata structure.

- Section 16.1.1, "What Verifying Does Not Do," on page 193
- Section 16.1.2, "What Rebuilding Does Not Do," on page 193
- Section 16.1.3, "Before Verifying a Pool," on page 194
- Section 16.1.4, "Before You Rebuilding a Pool," on page 194

16.1.1 What Verifying Does Not Do

Verifying a pool does not fix any problems. It is a read-only assessment of the pool's metadata structure to identify the types of errors, the severity of errors, and in what volumes the errors occur.

16.1.2 What Rebuilding Does Not Do

Rebuilding a pool restores the consistency of the pool's metadata structure. Rebuilding a pool does not restore lost data and does not repair the data integrity of corrupted data.

Rebuilding a pool does not fix problems for the following:

- Journaling errors

- Hardware and media errors
- File system trustee assignments, trustee rights, and inherited rights filters
- File system attributes for files and directories
- Opportunistic locking
- Content of files

16.1.3 Before Verifying a Pool

Volume errors are typically transactions left unfinished during a system crash of some kind. Most volume errors are fixed automatically during volume mount when NSS resolves the journaled errors. If the pool can be mounted, mount its volume to allow the NSS journaling feature to repair any transactional errors that occurred during a system failure.

Afterwards, if there are still problems, use diagnostic tools to rule out hardware problems as the cause.

If non-hardware errors persist, and if you have a viable backup to restore the pool to the last known good state, restore the backup to recover the pool and restore the data. It is probably not necessary to verify or rebuild the pool.

If non-hardware errors persist, and if you do not have a viable backup, use the following Pool Verify utilities to identify any errors in the pool's metadata:

- `ravsui` (verify option)
- `ravview` (reformats log files to human-readable format)

16.1.4 Before You Rebuilding a Pool

Review the verification log to determine the type and severity of problems with the pool's metadata.

If all of the following conditions exist, then you should rebuild the pool to restore its metadata integrity.

- Errors were not corrected by mounting the volume, or you could not mount the volume.
- Errors were not caused by media or hardware problems, or they persisted after correcting any media or hardware issues.
- You have no viable backup of the pool's volumes to restore the pool to the last known good state.
- The Pool Verify process reports errors in the physical integrity of any of the volumes' metadata that would definitely cause data corruption if no action is taken.
- More data will be lost from continued data corruption than will be lost from rebuilding the pools now.

WARNING: You should rebuild a pool only as a last resort to restore the consistency of the pool's metadata. The rebuild repairs the metadata; it does not recover lost data or repair the integrity of the data itself. Data loss occurs during a rebuild if the utility must prune leaves in the data structure to restore metadata consistency.

If the Pool Verify process did not report errors, but you cannot create files or directories, you should run rebuild with the ReZID option. For information, see Section 16.3, "ReZIDing Volumes in an NSS Pool," on page 200.

If you are not sure whether you can tolerate a system rebuild, take a pool snapshot and run the rebuild against the pool snapshot instead. Then if the rebuild is acceptable, you can replace the pool with the rebuilt snapshot. For information about pool snapshots, see Chapter 17, “Managing NSS Pool Snapshots,” on page 203.

If necessary, rebuild the pool's metadata by using the following utilities:

- `ravsui` (build option)
- `ravview` (reformats log files to human-readable format)

16.2 Verifying and Rebuilding an NSS Pool and Its Volumes

- Section 16.2.1, “Mounting the Volume to Repair Journaled Errors,” on page 195
- Section 16.2.2, “Ruling Out Hardware Causes,” on page 195
- Section 16.2.3, “Verifying the Pool to Identify Metadata Inconsistencies,” on page 196
- Section 16.2.4, “Reviewing Log Files for Metadata Consistency Errors,” on page 197
- Section 16.2.5, “Rebuilding NSS Pools to Repair Metadata Consistency,” on page 198

16.2.1 Mounting the Volume to Repair Journaled Errors

Volume errors are typically transactions left unfinished during a system crash of some kind. This type of error is fixed automatically during volume mount by the NSS journaling feature.

If errors persist after you mount the volume, or if you cannot mount the volume, first rule out hardware causes for the problems. For information, see Section 16.2.2, “Ruling Out Hardware Causes,” on page 195.

16.2.2 Ruling Out Hardware Causes

If a volume cannot be mounted or problems persist after journaling errors are resolved, check the hardware for faulty media or controller problems.

1. Make sure you have a good backup of the data.
2. Use the latest diagnostic software and utilities from the manufacturer of your hard drives and controllers to troubleshoot the hard drives without destroying the data.

   For example, verify the media integrity and that devices are operating correctly.
3. If necessary, repair the media or controllers.

If errors persist after you have ruled out hardware causes, and you do not have a viable backup to restore to the last known good state, you should check the pool for metadata inconsistencies. For information, see Section 16.2.3, “Verifying the Pool to Identify Metadata Inconsistencies,” on page 196.

16.2.3 Verifying the Pool to Identify Metadata Inconsistencies

The verify process is a read-only assessment of the pool. The Pool Verify option searches the pool for inconsistent data blocks or other errors in the file system's metadata and reports data in the verification log. For information on where to find the verification log and how to interpret any reported errors, see Section 16.2.4, "Reviewing Log Files for Metadata Consistency Errors," on page 197.

1 For a 32-bit machine, make sure you have enough space available in the Linux kernel cache memory to run a pool verify.

When running `ravsui(8)` for a pool verify or a pool rebuild on Linux, the utility needs contiguous space in kernel memory separate from the space allocated to the core NSS process. The larger the pool, the larger the space that is needed. To make space available, you might need to reduce the space used by other processes. You can optionally reduce the minimum number of buffers reserved for the core NSS process to as little as 10,000 4-KB buffers.

1a Open a terminal console as the `root` user.

1b At the console prompt, enter

```
nsscon
```

1c In nsscon, enter

```
nss /MinBufferCacheSize=10000
```

2 Place the pool in maintenance mode.

2a At a terminal prompt, enter

```
nsscon
```

2b In nsscon, enter

```
nss /PoolMaintenance=poolname
```

3 Start the pool verify by entering the following at the terminal console prompt:

```
ravsui verify poolname
```

4 Use RAVVIEW to read the logs.

For information about using RAVVIEW, see Section B.9, "ravview," on page 439.

5 Do one of the following:

- If the log reports no errors with the pool's metadata, it is safe to activate the pool and mount the volumes.
- If the log reports no errors with the pool's metadata, but you still cannot create files or directories, run a Pool Rebuild with the ReZID option. For information, see Section 16.3, "ReZIDing Volumes in an NSS Pool," on page 200.
- If the log reports errors with the pool's metadata, the affected volumes remain in Maintenance mode. Decide whether to rebuild the pool based on the type of error and potential outcomes. For information about rebuilding the pool, see Section 16.2.5, "Rebuilding NSS Pools to Repair Metadata Consistency," on page 198.

6 For a 32-bit machine, if you modified the MinBufferCacheSize setting in Step 1, you can change it back to its original setting now, unless you are continuing with a pool rebuild.

6a Open a terminal console as the `root` user.

6b At the console prompt, enter

```
nsscon
```

6c In nsscon, enter

```
nss MinBufferCacheSize=value
```

Replace *value* with the desired minimum number of 4-KB buffers. The default value is 30000.

16.2.4 Reviewing Log Files for Metadata Consistency Errors

Make sure to check the error log whenever an NSS volume does not come up in active mode after a verify or rebuild.

- "Log Files and On-Screen Display" on page 197
- "Warnings Reported" on page 197
- "Errors Reported" on page 198
- "No Errors Reported, but Cannot Create Files or Directories" on page 198

Log Files and On-Screen Display

Messages are written to the following logs:

Table 16-1 *Location of Log Files for the NSS Pool Verify and Pool Rebuild Utilities*

Log	Purpose
`/var/opt/novell/log/nss/rav/`*`filename`*`.vbf` This is the default location, but you can specify the location and the filename.	Log of the pool verify process using `ravsui verify`. If a volume has errors, the errors are displayed on the screen and written to this log file of errors and transactions. On Linux, use the `ravview` utility to read logs. For information, see Section B.9, "ravview," on page 439.
`/var/opt/novell/log/nss/rav/`*`filename`*`.rtf`	Log of the pool rebuild process using `ravsui rebuild`. This log contains information about data that has been lost during a rebuild by the pruning of leaves in the data structure.

Whenever you verify or rebuild a pool, the new information is appended at the end of the log file. If you want to keep old log files intact, rename the log file or move it to another location before you start the verify or rebuild process.

Warnings Reported

Warnings indicate that there are problems with the metadata, but that there is no threat of data corruption. Performing a data restore from a backup tape or rebuilding the pool's metadata are optional. However, rebuilding a pools's metadata typically results in some data loss.

Errors Reported

Errors indicate that there are physical integrity problems with the pool's metadata, and data corruption will definitely occur, or it will continue to occur, if you continue to use the pool as it is.

If you decide to rebuild the pool, use the Pool Rebuild utility. For information, see Section 16.2.5, "Rebuilding NSS Pools to Repair Metadata Consistency," on page 198.

No Errors Reported, but Cannot Create Files or Directories

If the verify log does not report errors, but you continue to be unable to create files or directories on volumes in the pool, it might be because the files' ID numbers have exceeded the maximum size of file numbering field. You might need to rebuild the pool with the ReZID option. For information about how to decide if a ReZID is needed, see Section 16.3, "ReZIDing Volumes in an NSS Pool," on page 200.

16.2.5 Rebuilding NSS Pools to Repair Metadata Consistency

The purpose of a pool rebuild is to repair the metadata consistency of the file system. Rebuild uses the existing leaves of an object tree to rebuild all the other trees in the system to restore visibility of files and directories. It checks all blocks in the system. Afterwards, the NSS volume remains in maintenance mode if there are still errors in the data structure; otherwise, it reverts to the active state.

WARNING: Data will be lost during the rebuild.

A pool rebuild depends on many variables, so it is difficult to estimate how long it might take. The number of storage objects in a pool, such as volumes, directories, and files, is the primary consideration in determining the rebuild time, not the size of the pool. This is because a pool rebuild is reconstructing the metadata for the pool, not its data. For example, it would take longer to rebuild the metadata for a 200 GB pool with many files than for a 1 TB pool with only a few files. Other key variables are the number of processors, the speed of the processors, and the size of the memory available in the server.

You do not need to bring down the server to rebuild a pool. NSS allows you to temporarily place an individual storage pool in maintenance mode while you verify or rebuild it. While the pool is deactivated, users do not have access to any of the volumes in that pool.

If you do not place the pool in maintenance mode before issuing the rebuild or verify commands, you receive NSS Error 21726:

```
NSS error: PoolVerify results
   Status: 21726
     Name: zERR_RAV_STATE_MAINTENANCE_REQUIRED
   Source: nXML.cpp[1289]
```

To rebuild the pool:

1. Depending on the nature of the reported errors, you might want to open a call with Novell Support before you begin the rebuild process.
2. For a 32-bit machine, make sure you have enough space available in the Linux kernel cache memory to run a pool rebuild.

When running `ravsui(8)` for a pool verify or a pool rebuild on Linux, the utility needs contiguous space in kernel memory separate from the space allocated to the core NSS process. The larger the pool, the larger the space that is needed. To make space available, you might need to reduce the space used by other processes. You can optionally reduce the minimum number of buffers reserved for the core NSS process to as little as 10,000 4-KB buffers.

2a Open a terminal console as the `root` user.

2b At the console prompt, enter

```
nsscon
```

2c In nsscon, enter

```
nss MinBufferCacheSize=10000
```

3 Place the pool in maintenance mode.

3a At a terminal prompt, enter

```
nsscon
```

3b In nsscon, enter

```
nss /PoolMaintenance=poolname
```

4 Start the pool rebuild. At the terminal console prompt, enter

```
ravsui rebuild poolname
```

For information, see Section B.8, “ravsui,” on page 436 for options to set the pruning parameters for the rebuild.

Rebuilding can take several minutes to several hours, depending on the number of storage objects in the pool.

5 Review the log on-screen or in the *`filename`*`.rtf` file to learn what data has been lost during the rebuild.

For information, see Section 16.2.4, “Reviewing Log Files for Metadata Consistency Errors,” on page 197.

6 Do one of the following:

- **No Errors:** If errors do not exist at the end of the rebuild, the pool’s volumes are available for mounting.
- **Errors:** If errors still exist, the pool remains in the maintenance state. Repeat the pool verify to determine the nature of the errors, then call Novell Support for assistance.

7 For a 32-bit machine, if you modified the MinBufferCacheSize setting in Step 2, you can change it back to its original setting.

7a Open a terminal console as the `root` user.

7b At the console prompt, enter

```
nsscon
```

7c In nsscon, enter

```
nss MinBufferCacheSize=value
```

Replace *value* with the desired minimum number of 4-KB buffers. The default value is 30000.

16.3 ReZIDing Volumes in an NSS Pool

- Section 16.3.1, “What Is a ZID?,” on page 200
- Section 16.3.2, “Understanding ReZID,” on page 200
- Section 16.3.3, “When to ReZID,” on page 200
- Section 16.3.4, “Viewing the Highest ZID for a Volume,” on page 201
- Section 16.3.5, “ReZIDing Volumes,” on page 201

16.3.1 What Is a ZID?

When a file is created, it is assigned a unique file number, called a ZID. In NSS, the maximum number of file ZIDs available is a 64-bit number, which provides for up to 8 trillion (8E12) ZIDs, so NSS was designed to not re-use ZIDs. However, NCP clients and other traditional applications can only work with 32-bit IDs, which support up to 4 billion (4E9) ZIDs. NSS restricts ZIDs, and thus the number of files, to the lower value.

It is possible for a file system to reach the 32-bit limit on the ZID number. For example, if a lot of files and directories are regularly created, exist for a short time, and are then deleted, the ZIDs are used up at that rate. Otherwise, reaching the upper limit is something that happens rarely.

The ZID of a file is an internal file system bit of information. Under Linux, inode number and ZIDs are the same. You can view a file's ZID using the command `ls --inode`. However, the highest ZID number in use for each volume is reported when you verify a pool.

16.3.2 Understanding ReZID

The ReZID option for a pool rebuild changes the ZIDs for all the files on the volume, thus freeing ZIDs so they are available for creating new files and directories. The rezid does not modify any other metadata on the volumes, nor does it modify any file’s content. The reZID is unrelated to any other rebuild activities that might occur.

IMPORTANT: The reZID step in a rebuild adds a third review of the pool and can increase the time of a rebuild by 50%.

16.3.3 When to ReZID

After verifying a pool, the log reports the highest ZID (highestZID parameter) for each of the pool’s volumes. If the highest ZID number is close to the 4 billion ZID limit (4E9), you should reZID the volume. For NSS volumes on Linux, if the highest ZID is 2 billion (2E9) or greater, the reZID option occurs automatically when you rebuild a pool. You can optionally specify a different ZID limit to trigger the rezid, or use the /noReZID option to stop the reZID from occurring with that rebuild.

There are no errors reported if ZIDs are nearing the upper limit of 4 billion for a volume. You might get errors creating a file or directory that suggest a reZID needs to be done. For example:

- NDS database is locked.
- Server hangs at the end of load stage 1.
- Cannot copy to a volume.

NSS API calls return `Error 20108 zERR_ZID_GREATER_THAN_32_BITS`, which means that the ZID numbering has exceeded the 4 billion (4E9) limit. NSS also sends a volume alert to the server console that reZID needs to be done on a specified volume. The calling application gets only a generic error when it attempts and fails to create the file.

After rebuilding a pool with the ReZID option, the errors you were getting when creating files and directories no longer occur. You can also verify the pool again, then check the highest ZID number reported for the pool's volumes to know that each is well under the 4 billion ZIDs limit.

If you do not place the pool in maintenance mode before rebuilding the pool with the ReZID option, you receive NSS Error 21726:

```
NSS error: PoolVerify results
   Status: 21726
     Name: zERR_RAV_STATE_MAINTENANCE_REQUIRED
   Source: nXML.cpp[1289]
```

16.3.4 Viewing the Highest ZID for a Volume

To view the highest ZID per volume:

- On verifying a pool, look in the log to find the highest ZID value that has been assigned for each of the pool's volume. Look at each value to see whether you should rezid the pool as part of the rebuild process.

  OR

- Go to the file, `_admin\Manage_NSS\Volume\SYS\VolumeInfo.xml` and search for `nextAllocatableZid`.

You should be aware of the rate at which you are consuming ZIDs by creating and deleting files. If the highest ZID for a given volume reaches the limit of 4 billion (4E9), you cannot create new files on the volume until you rezid the pool.

16.3.5 ReZIDing Volumes

1. For a 32-bit machine, make sure you have enough space available in the Linux kernel cache memory to run a pool rebuild.

   When running `ravsui(8)` for a pool verify or a pool rebuild on Linux, the utility needs contiguous space in kernel memory separate from the space allocated to the core NSS process. The larger the pool, the larger the space that is needed. To make space available, you might need to reduce the space used by other processes. You can optionally reduce the minimum number of buffers reserved for the core NSS process to as little as 10,000 4-KB buffers.

   1a. Open a terminal console as the `root` user.

   1b. At the console prompt, enter

   ```
   nsscon
   ```

   1c. In nsscon, enter

   ```
   nss MinBufferCacheSize=10000
   ```

2. Place the pool in maintenance mode.

   2a. At a terminal prompt, enter

```
nsscon
```

2b In nsscon, enter

```
nss /PoolMaintenance=poolname
```

3 If you have not already verified the volume, enter the following at a command prompt:

```
ravsui verify poolname
```

For information, see Section B.8, “ravsui,” on page 436.

4 Review any errors on-screen or in the *filename*`.vbf` file, located where you specified.

For information, see Section 16.2.4, “Reviewing Log Files for Metadata Consistency Errors,” on page 197.

5 Rebuild a pool by entering the following at a command prompt

```
ravsui --rezid=zid rebuild poolname
```

Replace *zid* with the value of a threshold to cause a reZID of a volume. The default value is `0xeffffffe`. For information, see Section B.8, “ravsui,” on page 436 for options to set the pruning parameters for the rebuild.

For NSS on OES Linux, rebuild automatically causes a reZID of a volume if rebuild finds a ZID over 2 billion.

This checks all blocks in the system. Rebuilding can take several minutes to several hours, depending on the number of objects in the pool. For all systems, reZID adds a third pass to the rebuild, which increases the time to rebuild a volume by about 50%.

6 Review the log on-screen or in the *filename*`.rtf` file to learn what data has been lost during the rebuild.

For information, see Section 16.2.4, “Reviewing Log Files for Metadata Consistency Errors,” on page 197.

7 Do one of the following:

- **Errors:** If errors still exist, the pool remains in the maintenance state. Repeat the pool verify to determine the nature of the errors, then contact Novell Support for assistance.
- **No Errors:** If errors do not exist, the pool’s volumes are mounted automatically.

8 For a 32-bit machine, if you modified the MinBufferCacheSize setting in Step 1, you can change it back to its original setting.

8a Open a terminal console as the `root` user.

8b At the console prompt, enter

```
nsscon
```

8c In nsscon, enter

```
nss MinBufferCacheSize=value
```

Replace *value* with the desired minimum number of 4-KB buffers. The default value is 30000.

17 Managing NSS Pool Snapshots

Novell Storage Services supports pool snapshots to improve backup and restore services. This section describes the following:

- Section 17.1, “Understanding Pool Snapshots,” on page 203
- Section 17.2, “Guidelines for Using and Managing Pool Snapshots,” on page 205
- Section 17.3, “Creating a New Pool Snapshot,” on page 210
- Section 17.4, “Viewing a List of Snapshots for a Given Pool,” on page 212
- Section 17.5, “Viewing Pool Snapshot Details,” on page 213
- Section 17.6, “Modifying the Stored-On Location for Snapshots,” on page 214
- Section 17.7, “Onlining or Offlining a Pool Snapshot,” on page 214
- Section 17.8, “Viewing and Managing an Online Pool Snapshot,” on page 216
- Section 17.9, “Restoring Data from an Online Pool Snapshot,” on page 217
- Section 17.10, “Deleting a Pool Snapshot,” on page 218

17.1 Understanding Pool Snapshots

- Section 17.1.1, “How Snapshots Work,” on page 203
- Section 17.1.2, “Benefits of Using Snapshots,” on page 204

17.1.1 How Snapshots Work

A pool snapshot is a metadata copy of a storage data pool that preserves a point-in-time view of a data pool. The pool snapshot function uses copy-on-write technology to enable the instantaneous block-level snapshot of a pool, while requiring only a fraction of the storage space of the original data pool. A pool snapshot does not save an exact copy of the original data pool. Instead, the snapshot is a metadata-based copy that stores only the blocks of data that change subsequent to the instant of the snapshot. The snapshot combines the metadata and stored block data with the unchanged data on the original pool to provide a virtual image of an exact copy of the data at the instant the snapshot was taken, plus any end-user modifications made to that snapshot.

Before the snapshot can occur, the snapshot function must quiesce the original pool by briefly halting all data transaction activity when current transactions complete. It temporarily prevents new writes to the pool and flushes the file system cache to make the pool current with existing writes. Any open files are seen by the snapshot feature as being closed after these outstanding writes occur. Then, it snapshots the now-stable pool, and allows data transaction activity to resume.

The quiescence process provides a transactionally consistent image at the instant the snapshot is made. Because the snapshot is consistent, it is not necessary to check the consistency of the file system or database if you activate the snapshot for access.

After the snapshot, the snapshot function continues to track the transaction activity in the original pool. It determines which blocks in the original pool will change as data writes are made to the original pool. It temporarily suspends the write activity while it copies the original block data to the designated pool where it stores the pool snapshot. The snapshot storage area is referred to as the *stored-on partition* on Linux. After the data is copied, the snapshot function allows the write to that block in the original pool. This copy-on-write process keeps the snapshot metadata consistent in time with the exact instant the snapshot was taken.

As data on the original pool changes, the snapshot can theoretically grow to the size of the stored-on pool. The average disk space requirements for a pool snapshot are 10 percent to 20 percent of the original pool size. A combination of up to 15 snapshots can exist on OES 2 Linux on any given stored-on partition. The amount of space required depends on the number of snapshots, the snapshot retention policy, and the turnover rate for data in the original pool.

While the snapshot exists, the performance for volumes on the pool can decrease slightly because the number of disk writes increases for the copy-on-write activity. The decrease depends on the volatility of your data and the number of pool snapshots that exist for the original pool.

17.1.2 Benefits of Using Snapshots

Pool snapshots save time and preserve data. They provide an instant copy of a pool that can help expedite routine maintenance procedures to back up, archive, and protect data on that pool. Because traditional methods of duplicating large amounts of data can be expensive and time-consuming, the efficiency of snapshots can be an important benefit for your enterprise. You can make snapshots as frequently as needed to meet your data availability and resilience requirements.

You can use pool snapshots in a variety of ways to enhance your current storage infrastructure, including the following scenarios.

- "Supporting Backup Operations" on page 204
- "Archiving Data" on page 204
- "Restoring Data" on page 205
- "Re-Creating Operational and Development Environments" on page 205
- "Testing and Training" on page 205

Supporting Backup Operations

A pool snapshot facilitates non-disruptive backups because the snapshot becomes the source of the backup. When you back up volumes in a pool from a pool snapshot, your backup can capture every file in the pool, even those that are in use at the time. You can create, manage, and delete a pool snapshot for any pool on your server.

As contrasted to a traditional, full-data copy of the pool, the metadata copy only takes a moment to create and occurs transparently to the user. With traditional backups, applications might be shut down throughout the backup routine. In comparison, the pool snapshot process makes the original pool available with almost imperceptible delay.

Archiving Data

You can archive pool snapshots to maintain a point-in-time history of the changes made to the original data pool.

Restoring Data

Pool snapshots can serve as a source for recovering a point-in-time version of a file. After you take a snapshot, you can activate it at a later time to access the original pool's data as it existed at the time of the snapshot. Both the pool and its snapshots can be active and available concurrently. You access data on the active pool snapshot just as you would any other pool, even while data is changing on the original pool you snapped. To restore data, manually copy the old version of the file from the online snapshot volume to the original volume. For information, see Section 17.7, "Onlining or Offlining a Pool Snapshot," on page 214.

Two common reasons to restore information are user error and application errors.

- A user might inadvertently make changes to a file that need to be reversed. Files can become corrupted or deleted. The pool snapshot provides a quick and easy way to locate and reinstate selected files.
- An application might be infected by a virus or be corrupted by other problems, causing the application to store erroneous data throughout the pool. With a pool snapshot, you can easily restore all or part of the original pool to a point in time before the virus or problem was known to exist in the system.

Re-Creating Operational and Development Environments

You can also write to the pool snapshot, just as you would any pool. You can work with and modify the snapshot version of the data. For example, in a software development environment, engineers might want to repeat builds and tests of data within a given snapshot.

Testing and Training

Snapshots can provide a convenient source for testing and training environments and for data mining purposes.

17.2 Guidelines for Using and Managing Pool Snapshots

Use the guidelines in this section when planning your snapshot solution:

- Section 17.2.1, "Differences Between Snapshots on Linux and NetWare," on page 206
- Section 17.2.2, "Guidelines for Creating a Pool Snapshot," on page 207
- Section 17.2.3, "Guidelines for Creating Pool Snapshots of Clustered Pools," on page 207
- Section 17.2.4, "Guidelines for Naming Pool Snapshots," on page 207
- Section 17.2.5, "Guidelines for Choosing the Stored-On Location," on page 208
- Section 17.2.6, "Guidelines for Maintaining the Stored-On Location," on page 208
- Section 17.2.7, "Guidelines for Onlining Pool Snapshots," on page 209
- Section 17.2.8, "Guidelines for Deleting Pool Snapshots," on page 209

17.2.1 Differences Between Snapshots on Linux and NetWare

For NSS on Linux, snapshot volumes are not automatically mounted on reboot as they are in NetWare. The snapshots are active and performing their snapshot functions, but they are not mounted. If a snapshot was mounted when the server went down and you want the snapshot mounted after reboot, you must mount it manually. Mounting a snapshot is necessary only if users require access to the point-in-time version of the data.

In NSSMU, devices that contain NSS pool snapshots cannot be re-initialized. To initialize the device, you must first delete all NSS pool snapshots on the device. For information about deleting snapshots, see Section 17.10, "Deleting a Pool Snapshot," on page 218.

Table 17-1 identifies the differences for using snapshots for NSS pools on Linux and NetWare:

Table 17-1 *Comparison of NSS Pool Snapshots on Linux and NetWare*

Capability	NetWare	Linux
Rename a snapshot	Supported	Not supported. If you attempt to rename a snapshot, you get an eDirectory error because eDirectory objects are not automatically created for pool snapshots.
Snapshot stored-on location	An NSS pool is designated as the stored-on pool for a given original pool.	An EVMS-managed Linux partition is designated as the stored-on partition for a given original pool.
Snapshots of cluster-enabled pools	Supported The stored-on pool must be the same as the original pool.	Not supported
eDirectory object for the snapshot	eDirectory objects are automatically created for the snapshot pools and volumes.	No eDirectory objects are created. In order to allow users to access data on an NSS pool snapshot (snapshots can only be accessed as read only, of course), you must first activate and mount the snapshot as an NSS pool, then use the *Update eDirectory* option on the *Storage* > *Pools* page to create an eDirectory object for the snapshot pool or volume.
Taking new snapshots	The stored-on pool must be activated and mounted.	The stored-on Linux partition must be mounted.
Deleting snapshots	Delete pool snapshots in a first-created, first-deleted order.	Snapshots can be deleted in any sequence.
Shredding deleted snapshots	Supported	Not supported

17.2.2 Guidelines for Creating a Pool Snapshot

Create a pool snapshot when you want to capture a point-in-time view of a active data pool. The original pool must be active when you create the snapshot. For instructions on creating a pool snapshot, see "Creating a New Pool Snapshot" on page 210.

17.2.3 Guidelines for Creating Pool Snapshots of Clustered Pools

Pool snapshots are not supported for clustered NSS pools on Linux.

17.2.4 Guidelines for Naming Pool Snapshots

You name a pool snapshot at the time you order the snapshot. Specify a unique name for each snapshot. Because the name also serves as the snapshot's poolname when active, the name you give it should be unique among snapshots and among pools. The combination of the snapshot's name and time stamp when the snapshot was taken can help you identify the snapshot version you want to manage.

- "Default Naming Scheme When Using iManager" on page 207
- "Alternate Naming Scheme" on page 208
- "Considerations for Naming" on page 208

Default Naming Scheme When Using iManager

When you create a snapshot in iManager, the snapshot name is by default a modified version of the original pool's name, which allows a simple identification of all snapshots for any given pool. NSS adds a letter and number designator (*_Sn*) to the original pool name. The *S* indicates that it is a snapshot. The *n* represents an incremental number (1 to 500) of snapshots taken for this pool.

IMPORTANT: When you create a snapshot in NSSMU, no default name is suggested. You can optionally adopt the default naming scheme when you provide a name for the pool snapshot.

For example, pool snapshot names for `POOLA` might be `POOLA_S1`, `POOLA_S2`, and so on.

If you delete snapshots out of sequence, it is possible that the numbers could be reused. A simple sort by snapshot name could be confusing. Make sure to verify the create stamp on the pool when you work with pool snapshots that use the default naming scheme.

The snapshot name can be 2 to 16 characters in length and must adhere to the same character conventions as for poolnames. If the poolname is too long to allow the snapshot identifier to be appended, the poolname is truncated so that the length of the pool snapshot name is 16 characters. For example, if the poolname is `POOL_EUR_MANUF` (14 characters), its name would be truncated then the snapshot identifier appended. The number of characters to be truncated would depend upon the pool snapshot number, such as POOL_EUR_MANU_S1, POOL_EUR_MAN_S12, or POOL_EUR_MA_S102

If you bring a pool snapshot online, its volume names are automatically renamed to indicate that they are snapshot volumes. By default, *_SV* is added to volume names to indicate the storage object is a volume in a pool snapshot.

For example, if your original pool is named `users`, its default pool snapshot name is `users_s1`. If its volumes are named `users_aj` and `users_ kz`, the volumes in the snapshot pool are `users_aj_sv`, `users_aj_sv001` and `users_kz_sv`, `users_kz_sv001` and so on.

Alternate Naming Scheme

You can optionally adopt your own naming convention for pools. If you create multiple snapshots of a pool each day, consider using a logical naming convention that identifies the poolname and numbers that allow sequential listing based on the order the snaps were taken. Of course, the time stamp shows the exact time that the snapshot was taken, and you can always refer to it to be sure you have the right snapshot.

Considerations for Naming

It is also important to consider the names of existing pools and pool snapshots and your naming conventions when you name new data pools and volumes. You should get errors if you attempt to create pools with names that are in use by pool snapshots, and vice versa.

If a volume with the same name as a snapshot volume exists on the server when you mount a snapshot pool, NSS automatically appends the snapshot volume name with an additional sequential number (such as `VOL1_SV001`) or characters (such as `VOL1_SV_SV`) as it onlines the volume. This makes the snapshot name unique with respect to the active volumes while the pool snapshot is online.

If name conflicts occur, you might need to rename a pool or pool snapshot to a unique name in order to bring the pool snapshot online.

17.2.5 Guidelines for Choosing the Stored-On Location

The stored-on partition is the partition on an EVMS-managed device where you want to store a given pool snapshot for a given original pool.

IMPORTANT: On Linux, creating snapshots of clustered NSS pools is not supported.

When you create a pool's snapshot, you select the device and specify the size to use. You cannot increase the size of the partition later, so make sure you allow sufficient space.

If the destination partition that stores the snapshot data runs out of space, it causes write errors to happen on the original pool. Allow ample space for snapshots to grow over time when sizing the snapshot's destination pool. The amount of space required depends on the number of snapshots, the snapshot retention policy, and the turnover rate for data in the original pool.

17.2.6 Guidelines for Maintaining the Stored-On Location

The status of any given pool snapshot partition is closely tied to the operational status of the original pool. You can deactivate the original pool, as needed, without adversely impacting the pool snapshot or the status of the stored-on partition. If the original pool is deactive, there are no active transactions

for the pool snapshot function to process. For Linux, the stored-on partition hosts only the a single snapshot, so it can be safely deactivated after you deactivate its original pool. Make sure that you re-activate the stored-on partition first when bringing the original pool back into service.

In contrast, deactivating the stored-on partition first can cause the ungraceful deactivation of the corresponding original pool.

IMPORTANT: The stored-on partition should remain active as long as it hosts any pool snapshots. You can deactivate it safely after its original pool is deactivated, and for the duration of the pool's deactivation. Activate the stored-on partition before re-activating the original pool.

17.2.7 Guidelines for Onlining Pool Snapshots

For pool snapshots, Online and Offline are conditions related to the visibility of the pool snapshot to users. The pool snapshot is offline by default. The snapshot functions are working in the background to capture any changes being made to the original pool whether the pool is offline or online.

You activate a pool snapshot as a pool by bringing it *online* whenever you want to access the data on it, such as for data retrieval and data backup. After the pool snapshot is online, it appears by its snapshot name in the pool list. Treat it as you would any pool to activate and mount its volumes. Because you are working with a snapshot and not the original pool and its volumes, other management tasks are limited.

The names of volumes on the pool snapshot are a modified version of the volumes on the original pool. By default, the characters *_SV* (snapshot volume) are appended to the volumes' names. When you deactivate the pool snapshot, the corresponding snapshot volumes are automatically deactivated, and the pool snapshot is no longer listed in the pool list.

The Pool object and Volume object for a snapshot are not automatically created in Novell eDirectory when you bring an NSS volume snapshot online. These objects are needed only if you want to verify the NSS metadata information on a snapshot volume. For this case, you must create the objects manually by using the *Update eDirectory* option to create the storage objects for the online snapshot NSS pool and each of its volumes. For information, see Section 15.13, "Updating eDirectory Pool Objects," on page 191 and Section 18.5, "Updating eDirectory Volume Objects," on page 231.

If you reboot the server while a pool snapshot is online, the snapshot might be online or offline after the restart, depending on the platform. If the pool snapshot is online when the server goes down, the pool snapshot is automatically set in the Offline state after a reboot.

For instructions, see Section 17.7, "Onlining or Offlining a Pool Snapshot," on page 214.

17.2.8 Guidelines for Deleting Pool Snapshots

Delete pool snapshots as follows:

- Delete all pool snapshots before you move devices that contain the original pool from NetWare to Linux. Different technologies are used for pool snapshots on Linux and NetWare, so existing pool snapshots cannot be used on a different platform.

  WARNING: Without first deleting the pool's snapshots, you might not be able to access or manage the original pool after you move the pool's device cross-platform.

- Delete a pool snapshot when you no longer need it.
- Delete a pool snapshot when you need free space on the device where the stored-on partition exists.

Make sure that the pool snapshot is not mounted as an online pool before you delete it.

Snapshots can be deleted in any sequence.

For instructions, see Section 17.10, “Deleting a Pool Snapshot,” on page 218.

17.3 Creating a New Pool Snapshot

- Section 17.3.1, “Prerequisites for Creating a Pool Snapshot,” on page 210
- Section 17.3.2, “Using iManager,” on page 210
- Section 17.3.3, “Using NSSMU for Linux,” on page 212

17.3.1 Prerequisites for Creating a Pool Snapshot

- The pool you want to snapshot must already exist and be active.
- Free space must be available on an EVMS-managed device that you want to use as the stored-on partition.
- You cannot create snapshots of shared NSS pools. Pool snapshots are not supported for shared pools.

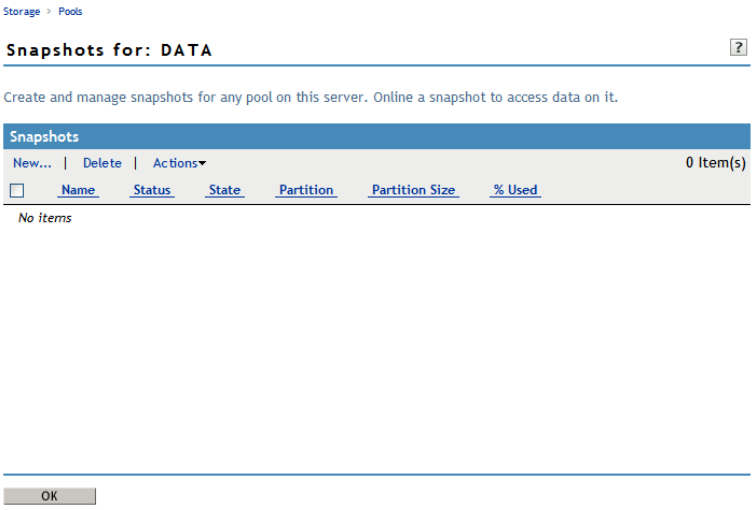
17.3.2 Using iManager

1. In iManager, click *Storage* > *Pools*.

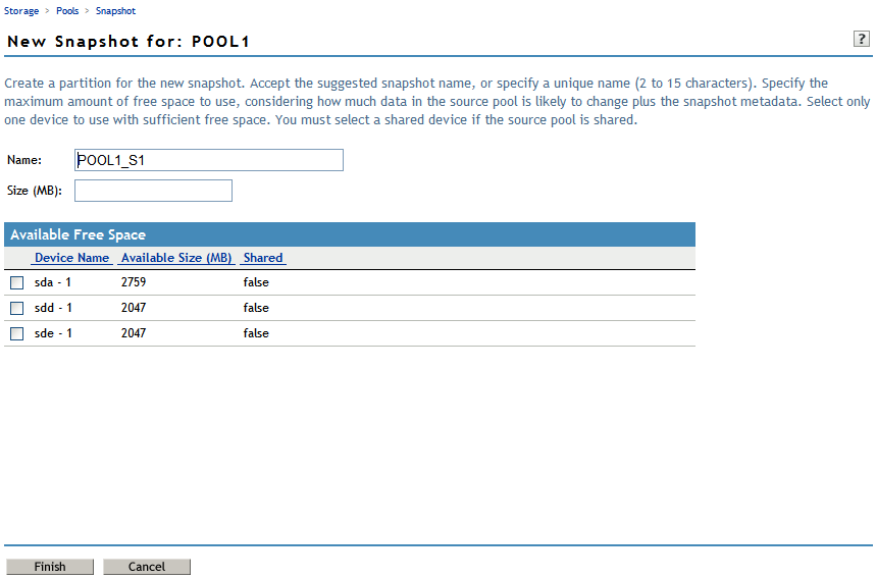
   For instructions, see Section 9.1.5, “Accessing Roles and Tasks in iManager,” on page 94.
2. In the server field on the *Pools* page, select a server to manage to view a list of pools.

   For instructions, see Section 9.1.6, “Selecting a Server to Manage,” on page 95.
3. If the pool you want to snapshot is not active, select the pool from the *Pools* list, then click *Activate*.
4. In the *Pools* list, select the active pool that you want to snapshot, then click *Snapshot* to go to the *Snapshots for: poolname* page.

   IMPORTANT: If the selected pool is a online pool snapshot, the *Snapshot* option is not available. Select the original pool instead.



5 In the *Snapshots* menu, select *New* to open the *New Snapshot for: <poolname>* page.



6 On the *New Snapshot* page, specify the following:

- **Name:** Optionally modify the default snapshot name.

  For information about pool snapshot names, see "Guidelines for Naming Pool Snapshots" on page 207.

- **Size:** Type the amount of free space (in MB) to use for the stored-on partition.

- **Stored-on Partition:** From the list of active devices, select the device where you want to create the stored-on partition.

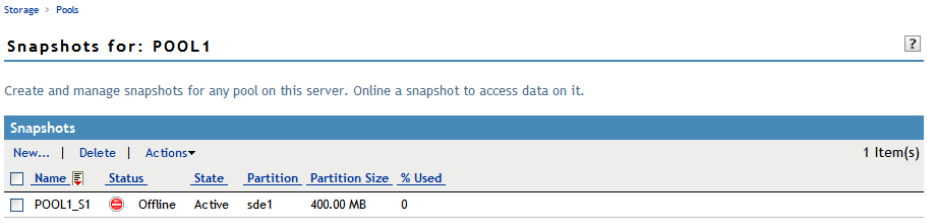
  Each snapshot is stored on a separate partition. The partition for the snapshot cannot be expanded after it is created. If the pool is shared in a cluster, the snapshot feature is not supported. For information, see "Guidelines for Choosing the Stored-On Location" on page 208.

7 Click *Finish* to create the snapshot, or click *Cancel* to back out of the process.

8 After NSS creates the pool snapshot, NSS automatically opens to the *Snapshots* page so that you can further manage the snapshot. The *Snapshots* list contains the newly created snapshot.

IMPORTANT: You might see an error message if the iManager connection to the server you are managing times out before the snapshot is created. The pool snapshot creation should continue on the managed server. If a timeout error occurs, navigate to the *Snapshots* page to view and manage the snapshot.

By default, the snapshot is always *Offline* and *Active*. This means that the snapshot is functioning, but that the pool snapshot is not mounted as an online pool.



17.3.3 Using NSSMU for Linux

1 Open a terminal console, then log in as the `root` user.

2 At the terminal console prompt, enter

```
nssmu
```

3 If the pool that you want to snapshot is not currently mounted, mount it now by using your normal mount methods.

4 In NSSMU, select *Snapshot*.

5 Press *Insert* to begin the create process.

6 Specify a name for the pool snapshot.

7 From the *Pools* list, select the pool you want to snapshot, then press *Enter*.

8 From the *Devices* list, select the device where you want to create a partition for the snapshot stored-on partition, then press *Enter*.

Each snapshot is stored on a separate partition, not on a pool.

9 Specify how much space in MB to allocate to the partition.

The partition for the snapshot cannot be expanded after it is created.

10 Press *Enter* to create the snapshot.

The newly created snapshot appears in the *Snapshots* list.

17.4 Viewing a List of Snapshots for a Given Pool

1 In iManager, click *Storage* > *Pools*.

For instructions, see Section 9.1.5, “Accessing Roles and Tasks in iManager,” on page 94.

2 In the server field on the *Pools* page, select a server to manage to view a list of pools.

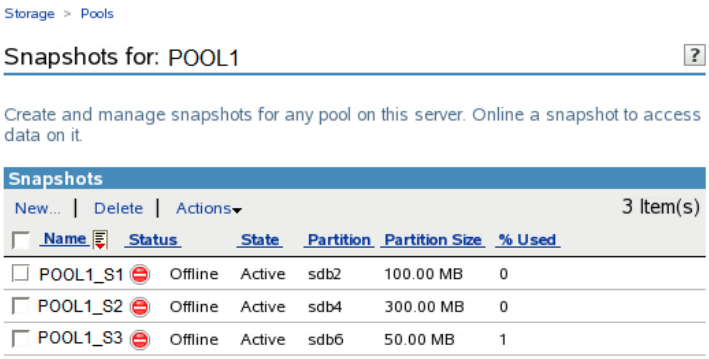
For instructions, see Section 9.1.6, “Selecting a Server to Manage,” on page 95.

3 If the original pool for the snapshots you want to view is not active, select the pool from the *Pools* list, then click *Activate*.

4 In the *Pools* list, select the active pool that has snapshots you want to manage, then click *Snapshot* to go to the *Snapshots for: poolname* page.

IMPORTANT: If the selected pool is an online pool snapshot, the *Snapshot* option is not available. Select the original pool instead.

The *Snapshots* report includes the snapshot name, status (*Offline* (default) or *Online*), state (*Active* (default) or *Deactive*), the name and size of the stored-on partition, and the percent of space used on the partition.



17.5 Viewing Pool Snapshot Details

In iManager, you can view the following details about a pool snapshot:

Table 17-2 *Explanation of Pool Snapshot Details*

Snapshot Details	Parameter	Description
Snapshot	Status	Offline (default) or Online. Online pool snapshots appear in the *Pools* page and its snapshot volumes appear in the *Volumes* page.
	State	Deactive (default) or Active. Active indicates that the pool snapshot operation is active. Disabled/Full means the snapshot is invalid because the stored-on partition is full. You should delete the invalid snapshot. Other snapshots continue working. Disabled/Full snapshots are ignored by the pool and do not impact the I/O performance for the pool.
	Size	The current size of the pool snapshot. The pool's snapshot can continue to add metadata for the snapshot until it reaches the size allocated.
	Creation Date	The time stamp that shows the date and time the original pool was snapped.

Snapshot Details	Parameter	Description
Snapshot of	Name	The name of the original pool that was snapped.
	Total space	The total space allocated for the original pool.
	Used space	The amount of space currently in use for the original pool.
Stored-On Location (pool or partition)	Name	The pool where the snapshot metadata resides. This can be the same as the original pool.
	State	The current state of the stored-on pool, either Active (default) or Deactive.
	Total space	The total space allocated for the pool where the snapshot is stored.
	Used space	The amount of space currently in use for the pool where the snapshot is located. The used space represents all uses of the pool, not just the snapshot.

To view details of a pool snapshot:

1. In iManager, log on to the tree for the server you want to manage.
2. In *Roles and Tasks*, click *Storage* > *Pools* to open the *Pools* page.
3. Select the server that contains the original pool of the snapshot you want to view.
4. In the *Pools* list, select the original pool of the snapshot you want to view, then click *Snapshot*.
5. On the *Snapshots* page, select the snapshot, then click *Actions* > *Details* to open the Details dialog box.

17.6 Modifying the Stored-On Location for Snapshots

After you specify a partition to use for a given snapshot, that partition cannot be changed or resized. When you delete the snapshot, the stored-on partition is also deleted.

17.7 Onlining or Offlining a Pool Snapshot

You can mount a pool snapshot as a pool in order to make the point-in-time versions of the volumes available.When it is mounted, the pool snapshot appears on the *Pools* page by its snapshot name. The volumes on the pool appear on the *Volumes* page with an `_SV` appended to the name, such as `VOL1_SV`.

For example, you might want to mount a snapshot as a pool to back up data from the snapshot version of the volumes. Snapshot functions occur while the snapshot pool is active, whether the snapshot is mounted or dismounted. Snapshots are typically not mounted for general user access purposes.

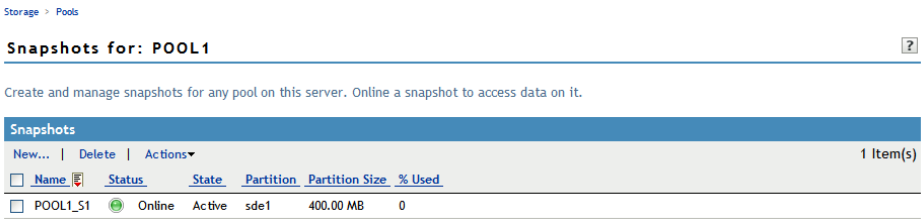
- Section 17.7.1, “Using iManager to Online a Pool Snapshot,” on page 215
- Section 17.7.2, “Using iManager to Offline a Pool Snapshot,” on page 215
- Section 17.7.3, “Using NSSMU for Linux to Online or Offline a Pool Snapshot,” on page 216

17.7.1 Using iManager to Online a Pool Snapshot

You can use iManager to online or offline pool snapshots.

1. In iManager, log on to the tree for the server you want to manage.
2. In *Roles and Tasks*, click *Storage* > *Pools* to open the *Pools* page.
3. Select the server that contains the original pool of the snapshot you want to manage.
4. In the *Pools* list, select the original pool of the snapshot you want to manage, then click *Snapshot* to open the *Snapshots* page.
5. Select one or more pool snapshots that you want to manage, then click *Actions* > *Online*.

   This activates the selected pool snapshots and their volumes. The volumes are not mounted automatically.



6. If you need to access a pool snapshot volume, mount the volume.
   - **6a** In *Roles and Tasks*, click *Storage* > *Volumes* to open the *Volumes* page.
   - **6b** If you need to verify NSS metadata information for the snapshot volume while it is online, select the snapshot volume, then click *Update eDirectory* to create a Volume object for the volume.
   - **6c** On the *Volumes* page, select the snapshot volume you want to manage, then click *Mount*.

17.7.2 Using iManager to Offline a Pool Snapshot

You can use iManager to offline pool snapshots.

1. In iManager, log on to the tree for the server you want to manage.
2. In *Roles and Tasks*, click *Storage* > *Pools* to open the *Pools* page.
3. Select the server that contains the original pool of the snapshot you want to manage.
4. If the snapshot volumes for the pool snapshot are currently mounted, go to the *Volumes* page, select the mounted snapshot volumes, then click *Dismount*.
5. In the *Pools* list, select the original pool of the snapshot you want to manage, then click *Snapshot* to open the *Snapshots* page.

   All snapshot volumes are automatically offlined at this time.
6. Select one or more pool snapshots that you want to manage, then click *Actions* > *Offline*.

   This makes the selected pool snapshots and all the volumes in them unavailable to users. It does not destroy volumes in the snapshots, nor does it destroy the data contained in the volumes.

17.7.3 Using NSSMU for Linux to Online or Offline a Pool Snapshot

On Linux, you can use NSSMU for Linux to online or offline the pool snapshot.

1. Open a terminal console, then log in as the `root` user.
2. At the terminal console prompt, enter

   ```
   nssmu
   ```

3. In NSSMU, select *Snapshot*.
4. Select the pool snapshot that you want to manage, the press *F7* to mount or dismount the pool snapshot.

   The pool snapshot functions continue even though the snapshot is not mounted for general user access.

17.8 Viewing and Managing an Online Pool Snapshot

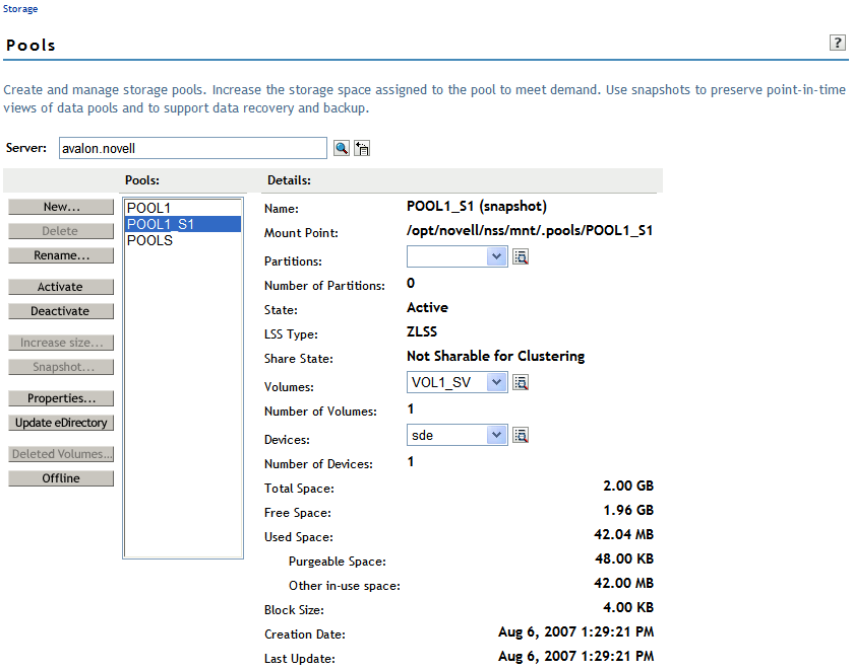
When online, pool snapshots appear and function as a pool in the *Pools* list on the *Pools* page.

1. In iManager, click *Storage* > *Pools*.

   For instructions, see Section 9.1.5, “Accessing Roles and Tasks in iManager,” on page 94.
2. Select a server to manage to view a list of its pools.

   For instructions, see Section 9.1.6, “Selecting a Server to Manage,” on page 95.
3. In the *Pools* list, select the online pool snapshot.

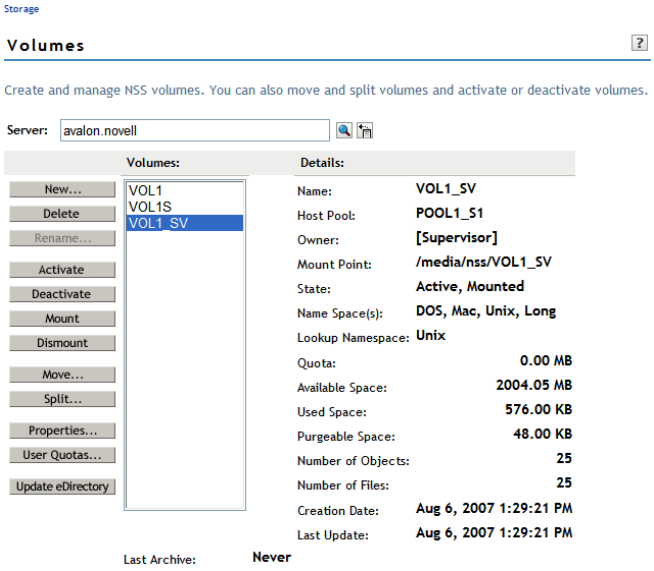
   Wait for the page to refresh. It displays the pool snapshot’s details and enables its management options. The Name is followed by *snapshot* in parens to indicate that the selected pool is a snapshot.



4. Click *Storage* > *Volumes* to go to the volumes page.

The snapshot volumes are listed in the *Volumes* list. They are deactive and unmounted by default.

5 Optionally select the snapshot volume, then click *Mount* to mount the snapshot volume so that you are able to access its data.



6 When you are done, go to the *Pools* page, select the snapshot pool, then click *Offline* to take the pool snapshot offline and dismount its snapshot volumes.

17.9 Restoring Data from an Online Pool Snapshot

You can restore a point-in-time version of data from a pool snapshot by manually copying the data from an online snapshot volume to another location.

1 In iManager, click *Storage* > *Pools*.

For instructions, see Section 9.1.5, “Accessing Roles and Tasks in iManager,” on page 94.

2 Select a server to manage to view a list of its pools.

For instructions, see Section 9.1.6, “Selecting a Server to Manage,” on page 95.

3 Online the pool snapshot that contains the version of the file you want to restore.

For information, see Section 17.7.1, “Using iManager to Online a Pool Snapshot,” on page 215.

4 Select *Storage* > *Volumes* to go to the volumes page.

5 Select the snapshot volume (such as `VOL1_SV`) from the *Volumes* list, then click *Mount*.

Snapshot volumes are mounted Read Only. You cannot modify the content of files on the snapshot.

6 Use any normal method to copy the file of interest from the mounted snapshot volume to a new location.

17.10 Deleting a Pool Snapshot

Use the Delete option to permanently remove one or more selected pool snapshots from the server. Deleting a pool snapshot removes the ownership of the space it occupied, freeing the space for reassignment. For guidelines, see "Guidelines for Deleting Pool Snapshots" on page 209.

IMPORTANT: Delete the oldest snapshot first in a first-created, first-deleted manner.

- Section 17.10.1, "Using iManager to Delete a Pool Snapshot," on page 218
- Section 17.10.2, "Using NSSMU to Delete a Pool Snapshot," on page 218

17.10.1 Using iManager to Delete a Pool Snapshot

1. In iManager, click *Storage* > *Pools*.

   For instructions, see Section 9.1.5, "Accessing Roles and Tasks in iManager," on page 94.

2. In the server field on the *Pools* page, select a server to manage to view a list of its pools.

   For instructions, see Section 9.1.6, "Selecting a Server to Manage," on page 95.

3. If the pool that has snapshots you want to manage is not active, select the pool from the *Pools* list, then click *Activate*.

4. If a pool snapshot for the selected pool is currently online, do the following to offline the pool snapshot:

   4a. If the snapshot volumes for the pool snapshot are currently mounted, go to the *Volumes* page, select the mounted snapshot volumes, then click *Dismount*.

   4b. On the *Pools* page, select the pool snapshot from the *Pools* list, then click *Offline*.

5. On the *Pools* page, select the active pool from the *Pools* list that has snapshots you want to manage, then click *Snapshot* to go to the *Snapshots for: <poolname>* page.

   IMPORTANT: If the selected pool is a online pool snapshot, the *Snapshot* option is not available. Select the original pool instead.

   ---

6. In the *Snapshots* list, select one or more snapshots that you want to delete.

7. Click *Delete*, then click *Yes* to confirm the delete.

17.10.2 Using NSSMU to Delete a Pool Snapshot

1. Open a terminal console, then log in as the `root` user.

2. At the terminal console prompt, enter

   ```
   nssmu
   ```

3. If the pool that has snapshots you want to manage is not active, select *Pools* from the main menu, select the pool, then press F7 to activate the pool.

4. In NSSMU, click *Snapshots*.

5. If the pool snapshot you want to delete is currently online, select the pool snapshot from the *Snapshots* list, the press F7 to dismount the pool.

6. Select the pool snapshot that you want to delete from the *Snapshots* list, then press *Delete* to delete the snapshot.
7. Click *Y (Yes)* to confirm the delete.

18 Managing NSS Volumes

Novell Storage Services uses storage volumes to logically organize your data. After creating NSS pools, you can create any number of NSS volumes for each pool, depending on the physical space available.

This section describes how to configure and manage NSS volumes by completing the following tasks:

- Section 18.1, “Understanding Volume Properties,” on page 221
- Section 18.2, “Guidelines for NSS Volumes,” on page 227
- Section 18.3, “Creating Unencrypted NSS Volumes,” on page 228
- Section 18.4, “Configuring Encrypted NSS Volumes with NSSMU,” on page 231
- Section 18.5, “Updating eDirectory Volume Objects,” on page 231
- Section 18.6, “Viewing the Details of an NSS Volume,” on page 232
- Section 18.7, “Viewing Properties of an NSS Volume,” on page 232
- Section 18.8, “Modifying Attributes of an NSS Volume,” on page 234
- Section 18.9, “Modifying the NSS Volume Size,” on page 235
- Section 18.10, “Configuring the Name Space for an NSS Volume,” on page 236
- Section 18.11, “Mounting NSS Volumes with Linux Commands,” on page 237
- Section 18.12, “Renaming an NSS Volume,” on page 238
- Section 18.13, “Renaming (Modifying) the Mount Point for an NSS Volume,” on page 239
- Section 18.14, “Activating and Deactivating an NSS Volume,” on page 240
- Section 18.15, “Mounting and Dismounting an NSS Volume,” on page 240
- Section 18.16, “Exporting and Importing NSS Volumes for NFS Access,” on page 242
- Section 18.17, “Deleting an NSS Volume,” on page 247
- Section 18.18, “Finding the Filename for a Given ZID,” on page 248
- Section 18.19, “Verifying or Rebuilding NSS Volumes,” on page 248
- Section 18.20, “Moving Volumes with DFS,” on page 248
- Section 18.21, “Splitting Volumes with DFS,” on page 248
- Section 18.22, “What’s Next,” on page 248

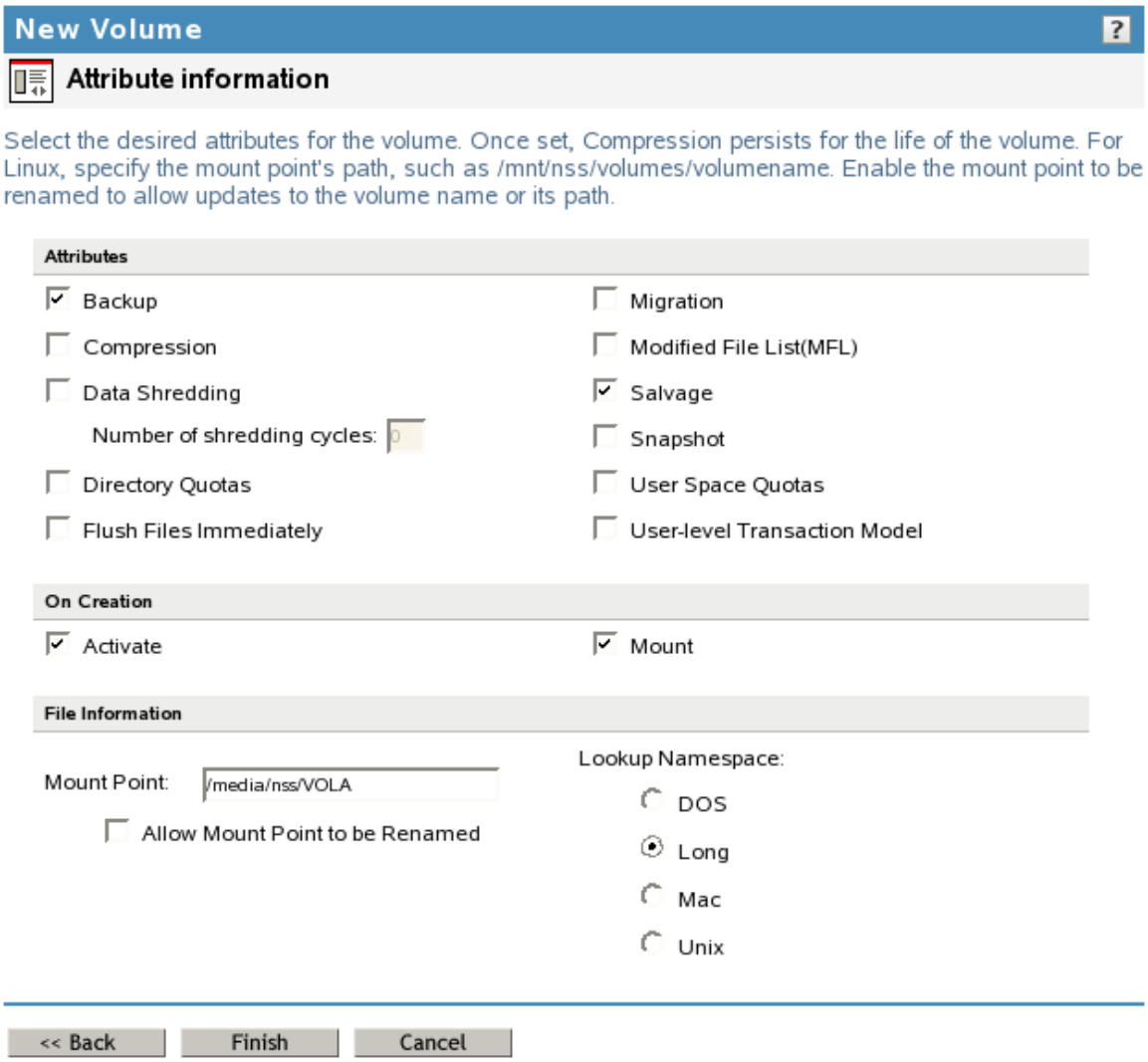
18.1 Understanding Volume Properties

- Section 18.1.1, “Volume Attributes,” on page 222
- Section 18.1.2, “Encryption Support,” on page 226
- Section 18.1.3, “Enhanced Hard Link Support,” on page 226

18.1.1 Volume Attributes

Figure 18-1 shows the volume attributes for an NSS volume that can be set in iManager when you create volumes. An explanation of each attribute is provided below.

Figure 18-1 *Volume Attributes*



- "Backup" on page 223
- "Compression" on page 223
- "Data Shredding" on page 223
- "Directory Quotas" on page 223
- "Flush Files Immediately (NetWare)" on page 223
- "Migration (to Third-Party Near-Line or Offline Storage)" on page 223
- "Modified File List" on page 224
- "Salvage Files" on page 224
- "Snapshot (File-Level) (NetWare)" on page 224
- "User Space Quotas" on page 224

- "User-Level Transaction Mode (NetWare)" on page 225
- "Mount Point" on page 225
- "Lookup Namespace" on page 225

Backup

The Backup attribute sets a flag to indicate to the backup software that the volume contains data you want to back up. Disable this flag if the volume is empty or if backing up the data is unnecessary. This backup flag is independent of the third-party backup system you use; your backup system might not recognize this option, even if you select it. The Backup attribute is enabled by default.

Compression

The Compression attribute activates file compression in NSS volumes. Compression can be activated at creation time only and this choice persists for the life of the volume. Data in the volume might be stored normally or in compressed form, depending on how frequently it is used. Compression parameters can be set at the server level to control compression behavior. For information, see "Managing Compression on NSS Volumes" on page 275.

Data Shredding

The Data Shredding attribute allows you to electronically overwrite deleted and purged data areas to prevent unauthorized users from using a disk editor to access purged files. You can specify the number of times (1 to 7) to shred data. For information, see Section 20.3, "Using Data Shredding to Prevent Access to Purged Files," on page 268.

Directory Quotas

The Directory Quotas attribute enables you to assign a maximum quota of space that a directory can consume. For information, see "Managing Space Quotas for Volumes, Directories, and Users" on page 293.

Flush Files Immediately (NetWare)

The Flush Files Immediately attribute enables NSS to immediately write to disk all data in cache that is pending writes to the file when you close the file. Otherwise, the data in cache must wait until the next write cycle to be written to the disk, putting the information at risk for loss during the interim, for example, if the server failed. For information, see "Enabling Flush Files Immediately to Write Data to the Disk on Close" in the *NW 6.5 SP8: NSS File System Administration Guide*.

IMPORTANT: On Linux, a group write function controls how writes to disk occur. For information, see Section 27.3, "Configuring or Tuning Group I/O," on page 352.

Migration (to Third-Party Near-Line or Offline Storage)

The Migration attribute sets a flag that indicates to third-party software that this volume's data can be migrated to near-line or offline storage media after it is inactive for specified lengths of time. This attribute requires third-party software to take advantage of the capability.

Modified File List

The Modified File List (MFL) attribute enables NSS to create a list of all files modified since the previous backup. The log is available only through third-party software.

NOTE: This feature is seldom-used since the introduction of the Event File List support in OES 1 SP1 Linux. Consider using the Event File List instead. For information, see "FileEvents.xml Definitions" (http://developer.novell.com/documentation/vfs/vfs__enu/data/ak7gh2x.html) in *NDK: Virtual File Services* (http://developer.novell.com/documentation/vfs/vfs__enu/data/bktitle.html).

Salvage Files

The Salvage Files attribute enables deleted files to remain on the volume until the Purge Delay time expires or until space is needed on the volume for other data. Until the Purge Delay time expires, the Salvage feature tracks the deleted files and allows the deleted files to be salvaged and restored. If space is needed, the oldest deleted files are purged to clear space. Salvage is enabled by default.

If the Salvage Files attribute is disabled, deleted files are purged immediately on deletion.

IMPORTANT: The Salvage Files attribute does not affect whether deleted volumes can be salvaged or purged. Salvage for deleted volumes is determined at the server level with the `nss /ImmediatePurgeOfDeletedFiles=<on | off>` setting. For more information, see Section 23.2.2, "Setting the Immediate Purge of Deleted Files for All NSS Volumes," on page 313.

For information, see Chapter 23, "Salvaging and Purging Deleted Volumes, Directories, and Files," on page 309.

Snapshot (File-Level) (NetWare)

The File-level Snapshot attribute enables a backup utility to capture the last closed version of a file that is open at the time a backup is in progress. You must manually deactivate the volume, then activate the volume after setting this attribute to let the volume set up the virtual volume for the metadata about file snapshots.

If the File Snapshot attribute is enabled, Novell Storage Management Services (SMS) saves the snapshot version of the file to backup media if a file is in use when the backup occurs.

IMPORTANT: Not all third-party backup software can take advantage of the file snapshot attribute, even if you set it.

For more information, see "Using the File-Level Snapshot Attribute to Enable the Backup of Open Files" in the *NW 6.5 SP8: NSS File System Administration Guide*.

User Space Quotas

The User Space Quotas (user space restrictions) attribute enables you assign a maximum quota of space that a user's data can consume across all directories in the volume.

For information, see "Managing Space Quotas for Volumes, Directories, and Users" on page 293.

User-Level Transaction Mode (NetWare)

The User-Level Transaction mode enables the Transaction Tracking System (TTS) function for NSS volumes on Netware. TTS logs changes made to a file contents, and protects database applications by backing out transactions that are incomplete because of a system failure. For information, see "Using the Transaction Tracking System for Application-Based Transaction Rollback (NetWare)" in the *NW 6.5 SP8: NSS File System Administration Guide*.

IMPORTANT: The TTS capability is available only on NetWare. If you enable this attribute for an NSS volume on Linux, it is ignored.

When working on OES 2 Linux, if your data requires content-level transaction tracking and you want to continue to control access to data with trustees, you can use NCP volumes on Linux Reiser, XFS, or Ext3 file systems. Configure the journaling mode for the file system to the Journaling level, which provides content-level transaction tracking. For information about creating and managing NCP volumes on Linux, see "Managing NCP Volumes" in the *OES 2 SP3: NCP Server for Linux Administration Guide*.

Mount Point

For a Linux server, specify the mount point for the NSS volume, such as `/media/nss/VOLA`.

The default mount path for NSS volumes is `/media/nss/volumename`, where *volumename* is the name of the volume. You can optionally specify another path as the mount point.

Allow Mount Point to Be Renamed: Select this option if you want to allow the mount point to be renamed if the volume is renamed.

This feature works only if the volume is mounted in its default location (`/media/nss/volumename`). For example, you have a volume `VOL1` and the default mount point location is `/media/nss/VOL1`. For this volume, you have selected the option *Allow Mount Point to be Renamed*.

You renamed `VOL1` to `MYVOL`, the default mount point after renaming becomes as `/media/nss/MYVOL`.

Lookup Namespace

NSS provides multiple name spaces for the volume: Long, UNIX, DOS, and Macintosh. The Lookup Namespace attribute sets the primary name space to use when you mount the volume, but all name spaces are available for use by various applications.

For NSS volumes, the Long name space is highly recommended because names on NSS are case insensitive by default. The UNIX name space supports case-sensitive naming.

For OES 2 SP1 and later, Long is also the default name space for NSS volumes. Using the Long name space as primary improves performance over using the UNIX name space, especially if you expect to store millions of files on the volume.

NOTE: In OES 2 Linux and earlier, UNIX was the default name space for mounting NSS volumes on Linux.

For Linux, NCP tools require that only the Long or UNIX be set as the primary name space. With DOS or Mac set as the primary name space, you cannot view or manage the volume from Novell Remote Manager, and users are unable to map to the volume using NCP clients. If you use the Long or UNIX name space, the DOS and Mac name spaces are still available, but they are not the primary.

The UNIX name space supports some special characters that are not allowed in the Long name space, such as characters `0x01` through `0x07` and `0x10` through `0x1f`. If you need to use these special characters in filenames, choose UNIX as the default name space.

If you change the name space for an existing shared volume by using NSSMU or the Storage plug-in for iManager, you must modify the load script for the pool cluster resource to add the name space to the ncpcon mount command for the volume. Otherwise, the cluster assumes the default name space for mounting the volume. You can do this by using the `/opt=ns=<long|unix|dos|mac>` switch in the `ncpcon mount` command.

For example, to specify the LONG name space, add the `/opt=ns=long` switch as follows:

```
ncpcon mount /opt=ns=long <VOLUMENAME>=<VOLUMEID>
```

For example, to specify the UNIX name space, add the `/opt=ns=unix` switch as follows:

```
ncpcon mount /opt=ns=unix <VOLUMENAME>=<VOLUMEID>
```

18.1.2 Encryption Support

Encryption provides password-protected activation of encrypted NSS volumes. Encryption can be activated at creation time only, and this choice persists for the life of the volume. Encrypted volume support is available on OES 1 SP1 Linux and later.

Encrypted volumes can be created only from NSSMU. Encrypted volumes require special handling on the first activation after startup, but all attributes are available for encrypted volumes and are managed the same as for unencrypted volumes. For information about creating and activating encrypted volumes, see "Managing Encrypted NSS Volumes" on page 251.

18.1.3 Enhanced Hard Link Support

Enhanced hard link support for an NSS volume allows users to create multiple names for a single, existing file object in the same directory or in multiple directories in the same NSS volume. NSS supports zero to 65,535 hard links per file on NSS volumes.

You must upgrade the media format before you can set the Hard Links attribute and create new hard links on a volume. For information about upgrading the media format, see Chapter 4, "Upgrading the NSS Media Format," on page 49.

After the media upgrade for enhanced hard links support, the Hard Links attribute must be enabled or disabled by using commands. The attribute cannot be enabled or disabled in NSSMU or in iManager. For information about enabling Hard Link support for a volume, see Section 24.3, "Enabling or Disabling the Hard Links Attribute," on page 326.

After the volume has been enabled for enhanced hard links, you can create hard links. For information about creating and managing hard links, see Chapter 24, "Managing Hard Links," on page 321.

Beginning in OES 2 SP1, Novell Storage Management Services supports the backup and restore of hard links on NSS volumes.

Hard links are lost when you use the Move Volume or Split Volume features of Distributed File Services.

18.2 Guidelines for NSS Volumes

- Section 18.2.1, “Guidelines for Sizing Volumes,” on page 227
- Section 18.2.2, “Guidelines for Name Spaces,” on page 227
- Section 18.2.3, “Guidelines for NSS Volumes in a Cluster,” on page 227
- Section 18.2.4, “Guidelines for NSS Volumes in a Mixed-Node Cluster,” on page 228

18.2.1 Guidelines for Sizing Volumes

NSS volumes are logical storage media that acquire space from pools of storage. When you create a logical volume, you can either assign it a fixed quota as the maximum size, or allow it to expand to the pool size. To grow a volume, you might need to add new segments to grow the pool first, up to the maximum pool size of 8 TB.

If a pool contains multiple volumes, the cumulative administrative maximum sizes of all volumes can exceed the pool's maximum size by overbooking, although real total size is bound by physical limitations. Because space is allocated to volumes as needed, a volume might not reach its quota. As the overbooked volumes consume the available physical space, you need to add more disk space to the pool to accommodate the growth, or consider moving or splitting volumes to move data to other pools.

For example, suppose you have an 800 MB storage pool with eight volumes set at 100 MB each. The administrative size equals the physical limits. To overbook the pool, you can add volumes, set one or more of the volumes to expand to the pool size, or increase the size of existing volumes, with the understanding that these are administrative maximum sizes, not physical sizes.

Because volume sizes can be overbooked in a pool, NSS automatically considers what space is remaining in a pool in order to report the maximum size that is currently possible for the volume. In addition to other volumes that can consume space in a pool, NSS snapshots and third-party snapshots can consume space that might not be reported in all of the management tools that report space. NSS reports the total space possible for the volume and the amount of space used by the volume so that tools can properly calculate the maximum free space available.

18.2.2 Guidelines for Name Spaces

NSS recognizes DOS, Macintosh, UNIX, and Long name spaces. Volume names, directory names, and filenames in NSS are case insensitive. This differs from Linux POSIX file systems, which are case sensitive by default. For information, see “Lookup Namespace” on page 225.

18.2.3 Guidelines for NSS Volumes in a Cluster

You must create at least one shared volume in a cluster-enabled pool. Typically, all volumes are created when you initially set up the cluster resource and before you need to cluster migrate or fail over the resource to other servers in the cluster.

The Server, Pool, Volume, Cluster Resource, and Cluster objects are recommended to be in the same context (such as ou=ncs,o=novell).

If the objects are in different contexts, you might receive an eDirectory error when you attempt to modify the pool, create or modify the volumes, home directories, Distributed File Services junctions, or any other elements that are managed using eDirectory objects. To resolve the problem, you must cluster migrate the pool cluster resource back to the node where the pool was created in order to perform those management tasks.

18.2.4 Guidelines for NSS Volumes in a Mixed-Node Cluster

In a clustered storage area network with Novell Cluster Services, NSS volumes can fail over between kernels, allowing for full data and file system feature preservation when migrating data to Linux. However, you cannot SAN boot cross-platform.

For information about using NSS volumes cross-platform, see the following:

- Section 7.2, "Cross-Platform Issues for NSS Volumes," on page 79
- Section 7.3, "Cross-Platform Issues for NSS Features," on page 80
- Section 7.4, "Cross-Platform Issues for File Access," on page 81

For information about clustering, see the following:

- *OES 2 SP3: Novell Cluster Services 1.8.8 Administration Guide for Linux*
- *NW6.5 SP8: Novell Cluster Services 1.8.5 Administration Guide*

18.3 Creating Unencrypted NSS Volumes

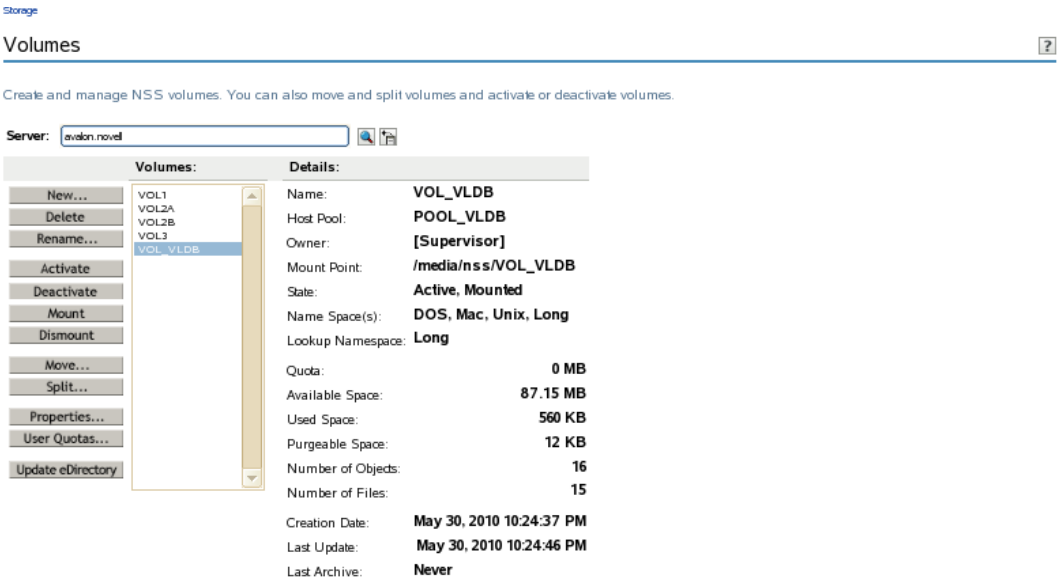
This section describes how to create an unencrypted volume with iManager. Encrypted volumes can be created only in NSSMU. For information on creating encrypted volumes, see "Managing Encrypted NSS Volumes" on page 251.

1. In iManager, click *Storage* > *Volumes*.

   For instructions, see Section 9.1.5, "Accessing Roles and Tasks in iManager," on page 94.
2. Select a server to manage.

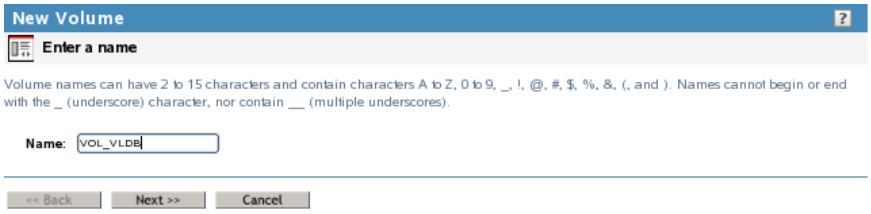
   For instructions, see Section 9.1.6, "Selecting a Server to Manage," on page 95.

   A list of volumes appears in the *Volumes* list, as illustrated in the following figure.



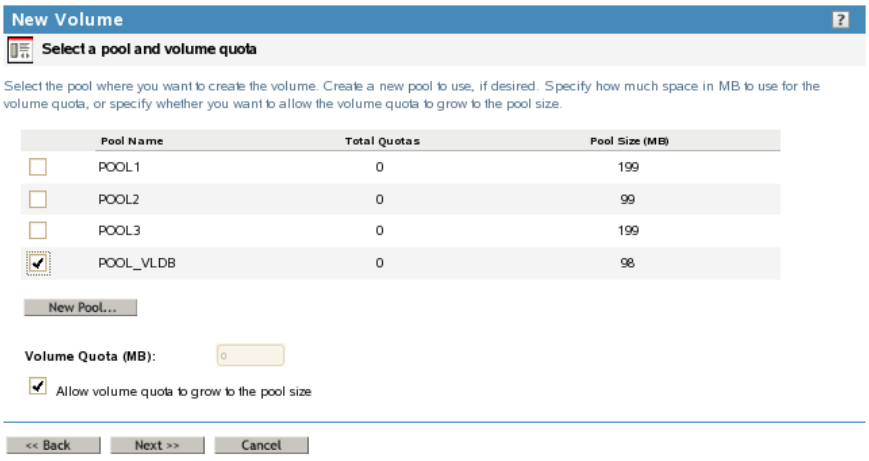
3 To create a new volume, click *New*.

This opens the *New Volume* Wizard to guide you through the process.



4 Specify a name for the new volume, then click *Next*.

If the name you provide is not unique, you receive an error message. For guidelines about naming volumes, see Section 5.4, “Naming NSS Storage Objects,” on page 59.



5 Do one of the following to specify the pool to use:

- Select an existing pool from the list where you want the new volume to reside.
- If no pools exist, click *New Pool*, create a pool to use, select the pool.

- If existing pools do not have sufficient space for the volume you want to create, click *Cancel* to close the Wizard. You must add more segments of free space to the pool, then return to the *Volumes* page to create the new volume.
- If no pools exist and no space is available to create one, click *Cancel* to close the Wizard. You must add more devices to the server or free up space on existing pools, then return to the Volumes page to create the new volume.

6 Specify the size of the volume:

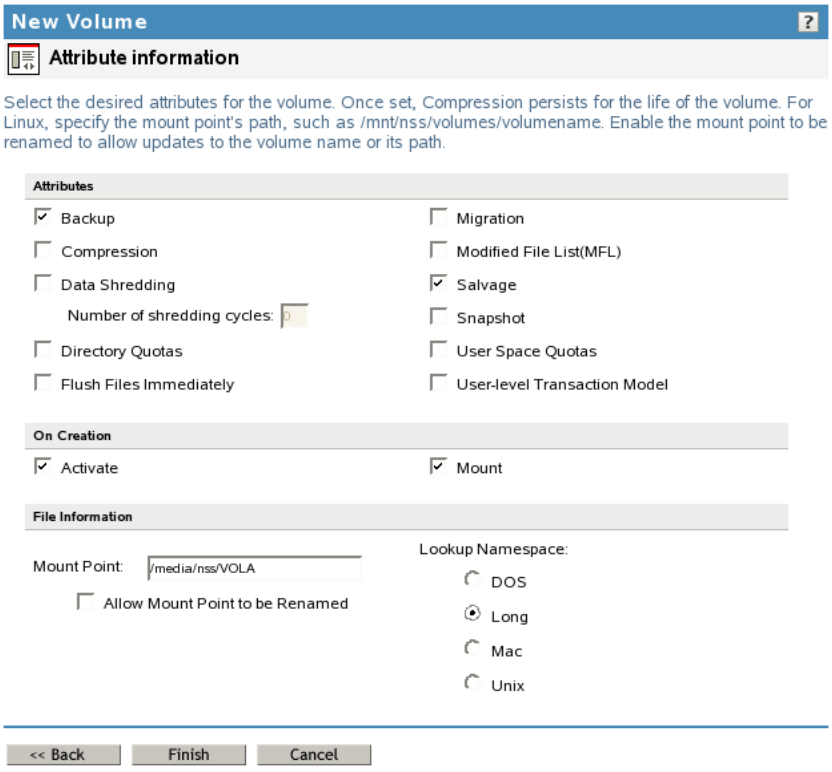
- **No Volume Quota:** Select *Allow Volume Quota to Grow to the Pool Size* if you want the volume to expand to the size of the pool. This is the default.

  Pools can be overbooked; each volume can potentially grow to the size of the pool. NSS allocates space as it is needed.
- **Volume Quota:** Deselect *Allow Volume Quota to Grow to the Pool Size*, then type a *Volume Quota* size in MB for the volume if you want to limit the size of the volume.

7 Click *Next*.

8 On the *Attribute Information* page under the *Attributes* section, set the attributes for the new volume you are creating. The Backup and Salvage attributes are selected by default.

For information about volume attributes, see Section 18.1, "Understanding Volume Properties," on page 221.



9 On the *Attribute Information* page under the *On Creation* section, set the following preferences:

- *Activate*. Activates logical volumes as soon as you create them.
- *Mount*. Mounts logical volumes as soon as you create them.

10 On the *Attribute Information* page under *File Information*, specify the following parameters:

- **Mount Point:** For a Linux server, specify the mount point for the NSS volume, such as `/media/nss/VOLA`.

  The default mount path for NSS volumes is `/media/nss/volumename`, where *volumename* is the name of the volume. You can optionally specify another path as the mount point.

- **Allow Mount Point to Be Renamed:** Select this option if you want to allow the mount point to be renamed if the volume is renamed.

  This feature works only if the volume is mounted in its default location (`/media/nss/volumename`).

- **Lookup Name Space:** Select the name space to use when you mount the volume. The name spaces are UNIX, Long, DOS, or Macintosh. The default name space is Long.

  The recommended setting is Long. This setting ensures that filenames are case insensitive whether the volume is mounted. It also improves performance over using UNIX, especially if you expect to store millions of files on the volume.

11 Click *Finish*.

12 If you enabled the *Directory Quotas* attribute, restart NCP2NSS by entering at a terminal prompt:

```
/etc/init.d/ncp2nss restart
```

18.4 Configuring Encrypted NSS Volumes with NSSMU

NSS Encrypted Volume Support allows you to create encrypted NSS volumes using NSSMU. For information, see "Managing Encrypted NSS Volumes" on page 251.

18.5 Updating eDirectory Volume Objects

In Novell eDirectory, each NSS volume is represented by a Volume object. Volume objects are leaf objects that represent a physical or logical volume on the network.

The Volume object's properties contains the following information:

- The server where the volume resides
- The volume name recorded when the volume was initialized on the server
- The volume's owner (login username of the administrator who created it)
- Space use restrictions for users
- A description of the volume's use
- Statistical information on disk space availability, block size, directory entries, name space support, and so on.

Usually, NSS creates the Novell eDirectory Volume object when you create the volume, and it updates the properties of the volume as needed. The *Update eDirectory* option on the Volumes page allows you to add or replace a Volume object for a selected volume at the same context level as the server.

IMPORTANT: When you delete (or delete and replace) a Volume object in eDirectory, the home directory attribute is removed in the User objects for any users that reference that Volume. The home directory attribute points to a particular Volume object. When that Volume object is deleted, eDirectory needs to clean up all references to the object being deleted.

When you select Update eDirectory, NSS searches for the object.

1. In iManager, click *Storage* > *Volumes*.

   For instructions, see Section 9.1.5, "Accessing Roles and Tasks in iManager," on page 94.

2. Select a server to manage.

   For instructions, see Section 9.1.6, "Selecting a Server to Manage," on page 95.

3. In the *Volumes* list, select the volume you want to update.

   Wait for the page to refresh and display the details.

4. Click *Update eDirectory*.

   Wait while NSS searches for the Volume object in the server context.

5. Do one of the following:

   - If the Volume object does not exist, NSS adds the Volume object to the context level. Confirm the addition.
   - If the Volume object exists, NSS prompts you with two options: Delete and Replace the existing object or Retain the existing object. Select one option and confirm your choice.

18.6 Viewing the Details of an NSS Volume

1. In iManager, click *Storage* > *Volumes*.

   For instructions, see Section 9.1.5, "Accessing Roles and Tasks in iManager," on page 94.

2. Select a server to manage.

   For instructions, see Section 9.1.6, "Selecting a Server to Manage," on page 95.

3. In the *Volumes* list, select a volume that you want manage.

   When the page refreshes, the details for the volume appear in the *Details* area. The volume must be mounted and active for the details to be available.

4. (Conditional) Activate the volume, select the volume, then click *Activate*.

18.7 Viewing Properties of an NSS Volume

After you set up and configure NSS volumes, you can view the properties, such as attribute settings, volume statistics, and volume usage.

1. In iManager, click *Storage* > *Volumes*.

   For instructions, see Section 9.1.5, "Accessing Roles and Tasks in iManager," on page 94.

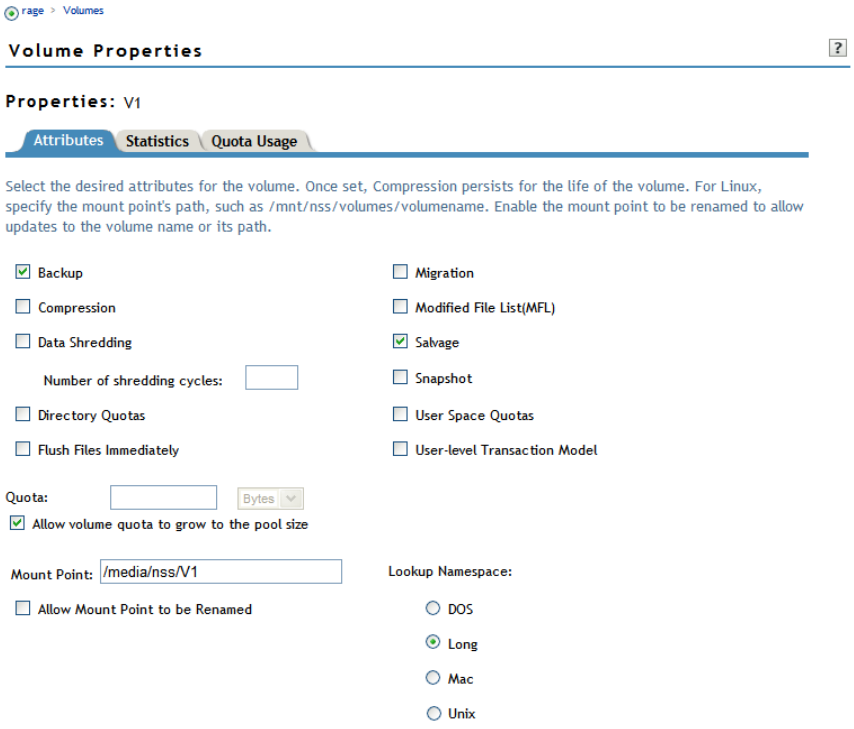
2. Select a server to manage.

   For instructions, see Section 9.1.6, "Selecting a Server to Manage," on page 95.

3. In the *Volumes* list, select a volume that you want manage.

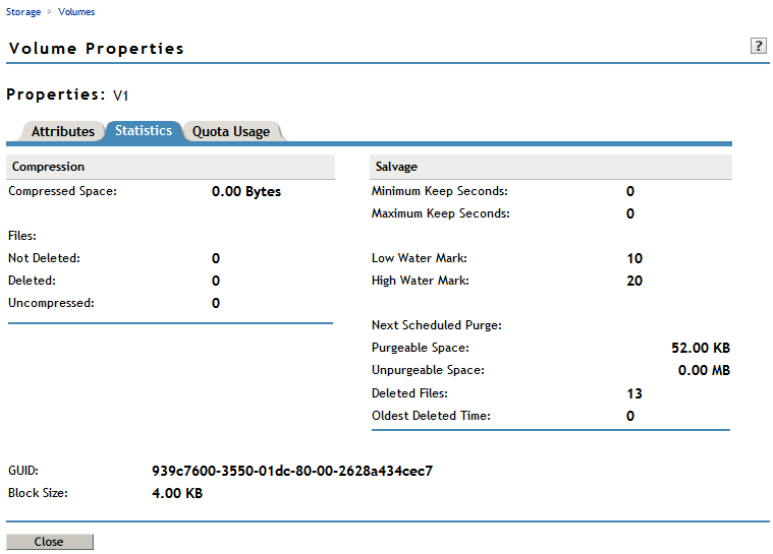
4. Click *Properties*.

The *Properties* page has three tabs: *Attributes*, *Statistics*, and *Quota Usage*. It opens by default to the *Attributes* tab.



Use the *Attributes* page to view the volume's attribute configuration, the volume quota, and the volume mount point. For information about modifying attributes, see Section 18.8, "Modifying Attributes of an NSS Volume," on page 234.

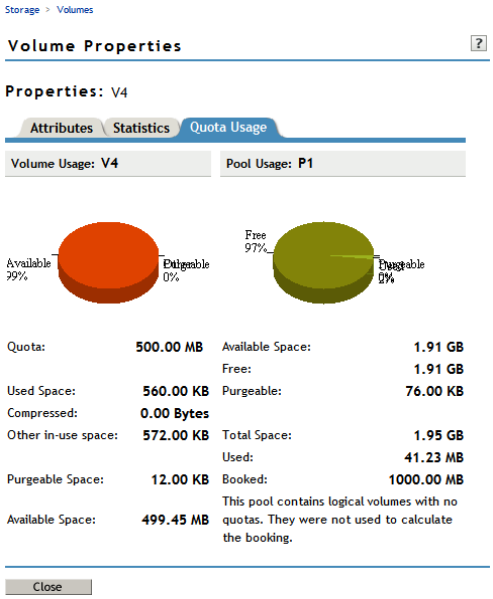
5 Click the *Statistics* tab to view the current space usage statistics for the selected volume.



If the Salvage attribute is enabled, values are displayed for the salvage parameters. The low and high watermark displays the default settings for the pool-level watermarks for the pool where the volume resides. For information about managing salvage parameters, see Chapter 23, "Salvaging and Purging Deleted Volumes, Directories, and Files," on page 309.

If the Compression attribute is enabled, statistics are displayed for the compression data. For information about configuring compression parameters, see Chapter 21, “Managing Compression on NSS Volumes,” on page 275.

6 Click the *Quota Usage* tab to view the volume and pool space usage for the selected volume.



18.8 Modifying Attributes of an NSS Volume

After you set up and configure NSS volumes, you can modify most of the attribute settings. The Encrypted Volume Support attribute and the Compression attribute can be set only at the time the volume is created. If you try to modify those settings, iManager or NSSMU returns an error message.

You can also specify a Volume Quota or modify the mount point.

1 In iManager, click *Storage* > *Volumes*.

For instructions, see Section 9.1.5, “Accessing Roles and Tasks in iManager,” on page 94.

2 Select a server to manage.

For instructions, see Section 9.1.6, “Selecting a Server to Manage,” on page 95.

3 In the *Volumes* list, select a volume that you want manage.

4 Click *Properties*.

The *Properties* page has three tabs: *Attributes*, *Statistics*, and *Quota Usage*. Use the *Attributes* page to view or modify the attributes for the selected volume.

5 Do one or more of the following:

- Select or deselect a modifiable attribute, then click *Apply*.

  The Encryption and Compression attributes can be set only at the time the volume is created. If you try to modify those settings, iManager returns an error message.

  For information about attributes, see Section 18.1, “Understanding Volume Properties,” on page 221.

- Specify a volume quota, then click *Apply*.
- Specify the default *Lookup Namespace* to use when mounting the volume, then click *Apply*.

The next time the volume is mounted, this will be the name space used. The default name space is Long.

- Specify a new *Mount Point* for your volume, then click *Apply*. For example:

  ```
  /media/nss/VOL1
  ```

6 If you enabled or disabled the *Directory Quotas* attribute, restart NCP2NSS by entering at a terminal prompt:

```
/etc/init.d/ncp2nss restart
```

For information about setting quotas after you have enabled the Directory Quotas attribute or User Space Quotas attribute, see "Managing Space Quotas for Volumes, Directories, and Users" on page 293.

18.9 Modifying the NSS Volume Size

1 In iManager, click *Storage* > *Volumes*.

For instructions, see Section 9.1.5, "Accessing Roles and Tasks in iManager," on page 94.

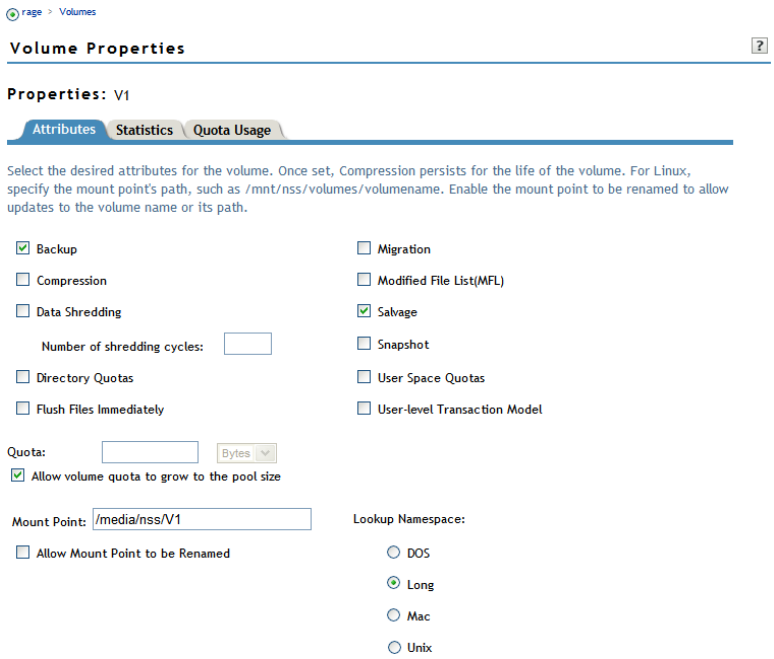
2 Select a server to manage.

For instructions, see Section 9.1.6, "Selecting a Server to Manage," on page 95.

3 In the *Volumes* list, select a volume that you want manage.

4 Click *Properties*.

The *Properties* page has three tabs: *Attributes*, *Statistics*, and *Quota Usage*. It opens to the *Attributes* tab.



5 In the *Quota* field, do one of the following:

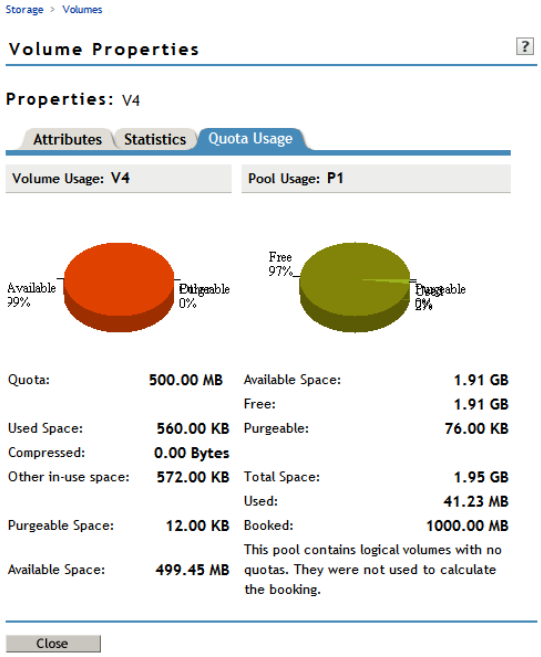
- **No Quota:** Select *Allow Volume Quota to Grow to the Pool Size*. NSS pools allow overbooking so the administrative sum of all volumes' quotas in a pool can exceed the physical pool quota.

- **Quota:** Deselect *Allow Volume Quota to Grow to the Pool Size*, then specify the maximum size you want to allow volume to grow. The quota cannot exceed the pool size.

  If you set a quota that is less than the volume's current size, no files can be saved to the file until you purge files to make room on the volume.

6 Click *Apply*.

7 Click the *Quota Usage* tab to view the volume and pool space usage for the selected volume and to verify the new setting.



18.10 Configuring the Name Space for an NSS Volume

NSS supports the Long, DOS, UNIX, and Macintosh name spaces. By default, names on the NSS file system are case insensitive, which is supported by the Long name space. The Long name space is the default setting used when mounting NSS volumes. In order to mount a volume with a different name space, you must specify the name space explicitly in the mount command, or you can specify the name space to use as a property of the NSS volume.

On Linux POSIX file systems, the UNIX name space is typically used. If your volume contains large directories with millions of files, using the default UNIX name space on NSS volumes can cause volumes to mount very slowly. Using the Long name space allows the NSS volume to mount normally. Unless you need to support case sensitive filenames, we strongly recommend using the Long name space.

The preferred name space can be set when you create the volume and set its attributes, or at any time by modifying the Lookup Namespace attribute in the volume's properties.

You can also mount the volume by specifying the name space to use as an option of the mount command. For instructions, see Section 18.11, "Mounting NSS Volumes with Linux Commands," on page 237.

To view or modify the Lookup Namespace attribute for the NSS volume:

1 In iManager, click *Storage* > *Volumes*.

For instructions, see Section 9.1.5, "Accessing Roles and Tasks in iManager," on page 94.

2 Select a server to manage to view a list of its volumes.

For instructions, see Section 9.1.6, "Selecting a Server to Manage," on page 95.

3 In the *Volumes* list, select a volume that you want manage.

4 Click *Properties* to view the volume's properties.

The *Properties* page has three tabs: *Attributes*, *Statistics*, and *Quota Usage*.

5 On the *Attributes* page, view the current setting of the *Lookup Namespace* for the selected volume.

6 On the *Attributes* page, optionally modify the *Lookup Namespace* to use by selecting the radio button next to it.

- *Long* (recommended, default)
- *DOS*
- *UNIX*
- *Mac*

This is the new value that is applied automatically whenever you mount the volume.

7 Click *Apply* to save your changes.

8 On the *Volumes* page, click *Dismount* to unmount the volume.

Wait until the volume unmounts gracefully before continuing.

9 On the Volumes page, click *Mount* to mount the volume to mount it the new name space.

10 If you change the name space for an existing shared volume by using NSSMU or the NSS plug-in for iManager, you must modify the load script for the pool cluster resource to add the name space to the ncpcon mount command for the volume. Otherwise, the cluster assumes the default name space for mounting the volume. You can do this by using the `/opt=ns=<long|unix|dos|mac>` switch in the ncpcon mount command.

For example, to specify the LONG name space, add the `/opt=ns=long` switch as follows:

```
ncpcon mount /opt=ns=long <VOLUMENAME>=<VOLUMEID>
```

For example, to specify the UNIX name space, add the `/opt=ns=unix` switch as follows:

```
ncpcon mount /opt=ns=unix <VOLUMENAME>=<VOLUMEID>
```

For more information, see "Configuring a Load Script for the Shared NSS Pool" in the *OES 2 SP3: Novell Cluster Services 1.8.8 Administration Guide for Linux*.

18.11 Mounting NSS Volumes with Linux Commands

When mounting an NSS volume on Linux, specify the Long name space to make its directory names and filenames case insensitive. Long is the default name space, and improves performance over using the UNIX name space. If your volume contains large directories with millions of files, using the UNIX name space can cause volumes to mount very slowly and can degrade performance.

Mounting an NSS Volume

To mount an NSS volume from a terminal command line, enter

```
mount -t nssvol volname mount_point -o name=volname,ns=long
```

For the `-t` option, *`nssvol`* is the file system type for NSS volumes. *`Volname`* is the name of the NSS volume.

The *`mount_point`* is the full path with the volume name where you want to mount the volume, such as `/media/nss/VOL1`. The default mount location for NSS volumes is in the `/media/nss/` directory.

For the `-o` option, specify the volume name and the primary name space type. Valid name space options are `dos`, `mac`, `long`, or `unix`.

For example, to mount an NSS volume named VOL1 as case insensitive, enter the following at a terminal prompt:

```
mount -t nssvol VOL1 /media/nss/VOL1 -o name=VOL1,ns=long
```

Mounting an NSS Volume Automatically on System Reboot

You can automatically mount the NSS volume on system reboot by adding a line to the `/etc/fstab` file in the following general format:

```
label mount_point fstype mount_options dump_frequency fsck_order
```

For example:

```
VOL1 /media/nss/VOL1 nssvol noauto,rw,name=VOL1,ns=long 0 0
```

Using Samba with NSS Volumes

When using Samba, make sure to do the following:

- Mount the NSS volume as case insensitive by using the Long name space.
- Specify `Case Sensitive=No` when exporting Samba shares for NSS volumes with case insensitive name spaces.

  Edit the `/etc/samba/smb.conf` file to set the Case Sensitive parameter to No.

This improves performance for your NSS volumes on Linux, especially those with larger directories.

18.12 Renaming an NSS Volume

You can rename NSS volumes. For example, you might want to change the name of a volume to reflect the department or organization that uses it.

1. In iManager, *Storage* > *Volumes*.

   For instructions, see Section 9.1.5, “Accessing Roles and Tasks in iManager,” on page 94.
2. Select a server to manage.

   For instructions, see Section 9.1.6, “Selecting a Server to Manage,” on page 95.
3. In the *Volumes* list, select a volume.
4. Click *Rename*.

   The Rename Volume Wizard opens.
5. Specify the new name of the volume.
6. Click *Finish*.

   After the page refreshes, the volume appears in the *Volumes* list with its new name.

18.13 Renaming (Modifying) the Mount Point for an NSS Volume

The default mount point for NSS volumes is `/media/nss/volumename`. You must enable the *Allow the Mount Point to Be Renamed* option for the volume to allow the mount point to be renamed.

NOTE: Currently, for clustered volumes renaming the volume mount points is not supported.

- Section 18.13.1, "Renaming the Mount Point for a New Volume," on page 239
- Section 18.13.2, "Enabling the Mount Point for the NSS Volume to Be Renamed," on page 239
- Section 18.13.3, "Renaming the Mount Point for an Existing NSS Volume," on page 239

18.13.1 Renaming the Mount Point for a New Volume

The default mount point for NSS volumes is `/media/nss/volumename`. You can specify a different mount point (that is, modify the volume's directory path) as you create the volume if you create the volume in iManager. Creating the volume in the NSSMU (`nssmu`) does not allow for the mount point to be changed during the volume setup, but you can change it afterwards.

18.13.2 Enabling the Mount Point for the NSS Volume to Be Renamed

The *Allow the Mount Point to Be Renamed* option enables the NSS volume's mount point to be renamed. This option is disabled by default. Enable the option as you create the volume, or enable it at any time for an existing volume by modifying the setting on the *Attributes* page (*Storage* > *Volumes* > *Properties* > *Attributes*) in iManager.

1. In iManager, click *Storage*, then click *Volumes*.
2. Select the server you want to manage to view a list of its volumes.
3. From the *Volumes* list, select the volume, then click *Properties* to view the volume attributes.
4. On the *Attributes* page, select *Allow the Mount Point to Be Renamed*.
5. Click *Apply* to save the change.

18.13.3 Renaming the Mount Point for an Existing NSS Volume

Whenever you change the mount point for an existing NSS volume, you must also restart Novell eDirectory to update the NetWare Core Protocol (NCP) Server cache. When an NSS volume is created, the NCP Server gets the path to the volume and caches it, assuming that it never changes. When you later run `ncpcon` and enter the `volume` command, it reports which volumes are still found at their respective mount points. Only the volumes that are still valid as compared to the list in cache are reported. Restarting eDirectory forces the NCP Server volume cache to update, so that the correct path is stored for reporting volume status.

1. Use either iManager or `nssmu` to change the volume's mount point.

   The following instructions are for iManager.

   1a. In iManager, click *Storage* > *Volumes*.

   1b. Select the server you want to manage to view a list of its volumes.

   1c. From the *Volumes* list, select the volume, then click *Properties* to view the volume attributes.

   1d. If the *Allow the Mount Point to be Renamed* option is not selected, select it and click *Apply*.

NOTE: Select this option if you want to allow the mount point to be renamed if the volume is renamed. This feature works only if the volume is mounted in its default location (`/media/nss/volumename`).

1e In *Mount Point*, type the new mount point.

The default mount point for NSS volumes is `/media/nss/volumename`. The new path should also include the *volumename*.

```
/mnt/nss/volumes/volumename
```

1f Click *Apply* to save the change.

2 Open a terminal console on the server, then log in as the `root` user or equivalent.

3 Restart eDirectory by entering

```
/etc/init.d/ndsd restart
```

Restarting eDirectory causes the NCP Server's volume cache to be updated.

18.14 Activating and Deactivating an NSS Volume

After you set up and configure NSS volumes, you can activate and deactivate volumes to make them available to users and applications. To view details of a volume, it must be active.

1 In iManager, *Storage* > *Volumes*.

For instructions, see Section 9.1.5, "Accessing Roles and Tasks in iManager," on page 94.

2 Select a server to manage.

For instructions, see Section 9.1.6, "Selecting a Server to Manage," on page 95.

3 In the *Volumes* list, select one or more volumes that you want to make active or deactive.

4 Click *Activate* or *Deactivate*.

After the page refreshes, you can see that each volume's state matches the state you specified. If a selected volume is already in the specified state, no change occurs. The details of deactive volumes are not available.

18.15 Mounting and Dismounting an NSS Volume

After you set up and configure NSS volumes, you can mount and dismount volumes to make them available to users and APIs. After you mount a volume, it is only available to APIs until you activate it. Dismounting a volume makes it unavailable to users and to APIs.

- Section 18.15.1, "Dismounting an NSS Volume from the NCP Server," on page 241
- Section 18.15.2, "Mounting or Dismounting an NSS Volume with iManager," on page 241
- Section 18.15.3, "Mounting an Encrypted NSS Volume with NSSMU," on page 241
- Section 18.15.4, "Dismounting an Encrypted NSS Volume with NSSMU," on page 241

18.15.1 Dismounting an NSS Volume from the NCP Server

Before you can dismount an NSS volume on Linux, you must dismount the volume from NCP Server; otherwise, the dismount function fails.

1. At the server prompt, open the NCP Console by entering

   ```
   ncpcon
   ```

2. Dismount the volume from NCP.

   The volume is no longer accessible or visible to NCP clients.

18.15.2 Mounting or Dismounting an NSS Volume with iManager

1. In iManager, click *Storage* > *Volumes*.

   For instructions, see Section 9.1.5, “Accessing Roles and Tasks in iManager,” on page 94.

2. Select a server to manage.

   For instructions, see Section 9.1.6, “Selecting a Server to Manage,” on page 95.

3. In the *Volumes* list, select one or more volumes that you want to mount or dismount.

4. Click *Mount* or *Dismount*.

   After the page refreshes, you can see that the volume’s state changed. If a selected volume is already in the specified state, no change occurs. The details of dismounted volumes are not available.

18.15.3 Mounting an Encrypted NSS Volume with NSSMU

On Linux, you must mount an encrypted NSS volume from NSSMU on the first time it is started after a reboot in order to be able to supply the password. NSSMU allows you to mount only one volume at a time so that you can enter its password.

1. In NSSMU, select *Volumes*.
2. In the *Volumes* list, select the encrypted volume that you want to mount.
3. Press *F7* to mount the volume.
4. If you are prompted to enter the password, enter the password, then click *OK*.

   You are prompted for the password on the first time the volume is mounted after a system reboot.

18.15.4 Dismounting an Encrypted NSS Volume with NSSMU

1. In NSSMU, select *Volumes*.
2. In the *Volumes* list, select the encrypted volume that you want to mount.
3. Press *F7* to dismount the mounted volume.

18.16 Exporting and Importing NSS Volumes for NFS Access

NSS volumes on OES 2 Linux and their directories are NFSv3 exportable and accessible from remote systems. NFSv4 is not supported for NSS, but exports for other file systems using NFSv4 can coexist with NSS exports using NFSv3.

- Section 18.16.1, "Understanding NFS Export and Mount Options," on page 242
- Section 18.16.2, "Exporting NSS Volumes for NFSv3," on page 244
- Section 18.16.3, "Importing NSS Volumes," on page 246

18.16.1 Understanding NFS Export and Mount Options

- "Host Options" on page 242
- "Mount Options for Export via NFSv3" on page 242
- "Mount Options for Import via NFSv3" on page 243
- "Additional Information" on page 244

Host Options

The following table describes options for specifying which servers on the network can import the NFS volume. For more information, see the `exports(5)` man page.

Table 18-1 *Host Options for NFSv3 Export of NSS Volumes on Linux*

Mount Option	Description
Single host	Specify a single host by its fully qualified domain name or its IP address.
Netgroups	Specify NIS netgroups as *`@groupname`*, such as `@trusted`.
Wildcards	Specify a asterisk (*) to specify all hosts. Use the wildcard characters of asterisk (*) and question marks (?) in server names to match multiple servers. For example, `proj*.example.com` matches all hosts in the domain `example.com` that begin with `proj`.
IP networks	Specify all hosts on a network or subnetwork by specifying the IP address and netmask pair as *address/netmask*. For example: 10.10.10.1/255.255.252.0.

Mount Options for Export via NFSv3

Table 18-2 describes mount options available for mounting NSS volumes for export via NFSv3. For more information, see the `exports(5)` man page and the `mount(8)` man page.

Table 18-2 *Mount Options for NFSv3 Export of NSS Volumes on Linux*

Mount Option	Description
rw	Mount the NSS file system with Read/Write (`rw`) access.

Mount Option	Description
no_root_squash	Disable `root` squashing for the superuser with the No Root Squash (`no_root_squash`) option. This allows `root` users on client computers to have `root` access on the server. With the No Root Squash option, mount requests for `root` are not mounted to the anonymous user (`nobody`). This option is needed for diskless clients. NSS volumes are logical volumes. They are not directly mounted on devices, but are associated with pools, which are mounted on devices. Because NSS volumes do not have a device directly associated with them, NFS treats the volume like a diskless client, which makes the `no_root_squash` option necessary when you mount NSS volumes.
sync	Specify the Sync (`sync`) option, which requires all file system writes to be committed to disk before the request can be completed.
fsid=value	Importing with the `fsid` option works around the fact that there is no device associated with a logical volume. You must import the NSS volume or directory with the FSID option set on it for export: `fsid=`*n* Replace *n* with an integer value greater than 0. The numbers do not need to be sequential. For example, `fsid=1` and `fsid=10`. Make sure to use a unique `fsid` number for each NSS volume or directory you are exporting. **IMPORTANT**: FSID=0 is reserved for NFSv4 as the pseudo root of the exported file system for exported volumes on the Linux server.

Mount Options for Import via NFSv3

Table 18-3 describes mount options available for mounting NSS volumes for import via NFSv3. For more information, see the `mount(8)` man page.

Table 18-3 *Mount Options for NFSv3 Import of NSS Volumes on Linux*

Mount Option	Description
rw	Mount the NSS file system with Read/Write (`rw`) access.
sync	Specify the Sync (`sync`) option, which requires all file system writes to be committed to disk before the request can be completed.
noatime	NSS also supports the optional use of the `noatime` for importing and mounting NSS volumes by using NFS. The noatime option disables the updating of the access time for files so that reading a file does not update its inode access time (`atime`). For more information, see Section A.23, “noatime and nodiratime Support for Linux open, mount, nfsmount, and /etc/fstab,” on page 408.

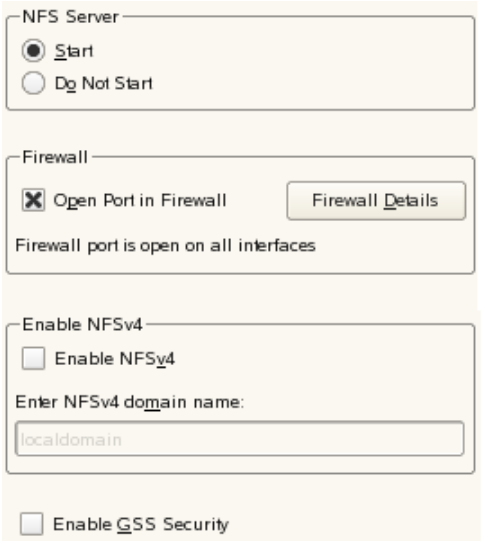
Additional Information

When you use NFS to export or import NSS volumes on Linux, other supporting services are needed, including DNS, NIS, and NFS. For information about configuring and managing these services, see the following sections in the *SLES 10 SP3 Installation and Administration Guide* (http://www.novell.com/documentation/sles10/book_sle_reference/data/book_sle_reference.html):

- "The Domain Name System" (http://www.novell.com/documentation/sles10/book_sle_reference/data/cha_dns.html)
- "Using NIS" (http://www.novell.com/documentation/sles10/book_sle_reference/data/cha_nis.html)
- "Sharing File Systems with NFS" (http://www.novell.com/documentation/sles10/book_sle_reference/data/cha_nfs.html)

18.16.2 Exporting NSS Volumes for NFSv3

1. In a terminal console, log in as the `root` user.
2. In YaST, select *Network Services*, then select *NFS Server* to open the *NFS Server Configuration* page.
3. If NFS Server is not started and enabled, you must configure the NFS Server.



   3a **NFS Server:** Select *Start*.

   3b **Firewall:** Select *Open Port in Firewall* to allow access to the NFS service from remote computers, then click *Firewall Details* to specify the network interfaces where you want to open the port.

   3c **Enable NFSv4:** Make sure that *Enable NFSv4* is not selected if you are exporting only via NFSv3.

   IMPORTANT: NFSv4 is not supported for NSS, but exports for other file systems using NFSv4 can coexist with NSS exports using NFSv3. If you enable NFSv4, make sure that you enter the NSS directories for export with options that use non-zero settings for their FSIDs, and do not bind the NSS directories to paths in the pseudo-root file system that you set up for NFSv4 exports.

3d **Enable GSS Security:** To enable Kerberos secure access to the server, click *Enable GSS Security*. A prerequisite for this is to have Kerberos installed in your domain and both the server and the clients are kerberized.

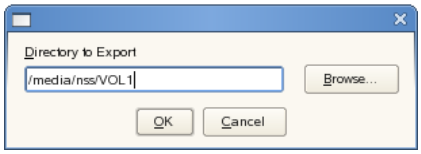
3e Click *Next* to continue to the *Directories to Export* page.

4 On the *Directories to Export* page, do the following for each NSS volume on the server that you want to export via NFSv3.

4a Under *Directories*, click *Add Directory*, to open a dialog box where you can configure the settings for a volume.

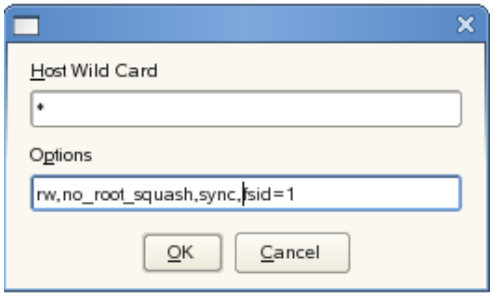
4b Specify the NSS volume that you want to export by typing the Linux path for the volume, or browse the Linux file system to locate and select the NSS volume, then click *OK*.

The default location of NSS volumes is `/media/nss/volumename`, such as `/media/nss/VOL1`.



4c In the Host Wildcard field, specify the servers where you want to be able to mount the NSS volume via NFSv3.

A default asterisk (*) wildcard indicates all servers. You can specify a single host, netgroups, wildcards, or IP networks. For information, see "Host Options" on page 242.



4d Enter the following required mount options:

`rw,no_root_squash,sync,fsid=value`

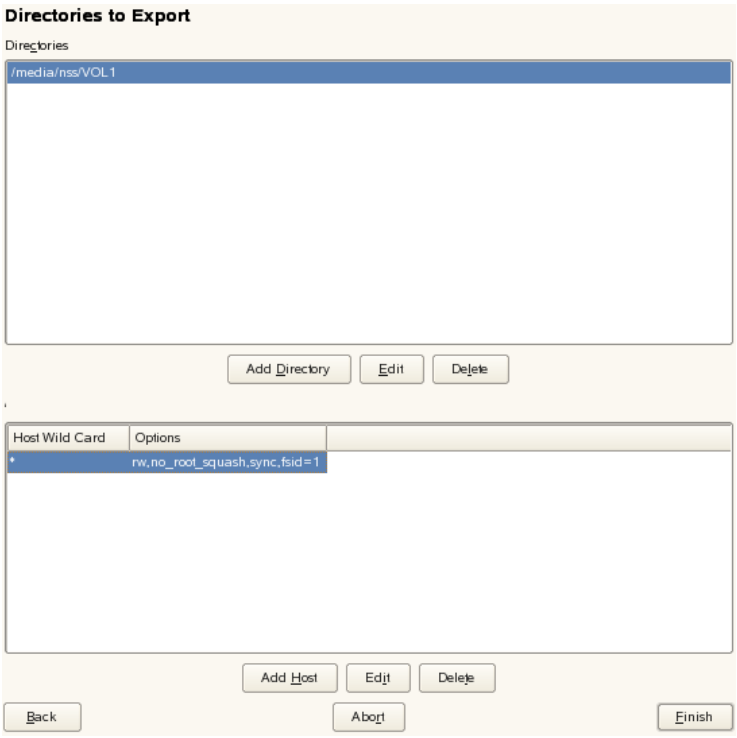
For NFSv3, make sure you do not include the fsid=0 or bind=`/pseudo_rootdir/volumename` options. Not using these options allows the export to be processed as an NSFv3 export.

For example:

`rw,no_root_squash,sync,fsid=1`

Separate the options with commands and no spaces. For information, see "Mount Options for Export via NFSv3" on page 242.

4e Click *OK* to save your settings and return to the *Directories to Export* page.



5 On the *Directories to Export* page, click *Finish* to apply the settings.

18.16.3 Importing NSS Volumes

1 On the OES 2 Linux server where you want to import the NSS volume via NFS, open YaST.

2 In YaST, select *Network Services*, then select *NFS Client* to open the *NFS Client Configuration* page.

3 Near the bottom of the page, select *Open Port in Firewall* to allow access to the NFS service from remote computers, then click *Firewall Details* to specify the network interfaces where you want to open the port

4 Do the following for each NSS volume on remote servers that you want to import via NFS.

4a Click *Add* to open a dialog box where you can specify the information for the volume you want to import.

4b In *NFS Server Hostname*, specify the remote server where the volume resides. Type the fully distinguished name (such as *servername.ou_context.o_context.com*), or click *Choose*, select the NFS server from a list of servers, then click *OK*.

4c In *Remote File System*, specify the path on the remote server where the volume resides. Type the full path such as `/media/nss/VOL1`, or click *Select* to open the Exported Directories dialog box, then select the path from the list of NFS exported directories on the selected server, then click *OK*.

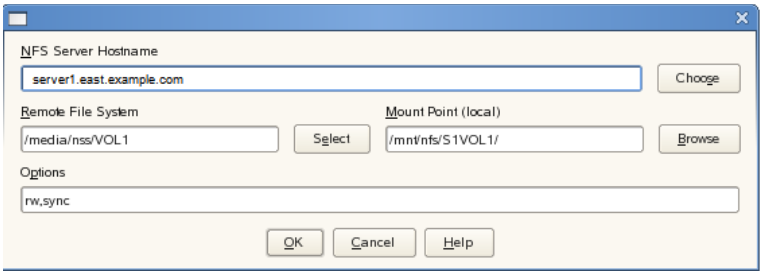
4d In *Mount Point (local)*, specify the path on the server (the NFS Client location) where you want to mount the remote volume, such as `/mnt/nfs/volumename`, or click *Browse* to locate and select the location.

The *Browse* option allows you to create a new folder on the server for the target path.

4e Enter the following required mount options:

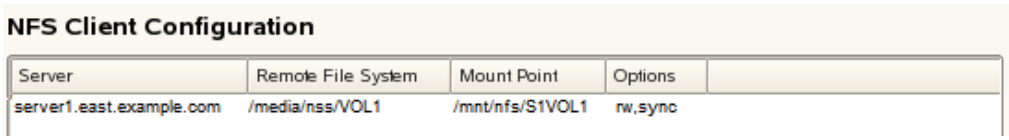
`rw,sync`

You can optionally specify the `noatime` option. For information, see Table 18-3 on page 243 and the `mount(8)` man page.



4f Click *OK* to save your settings and return to the *NFS Client Configuration* page.

The entry you just made should appear in the list.



4g When you are done adding volumes to be imported, continue with the next step.

5 On the *NFS Client Configuration* page, click *Finish* to apply the settings.

18.17 Deleting an NSS Volume

Deleting a volume removes the data in the volume and frees the space to be used by other volumes in the same pool. When you delete a volume, it is salvageable until one of the following events occurs:

- Volume Purge Delay times out. The deleted volume is purged automatically. For information, see Section 23.2.1, “Setting the Purge Delay for All Deleted Volumes,” on page 312.
- You manually purge the deleted volume. For information, see Section 23.4, “Viewing, Salvaging, or Purging Deleted NSS Volumes in a Pool,” on page 315.

During the purge delay time, the deleted volume is salvageable, but the space belonging to the deleted volume is not available to other volumes and. When the purging process begins, the volume is no longer salvageable.

If it is necessary, you can restore a deleted volume before it is purged. See Section 23.4, “Viewing, Salvaging, or Purging Deleted NSS Volumes in a Pool,” on page 315.

1 In iManager, click *Storage* > *Volumes*.

For instructions, see Section 9.1.5, “Accessing Roles and Tasks in iManager,” on page 94.

2 Select a server to manage.

For instructions, see Section 9.1.6, “Selecting a Server to Manage,” on page 95.

3 In the *Volumes* list, select one or more volumes that you want to delete.

Wait for the page to refresh and make the *Delete* option available for the selected volume.

4 Click *Delete*.

5 Click *Yes* to confirm the deletion, or click *No* to cancel the deletion.

18.18 Finding the Filename for a Given ZID

You might get an error report that identifies the ZID for a file, but not the filename and path on the volume. To find the associated filename and full path for the file on a given volume and name space, use the /ZIDtoFilename option.

1 At the NSS Console (`nsscon`) prompt, enter the following command (all on the same line, of course):

```
nss /ZIDtoFilename=ZIDnumber /ZIDNameSpace=namespace /ZIDVolumeName=volumename
```

Replace *ZIDnumber* with the ZID of the file. Replace *namespace* with the Long, UNIX, Macintosh, or DOS name space to use for the search. Replace *volumename* with the name of the volume for the search.

18.19 Verifying or Rebuilding NSS Volumes

You cannot rebuild or verify an NSS volume independently of other volumes in the same pool. For guidelines and procedures for verifying and rebuilding NSS pools and volumes, see Chapter 16, "Verifying and Rebuilding NSS Pools and Volumes," on page 193.

18.20 Moving Volumes with DFS

The Move Volume function uses Novell Distributed File Services to move a volume's file structure, data, and the file system trustee rights information from the original location to a new volume in the network. For guidelines and procedures for moving volumes, see "Using DFS to Move NSS Volumes" in the *OES 2 SP3: Novell Distributed File Services Administration Guide for Linux*.

18.21 Splitting Volumes with DFS

The Split Volume function uses Novell Distributed File Services to move a specified part of a volume's file structure, data, and the file system trustee rights information from the original location to a new volume in the network. A DFS junction replaces the selected directory and its contents in the source volume. The data and metadata in the directory are moved to the target location, which can be the root directory or other directory in the destination volume. For guidelines and procedures for splitting volumes, see "Using DFS to Split NSS Volumes" in the *OES 2 SP3: Novell Distributed File Services Administration Guide for Linux*.

18.22 What's Next

For information about advanced volume features, see the following:

- "Managing Encrypted NSS Volumes" on page 251
- "Securing Access to NSS Volumes, Directories, and Files" on page 259
- "Managing Compression on NSS Volumes" on page 275
- "Managing Space Quotas for Volumes, Directories, and Users" on page 293
- "Salvaging and Purging Deleted Volumes, Directories, and Files" on page 309
- "Managing Hard Links" on page 321

- *OES 2 SP3: Novell Distributed File Services Administration Guide for Linux*
- *OES 2 SP3: Dynamic Storage Technology Administration Guide*

19 Managing Encrypted NSS Volumes

Novell Storage Services provides optional Encrypted Volume Support (EVS) for NSS volumes on OES 1 SP1 Linux and later operating systems.

This section describes the following:

- Section 19.1, “Understanding Encrypted Volume Support,” on page 251
- Section 19.2, “Security Considerations for Encrypted Volumes,” on page 253
- Section 19.3, “Creating an Encrypted Volume,” on page 254
- Section 19.4, “Mounting an Encrypted NSS Volume with NSSMU,” on page 255
- Section 19.5, “Mounting Encrypted NSS Volumes with NSS Commands,” on page 255
- Section 19.6, “Dismounting an Encrypted NSS Volume with NSSMU,” on page 256
- Section 19.7, “Using Encrypted Volumes in a Server Cluster,” on page 257
- Section 19.8, “Removing Encrypted Volumes,” on page 257
- Section 19.9, “What’s Next,” on page 258

19.1 Understanding Encrypted Volume Support

NSS Encrypted Volume Support meets the legal standard of making data inaccessible to software that circumvents normal access control, such as if the media were stolen. EVS is available only for newly created NSS volumes. EVS stores user data in encrypted format on the NSS volume, yet works transparently with most applications, NLM programs, and backup utilities that currently work with NSS.

Any NSS volume on Linux can be designated at volume creation time to be an encrypted volume. The Encrypted attribute stays with the volume throughout its life. An encrypted volume cannot later be converted to be unencrypted, nor can an unencrypted volume later be converted to be encrypted. This is a creation-time-only decision.

Dynamic Storage Technology (NSS) does not support using encrypted volumes in a DST shadow volume pair.

Encryption is transparent above the physical read/write layer of an NSS volume. It requires no changes for applications. All the rules of file system trustee assignments, trustee rights, ownership, sharing, visibility, locking, transactions, and space restrictions remain the same. Performance for an encrypted volume is slightly degraded compared to an unencrypted volume under the same conditions.

- Section 19.1.1, “Encryption Method,” on page 252
- Section 19.1.2, “Encryption Password,” on page 252

- Section 19.1.3, “How Encrypted Volume Support Works,” on page 252
- Section 19.1.4, “Guidelines for Using Encrypted Volumes,” on page 252

19.1.1 Encryption Method

Encrypted volume support uses the NICI libraries for all cryptographic support. NICI generates a 128-bit AES key for encryption that persists for the life of the volume. You cannot change the password because it is the key used to encrypt data. NICI uses the password to wrap the key and other volume-specific cryptographic information into a 128-bit package that is persistently stored in two locations on the NSS media: the Volume Data Block and the Volume Locator storage object. After the cryptographic data is wrapped for the activated volume, EVS eliminates the password from memory.

19.1.2 Encryption Password

The encryption password can be 2 to 16 standard ASCII characters, with a suggested minimum of 6. The password generates a 128-bit NICI key for encryption. The password is set when you create the volume. It persists for the life of the volume; it cannot be changed later.

19.1.3 How Encrypted Volume Support Works

On the first activation after a system reboot, you must enter a valid password. When the volume is activated, NSS loads the volume’s persistent data from the Volume Data Block. If the Encrypted attribute is enabled for a volume, NSS searches in memory for a known key in the list of volume names and keys. If the key is present, it is used. If no key is present, NSS consults the list of volumes and passwords. If a password is available, it is used to unwrap the key from the persistent data and the new key is placed in the list of volumes and keys. The password is eliminated from memory.

After the encrypted volume is activated, all encryption operations on user data are transparent to file system applications that use normal file I/O functions. Data written to files is held in cache until the time it would be normally written. At physical write time, the data is encrypted to a temporary write buffer and written to the volume in encrypted format.

During reads, the cache is consulted, as it would normally be, to determine if a requested block is already in memory. If the requested data block is in cache, the clear-text data is transferred. If it is not, a physical read request is made, with the read directed to a temporary buffer. After read completion, but before control is returned to the calling program, the encrypted data in the temporary buffer is decrypted into a cache buffer. The read proceeds normally, with clear-text data being made available to all future requestors.

19.1.4 Guidelines for Using Encrypted Volumes

- We recommend that you avoid mixing encryption and compression features in a volume. Use one or the other, but not both.
- You can enable the Encryption attribute only at volume creation time.
- If it is enabled, the Encrypted volume attribute persists for the life of the volume.
- To encrypt an existing volume, you must create a new encrypted volume, then migrate existing data from the unencrypted volume to the encrypted volume.
- The encryption password is 6 to 16 standard ASCII characters.

19.2 Security Considerations for Encrypted Volumes

- Section 19.2.1, “Choosing a Strong Encryption Password,” on page 253
- Section 19.2.2, “Backing Up Data from an Encrypted Volume,” on page 253
- Section 19.2.3, “Excluding the NSS Cache Memory from Core Dumps,” on page 253
- Section 19.2.4, “Disabling Logs,” on page 253
- Section 19.2.5, “Archiving Files from an Encrypted Volume,” on page 254
- Section 19.2.6, “Using Direct I/O to an Encrypted Volume,” on page 254
- Section 19.2.7, “Sharing Encrypted NSS Volumes in a Cluster,” on page 254

19.2.1 Choosing a Strong Encryption Password

The encryption password is 6 to 16 standard ASCII characters. Make sure to employ security best practices for passwords. For information, see Section 30.15, “Creating Strong Passwords,” on page 384.

19.2.2 Backing Up Data from an Encrypted Volume

Make sure to encrypt the data from an encrypted volume on backup media. Backups of an encrypted volume are not encrypted, unless it is a feature of the backup software you use. For information, see Section 30.4, “Protecting Data During Backup and on Backup Media,” on page 377.

19.2.3 Excluding the NSS Cache Memory from Core Dumps

Make sure that you exclude the NSS cache memory from core dumps; otherwise, encrypted NSS volume data might be displayed in the clear. For information, see Section 30.5, “Preventing Exposure of Sensitive Data in a Core Dump,” on page 378.

19.2.4 Disabling Logs

When working with encrypted volumes on Linux, it is important to realize that the volume password and key information is exchanged between user and kernel space as encrypted volumes are created and/or mounted. If you have logging enabled on the Linux server when you enter the encryption password, your password and volume key information might show up in the log file.

Even though the logging mechanisms are `root` user protected, we strongly recommend that you make sure logging is disabled when creating an encrypted volume or mounting the encrypted volume after a system reboot in order to protect the secrecy of your password credentials at these critical times when you are entering the encryption password.

For information, see Section 30.6, “Preventing Exposure of the Encryption Password in a Log,” on page 378.

19.2.5 Archiving Files from an Encrypted Volume

If you use Novell Archive and Version Services to archive files from an encrypted volume, the destination path for Archive Manager must be on an encrypted volume. If the destination path is an unencrypted volume, the versioned data is stored in an unencrypted state.

Make sure to encrypt the archive volume when you create it on the archive server. Otherwise, the file versions are not secure.

For information about managing Archive and Version Services, see the following:

- *OES 2 SP3: Novell Archive and Version Services 2.1 Administration Guide for Linux*
- *NW 6.5 SP8: Novell Archive and Version Services 2.1 Administration Guide*

19.2.6 Using Direct I/O to an Encrypted Volume

Direct I/O to an encrypted volume bypasses the EVS encryption engine and allows data to be stored in unencrypted format on the encrypted volume. This capability is useful for diagnostic, repair, or special-purpose applications, but should be avoided otherwise.

You should avoid using direct-I/O applications on encrypted volumes, especially for user data that you intend to be stored in encrypted format.

19.2.7 Sharing Encrypted NSS Volumes in a Cluster

When you mount the shared volume and enter the password, NSS uses the password to create a key, which it stores in the server memory. The Novell Cluster Services software passes the key to other nodes. After all servers hold the key, the volume is available while any one of the servers is still participating actively in the cluster. If all servers in the cluster fail, you must repeat this procedure when you recover the cluster and restart services.

19.3 Creating an Encrypted Volume

NSS Encrypted Volume Support allows you to create encrypted NSS volumes using NSSMU version 3.20 build 940 or later. You can create encrypted user data volumes only after the installation or upgrade process.

If you choose to encrypt a volume, you cannot roll back the system to earlier versions of OES 1 Linux without taking steps to preserve your data before the rollback. For information, see Section 19.8, “Removing Encrypted Volumes,” on page 257.

WARNING: We strongly recommend that you verify that your system is working as desired before creating encrypted volumes on the system.

---

1. In NSSMU, select *Volumes*, then press *Enter*.
2. To create a new volume, press the *Insert* key.

   A query asks if you want to encrypt the volume.
3. To encrypt the new volume, select *Yes*, then press *Enter*.

   NSS enables the Encrypted attribute for the volume, then prompts you to enter a password for the volume.

4 Enter an encryption password, then enter it again to verify it.

   The encryption password can be 2 to 16 standard ASCII characters, with a suggested minimum of 6. The password generates a 128-bit NICI key for encryption. The password persists for the life of the volume; it cannot be changed later.

5 Set the volume size and other attributes, as desired.

   When you are done, the encrypted volume is active and mounted.

You must supply the encryption password for the volume on the first volume mount after a system boot or reboot. For information, see Section 19.4, "Mounting an Encrypted NSS Volume with NSSMU," on page 255.

For information about entering the password for a volume in a cluster, see Section 19.7, "Using Encrypted Volumes in a Server Cluster," on page 257.

19.4 Mounting an Encrypted NSS Volume with NSSMU

Mount only one volume at a time so that you can enter its password.

IMPORTANT: For encrypted NSS volumes on Linux, you can mount the volume only from NSSMU the first time it is mounted after a reboot.

---

1 In NSSMU, select *Volumes*.

2 In the *Volumes* list, select the encrypted volume that you want to mount.

3 Press *F7* to mount the volume.

4 If you are prompted to enter the password, enter the password, then click *OK*.

   You are prompted for the password on the first time the volume is mounted after a system reboot. The password is stored on the system until the next system reboot. You can mount the volume without the password until a system reboot occurs.

19.5 Mounting Encrypted NSS Volumes with NSS Commands

You must enter a password only on the first activation following a system reboot. Thereafter, other environmental security and authentication measures control access to user data.

IMPORTANT: On Linux, the NSS Console (`nsscon`) does not support entering the password from the command line. You must mount the encrypted volume from NSSMU on the first time after a system reboot. Thereafter, you can use the commands in this section without supplying the password. For information, see Section 19.4, "Mounting an Encrypted NSS Volume with NSSMU," on page 255.

Syntax

The following table provides the syntax for NSS commands to use with encrypted volumes on subsequent mounts of the volume until the system reboots. Enter the commands from nsscon. In each case, replace *volname* with the name of the encrypted NSS volume.

You cannot use the wildcard option of `all` as the *`volname`* before an encrypted volume is mounted with its password following each system reboot. The All option does not find the volume and does not execute the command.

Table 19-1 *Volume Mount Commands*

Command	Description
`mount` *`volname`*	Mounts an encrypted or unencrypted NSS volume. The `mount` command is usable for encrypted volumes only after a previous activation with password. Otherwise, it returns an error message, requesting more information.
`mount all`	Activates and mounts all encrypted NSS volumes that have been previously activated with their passwords. Encrypted NSS volumes that were not previously activated are not mounted. Mount them from NSSMU, where you can provide the encryption password.
`nss /volumes`	Displays a list of encrypted and unencrypted NSS volumes, showing their attributes. The encrypted volume returns a status of Encrypted.

19.6 Dismounting an Encrypted NSS Volume with NSSMU

Before you can dismount an NSS volume on Linux, you must dismount the volume from NCP Server; otherwise, the dismount function fails.

1. If NCP Server is running, dismount the volume from NCP Server.
   1a. At the server prompt, open the NCP Console by entering

   ```
   ncpcon
   ```

   1b. Dismount the volume from NCP.

   The volume is no longer accessible or visible to NCP clients.
2. Dismount the volume.
   2a. From a terminal console, start NSSMU, then select *Volumes*.
   2b. In the *Volumes* list, select the encrypted volume that you want to dismount.
   2c. Press *F7* to dismount the mounted volume.

19.7 Using Encrypted Volumes in a Server Cluster

If you use an encrypted NSS volume in a Novell Cluster Services cluster, you must manually enter the password for the volume on one of the servers only when you first start or restart the cluster. You use NSSMU to mount the encrypted volume on one of the OES Linux servers and enter the volume password, then dismount volume before you can bring the cluster resource online for the first time.

NSS uses the password to create a key, which it stores in the server memory. The Novell Cluster Services software passes the key to other nodes. After all servers hold the key, the volume is available while any one of the servers is still participating actively in the cluster. If all servers in the cluster fail, you must repeat this procedure when you recover the cluster and restart services.

1. Boot or restart the servers in the cluster.

   If you automated the loading of cluster resources, the cluster reports that each resource is comatose because it cannot bring the corresponding encrypted volume online.

   If you opt to manually start cluster resources, the cluster resources are not yet active.

2. From one of the nodes in the cluster, repeat the following steps for each of the encrypted volumes in the cluster.

   2a In NSSMU, select *Volumes*.

   2b In the *Volumes* list, select the shared volume you want to mount.

   2c Press *F7* to mount the shared volume.

   2d When prompted, enter the password, then click *OK*.

   If the server already knows the key for the volume, you are not prompted for the password.

   2e In the *Volumes* list, select the shared volume that you want to dismount.

   2f Press *F7* to dismount the shared volume.

3. Follow the normal procedures to activate the cluster resources.

   For information, see the *OES 2 SP3: Novell Cluster Services 1.8.8 Administration Guide for Linux*. The node passes the key information to the other nodes. While at least one of the servers is actively participating in the cluster, you do not need to reenter the encryption password again.

19.8 Removing Encrypted Volumes

If a rollback becomes necessary, you must remove the encrypted volume from the server before you perform the rollback.

Encrypted volumes require OES 1 SP1 Linux or later. Because earlier releases of NSS cannot activate an encrypted volume, you cannot roll back the system to the earlier release. If you do, the encrypted volume fails to activate or mount, and its pool cannot be repaired.

To prevent this potential data loss, make sure that the system upgrade to a supported platform is active and performing as desired before creating encrypted volumes.

1. Create an unencrypted volume where you want to copy the data.

   For information, see Section 19.3, “Creating an Encrypted Volume,” on page 254.

2 Use one of these methods to save the encrypted volume's data on the unencrypted volume:

- Back up the volume's data in unencrypted format on backup media, then restore the data to the unencrypted volume.
- Make a volume-to-volume copy of the data from the encrypted volume to the unencrypted volume.

3 Delete the encrypted volume.

4 Perform the system rollback.

19.9 What's Next

Manage other NSS features of your encrypted volume as you would for an unencrypted volume. For information, see "Managing NSS Volumes" on page 221.

20 Securing Access to NSS Volumes, Directories, and Files

This section describes measures you can use to help secure access to your Novell Storage Services (NSS) volumes and user data.

- Section 20.1, “Configuring File System Trustees, Trustee Rights, Inherited Rights Filters, and Attributes,” on page 259
- Section 20.2, “Configuring the Security Equivalence Vector Update Frequency,” on page 265
- Section 20.3, “Using Data Shredding to Prevent Access to Purged Files,” on page 268
- Section 20.4, “Enabling or Disabling LAF Audit Log Messages for Trustee Events,” on page 269

20.1 Configuring File System Trustees, Trustee Rights, Inherited Rights Filters, and Attributes

NSS uses the Novell Trustee model for controlling access to user data. As an administrator or a user with the Supervisor right or Access Control right, you can use the Files and Folders plug-in to iManager to manage file system trustees, trustee rights, inherited rights filters, and attributes for a file or folder on an NSS volume. A user who has only the Access Control right cannot modify the rights of another user who has the Supervisor right.

IMPORTANT: For more information and alternate methods for configuring file system trustees and attributes for directories and files on NSS volumes, see the *OES 2 SP3: File Systems Management Guide*.

- Section 20.1.1, “Prerequisites for Configuring Trustees,” on page 259
- Section 20.1.2, “Viewing Properties of a File or Folder,” on page 260
- Section 20.1.3, “Configuring File or Folder Attributes,” on page 260
- Section 20.1.4, “Configuring Rights Properties (File System Trustees, Trustee Rights, and Inherited Rights Filter),” on page 262
- Section 20.1.5, “Viewing Effective Rights for a Trustee,” on page 265

20.1.1 Prerequisites for Configuring Trustees

- The volume that you want to manage must be in the same tree where you are currently logged in to iManager.
- You must have trustee rights for the volume, folder, and file that you want to manage.
- The volume must be a file system that uses the Novell trustee model for file access, such as an NSS volume on OES 2 Linux, an NSS or NetWare traditional volume on NetWare 6.5, or an NCP (NetWare Core Protocol) volume (an NCP share on a Linux POSIX file system) on OES 2 Linux.

20.1.2 Viewing Properties of a File or Folder

1. In iManager, click *Files and Folders* > *Properties* to open the *Properties* page.
2. Click the *Search* icon to browse and locate volume, folder or file from the Storage objects, then click the name link of the object to select it.

   The pathname of the object appears in the *Name* field.
3. View the following properties in three *Properties* tabs:

Properties Tabs	Description	For Information
Information	◆ View details about the selected volume, folder, or file. ◆ Configure directory quotas for folders on NSS volumes where the Directory Quotas attribute is enabled. ◆ Modify the file owner. ◆ Configure file or directory attributes.	See Section 25.7, "Viewing or Modifying File or Folder Properties," on page 336. See Section 25.9, "Viewing, Adding, Modifying, or Removing a Directory Quota," on page 342. See Section 25.8, "Viewing or Modifying File Ownership," on page 340. See Section 20.1.3, "Configuring File or Folder Attributes," on page 260.
Rights	◆ View details about trustees, trustee rights, and inherited rights filter for the selected volume, folder, or file. ◆ Add or remove trustees. ◆ Grant or revoke trustee rights for one or more trustees. ◆ Configure the inherited rights filter.	See Section 20.1.4, "Configuring Rights Properties (File System Trustees, Trustee Rights, and Inherited Rights Filter)," on page 262.
Inherited Rights	◆ View details about explicitly assigned trustee rights and inherited rights at all levels along the path from the selected file or folder to the `root` of the volume. ◆ View the effective rights for a given trustee for the selected volume, folder, or file.	See Section 20.1.5, "Viewing Effective Rights for a Trustee," on page 265.

20.1.3 Configuring File or Folder Attributes

File attributes determine how the file or folder behaves when accessed by any user. File attributes apply universally to all users. For example, a file that has a read-only attribute is read-only for all users.

Attributes can be set by any trustee with the Modify right to the directory or file, and attributes stay set until they are changed. Attributes do not change when you log out or when you down a file server.

For example, if a trustee with the Modify right enables the Delete Inhibit attribute for a file, no one, including the owner of the file or the network administrator, can delete the file. However, any trustee with the Modify right can disable the Delete Inhibit attribute to allow the file's deletion.

1. In iManager, click *Files and Folders* > *Properties* to open the *Properties* page.
2. Click the *Search* icon to browse and locate volume, folder or file from the Storage objects, then click the name link of the object to select it.

   The pathname of the object appears in the *Name* field. For example:

   ```
   VOL1:dir1\dirB\filename.ext
   ```

3. Click the *Information* tab to view or modify the file or folder attributes. Enable or disable an attribute by selecting or deselecting the check box next to it.

   IMPORTANT: Changes do not take effect until you click *OK* or *Apply*. If you click a different tab before you save, changes you make on this page are lost.

The following table defines file system attributes and whether they apply to files, folders, or both files and folders.

Attribute	Description	Files	Folders
Read Only	Prevents a file from being modified. This attribute is typically used in combination with Delete Inhibit and Rename Inhibit.	Yes	No
Archive	Identifies files and folders that have been modified since the last backup. This attribute is assigned automatically.	Yes	Yes
Hidden	Hides directories and files so they do not appear in a file manager or directory listing.	Yes	Yes
Shareable	Allows more than one user to access the file at the same time. This attribute is usually used with Read Only.	Yes	No
Transactional (NetWare)	Allows a file on an NSS volume or a NetWare Traditional volume to be tracked and protected by the Transaction Tracking System™ (TTS™) for NetWare. For NSS, the TTS attribute for the volume must be enabled in order for this setting to be enforced. TTS is not available for NSS on Linux.	Yes	No
Purge Immediate	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
Rename Inhibit	Prevents the directory or filename from being modified.	Yes	Yes
Delete Inhibit	Prevents users from deleting a directory or file. This attribute overrides the file system trustee Erase right. When Delete Inhibit is enabled, no one, including the owner and network administrator, can delete the directory or file. A trustee with the Modify right must disable this attribute to allow the directory or file to be deleted.	Yes	Yes
Copy Inhibit (NetWare)	Prevents users from copying a file. This attribute works only for clients using Macintosh operating systems to access NSS volumes on NetWare. This attribute overrides the trustee Read right and File Scan right. A trustee with the Modify right must disable this attribute to allow the file to be copied.	Yes	No

4 If you modified any settings, click *Apply* or *OK* to save your changes.

20.1.4 Configuring Rights Properties (File System Trustees, Trustee Rights, and Inherited Rights Filter)

File system trustees, trustee rights, and inherited rights filters are used to determine access and usage for directories and files on NSS volumes on OES 2 Linux, NCP volumes on OES 2 Linux, and NSS and NetWare Traditional volumes on NetWare 6.5 SP8. If you modify any settings, you must click *Apply* or *OK* to save the changes.

Viewing, Adding, or Removing File System Trustees

A trustee is any Novell eDirectory object (such as a User object, Group object, Organizational Role object, or other container object) that you grant one or more rights for a directory or file. Trustee assignments allow you to set permissions for and monitor user access to data.

1. In iManager, click *Files and Folders*, then click *Properties* to open the *Properties* page.
2. On the *Properties* page, select a volume, folder, or file to manage.

   For instructions, see Section 20.1.2, "Viewing Properties of a File or Folder," on page 260.
3. Click the *Rights* tab to view the trustees, trustee rights, and inherited rights filter for the selected volume, folder, or file.
4. Add trustees.

   4a Scroll down to the *Add Trustees* field.

   4b Use one of the following methods to add usernames as trustees:

   - Click the *Search* icon, browse to locate the usernames of the users, groups, or roles that you want to add as trustees, click the name link of the objects to add them to the *Selected Objects* list, then click *OK*.
   - Click the *History* icon to select usernames from a list of users, groups, or roles that you recently accessed.
   - Type the typeless distinguished username (such as username.context) in the *Add Trustees* field, then click the *Add* (+) icon.

   The usernames appear in the Trustees list, but they are not actually added until you click *Apply* or *OK*. Each of the usernames has the default Read and File Scan trustee rights assigned.

   4c On the *Properties* page, click *Apply* to save the changes.
5. Remove trustees.

   5a Scroll down to locate and select the username of the user, group, or role that you want to remove as a trustee.

   5b Click the *Remove* (red X) icon next to the username to remove it as a trustee.

   The username disappears from the list, but it is not actually removed until you click *Apply* or *OK*.

   5c On the *Properties* page, click *Apply* to save changes.

Viewing, Granting, or Revoking File System Trustee Rights

Administrator users and users with the Supervisor right or the Access Control right can grant or revoke file system trustee rights for a volume, folder, or file. Only the administrator user or user with the Supervisor right can grant or revoke the Access Control right.

1. In iManager, click *Files and Folders*, then click *Properties* to open the *Properties* page.
2. On the *Properties* page, select a volume, folder, or file to manage.

   For instructions, see Section 20.1.2, "Viewing Properties of a File or Folder," on page 260.
3. Click the *Rights* tab to view the trustees, trustee rights, and inherited rights filter for the selected volume, folder, or file.
4. Scroll to locate the username of the trustee you want to manage.

5 In the check boxes next to the trustee name, select or deselect the rights you want to grant or revoke for the trustee.

IMPORTANT: Changes do not take effect until you click *OK* or *Apply*. If you click a different tab before you save, any changes you have made on this page are lost.

Trustee Right	Description
Supervisor (S)	Grants the trustee all rights to the directory or file and any subordinate items. The Supervisor right cannot be blocked with an inherited rights filter (IRF) and cannot be revoked. Users who have this right can also grant other users any rights to the directory or file and can change its inherited rights filter. Default=Off
Read (R)	Grants the trustee the ability to open and read files, and open, read, and execute applications. Default=On
Write (W)	Grants the trustee the ability to open and modify (write to) an existing file. Default=Off
Erase (E)	Grants the trustee the ability to delete directories and files. Default=Off
Create (C)	Grants the trustee the ability to create directories and files and salvage deleted files. Default=Off
Modify (M)	Grants the trustee the ability to rename directories and files, and change file attributes. Does not allow the user to modify the contents of the file. Default=Off
File Scan (F)	Grants the trustee the ability to view directory and filenames in the file system structure, including the directory structure from that file to the root directory. Default=On
Access Control (A)	Grants the trustee the ability to add and remove trustees for directories and files and modify their trustee assignments and inherited rights filters. Default=Off

6 Click *Apply* or *OK* to save changes.

Configuring the Inherited Rights Filter for a File or Directory

File system trustee rights assignments made at a given directory level flow down to lower levels until they are either changed or masked out. This is referred to as inheritance. The mechanism provided for preventing inheritance is called the inherited rights filter. Only those rights allowed by the filter

are inherited by the child object. The effective rights that are granted to a trustee are a combination of explicit rights set on the file or folder and the inherited rights. Inherited rights are overridden by rights that are assigned explicitly for the trustee on a given file or folder.

1. In iManager, click *Files and Folders*, then click *Properties* to open the *Properties* page.
2. On the *Properties* page, select a volume, folder, or file to manage.

   For instructions, see Section 20.1.2, "Viewing Properties of a File or Folder," on page 260.
3. Click *Information*, then scroll down to view the inherited rights filter.

   The selected rights are allowed to be inherited from parent directories. The deselected rights are disallowed to be inherited.
4. In the *Inherited Rights Filter*, enable or disable a right to be inherited from its parent directory by selecting or deselecting the check box next to it.
5. Click *Apply* or *OK* to save the changes.

20.1.5 Viewing Effective Rights for a Trustee

Effective rights are the explicit rights defined for the trustee plus the rights that are inherited from the parent directory. The *Inherited Rights* page shows the inheritance path for a trustee for the selected file or folder and the effective rights at each level from the current file or directory to the root of the volume. You can use this information to help identify at which directory in the path a particular right was filtered, granted, or revoked.

1. In iManager, click *Files and Folders*, then click *Properties* to open the *Properties* page.
2. On the *Properties* page, select a volume, folder, or file to manage.

   For instructions, see Section 20.1.2, "Viewing Properties of a File or Folder," on page 260.
3. On the *Properties* page, click the *Inherited Rights* tab to view the effective rights for a given trustee.

   By default, the page initially displays the effective rights for the username you used to log in to iManager.
4. On the *Inherited Rights* page, click the *Search* icon next to the *Trustee* field to browse for and locate the username of the trustee you want to manage, then select the username by clicking the name link.

   The path for the selected file or folder is traced backwards to the root of the volume. At each level, you can see the rights that have been granted and inherited to create the effective rights for the trustee.
5. If you make any changes, click *Apply* or *OK* to save them.

20.2 Configuring the Security Equivalence Vector Update Frequency

The Security Equivalence Vector (SEV) is used to validate the user against the trustee rights of the directory and file the user is attempting to access. You can use commands in the NSS Console utility (`nsscon`) on Linux to enable or disable the update, to set the update interval from 5 minutes to 90 days (specified in seconds), and to force an immediate update of security equivalence vectors.

- Section 20.2.1, "Understanding the SEV," on page 266
- Section 20.2.2, "Enabling or Disabling the Background SEV Update," on page 266

- Section 20.2.3, “Configuring the Background SEV Update Interval,” on page 267
- Section 20.2.4, “Forcing a Background SEV Update,” on page 267

20.2.1 Understanding the SEV

The Security Equivalence Vector (SEV) is calculated for each NSS user based on information in the user’s profile in Novell eDirectory. It is a list of eDirectory GUIDs, for example:

- the user’s own GUIDs
- GUIDs of groups that include the user
- GUIDs of parent containers for the user and his or her groups
- security equivalent GUIDs

After you boot the Linux server, when a user first attempts to connect to the NSS file system, NSS contacts Novell eDirectory to retrieve the user’s Security Equivalence Vector (SEV). eDirectory calculates the user’s effective rights for the NSS volume, creates the SEV, and passes it to NSS. NSS compares the user’s SEV with file system trustees and trustee rights for the specified file or directory to determine if the user can access the resource.

For NetWare, whenever a user connects to the NSS file system, NetWare retrieves the user’s SEV from eDirectory and maintains it as part of the connection structure for the user’s session. NSS automatically retrieves the user’s SEV from the NetWare connection structure, then deletes it when the session ends.

On Linux, the SEV behavior differs from the NetWare behavior because NSS does not have the same integrated relationship to the connection infrastructure as it does on NetWare. NSS caches the SEV locally in the server memory, where it remains until the server is rebooted or the user is deleted from eDirectory. NSS polls eDirectory at a specified interval for updates to the SEVs that are in cache.

20.2.2 Enabling or Disabling the Background SEV Update

By default, the SEV is updated in the background and whenever the server is rebooted. You can optionally disable the background updating. If it is disabled, the user access can become unsynchronized over time, so that users might have less or more access than you have configured. We recommend that you leave the SEV updating feature enabled, then modify the polling frequency to best meet the security needs of your production environment.

To enable or disable the setting:

1. Open a terminal console, then log in as the `root` user.
2. At the terminal console prompt, start the NSS Console by entering

   ```
   nsscon
   ```

3. At the `nsscon` prompt, do one of the following:
   - **Enable:** This is the default. To enable the background updating of the SEV in addition to the default update at server reboot, enter

     ```
     nss /SecurityEquivalenceUpdating
     ```

   - **Disable:** To disable the background updating, enter

     ```
     nss /NoSecurityEquivalenceUpdating
     ```

The SEV Update is enabled when you first reboot the server. If you disable SEV updates and want the setting to persist across server reboots, include the `/SecurityEquivalenceUpdating` option in the `/etc/opt/novell/nss/nssstart.cfg` file.

20.2.3 Configuring the Background SEV Update Interval

You might want to modify the background SEV update interval to make the polling for eDirectory updates to be more or less frequent. Polling too frequently can impact performance. Polling too infrequently can cause delays in granting or restricting access for certain users. To avoid possible security violations, you can also force an update at any time by using the /ForceSecurityEquivalenceUpdate command. For information, see Section 20.2.4, "Forcing a Background SEV Update," on page 267.

The interval for the background updating of the SEV is the elapsed time between the last update and the next one. At the end of the elapsed time, NSS requires updated SEVs from eDirectory. The default interval is 7200 seconds (2 hours). The valid range is 300 (5 minutes) to 7776000 (90 days).

To set the interval to use until the next server reboot:

1. Open a terminal console, then log in as the `root` user.
2. At the terminal console prompt, start the NSS Console by entering

   ```
   nsscon
   ```

3. At the `nsscon` prompt, enter

   ```
   nss /UpdateSecurityEquivalenceInterval=value
   ```

   Replace *value* with the desired interval.

To make the interval setting persistent across server reboots, include the `/UpdateSecurityEquivalenceInterval=value` option in the `/etc/opt/novell/nss/nssstart.cfg` file.

20.2.4 Forcing a Background SEV Update

If you modify user's access control settings or remove a user from eDirectory in between SEV update intervals, you can to force the SEV to be updated immediately after that to avoid possible security violations. Use the `/ForceSecurityEquivalenceUpdate` option to force an immediate update for all users in the NSS file system so that your changes can be reflected immediately in the user's active SEV for this server.

To force an immediate update:

1. Open a terminal console, then log in as the `root` user.
2. At the terminal console prompt, start the NSS Console by entering

   ```
   nsscon
   ```

3. At the `nsscon` prompt, enter

   ```
   nss /ForceSecurityEquivalenceUpdate
   ```

20.3 Using Data Shredding to Prevent Access to Purged Files

Data shredding hides purged files by overwriting them with random patterns of hexadecimal characters. This prevents unauthorized users from using a disk editor to access purged files.

If the Data Shredding attribute for an NSS volume is disabled, unauthorized access to data is possible. An individual can extend a file, `LSEEK` to the end of the existing file data, and then read the data. This returns the decrypted leftover data that is in the block.

You can place up to seven data shred patterns over deleted data. Data shredding truly erases files. Only files that have been purged are shredded. If Salvage is enabled, there remains a purge delay between when the file is deleted and purged during which users can still salvage deleted files.

Data shredding consumes a great deal of disk connection bandwidth, resulting in a performance penalty for using the disk and system resources needed to overwrite the shredded file. Unless you must use data shredding for security reasons, the Data Shredding attribute for your NSS volume can be disabled or set to a lower number of shredding passes.

This section describes the following:

- Section 20.3.1, "Setting the Data Shredding Attribute When You Create a Volume," on page 268
- Section 20.3.2, "Setting the Data Shredding Attribute for an Existing Volume," on page 268
- Section 20.3.3, "Disabling Data Shredding for an Existing Volume," on page 269

20.3.1 Setting the Data Shredding Attribute When You Create a Volume

When you create a volume, simply select the *Data Shredding* check box and specify the number of shredding cycles with an integer number between 1 and 7 times (or specify 0 to indicate no shredding capability) when you set the volume's attributes. For more information, see Section 18.3, "Creating Unencrypted NSS Volumes," on page 228.

20.3.2 Setting the Data Shredding Attribute for an Existing Volume

1. In iManager, click *Storage* > *Volumes* to open the Volumes page.

   For instructions, see Section 9.1.5, "Accessing Roles and Tasks in iManager," on page 94.
2. Select a server to manage.

   For instructions, see Section 9.1.6, "Selecting a Server to Manage," on page 95.

   Wait until the page refreshes with a list of volumes in the *Volumes* list.
3. From the *Volumes* list, select the volume that you want to manage.
4. Click *Properties* > *Attributes*.

   This opens the *Volume Properties* page to the *Attributes* tab.
5. Select the *Data Shredding* check box.
6. Specify the number of shredding cycles, where 0 is no shredding and 1 to 7 are the valid number of cycles to shred data.
7. Click *Apply* or *OK* to save the change, or click *Cancel* to back out of the process.

   If you click *Apply*, iManager saves the change and remains on the device page. If you click *OK*, iManager saves the change and takes you to the main Storage page. If you do not click *Apply* or *OK*, the setting is not implemented.

20.3.3 Disabling Data Shredding for an Existing Volume

WARNING: If you disable data shredding, an individual can recover leftover data on the drive and secure data might be exposed.

1 At the server console, enter

```
nss /nodatashredding=volumename
```

where *volumename* is the name of the volume where you want to prevent the shredding capability.

20.4 Enabling or Disabling LAF Audit Log Messages for Trustee Events

Use the NSS audit log messages commands to enable or disable messages via Lightweight Auditing Format (LAF) for NSS trustee changes for NSS volumes on OES 2 Linux.

- Section 20.4.1, "Understanding NSS Audit Log Messages," on page 269
- Section 20.4.2, "Enabling or Disabling LAF Audit Messages for Trustee Events," on page 272
- Section 20.4.3, "Viewing LAF Audit Messages," on page 272
- Section 20.4.4, "Additional Information," on page 273

20.4.1 Understanding NSS Audit Log Messages

When the LAFAuditTrustee parameter is enabled, NSS reports changes for the following subset of NSS events:

- Adding trustees (AddTrustee)
- Removing trustees (RemoveTrustee)
- Setting the inherited rights mask (SetInheritedRightsMask)

Comma separated name value pairs are used for the NSS audit log messages. The messages are written to the`/var/log/audit/audit.log` file.

The types of information reported are described below:

- "Message Type and ID" on page 270
- "Add Trustee Event Messages" on page 270
- "Remove Trustee Event Messages" on page 270
- "Set Inherited Rights Mask Event Messages" on page 270
- "Trustee Rights" on page 271
- "Inherited Rights Mask for Trustee Rights" on page 271
- "Special Rights" on page 271
- "Inheritance Attributes" on page 272

Message Type and ID

All NSS Audit Log messages are of the type AUDIT_KERNEL_OTHER (1316) for LAF. For example, the log messages begin

```
type=UNKNOWN[1316] msg=audit(message_id):
```

Add Trustee Event Messages

The general format of NSS audit log messages for a single AddTrustee event is:

```
NSS: AddTrustee: fsuid=<user requesting the
operation>,vol=<VOLNAME>,path=<FULL_PATH (relative to the
volume)>,trustee=<typeful Fully Distinguished eDirectory username of the trustee
being added>,rights=<RIGHTS>,attributes=<ATTRIBUTES>
```

For example, the following message is for a single event for adding a trustee:

```
type=UNKNOWN[1316] msg=audit(1164926678.066:7): NSS: AddTrustee:
fsuid=0,vol=NSS1,path=/abc/
a,trustee=.CN=user5.O=company.T=COMPANY_TREE.,rights=0x1fb,attributes=0xc000
```

In this example, the trustee user5.company.company_tree is assigned the SRWCEMFA rights, totaling 0x1fb. For a map of rights to values, see "Trustee Rights" on page 271.

Remove Trustee Event Messages

The general format of NSS audit log messages for a single RemoveTrustee event is:

```
NSS: RemoveTrustee: fsuid=<user requesting the
operation>,vol=<VOLNAME>,path=<FULL_PATH (relative to the
volume)>,trustee=<typeful Fully Distinguished eDirectory username of the trustee
being removed>
```

For example, the following message is for a single event for removing a trustee:

```
type=UNKNOWN[1316] msg=audit(1164926734.422:8): NSS: RemoveTrustee:
fsuid=0,vol=NSS1,path=/abc/a,trustee=.CN=user5.O=company.T=COMPANY_TREE.
```

Set Inherited Rights Mask Event Messages

The general format of NSS audit log messages for a single SetInheritedRightsMask event is:

```
NSS: SetInheritedRightsMask: fsuid=<user>,vol=<VOLNAME>,path=<FULL_PATH(relative
to the volume)>,inheritedRightsMask=<RIGHTS>
```

For example, the following message is for a single event for changes to the inherited rights mask:

```
type=UNKNOWN[1316] msg=audit(1164926882.005:10): NSS: SetInheritedRightsMask:
fsuid=0,vol=NSS1,path=/abc/a,inheritedRightsMask=0x149
```

In this example, the trustee rights settings can be inherited from the parent directory for the Supervisor (0x0100), Read (0x0001), Create (0x0008), and File Scan (0x0040) rights, totaling 0x0149.

Trustee Rights

The file system trustee rights setting in the message is a hexadecimal value that represents the combination of rights assigned.

The following table maps the trustee rights to hexadecimal values. The values for enabled rights are added to get the reported value for the Rights and Inherited Rights Mask.

Trustee Right	Hexadecimal Value
Supervisor (S)	0x0100
Read (R)	0x0001
Write (W)	0x0002
Create (C)	0x0008
Erase (E, Delete)	0x0010
Modify (M)	0x0080
File Scan (F, See Files)	0x0040
Access Control (A)	0x0020

For example, if the trustee has SRWCEMFA rights, the value is the sum of these or 0x1fb in hexadecimal.

Inherited Rights Mask for Trustee Rights

An inherited rights mask (IRM) specifies which trustee rights are allowed to be inherited downward through a directory. If a trustee bit is set in the IRM of a directory, that bit can be inherited downward in the tree. If a trustee bit is not set in the IRM of a directory, then that right cannot be inherited by the directory's contents, even if a higher level in the directory tree had that right.

The bit definitions for inherited rights masks are the same bits as the trustee rights themselves as described in "Trustee Rights" on page 271. For example, if the Read and File Scan rights can be inherited, the inherited rights mask value is 0x0041 in hexadecimal.

Special Rights

In addition to trustee rights, the following are special rights that might be reported in the Rights field. They cannot be inherited.

Special Right	Hexadecimal Value
Salvage	0x0200
Secure	0x8000

Inheritance Attributes

The attributes reported in the log are flags that tell the trustee how it gets inherited. (They are not file system attributes.) By default, the NetWare trustee model inherits downward and upward (visibility inherits upward; actual rights inherit downward).

The following table maps the inheritance attributes to hexadecimal values. The values for enabled inheritance attributes are added to get the reported value for the Attributes parameter.

Inheritance Attribute	Hexadecimal Value
Inherit Down Make rights inherit downward.	0x8000
Inherit Up Make directories above this file visible.	0x4000
Negative Rights (Not currently used) All other bits are ignored if this parameter is set.	0x2000

For example, an Attribute value of 0xc000 in the audit message indicates that both the Inherit Down and Inherit Up parameters are enabled. This is the typical setting for NSS file systems.

20.4.2 Enabling or Disabling LAF Audit Messages for Trustee Events

Enable or disable the generation of audit messages via LAF for NSS trustee changes. After you enable the audit log messages, the setting persists until the server reboot. After a server reboot, the audit log is disabled again by default. To make the command persist across reboots, add it to the `/etc/opt/novell/nss/nssstart.cfg` file. The messages are written to the`/var/log/audit/audit.log` file.

1. Open a terminal console, then log in as the `root` user.
2. At the terminal console prompt, start the NSS Console by entering

   ```
   nsscon
   ```

3. At the `nsscon` prompt, do one of the following:
   - **Enable:** To enable audit messages for an NSS volume, enter

     ```
     nss /LAFAuditTrustee
     ```

   - **Disable:** To disable audit messages for an NSS volume, enter

     ```
     nss /NoLAFAuditTrustee
     ```

20.4.3 Viewing LAF Audit Messages

View audit messages in the `/var/log/audit/audit.log` file.

For information about the format of the messages, see Section 20.4.1, “Understanding NSS Audit Log Messages,” on page 269.

20.4.4 Additional Information

For information about configuring Linux Audit, see the *Linux Audit Quick Start* (http://www.novell.com/documentation/sled10/auditqs_sp1/data/art_audit_qs.html).

For information about the Linux Audit Framework, see *The Linux Audit Framework* (http://www.novell.com/documentation/sled10/audit_sp1/data/book_sle_audit.html).

21 Managing Compression on NSS Volumes

Novell Storage Services file compression uses algorithms to reduce the amount of space a file consumes in your storage system. Compression can optionally be used to conserve disk space and increase the amount of data a volume can store. No data in the file is permanently eliminated to compress the file; all original data is recovered when the file is decompressed.

This section describes the following:

- Section 21.1, “Understanding Compression,” on page 275
- Section 21.2, “Configuring Compression for a Server,” on page 280
- Section 21.3, “Configuring a Volume for Compression,” on page 285
- Section 21.4, “Suspending Compression for Volumes or Files,” on page 287
- Section 21.5, “Disabling Compression for a Volume,” on page 287
- Section 21.6, “Restoring Data to a Uncompressed Volume,” on page 287
- Section 21.7, “Configuring Compression Preferences for Directories and Files,” on page 287
- Section 21.8, “Using NSS Commands to Configure and Monitor Compression,” on page 290
- Section 21.9, “Viewing Compression Statistics with the NDIR Command,” on page 290
- Section 21.10, “Repairing Compressed Volumes with the Compfix Utility,” on page 291
- Section 21.11, “Backing Up Compressed Files,” on page 291

21.1 Understanding Compression

This section describes the following:

- Section 21.1.1, “Compression and Decompression Processes,” on page 276
- Section 21.1.2, “Compression Settings,” on page 276
- Section 21.1.3, “Guidelines for Compression,” on page 277
- Section 21.1.4, “Factors Affecting Compression,” on page 279
- Section 21.1.5, “Factors Affecting Decompression,” on page 280
- Section 21.1.6, “Monitoring Compression Activity,” on page 280

21.1.1 Compression and Decompression Processes

File compression and decompression processes occur in the background, as needed for each compressed volume, to support normal file access and immediate file compression settings. Scheduled compression occurs during a specified time each day. Typically, the scheduled period is set to non-peak hours, but it can occur at any time you prefer.

A file must be idle for the period specified in the Days Untouched before Compression parameter before it is considered eligible for a scheduled compression. During scheduled compression, NSS evaluates file time stamps and all compression settings to determine which files qualify for compression. When it queues eligible files for compression, the compression process begins and handles as many compression tasks as it can in the available time. Any remaining queued files wait for the next compression opportunity.

To minimize the impact of compression and decompression on system performance, you can limit the maximum number of concurrent process threads the system devotes to it. The system queues compression and decompression requests, then processes them as process threads become available.

NSS retains the uncompressed file during the compression process. Before NSS compresses a file, it verifies that the file system has enough space available for both the uncompressed file and the compressed file to temporarily coexist. If there is not enough space available, the file is not compressed. After the compression completes successfully, NSS deletes the uncompressed file, and keeps the compressed file. If errors occur during compression, NSS discards the compressed file and marks the uncompressed file with a Cannot Compress (Cc) attribute.

NSS does not attempt to compress a file while its Cc attribute is set to On. If the file is opened and saved, its Cc attribute is reset to Off. You can also run the Compfix utility to clear the Cc attribute. For information, see Section 21.10, “Repairing Compressed Volumes with the Compfix Utility,” on page 291.

NSS retains the compressed file when it is opened. Before NSS opens a compressed file, it verifies that the file system has enough space available for both the compressed file and the uncompressed file to temporarily coexist. If there is not enough space available, the file is not opened. You must make free space available for the volume before the file can be opened. Use any measures you normally take to make space available for the volume to use.

21.1.2 Compression Settings

Although the cost of storage media is decreasing, you might consider compression to store more information on media where available space is limited. File compression requires configuration for the server level, for the volume, and optionally for individual directories and files.

Common Service Compression Parameters

At the server level, the settings for compression parameters in Common Services govern when and how compression works for the NSS volumes where the compression attribute is enabled. For information about these parameters, see Section 21.2, “Configuring Compression for a Server,” on page 280.

The Volume's Compression Attribute

The volume's Compression attribute determines if its files can be compressed. You can enable the attribute when you create a new volume or add it at any time for an existing volume. After it is set, the Compression attribute persists for the life of the volume. For information about setting attributes for existing volumes, see Section 21.3, "Configuring a Volume for Compression," on page 285.

Compression Preferences for Directories and Files

For individual directories and files, you can optionally set compression preferences that allow file compression to occur immediately for specified files, regardless of the server's compression parameters. You can also specify restrictions for individual files that make them ineligible for compression. For information about how to set compression preferences for individual directories and files, see Section 21.7, "Configuring Compression Preferences for Directories and Files," on page 287.

21.1.3 Guidelines for Compression

To effectively use compression for your NSS volumes, you must understand the following key concepts:

- "Some Volumes Are Not Good Candidates for Compression" on page 277
- "After It Is Set, the Compression Attribute Persists for the Life of the Volume" on page 277
- "Inactivity Determines Which Files Are Eligible for Background Compression" on page 278
- "Some Files Do Not Compress Well" on page 278
- "Decompression Activity Depends on Available Space" on page 278
- "Immediate Compression Impacts CPU Performance" on page 279
- "Files Remain Compressed during Backup and Restore" on page 279

Some Volumes Are Not Good Candidates for Compression

Compression is not recommended for the `sys:` volume. Reserve compression for user data volumes.

You cannot use compression on an NSS volume on a CD or DVD drive.

After It Is Set, the Compression Attribute Persists for the Life of the Volume

The Compression attribute for a volume can be set when you create the NSS volume, or it can be set at any time thereafter. After you set the Compression attribute for a volume, you cannot turn it off; the parameter is in effect for the life of the volume.

You can suspend the compression activity, as needed, by using the Enable File Compression parameter. This parameter suspends compression for all volumes on the server. For information, see Section 21.4, "Suspending Compression for Volumes or Files," on page 287 and Section 21.5, "Disabling Compression for a Volume," on page 287.

If you want to turn off file compression permanently, you must uncompress the data, back up the volume in its uncompressed state, then restore the uncompressed data to a new volume on which the Compression attribute is not set.

Inactivity Determines Which Files Are Eligible for Background Compression

NSS compresses files based on the interval of time that a file remains inactive. With background compression, files automatically pass in and out of their compressed state as they are unused and qualify for compression, then are accessed and uncompressed. It is not necessary to separate application files from data files for file compression. Most application files are used regularly and are not inactive long enough to qualify for compression.

Use the compression parameter named Days Untouched before Compression to set the length of the interval of inactivity. The parameter uses the date the file was last accessed for reading or writing to determine if a file is inactive, and therefore, eligible for compression.

To determine the optimal period of inactivity to use, consider the frequency of use of different types of files and your compression goals. Application files tend to be used more frequently, while user data is used less frequently. For example, the shorter the period of inactivity is, the higher the frequency of compression. The longer the period of inactivity is, the lower the frequency of compression, and the less likely it is that files are ever compressed.

If the volume is on a shared pool, its files might be queued for compression on one node, when its pool is cluster migrated or failed over to another node. The Compression Queue is non-persistent, so on the new node, the volume does not have information about the compression queue from the old node. Therefore, the files must re-qualify for compression when the Background Compression starts on the new node.

Some Files Do Not Compress Well

A file must be larger than 8 KB and smaller than 256 MB to be eligible for compression. The compression algorithm determines these limits.

To avoid the overhead of decompressing files that do not compress well, the system calculates the compressed size of a file before actually compressing it. If no disk space is saved by compression, or if the size difference does not meet the value specified by the set command's Minimum Percentage Compression Gain parameter, the file is not compressed.

NSS does not compress NSS sparse files. A sparse file contains numerous contiguous zeros that NSS stores in a special way to conserve space. A sparse file's logical size is larger than its physical disk usage. If a sparse file were compressed, it would actually consume more storage space than it normally does.

Some database files become unavailable when they are compressed, such as Sybase database files.

IMPORTANT: If you use Sybase database files in a volume, such as for ZENworks databases, do not enable compression on the volume, or mark each database file with the Don't Compress (Dc) attribute so that it is never compressed even if compression is enabled for the volume. For details, see *Technical Information Document 10075966* (http://support.novell.com/cgi-bin/search/searchtid.cgi?/10075966.htm).

Decompression Activity Depends on Available Space

Compressed files are uncompressed as they are needed, then remain uncompressed until they are inactive for a designated period. For a file to be uncompressed, there must be enough free space on the volume to accommodate the decompression process and the uncompressed file size.

Immediate Compression Impacts CPU Performance

Compression requires processor resources, memory resources, and hard disk space during the compression and decompression processes. Compression is usually a low-priority process thread because of compression's impact on performance. If you flag many large files for immediate compression during peak system usage, CPU performance might deteriorate.

You can configure the server's compression parameters to control how compression services use resources. For example, you can schedule compression to occur only during non-peak hours to free CPU resources during peak and normal hours. For information, see Section 21.2, "Configuring Compression for a Server," on page 280.

Files Remain Compressed during Backup and Restore

Novell Storage Management Services (SMS) backs up and restores compressed files in their compressed state. It does not compress uncompressed files for backup; they are stored and restored in their uncompressed state. For more information, see Section 21.11, "Backing Up Compressed Files," on page 291.

21.1.4 Factors Affecting Compression

Typically, files that have been inactive for a specified period of time set in the Days Untouched before Compression parameter are eligible for compression.

The Immediate Compression attribute for a file or directory can also be used to identify files for compression:

- Files residing in a directory marked for immediate compression
- Files residing in subdirectories of a directory marked recursively for immediate compression
- Individual files that are marked for immediate compression

Several factors prevent an uncompressed file from being compressed, even if it meets inactivity criteria:

- The file has not been inactive for a period longer than the value in Days Untouched before Compression parameter when the compression daily check begins and compares the file's time stamp to the starting time. The daily check is controlled by the Compression Daily Check Starting Hour parameter.
- The file is flagged with a Don't Compress (Dc) attribute. For information, see Section 21.7, "Configuring Compression Preferences for Directories and Files," on page 287.
- The file is an NSS sparse file, so its physical storage size is already minimized. A sparse file contains numerous contiguous zeros that NSS stores in a special way to conserve space.
- The amount of space freed by compressing a file does not meet the specified minimum reduction criteria. For example, if the Minimum Compression Percentage Gained parameter is set to 20%, a file would not be compressed if compression reduced its file size by only 10%.
- The file compression service is suspended. For information, see Section 21.4, "Suspending Compression for Volumes or Files," on page 287.
- The queue of files marked for compression is long and cannot be completed during the specified hours set aside for compression activities. For information on how to modify the Compression Daily Check Stop Hour, see Section 21.2, "Configuring Compression for a Server," on page 280.

- The volume does not contain enough space to hold both the original version and the compressed version of the file while compression occurs.
- The file has been deleted, and the Deleted File Compression Option parameter does not allow compression of deleted files. For information on how to modify this setting, see Section 21.2, "Configuring Compression for a Server," on page 280.

21.1.5 Factors Affecting Decompression

Decompression occurs as needed to support file access, but other factors affect whether the uncompressed version or compressed version of the file remains in the volume after the access. The files remain compressed in the following cases:

- The percentage of free disk space available on the volume is insufficient to allow a decompressed file to remain in its uncompressed state.
- The Convert Compressed to Uncompressed Option parameter requires that compressed files always remain compressed.
- The file was opened for the first time for viewing only and the Convert Compressed to Uncompressed Option parameter requires that the file must be opened at least twice for viewing or opened once for modification before the file remains uncompressed after access.

  Whenever you open a compressed file, NSS decompresses the file, but it keeps the compressed copy of the file while the file is open. The first time you open a compressed file for viewing only, NSS discards the decompressed copy of the file when you close the file. The compressed file remains on the system. If you open the file a second time for viewing only, the file is considered active. When you close the file, NSS keeps the uncompressed file and discards the compressed copy of the file. If you modify the file and save it, NSS saves the uncompressed file, then discards the compressed file.

21.1.6 Monitoring Compression Activity

Monitor compression activity using the `nss /compscreen` command. For instructions, see Section 21.8, "Using NSS Commands to Configure and Monitor Compression," on page 290.

21.2 Configuring Compression for a Server

The server's compression parameters govern compression behavior for all NSS volumes on your server. The server-level settings apply to all files and directories in compression-enabled NSS volumes, but some settings can be overridden by individual file or directory attributes.

Before you set parameters, make sure you understand how compression works for NSS. For information, see Section 21.1, "Understanding Compression," on page 275.

- Section 21.2.1, "Understanding Server-Level Compression Parameters," on page 280
- Section 21.2.2, "Configuring Server-Level Compression Parameters with Commands," on page 284

21.2.1 Understanding Server-Level Compression Parameters

The following table describes each compression parameter, its purpose, supported values, and default value.

Table 21-1 *Explanation of Compression Parameters*

Parameter	Description
Days Untouched Before Compression	Specifies the number of days the system waits after a file was last accessed before it is compressed. The parameter uses the date the file was last accessed for reading or writing to determine if a file is inactive, and therefore, eligible for compression. When background compression starts, it first evaluates which files meet this inactivity requirement to determine which files are to be compressed during the compression period. To effectively stop compression for a volume, set the elapsed time very high. Eventually, files are decompressed and remain uncompressed because they never cross the inactivity threshold. **Range:** 0 to 100000 **Default:** 14
Compression Daily Check Starting Hour	Specifies the hour when you want the file compressor to start scanning enabled volumes for files that need to be compressed and to compress them. If the Compression Daily Check Stop Hour parameter is the same as the Compression Daily Check Starting Hour, then the file compressor starts checking every day at the Compression Daily Starting Hour time and runs as long as necessary to finish all files that meet the compressible criteria. **Range:** 0 to 23 Hours are specified by a 24-hour clock: (0=midnight; 23=11 p.m.). **Default:** 0
Compression Daily Check Stop Hour	Specifies the hour when you want the file compressor to stop scanning enabled volumes for files that need to be compressed and to stop compressing them. **Range:** 0 to 23 Hours are specified by a 24-hour clock: (0=midnight; 23=11 p.m.). **Default:** 6

Parameter	Description
Enable File Compression	Specifies whether file compression is enabled or suspended for all volumes where the Compression attribute is enabled. After an NSS volume's Compression attribute is enabled, it cannot be turned off because the volume contains compressed files and metadata about compression. The server-level Enable File Compression parameter allows you to turn off the compression of more files on the server's compressed volumes. While file compression is suspended, files that would have been compressed are queued for compression, then are compressed only when (or if) the Enable File Compression parameter is reset to On. Files that are already compressed remain compressed, unless they are decompressed when they are opened and used. **Range:** On (default) or Off The On setting allows file compression activity to occur on volumes where the Compression attribute is enabled. It does not enable the Compression attribute on the server's volumes. The Off setting suspends compression on volumes where the Compression attribute is enabled. Immediate compression requests are queued until the value is reset to On, when the files meeting criteria are compressed. The Off setting does not disable the Compression attribute on individual volumes, and it does not prevent you from enabling the Compression attribute for a volume. **Default:** On
Minimum Compression Percentage Gain	Sets the minimum percentage a file must compress to remain in a compressed state. **Range:** 0 to 50 **Default:** 20
Maximum Concurrent Compressions	Specifies the maximum concurrent or simultaneous compressions allowed. **Range:** 1 to 8 **Default:** 2

Parameter	Description
Convert Compressed to Uncompressed Option	Specifies what the file system does with an uncompressed version of a file after the server has decompressed it. **IMPORTANT**: Before a compressed file can be opened, there must be sufficient space available on the volume for the uncompressed and compressed copies of the file to coexist while the file is open. **Range:** 0, 1 (default), or 2 0 = Always leave the file compressed. While the file is open, both the uncompressed and compressed copies of the file coexist on the volume. If the file is closed without changes, the uncompressed copy of the file is discarded. If changes are saved, the compressed copy of the file is discarded. After the modified file is closed, it is queued for immediate compression. Sufficient space must be available for both the compressed and uncompressed copies of the file to temporarily coexist on the volume in order for the compression to occur. After successful compression, the uncompressed copy of the modified file is discarded. 1 = Leave the file compressed until second access if it is read only once during the time specified by the Days Untouched Before Compression parameter. This is the default behavior for compression. While the file is open, both the uncompressed and compressed copies of the file coexist on the volume. The first time that the file is closed without changes in the specified period, the uncompressed copy of the file is discarded. The second time that the file is closed without changes in the specified period, the compressed copy of the file is discarded. If changes are saved, the compressed copy of the file is discarded. The uncompressed file remains uncompressed until it meets requirements for being compressed. 2 = Always leave the file uncompressed. While the compressed file is open, both the uncompressed and compressed copies of the file coexist on the volume. When the file is closed or when changes are saved, the compressed copy of the file is discarded. The uncompressed file remains uncompressed until it meets requirements for being compressed.
Decompress Percent Disk Space Free to Allow Commit	Specifies the percentage of free disk space required on a volume for file decompression to permanently change compressed files to decompressed. This parameter prevents newly decompressed files from filling up the volume. **Range:** 0 to 75 **Default:** 10
Decompress Free Space Warning Interval	Specifies the time between alerts when the file system is not changing compressed files to decompressed because of insufficient disk space. **Range:** 0 seconds to 29 days 15 hours 50 minutes 3.8 seconds Setting the interval to 0 turns off the alert. **Default:** 31 minutes 18.5 seconds

Parameter	Description
Deleted Files Compression Option	Specifies whether and when deleted files are compressed. **Range:** 0, 1, or 2 0 = Do not compress deleted files 1 = Compress deleted files the next day 2 = Compress deleted files immediately **Default:** 1

21.2.2 Configuring Server-Level Compression Parameters with Commands

Use the following commands to modify server-level compression parameters from the `nsscon` prompt. For details about each parameter, see Section 21.2.1, "Understanding Server-Level Compression Parameters," on page 280.

Command	Values
nss /DaysUntouchedBeforeCompression=*value*	**Range:** 0 to 100000 (in days) **Default:** 14
nss /CompressionDailyCheckStartingHour=*value*	**Range:** 0 to 23 Hours are specified by a 24-hour clock: (0=midnight; 23=11 p.m.). **Default Value:** 0
nss /CompressionDailyCheckStopHour=*value*	**Supported Values:** 0 to 23 Hours are specified by a 24-hour clock: (0=midnight; 23=11 p.m.). **Default Value:** 6

nss /(No)EnableFileCompression
To enable compression, enter
`nss /EnableFileCompression`
To disable compression, enter
`nss /NOEnableFileCompression`
	Supported Values: On (default) or Off
	Default Value: On

nss /MinimumCompressionPercentageGain=*value*	**Supported Values:** 0 to 50 **Default Value:** 20
nss /MaximumConcurrentCompressions=*value*	**Supported Values:** 1 to 8 **Default Value:** 2

Command	Values
nss /ConvertCompressedToUncompressedOption=*value*	**Supported Values:** 0, 1, or 2 0 = Always leave the file compressed 1 = Leave the file compressed until second access if it is read only once during the time specified by the Days Untouched Before Compression parameter 2 = Always leave the file decompressed **Default Value:** 1
nss /DecompressPercentDiskSpaceFreeToAllowCommit=*value*	**Supported Values:** 0 to 75 **Default Value:** 10
nss /DecompressFreeSpaceWarningInterval=*value*	**Supported Values:** 0 seconds to 29 days 15 hours 50 minutes 3.8 seconds Setting the interval to 0 turns off the alert. **Default Value:** 31 minutes 18.5 seconds
nss /DeletedFilesCompressionOption=*value*	**Supported Values:** 0, 1, or 2 0 = Do not compress deleted files 1 = Compress deleted files the next day 2 = Compress deleted files immediately **Default Value:** 1

21.3 Configuring a Volume for Compression

To use compression on a volume, set the volume's Compression attribute to On. You can set the Compression attribute when you create a new volume or enable the attribute for an existing non-compressed volume.

After you enable compression for a volume, you can suspend compression, but you cannot turn the Compression attribute off. For more information, see Section 21.4, "Suspending Compression for Volumes or Files," on page 287.

IMPORTANT: You cannot use file compression on a volume on a CD or DVD drive.

- Section 21.3.1, "Enabling Compression for a New Volume," on page 286
- Section 21.3.2, "Enabling Compression for an Existing Volume," on page 286

21.3.1 Enabling Compression for a New Volume

When you create a new volume, simply select the *Compression* check box when you set the volume's attributes. For information, see Section 18.3, "Creating Unencrypted NSS Volumes," on page 228.

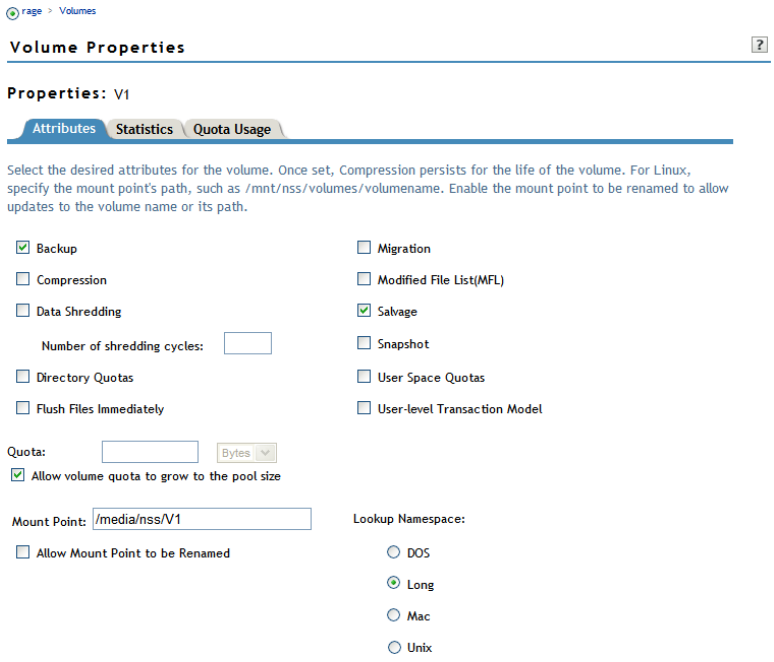
21.3.2 Enabling Compression for an Existing Volume

1. In iManager, click *Storage* > *Volumes* to open the Volumes page.

   For instructions, see Section 9.1.5, "Accessing Roles and Tasks in iManager," on page 94.
2. Select a server to manage.

   For instructions, see Section 9.1.6, "Selecting a Server to Manage," on page 95.
3. From the *Volumes* list, select the volume that you want to manage.
4. Click *Properties* > *Attributes*.

   This opens the *Volume Properties* to the *Attributes* page.



5. Select the *Compression* check box to enable file compression for the selected volume.

   IMPORTANT: After compression is enabled for a volume, you cannot deselect the *Compression* check box to turn off compression. You can suspend compression or restore uncompressed data to an uncompressed volume. For information, see Section 21.4, "Suspending Compression for Volumes or Files," on page 287 or Section 21.6, "Restoring Data to a Uncompressed Volume," on page 287.
6. Click *Apply* or *OK* to save the change, or click *Cancel* to back out of the process.

   If you click *Apply*, iManager saves the change and remains on the Volumes page. If you click *OK*, iManager saves the change and takes you to the main Storage page. If you do not click *Apply* or *OK*, the setting is not implemented; the volume remains uncompressed.

21.4 Suspending Compression for Volumes or Files

You can temporarily suspend file compression for all volumes by using the `Set` command's Enable File Compression parameter. While file compression is suspended, files that would have been compressed are queued for compression, then compressed when compression is re-enabled. For information, see Section 21.7, "Configuring Compression Preferences for Directories and Files," on page 287.

You can suspend compression for a file by setting its Don't Compress flag. For information, see Section 21.7, "Configuring Compression Preferences for Directories and Files," on page 287.

21.5 Disabling Compression for a Volume

After compression is enabled for an NSS volume, you cannot deselect the *Compression* attribute check box to turn off compression. Use one of the following methods to disable compression for a volume.

- To effectively stop compression for a volume, set the Days Untouched Before Compression parameter's elapsed time to the maximum value. Eventually, files are decompressed as they are used and remain uncompressed because they never cross the threshold for inactivity.
- Restore the data to an uncompressed volume. For information, see Section 21.6, "Restoring Data to a Uncompressed Volume," on page 287.
- Set Enable File Compression to Off. Eventually, files are decompressed as they are used and remain uncompressed.

21.6 Restoring Data to a Uncompressed Volume

1. Decompress the volume data.
2. Back up the uncompressed data.
3. Create a new volume with the Compression attribute disabled.
4. Restore the old volume contents as uncompressed data from your backup media.

21.7 Configuring Compression Preferences for Directories and Files

File and directory compression preferences override the compression settings for the volume and server.

- Section 21.7.1, "Using the Novell Client," on page 288
- Section 21.7.2, "Using ATTRIB," on page 288

21.7.1 Using the Novell Client

1. From a workstation, click the Novell Client icon (the red N in the notification area), select *Novell Map Network Drive*, then map a drive to the NSS volume by using the login and password of the Administrator user.
2. Use either of the following methods to open the *Novell Info* (*NetWare Info* in older client versions) dialog box for the file or directory you want to manage:
   - In a file manager, navigate to the directory or file you want to manage. Right-click the directory or file, select *Properties*, then select the *Novell Info* (*NetWare Info* in older client versions) tab in the *Properties* window.
   - Click the *Novell Client icon*, select *NetWare Utilities* > *Object Properties*, navigate to and select the directory or file you want to manage, click *OK*, then select the *Information* tab in the NetWare Services window.
3. Do any of the following:
   - Select its check box to enable (set) the *Don't Compress* or *Immediate Compression* attribute.
   - Deselect its check box to disable (clear) the *Don't Compress* or *Immediate Compression* attribute.
4. Click *OK* or *Apply* to accept the changes, or click *Cancel* to back out of the process.

21.7.2 Using ATTRIB

Use the ATTRIB utility at the Linux terminal console prompt to view or modify file and directory attributes for compression on NSS volumes where compression is enabled.

Syntax

`attrib [options] [filename]`

Options

If both the set and clear options are selected, the clear option is completed before the set option. If the *filename* is not specified, the operation is completed on the current directory.

Table 21-2 *Operations Options for the ATTRIB Utility*

Option	Description
-s, --set=ATTRIBUTES	Sets the attributes on the specified file or directory.
-c, --clear=[ATTRIBUTES | all]	Clears the attributes on the specified file or directory.

Compression Attributes Options

Table 21-3 *Compression Attributes Options for the ATTRIB Utility*

Attribute	Description	Applies to Files	Applies to Directories
dc	Don't 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
ic	Immediate Compression 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. The files in the specified directory are compressed as soon as the operating system can perform the operation after the file is closed. This does not apply to the directory's subdirectories and the files in them.	Yes	Yes

For example, to set the Don't Compress attribute for all files in the current directory, enter

```
attrib --set=dc
```

To clear the Immediate Compression attribute from the `/usr/course/winter/students.sxi` file, enter

```
attrib --clear=ic /usr/course/winter/students.sxi
```

Viewing Compression Status for Files and Directories

Enter `attrib` without options to show the compression attribute information for a specified file or for all files in the directory. You cannot modify Status attributes.

Table 21-4 *Compression Status for the ATTRIB Utility*

Status	Description
cc	Cannot Compress (status display only) displays if the file cannot be compressed because of limited space savings.
cm	Compressed (status display only) indicates whether the file is currently stored in compressed format.

To view the compression status of a file, enter the following at the server console:

```
attrib filename
```

Replace *filename* with the path to the file. For example, to view the attributes of the `/usr/course/winter/students.sxi` file, enter

```
attrib /usr/course/winter/students.sxi
```

To view the compression attributes of all files in the current directory, enter

```
attrib
```

21.8 Using NSS Commands to Configure and Monitor Compression

NSS offers the following commands for configuring and monitoring compression. Enter the commands from `nsscon`.

Table 21-5 *Compression Management Commands*

Command	Description
`nss /Compression=volume_name`	Enables the Compression attribute for the specified volume.
`nss /Compression=all`	Enables the Compression attribute for all volumes on the server.
`nss /StopNormalCompression`	Stops all queued compression for files, based on the compression triggered by a file open or close.
`nss /BGCompression`	Allows compression to occur in the background at any time, instead of only within specified hours.
`nss /NoBGCompression`	Stops background compression. Allow compression to occur only within the specified hours.
`nss /CompScreen`	Displays the NSS volume compression statistics on the compression screen.

21.9 Viewing Compression Statistics with the NDIR Command

The NDIR (`ndir`) command allows you to view file attributes and compression information for all files in a volume or directory. You can use NDIR for NSS volumes when NCP Server is running on the server. NDIR is an MS-DOS command that you run from a Windows desktop where you have mapped a drive letter to the network volume (or directory in a volume) that you want to manage.

Two useful statistics that NDIR provides are *Space Used By Compressed Files* and *Space Used If Files Were Not Compressed*. Subtracting one value from the other indicates how much space you need if all files are decompressed.

The following is an example report:

```
M:\>ndir /comp /vol
Statistics for fixed volume SRV1:
 Space statistics are in KB (1024 bytes).
 Total volume space: 979,628,112 100.00%
 Space used by 131,072,000 entries: 223,924,804 22.86%
 Deleted space not yet purgeable: 0 0.00%
 ------------ --------
 Space remaining on volume: 755,703,308 77.14%
 Space available to <username>: 755,703,308 77.14%
 Maximum directory entries: 2,147,483,647
 Available directory entries: 2,016,411,647 93.90%
```

```
Space used if files were not compressed: 0
Space used by compressed files: 0
-------------
Space saved by compressing files: 0 0.00%
Uncompressed space used: 223,924,804
Name spaces loaded: Long
```

To generate a report on compression statistics for the volume:

1. Make sure that NCP Server is configured and running on the server.

   The NDIR command requires the NCP protocol.

2. On your Windows desktop, open Explorer, then click *Tools* > *Map Network Drive* to map a drive letter to the NSS volume (or directory) you want to manage.

3. On your Windows desktop, click *Start* > *Run* to open an MS-DOS command window.

4. Navigate to the mapped drive using the Change Directory (`cd`) command. For example, if the mapped drive letter is `N:`, enter

   ```
   cd N:
   ```

5. Get a report on compression statistics by entering

   ```
   ndir /comp /vol
   ```

   For details about NDIR, see Section B.4, “ndir,” on page 432.

21.10 Repairing Compressed Volumes with the Compfix Utility

Use the Compfix utility to repair compression information for compressed volumes or to clear the Cannot Compress attribute for files in the compressed volume. For information, see Section B.2, “compfix,” on page 426.

21.11 Backing Up Compressed Files

When you back up a compressed volume, files are written to the backup media in compressed or uncompressed format, according to how they are currently stored. To back up compressed files in uncompressed format, you must decompress the files first, then back up the files.

When you recover a volume, the files are restored in their saved format to the destination volume. If you try to restore a compressed file to a volume without compression, the file is not readable. For information, see “Backing Up Compressed files” in the *OES 2 SP3: Storage Management Services Administration Guide for Linux*, or see your third-party backup application’s documentation.

22 Managing Space Quotas for Volumes, Directories, and Users

This section describes how to manage space quotas for volumes, directories, and users of Novell Storage Services (NSS) volumes.

- Section 22.1, “Understanding Space Quotas,” on page 293
- Section 22.2, “Managing NSS Volume Quotas,” on page 295
- Section 22.3, “Managing Directory Quotas,” on page 296
- Section 22.4, “Managing User Space Quotas,” on page 300

22.1 Understanding Space Quotas

You can control how space is allocated in an NSS pool or volume by restricting the amount of space available to a particular volume, directory, or user. These space restrictions, or quotas, work independently, with the lower value being the most restrictive if all constraints apply. NSS allocates the space as it is needed; the quota does not reserve the space.

If you set a quota to a value equal to or less than the current size of space in use for the specified volume, directory, or user, users cannot add files until enough files are deleted to free up space in the volume, directory, or user files. Users can continue to access existing files for which they are authorized users, but they cannot save them.

Quotas restrict the actual physical space that the volume, directory, or user is allowed to consume. When enforcing quotas, NSS considers only the actual physical blocks consumed (in 4 KB blocks), not the file’s logical size. If you have sparse files or compressed files, only the actual physical space they consume is counted against the quota. In order for a compressed file to be uncompressed, there must be enough space available in the most restrictive of the quotas set (whether volume, directory, or user) to accommodate the decompression process and the uncompressed file size. Otherwise, the user is not able to open the file. For more information about the space requirements for compressing and decompressing files, see Section 21.1.5, “Factors Affecting Decompression,” on page 280.

As the amount of space consumed by a user’s files approaches the user’s space quota, the user should use caution when saving files. Data loss can occur if the user attempts to save a file that is too large for the remaining unused space.

To get the correct disk utilization information, use NSSMU or `nsscon /SpaceInformation`. For NSS volume, used space = in-use space + purgeable space. If you use `df-h` command or any other non-NSS utility to get the disk utilization information, the output may confuse the user as it shows only in-use space and does not take account of purgeable space.

WARNING: If storing a file would cause a quota to be exceeded, only part of the file is actually saved, resulting in data corruption.

If the Salvage attribute is enabled for a volume, deleted files are not immediately purged from the volume. Deleted files on the volume are not counted against quotas.

Volume Quotas

When you create an NSS volume, you have the option of setting a space quota for the volume or letting it grow to the size of the pool. At any time thereafter, you can view and configure the volume quota from the *Storage* > *Volumes* > *Properties* > *Attributes* tab in iManager. For information, see Section 22.2, "Managing NSS Volume Quotas," on page 295.

If you set a volume quota to grow to the pool size, you can also add segments to the volume's pool to expand its size, and, therefore, expand the volume quota.

As a volume nears its quota, automatic controls can be configured to manage space. For information, see Section 28.3, "Monitoring Quotas and Space Usage for NSS Pools and Volumes," on page 360.

Directory Quotas

Directory quotas limit the space available in an individual NSS directory. To use directory quotas on an NSS volume, you must first enable the Directory Quotas attribute.

For information about configuring attributes when you create a volume, see "Understanding Volume Properties" on page 221.

For information about setting directory quotas, see Section 22.3, "Managing Directory Quotas," on page 296

User Space Quotas

User space restrictions limit the space available to a user of the NSS volumes across all directories and files owned by the user. For information about setting user space quotas, see Section 22.4.3, "Configuring a User Space Quota," on page 304.

You must first enable the User Space Quotas attribute on the NSS volume where you want to configure user space restrictions. You can set the attribute at any time. For information about configuring the User Space Quotas attribute for an existing volume, see "Modifying Attributes of an NSS Volume" on page 234.

Example of Directory and User Space Quotas

Quotas are beneficial for systems where you want to control how your storage resources are used. In environments such as a university, where you set up a common work area for a large number of students and you want to limit the space that directory can consume, set a Directory Quota. You might also limit the amount of space an individual user's work can consume by setting the User Quota.

For example, if a directory's quota is 500 MB and the user's quota is 1 GB, the user is limited to up to 500 MB in the specific directory. If the user can access multiple directories, each with a 500 MB quota, the maximum space the user's work can consume for all directories combined is limited to the user's 1 GB administrative limit.

22.2 Managing NSS Volume Quotas

1 In iManager, click *Storage* > *Volumes*.

For instructions, see Section 9.1.5, “Accessing Roles and Tasks in iManager,” on page 94.

2 Select a server to manage.

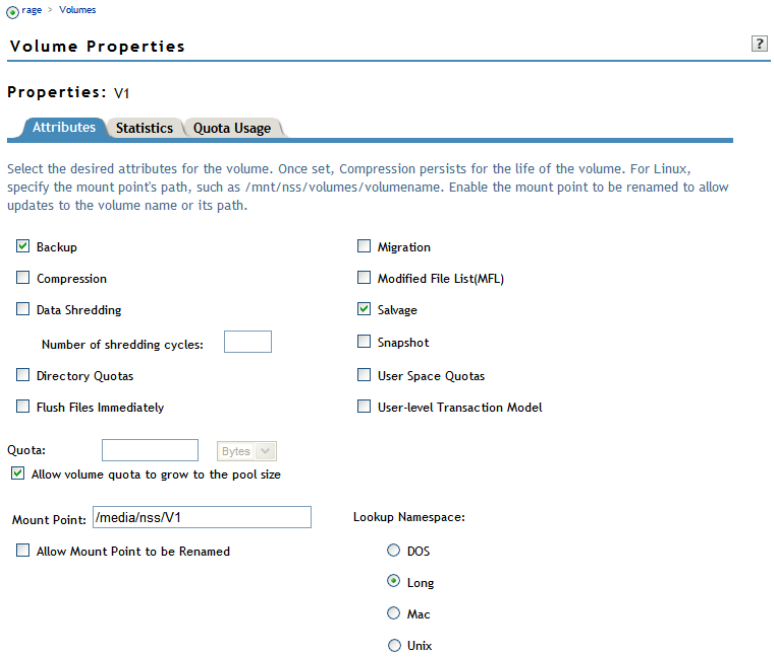
For instructions, see Section 9.1.6, “Selecting a Server to Manage,” on page 95.

A list of volumes appears in the *Volumes* list.

3 In the *Volumes* list, select a volume that you want manage.

4 Click *Properties*.

The *Properties* page has three tabs: *Attributes*, *Statistics*, and *Quota Usage*. It opens to the *Attributes* tab.



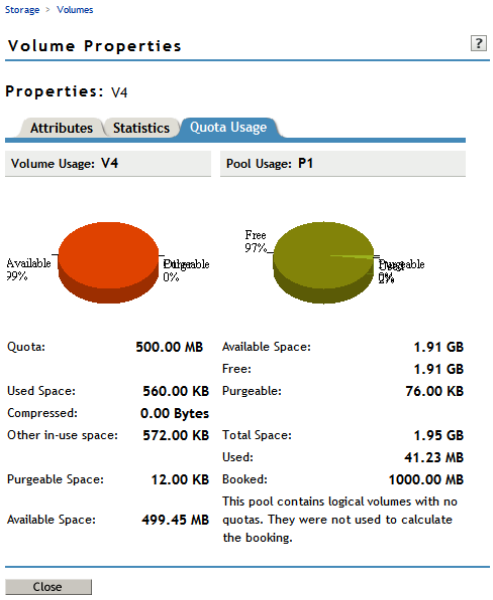
5 In the *Quota* field, do one of the following:

- **No Quota:** Select *Allow Volume Quota to Grow to the Pool Size*. NSS pools allow overbooking so the administrative sum of all volumes' quotas in a pool can exceed the physical pool quota.
- **Quota:** Deselect *Allow Volume Quota to Grow to the Pool Size*, then specify the maximum size you want to allow volume to grow. The quota cannot exceed the pool size.

  If you set the quota to a value less than the current volume size, you cannot save files to the volume until you purge some files to make room.

6 Click *Apply*.

7 Click the *Quota Usage* tab to view the volume and pool space usage for the selected volume and to verify the new setting.



22.3 Managing Directory Quotas

A directory quota limits the amount of space on a volume that can be consumed by all of the files and folders in that directory. You can specify any positive value for the quota. If the current size of the directory exceeds the specified limit, users cannot save data to the directory until space is cleared by removing files from the directory. If the specified directory quota exceeds the volume quota, the volume quota overrides the directory quota in determining whether data can be saved to the directory as data is written. Because overbooking is allowed for directory and volume quotas, the physical space limits for the pool might also prevent the directory from growing to its specified maximum. Physical space limits for the pool override the volume and directory quotas.

For example, lets assume that volume `VOL1:` has a volume quota of 50 GB in pool `POOL1`. You set the directory quota to 100 GB for directory `VOL1:\finance\sales`. Users cannot save 100 GB of files in the `sales` directory because NSS reaches the volume quota long before it reaches the directory quota. Because of overbooking, other directories are competing for the 50 GB of space in the volume, and `VOL1:` is competing for space with other volumes in `POOL1`. You might not be able to put as much as 50 GB of data in the `sales` directory.

Before you can set directory quotas, you must enable the volume's Directory Quotas attribute. As the administrator user, you can view and configure directory quotas with the Files and Folders plug-in for iManager, NetStorage, and the Novell Client.

This section describes the following:

- Section 22.3.1, "Enabling or Disabling the Directory Quotas Attribute for an NSS Volume," on page 297
- Section 22.3.2, "Configuring Directory Quotas," on page 297
- Section 22.3.3, "Removing a Directory Quota," on page 300
- Section 22.3.4, "Removing All Directory Quotas for an NSS Volume," on page 300

22.3.1 Enabling or Disabling the Directory Quotas Attribute for an NSS Volume

Before setting directory quotas on a volume, you must enable the Directory Quotas attribute for the volume. You can set the attribute at create time or at any time for an existing volume.

To set the Directory Quotas attribute for an existing volume:

1. In iManager, click *Storage* > *Volumes*.

   For instructions, see Section 9.1.5, "Accessing Roles and Tasks in iManager," on page 94.
2. Select a server to manage to view a list of NSS volumes on the server.

   For instructions, see Section 9.1.6, "Selecting a Server to Manage," on page 95.
3. In the *Volumes* list, select a volume that you want manage.

   Wait for the volume details to be displayed before you continue.
4. Click *Properties*.

   The *Properties* page has three tabs: *Attributes*, *Statistics*, and *Quota Usage*. It opens to the *Attributes* tab.
5. On the *Attributes* tab, select or deselect the *Directory Quotas* check box, then click *Apply*.
6. If you enabled or disabled the *Directory Quotas* attribute, restart NCP2NSS by entering the following at a terminal console prompt:

   ```
   /etc/init.d/ncp2nss restart
   ```

22.3.2 Configuring Directory Quotas

- "Adding or Modifying a Directory Quota with iManager" on page 297
- "Adding or Modifying a Directory Quota with Novell NetStorage" on page 298
- "Adding or Modifying Directory Quotas with the Novell Client" on page 298

Adding or Modifying a Directory Quota with iManager

1. In iManager, select *Files and Folders* > *Properties*.
2. Click the *Search* icon, then browse to locate and select the folder you want to manage on an NSS volume.
3. View the current status of the Directory Quota.

   If a Directory Quota is set, the *Restrict Size* field is selected and the *Limit* field shows the quota size in KB.

   If the Directory Quota is not set, the *Restrict Size* field is deselected and the *Limit* field is dimmed (grayed out).
4. Do one of the following:
   - **Add a Quota:** On the *Information* tab, select *Restrict Size* to enable space restrictions for the selected directory. In the *Limit* field, type the directory quota in KB. The value must be an increment of 4 KB; that is, it must be divisible by 4 with no remainder.
   - **Modify an Existing Quota:** In the *Limit* field, type the new directory quota in KB/MB/GB/TB. Select a value from the drop-down list. The value must be an increment of 4 KB; that is, it must be divisible by 4 with no remainder.

- **Remove a Quota:** On the *Information* tab, deselect *Restrict Size* to disable space restrictions for the selected directory. The *Limit* field is automatically dimmed (grayed out).

5 On the *Information* page, click *Apply* or *OK* to apply the changes.

Adding or Modifying a Directory Quota with Novell NetStorage

Using Novell NetStorage, you can manage directory quotas for directories in an NSS volume from any computer with a supported Web browser. This requires you to first configure a NetStorage server in the same context. For information, see the *OES 2 SP3: NetStorage Administration Guide*.

To create or modify NSS directory quotas with NetStorage:

1 In a Web browser, connect to NetStorage.

For information, see Section 9.4, "Novell NetStorage," on page 107.

2 Log in to NetStorage with the username and password of the Administrator user or equivalent user.

3 Navigate to the directory you want to manage.

4 Right-click the directory, then select *Properties*.

5 Click the *NetWare Info* tab.

Although the option label refers to NetWare, you can use the option for your NSS and NCP volumes on Linux.

6 Do one of the following to configure the directory quota:

- **Space Restriction:** Select *Restrict Size*, then specify the directory quota in KB. The value must be a multiple of 4.
- **No Space Restriction:** Deselect *Restrict Size* to set the directory quota to Unlimited.
- **Complete Space Restriction:** Select *Restrict Size*, then specify the directory quota as 0 KB. If the directory already contains files and subdirectories, the directory cannot grow beyond the current space consumed.

7 Click *Apply* to accept the directory quota configuration.

Adding or Modifying Directory Quotas with the Novell Client

The Novell Client for Windows 2000/XP allows the Administrator user to manage directory quotas for directories in an NSS volume from a Windows computer.

1 In the Novell Client, map a drive to the NSS directory you want to manage, or map to its parent directory.

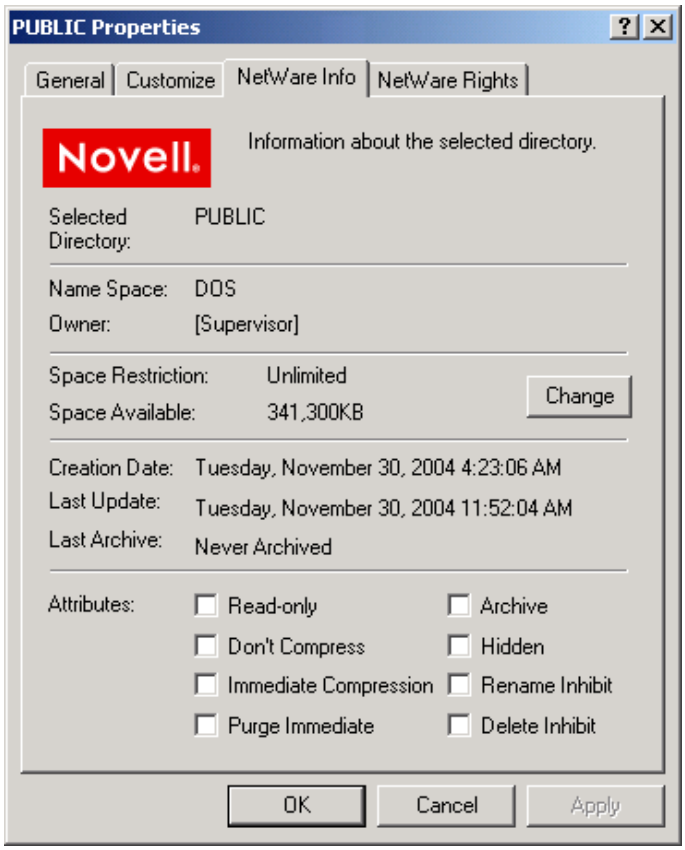
1a Right-click the *Novell Client* icon (the red N icon in the notification area), then select *Novell Map Network Drive*.

1b Specify the network path to the directory. For example: `192.168.1.1/users`.

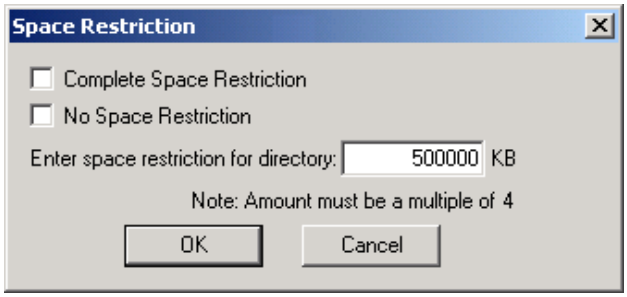
1c Specify the username of the Administrator user or equivalent user, then click *Map*.

1d When prompted, enter the user's password.

2 In a file browser, locate and right-click the directory you want to manage, then click *Properties* > *Novell Info* (*or NetWare Info* on older clients).



3 In the *Space Restriction* field, click *Change* to open the *Space Restriction* dialog box.



4 Do one of the following to configure the directory quota:

- **Space Restriction:** Specify the directory quota in KB. The value must be a multiple of 4.
- **No Space Restriction:** Select *No Space Restriction* to set the directory quota to Unlimited.
- **Complete Space Restriction:** Select *Complete Space Restriction* to set the directory quota to 0 KB. If the directory already contains files and subdirectories, the directory cannot grow beyond the current space consumed.

5 Click *OK* to accept the directory quota.

22.3.3 Removing a Directory Quota

1. In iManager, select *Files and Folders* > *Properties*.
2. Click the *Search* icon, then browse to locate and select the folder you want to manage on an NSS volume.
3. On the *Information* tab, deselect *Restrict Size* to disable space restrictions for the selected folder.
4. Click *Apply* or *OK* to apply the changes.

22.3.4 Removing All Directory Quotas for an NSS Volume

To delete the directory quotas for all directories on an NSS volume without dealing individually with each directory, you can simply disable the Directory Quotas attribute for the NSS volume.

1. In iManager, click *Storage* > *Volumes*.

   For instructions, see Section 9.1.5, "Accessing Roles and Tasks in iManager," on page 94.
2. Select a server to manage.

   For instructions, see Section 9.1.6, "Selecting a Server to Manage," on page 95.

   A list of volumes appears in the *Volumes* list.
3. In the *Volumes* list, select a volume that you want manage.
4. Click *Properties*.

   The *Properties* page has three tabs: *Attributes*, *Statistics*, and *Quota Usage*. It opens to the *Attributes* tab.
5. On the *Attributes* tab, deselect the *Directory Quotas* check box, then click *Apply*.
6. Restart NCP2NSS by entering the following at a terminal prompt:

   ```
   /etc/init.d/ncp2nss restart
   ```

22.4 Managing User Space Quotas

User space quotas are the space restrictions you optionally set for users of an NSS volume where the User Space Quotas attribute is enabled. The Users with Quotas page of the Storage plug-in reports the quota setting and space usage for each user who has space restrictions in place for a specified volume, whether the user has data stored on the volume or not.

NOTE: If the user gets deleted, it's corresponding associated files does not get deleted and the ownership does not change which may cause quota inconsistency.

This section describes the following:

- Section 22.4.1, "Setting the User Space Quotas Attribute for an NSS Volume," on page 301
- Section 22.4.2, "Viewing User Space Quotas," on page 301
- Section 22.4.3, "Configuring a User Space Quota," on page 304
- Section 22.4.4, "Modifying a User Space Quota," on page 304
- Section 22.4.5, "Deleting a User Space Quota," on page 306
- Section 22.4.6, "Configuring User Space Quotas on Volumes After Upgrading or Migrating from OES 1 Linux," on page 306

22.4.1 Setting the User Space Quotas Attribute for an NSS Volume

The administrator user can view and modify the User Space Quotas attribute at any time.

1. In iManager, click *Storage* > *Volumes*.

   For instructions, see Section 9.1.5, "Accessing Roles and Tasks in iManager," on page 94.

2. Select a server to manage to view a list of its volumes.

   For instructions, see Section 9.1.6, "Selecting a Server to Manage," on page 95.

3. In the *Volumes* list, select a volume that you want manage, then wait for the page to refresh to view its details.

4. Click *Properties*.

   The *Properties* page has three tabs: *Attributes*, *Statistics*, and *Quota Usage*. It opens to the *Attributes* tab.

5. On the *Attributes* tab, select (enable) or deselect (disable) the *User Space Quotas* check box, then click *Apply*.

22.4.2 Viewing User Space Quotas

As the Administrator user or a user with the Supervisor right for the volume can view and configure user space quotas with the Storage plug-in for iManager. Users can view their own user quotas and space usage statistics, but they cannot modify the quota settings.

The *Users with Quotas* page reports the quota setting and space usage for each user who has space restrictions in place for a specified volume, whether the user has data stored on the volume or not. The *All Users* page reports the current usage of all users on the volume who have data stored on the volume, whether the users have a quota on the volume or not.

The tracking of user space usage and quotas is an expensive operation in terms of performance. For this reason, NSS does not begin tracking user space usage until you create the first user quota on the volume. If you have never assigned a user quota to a volume, the All Users page has no information to report. After you create the first user quota on the volume, NSS begins tracking all of the user space used on the volume. From then on, the All Users page reports usage for all users with data on the volume.

The *Users with Quotas* report and *All Users* report include the following information:

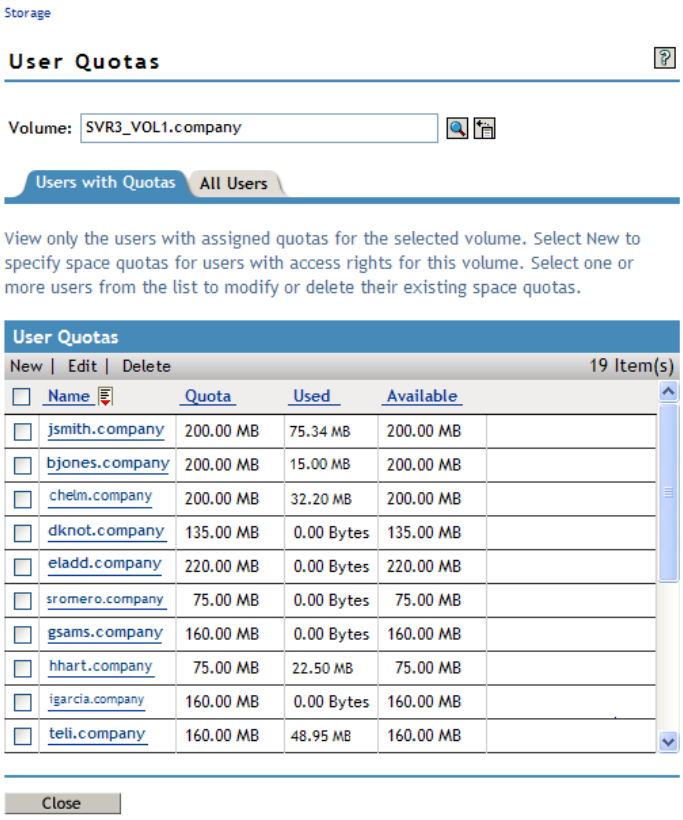
Table 22-1 *Report of User Space Quotas*

Parameter	Description
User Name	The distinguished user name. For example: userid.context, jsmith.geo.example, asantiago.example
Quota	Indicates the amount of space in MB that the user can use on the selected volume. The user's data can grow only to the size of the quota or to the amount of available physical space on the volume, whichever is less. NSS allocates space only as needed. You can set user quotas that total more than the total available space on the volume. This is called overbooking. However, you cannot set any single quota to be greater than the volume size.
Used	Reports the current amount of space used by the user's data in all directories combined on the specified volume. Reports the current amount of space used by the user's data in all directories combined on the specified volume.
Available	Reports the free, unused space within the user's quota for the specified volume. Because of overbooking, other users might be competing for a portion of this space.

Viewing User Quotas as the Administrator User

1. Log in to iManager as the Administrator user or equivalent user.
2. In iManager, click *Storage* > *User Quotas*.
3. Click the *Volume* browser, then select the volume that you want to manage.

   Wait for the page to refresh to see the user space restrictions for all users with quotas for the selected volume.



4 To view all users (with or without quotas) who have data stored on that volume, click *All Users*.

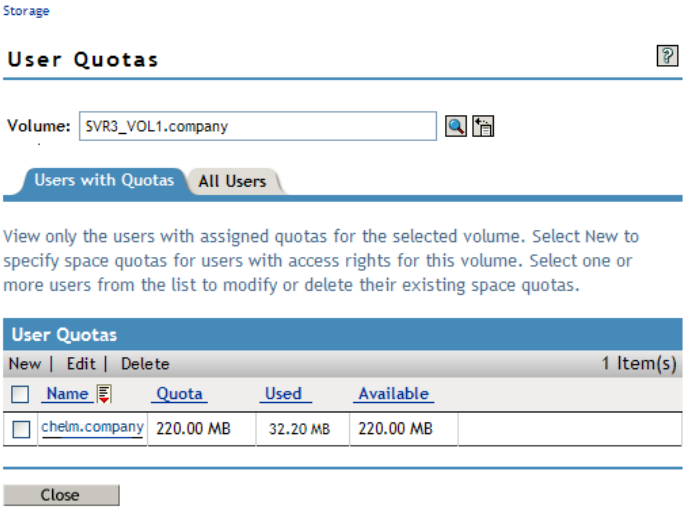
Viewing User Quotas as an Individual User

1 Log in to iManager as an individual user with your eDirectory username and password.

2 In iManager, click *Storage* > *User Quotas*.

3 Click the Volume browser, then select the volume that you want to manage.

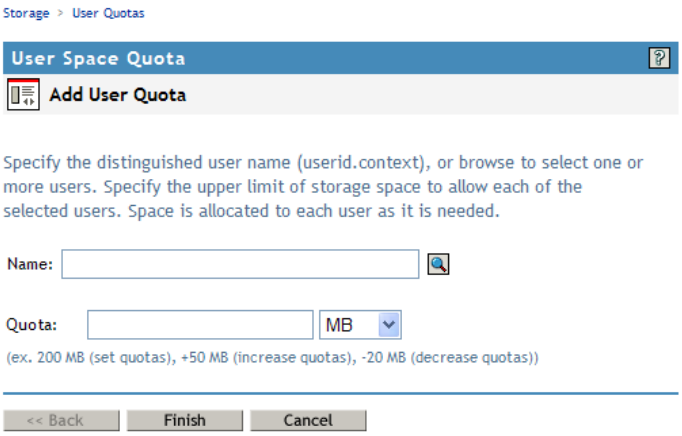
Wait for the page to refresh to see the individual user's space restrictions for the selected volume on the *Users with Quotas* page.



22.4.3 Configuring a User Space Quota

The Administrator user or equivalent user can configure the user space quota for one user or multiple users at a time.

1. In iManager, click *Storage* > *User Quotas*, then select the volume you want to manage.
2. Click *New* to open the *Add User Quota* dialog box.



3. Click the *Browse* icon to open the User object list, then browse to select one or more users who you want to share the same quota.
4. In *User Quotas*, specify the upper limit of storage space that you want to assign to each of the selected users.
5. Use the *Units* drop-down list to select the units to use for the quota you specified in Step 4. Options are bytes, kilobytes, megabytes, and gigabytes.
6. Click *Finish* to apply the quota, or click *Cancel* to back out of the transaction.

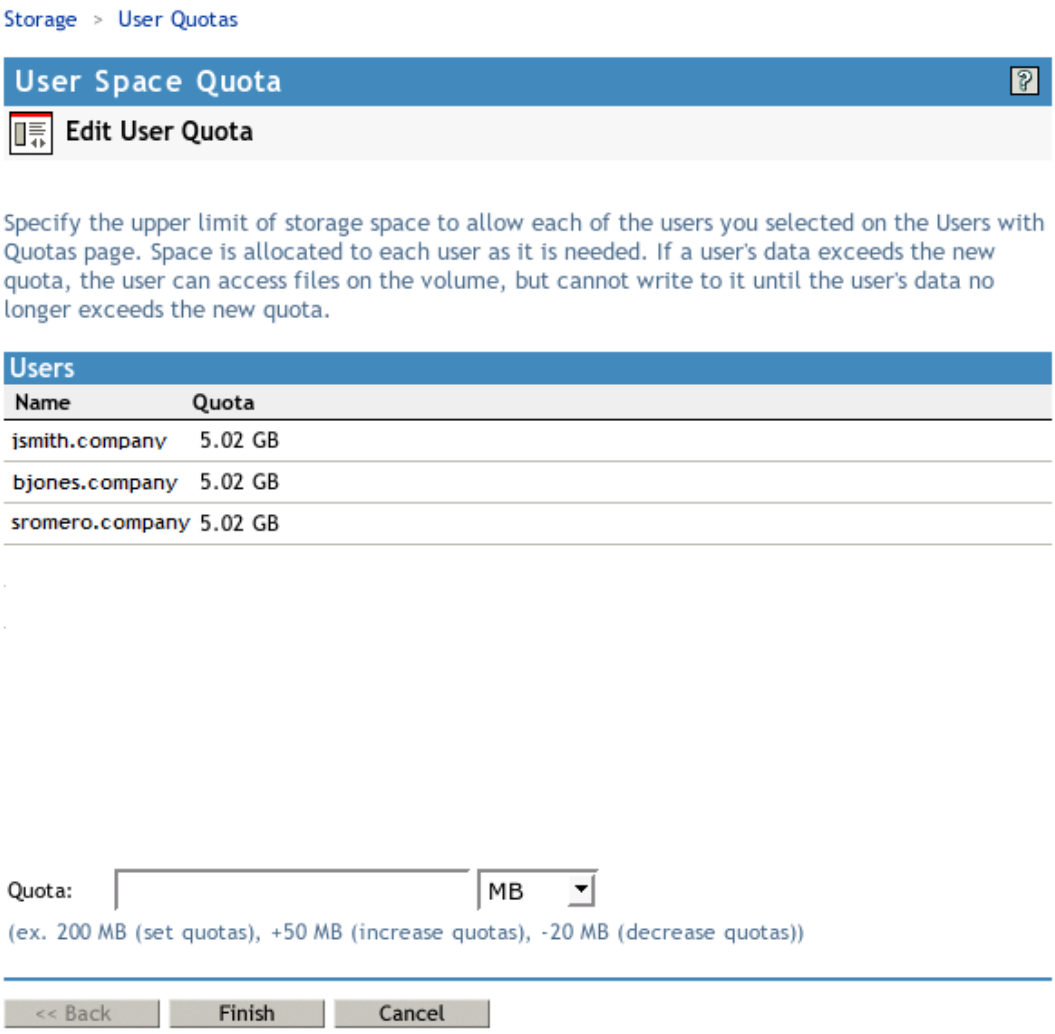
   Each of the usernames you selected now has user space quotas assigned to it.

22.4.4 Modifying a User Space Quota

The Administrator user or equivalent user can modify the quota for one user or multiple users at a time. Modify the current quotas for the selected users by setting a new quota for all users, increasing each quota by the same amount, or decreasing each quota by the same amount.

1. In iManager, click *Storage* > *Volumes*, select a server, then select the volume you want to manage.
2. Click *Quotas* > *Users with Quotas*.
3. Open the *Edit User Quotas* dialog box by doing one of the following:
   - **Single User:** Select the name link for the user.

- **Multiple Users:** Select the *User* check box next to one or more user names whose user space quota you want to delete, then click *Edit*.



4 Specify the change that you want to apply to each of the selected users by doing one of the following:

- **Modify Quota:** Specify a value to set each selected user's quota to the specified value, such as 200 MB.
- **Increase Quota:** Use a plus (+) with the value to increase each selected user's quota by that amount, such as +50 MB.

  If any individual quota or the total of all quotas exceeds the volume size, the increase is processed, because space is allocated to the users as needed, on a first-come-first-served basis.

  If you attempt to increase the quota for a user with an Unlimited quota, no changes are made for that user's quota. The setting remains Unlimited.
- **Decrease Quota:** Use a minus (-) with the value to decrease each selected user's quota by that amount, such as -20 MB.

If a reduction takes a user's quota to 0 MB, then the user is fully restricted. The user cannot add any new files no matter how many existing files are deleted. To remove the restriction, set a non-zero quota or delete the quota for the user.

If a reduction takes a user's quota to a negative value, then an error message reports the quota as an Invalid Quota. You must repeat the process to set a valid quota for the user.

5 Use the *Units* drop-down list to select the units to use for the quota you specified in Step 4. Options are bytes, kilobytes, megabytes, and gigabytes.

6 Click *Finish*.

Each of the users you selected now has the new user quota assigned to his or her individual account on this volume.

22.4.5 Deleting a User Space Quota

The Administrator user or equivalent user can delete the user space quota for one or more users. Deleting the user space quota for a user removes the space restriction for the user on the selected volume. Of course, any directory quotas or volume quotas still apply.

1 In iManager, click *Storage* > *User Quotas*, then select the volume you want to manage.

2 Select the *User* check box next to one or more user names whose user space quota you want to delete, then click *Delete*.

3 Do one of following:

- To confirm, click *Yes* to remove the quotas. The user accounts no longer have quotas assigned to them for the selected volume.
- To back out of the process, click *No*.

To remove all user space quotas on the volume at the same time, you can simply disable the User Space Quota attribute for the volume. For information about disabling the attribute, see Section 22.4.1, “Setting the User Space Quotas Attribute for an NSS Volume,” on page 301.

22.4.6 Configuring User Space Quotas on Volumes After Upgrading or Migrating from OES 1 Linux

Beginning with OES 2 Linux, file ownership is properly assigned for access via the NCP protocol whether the user is Linux-enabled or not. User quotas for NCP users no longer require that a user be Linux-enabled.

For OES 1 Linux, using user space quotas required usernames to be Linux-enabled with Linux User Management (LUM). If an NCP user was not Linux-enabled on OES 1 Linux, any files the user created were assigned as the `root` user identity (after verifying the username's trustee rights to do so, of course) instead of the actual username.

If you migrate an NSS volume where NCP users were not Linux-enabled from OES 1 Linux to OES 2 Linux, you will observe that the file ownership is now recorded as the actual user. However, existing files might still belong to the `root` user and are not counted against user space quotas.

IMPORTANT: Directories and files that were created while users were not Linux-enabled on the OES 1 Linux server are owned by the `root` user and are not counted against the user space quotas you set unless you reassign file ownership to the individual users.

1. Use one of the following tools to change ownership of any files that the user normally uses that were previously assigned to the `root` user as owner:
   - Novell Client
   - Files and Folders plug-in to iManager

You cannot use the Linux `chown` command to change the creator field for the NSS file system. It changes the root user's view of who is reported as the owner user in the Linux path, but the change has no effect on the NSS metadata. The Linux `chown` command also does not modify the owner group.

23 Salvaging and Purging Deleted Volumes, Directories, and Files

This section describes how to configure the salvage system for Novell Storage Services file systems on Novell Open Enterprise Server 2.

- Section 23.1, “Understanding the NSS Salvage System,” on page 309
- Section 23.2, “Configuring the Purge Behavior for NSS,” on page 312
- Section 23.3, “Enabling or Disabling the Salvage Attribute for an NSS Volume,” on page 315
- Section 23.4, “Viewing, Salvaging, or Purging Deleted NSS Volumes in a Pool,” on page 315
- Section 23.5, “Salvaging or Purging Deleted Files with iManager,” on page 317
- Section 23.6, “Salvaging or Purging Deleted Files with Other Tools,” on page 319

23.1 Understanding the NSS Salvage System

- Section 23.1.1, “Volume Salvage versus File Salvage,” on page 309
- Section 23.1.2, “Trustees and Rights Handling for Salvaged Data,” on page 311
- Section 23.1.3, “Understanding Purging Triggers,” on page 311

23.1.1 Volume Salvage versus File Salvage

The NSS salvage system makes it possible to retain deleted files for a specified period of time or until space is needed. The volume salvage and file salvage subsystems function separately.

For volume salvage, the NSS volumes are automatically retained on deletion. The deleted volume can be salvaged for a period of time that is determined by the server-level Logical Volume Purge Delay setting. Administrators with the Supervisor right can salvage or purge deleted volumes at any time before the purge delay elapses.

Table 23-1 describes parameters that control the volume salvage behavior for NSS volumes. The server-level settings apply to directories and files on all NSS volumes.

Table 23-1 *Volume Salvage Parameters*

Salvage Policy	Range of Influence	Refer to
Logical Volume Purge Delay	Server-level Default: 345600 seconds (4 days) The automatic purging delay applies to deleted NSS volumes.	Section 23.2.1, "Setting the Purge Delay for All Deleted Volumes," on page 312
Logical Volume Purge Delay After Continue	Server-level Default: 900 seconds Seconds to delay purging a deleted volume after a continue.	Section 23.2.1, "Setting the Purge Delay for All Deleted Volumes," on page 312
Logical Volume Purge Delay After Load	Server-level Default: 7200 seconds Seconds to delay purging a deleted volume after an NSS load if the purge delay elapses while NSS is disabled.	Section 23.2.1, "Setting the Purge Delay for All Deleted Volumes," on page 312

Auto Purging of Logical Volumes: The auto purging of logical volumes is determined by all the above mentioned volume salvage parameters. For example, you have deleted a volume and set the following parameters for auto purging:

LogicalVolumePurgeDelay: 7:24:16 p.m.

LogicalVolumePurgeAfterContinue: 7:39:06 p.m.

LogicalVolumePurgeAfterLoad: 7:20:00 p.m.

The latest time is considered for auto purging. Therefore, the volume is purged at 7:39:06 p.m.

Salvage for directories and files is controlled by each volume's Salvage attribute. You can enable the Salvage attribute when you create the volume, or modify the setting later in the volume's properties. Deleted directories and files are retained and can be salvaged until space is needed in the pool where the volume resides, as determined by the pool's available-space watermark settings. The administrator user or any user who is a trustee with the Create right can salvage deleted directories and files.

Table 23-2 describes parameters that control the file-system salvage behavior for NSS volumes.

Table 23-2 *Files Salvage Parameters*

Salvage Policy	Range of Influence	Refer to
Salvage attribute	Volume-level Default: Enabled	Section 23.3, "Enabling or Disabling the Salvage Attribute for an NSS Volume," on page 315
Immediate Purge of Deleted Files	Server-level Default: Disabled	Section 23.2.2, "Setting the Immediate Purge of Deleted Files for All NSS Volumes," on page 313
Low and High Watermarks	Pool-level Default: low 10%; high 20% Volume-level watermarks are not available.	Section 23.2.3, "Setting the Low and High Salvage Watermarks for Automatically Purging Deleted Directories and Files," on page 313
Purge Immediate file system attribute	Individual directory or file where the attribute is enabled.	Section 23.2.4, "Setting the Purge Immediate Attribute for a Directory or File," on page 315

23.1.2 Trustees and Rights Handling for Salvaged Data

When you salvage a volume, the data and metadata is exactly the same as it was at delete time, with no changes.When salvaging deleted directories or files, the content, trustees, trustee rights, and the inherited rights filters are just as they were before the file was deleted. If the rights in the tree above the salvaged file have changed, then the inherited rights for the salvaged deleted file are calculated based on the current rights above it in the directory tree.

23.1.3 Understanding Purging Triggers

Purging is triggered to begin by the following events. After the deleted data enters a Purge state by manually starting a purge or by autopurging, deleted files can no longer be salvaged (do not return to a Salvageable state), even if you pause the autopurging process.

- The Logical Volume Purge Delay setting times out for a deleted volume. Autopurging begins automatically and can take some time, depending on the size of the volume.

  The elapsed time between the delete and the purge is called the purge delay. The server-level LogicalVolumePurgeDelay parameter applies to all NSS volumes. For information, see Section 23.2.1, "Setting the Purge Delay for All Deleted Volumes," on page 312.

- The pool's Low Salvage Watermark setting is reached, indicating that the amount of free space is below the administrator-specified minimum. NSS automatically purges the deleted files and directories for all volumes in the pool with a first deleted, first purged policy until the free space reaches the high watermark, or until all of the existing deleted directories and files are purged, whichever occurs first.

  You configure thresholds for space-based purging on each pool. Low and high watermarks determine when to begin and stop automatic purging of deleted files to free up space on the pool. For information, see Section 23.2.3, "Setting the Low and High Salvage Watermarks for Automatically Purging Deleted Directories and Files," on page 313.

- A user or administrator purges the deleted file or directory.

  Deleted directories and files can be purged by the administrator user or by any user who is a trustee with the Erase right at any time before the automatic purge begins. For information, see Section 23.5.3, “Purging Deleted Files,” on page 318.

- An administrator purges the deleted volume.

  Delete volumes can be purged by the administrator with Supervisor right to the volume. For information, see Section 23.5.3, “Purging Deleted Files,” on page 318.

- Salvage is disabled at the server level for directories and files.

  Directories and files are purged immediately on deletion if the server-level ImmediatePurgeOfDeletedFiles parameter is enabled. If the Salvage attribute is enabled for a volume, this setting overrides it. For information, see Section 23.2.2, “Setting the Immediate Purge of Deleted Files for All NSS Volumes,” on page 313.

- Salvage is disabled for the individual directory or file.

  If the Salvage attribute is enabled for an NSS volume, you can set the PurgeImmediate file-system attribute on individual directories and files so that they are purged immediately on deletion. For information, see Section 23.2.4, “Setting the Purge Immediate Attribute for a Directory or File,” on page 315.

23.2 Configuring the Purge Behavior for NSS

- Section 23.2.1, “Setting the Purge Delay for All Deleted Volumes,” on page 312
- Section 23.2.2, “Setting the Immediate Purge of Deleted Files for All NSS Volumes,” on page 313
- Section 23.2.3, “Setting the Low and High Salvage Watermarks for Automatically Purging Deleted Directories and Files,” on page 313
- Section 23.2.4, “Setting the Purge Immediate Attribute for a Directory or File,” on page 315

23.2.1 Setting the Purge Delay for All Deleted Volumes

The Purge Delay setting for the NSS volume determines the amount of time (in seconds) that you can still access the deleted volume before it is removed from the system. The default value for the Purge Delay setting is 345600 seconds (4 days). The volume name is changed during delete so that a new volume with the same name can be immediately created. The management tool used to delete the volume should clean up any Novell eDirectory Storage objects at delete time. Use NSSMU or the Storage plug-in to iManager to purge or salvage the deleted volume before the Purge Delay time elapses.

To configure the Purge Delay time, enter the following at the server console:

```
nss /LogicalVolumePurgeDelay=value
```

In this command, replace *value* with the actual number of seconds to delay the purge. For example, if you want to change the Purge Delay time from the default of 4 days to 1 day, set the value to 86400 by entering:

```
nss /LogicalVolumePurgeDelay=86400
```

The Purge Delay change command is not permanent when entered from the command line. You must enter the command each time you restart the server. To make the new setting permanent, add the command to the `autoexec.ncf` file.

23.2.2 Setting the Immediate Purge of Deleted Files for All NSS Volumes

The salvage capability for directories and files can be turned on and off for NSS at the server level by using the /(No)ImmediatePurgeOfDeletedFiles flag. By default, the setting is disabled (set to NoImmediatePurgeOfDeletedFiles). You might want to enable this setting if you have Salvage enabled for multiple volumes, but want to disable salvage across all of them without separately changing the volumes' Salvage attribute settings.

This server-level salvage setting overrides the settings for the volume-level Salvage attribute. It does not affect deleted NSS volumes.

Table 23-3 *Server-Level Salvage Parameter*

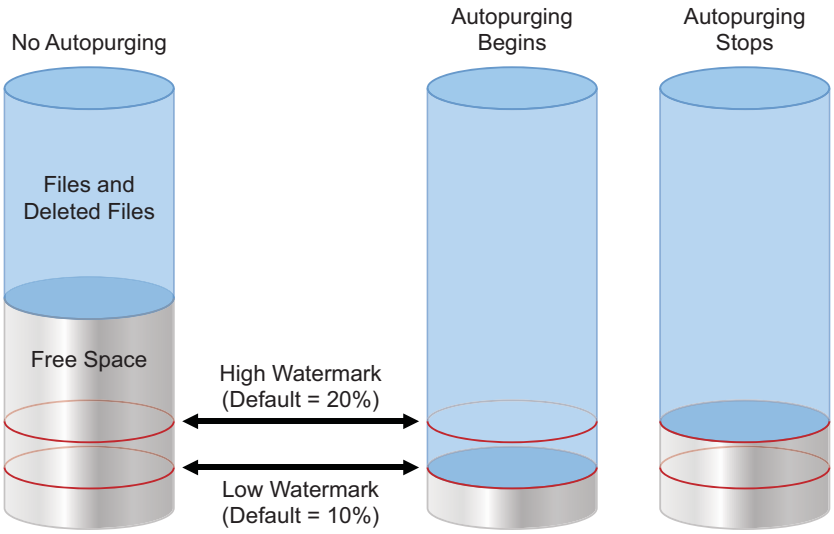
Parameter	Description
`nss /NoImmediatePurgeOfDeletedFiles`	**Supported Values:** Enabled or disabled (default)
`nss /ImmediatePurgeOfDeletedFiles`	If this parameter is enabled, it overrides the Salvage attribute setting for individual NSS volumes so that the directories and files are immediately purged on deletion.

23.2.3 Setting the Low and High Salvage Watermarks for Automatically Purging Deleted Directories and Files

Salvage watermarks are parameters associated with the salvage feature of NSS pools. Automatic purging of deleted files begins when the pool's low watermark is reached and continues until its high watermark is reached, or until all existing deleted files and directories have been purged. Files and directories are purged on a first-deleted, first-purged bases. If you have deleted volumes in the pool, any deleted files and directories that existed when the volume was deleted are considered for this space-based purge, but the deleted volume is not.

When free space in the pool falls below a low watermark, NSS begins autopurging the deleted files. When enough files are purged so that the free space increases to a percentage equal to or greater than the high watermark, the autopurge stops. The autopurge also stops before the high watermark is reached if there are no more deleted files or directories to be purged. Autopurging does not start again until free space again drops below the low watermark.

Figure 23-1 *How Autopurging Works*



The high and low watermarks can be configured only at a pool level. The default low watermark is 10% of the maximum pool size. The default high watermark is 20% of the maximum pool size. The low watermark's percentage can range from a minimum of 0% to a maximum of 98%. The high watermark's percentage can range from a minimum 2% to a maximum of 100%. The high and low watermarks must be at least 2% apart from each other.

IMPORTANT: The pool's watermark settings are enforced only at the pool level. Volume-level watermarks are not supported. The Storage plug-in to iManager displays default values for volume watermarks, but they have no effect. In order for a volume to benefit from the watermark protection, set the volume's size to grow to the size of the pool.

At the minimum setting of 0%, the low watermark activates the autopurge only when the pool is totally out of free space. If the watermark is set this low, users are likely to get out-of-space errors when they try to save files. Setting the low watermark to a percentage a little higher than 0% guarantees that autopurging begins before free space is completely used, and users are less likely to get out-of-space errors.

The low and high salvage watermarks for a pool are set on boot to the default levels. Commands to modify the watermarks can be issued from the command line or placed in a startup file. Settings in the startup file persist across server reboots. Commands issued at the command line persist until the next reboot, or until the command is issued again, whichever occurs first.

Use the following commands to configure the high and low watermarks for pools. Issue the commands in the NSS Console (`nsscon`) as the `root` user from within a terminal console.

```
nss /PoolHighWaterMark=poolname:Percent/MB/GB
```

```
nss /PoolLowWaterMark=poolname:Percent/MB/GB
```

Replace the *poolname* with the name of an individual pool or with All to set the value for all pools. For example, to set the low watermark to 5% and the high watermark to 10% for pool `p_users`, enter

```
nss /PoolHighWaterMark=p_users:10%/MB/GB
```

```
nss /PoolLowWaterMark=p_users:5%/MB/GB
```

23.2.4 Setting the Purge Immediate Attribute for a Directory or File

The Purge Immediate file-system attribute flags a directory or file to be erased from the system as soon as it is deleted. Purged directories and files cannot be recovered. When this attribute is enabled, it overrides the salvage settings at the volume and server level. When it is disabled, the server and volume salvage settings apply. In order to modify this setting, you must be the administrator user or a user who is a trustee with the Erase right.

1. In iManager, select *Files and Folders* > *Properties*.
2. Click the *Search* icon to locate and select the directory or file you want to manage.
3. Click the *Information* tab to view the properties for the selected directory or file.
4. Scroll down to view the *Attributes* section, then select the *Purge Immediate* attribute to enable the selected directory or file to be purged immediately on deletion, or deselect it to allow the salvage settings to control the fate of the deleted directory or file.
5. Click *Apply* or *OK* to save your changes.

23.3 Enabling or Disabling the Salvage Attribute for an NSS Volume

You can enable the Salvage attribute when you create the volume, or modify the setting later in the volume's properties.

1. In iManager, click *Storage* > *Volumes*.

   For instructions, see Section 9.1.5, "Accessing Roles and Tasks in iManager," on page 94.
2. Select a server to manage.

   For instructions, see Section 9.1.6, "Selecting a Server to Manage," on page 95.
3. In the *Volumes* list, select a volume that you want manage.
4. Click *Properties*.

   The Properties page has three tabs: *Attributes*, *Statistics*, and *Quota Usage*. Use the Attributes page to view or modify the attributes for the selected volume.
5. Select (enable) or deselect (disable) the Salvage attribute, then click *Apply*.

23.4 Viewing, Salvaging, or Purging Deleted NSS Volumes in a Pool

If you delete a volume, NSS removes it from the pool. During the Purge Delay (by default, four days after a volume is deleted), you can manually purge deleted volumes, view the volume contents, transfer files from the deleted volume to other volumes, or salvage the entire volume. When you salvage a volume, the data and metadata are exactly the same as they was at delete time, with no changes. After the Purge Delay time elapses, NSS automatically purges the deleted volume from the system and you can no longer access it. You can also manually purge any volumes you have deleted.

WARNING: If you delete an entire pool, all the volumes are deleted with it. You cannot restore a deleted pool or any deleted volumes in it.

You can change the Purge Delay time to extend or reduce the time for the automatic purging cycle. For information, see Section 23.2.2, “Setting the Immediate Purge of Deleted Files for All NSS Volumes,” on page 313.

The *Deleted Volumes* option on the Pools page opens a separate Deleted Volumes page where you can purge or salvage the deleted volumes for the pool. This option is only available if the selected pool has deleted volumes on it.

To manage the deleted volumes in a pool:

1. In iManager, click *Storage* > *Pools*.

   For instructions, see Section 9.1.5, “Accessing Roles and Tasks in iManager,” on page 94.

2. Select a server to manage.

   For instructions, see Section 9.1.6, “Selecting a Server to Manage,” on page 95.

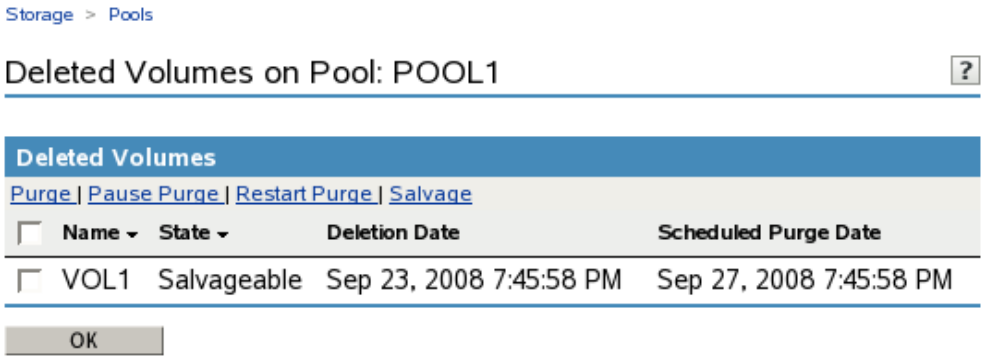
   A list of pools appears in the *Pools* list.

3. Select the pool that you want to manage.

   Wait for the page to refresh and display the details. The *Deleted Volumes* button is active only when there are deleted volumes in that list.

4. If the button is available, click *Deleted Volumes*.

   This opens the Deleted Volumes page.



5. Select a volume from the *Deleted Volumes* list.

   The browser refreshes to display details in the *Details* area.

   - **Pool:** The pool name.
   - **Volume Was Deleted:** The time stamp when the volume was deleted.
   - **Scheduled Purge Time:** The time that the Purge Delay expires for this deleted volume and the purging process is scheduled to begin.
   - **Current Deletion State:** The deletion states are salvageable, purging, or paused.

6. Select one or more volumes, then perform one or more of these actions:

   - **Purge:** Immediately begins the process of purging the selected volumes and their contents. After this option is selected, the deleted volume can no longer be salvaged (does not return to a Salvageable state). You cannot stop the purging by clicking *Pause Purge* for the autopurging process; the two options are unrelated.

- **Pause Purge/Restart Purge:** *Pause Purge* disables autopurging for the selected volumes so that purging does not begin automatically for a deleted volume when its Purge Delay time elapses. During the purge delay or while autopurging is disabled, the deleted volume is salvageable.

  Restart Purge enables autopurging for the selected volumes. The deleted volume is purged when the purge delay time elapses.

  This option does not make it possible to salvage a deleted volume that has already entered a Purge state.
- **Salvage:** Begins the restore process for deleted volumes you selected.

  If you salvage a volume, you can assign a new name to that volume, or reuse the old one if no current volume is using that name. A wizard opens to allow you to name the salvaged volume.

  The volume salvage process can slow the server response time, so you might want to do this when there is less server activity.
- **Close:** Closes the Deleted Volumes page.

23.5 Salvaging or Purging Deleted Files with iManager

As an administrator, you can use the Files and Folders plug-in to iManager to salvage or purge deleted files from an NSS volume where the Salvage attribute is enabled. When salvaging deleted files, the file content, trustees, trustee rights, and inherited rights filter are just as they were before the file was deleted. If the rights in the tree above the salvaged file have changed, then the inherited rights for the salvaged deleted file are calculated based on the current rights above it in the directory tree.

- Section 23.5.1, “Prerequisites,” on page 317
- Section 23.5.2, “Salvaging a Deleted File,” on page 318
- Section 23.5.3, “Purging Deleted Files,” on page 318

23.5.1 Prerequisites

- The NSS volume that you want to manage must be in the same tree where you are currently logged in.
- You must have trustee rights for the file that you want to manage.
- The NSS volume must be configured for salvage at the time the files, directories, or volumes are deleted in order for deleted files to be available. Enable the Salvage attribute by going to the volume’s Attributes page (*Storage* > *Volumes* > *Properties* > *Attributes*), select *Salvage*, then click *OK*.
- Deleted files are typically purged according to the Purge Delay settings on the server. When the delay time elapses, the deleted data is no longer available for salvage.
- Deleted files can be salvaged by any trustee for the file with the Create right. If another user has purged the deleted file, it is no longer available for salvage.
- Deleted files can be purged by any trustee for the file with the Erase right. If another user has purged the deleted file, it is no longer available for salvage.
- If the Purge Immediate attribute is set for a file or folder, the file or folder is immediately and permanently removed from the volume upon deletion.

23.5.2 Salvaging a Deleted File

You can salvage a deleted file and restore it to the directory from which it was deleted if you are a trustee of the file with the Create write. You can choose to overwrite any existing copies of the file in that location, or to rename the deleted file before it is salvaged. Review the guidelines in Section 23.5.1, "Prerequisites," on page 317 to understand when deleted files are available for salvage.

1. In iManager, click *Files and Folders*, then click *Deleted File* to open the Deleted File page.
2. On the Deleted File page, use one of the following methods to locate the folder on an NSS volume where the deleted file existed when it was deleted:
   - Click the *Search* icon to browse and locate the folder, then click the name link of the folder to select it.
   - Click the *History* icon to select a folder from the list of folders that you recently accessed.

   The *Deleted Files* report lists the deleted files in the folder and shows who deleted each file and when it was deleted.
3. Browse the list of deleted files to locate the version of the file you want to salvage.
4. Select the deleted file that you want to salvage, then click *Salvage*.
5. If a current file in the folder is named the same as the salvaged file, you are prompted to do one of the following:
   - Type a new name for the salvaged file, then click *OK*.
   - Click *OK* to overwrite the current file with the salvaged file.

23.5.3 Purging Deleted Files

You can purge a deleted file to remove it immediately from the volume if you are a trustee of the file with the Erase right. Purged files can no longer be salvaged. Review the guidelines in Section 23.5.1, "Prerequisites," on page 317 to understand when deleted files are available for purging.

1. In iManager, click *Files and Folders*, then click *Deleted File* to open the Deleted File page.
2. On the Deleted File page, use one of the following methods to locate the folder on an NSS volume where the deleted file existed when it was deleted:
   - Click the *Search* icon to browse and locate the folder, then click the name link of the folder to select it.
   - Click the *History* icon to select a folder from the list of folders that you recently accessed.

   The *Deleted Files* report lists the deleted files in the folder and shows who deleted each file and when it was deleted.
3. Browse the list of deleted files to locate the version of the file you want to purge.
4. Select one or more deleted files that you want to purge, then click *Purge*.

23.6 Salvaging or Purging Deleted Files with Other Tools

You can use any of the following methods to salvage or purge deleted files. To purge, the user must be a trustee of the file with the Erase right. To salvage, the user must be a trustee of the file with the Create right.

- Section 23.6.1, "Using NetStorage," on page 319
- Section 23.6.2, "Using the Novell Client," on page 319

23.6.1 Using NetStorage

Using NetStorage, the Administrator user, the Admin-equivalent user, and individual users can purge and possibly undelete NSS files that were previously deleted on the server.

1. Access NetStorage.

   For information, see Section 9.4, "Novell NetStorage," on page 107.
2. In the left column, select the directory where the deleted files were located when they were deleted.
3. Click *View*, then click *Show Deleted Files*.
4. Select the check box next to one or more files you want to undelete or purge.
5. Click *File*, then click *Undelete* or click *Purge*.

23.6.2 Using the Novell Client

Using the Novell Client for Windows 2000/XP/2003, Administrator users, Admin-equivalent users, and individual users can purge and possibly undelete NSS files that were previously deleted on the server.

1. Right-click the Novell Client icon (the red N) in the notification area to display the menu.
2. If you want to salvage a deleted file, click *Novell Utilities* > *Salvage* (or *NetWare Utilities* > *Salvage* on older client versions), browse to locate the directory where the deleted file resided, then do one of the following:
   - To restore one or more deleted files, select the deleted files, then click *Salvage File*.
   - To restore all deleted files in the directory, click *Salvage All*.
3. When you are done, click *OK*.
4. If you want to purge a deleted file, click *Novell Utilities* > *Purge* (or *NetWare Utilities* > *Purge* on older client versions), browse to locate the directory where the deleted file resided, then do one of the following:
   - To purge one or more deleted files, select the deleted files, then click *Purge File*.
   - To purge all deleted files in the directory, click *Purge All*.
   - To purge the directory's subdirectories and all deleted files in them, click *Purge Subdirectories*.
5. When you are done, click *OK*.

You can also purge deleted files on Linux from NCPCON using the command `purge volume`. For more information, see "Purging Deleted Files with NCPCON" in the *OES 2 SP3: NCP Server for Linux Administration Guide*.

24 Managing Hard Links

This section describes how to configure, create, and delete hard links on Novell Storage Services volumes on Novell Open Enterprise Server 2 server.

- Section 24.1, “Understanding Hard Links,” on page 321
- Section 24.2, “Upgrading the Media Format for Hard Links Support,” on page 325
- Section 24.3, “Enabling or Disabling the Hard Links Attribute,” on page 326
- Section 24.4, “Creating a Hard Link Using Ln on an NSS Volume,” on page 327
- Section 24.5, “Creating a Hard Link Using a zLink API,” on page 328
- Section 24.6, “Creating a Hard Link for Testing Purposes,” on page 328
- Section 24.7, “Viewing Hard Links for a File,” on page 329
- Section 24.8, “Deleting a Hard Link,” on page 330
- Section 24.9, “Deleting a Primary Link,” on page 330

24.1 Understanding Hard Links

Novell Storage Services supports zero to 65,535 hard links per file on NSS volumes. Hard link support for an NSS volume allows users to create multiple names for a single, existing file object in the same directory or in multiple directories in the same NSS volume.

IMPORTANT: Hard links to directories, data streams, and extended attributes are not allowed.

The alternate names for the file object link to the primary file inode in the NSS file system. One file can have different filenames in the same directory or multiple directories as long as all of the directories reside on the same volume. It is not possible to create hard links from different volumes and have them point to the same file.

This section describes the following:

- Section 24.1.1, “Hard Links and the Primary Link,” on page 322
- Section 24.1.2, “Hard Links and Linux Users,” on page 322
- Section 24.1.3, “Hard Links and File Ownership,” on page 322
- Section 24.1.4, “Hard Links and File System Trustees,” on page 323
- Section 24.1.5, “Hard Links and Directory Space Quotas,” on page 323
- Section 24.1.6, “Hard Links and User Space Quotas,” on page 324
- Section 24.1.7, “Hard Links and the Hard Links Attribute,” on page 324
- Section 24.1.8, “Hard Links and File Salvage and Purge,” on page 324
- Section 24.1.9, “Hard Links and DFS Move Volume,” on page 324

24.1.1 Hard Links and the Primary Link

Every file has what is considered to be the primary link, which is originally the path and filename assigned at file creation time. The primary parent directory is originally the path and directory name where the file is created. When you create hard links for the file, the file's primary link and all of its hard links share the file content by pointing to the file's inode. All links share all of the file's metadata except for name information; each link accesses only its own filename information.

When multiple hard links exist for a file, you can delete the file's primary link or its hard links, but the file's content and metadata are not deleted until the last remaining link is deleted. If you delete a hard link, the link name is deleted, not the file. If hard links exist, whenever you delete a primary link, the most recently created hard link automatically becomes the new primary link.

When the primary link is deleted and the status of primary is given to the next hard link, the following occurs:

- The file owner does not change.
- The explicitly assigned file system trustee assignments, trustee rights, and file attributes for the file do not change.
- If the new primary link is in a different directory, the file's inherited rights filter applies to the new parent directory, so effective rights for the file's trustees can change. For information, see Section 24.1.4, "Hard Links and File System Trustees," on page 323.

  IMPORTANT: Make sure to check the consequences to effective rights before deleting the primary link.

- For the directory space quota, the total disk space used by the file is reassigned from the old primary link's parent directory to the new primary link's parent directory. For information, see Section 24.1.5, "Hard Links and Directory Space Quotas," on page 323.
- For the user space quota, the total disk space used by the file continues to be associated with the file's assigned owner.

24.1.2 Hard Links and Linux Users

When hard links are used on NSS volumes on Linux, users must be Linux-enabled eDirectory users.

24.1.3 Hard Links and File Ownership

In the NSS file system, the user who creates a file is assigned as its owner at file creation time. File ownership is not affected by transferring the primary link, creating hard links, or deleting hard links. A file can have only one owner, even if has multiple hard links.

File ownership rarely, if ever, changes, but an administrator or administrator equivalent user can assign a new owner when necessary. Changing file ownership requires the Supervisor right for the primary parent directory and the file. Use whatever tools you normally use to modify the file's ownership.

NSS uses the Novell trustee model to secure access to the file, not file ownership. For information about how access control is affected by hard links, see Section 24.1.4, "Hard Links and File System Trustees," on page 323.

File ownership allows accounting of disk block usage per user and enables user space quotas to operate effectively. For information, see Section 24.1.6, “Hard Links and User Space Quotas,” on page 324.

File ownership has no affect on the directory space quotas. For information, see Section 24.1.5, “Hard Links and Directory Space Quotas,” on page 323.

24.1.4 Hard Links and File System Trustees

Explicit file system trustee assignments, trustee rights, and attributes for a file are stored in the file’s metadata where the information is shared equally by the primary link and all hard links. For users who match the trustee, the file is visible along any path of the file’s primary link and hard links. Explicit access security is enforced equally for any of these paths.

Inherited trustee assignments and trustee rights are inherited only through the primary link’s parent directory. When calculating effective rights to a file, rights are granted based on explicit rights and rights inherited from the primary link’s parent directory path.

If the primary link is deleted and reassigned, the inheritance changes to the settings of the newly assigned primary link’s parent directory.

IMPORTANT: Make sure you verify the effective rights on the new primary link whenever you delete a primary link.

24.1.5 Hard Links and Directory Space Quotas

If you set a directory space quota for a file’s primary parent directory, the file’s size is charged against the quota. All metadata increases associated with hard links are included in the file’s total disk space usage. For hard links in the primary parent directory, the file has an alternate name, but the charge for space usage is not duplicated. For hard links in other directories, quotas for their parent directories are not charged for space usage.

Whenever you delete a primary link, the most recently created hard link automatically becomes the new primary link. At that time, the file’s size is subtracted from the space usage reported on an old primary link’s parent directory and added to the space usage reported on the newly assigned primary link’s parent directory. The file’s space usage is no longer charged against the directory space quota on the old directory. If a quota is set on the new primary link’s parent directory, the file’s space usage is charged against it.

When you delete a primary link, the transfer of responsibility for space usage to the new primary parent directory is allowed even if the added file size overbooks its directory space quota. NSS allows the quota to be overbooked, and then enforces the directory quota restrictions.

IMPORTANT: Make sure you verify the directory quota on the new primary link’s parent directory whenever you delete a primary link.

24.1.6 Hard Links and User Space Quotas

User space restrictions are charged based on ownership of the file. Ownership is tracked with the user's GUID, not the username. If the username ever becomes invalid, the file continues to be charged to the GUID. In a space usage report, the value of the GUID appears in place of where the a valid username would normally be.

If other users create hard links to the file, they are not charged a quota on that file. The file size is charged to the file owner's user space quota, even if the owner no longer has the necessary rights to access the file. If hard links exist, deleting the primary link does not delete the file, and the owner continues to be responsible for the space used.

The file's users can delete the primary link and hard links to the file only in directories where they have the necessary access rights. Hard links from directories the owner cannot access causes the file to be retained, and the owner continues to be charged for its quota. The file continues to be charged against the owner's user space quota until the file itself is deleted or until the system administrator reassigns another user as the file owner.

When file ownership is changed, the new owner's user space quota is checked before the change of ownership is allowed. If the file size will overbook the user space quota, the change is not allowed.

IMPORTANT: Make sure you verify the user space quota on the new owner whenever you change ownership of a file.

24.1.7 Hard Links and the Hard Links Attribute

On Linux, hard links support is available on OES 2 Linux and later.

A media upgrade is required. For instructions, see Chapter 4, "Upgrading the NSS Media Format," on page 49.

The Hard Links attribute for the NSS volume must be enabled to allow hard links to be created. For information, see Section 24.3, "Enabling or Disabling the Hard Links Attribute," on page 326.

24.1.8 Hard Links and File Salvage and Purge

The interaction between hard links and the salvage system depends on how many links exist for a specified file. If a file has multiple links pointing to it, and one of the links is deleted, the hard link name is not added to the salvage system, and cannot be recovered later via a salvage operation. When the last and only remaining link to a file is deleted, that last name is a candidate for the salvage system. If the Salvage Files attribute is enabled on the volume, and an immediate purge is not in force, then the last link to be deleted is added into the salvage system. Under this final primary link and filename, the file can be salvaged or purged until the file is autopurged from the system.

24.1.9 Hard Links and DFS Move Volume

If you use the Novell Distributed File Services Volume Move operation to move a volume that has been upgraded to the new media format for hard links, consider the following guidelines:

- Before you create the DFS Move Volume job, make sure that NSS is set so that the new target volume is automatically created with the upgraded media format for enhanced hard links. For information and command options, see Section 4.3, "Upgrading the Media Format Automatically for New NSS Volumes," on page 53.

- If you moved the volume without enabling the new media format, you must upgrade the volume to the new media format after the move completes successfully. For information and command options, see Section 4.2, “Upgrading the Media Format for Existing NSS Volumes,” on page 51.
- In the initial release of OES 2, the Move Volume Wizard does not have an option to enable the Hard Links attribute for the new target volume. After the move is completed and the media format is upgraded for enhanced hard links support, you must manually enable the Hard Links attribute. For instructions, see Section 24.3, “Enabling or Disabling the Hard Links Attribute,” on page 326.

24.2 Upgrading the Media Format for Hard Links Support

An enhanced NSS media format is available that provides improved support for hard links. After you install or upgrade your operating system to Novell Open Enterprise Server 2, you can decide whether to upgrade the media format for your NSS volumes to use the new metadata structure; some restrictions apply. For information, see Section 4.1, “Guidelines for Upgrading the Media Format of NSS Volumes,” on page 49.

24.2.1 New Metadata Structure Supports Up to 65,535 Hard Links for a File

NSS volumes can support up to 65,535 hard links for a file, regardless of the length of the filename and the number of name spaces used. To use hard links on these operating systems, you must upgrade the NSS volume to use a new metadata structure.

24.2.2 Old Metadata Structure Supports Limited Hard Links for a File

Previously, NSS volumes support only a limited number of hard links for a file. These volumes use a metadata structure that provides limited space for the file’s filenames across all name spaces.

With the old metadata structure, the number of hard links you can use for a file depends on the length of the names you choose for a file, and how those names can be shared across the UNIX, Long, DOS, and Macintosh name spaces. It is also limited by the amount of space available in the metadata structure.

IMPORTANT: The sum total of all metadata for a file cannot exceed 2 KB. In the old metadata structure, this includes all hard link names. The longer the names are, the fewer hard links you can create.

If you reach the 2 KB metadata limit, you cannot create new hard links until you make room for them. Use any of the following methods:

- Delete one or more hard links for the file.
- Create hard links for the file with shorter names that can be stored optimally in each name space.
- Rename the original file with a shorter name that can be stored optimally in each name space.

24.3 Enabling or Disabling the Hard Links Attribute

The new media format for enhanced hard link support provides the Hard Links attribute for NSS volumes. The Hard Links attribute must be enabled in order to create and manage hard links on an NSS volume.

When you upgrade the NSS volume to use the new media format, if any old-style hard links are detected, the Hard Links attribute is automatically enabled. Otherwise, the volume is upgraded, but the Hard Links attribute is disabled. The attribute must be enabled before you can create hard links.

- Section 24.3.1, "Prerequisite," on page 326
- Section 24.3.2, "Hard Links Attribute Commands," on page 326
- Section 24.3.3, "Viewing the Hard Link Attribute Setting," on page 326

24.3.1 Prerequisite

The NSS volume must be upgraded to the new media format for enhanced hard link support. For instructions, see Chapter 4, "Upgrading the NSS Media Format," on page 49.

24.3.2 Hard Links Attribute Commands

Use the commands in this section to enable or disable the Hard Links attribute for an NSS volume. The Hard Links attribute cannot be set or viewed in NSSMU or in the Storage plug-in to iManager.

Issue the commands as the `root` user from the NSS Console (`nsscon`) in a Linux terminal console.

`nss /HardLinks=`*`volumename`*

Enables the Hard Links attribute for the specified volume. This enables hard links to be created on the volume.

`nss /HardLinks=all`

Sets the Hard Links attribute for all NSS volumes on the server. This enables hard links to be created on any volume on the server. Any given hard link can point only to a file on the same volume.

`nss /NoHardLinks=`*`volumename`*

Disables the Hard Links attribute for the specified volume. Existing hard links continue to function, but no new hard links can be created on the specified volume.

`nss /NoHardLinks=all`

Disables the Hard Links attribute for all NSS volumes on the server. Existing hard links continue to function, but no new hard links can be created on any NSS volume on the server.

24.3.3 Viewing the Hard Link Attribute Setting

The Hard Links attribute cannot be viewed in NSSMU or in the Storage plug-in to iManager. Use the `nss /volumes` command to determine whether the Hard Links attribute is set for the NSS volume. In the *Attributes* column, the Hard Links attribute is listed if the attribute is enabled.

1. Open a terminal console, then log in as the `root` user.
2. At the terminal console prompt, enter the following to start the NSS Console:

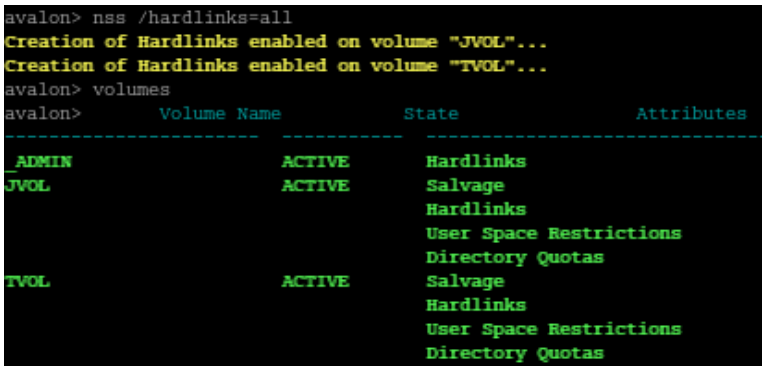
```
nsscon
```

3 At the `nsscon` prompt, enter either of the following commands:

```
nss /volumes
```

```
volumes
```

In the *Attributes* column, the Hard Links attribute is listed if the attribute is enabled.



24.4 Creating a Hard Link Using Ln on an NSS Volume

Typically, you create hard links by using clients (like NFS) that have existing commands to manipulate links. This section explains how to create a hard link in a volume by mounting the volume with NFS, then using the Link (`ln`) command to create a hard link. For help with syntax and options, refer to the Link Manual Page from a Linux client. At a terminal console, enter

```
man ln
```

Creating a hard link to a file does not copy the contents of the file to the new location; it simply makes a new name by which the file can be known, in addition to the file's existing name or names. All of the names are equally real, and no one of them is preferred to the others except regarding access control and directory space quotas. For information, see Section 24.1, "Understanding Hard Links," on page 321.

The actual content of the file is maintained in only the original file. Users in different directories can use hard links to access and share the same file. A single user can use hard links to access a file from different directories.

Prerequisites

- The NSS volume must be upgraded to use the new metadata structure. For information, see "Upgrading the NSS Media Format" on page 49.
- The Hard Links attribute must be enabled for the volume. For information, see Section 24.3, "Enabling or Disabling the Hard Links Attribute," on page 326.
- Mount the volume with NFS.

Procedure

To create a hard link, use the Link (`ln`) command from a Linux client.

1 At a terminal console, enter

```
ln /path/filename /linkpath/linkfilename
```

Replace */path/filename* with the pathname for the original file. Replace */linkpath/linkfilename* with the pathname for the hard linked filename.

For example, to link the file `/tmp/timetest` to `/usr/tmp/t1`, enter

```
ln /media/nss/VOL1/timetest /usr/media/nss/VOL1/t1
```

The file can now be referred to by either name. You can delete the original name or any link name, but the contents of the file are not removed until the final name is deleted.

24.5 Creating a Hard Link Using a zLink API

To create a hard link from an application or script, you can use a zLink API. For information, see the *NDK: File System Services (64-bit)* (http://developer.novell.com/ndk/doc/fs64/fs64_enu/data/a5p4x94.html).

You can also use the Linux `link(2)` command to create hard links from applications or scripts.

24.6 Creating a Hard Link for Testing Purposes

While working on a server, you can use the `nss /CreateHardLink` command to create hard links for testing purposes only. In a production environment, use the Link (`ln`) command from a client instead, as described in Section 24.4, "Creating a Hard Link Using Ln on an NSS Volume," on page 327.

IMPORTANT: Do not use the `nss /CreateHardLink` command in a production environment.

- Section 24.6.1, "Prerequisites," on page 328
- Section 24.6.2, "Procedure," on page 328

24.6.1 Prerequisites

- The NSS volume must be upgraded to use the new metadata structure. For information, see "Upgrading the NSS Media Format" on page 49.
- The Hard Links attribute must be enabled for the volume. For information, see Section 24.3, "Enabling or Disabling the Hard Links Attribute," on page 326.
- Hard links must be created on the same volume as the original file.

24.6.2 Procedure

To create a hard link for testing purposes on your server:

1 At the NSS Console command prompt, enter

```
nss /CreateHardLink=PrimaryFilePath|HardLinkFilePath
```

Replace *PrimaryFilePath* with the complete volume name, pathname, and filename of the primary file. Replace *HardLinkFilePath* with the complete volume name, pathname, and filename of the new hard link.

IMPORTANT: The file paths are specified using the Long name space.

For example, to create a hard link on a volume named VOL1:

```
nss /CreateHardLink=VOL1:\path\file.ext|VOL1:\newpath\newfile.ext
```

24.7 Viewing Hard Links for a File

You can view a report of hard links for a file to identify its primary link and the hard link that becomes the primary link if the primary link is deleted. The `nss /ListHardLinks` command returns a list of all hard links for a specified file, where the first link in the list is the primary link. The second link is the most recently created hard link. All other hard links follow in reverse chronological order of their create time. All links for the file are listed in the order that they appear in the metadata, which is also the order in which a new primary name would be assigned.

IMPORTANT: If the primary link is deleted, the most recently created hard link (the second link reported in the list) becomes the new primary link. Changing the primary link can impact the trustees and inheritance for the file. For more information, see Section 24.1.4, "Hard Links and File System Trustees," on page 323.

The list of hard links contains the following information for the file:

List of Hard Links	Information
Line 1 of the report	The ZID (file number) of the inode that contains the metadata for the hard link file set and the number of links associated with that inode.
Line 2 of the report	The complete name of the primary link, including the path and filename
Line 3 of the report	The complete name of the most recently created hard link name, including the path and filename. This is the next candidate in line to become the primary link if the primary link is deleted.
Lines 4 through 65,536 (up to 65,535 links per file) of the report	The complete name of each of the hard link names, including the path and filename, are listed in the reverse chronological order of their creation time.

To view information about the primary link and hard links for a file on an NSS volume:

1. Open a terminal console, then log in as the `root` user.
2. At the terminal console prompt, enter the following to open the NSS Console:

   ```
   nsscon
   ```

3. At the `nsscon` prompt, enter

   ```
   /nss /ListHardLinks=vol:path\filename.ext
   ```

   Replace *path* with the file's primary link path or one of its hard link paths where you want to start the search. Replace *`filename.ext`* with the actual filename of the file, including the extension.

24.8 Deleting a Hard Link

If multiple links exist for a file, deleting a hard link to a file deletes only the link name, not the file's contents. NSS keeps count of how many hard links a file has and does not delete the file contents until all hard link names for the file and its primary link have been deleted (the link count goes to zero).

There are no special commands required to delete a hard link. In a file manager, locate the link name to be deleted, then delete it with the delete commands and procedures native to the client you use to access the file.

24.9 Deleting a Primary Link

When multiple hard links exist for a file, deleting its primary link does not delete the content and metadata. These are deleted only when the last remaining link is deleted. While a file has multiple links, if you delete a primary link, the most recently created hard link automatically becomes the new primary link.

If the most recently created hard link is not the link you want to become the primary link, you can delete and re-create the preferred link, then delete the primary link. Make sure you do not create any other new hard links in the meantime.

Deleting a primary link has the following consequences:

- **Order of Ascendancy:** Whenever you delete a primary link for a file with hard links, the most recently created hard link automatically becomes the new primary link.

  To identify the pathname of the hard link that is next in line to become the new primary link, see Section 24.7, "Viewing Hard Links for a File," on page 329.

  For information about primary links, see Section 24.1.1, "Hard Links and the Primary Link," on page 322
- **Effective Rights for File System Trustees:** When the inherited rights filter is applied to the new primary link's parent directory, the effective rights for trustees might change.

  For information, see Section 24.1.4, "Hard Links and File System Trustees," on page 323
- **Directory Quotas:** When the new primary link is in a different directory, the directory quotas are affected for the old and new parent directories.

  For information, see Section 24.1.5, "Hard Links and Directory Space Quotas," on page 323

There are no special commands required to delete a primary link. In a file manager, locate the link name to be deleted, then delete it with delete commands and procedures native to the client you use to access the file.

25 Managing Files and Folders on NSS Volumes

This section provides an overview of how to manage files and folders as an administrator of a Novell Storage Services (NSS) volume using the Files and Folders plug-in for Novell iManager 2.7. For more information about using the Files and Folders plug-in to configure the file system trustees, trustee rights, inherited rights filters, and file and folder attributes, see Section 20.1, "Configuring File System Trustees, Trustee Rights, Inherited Rights Filters, and Attributes," on page 259.

- Section 25.1, "Creating a Folder on an NSS Volume," on page 331
- Section 25.2, "Deleting a File or Folder on an NSS Volume," on page 332
- Section 25.3, "Uploading Files to an NSS Volume," on page 333
- Section 25.4, "Downloading Files from an NSS Volume," on page 334
- Section 25.5, "Renaming a File on an NSS Volume," on page 335
- Section 25.6, "Moving a File to Different Folder on an NSS Volume," on page 335
- Section 25.7, "Viewing or Modifying File or Folder Properties," on page 336
- Section 25.8, "Viewing or Modifying File Ownership," on page 340
- Section 25.9, "Viewing, Adding, Modifying, or Removing a Directory Quota," on page 342

25.1 Creating a Folder on an NSS Volume

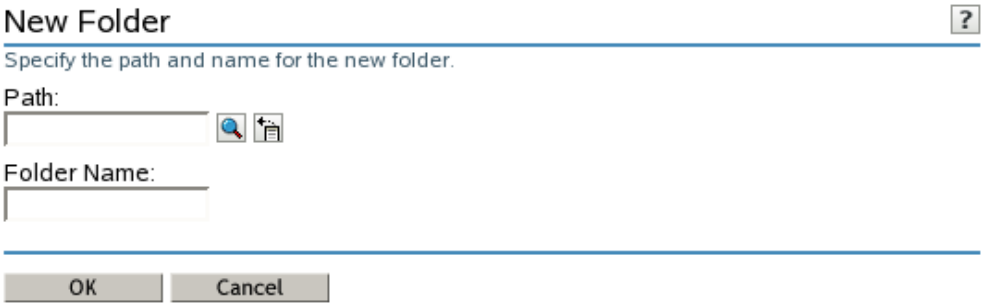
As an administrator, you can use the Files and Folders plug-in to iManager to create a folder on an NSS volume.

25.1.1 Prerequisites

- The destination NSS volume must be in the same tree where you are currently logged in to iManager.
- You must have trustee rights for the volume and destination location where you want to create the new folder. The Create right is required for creating files and folders.

25.1.2 Procedure

1 In iManager, click *Files and Folders*, then click *New Folder* to open the *New Folder* page.



2 Use one of the following methods to specify the destination path on the NSS volume where you want to create the new folder:

- Click the *Search* icon to browse and locate the destination folder, then click the name link of the folder to select it.
- Click the *History* icon to select a folder from the list of folders that you recently accessed.

The pathname of the folder appears in the *Path* field.

3 In *Folder Name*, type the name the folder you want to create in the selected location.

4 Click *OK* to create the folder, or click *Cancel* to abandon it.

A message confirms when the folder has been successfully created.

5 Click *Repeat Task* to create another folder, or click *OK* to dismiss the confirmation message.

6 Click *Files and Folders*, then click *Properties* to set file system trustees, trustee rights, and attributes for the new folder or folders.

For instructions for configuring properties, see Section 20.1, "Configuring File System Trustees, Trustee Rights, Inherited Rights Filters, and Attributes," on page 259.

25.2 Deleting a File or Folder on an NSS Volume

As an administrator, you can use the Files and Folders plug-in to iManager to delete a file or folder on an NSS volume.

25.2.1 Prerequisites

- The NSS volume must be in the same tree where you are currently logged in to iManager.
- You must have trustee rights for the file or folder that you want to delete. The Erase right is required to delete the file.

25.2.2 Procedure

1 In iManager, click *Files and Folders*, then click *Delete* to open the *Delete File or Folder* page.

2 Use one of the following methods to specify the file or folder that you want to delete from the NSS volume:

- Click the *Search* icon to browse and locate the file or folder, then click the name link of the object to select it.
- Click the *History* icon to select a file or folder from the list of files and folders that you recently accessed.

The pathname of the folder appears in the *Name* field.

3 Click *OK* to delete the selected file or folder, or click *Cancel* to abandon the delete process.

A message confirms when the file or folder has been successfully deleted.

4 Click *Repeat Task* to delete another folder, or click *OK* to dismiss the confirmation message.

25.3 Uploading Files to an NSS Volume

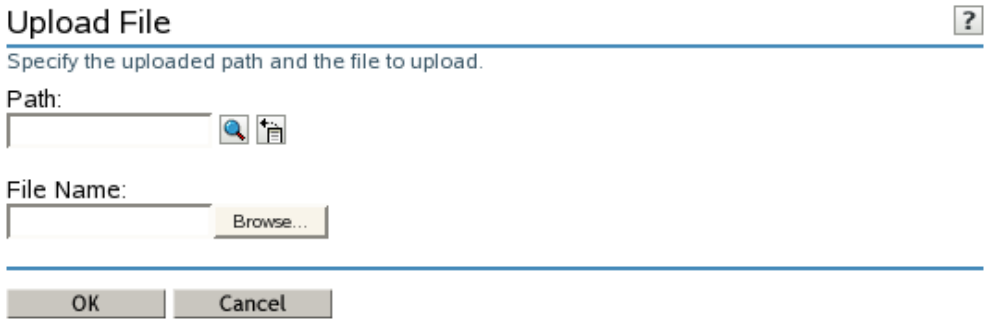
As an administrator, you can use the Files and Folders plug-in to iManager to upload files from your local computer to an existing folder on an NSS volume.

25.3.1 Prerequisites

- The destination NSS volume must be in the same tree where you are currently logged in to iManager.
- You must have trustee rights for the destination folder in order to be able to find the folder and upload the file. The Create right is required for file uploads.

25.3.2 Procedure

1 In iManager, click *Files and Folders*, then click *Upload* to open the *Upload File* page.



2 Use one of the following methods to specify the path to the folder on the NSS volume where you want to put the file:

- Click the *Search* icon to browse and locate the folder, then click the name link of the folder to select it.
- Click the *History* icon to select a folder from the list of folders that you recently accessed.

The pathname appears in the Path field.

3 Select the file on your local computer that you want to upload:

3a Click *Browse* to open a local file browser dialog box.

3b Browse and locate the file.

3c Select the file, then click *Open*.

The local pathname for the selected file appears in the *File Name* field.

4 Click *OK* to begin the upload, or click *Cancel* to abandon the process.

A message confirms when the file has been successfully uploaded. Wait until the upload completes before proceeding to other tasks.

5 Click *Repeat Task* to upload another file, or click *OK* to dismiss the confirmation message.

25.4 Downloading Files from an NSS Volume

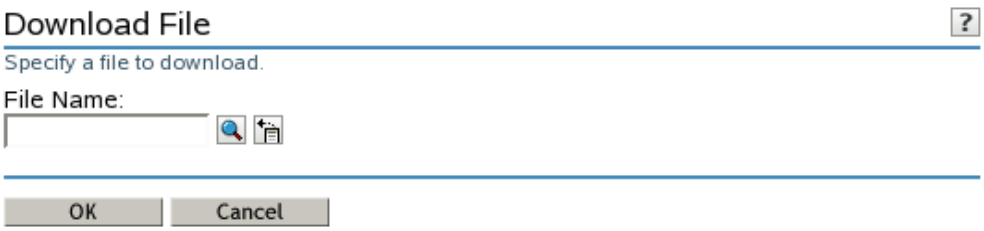
As an administrator, you can use the Files and Folders plug-in to iManager to download a file from an NSS volume to your local computer.

25.4.1 Prerequisites

- The NSS volume must be in the same tree where you are currently logged in to iManager.
- You must have trustee rights for the file in order to be able to browse to and download the file.

25.4.2 Procedure

1 In iManager, click *Files and Folders*, then click *Download* to open the *Download File* page.



2 Use one of the following methods to select the file that you want to download from the NSS volume to your local drive:

- Click the *Search* icon to browse and locate the file, then click the name link of the file to select it.
- Click the *History* icon to select a file from the list of files that you recently accessed.

The pathname appears in the *File Name* field.

3 Click *OK* to open the *File Download* dialog box.

IMPORTANT: If the File Download dialog box does not open, make sure the security settings in your browser allow downloads from the server by adding the server as a trusted site, then try again.

4 Use one of the following methods to save the file to the local computer:

- Click *Open* to view the file in an appropriate application, then save the file by using the application's *File* > *Save* options.

  The application that opens the file must already be installed on your computer.

- Click *Save* to open the *Save As* dialog box, browse to an existing folder or create a new local folder where you want to save the file, then click *Save*.

  The browser's download manager manages the download and notifies you when the download is complete.

You can continue with other iManager tasks while the file is downloading.

25.5 Renaming a File on an NSS Volume

Use this task to rename your file to a different name.

25.5.1 Prerequisites

You must have trustee rights for the file in order to be able to find the file and rename it the file. Create and modify rights are required to rename the files.

25.5.2 Procedure

1 Use one of the following methods to select the file that you want to rename:

- Click the Search icon to browse and locate the file, then click the name link of the file to select it.
- Click the History icon to select a file from the list of files that you recently accessed.

The pathname appears in the Path field.

2 Type the new name in the New name field.

3 Click OK to rename the file, or click Cancel to discard the changes.

A message confirms that the file has been successfully renamed. Wait until the rename completes before proceeding to other tasks.

25.6 Moving a File to Different Folder on an NSS Volume

Use this task to move your file to a different folder on the same NSS volume.

25.6.1 Prerequisites

You must have trustee rights for the file in order to be able to find the file and move it. Create and modify rights are required to move a file.

25.6.2 Procedure

1 Use one of the following methods to select the file that you want to move:

- Click the Search icon to browse and locate the file, then click the name link of the file to select it.
- Click the History icon to select a file from the list of folders that you recently accessed.

2 Click Browse to open a local file browser dialog box. Browse to locate and select the folder where you want to move the file, then click Open.

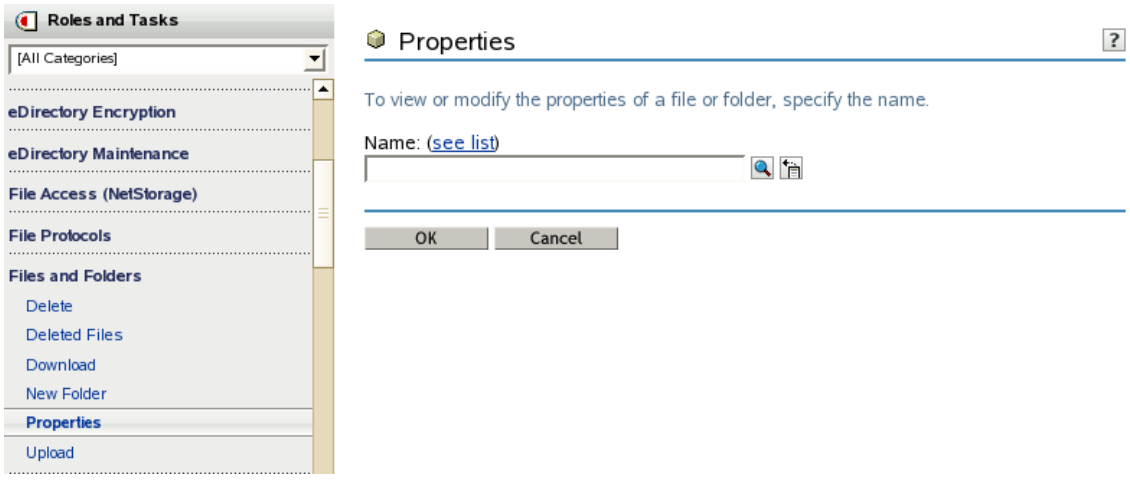
The pathname for the selected folder appears in the Folder Name field.

3 Click OK to begin the upload, or click Cancel to discard the changes.

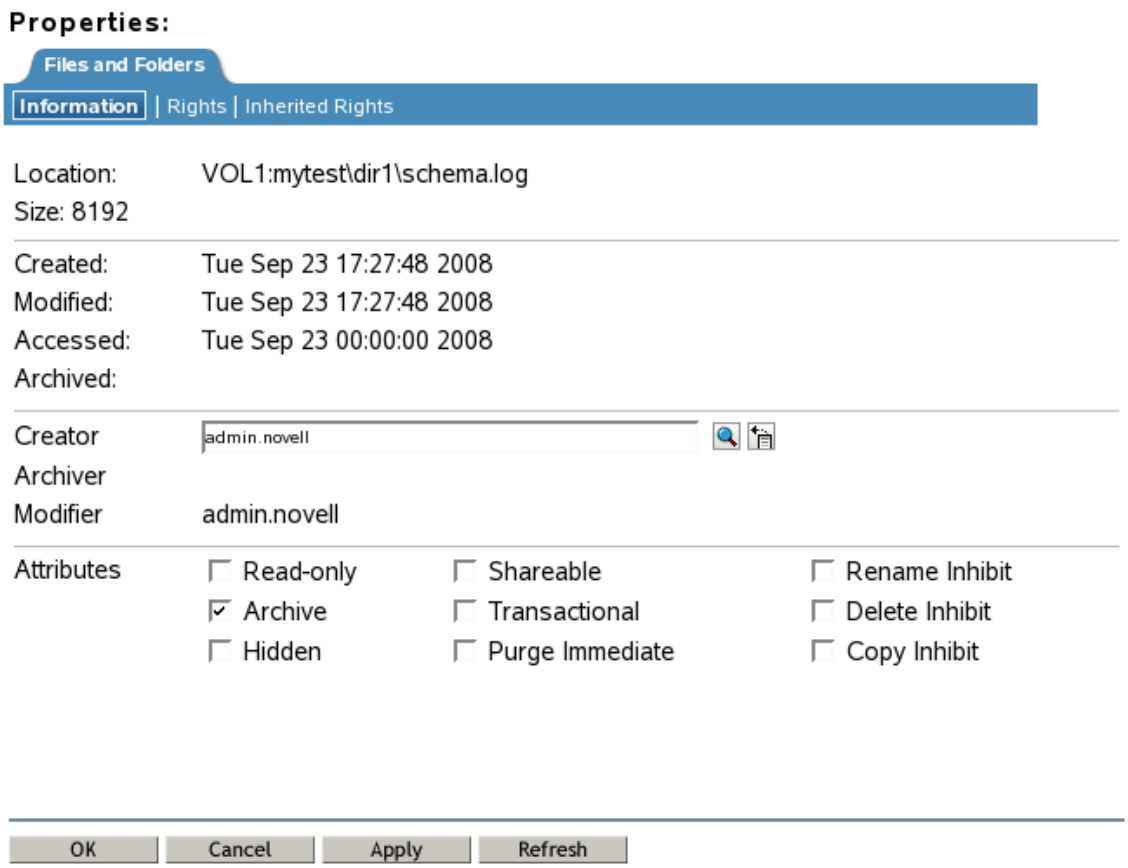
A message confirms that the file has been successfully uploaded. Wait until the upload completes before proceeding to other tasks.

25.7 Viewing or Modifying File or Folder Properties

1 In iManager, click *Files and Folders* > *Properties* to open the *Properties* page.



2 Click the *Search* icon to browse the Storage objects, locate and select the name link of the file or folder you want to manage, then click *OK* to view the Properties for the file.



3 Click the *Information* tab to view or modify the following information for the selected folder or file:

Property	Description
Location	The pathname of the selected volume, folder, or file. For example: `VOL1:dir1\dirB\filename.ext`
Restrict Size (Enable or Disable a Directory Quota on a Folder)	Enable (select) or disable (deselect) a directory quota on the specified folder on an NSS volume where the Directory Quotas attribute is enabled. The default is Disabled. If this option is enabled, you must also specify a value for the quota in the Limit field. A directory quota limits the amount of space on a volume that can be consumed by all of the files and folders in that directory. The directory quota applies to files and folders created by any user of the directory. Select *Restrict Size* to enable a directory quota for the selected folder, specify the quota value in *Limit*, then click *Apply*. Deselect *Restrict Size* to disable a directory quota for the selected folder, then click *Apply*.

Property	Description
Limit (Set Limit for a Directory Quota on a Folder)	The maximum size allowed for the specified directory and its contents. Default: Disabled (not available unless *Restrict Size* is enabled). If you enable *Restrict Size* for the selected folder, you must specify a limit for the directory quota. Type a value in KB for the quota. The value must be an increment of 4 KB; that is, it must be divisible by 4 with no remainder. Click *Apply* to save the changes. If the directory quota exceeds the volume quota, the volume quota is enforced. If the current size of the selected folder exceeds the specified limit, users cannot save data to the folder until space is cleared by removing files from it. If a user quota is set for a user on the volume, the user space restriction overrides the directory quota. That is, the user cannot save data to the folder if doing so causes the user to exceed his or her user quota.
Created	The time stamp (MM/DD/YYYY hh:mm) for when the file or folder was created.
Modified	The time stamp (MM/DD/YYYY hh:mm) for when the file or folder was last modified.
Accessed	The time stamp (MM/DD/YYYY hh:mm) for when the file or folder was last accessed.
Archived	The time stamp (MM/DD/YYYY hh:mm) for when the file or folder was last archived.
Creator (View or Modify Ownership)	The typeless distinguished Novell eDirectory username (such as username.context) of the user who created the file or folder. If the username becomes invalid, such as if an employee leaves the company, the GUID of the username is reported. For NSS, any number of files or folders can be represented by GUIDs instead of valid usernames. User quotas for NSS volumes consider file ownership to enforce user space restrictions. You might need to change the ownership of a file or folder in order to make the space it consumes be charged against a different user. For NSS volumes (as for all volumes that use the Novell trustee model of access), all access to data is controlled by file system trustees and trustee rights instead of by ownership. When a user creates a file or folder, the trustees and trustee rights for accessing the file are automatically inherited from the directory where the file is created. If you intend different trustees and rights for the file, you must assign them explicitly by user, or assign the rights to a group and put the users into that group. For instructions, see Section 20.1.4, “Configuring Rights Properties (File System Trustees, Trustee Rights, and Inherited Rights Filter),” on page 262. Changing the ownership of the file or folder does not modify who can access it, but it does modify whose username is charged for the space it consumes. If you modify the ownership, you must click Apply or OK to save the changes.
Archiver	The distinguished username (such as username.context) of the user who modified the version of the file or folder that was last archived.
Modifier	The distinguished username (such as username.context) of the user who last modified the current version of the file or folder.

Property	Description
Attributes	File attributes determine how the file or folder behaves when accessed by any user. Enable or disable an attribute by selecting or deselecting the check box next to it. If you modify a setting, click *Apply* or *OK* to save the changes. File attributes apply universally to all users. For example, a file that has a read-only attribute is read-only for all users. Attributes can be set by any trustee with the Modify right to the directory or file, and attributes stay set until they are changed. Attributes do not change when you log out or when you down a file server. For example, if a trustee with the Modify right enables the Delete Inhibit attribute for a file, no one, including the owner of the file or the network administrator, can delete the file. However, any trustee with the Modify right can disable the Delete Inhibit attribute to allow the file's deletion.

The following table defines file system attributes and whether they apply to files, folders, or both files and folders.

Attribute	Description	Files	Folders
Read Only	Prevents a file from being modified. This attribute is typically used in combination with Delete Inhibit and Rename Inhibit.	Yes	No
Archive	Identifies files and folders that have been modified since the last backup. This attribute is assigned automatically.	Yes	Yes
Hidden	Hides directories and files so they do not appear in a file manager or directory listing.	Yes	Yes
Shareable	Allows more than one user to access the file at the same time. This attribute is usually used with Read Only.	Yes	No
Transactional (NetWare)	Allows a file on an NSS volume or a NetWare Traditional volume to be tracked and protected by the Transaction Tracking System™ (TTS™) for NetWare. For NSS, the TTS attribute for the volume must be enabled in order for this setting to be enforced. TTS is not available for NSS on Linux.	Yes	No
Purge Immediate	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
Rename Inhibit	Prevents the directory or filename from being modified.	Yes	Yes
Delete Inhibit	Prevents users from deleting a directory or file. This attribute overrides the file system trustee Erase right. When Delete Inhibit is enabled, no one, including the owner and network administrator, can delete the directory or file. A trustee with the Modify right must disable this attribute to allow the directory or file to be deleted.	Yes	Yes
Copy Inhibit (NetWare)	Prevents users from copying a file. This attribute works only for clients using Macintosh operating systems to access NSS volumes on NetWare. This attribute overrides the trustee Read right and File Scan right. A trustee with the Modify right must disable this attribute to allow the file to be copied.	Yes	No

4 If you modified any settings, click *Apply* or *OK* to save your changes.

25.8 Viewing or Modifying File Ownership

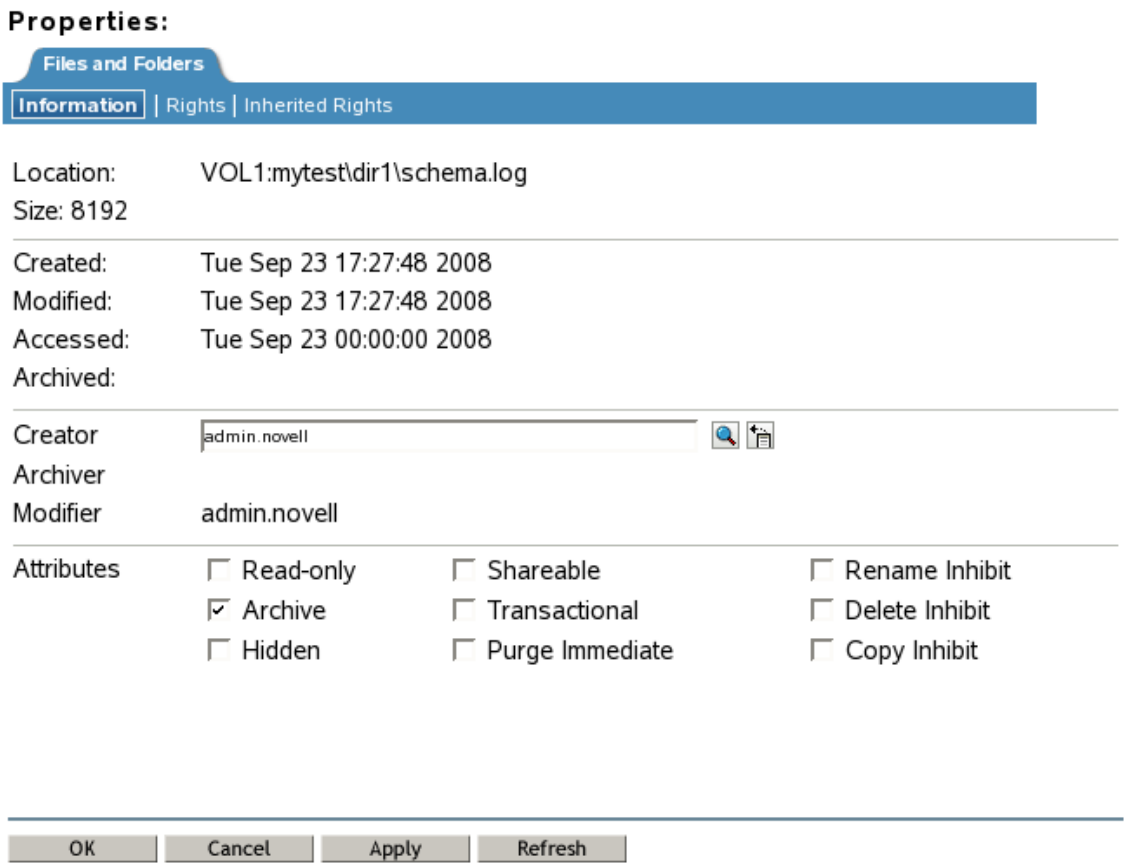
The owner of a file is assigned by default to be the identity of the user who creates the file. Ownership does not determine who can access a file because the NSS file system uses the Novell trustee model to control access. However, user quotas for NSS volumes consider file ownership to enforce user space restrictions. You might need to change the ownership of a file or folder in order to make the space it consumes be charged against a different user. Changing the ownership of the file or folder does not modify who can access it, but it does modify whose username is charged for the space it consumes.

NOTE: As an administrator you can modify the file or folder ownership.

The Creator field shows the typeless distinguished Novell eDirectory username (such as username.context) of the user who owns the file or folder. If the username becomes invalid, such as if an employee leaves the company, the GUID of the username is reported. For NSS, any number of files or folders can be represented by GUIDs instead of valid usernames.

1. In iManager, click *Files and Folders*, then click *Properties* to open the *Properties* page.
2. Click the *Search* icon to browse and locate file from the Storage objects, click the name link of the file to select it.

   The pathname of the file or folder appears in the *Name* field.
3. Click *OK* to open the file's Properties page.



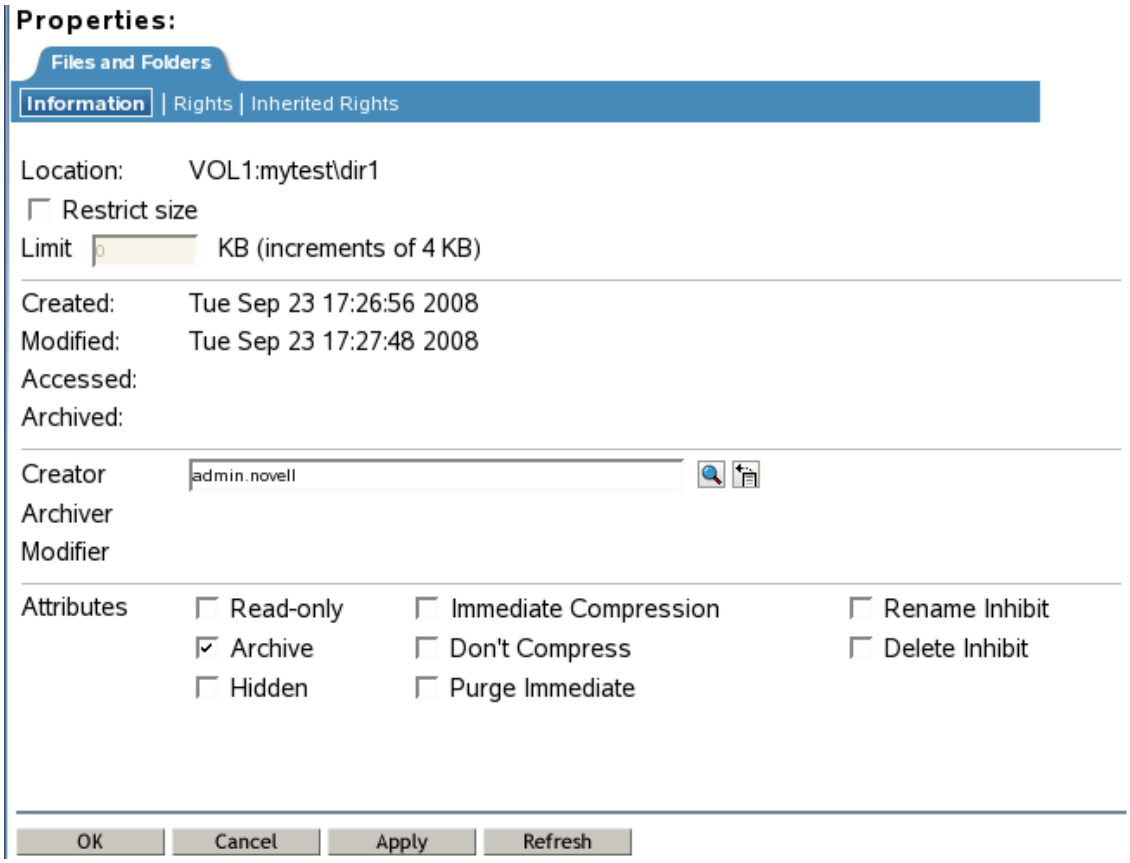
4. On the Information page, the *Creator* field shows the typeless distinguished username of the current owner, such as `username.context`.

5. If you want to modify the owner, click the *Search* icon to open the *Object Browser* dialog box, then locate and select the username of the new owner.
6. If you modified the owner, click *Apply* or *OK* on the Information page in order to save the change.

25.9 Viewing, Adding, Modifying, or Removing a Directory Quota

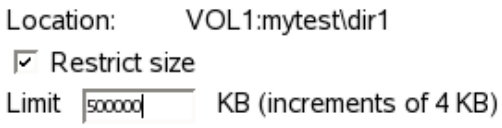
Directory quotas for NSS volumes require that the Directory Quotas attribute be set for the volume. For information, see Section 22.3.1, "Enabling or Disabling the Directory Quotas Attribute for an NSS Volume," on page 297.

1. In iManager, select *Files and Folders* > *Properties*.
2. Click the *Search* icon, browse to locate and select the folder you want to manage on an NSS volume, then click *OK* to open the Properties page for the selected folder.

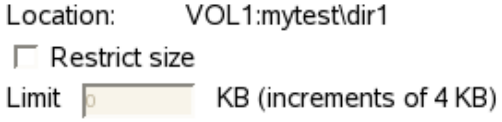


3. View the current status of the Directory Quota.

   If a Directory Quota is set, the *Restrict Size* field is selected and the *Limit* field shows the quota size in KB.



   If the Directory Quota is not set, the *Restrict Size* field is deselected and the *Limit* field is dimmed (grayed out).



4 Do one of the following:

- **Add a Quota:** On the *Information* tab, select *Restrict Size* to enable space restrictions for the selected directory. In the *Limit* field, type the directory quota in KB. The value must be an increment of 4 KB; that is, it must be divisible by 4 with no remainder.
- **Modify an Existing Quota:** In the *Limit* field, type the new directory quota in KB. The value must be an increment of 4 KB; that is, it must be divisible by 4 with no remainder.
- **Remove a Quota:** On the *Information* tab, deselect *Restrict Size* to disable space restrictions for the selected directory. The *Limit* field is automatically dimmed (grayed out).

5 On the *Information* page, click *Apply* or *OK* to apply the changes.

26 Managing Backup and Restore for Data and Trustee Information

This section describes your backup and restore options for data and trustee information for Novell Storage Services volumes on Novell Open Enterprise Server 2.

- Section 26.1, “Using Novell Storage Management Services,” on page 345
- Section 26.2, “Using the Event File List to Refine the Backup,” on page 346
- Section 26.3, “Using METAMIG to Save and Restore Trustee Information on NSS and Linux POSIX File Systems,” on page 346
- Section 26.4, “Using Extended Attributes (xAttr) Commands,” on page 346
- Section 26.5, “Backing Up Files Without Altering the Access Time,” on page 348
- Section 26.6, “Additional Information,” on page 348

26.1 Using Novell Storage Management Services

Novell Storage Management Services (SMS) provide backup, restore, and data migration services for NSS volumes. For information, see the following:

- *OES 2 SP3: Storage Management Services Administration Guide for Linux*
- *NW 6.5 SP8: SBCON Administration Guide*
- *NBACKUP Utility for OES Linux* (`nbackup(1)`) (http://www.novell.com/documentation/oes/smsadmin/data/nbackup.1.html). The `nbackup` utility is included in the `novell-sms` RPM file under `/opt/novell/sms/bin`. It can be used to back up and restore NSS and non-NSS volumes by using the SMS framework. It backs up and restores NSS metadata, which includes file system trustees and trustee rights information. Trustees on NSS volumes are tied to Novell eDirectory users and objects, so you need to protect eDirectory in addition to backing up data. The man page for `nbackup` provides further details on its usage.

  Related utilities and configuration files include the following:

  - `smdrd(8)` (http://www.novell.com/documentation/oes/smsadmin/data/smdrd.8.html)
  - `smdrd.conf(5)` (http://www.novell.com/documentation/oes/smsadmin/data/smdrd.conf.5.html)
  - `sms(7)` (http://www.novell.com/documentation/oes/smsadmin/data/sms.7.html)
  - `smsconfig(1)` (http://www.novell.com/documentation/oes/smsadmin/data/smsconfig.1.html)
  - `tsafs(1)` (http://www.novell.com/documentation/oes/smsadmin/data/tsafs.1.html)
  - `tsafs.conf(5)` (http://www.novell.com/documentation/oes/smsadmin/data/tsafs.conf.5.html)

Encrypted NSS volumes store user data in encrypted format on the NSS volume, yet work transparently with most applications, NLM programs, and backup utilities that currently work with NSS.

SMS backs up and restores compressed files in their compressed state. It does not compress uncompressed files for backup; they are stored and restored in their uncompressed state.

26.2 Using the Event File List to Refine the Backup

NSS uses the Event File List (EFL) feature to track files that have changed on a volume during an interval called an *epoch*. It logs changes that are made to data and metadata for each active epoch on a specific NSS volume in the `_admin:manage_nss\volume\volumename\FileEvents.xml` file.

Your backup solution can take advantage of this file in order to get a list of modified files for NSS volumes. You can use the API commands in scripts to start and stop an epoch, reset the event list for an epoch, and to affect how long epochs are retained.

For information about the Event File List (EFL) APIs for developers, see "FileEvent.xml Definitions" (http://developer.novell.com/documentation/vfs/vfs__enu/data/ak7gh2x.html) in *NDK: Virtual File Services (http://developer.novell.com/documentation/vfs/vfs__enu/data/bktitle.html)*.

See Cool Tools (search for EFL) (http://www.novell.com/communities/search/node/EFL) on the Novell Cool Solutions Web site for scripts that use the Event File List APIs.

26.3 Using METAMIG to Save and Restore Trustee Information on NSS and Linux POSIX File Systems

The `metamig` utility allows you to save and restore trustee information for NSS volumes. You can also restore trustee information for any NCP volume that was backed up as raw data with a third-party backup application. For information, see Section B.3, "metamig," on page 429.

For OES Linux, the NCP Server allows you to create NCP volumes for Linux POSIX file systems. NSS volumes are NCP volumes by default. You can assign trustees and trustee rights for NCP volumes based on Linux POSIX file systems just as you do for NSS volumes. The trustee information is located in a hidden file on the volume rather than being integrated in the volume. When you use a third-party backup application to backup files as raw data, the trustee file is also backed up as raw data. You can use the `metamig -ncp` option to restore trustee information for NCP volumes on OES Linux that use the NSS file system or Linux POSIX file systems.

For information about creating NCP volumes, see "Managing NCP Volumes" in the *OES 2 SP3: NCP Server for Linux Administration Guide*.

26.4 Using Extended Attributes (xAttr) Commands

In OES SP2 and later, NSS supports the Linux extended attributes (XAttr) option that allows listing, saving, and restoring the trustee information that is stored in the `netware.metadata` extended attribute. Third-party backup software that supports the standard Linux Extended Attributes (xattr) can use this feature for NSS volumes to preserve trustees, trustee rights, file attributes, and quotas in backup and restore.

Support for Linux `xattr` is disabled by default. It is necessary to set the following NSS switches to enable this behavior:

```
nss /ListXattrNWMetadata
nss /CtimeIsMetadataModTime
```

If you issue the commands from the command line, the support is automatically disabled at the next server reboot. You can enable the support for Linux `xattr` across server reboots by adding the switches to the `/etc/opt/novell/nss/nssstart.cfg` file.

- Section 26.4.1, "Enabling NSS Support for Linux xAttr," on page 347
- Section 26.4.2, "Disabling NSS Support for Linux xAttr," on page 347
- Section 26.4.3, "Additional Information," on page 348

26.4.1 Enabling NSS Support for Linux xAttr

- "Using NSSCON" on page 347
- "Using the nssstart.cfg File" on page 347

Using NSSCON

To enable support for Linux `xattr` from NSSCON:

1. Open a Linux terminal console, then log in as the `root` user.
2. Start NSSCON by entering the following at the console prompt:

   ```
   nsscon
   ```

3. To enable the Linux `xattr` support for all NSS volumes on the server, enter

   ```
   nss /ListXattrNWMetadata
   nss /CtimeIsMetadataModTime
   ```

   The commands are enabled until the next server reboot. You can also issue commands that disable the support.

Using the nssstart.cfg File

You can enable the support for Linux `xattr` across server reboots by adding the following lines to the `/etc/opt/novell/nss/nssstart.cfg` file:

```
/ListXattrNWMetadata
/CtimeIsMetadataModTime
```

Make sure the switches are spelled correctly, and do not have spaces after the forward slash (`/`). If the switch names are entered incorrectly in the `nssstart.cfg` file, parsing errors can prevent the NSS pool from mounting.

26.4.2 Disabling NSS Support for Linux xAttr

- "Using NSSCON" on page 348
- "Using the nssstart.cfg File" on page 348

Using NSSCON

To disable support for Linux `xattr` from NSSCON:

1. Open a Linux terminal console, then log in as the `root` user.
2. Start NSSCON by entering the following at the console prompt:

   ```
   nsscon
   ```

3. To disable the Linux `xattr` support for all NSS volumes on the server, enter

   ```
   nss /noListXattrNWMetadata
   nss /noCtimeIsMetadataModTime
   ```

Using the nssstart.cfg File

If you added the switches to the `/etc/opt/novell/nss/nssstart.cfg` file, and you want the support for Linux xattr to be automatically disabled after a server reboot, remove the switches from the file. When the server reboots, the Linux xattr support is disabled, which is the default behavior.

26.4.3 Additional Information

For information, see Section A.10, “Extended Attributes (XAttr) Commands,” on page 397.

26.5 Backing Up Files Without Altering the Access Time

You can set the `noatime` option to control whether the access time is updated when reading files and directories.

In OES 2 SP1 Linux, NSS provides the `/atime` and `/noatime` options for Linux. For information, see Section A.22, “noatime and atime Commands,” on page 407.

In OES SP2 and later, NSS provides `noatime` and `nodiratime` support for the Linux `open(2)` API command, `mount` command, and the `/etc/fstab` configuration file. Backup applications can take advantage of this option to back up a file without altering its access time. For information, see Section A.23, “noatime and nodiratime Support for Linux open, mount, nfsmount, and /etc/fstab,” on page 408.

26.6 Additional Information

For a current list of backup software vendors that support Novell Open Enterprise Server, see *Novell Open Enterprise Server Partner Support: Backup and Antivirus Support* (http://www.novell.com/products/openenterpriseserver/partners/). This list is updated quarterly.

27 Tuning NSS Performance on Linux

This section describes how to tune the Novell Storage Services cache buffers to improve performance on a Novell Open Enterprise Server 2 Linux server.

- Section 27.1, “Do I Need to Tune NSS?,” on page 349
- Section 27.2, “Tuning Cache Buffers for NSS on Linux,” on page 349
- Section 27.3, “Configuring or Tuning Group I/O,” on page 352

27.1 Do I Need to Tune NSS?

There are many factors that contribute to decreasing server performance; however, if your server is performing poorly and you suspect the storage subsystem (NSS), you can monitor the storage subsystem by using specific NSS command line options. These options help you determine if any tuning is required. For more information, see Appendix A, “NSS Commands,” on page 387.

27.2 Tuning Cache Buffers for NSS on Linux

- Section 27.2.1, “Understanding How NSS Uses Cache on Linux,” on page 349
- Section 27.2.2, “Setting the Minimum Number of Cache Buffers to Use for Kernel Memory,” on page 350
- Section 27.2.3, “Configuring High Memory Cache,” on page 350
- Section 27.2.4, “Setting the Name Cache Size,” on page 352

27.2.1 Understanding How NSS Uses Cache on Linux

NSS manages cache buffers on Linux using methods similar to those used in other Linux file systems such as Reiser, Polyserve, and XFS, with the exception of EXT.

For file data, NSS uses the Linux cache page manager to gain access to available memory in the system. There are some limits in place so that when copying large files, NSS does not starve other user applications for memory. This is similar to the cache handling used in NetWare.

For metadata, NSS uses kernel memory. NSS can use only a percentage of this space because other applications share this space. By default, NSS reserves a minimum buffer cache size of 30,000 4-KB buffers, which is about 120 MB of the kernel memory space. You can adjust the minimum number of buffers to be used by NSS with the MinBufferCacheSize parameter.

For a 32-bit machine, the kernel cache memory limit is 1 GB cache. Depending on what else is running, you might need to modify how much space you allocate for NSS.

For example, when running `ravsui(8)` for a pool verify or a pool rebuild, the utility needs contiguous space in kernel memory separate from the space allocated to the core NSS process. The larger the pool, the larger the space that is needed. On a 32-bit machine with a 1 GB limit, you might need to stop other processes temporarily to free up space so that the verify or rebuild process can run. You can optionally modify the amount of space used by the core NSS process by lowering the setting for MinBufferCacheSize to as little as 10000 4-KB buffers. When the verify or rebuild is done, you can change the setting back to its normal setting.

27.2.2 Setting the Minimum Number of Cache Buffers to Use for Kernel Memory

1. Open a terminal console as the `root` user.
2. Start `nsscon(8)`. At the console prompt, enter

   ```
   nsscon
   ```

3. Set the minimum number of cache buffers used by NSS on Linux. In `nsscon`, enter

   ```
   nss /MinBufferCacheSize=value
   ```

   where *value* is the number of 4-KB buffers to assign for NSS. The default value is 30000.

   The maximum setting is the amount of memory in KB divided by 4 KB. For a 32-bit machine the maximum setting is 250000 buffers.

27.2.3 Configuring High Memory Cache

Linux limits the low memory to less than 1GB on 32-bit machines, but places all physical memory in the low-memory area for 64-bit machines. By default, NSS on Linux caches its metadata blocks in the server's low memory. When the working set of metadata does not fit into low memory, performance is affected. In particular, metadata caching on servers with large numbers of files can create performance issues for servers that are low memory constrained as for 32-bit machines.

NSS for Linux supports metadata caching in high memory for servers that are low-memory constrained. This can greatly improve metadata reads on 32-bit systems with large numbers of files.

Configuring High Memory Cache Type and Size

Enter the following command in the NSS Console (`nsscon`):

nss /HighMemoryCacheType=[private | linux | none]

Set the type of use of User memory in 32-bit OES Linux as `none`, `linux`, or `private`. On 64-bit OES Linux, NSS does not use User memory at all.

Cache Type Options

private

Set up a separate user-mode cache in memory outside of the Linux cache. This is the default for 32-bit machines. By default, NSS takes 20 percent of the total high memory. You can modify this setting with the `nss /PrivateCacheSizeInBlocks=value` command.

However, If the number of Private Cache blocks is less than twice the NSS Cache blocks, then the default high memory cache type is `linux`. If the high memory is less than twice the NSS Cache blocks, then the default high memory cache type is `none`.

Private Cache is best used for dedicated file-servers. The Private Cache increases the performance of NSS, but reduces the amount of memory available to other file systems and tasks.

linux

Integrate caching into the regular Linux caches. This is the default for 32-bit machines where the number of Private Cache blocks is less than twice the NSS Cache blocks.

This can be a problem on a dual purpose file-server and application-server system, because memory-hungry applications can cause the file-system cache to purge completely.

none

Use the same algorithm as the initial release of OES 1 Linux, which is to try and cache everything in Kernel-mode memory. This is the only option on 64-bit OES Linux. This is the default for 32-bit machines if the high memory is less than twice the NSS Cache blocks.

nss /PrivateCacheSizeInBlocks=*value*

Sets the number of metadata blocks to cache for a 32-bit OES Linux machine where you have set the HighMemoryCacheType=private.

By default, NSS takes 20% of all high memory to use for the Private Cache. We recommend against giving NSS 100 percent of the high memory. The actual percentage you should allot depends on your deployment scenario. For example:

- Which features of NSS are enabled--salvage, compression, and so on.
- Use of really long filenames.
- Use of extended attributes.

Default: 20 percent of all high memory blocks

Range: 0 blocks to the number of blocks available in high memory (total available high memory divided by 4KB)

Monitoring the High Memory Cache Use

To view the current settings for the high memory cache usage, enter

```
nsscon /status
```

View the following parameters in the Current NSS Status report:

```
Current NSS Status:
  ... (parameters omitted)
  Current Private Cache Size         = 387680k (96920)
  Private Cache Size Limit           = 596364k (149091)
  High Memory Cache Type             = private
 ... (parameters omitted)
```

The Current Private Cache Size indicates the amount of memory currently being used by the Private Cache. The Private Cache Size Limit shows the maximum amount of memory that the Private Cache can use. The High Memory Cache Type indicates the type of high memory cache that is being used as `none`, `linux`, or `private`.

27.2.4 Setting the Name Cache Size

The NSS Name Cache is responsible for caching the Name Tree information. This is the information that is read when you perform any kind of search by file or directory name. The Name Cache maps a name to a ZID (a unique file object ID). Directory listings do not do this as much as normal file opens that must resolve each name in the file path.

Use the NameCacheSize parameter to specify the amount of recently used Name Tree entries for files and directories that NSS caches. Each entry uses about 150 bytes of memory.

Increasing the maximum number of entries Name Cache entries does not necessarily improve the performance for getting directory listing information if NSS also needs to look up information about the file from a tree or structure outside of the name tree.

If you want to see how your name cache is performing, use the `nsscon /NameCacheStats` command.

nsscon /NameCacheSize=*value*

Specify the maximum number of recently used Name Tree entries for files and directories to cache. Name cache grows up to the specified limit. Unlike the file system cache, it does not take the maximum amount of memory allocated from the start.

Default: 100000

Range: 17 to 1000000

27.3 Configuring or Tuning Group I/O

Group write is a technique of writing data to the volume at regular intervals in order to reduce the seek time on the drive. It also reduces the number of writes because more changes to the same block are made only to memory.

In OES 1 Linux, NSS writes are done on a block-based timer. A block is written one second after the block becomes *dirty* (modified by a user or process). This can cause lots of head movement because there is no control over the order of blocks being sent to disk.

In OES 2 Linux, NSS performs group writes in three categories: journal, metadata, and user data. By setting policies for group writes, you can improve the performance of the file system for your particular environment.

For information, see the following:

- Section 27.3.1, “Viewing the Metadata Area Size,” on page 353
- Section 27.3.2, “Configuring the Journal Group Write Timer,” on page 354
- Section 27.3.3, “Configuring the Metadata Group Write Timer and Limit,” on page 354
- Section 27.3.4, “Configuring the User Data Group Write Timer,” on page 356
- Section 27.3.5, “Viewing Group Write Policies,” on page 356

27.3.1 Viewing the Metadata Area Size

NSS for OES 2 Linux provides a logical read-ahead capability. NSS is designed to physically store logically related data near each other, such as files in the same directory. By reading ahead using the logical information, performance is increased. When a block is read, its logically related blocks are also read. The area read is determined by the default area size.

To improve performance for NSS on OES 2 Linux, metadata blocks use an area seed logic to make sure that related metadata blocks are physically stored near each other. The default area size for metadata blocks is 16 blocks that are 4 KB each, or 64 KB total.

For metadata blocks, the seed is set to the block number for the area. When metadata is written, the seed logic determines the closest free block in the area to use next. When the area is new, a new free area is found in a higher area in the pool, and a new seed marks this area. When the search for a free area reaches the end of the pool, it wraps back to start searching for free areas to use at the start of the pool. If no free space of sufficient size is found, the size is temporarily halved from 16 to 8, 4, 2, or 1 blocks progressively as needed until the temporary size is 1. A setting of 1 block indicates that the pool is essentially out of space. As space is freed or the pool increases in size, future space allocations use the default area size of 16 blocks.

The maximum number of dirty data blocks that are allowed to accumulate is governed by the Metadata Group Write Limit parameter. By default, the limit is 20000 dirty blocks. For information, see Section 27.3.3, “Configuring the Metadata Group Write Timer and Limit,” on page 354.

You can view the metadata area size that is currently in use and the number of dirty blocks waiting to be written by viewing the Current Metadata Group Write Size parameter in the NSS status report. The information is reported in the following format:

```
Current Metadata Group Write Size  = areasize (number_dirty_blocks)
```

For example, with the default setting of 16 4-KB blocks, the metadata area is 64 KB. If 16000 dirty blocks are waiting to be written, the values are reported follows:

```
Current Metadata Group Write Size  = 64K (16000)
```

To view the Current Metadata Group Write Size information:

1. Open a terminal console, then log in as the `root` user.
2. At the console prompt, open the NSS Console by entering

   ```
   nsscon
   ```

3. At the `nsscon` prompt, enter

   ```
   nss /status
   ```

4. In the NSS status report, look for the Current Metadata Group Write Size parameter to view the current values:

   ```
   Current Metadata Group Write Size  = areasize (number_dirty_blocks)
   ```

27.3.2 Configuring the Journal Group Write Timer

For NSS, the journal keeps metadata consistent up to the time when its blocks are written to the device. The Journal Group Write Timer determines the elapsed time between writes of journal blocks. Thus, its timer policy determines how long ago that a consistent point is relative to a system crash.

Journal blocks are written by default as a group every second. Journal blocks might be written sooner than the one-second elapsed time if another timer policy triggers a write or if the journal gets full before the time elapses. Writing blocks as a group helps improve performance because it allows fewer writes, while ensuring that data is actually recorded to the device.

Use the following NSS command option to control the group write policy for journal blocks:

/JournalGroupWriteTime=*seconds*

Use the JournalGroupWriteTime parameter to specify the elapsed time to wait before group writes of journal blocks.

Journal Group Write Timer	Risk for Inconsistent Metadata (Time Elapsed Since Last Consistent Point)	File System Performance
1 second (default)	Minimized	Optimized for most scenarios
Greater than 1 second	Higher	Faster

To set the JournalGroupWriteTime parameter, issue the following command as the `root` user in the NSS Console (`nsscon`):

```
nss /JournalGroupWriteTime=seconds
```

Replace *seconds* with the maximum number of seconds to elapse before forcing journal blocks to be written to the volume. The default value of *seconds* is 1.

For example, to group write journal blocks every 2 seconds, enter

```
nss /JournalGroupWriteTime=2
```

27.3.3 Configuring the Metadata Group Write Timer and Limit

The metadata blocks are written by default as a group every 40 seconds, or when the MetadataGroupWriteLimit is reached, whichever occurs first. Metadata loss does not occur if the system crashes because all metadata changes are automatically recorded in the journal. However, increasing the timer setting increases the redo/undo time that is required to activate a pool (the mount time) after a crash because there is more unwritten metadata in the journal to be resolved.

IMPORTANT: Within a clustered environment, this means that the time to complete a failover is related to the setting of MetadataGroupWriteLimit parameter.

You can limit the amount of time it takes for a pool activation after a crash by decreasing the maximum number of metadata blocks that can be dirty in the MetadataGroupWriteLimit parameter. A group write is performed when the limit is reached.

You can increase performance of the file system by increasing the maximum number of metadata blocks that can be dirty.

Use the following NSS command options to control the group write behavior for metadata blocks:

/MetadataGroupWriteTime=*seconds*

Use the MetadataGroupWriteTime parameter to specify the elapsed time to wait before group writes of metadata blocks. Decreasing the metadata group write timer can help reduce the mount time for the volume after a crash.

Metadata Group Write Timer	Time to Mount After a System Crash	File System Performance
40 seconds (default)	Optimized for most scenarios	Optimized for most scenarios
Less than 40 seconds	Faster	Slower
More than 40 seconds	Slower	Faster

To set the MetadataGroupWriteTime parameter, issue the following command as the `root` user in the NSS Console (`nsscon`):

```
nss /MetadataGroupWriteTime=seconds
```

Replace *seconds* with the maximum number of seconds to elapse before forcing metadata blocks to be written to the volume. The default value of *seconds* is 40.

For example, to group write metadata blocks every 30 seconds, enter

```
nss /MetadataGroupWriteTime=30
```

/MetadataGroupWriteLimit=*blocks*

Use the MetadataGroupWriteLimit parameter to specify the maximum number of metadata blocks that can be dirty before a group write is performed. The following describes how the settings affect time to mount and file system performance:

Maximum Number of Dirty Metadata Blocks	Time to Mount After a System Crash	File System Performance
20000 blocks (default)	Optimized for most scenarios	Optimized for most scenarios
Less than 20000 blocks	Faster	Slower
More than 20000 blocks	Slower	Faster

To set the MetadataGroupWriteLimit parameter, issue the following command as the `root` user in the NSS Console (`nsscon`):

```
nss /MetadataGroupWriteLimit=blocks
```

Replace *blocks* with the maximum number of metadata blocks that can be dirty before forcing them to be written to the volume. The default value of *blocks* is 20000.

For example, to decrease the maximum number of dirty metadata blocks to 15,000 for the purpose of reducing the mount time, enter

```
nss /MetadataGroupWriteLimit=15000
```

For example, to increase the maximum number of dirty metadata blocks to 30,000 for the purpose of increasing the file system performance, enter

```
nss /MetadataGroupWriteLimit=30000
```

27.3.4 Configuring the User Data Group Write Timer

The user data blocks are written as a group every 3 seconds. This increases the risk of data loss on a crash compared to previous versions of NSS that write data blocks every 1 second. You can set the user data group write timer (UserDataGroupWriteTime) to 1 second to get the familiar NSS behavior for data writes.

Use the following NSS command option to control the group write behavior for user data blocks:

/UserDataGroupWriteTime=*seconds*

Use the UserDataGroupWriteTime parameter to specify the elapsed time to wait before group writes of user data blocks. Decreasing the user data group write timer can help reduce the risk of data loss for a volume after a crash.

User Data Group Write Timer	Risk of Data Loss After a Crash	File System Performance
3 seconds (default)	Optimized for most scenarios	Optimized for most scenarios
1 second	Lower, typical of NSS on NetWare and OES 1 Linux and NetWare	Slower
Greater than 3 seconds	Higher	Faster

To set the UserDataGroupWriteTimer parameter, issue the following command as the `root` user in the NSS Console (`nsscon`):

```
nss /UserDataGroupWriteTime=seconds
```

Replace *seconds* with the maximum number of seconds to elapse before forcing user data blocks to be written to the volume. The default value of *seconds* is 3.

For example, to group write user data blocks every 1 second, enter

```
nss /UserDataGroupWriteTime=1
```

27.3.5 Viewing Group Write Policies

1. Open a terminal console, then log in as the `root` user.
2. At the terminal console prompt, enter

   ```
   nsscon
   ```

3. In nsscon, enter

   ```
   nss /status
   ```

4. Look for the following settings in the *Current NSS Status* report:

   ```
   Journal Flush Timer               = 1 second
   Metadata Flush Timer              = 40 seconds
   User Data Flush Timer             = 3 seconds
   Current Metadata Group Write Size  = 64k (16)
   Metadata Block Group Write Limit   = 80000k (20000)
   ```

28 Monitoring the Status of the NSS File System and Services

This section describes the following methods for monitoring the status of Novell Storage Services:

- Section 28.1, “Monitoring Status of NSS Devices, Pools, and Volumes with iManager,” on page 357
- Section 28.2, “Monitoring Compression and Salvage Statistics,” on page 358
- Section 28.3, “Monitoring Quotas and Space Usage for NSS Pools and Volumes,” on page 360
- Section 28.4, “Monitoring File System Parameters,” on page 362

28.1 Monitoring Status of NSS Devices, Pools, and Volumes with iManager

1 Use the following table to determine where to go to view the status of your NSS storage devices, pools, and volumes.

To monitor the status of:	Refer to:
Devices	Section 10.4, “Viewing Details for a Device,” on page 120
Partitioned free space	Section 10.8, “Viewing Partitions on a Device,” on page 124
Partition	Section 12.3, “Viewing Details for a Partition,” on page 145
Software RAIDs	Section 13.3, “Viewing a List of Software RAID Devices on a Server,” on page 155
Software RAID details	Section 13.4, “Viewing Details of a Software RAID Device,” on page 156
NSS pools	Section 15.7, “Viewing Pools on a Server,” on page 184
NSS pool details	Section 15.8, “Viewing Pool Details,” on page 184
NSS volumes in a pool	Section 15.10, “Viewing Volume Information for a Pool,” on page 186
NSS volume details	Section 18.6, “Viewing the Details of an NSS Volume,” on page 232
NSS volume quota and space usage	Section 18.7, “Viewing Properties of an NSS Volume,” on page 232, then click the Quotas tab

To monitor the status of:	Refer to:
NSS volume attributes	Section 18.7, “Viewing Properties of an NSS Volume,” on page 232, then click the *Attributes* tab
File and folder properties	Section 20.1, “Configuring File System Trustees, Trustee Rights, Inherited Rights Filters, and Attributes,” on page 259

28.2 Monitoring Compression and Salvage Statistics

For each volume, the *Volume Properties Statistics* page in iManager reports statistics about the compressed and salvageable files in the volume, the GUID of the volume, and the block size being used.

1. In iManager, click *Storage* > *Volumes*.

   For instructions, see Section 9.1.5, “Accessing Roles and Tasks in iManager,” on page 94.

2. Select a server to manage.

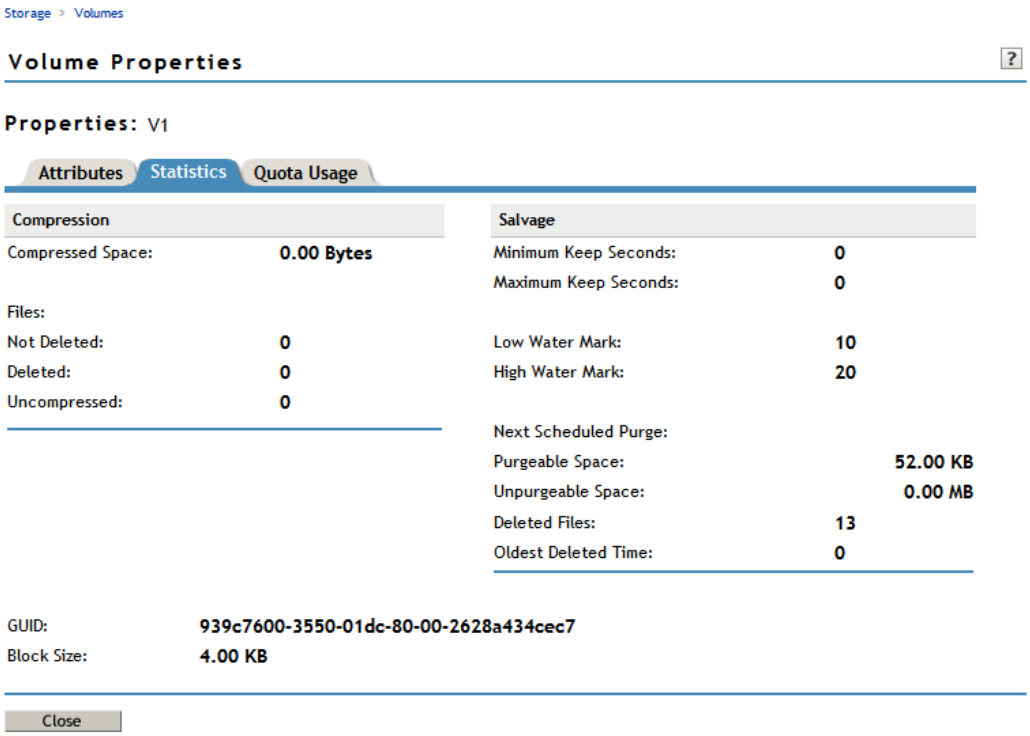
   For instructions, see Section 9.1.6, “Selecting a Server to Manage,” on page 95.

3. In the *Volumes* list, select a volume that you want manage.

4. Click *Properties*.

   The *Properties* page has three tabs: *Attributes*, *Statistics*, and *Quota Usage*. It opens by default to the *Attributes* tab.

5. Click the *Statistics* tab to view the compression and salvage statistics for the selected volume.



If the compression attribute is set, the Compression report shows statistics of all the compressed files for the selected volume.

Statistic	Description
Compressed Space	The amount of space in the volume in use by compressed files.
Files	The total number of files in the volume and information by the following categories: ◆ **Not Deleted:** The total number of files in the volume that are currently available to users. ◆ **Deleted:** The total number of files in the volume that are deleted but not yet purged from the system. ◆ **Uncompressed:** The total number of files in the volume that are not stored in compressed form.

If the Salvage Files attribute is enabled, the Salvage report shows statistics about deleted files that have not yet been purged.

Statistic	Description
Minimum Keep Seconds	Minimum time (in seconds) to keep deleted files.
Maximum Keep Seconds	Maximum time (in seconds) to keep deleted files.
Low Water Mark	If the amount of free space drops below this percentage, the file system begins purging deleted files.
High Water Mark	If there are files to delete, the autopurging process stops when the amount of free space reaches this percentage.
Next Scheduled Purge	Date and time of the next purge.
Purgeable Space	Amount of space in the volume that is occupied by deleted files that are queued for purging.
Unpurgeable Space	Amount of space in the volume that is occupied by files.
Deleted Files	The number of deleted files in salvage.
Oldest Deleted Time	Time line for deleted files. The file system purges the files in the same order they were deleted.
GUID	The Global Unique Identifier (GUID) number that NSS assigns to the volume. This number is necessary so your file system can locate the specific volume.
Block Size	The maximum amount of data committed to a single write process. Possible sizes include 4, 8, 16, 32, or 64 KB.

Other information reported includes the volume's GUID and block size.

Statistic	Description
GUID	The Global Unique Identifier (GUID) number that NSS assigns to the volume. This number is necessary so your file system can locate the specific volume.
Block Size	The maximum amount of data committed to a single write process. Possible sizes include 4, 8, 16, 32, or 64 KB.

28.3 Monitoring Quotas and Space Usage for NSS Pools and Volumes

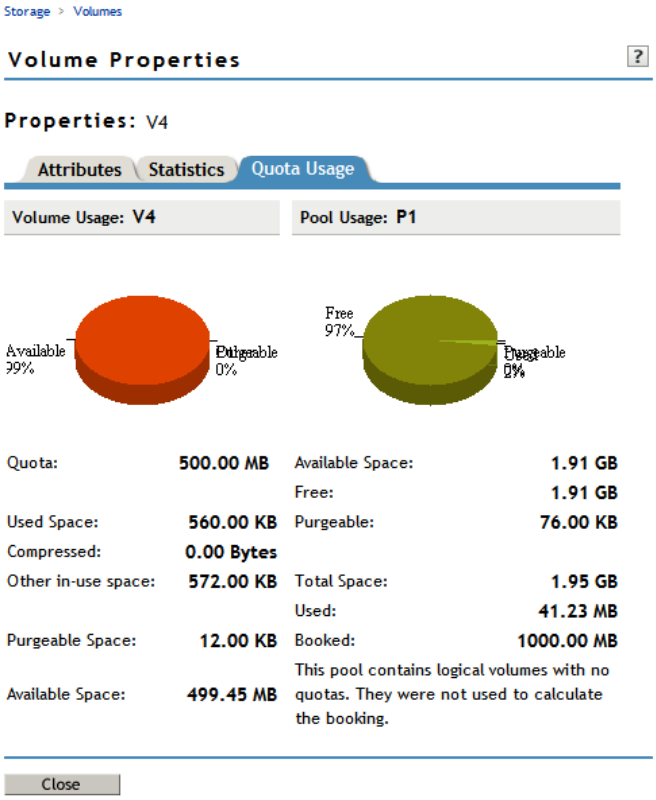
For each volume, the *Volume Properties* > *Quota Usage* page in iManager reports the space usage for the selected volume and the pool that contains the volume.

1. In iManager, click *Storage* > *Volumes*.

   For instructions, see Section 9.1.5, "Accessing Roles and Tasks in iManager," on page 94.
2. Select a server to manage.

   For instructions, see Section 9.1.6, "Selecting a Server to Manage," on page 95.
3. In the *Volumes* list, select a volume that you want manage.
4. Click Properties.

   The *Properties* page has three tabs: *Attributes*, *Statistics*, and *Quota Usage*. It opens by default to the *Attributes* tab.
5. Click the *Quota Usage* tab to view the current space usage statistics for the selected volume.



Volume Usage reports the amount of space on the volume, categorized by usage: Compressed, Other In-use, Purgeable, and Available.

Statistic	Description
Quota	Indicates whether the volume has a quota. If there is a quota, the volume can grow only to the size of the quota. If there is no quota, the volume can grow to the amount of available physical space in the pool.
Used Space	The amount of space currently in use and information by the following categories: ◆ **Compressed:** If the Compressed attribute is enabled, this is the amount of space in the volume containing data that is compressed. ◆ **Other In-Use Space:** The amount of space in the volume containing data that is not compressed. ◆ **Purgeable Space:** The amount of space in the Salvage system that you can use as free space. You can manually purge deleted files to free space. ◆ **Available:** Available free space that is not in the Salvage system.

Pool Usage reports the amount of space on the pool, categorized by usage: Free, Purgeable, Used, and Booked.

Statistic	Description
Available Space	The amount of space in the pool that is not currently in use and information by the following categories: ◆ **Free:** The total amount of free space that is available on the pool. ◆ **Purgeable:** The amount of space in the Salvage system that you can use as free space. You can manually purge deleted files to free space.
Total Space	The total amount of space allocated to the pool and information by the following categories: ◆ **Used:** The total amount of space currently in use by all volumes on the pool. ◆ **Overbooked/Booked:** If the amount of space assigned to the pool's volumes exceeds the amount of physical space available in the pool, the *Overbooked* field shows the amount of exceeded space. Otherwise, the *Booked* field shows the total amount of space in all volumes in the pool. If any of the volumes do not have a quota, these volumes are not calculated in the total combined quota.

28.4 Monitoring File System Parameters

- Section 28.4.1, "Using iManager to Monitor NSS File System Parameters," on page 362
- Section 28.4.2, "Using Novell Remote Manager to Browse Directories and Files," on page 362
- Section 28.4.3, "Using Novell NetStorage to Monitor NSS File System Parameters," on page 362

28.4.1 Using iManager to Monitor NSS File System Parameters

Use the File Manager plug-in to iManager to browse files and directories, and to manage access control for them. For information, see the following:

- Section 20.1, "Configuring File System Trustees, Trustee Rights, Inherited Rights Filters, and Attributes," on page 259
- Chapter 25, "Managing Files and Folders on NSS Volumes," on page 331

28.4.2 Using Novell Remote Manager to Browse Directories and Files

You can browse directories and files by using Novell Remote Manager for Linux. For information, see " Viewing File Systems " in the *OES 2 SP3: Novell Remote Manager for Linux Administration Guide*.

28.4.3 Using Novell NetStorage to Monitor NSS File System Parameters

Use the Novell NetStorage to monitor the status of the NSS file system parameters listed in the following table.

Use this link	To do these tasks
Volumes	◆ Monitor or restrict disk space usage by directory (directory quotas) ◆ Purge or salvage deleted volumes or files ◆ Configure file and directory Trustee rights and Inherited Rights filters ◆ View or change a list of Set parameters

29 Troubleshooting the NSS File System

This section describes some issues you might experience with Novell Storage Services (NSS) and provides suggestions for resolving or avoiding them.

For additional troubleshooting information, see the Novell Support Web site (http://support.novell.com).

- Section 29.1, "Cannot Connect to Target Servers from iManager," on page 365
- Section 29.2, "Cannot Create an NSS Pool or Volume," on page 366
- Section 29.3, "Cannot See NSS Devices, Pools, or Volumes," on page 367
- Section 29.4, "eDirectory Errors When Creating NSS Pools or Volumes," on page 368
- Section 29.5, "File Compression Is Not Working," on page 369
- Section 29.6, "Linux Fails to Execute Dismount, Umount, or Delete Commands for NSS Volumes," on page 369
- Section 29.7, "Multipath Devices Are Not Resolved," on page 370
- Section 29.8, "NSS Takes Up to 10 Minutes to Load When the Server Is Rebooted," on page 370
- Section 29.9, "NSS Volume Disappears from the NCP Console (ncpcon)," on page 371
- Section 29.10, "Pathname Exceeds 255-Character Limit," on page 371
- Section 29.11, "Server Hangs When Using an NSS Volume as a Netatalk Share," on page 371
- Section 29.12, "Slow Mount Performance for NSS Volumes Using the UNIX Name Space," on page 372
- Section 29.13, "Software RAID 1 Fails to Recognize a Replacement Device," on page 372
- Section 29.14, "Tuning NSS Volumes for GroupWise Servers," on page 372
- Section 29.15, "Unknown Users as File Owners," on page 372
- Section 29.16, "Using Scripts to Create or Manage NSS Pools and Volumes," on page 373
- Section 29.17, "NFS Volume Mount Failure Blocks the Mounting of Other File Systems," on page 373
- Section 29.18, "In the Process of Cluster Resource Going Offline, NSS Pool Deactivation Hangs," on page 373
- Section 29.19, "Trustee Entries are Stored in Different Formats in NetWare and Linux Platforms," on page 374

29.1 Cannot Connect to Target Servers from iManager

If you are having difficulty connecting to servers from iManager, it might be because you are using an unsupported protocol between the iManager server and the target server that you want to manage. For information, see "Interoperability of Protocols for the iManager Server and Target Server" on page 81 under the Section 7.5, "Cross-Platform Issues for Management Tools," on page 81.

29.2 Cannot Create an NSS Pool or Volume

If you cannot create an NSS pool or volume, consider these possible causes:

- Section 29.2.1, “General Issues,” on page 366
- Section 29.2.2, “Linux Issues,” on page 366

29.2.1 General Issues

- Your server might not have enough free space to create more storage pools or NSS volumes. Ensure you have enough free space to create another NSS storage pool or NSS volume. See Section 10.8, “Viewing Partitions on a Device,” on page 124.
- Each NSS volume must be part of an NSS pool. If you cannot create the pool at the same time as the volume, try creating a pool to use first.

29.2.2 Linux Issues

If you cannot create a pool on a device you can see in NSSMU, NSS might not own the free space you want to use for a storage pool. If the device you want to use is managed by LVM2 instead of EVMs, NSS does not recognize the device as being available and does not create the pool.

SUSE Linux Enterprise Server uses LVM2 as the default device manager, but NSS requires EVMS. The Linux 2.6 kernel prevents multiple volume managers from managing the same device. As a result, EVMS might display free space that it cannot actually manage.

To prevent display of space that is unavailable to EVMS, edit the `/etc/evms.conf` file to add the device to the exclude list of the `sysfs_devices` section.

For example, if your `hda` device is your boot device and contains the root volume, it cannot be used to create pools on. Edit the `/etc/evms.conf` file as follows:

```
sysfs_devices {
...
exclude = [hda]
}
```

To make a device that is being managed by another device manager available to EVMS, you can use one of the following options:

- Install Linux with EVMS as the default volume manager

  See Mounting Your Root File System through EVMS (http://evms.sourceforge.net/install/root.html) for more information.
- Convert LVM2 volumes to EVMS volumes after Linux installation.

  See Converting to EVMS (http://evms.sourceforge.net/convert.html) for more information.
- Patch the 2.6 kernel on your Linux server to allow multiple device managers.

  WARNING: This solution is not recommended, tested, nor supported, but it is mentioned here for completeness.

  See BD-Claim Patch (http://evms.sourceforge.net/install/kernel.html#bdclaim) for more information.

29.3 Cannot See NSS Devices, Pools, or Volumes

- Section 29.3.1, “Connection Failure,” on page 367
- Section 29.3.2, “NSS Tools Recognize Only EVMS-Managed Devices,” on page 367
- Section 29.3.3, “EVMS Not Running,” on page 367
- Section 29.3.4, “Pools Not Mounted by EVMS,” on page 367

29.3.1 Connection Failure

If you cannot see your volumes or the devices associated with those volumes, you might have a connection failure. Connection failures can occur if an adapter, cable, or switch in the path between the server and the storage device fails for any reason. If there is a connection failure, repair or reconfigure the equipment.

29.3.2 NSS Tools Recognize Only EVMS-Managed Devices

If the Storage plug-in for iManager or NSSMU for Linux does not recognize a device, it might be because NSS recognizes only what the Enterprise Volume Management System (EVMS) recognizes. NSS recognizes hard drives, CD drives, DVD drives, USB drives, and Zip drives that are managed by EVMS. If your hard drive is managed by Linux Volume Management (LVM), it cannot be managed by EVMS, and NSS does not recognize it.

For NSS on Linux, whenever you reboot your system, EVMS discovers and mounts the device nodes under `/dev/evms/`. For example, if you use commands to create and mount a partition at `/dev/sdb2/`, after the reboot, EVMS discovers and mounts the partition at `/dev/evms/sdb2`. The iManager Storage plug-in and NSSMU work through EVMS to manage partitions, and this behavior is expected. However, if you create and mount partitions from the command line, your partitions might appear to be lost after a reboot and EVMS discovery.

IMPORTANT: If you mount pools from the command line, you must modify your mount point to the partition’s new apparent location under `/dev/evms/`.

29.3.3 EVMS Not Running

NSS requires that EVMS be installed and running. If it is not running, you cannot see NSS devices, pools, or volumes on Linux.

To start EVMS:

1. Open a terminal console on the server, then log in as the `root` user.
2. At the console prompt, enter

   ```
   evms_activate
   ```

29.3.4 Pools Not Mounted by EVMS

Randomly after a crash, you might find that EVMS fails to activate an NSS pool on a server restart and the pool and its volumes are not available. Make sure EVMS is running by entering `evms_activate` at a terminal console prompt, then use iManager or NSSMU to manually activate the pool and mount its volumes.

29.4 eDirectory Errors When Creating NSS Pools or Volumes

- Section 29.4.1, “eDirectory Error 613 When Creating an NSS Pool or Volume,” on page 368
- Section 29.4.2, “eDirectory Error 672 When Creating an NSS Pool,” on page 368
- Section 29.4.3, “eDirectory Error 601 When Creating NSS Volume,” on page 369

29.4.1 eDirectory Error 613 When Creating an NSS Pool or Volume

When creating an NSS pool or volume with NSSMU on your Linux server, an Error 613 is returned if the server has no eDirectory Read/Write replica available in the same tree when you create the pool or volume so that the Storage objects can be written to eDirectory. The error occurs because NCP (NetWare Control Protocol) cannot map to the pool or volume.

To avoid this problem, make sure the server has an eDirectory Read/Write replica. You can also add the NSS volume path to the `/etc/opt/novell/ncpserv.conf` file for NCP Server on Linux.

29.4.2 eDirectory Error 672 When Creating an NSS Pool

When creating an NSS pool by using NSSMU or iManager, an Error 672 is returned if there is no NSS Admin object in the Novell eDirectory database for the server (such as *`HOSTNAMEadmin.context`*). NSS requires that an NSS Admin object must exist for each and every server, or management does not work.

NOTE: NSS Admin object must be placed under the default location, that is, the same place where the server object exists.

This situation occurs if you move a server across trees without also moving its NSS Admin object from one tree's eDirectory database to the other.

If you re-create the NSS Admin object, you are then able to successfully create pools.

To re-create the NSS Admin object, run `nssAdminInstall` at a Linux terminal console as the `root` user:

1. Open a terminal console, then log in as the `root` user.
2. At the console prompt, enter the following (all on the same line, of course):

   `nssAdminInstall -a adminname.context -P -o HOSTNAMEadmin.context`

   For example, the nssadmin user object is in the form of `server1admin.example`, where `server1` is the server name and `example` is the container where the server object also resides.

`nssAdminInstall -a admin.example -P -o cn=server1admin.o=example`

After the NSS Admin object is created, update the eDirectory Pool object. For information, see Section 15.13, “Updating eDirectory Pool Objects,” on page 191.

29.4.3 eDirectory Error 601 When Creating NSS Volume

When the eDirectory context of the nss admin user object changes, when doing NSS Volume/Pool management operations, for example, create, rename, you might get the error 601. To avoid this problem, perform the following steps:

1. Remove the nss admin user object from eDirectory using iManager. (By default, nss admin user resides in the container where the server object resides).

   For example, the nssadmin user object is in the form of `server1admin.example`, where `server1` is the server name and `example` is the container where the server object also resides.

2. Run `nssAdminInstall` to recreate the nssadmin object.

   For example, `nssAdminInstall -a admin.example -P -o cn=server1admin.o=example` where `admin.example` is the context of the eDirectory admin user and `server1admin.example` is the nssadmin user object to be recreated.

   NOTE: Run the `nssAdminInstall` command on all the servers whose nssadmin object context is changed.

29.5 File Compression Is Not Working

If you cannot compress a file, check the following:

- Check the Compression attribute for the volume to make sure it is enabled. To apply the file compression option to an existing NSS volume: From iManager, click *Storage* > *Volumes* > *Properties* > *Attributes*, select *Compression*, then click *OK*.
- Check to see if the Do Not Compress (dc) attribute for the file or directory is set.
- Review other factors that affect compression, as detailed in "Factors Affecting Compression" on page 279.

29.6 Linux Fails to Execute Dismount, Umount, or Delete Commands for NSS Volumes

When NCP Server is active, it always keeps a file open on a volume. As a result, issuing `dismount`, `umount`, or `delete` commands for an NSS volume fails, whether the command is issued from the command line, in NSSMU, or in iManager.

This occurs because Linux does not allow you to dismount a volume if a file is open on that volume. Linux does not provide a method of identifying which files are open on volumes.

To dismount or delete an NSS volume on your OES Linux server:

1. At the server prompt, open the NCP Console by entering

   ```
   ncpcon
   ```

2. Dismount the volume from NCP.

   The volume is no longer accessible or visible to NCP clients.

3. In iManager, dismount or delete the volume, as desired.

29.7 Multipath Devices Are Not Resolved

If you have multiple interconnect paths in your server-to-storage configuration, you must use multipath management software to resolve the multiple paths into a single mutlipath device.

See Chapter 14, "Managing Multipath I/O to Devices," on page 173.

29.8 NSS Takes Up to 10 Minutes to Load When the Server Is Rebooted

NSS requires the NDP user space module (`ndpapp`) to be loaded and running when NSS starts. If ndpapp is not running, modules in NSS that attempt eDirectory operations fail and prevent NSS from loading.

In some environments, when the NDP module (`ndpmod`) attempts to register the `/dev/ndp` device, the kernel routine misc_register() registers the device inside the kernel, but does not make it available in user space until about 17 seconds later. Because of the delay, the NDP user space module kills itself for about 10 seconds. NSS cannot start until `ndpapp` reloads itself. When these events occur, you see a message in the `/var/log/messages` file similar to the following that indicates the `/dev/ndp` is not available in user space:

```
Sep  1 19:37:54 servername ndpapp[10052]: stat: /dev/ndp: 2: No such file or
directory
```

Increasing the UDEV event handling limits to 1024 has been tested and circumvents this problem. The `/dev/ndp` device gets created and is seen by ndpapp so that NSS can start.

1. Log in as the `root` user.
2. Open `/etc/sysconfig/udev` in a text editor, then locate the following lines:

   ```
   UDEVD_MAX_CHILDS=64
   UDEVD_MAX_CHILDS_RUNNING=16
   ```

3. Specify 1024 as the value for each parameter:

   ```
   UDEVD_MAX_CHILDS=1024
   UDEVD_MAX_CHILDS_RUNNING=1024
   ```

4. Save the file.
5. Reboot the server.

For information, see TID 7004877 (http://www.novell.com/support/php/search.do?cmd=displayKC&docType=kc&externalId=7004877&sliceId=2&docTypeID=DT_TID_1_1&dialogID=58124347&stateId=1%200%2058126220) in the Novell Support Knowledgebase.

29.9 NSS Volume Disappears from the NCP Console (ncpcon)

An NSS volume might not be found by the `ncpcon` utility if the volume's mount point is renamed (the directory path is changed). For example, this might occur if you change the mount point's directory path from `/media/nss/volumename` (the default path) to `/targetpath/volumename`.

When an NSS volume is created, the NCP server gets the path to the volume and caches it, assuming that it never changes. When you later run the NCP Console (`ncpcon`) utility and enter the `volume` command, it reports the volumes that are still found at their respective mount points. Only the volumes that are still valid as compared to the list in cache are reported.

Use the following methods to avoid or resolve this problem:

- If you know in advance that you want to modify default path of the volume's mount point, make sure to create the NSS volume with iManager and change the default mount point as you configure the volume. For example, if you are setting up an NSS volume to use for the home directories, change the mount point from `/media/nss/home` to `/home.`

  Creating the volume in NSSMU does not allow for the mount point to be changed during the volume setup, only afterwards.

- To modify the mount point for an existing volume, you can use either iManager or NSSMU to change it, then restart eDirectory by entering the following at a terminal console prompt:

  ```
  /etc/init.d/ndsd restart
  ```

  Restarting eDirectory causes the NCP volume cache to be updated.

29.10 Pathname Exceeds 255-Character Limit

Pathnames for files on the server can have up to 255 characters, including the server name, volume name, path delimiters, filename, and file extension. If a user maps a drive letter to a location deep down the directory path, and subsequently creates a pathname that exceeds the limit for the name on the server, the file cannot be saved. Even if the file's path does not exceed 255 characters with respect to the mapped drive letter, it exceeds the maximum length on the server.

When mapping a drive letter to a folder deep down the directory path, users should adopt conventions for naming files and directories and for creating directory structures so that they do not exceed the 255-character pathname limit on the server.

29.11 Server Hangs When Using an NSS Volume as a Netatalk Share

The CopyCat application used by Netatalk uses sparse files for its database. Netatalk tries to create a CopyCat database as a sparse file called `.AppleDB` in the root of the volume by using memory mapped IO. This can cause the server to hang if you are using an NSS volume as the Netatalk share because of the limited support in NSS for this combination.

NSS has limited support for memory mapped files, primarily to support loading programs. NSS does not fully support memory mapped files especially if the application uses sparse files.

29.12 Slow Mount Performance for NSS Volumes Using the UNIX Name Space

Normally, NSS volumes mount in seconds, even if the volume contains large directories with millions of files. You might observe that an NSS volume mounts slowly if it contains large directories and if you are mounting it with a UNIX name space.

To avoid this problem, mount NSS volumes on Linux with a Long name space. For information, see Section 18.11, “Mounting NSS Volumes with Linux Commands,” on page 237.

29.13 Software RAID 1 Fails to Recognize a Replacement Device

If a drive fails that is part of a software RAID 1 device, your system might not recognize the replacement drive and does not begin remirroring automatically.

To recover:

1. Reboot the system to re-scan devices and recognize the replacement drive.
2. Unmount the NSS volumes on the software RAID device to stop the I/O.
3. Expand the software RAID 1 device and specify space from the replacement drive as a new RAID segment. Remirroring begins automatically.
4. Allow the remirror to complete before mounting the NSS volumes.

29.14 Tuning NSS Volumes for GroupWise Servers

NSS performance has been dramatically improved over NetWare 6.5 SP8. As a result, the only tuning that you need to do to enhance the performance of GroupWise on NSS is to disable the salvage feature by entering the following at the server command line:

```
nss /NoSalvage=<volumename | all>
```

29.15 Unknown Users as File Owners

In an NSS volume, a file’s owner is the user who created it. The Novell trustee model for file systems is used to control access to files, so ownership is a consideration only when enforcing user quotas.

Ownership is tracked with the user’s GUID, not the username. If the username ever becomes invalid (such as if the user is deleted from the system), the file continues to be charged to that user’s GUID. In a space usage report, the value of the GUID appears in place of where the a valid username would normally be. There is no limit on the space that can be associated with unknown users. Authorized users can continue to use the files without interruption or incident.

For the user space quota, the total disk space used by the file continues to be associated with the file’s assigned owner’s GUID. User quotas can be enforced only for valid users.You must change the file’s owner to a valid user if you want the files to be included in that user’s quota.

An administrator or administrator equivalent user can assign a new owner when necessary. Changing file ownership requires the Supervisor right for the file’s parent directory and the file. Use whatever tools you normally use to modify the file’s ownership.

29.16 Using Scripts to Create or Manage NSS Pools and Volumes

There is an XML interface that allows you to write scripts, such as Perl scripts, that will create and manage NSS pools and volumes. The API set can be downloaded from *NDK: Virtual File Services* (http://developer.novell.com/wiki/index.php/Virtual_File_Services_for_NetWare). These APIs are for NSS services on NetWare 6.5 SP8, OES 1 Linux, and OES 2 Linux servers.

Look for sample scripts at the link above or in Cool Solutions. For example:

- *NSS Pool Lister for Linux* (http://www.novell.com/coolsolutions/tools/18074.html)
- *NSS Volume Lister for Linux* (http://www.novell.com/coolsolutions/tools/18082.html)

29.17 NFS Volume Mount Failure Blocks the Mounting of Other File Systems

When mounting the volumes if the NFS volume mount fails, the subsequent file systems may fail to mount. The NFS volume mount may fail because of a problem with the NFS server or a network issue. To avoid the mount failure of the subsequent file systems, reset the default value of retry parameter of the NFS volume.

To change the value of retry parameter of NFS volume, do the following:

1. Open the `/etc/fstab` file in a text editor.
2. Edit and modify the NFS mount retry value. The default value is 10,000 minutes, which is approximately one week.

   For example, retry=5. If you have modified the default retry value to 5, the NFS server will try to remount the NFS volume for 5 minutes.

   You can change the retry value to the time you want the NFS server to retry mounting.
3. Save the file.

29.18 In the Process of Cluster Resource Going Offline, NSS Pool Deactivation Hangs

To troubleshoot this issue, add the `ncpcon dismount <volumeName>` command in the cluster unload script before `nss /pooldeac` command. For example,

```
del secondary ipaddress 10.10.102.111

CLUSTER CVSBIND DEL NSS_CLUSTER_DDDD_SERVER 10.10.102.111

NUDP DEL NSS_CLUSTER_DDDD_SERVER 10.10.102.111

ignore_error ncpcon dismount dvol

nss /pooldeactivate=DDDD /overridetype=question
```

Add this command for all the volumes.

29.19 Trustee Entries are Stored in Different Formats in NetWare and Linux Platforms

The `trusteeinfo.xml` file shows the DN entries in "typeless" form in NetWare and in a "typed" form in Linux. After pool or volume migration to Linux from NetWare, to convert all the DN entries to the "typed" form, run the nsscon utility and enter the following command at the NSS Console (nsscon) as the root user:

```
nss /ForceBackgroundCheck
```

30 Security Considerations

This section describes security issues and recommendations for Novell Storage Services for Novell Open Enterprise Server 2. It is intended for security administrators or anyone who is responsible for the security of the system. It requires a basic understanding of NSS. It also requires the organizational authorization and the administrative rights to effect the configuration recommendations.

- Section 30.1, “Security Features of NSS,” on page 375
- Section 30.2, “Preventing Unauthorized Access,” on page 376
- Section 30.3, “Securing Sensitive Information During Remote Management Sessions,” on page 377
- Section 30.4, “Protecting Data During Backup and on Backup Media,” on page 377
- Section 30.5, “Preventing Exposure of Sensitive Data in a Core Dump,” on page 378
- Section 30.6, “Preventing Exposure of the Encryption Password in a Log,” on page 378
- Section 30.7, “Using Data Shredding to Prevent Unauthorized Access to Purged Files,” on page 382
- Section 30.8, “Acquiring Security Equivalence Vectors for NSS Users,” on page 382
- Section 30.9, “Protecting Modules Responsible for Security Equivalence Vectors,” on page 383
- Section 30.10, “Controlling File System Access and Attributes for NSS Volumes,” on page 383
- Section 30.11, “Displaying Directory and File Attributes for NSS Volumes,” on page 383
- Section 30.12, “Security Best Practices for zAPIs,” on page 384
- Section 30.13, “Controlling Physical Access to Servers and Resources,” on page 384
- Section 30.14, “Securing Access to the Servers With a Firewall,” on page 384
- Section 30.15, “Creating Strong Passwords,” on page 384

30.1 Security Features of NSS

Issue/Feature	Description	Recommendation	For More Information
Encrypted volume support	Encrypted NSS volumes meet the legal standard of making data inaccessible to software that circumvents normal access control, such as if the media were stolen.	Encrypt data volumes that contain mission critical data or sensitive data. Use a strong encryption password and protect the password.	“Managing Encrypted NSS Volumes” on page 251 Section 30.15, “Creating Strong Passwords,” on page 384

Issue/Feature	Description	Recommendation	For More Information
Storage plug-in for iManager	iManager requires eDirectory authentication and SSL connections between your Web browser and the iManager server and between the iManager server and the target server being managed.	Use an Administrator user identity and a strong password. Section 30.15, "Creating Strong Passwords," on page 384	Section 9.1.7, "Storage Plug-In Quick Reference," on page 95 *Novell iManager 2.7.3 Administration Guide*
Files and Folders plug-in for iManager	Manage trustees, trustee rights, and inherited rights filters. View effective rights. Manage file system attributes.	Use an Administrator user identity and a strong password. Section 30.15, "Creating Strong Passwords," on page 384	Section 9.1.8, "Files and Folders Plug-In Quick Reference," on page 101 Section 20.1, "Configuring File System Trustees, Trustee Rights, Inherited Rights Filters, and Attributes," on page 259 *Novell iManager 2.7.3 Administration Guide*
NSSMU	NSSMU is executed locally on the server.	Secure physical access to servers.	Section 30.13, "Controlling Physical Access to Servers and Resources," on page 384
Novell Remote Manager	Novell Remote Manager requires eDirectory authentication and SSL connections between your Web browser and the Novell Remote Manager running on the server being managed.	Use an Administrator user identity or equivalent, and use a strong password. Section 30.15, "Creating Strong Passwords," on page 384	Section 9.5.3, "Accessing Novell Remote Manager," on page 110 *OES 2 SP3: Novell Remote Manager for Linux Administration Guide* *NW 6.5 SP8: Novell Remote Manager Administration Guide*

30.2 Preventing Unauthorized Access

NSS includes the following features to help prevent access to data that circumvents normal access control:

- **Encrypted volume support**

  Encrypted volume support encrypts the volume, which makes data inaccessible to software that circumvents normal access control, such as if the media were stolen. It meets U.S. Government security standards. For information, see "Managing Encrypted NSS Volumes" on page 251.

- **Data shredding**

  The Data Shredding attribute supports shredding of purged files (up to 7 times), which erases files completely. It meets the U.S. Government security standards. For information, see Section 20.3, "Using Data Shredding to Prevent Access to Purged Files," on page 268.

- **Multiple server access prevention for pools**

  Multiple server access prevention (MSAP) ensures data integrity by preventing unauthorized access to shared media in a storage area network. For information, see Section 15.12, "Preventing Pools from Activating on Multiple Servers," on page 187.

- **Novell Trustee model for access control**

  NSS uses the Novell Trustee model to greatly simplify access control management in the file system. It restricts visibility of data structures so that users only see subdirectories they have rights to see, not the whole tree like all other file systems.

  For information about the Novell Trustee model and NSS file system rights, see the *OES 2 SP3: File Systems Management Guide*.

30.3 Securing Sensitive Information During Remote Management Sessions

When you are managing OES-Linux and OES2-Linux servers in iManager, all information, including sensitive data, is typically sent via a Secure HTTP (HTTPS) connection between iManager and CIMOM on the Linux server you are managing. This ensures that sensitive data is not exposed during transmission. However, if CIMOM is not running on the Linux server you are managing, the plug-ins attempt to connect via NCP or CIFS. These connections are insecure and are a security concern only when transmitting sensitive information.

Effective in OES2-Linux, storage plug-ins have been modified to prevent this potential exposure of sensitive information. Where tasks involve the exchange of sensitive information between iManager and the Linux server you are managing, the plug-in now checks to see if CIMOM is running and available on the Linux server you are managing before it attempts to execute the command. If CIMOM is not running for some reason, it returns an error message and does not execute the task. The plug-ins do not allow sensitive data to be sent across insecure connections (such as NCP or CIFS/SAMBA) to the Linux server. You get an error message explaining that the connection is not secure and that CIMOM must be running before you can perform the task.

30.4 Protecting Data During Backup and on Backup Media

Backups of NSS volumes are not encrypted, unless it is a feature of the backup software or hardware you use. Although data is stored encrypted on an encrypted NSS volume, its data is transmitted and backed up in unencrypted format.

Use backup methods that protect data transmitted between the server and the backup media, according to your security needs.

Use one of the following methods to encrypt the data for backup:

- Use backup software that is able to encrypt data when you back it up. This method has performance and manageability challenges, especially for managing encryption keys.
- Use an encryption appliance that encrypts sensitive backup media as data is backed up.

If you transport and store media offsite, use a company that specializes in media shipment and storage. This way, your tapes are tracked via barcodes, stored in environmentally friendly conditions, and are handled by a company whose reputation rests on its ability to handle your media properly.

30.5 Preventing Exposure of Sensitive Data in a Core Dump

When a core dump occurs for an encrypted NSS volume, data from the encrypted volume might be included in the core dump as unencrypted data dumped from cache memory. To prevent encrypted data exposure in the dump, select to exclude cache during a core dump when prompted to select writing all of memory in the core dump or to exclude NSS cache.

This applies also for volumes that are not encrypted but contain confidential data. Although the data is not normally encrypted, you might not want to allow unauthenticated access to the information.

30.6 Preventing Exposure of the Encryption Password in a Log

This section describes NSS debugger logging features so you can identify when these logs are turned on and turn them off in your operational environment.

- Section 30.6.1, “NSS Logging,” on page 378
- Section 30.6.2, “NSS Logging and Security Implications,” on page 379
- Section 30.6.3, “Logging Communications between NSS and the _ADMIN Volume,” on page 379
- Section 30.6.4, “Logging Communications between NSS and eDirectory, NICI, or Linux User Management,” on page 381

30.6.1 NSS Logging

On OES Linux, most of the NSS code runs in kernel space, but some portions are required to run in user space. To communicate across the boundary between user and kernel space, some internal mechanisms were implemented. For debugging purposes, some logging features were added to track these communications between user and kernel space. These logging features are slow and cumbersome, and are intended for use by Novell support engineers to help diagnose any problems that arise. They are not intended for everyday use, and seriously impact performance when they are turned on.

There are two main areas where logging is built into the system. The first is the capacity to log all XML communication to/from the `_ADMIN` volume. The second is the capacity to log NSS kernel requests to communicate with eDirectory, NICI, and LUM, all of which run in user space.

30.6.2 NSS Logging and Security Implications

When working with encrypted volumes on Linux, it is important to realize that the volume password and key information is exchanged between user and kernel space as encrypted volumes are created and/or mounted. If you have logging enabled on the Linux server when you enter the encryption password, your password and volume key information might show up in the log file.

You must be the `root` user or an equivalent user with `root` user privileges to perform the steps required to enable logging, disable logging, or read `/var/log/messages`. This prevents ordinary users from manipulating the logging environment. We strongly recommend that you protect the physical access to the server and the `root` user passwords to prevent unauthorized access to your servers.

Even though the logging mechanisms are `root` user protected, we strongly recommend that you make sure logging is disabled whenever you plan to enter the encryption password for an encrypted NSS volume on your system. You enter an encryption password when you create the volume and when you mount the volume for the first time after any system start or reboot.

30.6.3 Logging Communications between NSS and the _ADMIN Volume

Applications such as NSSMU and Perl scripts communicate with NSS via the `_admin` volume. In these communications, the volume's encryption password is passed in the clear. There are two utilities that can log these exchanges, the `adminusd` daemon and the `nss /vfs` commands in NSSCON. Logs are written to `/var/log/messages`.

- "Prerequisite" on page 379
- "Enabling or Disabling adminusd Logging" on page 379
- "Enabling or Disabling VFS Logging" on page 380

Prerequisite

You must be the `root` user or an equivalent user with `root` user privileges to perform the steps required to enable logging, disable logging, or read `/var/log/messages`. This prevents ordinary users from manipulating the logging environment.

Enabling or Disabling adminusd Logging

On your OES Linux server, an NSS daemon called `adminusd` is installed into `/opt/novell/nss/sbin` directory. It is run from the `startnss.bsh` script. Output data is written to the `/var/log/messages` directory.

- "Enabling adminusd Logging" on page 379
- "Disabling adminusd Logging" on page 380

Enabling adminusd Logging

At a Linux terminal console, do the following to enable `adminusd` logging:

1. Log in as the `root` user.
2. Kill the `adminusd` daemon.
3. Run the daemon with logging turned on by entering

```
adminusd -l
```

Using the `-l` option enables logging of all communication to and from the `_ADMIN` volume in the `/var/log/messages` directory.

Disabling adminusd Logging

At a Linux terminal console, do the following to disable `adminusd` logging:

1. Log in as the `root` user.
2. Kill the `adminusd` daemon.
3. Run the daemon with logging turned off by entering

   ```
   adminusd
   ```

   Not using the `-l` option turns logging off.
4. Delete and purge the `adminusd` log files in /var/log/messages.

Enabling or Disabling VFS Logging

In the NSS Console (NSSCON), the VFS option for NSS can log communications between NSS and the `_ADMIN` volume. The logged data is displayed on the NSSCON screen and is also written to the `/var/log/messages` directory.

Enabling VFS Logging

At a Linux terminal console, do the following to enable VFS logging:

1. Log in as the `root` user, then enter

   ```
   nsscon
   ```
2. In NSSCON, enter

   ```
   nss /vfs
   ```

   Logging is turned on.

Disabling VFS Logging

At a Linux terminal console, do the following to disable VFS logging:

1. Log in as the `root` user, then enter

   ```
   nsscon
   ```
2. In NSSCON, enter

   ```
   nss /novfs
   ```

   Logging is turned off.
3. Exit NSSCON.
4. If the terminal console logging feature was on, turn it off, then delete and purge the logged session.
5. Delete and purge the VFS log files in `/var/log/messages`.

30.6.4 Logging Communications between NSS and eDirectory, NICI, or Linux User Management

All internal NSS kernel space requests for Novell eDirectory, NICI, and Linux User Management are routed through an interface called the NDP (Novell Data Portal). NDP has a user space daemon (`ndpapp`) and a kernel module (`ndpmod`). In communications between `ndpapp` and `ndpmod`, the volume's encryption password is obscured, but it can be easily broken. Both `ndpapp` and `ndpmod` have a logging capacity, and both of them write their log data to `/var/log/messages`.

- "Prerequisite" on page 381
- "Enabling or Disabling ndpapp Logging" on page 381
- "Enabling or Disabling npdmod Logging" on page 382

Prerequisite

You must be the `root` user or an equivalent user with `root` user privileges to perform the steps required to enable logging, disable logging, or read `/var/log/messages`. This prevents ordinary users from manipulating the logging environment.

Enabling or Disabling ndpapp Logging

On your OES Linux server, an NSS daemon called `ndpapp` is installed into `/opt/novell/nss/sbin` directory. It is run from the `startnss.bsh` script.

- "Enable ndpapp Logging" on page 381
- "Disable ndpapp Logging" on page 381

Enable ndpapp Logging

At a Linux terminal console, do the following to enable `ndpapp` logging:

1. Log in as the `root` user.
2. Kill the `ndpapp` daemon.
3. Run the daemon with logging turned on by entering

   ```
   ndpapp --debug=nn
   ```

   Replace *nn* with the log level desired. Set the log level to `1` and above to turn logging on. The higher the number, the greater and more detailed is the logged output.

Disable ndpapp Logging

At a Linux terminal console, do the following to disable `ndpapp` logging:

1. Log in as the `root` user.
2. Kill the `ndpapp` daemon.
3. Run the daemon with logging turned off by entering

   ```
   ndpapp
   ```

   Running `ndpapp` without the `--debug` option turns logging off.
4. Delete and purge the log files in `/var/log/messages`.

Enabling or Disabling npdmod Logging

- "Enabling ndpmod Logging" on page 382
- "Disabling ndpmod Logging" on page 382

Enabling ndpmod Logging

At a Linux terminal console, do the following to enable `ndpmod` logging:

1. Log in as the `root` user, then enter

   ```
   echo nn >/proc/driver/ndp/debug
   ```

   Replace *nn* with the log level desired. Set the log level to 1 and above to turn logging on. The higher the number, the greater and more detailed is the logged output.

Disabling ndpmod Logging

At a Linux terminal console, do the following to disable `ndpmod` logging:

1. Log in as the `root` user, then enter

   ```
   echo 0 >/proc/driver/ndp/debug
   ```

   Setting the Log Level field to 0 turns logging off.
2. Delete and purge the log files in `/var/log/messages`.

30.7 Using Data Shredding to Prevent Unauthorized Access to Purged Files

If the Data Shredding attribute for an NSS volume is disabled, unauthorized access to purged deleted files is possible. An individual can extend a file, `LSEEK` to the end of the existing file data, and then read the data. This returns the decrypted leftover data that is in the block.

To secure this vulnerability, make sure to enable Data Shredding for your NSS volumes by specifying an integer value of 1 to 7 times for the Data Shredding attribute. A value of 0 disables Data Shredding.

For information, see Section 20.3, "Using Data Shredding to Prevent Access to Purged Files," on page 268.

30.8 Acquiring Security Equivalence Vectors for NSS Users

When a user authenticates to the network, the system calculates the user's Security Equivalence Vector (SEV) based on information in the user's profile in Novell eDirectory. NSS validates the user's SEV against the file system trustee rights of the directory and file the user is attempting to access. In OES, SEVs are acquired differently for NSS on NetWare and NSS on Linux.

For NSS on NetWare, whenever a user connects to the NSS file system, NetWare retrieves the user's SEV from eDirectory and maintains it as part of the connection structure for the user's session. NSS automatically retrieves the user's SEV from the connection structure.

For NSS on Linux, NSS caches the SEV locally in the server memory, where it remains until the server is rebooted or the user is deleted from eDirectory. NSS polls eDirectory at a specified interval for updates to the SEVs that are in cache. Command line switches are available in the NSS Console utility (nsscon) to enable or disable the update, to set the update interval from 5 minutes to 90 days (specified in seconds), and to force an immediate update of security equivalence vectors. For information, see Section A.33, "Security Equivalence Vector Update Commands," on page 416.

30.9 Protecting Modules Responsible for Security Equivalence Vectors

The Linux modules in user space that are responsible for providing Security Equivalence Vectors for NSS users can be replaced without the kernel module being aware of it. Make sure that the directory `/opt/novell/nss/sbin/` and the files involved (`ndpapp` and `idbrokerd`) can only be modified by the `root` user. For example, make `root` the owner and set permissions to restrict access for Group and Other users.

30.10 Controlling File System Access and Attributes for NSS Volumes

To ensure that users have the appropriate effective file system rights to data on NSS volumes, make explicit file system trustee assignments, grant security equivalences for users, and filter inherited rights. To simplify the assignment of rights, you can create Group and Organizational Role objects in Novell eDirectory, then assign users to the groups and roles.

Set file system attributes for directories and files on an NSS volume to specify how a file or directory is used.

For information about controlling file system access and attributes for NSS volumes, see " Understanding File System Access Control Using Trustees " in the *OES 2 SP3: File Systems Management Guide*.

For information about access control issues for NSS on Linux, see Section 5.5, "Access Control for NSS on Linux," on page 62.

30.11 Displaying Directory and File Attributes for NSS Volumes

With NCP Server on Linux, NSS supports the Novell Trustee model, which is the same file system trustee rights and attributes for its directories and files as does NSS on NetWare. Management tools provide similar methods on each platform for configuring rights and attributes. For information, see the *OES 2 SP3: File Systems Management Guide*.

NSS on Linux displays some of the NSS file system directory and file attributes in the Linux POSIX directory and file permissions, including the Hidden, Read Only, Read/Write, and Execute attributes. These are not intended as a direct mapping of POSIX rights and behave differently. NSS does not support the POSIX set-user-ID mode bit and set-group-ID mode bit. For information, see "Viewing Key NSS Directory and File Attributes as Linux POSIX Permissions" in the *File Systems Management Guide for OES*.

30.12 Security Best Practices for zAPIs

The zAPIs for NSS on Linux create the character special device `/dev/zapi`. Because zAPIs run at a level beneath where auditing tools track access and use, you should consider restricting access on the `/dev/zapi` directory to the `root` user and setting the device's POSIX permissions to mode=0400.

If you are using AppArmor, add the following line to the AppArmor profile of any program that uses zAPIs for NSS on Linux:

```
/dev/zapi r,
```

You should grant `root` access only to members of the administrative group called `wheel`. The `root` user is a member of the `wheel` group by default. Users in the `wheel` group can access the device by using the `su` or `sudo` commands to obtain `root` privileges for any necessary tasks.

To add a user to the `wheel` group:

1. Log in as the `root` user.
2. In a terminal console, enter

   ```
   usermod -G wheel username
   ```

   Replace *username* with the username of the user being added to the `wheel` group.

Regardless of the POSIX access rights set for the device, the Novell trustee model is enforced for the trustees and trustee access rights you define on `/dev/zapi` for individual users.

The key is specific to a user rather than a user-process pair. Therefore, two processes running as the same user can use the same key without requiring the second process to actually open the file. This behavior is the same as for zAPIs running for NSS on NetWare.

30.13 Controlling Physical Access to Servers and Resources

- Servers must be kept in a physically secure location with access by authorized personnel only.
- The corporate network must be physically secured against eavesdropping or packet sniffing.

30.14 Securing Access to the Servers With a Firewall

Use firewalls between public access points and servers to prevent direct access to data by a would-be third-party intruders.

30.15 Creating Strong Passwords

Make sure to employ security best practices for passwords, such as the following:

- **Length:** The minimum recommended length is 6 characters. A secure password is at least 8 characters; longer passwords are better.
- **Complexity:** A secure password contains a combination of letters and numbers. It should contain both uppercase and lowercase letters and at least one numeric character. Adding numbers to passwords, especially when added to the middle and not just at the beginning or the end, can enhance password strength. Special characters such as &, $, and > can greatly improve the strength of a password.

Do not use recognizable words, such as proper names or words from a dictionary, even if they are bookended with numbers. Do not use personal information, such as phone numbers, birth dates, anniversary dates, addresses, or ZIP codes. Do not invert recognizable information; inverting bad passwords does not make them more secure.

- **Uniqueness:** Do not use the same passwords for all servers. Make sure to use separate passwords for each server so that if one server is compromised, all of your servers are not immediately at risk.

A NSS Commands

This section describes commonly used Novell Storage Services command line options for Novell Open Enterprise Server 2 servers. The commands are grouped by management tasks.

- Section A.1, “Using NSS Commands,” on page 388
- Section A.2, “Help and Find Commands,” on page 389
- Section A.3, “Access Time Command,” on page 390
- Section A.4, “Background File System Checker Commands,” on page 390
- Section A.5, “Cache Management Commands,” on page 390
- Section A.6, “Compression Commands,” on page 393
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- Section A.8, “Daylight Savings Time Commands,” on page 396
- Section A.9, “eDirectory Storage Object ID Commands,” on page 397
- Section A.10, “Extended Attributes (XAttr) Commands,” on page 397
- Section A.11, “Event File List (EFL) Command,” on page 400
- Section A.12, “Hard Links Commands,” on page 400
- Section A.13, “I/O Monitoring Commands,” on page 402
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- Section A.15, “LAF Audit Log Messages Commands,” on page 404
- Section A.16, “Load Commands for the nssstart.cfg File,” on page 404
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- Section A.18, “Migration Support Commands for Near-Line Storage,” on page 405
- Section A.19, “Modified File List (MFL) Commands,” on page 405
- Section A.20, “Multipath I/O Failover Commands,” on page 406
- Section A.21, “Multiple Server Activation Prevention (MSAP) Commands,” on page 406
- Section A.22, “noatime and atime Commands,” on page 407
- Section A.23, “noatime and nodiratime Support for Linux open, mount, nfsmount, and /etc/fstab,” on page 408
- Section A.24, “Opportunistic Locking Commands,” on page 410
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- Section A.28, “Pool Verify and Rebuild Commands,” on page 412
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- Section A.30, “Quotas Commands,” on page 413
- Section A.31, “Read Ahead Blocks and Allocate Ahead Blocks Commands,” on page 413
- Section A.32, “Salvage and Purge Commands,” on page 415
- Section A.33, “Security Equivalence Vector Update Commands,” on page 416
- Section A.34, “Sendfile API Support Command,” on page 417
- Section A.35, “Status Commands,” on page 417
- Section A.36, “Visibility Rebuild Command,” on page 418
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- Section A.38, “ZID Commands,” on page 422

A.1 Using NSS Commands

- Section A.1.1, “Issuing NSS Commands at Command Consoles,” on page 388
- Section A.1.2, “Making NSS Commands Persist Through a Reboot,” on page 388
- Section A.1.3, “Permissions,” on page 389
- Section A.1.4, “Descriptions,” on page 389

A.1.1 Issuing NSS Commands at Command Consoles

Enter NSS commands at the NSS Console (NSSCON, `nsscon(8)`) on an OES 2 Linux server. For information about NSSCON, see Section B.5, “nsscon,” on page 433.

A.1.2 Making NSS Commands Persist Through a Reboot

NSS commands issued at the command line do not persist through a server reboot. To make non-persistent command settings persist automatically through a server reboot, place the commands in the `nssstart.cfg` file, which NSS reads on startup. The file is in the `/etc/opt/novell/nss` directory. Some commands cannot be used in the `nssstart.cfg` file. Refer to the individual commands for information.

1. In a text editor, create a file called `nssstart.cfg` in the `/etc/opt/novell/nss/` directory.
2. Enter any NSS commands that you want to persist through server reboots.

   Each NSS command should be preceded by a forward slash (`/`) and followed with a space.

   For example, the `ListXattrNWmetadata` option enables the ability to return the `netware.metadata` extended attribute for a file or directory at `listxattr(2)` time. The `ZLSSUpgradeNewVolumeMediaFormat` option creates all new NSS volumes with the upgraded media structure that supports hard links. This applies to volumes on both local and shared pools.

   ```
   /numworktodos=40 /ListXattrNWmetadata /ZLSSUpgradeNewVolumeMediaFormat
   ```
3. Save and close your `nssstart.cfg` file.

A.1.3 Permissions

You must be logged in as the `root` user, or as a Linux user with equivalent privileges.

A.1.4 Descriptions

The descriptions of commands provide information about the default values, range of valid values, and persistence of the command.

Default Value

The default value is the setting used for a given server configuration parameter. Initially, the value reported is the default setting for the parameter. If you modify the value, it reports the actual value.

IMPORTANT: Default values are the best choice for a majority of server configurations, but you can modify the settings to meet your needs.

Range of Valid Values

The range of valid values establishes the constraints for any particular variable setting.

Persistence

If a command's setting is persistent, the value or policy you set remains in effect for the server through any subsequent server reboots until you next modify the settings. If a command is not persistent, the setting remains in effect only until the next server reboot. Some commands can be issued in the `nssstart.cfg` file in order to make the settings persist across reboots.

The file is `/etc/opt/novell/nss/nssstart.cfg`. For information, see Section A.1.2, "Making NSS Commands Persist Through a Reboot," on page 388.

A.2 Help and Find Commands

The `help` and `find` options provide information about various NSS switches and a brief description of the parameter. Enter the options at the `nsscon` prompt in the NSS Console.

/find *search_criteria*

To find a particular NSS switch, use the `/find` switch. Replace *search_criteria* with the characters to use in the search. Wild cards searches where you replace some characters with an asterisk (*) are allowed.

For example, the following command finds all of the NSS command options that contain the word "compress":

```
nss /find=*compress*
```

/help or /?

To access online Help for NSS commands, enter one of the following:

```
nss /help
nss /?
```

A.3 Access Time Command

nss /(No)UpdateAccessTimeForReaddir=*volumename*

Enable or disable the ability to update the access time when enumerating directories. Enabled is the default POSIX behavior.

Default: On

Examples

To enable access time to be updated when files in a directory are accessed for listing, enter

```
nss /UpdateAccessTimeForReaddir=volumename
```

To disable access time to be updated when files in a directory are accessed for listing, enter

```
nss /NoUpdateAccessTimeForReaddir=volumename
```

A.4 Background File System Checker Commands

The background file system checker checks the integrity of user ID metadata, directory quota metadata, and files. The output goes to the `nsscon` prompt. There is no built-in report to follow the process of a background check.

nss /(No)BackgroundChecking

Enables or disables the background file system checker.

Default: On (enabled)

Examples

To enable background checking, enter

```
nss /BackgroundChecking
```

To disable background checking, enter

```
nss /NoBackgroundChecking
```

ForceBackgroundCheck

Forces the background file system checker to start.

A.5 Cache Management Commands

Use the commands in this section to manage the cache for NSS volumes on Linux.

- Section A.5.1, “Cache Command,” on page 391
- Section A.5.2, “High Memory Cache Commands,” on page 391
- Section A.5.3, “ID Cache Commands,” on page 392
- Section A.5.4, “Cache Monitoring Commands,” on page 392
- Section A.5.5, “UnplugAlways Command for the Read Queue,” on page 392

A.5.1 Cache Command

nss /MinBufferCacheSize=*value*

Sets the specified minimum number of NSS buffer cache entries, where *value* is the number of 4-KB buffers to assign for NSS.

Default: 30000 for NSS on Linux

Range: 10000 for NSS on Linux to the amount of memory in KB divided by 4 KB (the block size). For a 32-bit machine, the maximum setting is 250000 buffers.

A.5.2 High Memory Cache Commands

nss /HighMemoryCacheType=[private | linux | none]

Set the type of use of User memory in 32-bit OES Linux as `none`, `linux`, or `private`. On 64-bit OES Linux, NSS does not use User memory at all.

Cache Type Options

private

Set up a separate user-mode cache in memory outside of the Linux cache. This is the default for 32-bit machines. By default, NSS takes 20 percent of the total high memory. You can modify this setting with the `nss /PrivateCacheSizeInBlocks=value` command.

However, If the number of Private Cache blocks is less than twice the NSS Cache blocks, then the default high memory cache type is `linux`. If the high memory is less than twice the NSS Cache blocks, then the default high memory cache type is `none`.

Private Cache is best used for dedicated file-servers. The Private Cache increases the performance of NSS, but reduces the amount of memory available to other file systems and tasks.

linux

Integrate caching into the regular Linux caches. This is the default for 32-bit machines where the number of Private Cache blocks is less than twice the NSS Cache blocks.

This can be a problem on a dual purpose file-server and application-server system, because memory-hungry applications can cause the file-system cache to purge completely.

none

Use the same algorithm as the initial release of OES 1 Linux, which is to try and cache everything in Kernel-mode memory. This is the only option on 64-bit OES Linux. This is the default for 32-bit machines if the high memory is less than twice the NSS Cache blocks.

nss /PrivateCacheSizeInBlocks=*value*

Sets the number of metadata blocks to cache for a 32-bit OES Linux machine where you have set the HighMemoryCacheType=private.

By default, NSS takes 20% of all high memory to use for the Private Cache. We recommend against giving NSS 100 percent of the high memory. The actual percentage you should allot depends on your deployment scenario. For example:

- Which features of NSS are enabled--salvage, compression, and so on.
- Use of really long filenames
- Use of extended attributes

Default: 20 percent of all high memory blocks

Range: 0 blocks to the number of blocks available in high memory (total available high memory divided by 4KB)

A.5.3 ID Cache Commands

Use the following command at the `nsscon` prompt in order to synchronize the cache of eDirectory IDs that is maintained for controlling access to NSS volumes.

nss /IDCacheResetInterval=*value*

Set the number of seconds between invalidation of the ID cache.

Default: 90000

Range: 0 to 200000000

ResetIDCache

Reset the various eDirectory ID caches.

If you Linux-enable a user who has been logged into the system before being Linux-enabled, ensure to execute the `resetidcache` command from the NSS Console (`nsscon`) utility. This allows proper reporting of ownership because it resets the mapping of user identities in the ID cache and forces it to update with the Linux UID for the user.

If you LUM disable the user, ensure to execute the `resetidcache` command from the NSS Console (`nsscon`) utility. Run this command after 30 minutes, because NCP server clears its cache periodically at the interval of 30 minutes. This allows proper reporting of ownership because it resets the mapping of user identities in the ID cache.

nss /IDCacheSize=*value*

Sets the maximum number of entries for NSS GUID to ID and ID to GUID cache.

For example, nss /IDCacheSize = 256000

Default: 16384

Range: 16384 to 524288

A.5.4 Cache Monitoring Commands

CacheStats

Shows the caching statistics for buffers.

ResetStats

Resets caching and file statistics.

A.5.5 UnplugAlways Command for the Read Queue

nss /(no)UnplugAlways

When enabled, this option allows NSS to unplug the device queue after queuing each read. This improves performance significantly on certain workloads, such as Linux copy (`cp`) command.

NOTE: In OES 2 SP1 Linux, the UnplugAlways default setting is on (enabled). OES 2 SP2 Linux onwards, the UnplugAlways default setting is off (disabled).

For OES 2 Linux, the UnplugAlways default setting is off (disabled). The OES 2 Linux version of this option is available as patch *Novell Storage Services (NSS) and Novell Cluster Services (NCS) 20080806* (oes2-novell-nss-5503) for 32-bit and 64-bit architectures. The patch is available on the Novell Downloads Web site (http://download.novell.com).

Examples

Enable UnplugAlways by entering the following at the `nsscon` prompt as the `root` user:

```
nss /UnplugAlways
```

Disable UnplugAlways by entering the following at the `nsscon` prompt as the `root` user:

```
nss /NoUnplugAlways
```

A.6 Compression Commands

Use the commands in this section to manage compression parameters for NSS volumes where the Compression attribute has been enabled. After compression is enabled for a volume, it cannot be disabled.

- Section A.6.1, "Server-Level Compression Parameters," on page 393
- Section A.6.2, "Volume-Level Compression Parameters," on page 395

A.6.1 Server-Level Compression Parameters

Server-level compression parameters apply to all NSS volumes on the server. For details about each parameter, see Section 21.2.1, "Understanding Server-Level Compression Parameters," on page 280.

nss /CompressionDailyCheckStartingHour=*value*

Default: 0

Range: 0 to 23

Hours are specified by a 24-hour clock: (0=midnight; 23=11 p.m.).

nss /CompressionDailyCheckStopHour=*value*

Default: 6

Range: 0 to 23

Hours are specified by a 24-hour clock: (0=midnight; 23=11 p.m.).

nss /DaysUntouchedBeforeCompression=*value*

Default: 14

Range: 0 to 100000 (in days)

nss /(No)EnableFileCompression

Enable file compression on volumes where the Compression attribute is enabled. Immediate Compress requests are queued until compression is allowed.

Default: On

Range: On or Off

Examples

To enable compression, enter

```
nss /EnableFileCompression
```

To disable compression, enter

```
nss /NOEnableFileCompression
```

nss /MinimumCompressionPercentageGain=*value*

The minimum percentage a file must compress in order to remain compressed.

Default: 20

Range: 0 to 50

nss /MaximumConcurrentCompressions=*value*

The number of simultaneous compressions allowed by the system (simultaneous compressions can only occur if there are multiple volumes).

Default: 2

Range: 1 to 8

nss /ConvertCompressedToUncompressedOption=*value*

Specify what the file system does with an uncompressed version of a file after the server has decompressed it.

IMPORTANT: Before a compressed file can be opened, there must be sufficient space available on the volume for the uncompressed and compressed copies of the file to coexist while the file is open.

Default: 1

Range: 0, 1, or 2

0 = Always leave the file compressed.

While the file is open, both the uncompressed and compressed copies of the file coexist on the volume. If the file is closed without changes, the uncompressed copy of the file is discarded. If changes are saved, the compressed copy of the file is discarded. After the modified file is closed, it is queued for immediate compression. Sufficient space must be available for both the compressed and uncompressed copies of the file to temporarily coexist on the volume in order for the compression to occur. After successful compression, the uncompressed copy of the modified file is discarded.

1 = Leave the file compressed until second access if it is read only once during the time specified by the Days Untouched Before Compression parameter. This is the default behavior for compression.

While the file is open, both the uncompressed and compressed copies of the file coexist on the volume. The first time that the file is closed without changes in the specified period, the uncompressed copy of the file is discarded. The second time that the file is closed without changes in the specified period, the compressed copy of the file is discarded. If changes are saved, the compressed copy of the file is discarded. The uncompressed file remains uncompressed until it meets requirements for being compressed.

2 = Always leave the file uncompressed.

While the compressed file is open, both the uncompressed and compressed copies of the file coexist on the volume. When the file is closed or when changes are saved, the compressed copy of the file is discarded. The uncompressed file remains uncompressed until it meets requirements for being compressed.

nss /DecompressPercentDiskSpaceFreeToAllowCommit=*value*

The percentage of disk space on a volume that is required to be free in order for file decompression to permanently change the compressed file version to uncompressed, which prevents newly uncompressed fils from entirely filling up the volume. Compressed files that are written to are always left uncompressed.

Default: 10

Range: 0 to 75

nss /DecompressFreeSpaceWarningInterval=*value*

The time interval (in minutes) between displaying warning alerts when the file system is not permanently changing compressed files to uncompressed files due to insufficient free disk space.

Setting the interval to 0 turns off the alert.

Default: 31 minutes

Range: 0 to 720 (0 seconds to 29 days 15 hours 50 minutes 3.8 seconds)

Setting the interval to 0 turns off the alert.

nss /DeletedFilesCompressionOption=*value*

Specifies whether and when to compress deleted files. This command presumes that you have enabled the Salvage attribute for NSS volumes. If Salvage is disabled, deleted files are purged immediately, so there are no deleted files to compress.

Default: 1

Range: 0, 1, or 2

0 = Do not compress deleted files.

1 = Compress deleted files the next day.

2 = Compress deleted files immediately.

A.6.2 Volume-Level Compression Parameters

NSS offers volume-level commands in this section for configuring and monitoring compression on a specified NSS volume.

CompScreen

Displays the NSS volume compression statistics on the compression screen.

nss /Compression=<*volumename* | all>

Enables the Compression attribute for the specified volume or for all volumes on the server. After you enable the Compression attribute, the setting persists for the life of the volume. You cannot disable compression, but you can set parameters to effectively turn it off. For information, see Chapter 21, “Managing Compression on NSS Volumes,” on page 275.

nss /StopNormalCompression, or StopNormalCompression

Stops all queued compression for files, based on the compression triggered by a file open or close.

nss /(No)BGCompression

Allows compression to occur in the background at any time, instead of only within specified hours.

nss /NoBGCompression

Stops background compression and clears any queued background compression requests. Allow compression to occur only within the specified hours.

A.7 Data Shredding Commands

nss /(No)DataShredding=*volumename*:*count*

Enables or disables the Data Shredding attribute for the specified volume. Specify the number of times you want to shred data.

Data shredding overwrites purged files with bit patterns up to seven times. Unless you must use this feature for security reasons, it should be disabled, because data shredding consumes a great deal of disk I/O bandwidth.

Default: 1

Range: 1 to 7, where 0 indicates no shredding

Examples

To enable data shredding on a volume VOL1 where the purged files are overwritten 7 times, enter

```
nss /DataShredding=VOL1:7
```

To disable data shredding for a volume VOL1, enter

```
nss /NoDataShredding=VOL1
```

A.8 Daylight Savings Time Commands

Use the commands in this section to manage daylight savings time for NSS volumes.

nss /DaylightSavingsTimeOffset=*value*

Issuing this command causes UTC time to be recalculated from local time. Specify the offset applied in time calculations when daylight savings time is in effect.

Default: +1 (one hour)

Range: 0 to 23

nss /StartOfDaylightSavingsTimeOffset=*value*

Local date and time when the switch on to daylight savings time should occur. Formats include a simple date and time enclosed in quotes, or rule enclosed in quotes and parenthesis. For example:

```
“April 1 2008 2:0:0 am”
```

```
“(April Sunday > 1 2:0:0 am)”
```

```
“(April Sunday First 2:0:0 am)”
```

Only rules cause rescheduling for the next year. You must set both the start and end dates before either is scheduled.

```
[Value=none]
```

nss /EndOfDaylightSavingsTimeOffset=*value*

Local date and time when the switch off of daylight savings time should occur. Formats include a simple date and time enclosed in quotes, or rules enclosed in quotes and parenthesis. For example:

```
"October 31 2008 2:0:0 am"
"(October Sunday <= 31  2:0:0 am)"
"(October Sunday Last 2:0:0 am)"
```

Only rules cause rescheduling for the next year. You must set both the start and end dates before either is scheduled.

[Value=none]

A.9 eDirectory Storage Object ID Commands

Use the commands in this section to remove or update the Storage objects in Novell eDirectory.

nss /RemoveObjectIDStore

Remove the object store.

nss /UpdateObjectIDStore

Scan and add all volume objects to an existing object store.

A.10 Extended Attributes (XAttr) Commands

The Extended Attributes (XAttr) extension for NSS provides accessibility into many extended attributes for NSS on Linux. It allows you to read, back up, and restore extended attributes of files on NSS. This section describes options to determine how extended attributes are handled for NSS on Linux.

- Section A.10.1, "CtimeIsMetadataModTime Option," on page 397
- Section A.10.2, "ListXattrNWmetadata Option," on page 398
- Section A.10.3, "Additional Information," on page 400

A.10.1 CtimeIsMetadataModTime Option

By default, the Linux `ctime` is mapped to NSS create time (CreateTime). We prefer that `ctime` be based on the NSS metadata modified time (MetadataModifiedTime) instead of the NSS create time, but modifying the Linux `ctime` function might cause unknown complications. Thus, NSS provides the `CtimeIsMetadataModTime` option to allow an administrator to select to map the metadata modified time as the Linux `ctime` value, rather than the NSS create time when the different time stamp matters for your deployment.

The `CtimeIsMetadataModTime` option can be set persistently in the `/etc/opt/novell/nss/nssstart.cfg` file, or it can be set from `nsscon` by a user with `root` access.

nss /CtimeIsMetadataModTime

Maps the NSS metadata modified time to Linux `ctime`. This is the default behavior in OES 2 Linux and later.

nss /noCtimeIsMetadataModTime

Maps the NSS create time to Linux `ctime`. This is the default behavior in OES 1 SP2 Linux and later.

A.10.2 ListXattrNWmetadata Option

- "ListXattrNWmetadata Option" on page 398
- "Security Issues for ListXattrNWmetadata" on page 399
- "Using the Linux cp Command to Copy Files with Extended Attributes" on page 399
- "Using the Linux rsync Command to Copy Files with Extended Attributes" on page 399

ListXattrNWmetadata Option

In OES 1 SP2 and later, the NetWare metadata (`netware.metadata`) extended attribute was added for files and directories. The `ListXattrNWmetadata` option for NSS allows a user or application with `root` access to select whether the `netware.metadata` extended attribute is returned for a file or directory at `listxattr(2)` time. The `ListXattrNWmetadata` option is disabled (OFF) by default. This option is intended for use by indexing or backup programs.

For users or applications without `root` access (without the `CAP_SYS_ADMIN` capability), the `listxattr(2)` command never lists the `netware.metadata` extended attribute, regardless of the `ListXattrNWmetadata` setting.

The `ListXattrNWmetadata` option can be set persistently in the `/etc/opt/novell/nss/nssstart.cfg` file, or it can be set from `nsscon` by a user with `root` access as follows:

nss /(No)ListXattrNWmetadata

Enables or disables the ability to return the `netware.metadata` extended attribute for a file or directory at `listxattr(2)` time.

The option is disabled by default in all OES versions. Enable the option if there is a need to use the Linux `xattr` functions to access or change NetWare metadata fields by name.

- **Off:** `listxattr()` does not return "netware.metadata" as an extended attribute for NSS files and directories. It is still possible to get extended attributes (`getxattr()`) and set extended attributes (`setxattr()`) by using the specific `xattr` name:

  `"netware.metadata"`

- **On:** `listxattr()` returns "netware.metadata" as an extended attribute for NSS files and directories.

Examples

To enable the return of netware.metadata information, enter the following in the NSS Console:

```
nss /ListXattrNWmetadata
```

To disable the return of netware.metadata information, enter the following in the NSS Console:

```
nss /NoListXattrNWmetadata
```

Security Issues for ListXattrNWmetadata

The `ListXattrNWmetadata` option is available only to the user or application with `root` access (the `CAP_SYS_ADMIN` capability). It is disabled (off) by default.

When this feature is enabled (on) (such as by the backup user or by third-party backup software), and if the user or application has `root` user access, the following occurs:

- When copying NSS files or directories with the Linux `cp` utility from NSS volumes to NSS volumes, the `cp` utility copies the trustees assigned to a file or directory to the destination file or directory. This means that the old trustees of the file or directory now have visibility into the destination directory. In addition, the old trustees inherit trustee rights from the destination directory for other files in that directory.

  NOTE: For users or applications without `root` access (without the `CAP_SYS_ADMIN` capability), the trustee information is not copied to the destination directory.

- When copying NSS files with the `cp` utility from NSS volumes to non-NSS volumes, the `cp` utility issues a warning message advising that it could not apply the `netware.metadata` extended attribute.

  NOTE: For users or applications without `root` access (without the `CAP_SYS_ADMIN` capability), the `cp` utility does not attempt to apply the `netware.metadata` extended attribute.

There is no work-around for these two copy-related issues for the user or application with `root` access. This is how the Linux `cp` utility works.

Using the Linux cp Command to Copy Files with Extended Attributes

The Linux `cp` command has changed for OES 2. In OES 1, when `listxattr` is enabled, the extended attributes are also copied when you use the `cp` command as the `root` user to copy files. However, in OES 2, in order to copy the extended attributes, you must use the `--preserve` option.

The man page of `cp` on OES2 provides the following description of the `--preserve` option:

--preserve[=ATTR_LIST]
Preserve the specified attributes (default: mode,ownership,timestamps), if possible additional attributes: links, xattrs, all.

For example, after you enable `listxattr`, you can copy a file and its `netware.metadata` by logging in as the `root` user, then entering the following at a terminal console prompt:

```
cp --preserve=all /path/file1 /newpath/file1
```

Using the Linux rsync Command to Copy Files with Extended Attributes

When using the Linux `rsync` command to copy files with extended attribute, use the `rsync -A` and `-X` options. For example:

```
rsync -A -X -av test/ test2/
```

Options	Description
`-A, --acls`	preserve ACLs (implies `-p`)
`-X, --xattrs`	preserve extended attributes
`-p, --perms`	preserve permissions

A.10.3 Additional Information

For information about how to use the XAttr Extension for NSS, see the *NDK: XAttr Extension for NSS* (http://developer.novell.com/documentation/xattr/attr_enu/data/bktitle.html).

For the latest patches for the `km_nss` module, visit the Novell Support *SUSE Patch Support Database (by date listing)* (http://support.novell.com/linux/psdb/bydate.html).

For information about how to use the Linux `listxattr(2)` command, see the man page (enter `man 2 listxattr` at a terminal console prompt).

Novell Cool Solutions has a listxattrs tool you can use to check if you get the extended attributes after enabling `/ListXattrNWmetadata`. The listxattrs tool can be downloaded from the *Cool Solutions > Cool Tools > List Extended Attributes with xattr APIs* (http://www.novell.com/coolsolutions/tools/18206.html).

A.11 Event File List (EFL) Command

For information about the Event File List (EFL) feature for developers, see "FileEvent.xml Definitions" (http://developer.novell.com/documentation/vfs/vfs__enu/data/ak7gh2x.html) in *NDK: Virtual File Services (http://developer.novell.com/documentation/vfs/vfs__enu/data/bktitle.html)*.

nss /ResetEFLTree=*volumename*

Reset the Event File List (EFL) tree on the given volume.

A.12 Hard Links Commands

Use the commands in this section for managing hard links capability for NSS volumes.

- Section A.12.1, "Hard Links Media Upgrade Commands for Existing Volumes," on page 400
- Section A.12.2, "Hard Links Media Upgrade Commands for New Volumes," on page 401
- Section A.12.3, "Hard Links Attribute Commands," on page 402
- Section A.12.4, "Hard Links Management Commands," on page 402

A.12.1 Hard Links Media Upgrade Commands for Existing Volumes

Use the commands in this section to perform the one-time upgrade for currently active volumes.

nss /ZLSSUpgradeCurrentVolumeMediaFormat=*volumename*

Upgrades the specified active volume. If it is a shared volume, the clustering system vetoes the upgrade until all nodes in the cluster are running a supported operating system.

nss /ZLSSUpgradeCurrentVolumeMediaFormat=all

Upgrades all currently active volumes. If a shared volume is encountered, the clustering system vetoes the upgrade until all nodes in the cluster are running a supported operating system.

nss /ZLSSUpgradeCurrentVolumeMediaFormat=all /include=shared

Upgrades all currently active volumes that are part of a shared pool, but only if the clustering system permits it.

nss /ZLSSUpgradeCurrentVolumeMediaFormat=all /include=local

Upgrades all currently active volumes that are not part of a shared pool.

nss /ZLSSUpgradeCurrentVolumeMediaFormat=all /include=local,shared

Upgrades all currently active volumes whether they are shared or local. If a shared volume is encountered, the clustering system vetoes the upgrade until all nodes in the cluster are running a supported operating system.

A.12.2 Hard Links Media Upgrade Commands for New Volumes

Use the commands in this section to enable all future NSS volumes to automatically be created with the new media format. Make sure to use the commands on the servers where you plan to use hard links. After a volume is created, you must manually enable the Hard Links attribute in order to create hard links on it. For command information, see Section A.12.3, "Hard Links Attribute Commands," on page 402.

If the command is issued from the command line, it persists until a server reboot. If the command is placed in the `nssstart.cfg` file, it persists across server reboots.

nss /ZLSSUpgradeNewVolumeMediaFormat

Creates all new NSS volumes with the upgraded structure. This applies to volumes on both local and shared pools.

nss /ZLSSUpgradeNewVolumeMediaFormat /include=shared

Creates all new NSS volumes with the upgraded structure if the new volume is on a shared pool. However, the clustering system vetoes the upgrade until all nodes in the cluster are running a supported operating system.

nss /ZLSSUpgradeNewVolumeMediaFormat /include=local

Creates all new NSS volumes with the upgraded structure if the new volume is not on a shared pool.

nss /ZLSSUpgradeNewVolumeMediaFormat /include=local,shared

Creates all new NSS volumes with the upgraded structure whether the volume is local or shared. In a cluster, the clustering system vetoes the upgrade until all nodes in the cluster are running a supported operating system.

A.12.3 Hard Links Attribute Commands

Use the commands in this section to enable or disable the Hard Links attribute for an NSS volume. The Hard Links attribute cannot be set or viewed in NSSMU or in the Storage plug-in to iManager.

nss /HardLinks=*volumename*

Enables the Hard Links attribute for the specified volume. This enables hard links to be created on the volume.

nss /HardLinks=all

Sets the Hard Links attribute for all NSS volumes on the server. This enables hard links to be created on any volume on the server. Any given hard link can point only to a file on the same volume.

nss /NoHardLinks=*volumename*

Disables the Hard Links attribute for the specified volume. Existing hard links continue to function, but no new hard links can be created on the specified volume.

nss /NoHardLinks=all

Disables the Hard Links attribute for all NSS volumes on the server. Existing hard links continue to function, but no new hard links can be created on any NSS volume on the server.

A.12.4 Hard Links Management Commands

You can view a report of hard links for a file to identify its primary link and the hard link that becomes the primary link if the primary link is deleted. For information, see Section 24.7, "Viewing Hard Links for a File," on page 329.

/nss /ListHardLinks=vol:*path\filename.ext*

View information about the primary link and hard links for a file on an NSS volume.

Replace *path* with the file's primary link path or one of its hard link paths where you want to start the search. Replace `filename.ext` with the actual filename of the file, including the extension.

Use the `/volumes` option to verify that the Hard Links attribute is enabled.

nss /volumes

View a list of NSS volumes on the server and information about them. In the Attributes column, the *HardLinks* attribute is listed if it is enabled for the volume.

A.13 I/O Monitoring Commands

nss /ZLSSIOStatus

Displays current NSS I/O status information.

nss /ZLSSPendingWriteIOs=*value*

Number of write inputs dropped to the storage subsystem.

Currently, there is no way to see the current setting for this parameter. Initially, you can assume that the value is the default setting. If you set ZLSSPendingWriteIOs to a valid value within the valid range, you can assume that NSS correctly applied the new value if no error is reported when you issue the command. You must keep track manually of whatever valid value you set.

Default: 1000

Range: 0 to 3000 (0=all available)

A.14 I/O Write Commands

Use the commands in this section to control the write behavior of dirty blocks from the cache to the disk. These commands are available for OES 2 Linux and later. For more information about using these commands, see Section 27.3, "Configuring or Tuning Group I/O," on page 352.

nss JournalGroupWriteTime=*seconds*

Specify the elapsed time to wait before group writes of journal blocks.

Replace *seconds* with the maximum number of seconds to elapse before forcing journal blocks to be written to the volume. The default value of *seconds* is 1.

Example

To group write journal blocks every 2 seconds, enter

```
nss Journal GroupWriteTime=2
```

nss MetadataGroupWriteTime=*seconds*

Specify the elapsed time to wait before group writes of metadata blocks. Decreasing the metadata group write timer can help reduce the mount time for the volume after a crash.

Replace *seconds* with the maximum number of seconds to elapse before forcing metadata blocks to be written to the volume. The default value of *seconds* is 40.

Example

To group write metadata blocks every 30 seconds, enter

```
nss MetadataGroupWriteTime=30
```

nss UserDataGroupWriteTime=*seconds*

Specify the elapsed time to wait before group writes of user data blocks. Decreasing the user data group write timer can help reduce the risk of data loss for a volume after a crash.

Replace *seconds* with the maximum number of seconds to elapse before forcing user data blocks to be written to the volume. The default value of *seconds* is 3.

Example

To group write user data blocks every 1 second, enter

```
nss UserDataGroupWriteTime=1
```

nss MetadataGroupWriteLimit=*blocks*

Specify the maximum number of metadata blocks that can be dirty before a group write is performed.

Replace *blocks* with the maximum number of metadata blocks that can be dirty before forcing them to be written to the volume. The default value of *blocks* is 20000.

Examples

To decrease the maximum number of dirty metadata blocks to 15,000 for the purpose of reducing the mount time, enter

```
nss MetadataGroupWriteLimit=15000
```

To increase the maximum number of dirty metadata blocks to 30,000 for the purpose of increasing the file system performance, enter

```
nss MetadataGroupWriteLimit=30000
```

A.15 LAF Audit Log Messages Commands

Use the NSS audit log messages commands to enable or disable messages via Lightweight Auditing Framework (LAF) for NSS trustee changes for NSS volumes on OES 2 Linux and later. When it is enabled, NSS reports changes for the following subset of NSS events:

- Adding trustees (AddTrustee)
- Removing trustees (RemoveTrustee)
- Setting the inherited rights mask (SetInheritedRightsMask)

The messages are stored in the`/var/log/audit/audit.log` file. For information about the content and format of messages in the log, see Section 20.4.1, “Understanding NSS Audit Log Messages,” on page 269.

nss /(No)LAFAuditTrustee

Enable or disable the generation of audit messages via Lightweight Auditing Framework for NSS trustee changes for NSS volumes.

After you enable the audit log messages, the setting persists until the server reboot. After a server reboot, the audit log is disabled again by default. To make the command persist across reboots, add it to the `/etc/opt/novell/nss/nssstart.cfg` file.

To have the setting persist across reboots, add it to the `/etc/opt/novell/nss/nssstart.cfg` file.

Default: Off (disabled)

Values: On or Off

Examples

To enable NSS audit messages, enter the following at the `nsscon` prompt:

```
nss /LAFAuditTrustee
```

To disable NSS audit messages, enter the following at the `nsscon` prompt:

```
nss /NoLAFAuditTrustee
```

A.16 Load Commands for the nssstart.cfg File

Use the commands in this section to load the services automatically by placing them in the `nssstart.cfg` file in the `/etc/opt/novell/nss` directory.

nss /(No)SkipLoadModules

If enabled, skips the auto-loading of the NSS support modules.

Default: Off

/NumWorkToDos=*value*

If used in the `nssstart.cfg` file, sets the number of WorkToDo entries. Entries can execute concurrently.

NSS uses WorkToDo entries for tasks such as flushing file metadata to disk in the background. Increasing the number of WorkToDo entries might be useful on a system that is heavily used. NSS always reserves 20 WorkToDo entries.

Default: 50

Range: 5 to 100

/zLSS

If it is specified in the `nssstart.cfg` file, loads only those modules that are essential for zLSS support.

A.17 Low Storage Alert Messages Commands

nss /(No)StorageAlertMessages

Enables or disables NSS to send Low Storage messages to all users.

Default: On

nss /StorageAlarmThreshold=*value*

Sets the threshold (in MB) for a Low Storage space warning.

Default: 10

Range: 0 to 1000000

nss /StorageResetThreshold=*value*

Resets the threshold (in MB) for a Low Storage space warning.

Default: 10

Range: 0 to 1000000

A.18 Migration Support Commands for Near-Line Storage

nss /(No)Migration=<*volumename* | all>

Enables or disables migration of files on the specified volumes to a third-party near-line storage system.

This option is used only for third-party vendor applications that provide near-line storage. It is not a migration tool for migrating data from NetWare to Linux, and it is not associated with Dynamic Storage Technology.

A.19 Modified File List (MFL) Commands

Use the commands in this section to manage the Modified File List (MFL) feature for NSS volumes. The MFL attribute enables NSS to create a list of all files modified since the previous backup. The log is available only through third-party software.

nss /(No)MFL=*volumename*

Enables or disables the Modified File List attribute for the specified volume.

Examples

To enable the MFL attribute for a given volume, enter

```
nss /MFL=volumename
```

To disable the MFL attribute for a given volume, enter

```
nss /NoMFL=volumename
```

nss /MFLVerify=*volumename*

Compares the modified file list with the specified volume and reports any inconsistencies.

nss /FixMFL=*volumename*

Repairs the modified file list to be consistent with the file system.

nss /GetMFLStatus=*volumename*

Shows the modified file list status for the specified volume.

A.20 Multipath I/O Failover Commands

The Media Manager multipath I/O management is not available for Linux. For devices on Linux, use the Linux multipath I/O management tools. For information, Chapter 14, "Managing Multipath I/O to Devices," on page 173.

A.21 Multiple Server Activation Prevention (MSAP) Commands

Use the commands in this section to prevent NSS pools from being concurrently active on multiple nodes. The management file for pool Multiple Server Activation Prevention (MSAP) is `_admin\manage_nss\pool\ poolname\zlss\msap.xml`. One file exists for each pool. This file contains MSAP statistics for the pool. The MSAP attribute is displayed in the enabledAttributes tag of the `poolinfo.xml` management file.

For `manage.cmd`, the pool operation `getPoolInfo` returns the MSAP tag (`<msap>`) in the supportedAttributes tag (`<supportedAttributes>`) and the enabledAttributes tag (`<enabledAttributes>`).

For APIs, the pool feature `zpool_feature_msap` can be viewed and controlled using the `zGetInfo` and `zModifyInfo` commands.

nss /MSAPServer

Enables MSAP for all the pools on the server. By default, MSAP is enabled for every pool on the server. We recommend that you never disable MSAP.

nss /NoMSAPServer

Disables MSAP for all the pools on the server. This command remains in effect only until the server is rebooted. We recommend that you never disable MSAP.

nss /MSAPRebuild=*poolname*

Rebuilds a corrupt MSAP block. If the MSAP block for a pool becomes corrupt, it prevents a pool from going into Maintenance state. Use this command to rebuild the MSAP block for a given pool. Before issuing the command to rebuild, you must deactivate the pool. Rebuilding an MSAP block does not give the rebuilder ownership of the pool.

nss /PoolMSAP=*poolname*

Enables MSAP for a given pool on the server. MSAP is enabled the next time the pool is activated. (Enter the command, deactivate the pool, then activate the pool. MSAP is now enabled.)

nss /NoPoolMSAP=*poolname*

Disables MSAP for a given pool. Use the command when the pool is activated. MSAP is disabled the next time the pool is activated. (Enter the command, deactivate the pool, then activate the pool. MSAP is now disabled.)

nss /MSAPServerID=*id*

Sets the ID for MSAP to use to uniquely identify the server.

nss /MSAPIDDisplay

Displays current IDs used by MSAP.

nss /pools

Displays the message *Multi-Use Detect* for NSS pools that have MSAP enabled.

A.22 noatime and atime Commands

The `/noatime` and `/atime` commands for a volume allow the administrator to control whether access times are updated when files and directories are read. They are available for NSS on OES 2 SP1 Linux and later. The setting persists across reboots.

Using `/noatime` is useful for backup, news servers, and mail servers where the extra disk activity associated with updating the access time is not desired. Avoiding the writes associated with updating the access time can result in measurable performance gains.

A.22.1 Using noatime or atime at the Command Line

Issue the following commands in the NSS Console.

nss /atime=*volumename*

This option enables the updating of access time for both files and directories in a specified volume so that reading a file updates its access time. This is enabled by default.

nss /noatime=*volumename*

This option disables the updating of access time for both files and directories in a specified volume so that reading a file does not update its access time.

A.22.2 Using noatime in a Cluster Load Script

You can also use the `noatime` option when mounting an NSS volume in a Novell Cluster Services cluster load script. The `atime` setting is enabled by default, so it is not necessary to specify it explicitly.

In the cluster load script, modify the `ncpcon mount` command for the volume:

```
exit_on_error ncpcon mount /opt="noatime" volumename=volume_id
```

When you create a new volume on a cluster-enabled pool, Cluster Services automatically assigns it a volume ID that is unique in the entire cluster and writes the value to the cluster resource load script for the pool. When you add the `/opt` option to volume's mount line in the load script, the volume ID is already part of the command.

For example, for a volume named VOL1 and a volume ID of 254, the commands would be:

```
mount /opt="noatime" VOL1 VOLID=254
```

```
exit_on_error ncpcon mount /opt="noatime" VOL1=254
```

A.22.3 Viewing the atime or noatime Setting

You can view the current setting for the `atime` attribute by using the `nss /volumes` command at the NSS Console.

`atime` attribute is enabled - Attribute is not displayed.

`atime` attribute is disabled - No Access Time is displayed.

A.23 noatime and nodiratime Support for Linux open, mount, nfsmount, and /etc/fstab

NSS on OES 2 Linux supports the `O_NOATIME` option for the Linux `open(2)` command, and the `noatime` and `nodiratime` options for the `mount` and `nfsmount` command and the `/etc/fstab` file. These options have the same objective—that is, to prevent the access time from being updated unless the access involves a modification of a file's or directory's metadata or content.

- **noatime:** Disables the updating of access time for both files and directories so that reading a file does not update their access time (atime).
- **nodiratime:** Disables updating of access time when opening directories so that the access time is not modified when enumerating directories. This routine also checks that the object is a directory, which slows down the routine.

These options are useful for backup, news servers, and mail servers where the extra disk activity associated with updating the access time is not desired. Avoiding the writes associated with updating the access time can result in measurable performance gains.

IMPORTANT: Typically, you need to use only the `noatime` option so that atime is not updated for the accessed file and its directory when the file is accessed. To determine if the `noatime` and `nodiratime` options can help the performance of a particular application, refer to the documentation and best practices for that application.

For information about applying these options, see the following:

- Section A.23.1, "Linux open(2) Command," on page 409
- Section A.23.2, "Linux mount Command," on page 409
- Section A.23.3, "Linux nfsmount Command," on page 410
- Section A.23.4, "Linux /etc/fstab File," on page 410
- Section A.23.5, "Patches for km_nss," on page 410

A.23.1 Linux open(2) Command

By default, the `open` command updates the access time whenever a file is opened or a directory is accessed. The `O_NOATIME` option disables the updating of access time, so that reading a file does not update its access time. Using this option allows you to back up a volume without modifying the access times (`ATIME`) of its files.

The man page for the `open(2)` command defines the `O_NOATIME` option as follows:

O_NOATIME

(Since Linux 2.6.8) Do not update the file last access time when the file is read. This flag is intended for use by indexing or backup programs, where its use can significantly reduce the amount of disk activity.

For information about how to use the `O_NOATIME` option, see the man page for the Linux `open(2)` command by entering `man 2 open` at a terminal console prompt.

A.23.2 Linux mount Command

The `noatime` and `nodiratime` options for the `mount` command are available for all Linux file systems, including NSS.

IMPORTANT: Typically, you need to use only the `noatime` option so that atime is not updated for the accessed file and its directory when the file is accessed. To determine if the `noatime` and `nodiratime` options can help the performance of a particular application, refer to the documentation and best practices for that application.

To enable `noatime` or `nodiratime` options when mounting an NSS volume:

1. Open a terminal console on the server, then log in as the `root` user.
2. At the terminal console prompt, enter (all on the same line, of course):

   ```
   mount -t nssvol VOL vol_mountpoint -o name=volname,noatime
   ```

   or

   ```
   mount -t nssvol VOL vol_mountpoint -o name=volname,nodiratime
   ```

   Replace *vol_mountpoint* with the mount point for the volume, such as `/media/nss/NSSV1`. Replace *volname* with the name of the volume, such as `NSSV1`.

   For example, enter:

```
mount -t nssvol VOL /media/nss/NSSV1 -o name=NSSV1,noatime
```

This command mounts the volume NSSV1 with the `noatime` option so that the file and directory access times are not updated when a file is accessed but not modified.

A.23.3 Linux nfsmount Command

1. In YaST, click *Network Services* > *NFS Server* > *NFS Mount*.
2. Specify the volume, then enter

   ```
   rw,no_root_squash,sync,fsid=value,noatime
   ```

   For information about the other `nfsmount` options used here, see Section 18.16, "Exporting and Importing NSS Volumes for NFS Access," on page 242.
3. Click *OK*.

A.23.4 Linux /etc/fstab File

The `noatime` and `nodiratime` options are available as mount options in the `/etc/fstab` file for all Linux file systems, including NSS. To enable the `noatime` and `nodiratime` options as default mounting options for a volume so they are in effect at boot time, modify the entry for the NSS volume in the `/etc/fstab` file.

1. Open the `/etc/fstab` file in a text editor.
2. Modify the entry for the NSS volume by adding `noatime` or `nodiratime` as options.

   For example, type

   ```
   volname vol_mountpoint nssvol noauto,rw,name=volname,noatime 0 0
   ```

   Replace *`volname`* with the name of the volume, such as `NSSV1`. Replace *`vol_mountpoint`* with the mount location of the NSS volume, such as `/media/nss/NSSV1`.

   For example (all on the same line, of course):

   ```
   NSSV1 /media/nss/NSSV1 nssvol noauto,rw,name=NSSV1,noatime 0 0
   ```
3. Save the file.
4. Reboot the server to apply the changes.

A.23.5 Patches for km_nss

NSS support for access time options is delivered in the `km_nss` RPM in the Linux kernel. For the latest patches for the `km_nss` module in SUSE Linux Enterprise Server 10, visit the Novell Support Patches & Security Web site (http://support.novell.com/patches.html).

A.24 Opportunistic Locking Commands

On Linux, the opportunistic locking is controlled by NCP Server. Use the NCP Server option `OPLOCK_SUPPORT_LEVEL` to manage oplocks for NSS volumes on OES Linux. For more information, see "Using Opportunistic Locking for NCP File Handling".

A.25 Pool Freeze and Thaw Commands

Use the commands in this section to temporarily freeze (quiesce) and thaw activity on a pool.

nss /PoolFreeze=*poolname*

Temporarily quiesces activity on the specified pool.

nss /PoolThaw=*poolname*

Resume activity on the specified pool that has previously been frozen.

A.26 Pool Management Commands

Enter the following commands to perform maintenance for NSS pools and volumes.

NOTE: On Linux, you can execute some commands from NSSCON and some commands from both NSSCON and server console.

A.26.1 Pool Status

nss /LVScan=*poolname*

Available from NSSCON. Scans for logical volumes within the specified active pool.

nss /pools, or pools

Available from NSSCON and server console both. Shows all of the currently available NSS pools.

nss /ZLSSPoolIOErrors

Available from NSSCON. Shows the last 100 pool I/O errors reported from the block layer that have occurred since the server's last reboot. The block layer does not have many error codes, so the usefulness of the error may be limited. NSS stores some block layer errors in the `/var/log/messages` file. Look for `BIO_` in the log file to see if any pool I/O error messages are present.

A.26.2 PoolAuto Commands for Load Time

Use the pool commands in this section at load time. Any encrypted volumes on the pool cannot be automatically activated. Encrypted volumes remain deactive until you activate the volume manually and provide the password on the first activation after a reboot.

Place the PoolAuto commands in the `nssstart.cfg` file to make them persist across reboots. The file is in the `/etc/opt/novell/nss` directory.

On Linux, the following commands are available only from NSSMU:

PoolAutoDisplay=<*poolname* | all>

Displays the pool's current load-time policies.

nss /PoolAutoActivate=<*poolname* | all>

Activates specified pools at load time.

nss /PoolAutoDeactivate=<*poolname* | all>

Leaves specified pools in the deactivated state at load time.

nss /PoolAutoMaintenance=<*poolname* | all>

Places specified pools in maintenance mode at pool load time.

nss /PoolAutoVerify=<*poolname* | all>

Verify the specified pool's physical integrity at startup time.

The following modifier commands can be used with the /PoolAuto commands to automatically handle pools of status type shared, corrupt, and questions.

nss </*PoolAuto_command*> [/IncludeType=*type* | OverrideType=*type*]

Use the IncludeType or OverrideType modifier commands to include or override pools of the specified status type for a given /PoolAuto... command. Possible status types are SHARED, CORRUPT, and QUESTIONS.

A.27 Pool Snapshot Commands

NSS pool snapshots are supported on OES 2 Linux and later; however, there are no command line options available on Linux. You must use NSSMU to manage NSS pool snapshots on Linux. For general information about pool snapshots, see Chapter 17, "Managing NSS Pool Snapshots," on page 203. For an NSSMU for Linux quick reference on snapshots, see "Snapshots" in Table 9-12 on page 104.

A.28 Pool Verify and Rebuild Commands

For NSS volumes on Linux, use the RAVSUI utility to verify and rebuild pools. For more information about rebuilding pools, see Chapter 16, "Verifying and Rebuilding NSS Pools and Volumes," on page 193.

A.29 POSIX Permission Mask Command

nss /PosixPermissionMask=*mask*

Specify the octal mask to control which bits in the POSIX permissions (`drwxrwxrwx`) are allowed to be set. The octal digits correspond to directory, user, group, and other fields. By default, NSS sets the POSIX permissions to 0777.

IMPORTANT: NSS uses the Novell trustee model to authenticate and give access to users, not the Linux ACLs and POSIX permissions.

The command applies to all NSS volumes on the Linux server. In a cluster environment, make sure that the setting is the same on all nodes. This command should normally be added in the `/etc/opt/novell/nss/nssstart.cfg` file so that it persists across reboots.

Example

For example, SSH requires that the permissions in the Other field be disabled. If you use NSS volumes for home directories and you want users to have SSH access to them, you must modify the POSIX permissions to 0770. The following command in the `/etc/opt/novell/nss/nssstart.cfg` file turns off all of the bits corresponding to the Other field:

`/PosixPermissionMask=0770`

The setting applies to all NSS volumes on the server. You must also Linux-enable users and enable SSH with Linux User Management

If the volume is shared in a cluster, make sure to add the command to the `nssstart.cfg` file on all nodes and to Linux-enable SSH on all nodes.

A.30 Quotas Commands

Use the commands in this section to manage quotas (space restrictions) for NSS pools and volumes.

- Section A.30.1, "Sys: Volume Quota Command," on page 413
- Section A.30.2, "Directory Quotas Commands," on page 413
- Section A.30.3, "User Quotas Commands," on page 413

A.30.1 Sys: Volume Quota Command

nss /ChangeSysQuota=*size*

Lets you change the quota (in MB) for the `sys:` volume. Setting this value to zero sets the Quota to none and allows the `sys:` volume to grow to the size of the `sys` pool.

A.30.2 Directory Quotas Commands

nss /(No)DirectoryQuotas=*volumename*

Enables or disables the Directory Quotas attribute on the volume.

nss /FixDirectoryQuotas=*volumename*

Recomputes used space for directory quotas for the specified volume.

This process can take time to recalculate, depending on the number of directory quotas set on the volume. There are no interim messages to report status.

A.30.3 User Quotas Commands

nss /(No)UserSpaceRestrictions=*volumename*

Enables or disables the User Quotas attribute on the volume. After you enable quotas, use go to the *Storage > User Quotas* page in iManager to set quotas for users.

A.31 Read Ahead Blocks and Allocate Ahead Blocks Commands

NSS offers the Read Ahead Blocks command for tuning read performance, and the Allocate Ahead Blocks command for tuning write performance. You can enter the commands in the NSS Console.

- Section A.31.1, "Read Ahead Blocks," on page 414
- Section A.31.2, "Allocate Ahead Blocks," on page 414

A.31.1 Read Ahead Blocks

The Read Ahead Blocks parameter can be set differently on each NSS volume. It specifies the number of data blocks that NSS reads ahead for any open file on which read operations are ongoing in the specified server. The Read Ahead Blocks parameter is enabled by default and set at 16 blocks. To modify the value, you must set it from the command line using the `ReadAheadBlks` switch. You can also set the value from NSSMU in the volume properties.

The default block count satisfies the performance requirements for a typical volume. The valid range for block count is 0 blocks to 1024 blocks, where a block count of zero (0) implies no read ahead. However, the practical maximum is 128 blocks.

The most efficient value for block count depends on your hardware. In general, we recommend a block count of 8 to 16 blocks for large data reads; 2 blocks for CDs, 8 blocks for DVDs, and 2 blocks for ZLSS.

The block count should not exceed 128 blocks for most implementations. Aggressive read ahead is optimal for sequential access but it degrades random access. Block counts greater than 128 can starve other system components for memory or buffers, which can result in poor performance or can cause system hangs. As the number of concurrent connections to unique files increases, you should reduce the read-ahead block count.

nss /ReadAheadBlks=*volname:count*

Specify *VolName* as the name of the volume that you are setting the attribute for. Specify the *Count* to be the number of 4 KB blocks that you want to NSS to read ahead. The valid range for a block count is 0 blocks to 1024 blocks, where a block count of zero (0) implies no read ahead. However, 128 blocks is the practical maximum.

Read-ahead block counts higher than 128 can starve other system components for memory or buffers, which can impair performance or cause the system to hang. As the number of concurrent connections to unique files increase, you should reduce the number of read-ahead blocks.

Default: 16

Range: 0 to 1024 blocks, where 0=Off; Practical maximum: 128

IMPORTANT: The default ReadAheadBlks count for OES 1 Linux is 2 blocks. If you have read performance issues after upgrading from OES 1 Linux to OES 2 Linux, check the volume settings for ReadAheadBlks count. For information, see Section 3.6, “Upgrading from OES 1 Linux to OES 2 Linux,” on page 46.

A.31.2 Allocate Ahead Blocks

Use the Allocate Ahead Blocks command for tuning write performance for all NSS volumes on the server.

nss /AllocAheadBlks=*value*

Sets the number of blocks to allocate ahead on writes.

Default: 0

Range: 0 to 63

A.32 Salvage and Purge Commands

Use the commands in this section for tuning the purging processes for NSS volumes. For more information about managing salvage for NSS volumes, see Chapter 23, "Salvaging and Purging Deleted Volumes, Directories, and Files," on page 309.

nss /(No)ImmediatePurgeOfDeletedFiles

Enables or disables files to be purged immediately upon deletion.

NSS volumes on the server can optionally use the salvage feature of NSS to save deleted files until space is needed. When you enable the Immediate Purge of Deleted Files parameter, it affects all volumes on the server. If the Salvage attribute is enabled for a volume, enabling this flag overrides it so that deleted files and directories are purged immediately.

Default: Disabled

nss /(No)Salvage=<*volumename* | all>

Enables or disables the ability to salvage of deleted files on volumes. *Volume* enables the Salvage command on the specified NSS volume on the specified server. *All* enables the Salvage command on all NSS volumes on the specified server.

nss /LogicalVolumePurgeDelay=*value*

The number of seconds before deleted logical volumes are purged. This allows time to reverse the deletion.

Default: 345600 (4 days)

nss /LogicalVolumePurgeDelayAfterLoad=*value*

The number of seconds after NSS loads before deleted logical volumes are purged. This allows time to pause autopurging.

Default: 7200

nss /LogicalVolumePurgeDelayAfterContinue=*value*

The number of seconds to delay purging a deleted logical volume after clicking Continue. After a volume starts to purge, it cannot be salvaged.

Default: 900

nss /PoolHighWaterMark=*poolname*:Percent

Purging begins in the salvage area when the pool's low watermark is reached, and continues until its high watermark is reached, or until there are no deleted files and volumes left to purge, whichever occurs first. Autopurging does not start again until free space again drops below the low watermark. Specify a given poolname or All to apply the setting to all pools.

The high and low watermarks must be at least 2% apart from each other.

The watermark is set to the default at boot unless you put the command in the startup file to set it to a different value.

Default: 20

Range: 2 to 100

nss /PoolLowWaterMark=*poolname*:Percent

Purging begins in the salvage area when the pool's low watermark is reached and continues until its high watermark is reached. When free disk space falls below a low watermark, NSS begins autopurging the salvage area. Specify a given poolname or All to apply the setting to all pools.

The high and low watermarks must be at least 2% apart from each other.

The watermark is set to the default at boot unless you put the command in the startup file to set it to a different value.

Default: 10

Range: 0 to 98

nss /SalvageSys

Lets you restore the `sys:` volume if you have deleted it (if it has not yet been purged).

nss /LVDeleteStatusBasic, or LVDeleteStatusBasic

Displays information about deleted logical volumes.

nss /LVDeleteStatusSalvageable, or LVDeleteStatusSalvageable

Displays information about salvageable logical volumes.

A.33 Security Equivalence Vector Update Commands

Use the Security Equivalence Vector (SEV) Update commands in the NSS Console utility (`nsscon`) to enable or disable the update, to set the update interval from 5 minutes to 90 days (specified in seconds), and to force an immediate update of security equivalence vectors. Polling too frequently can impact performance. Polling too infrequently can cause delays in granting or restricting access to certain users. For more information about SEV, see Section 20.2, "Configuring the Security Equivalence Vector Update Frequency," on page 265.

nss /(No)SecurityEquivalenceUpdating

Enables or disables SEV updates to occur in the background in addition to updates that occur when the system reboots. If it is disabled, SEV updates occur only at system reboots.

To make it persistent, include the command in the `/etc/opt/novell/nss/nssstart.cfg` file.

Default: On (enabled)

Examples

To enable background updating, enter

```
nss /SecurityEquivalenceUpdating
```

To disable background updating, enter

```
nss /NoSecurityEquivalenceUpdating
```

nss /UpdateSecurityEquivalenceInterval=*value*

Sets the SEV update interval to the specified value in seconds. At the end of the elapsed time, NSS requires updated SEVs from eDirectory.

To make it persistent, include the command in the `/etc/opt/novell/nss/nssstart.cfg` file.

Default: 7200 (2 hours)

Range: 300 (5 minutes) to 7776000 (90 days).

nss /ForceSecurityEquivalenceUpdate

Forces the SEV update to occur immediately for all users in the NSS file system. Use this command if you modify a user's access control settings in eDirectory and want those changes to be reflected immediately in the user's active SEV for this server.

This command is invalid if used in the `/etc/opt/novell/nss/nssstart.cfg` file.

A unique abbreviation such as

```
nss /ForceS
```

also works.

ForceSecurityEquivalenceUpdate

Forces the user security equivalence background updating to start immediately. Use this command if you modify a user's access control settings in eDirectory and want those changes to be reflected immediately in the user's active SEV for this server.

A.34 Sendfile API Support Command

nss /(No)SendfileSupport

Enable or disable support for the sendfile() API.

Default: On

A.35 Status Commands

Enter the following commands in a server console to show the status of various NSS parameters.

CompScreen

Displays the NSS volume compression statistics on the compression screen.

nss /pools, Pools

Lists all of the NSS pools that are currently available on the server.

PoolsAutoDisplay

Displays load-time policies for pools on the server.

nss /status, Status

Lists the current NSS status information.

nss /volumes, Volumes

Lists all of the NSS volumes that are currently mounted and active, including the `_admin` volume.

VolumesAutoDisplay

Displays load-time policies for volumes on the server.

SpaceInformation

Lists the amount of space on active pools and their associated volumes.

ListFreeSpace

Lists the amount of available space that has not been assigned to a pool.

nss /ErrorCode=*code*

Translates and describes the specified error code.

Modules

Lists the providers, loadable storage subsystems, and semantic agents.

Version

Displays the version information for NSS.

A.36 Visibility Rebuild Command

You might need to rebuild the visibility list in order to address problems where the computed value does not equal the stored value for the visibility lists. For example, if the `dmptrust volumename` command reports unknown trustees or many mismatched user GUIDs, you might need to run a visibility rebuild for the NSS volume.

You can use `checkvis.nlm` to check visibility for issues.

WARNING: The visibility rebuild process can be destructive. Users who could see directories before might not be able to afterwards. Run this operation only as required. Do not use visibility list rebuilds as a regular maintenance tool.

- Section A.36.1, “Description,” on page 418
- Section A.36.2, “Syntax,” on page 419
- Section A.36.3, “Additional Information,” on page 419

A.36.1 Description

When you perform a visibility rebuild, the system first deletes all current entries in the visibility list. Then, in a second pass, the system attempts to rebuild the visibility list for assigned trustees. The numbers you see at the conclusion of the rebuild give the following information:

Parameter	Description
Objects examined	Indicates the total number of file system objects looked at (a total of files and directories, plus special file system beasts).
Objects cleaned	Indicates the number of directories where visibility information was removed during the first pass.
Overflow objects removed	Indicates the number of visibility overflow objects removed during the first pass.
Trustees re-added	Indicates the number of trustees found on the volume and re-added to visibility lists. Although this number is non-zero, it doesn't mean problems were fixed or resolved. Instead, the number indicates the number of trustees found and included in the visibility list (whether they were there before the rebuild started or not).

After you run a visibility rebuild, make sure you run the visibility check again. If there are still errors, you must examine your trustees for problem before running a visibility rebuild again.

A.36.2 Syntax

nss /VisibilityRebuild=*volumename*

Rebuild the authorization visibility lists for an NSS volume.

A.36.3 Additional Information

For information about checking, repair, and troubleshooting the visibility list, see *NetWare 6 Trustee Rights: How They Work and What to Do When All Goes Wrong* (http://support.novell.com/techcenter/articles/ana20030202.html) in *Novell AppNotes* (2003, February 1).

A.37 Volume Management Commands

- Section A.37.1, "Volumes Command," on page 419
- Section A.37.2, "Volume Activity Commands," on page 420
- Section A.37.3, "Encrypted Volume Activity Commands," on page 421
- Section A.37.4, "VolumeAuto Commands for Load Time," on page 421

A.37.1 Volumes Command

NSS provides the `volumes` command and `/volumes` option for viewing a list of the currently mounted volumes, their status, and the attributes for NSS volumes. To view which attributes are currently set for a volume, enter

```
nss /volumes
```

You can also use enter the `volumes` command to get the same output.

The `volumes` utility for NCP provides additional information about the mounted volumes on a Linux server, such as its Linux path. For information, see Section B.12, "volumes (NCP Console Utility)," on page 446.

For example, the NSS `volumes` command outputs state and attributes information in a tabular format:

```
     Volume Name           State               Attributes
----------------------  -----------  ----------------------------------
_ADMIN                  ACTIVE       Hardlinks
DATA1                   ACTIVE       Salvage
                                     Compression
                                     Data Shredding
DATA2                   ACTIVE       Salvage
VOL1                    ACTIVE       Salvage
                                     User Space Restrictions
                                     Directory Quotas
VOL2                    ACTIVE        Salvage
```

The following volume attributes are displayed:

Attribute	For Information
Compression	Section A.6, “Compression Commands,” on page 393
Data shredding	Section A.7, “Data Shredding Commands,” on page 396
Directory quotas	Section A.30.2, “Directory Quotas Commands,” on page 413
Encryption	Section A.37.3, “Encrypted Volume Activity Commands,” on page 421
Hard links	Section A.12, “Hard Links Commands,” on page 400
Migration (for near-line storage support)	Section A.18, “Migration Support Commands for Near-Line Storage,” on page 405
Modified File List (MFL)	Section A.19, “Modified File List (MFL) Commands,” on page 405
Salvage	Section A.32, “Salvage and Purge Commands,” on page 415
User quotas	Section A.30.3, “User Quotas Commands,” on page 413

A.37.2 Volume Activity Commands

nss /ExtendMac=*volumename*

Enable extended Macintosh name space on the specified NSS volume.

nss /ForceActivate=*volumename*

Forces an NSS volume to become active. For encrypted NSS volumes, this command cannot force an activation unless the volume has been previously activated with a password on the first activation after a reboot.

nss /ForceDeactivate=*volumename*

Forces an NSS volume to the deactive state. Does not prompt for open files.

nss /VolumeActivate=*volumename*

Activates the specified NSS volume.

nss /VolumeDeactivate=*volumename*

Deactivates the specified NSS volume.

nss /VolumeMaintenance=*volumename*

Places a specified volume into maintenance mode. Volumes can be put in maintenance mode, but maintenance occurs only at the storage pool level.

mount *volume_name*

Mount the specified unencrypted NSS volume or an encrypted NSS volume that has been previously activated with its password. If it has not been previously activated, it returns an error message, requesting more information.

mount all

Mount all unencrypted NSS volumes and all encrypted NSS volumes that have been previously activated with their passwords. Encrypted NSS volumes that were not previously activated return error messages, requesting more information.

A.37.3 Encrypted Volume Activity Commands

Use the commands in this section to display volume status and to activate, mount, deactivate, or dismount encrypted NSS volumes.

You must enter a password the first time the volume is activated or mounted following a system reboot. Thereafter, other environmental security and authentication measures control access to user data.

IMPORTANT: Use NSSMU to mount encrypted volumes on Linux the first time after a server reboot. Thereafter, you can use the Linux `mount` command.

You cannot use wildcard commands, such as `nss /VolumeAutoActivate`, to activate encrypted NSS volumes.

You cannot use the wildcard option of All as the volume name for volumes where the password has not previously been provided. Until an encrypted volume is activated with its password following each system reboot, the All option does not find the volume and does not execute the command. The system returns an error message.

nss /activate=*volume_name*

Activate the specified unencrypted NSS volume.

On Linux, this command cannot be used to activate encrypted NSS volumes.

nss /activate=all

Activate all unencrypted NSS volumes. On Linux, this command cannot be used to activate encrypted NSS volumes.

mount *volume_name*

Mount the specified unencrypted NSS volume or an encrypted NSS volume that has been previously activated with its password. If it has not been previously activated, it returns an error message, requesting more information.

mount all

Mount all unencrypted NSS volumes and all encrypted NSS volumes that have been previously activated with their passwords. Encrypted NSS volumes that were not previously activated return error messages, requesting more information.

nss /volumeactivate=*volume_name*

Activate the specified unencrypted NSS volume. If you are prompted for it, enter the encryption password. The password is required only on the first activation following a system reboot.

On Linux, this command cannot be used to activate encrypted NSS volumes.

nss /volumes

View the status of an encrypted and unencrypted NSS volumes. The encrypted volume returns a status of Encrypted.

A.37.4 VolumeAuto Commands for Load Time

Use the following command to view the volume's current load-time policies.

VolumeAutoDisplay=*volumename*

Displays the volume's current load-time policies.

Use the following commands in the `nssstart.cfg` file to control which volumes are active at load time. You cannot use these commands for encrypted NSS volumes. You must use NSSMU to activate the volume on the first time after restart so you can provide the password.

nss /VolumeAutoActivate=*volumename*

Activates the specified volume at load time.

nss /VolumeAutoDeactivate=*volumename*

Deactivates the specified volume at load time.

A.38 ZID Commands

Use the commands in this section to manage the file numbering, or ZIDs, of files on an NSS volume.

nss /ZIDNameSpace=*namespace*

Specify the name space (DOS, Long, Macintosh, or UNIX) the command `/ZIDToFileName` should use.

nss /ZIDtoFilename=*ZIDnumber*

For a specified ZID, reports the file's full path and filename for a given volume and name space. Use only with `/ZIDVolumeName` and `/ZIDNameSpace` to provide context for the command.

nss /ZIDVolumeName=*volumename*

The volume name the command `/ZIDToFileName` should use.

/(No)ReZID

Use this option only with the pool rebuild options in the `ravsui` utility on Linux to enable or disable the rebuild to reZID the volume(s) in the pool that is being rebuilt.

Default: Off

Range: On or Off

Examples

For guidelines and instructions for how to use the ReZID option with pool rebuild commands, see Section 16.3, "ReZIDing Volumes in an NSS Pool," on page 200.

B NSS Utilities

This section details the syntax and options for the following Novell Storage Services utilities for Novell Open Enterprise Server 2 Linux.

- Section B.1, “attrib,” on page 423
- Section B.2, “compfix,” on page 426
- Section B.3, “metamig,” on page 429
- Section B.4, “ndir,” on page 432
- Section B.5, “nsscon,” on page 433
- Section B.6, “nssmu,” on page 435
- Section B.7, “nssupdate,” on page 435
- Section B.8, “ravsui,” on page 436
- Section B.9, “ravview,” on page 439
- Section B.10, “refreshids,” on page 442
- Section B.11, “rights,” on page 442
- Section B.12, “volumes (NCP Console Utility),” on page 446
- Section B.13, “quota,” on page 447
- Section B.14, “nssraid,” on page 449
- Section B.15, “ncsinit,” on page 450

B.1 attrib

Use the Attribute (`attrib`) utility to set NSS file system directory and file attributes on Linux.

B.1.1 Syntax

`attrib [options] [filename]`

If both the set and clear options are selected, the clear option is completed before the set option. If the filename is not specified, the operation is completed on the current directory.

B.1.2 Options

Option	Description
`-s, --set=ATTRIBUTES`	Set the attributes on the file.
`-c, --clear=[ATTRIBUTES | all]`	Clear the attributes on the file.
`-l, --long`	Displays a long version of the file attributes.
`-q, --quiet`	Does not display any normal output.
`-d, --dos`	Use DOS compatible attributes (that is, ro=ro,di,ri)
`-v, --version`	Displays the program version information.
`-h, --help`	Displays the ATTRIB help screen.
`-S, --softlink`	Do not follow link option.
`-r, --recursive`	Set the attributes recursively on the directory.

B.1.3 Attributes

Multiple attributes are separated with commas.

Attribute	Description	Applies to Files	Applies to Directories
`aa`	Attribute Archive identifies that a file's metadata has been modified since the last backup. This attribute is assigned automatically.	Yes	No
`all`	All (used only for the Clear option) represents all attributes that can be modified.	Yes	Yes
`ar`	Archive identifies files that have modified content since the last backup. This attribute is assigned automatically.	Yes	No
`cc`	Cannot Compress (status display only) displays if the file cannot be compressed because of limited space savings.	Yes	No
`ci`	Copy Inhibit prevents users from copying a file. This attribute overrides the Read and File Scan trustee rights. This attribute works only for clients using Macintosh operating systems to access NSS volumes on NetWare.	Yes	No
`cm`	Compressed (status display only) indicates whether the file is currently stored in compressed format.	Yes	No
`dc`	Don't 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

Attribute	Description	Applies to Files	Applies to Directories
di	Delete Inhibit prevents users from deleting a directory or file. This attribute overrides the Erase trustee right. When it is enabled, no one, including the owner and network administrator, can delete the directory or file. A trustee with the Modify right must disable this right to allow the directory or file to be deleted.	Yes	Yes
ex	Execute indicates program files, such as .exe or .com files.	Yes	No
hi	Hidden hides directories and files so they do not appear in a file manager or directory listing.	Yes	Yes
ic	Immediate Compression 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. The files in the specified directory are compressed as soon as the operating system can perform the operation after the file is closed. This does not apply to the directory's subdirectories and the files in them.	Yes	Yes
ip	Immediate 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
ln	Link (status display only) indicates a symbolic link (soft link).	Yes	No
mg	Migrated (status display only) displays if the file or directory is migrated to near-line media.	Yes	Yes
mi	Migrate Inhibit prevents directories and files from being migrated from the server's disk to a near-line storage medium.	Yes	Yes
ri	Rename Inhibit prevents the file or directory name from being modified.	Yes	Yes
ro	Read Only prevents a file from being modified.	Yes	No
sd	Subdirectory (status display only) indicates that the entry is a directory, not a file.	No	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
sy	System hides the directory or file so it does not appear in a file manager or directory listing. This attribute is normally used with system files.	Yes	Yes
tr	Transactional allows a file to be tracked and protected by the Transaction Tracking System (TTS).	Yes	No
vo	Volatile indicates that a file can change without being written to so that opportunistic locks cannot be set on it.	Yes	No

B.1.4 Example

```
attrib /designs/topsecret -c=all -s=ro,di
```

This command clears all attributes, then sets Read Only and Delete Inhibit on the `/designs/topsecret` file.

B.2 compfix

- Section B.2.1, “Prerequisite for Computing Compression Statistics,” on page 426
- Section B.2.2, “Syntax,” on page 426
- Section B.2.3, “Parameters,” on page 427
- Section B.2.4, “Help Options (HOPTION),” on page 427
- Section B.2.5, “General Options (GOPTION),” on page 427
- Section B.2.6, “Volume-Level Options (VOPTION),” on page 427
- Section B.2.7, “File-Level Options (FOPTION),” on page 428
- Section B.2.8, “Examples,” on page 428

Use the COMPFIX utility to repair compression information for compressed NSS volumes or to clear the Cannot Compress attribute for files in the compressed NSS volume. This tool can help identify which compressed files are corrupted and can be fixed; however, not all corrupted compressed files are fixable.

B.2.1 Prerequisite for Computing Compression Statistics

Before using the COMPFIX utility to compute compression statistics, make sure that your volume is in ACTIVE mode in order for statistics to be computed.

B.2.2 Syntax

On Linux, run the COMPFIX utility (`/opt/novell/nss/sbin/compfix`) from the terminal console prompt.

```
compfix [HOPTION]
compfix [GOPTION]... [VOPTION] VOLUMENAME
compfix [GOPTION]... [FOPTION] FILENAME
```

Mandatory arguments to long options are also mandatory for short options.

B.2.3 Parameters

Parameter	Description
VOLUMENAME	Specifies the volume name of the compressed volume you want to repair, such as VOL1.
FILENAME	Specifies the full path to the individual compressed file that has compression errors you want to repair, including its filename and extension. The filename must an absolute path. For example: */media/nss/VOL1/dir1/dir2/myfile.xxx*

B.2.4 Help Options (HOPTION)

Option	Description
`-h, --help`	Displays help information and exits.
`-v, --version`	Displays version information and exits.

B.2.5 General Options (GOPTION)

Multiple general options can be selected.

Option	Description
`-H, --no-header`	If this option is specified, COMPFIX does not validate compression headers. Use this option on volumes restored from scan files that do not have user data blocks.
`-p, --logpath=`*`path`*	Specifies the location of the log file. The default location is at the root of the compressed volume you are analyzing or fixing. **Default:** `./compfix.log`

B.2.6 Volume-Level Options (VOPTION)

Only one volume-level option can be selected.

Option	Description
`-D, --delete-all`	Deletes all non-fixable compressed files on the specified volume.
`-F, --fix-all`	Fixesall repairable compressed files on the specified volume.
`-L, --list-all`	Lists all problematic compressed files on the specified volume.
`-S, --fix-stats`	Fixes volume compression-related statistics. For accurate results, make sure the volume is in maintenance mode before issuing this command.
`-C, --clear-all`	Clears the Cc (Cannot_Compress_File) attribute for all files on the specified volume.

B.2.7 File-Level Options (FOPTION)

Only one file-level option can be selected.

Option	Description
`-b, --background`	Checks if the specified file is eligible for the next background compression process.
`-d, --delete`	Deletes the specified compressed file if it is non-fixable.
`-f, --fix`	Tries to fix the specified file's compression-related problem.
`-l, --list`	Lists the specified file's compression-related information.
`-c, --clear`	Clears the specified file's Cc (Cannot_Compress_File) attribute.

B.2.8 Examples

The following table illustrates typical uses of the COMPFIX utility. The commands in the left column should be written all on the same line, of course.

Command	Description
`compfix --fix-stats VOL1`	Fixes compression statistics for the specified volume, `VOL1`. Log the results in the default location of `./compfix.log`.
`compfix --list-all VOL1 --logpath=/var/log/compfix.log`	Lists all corrupted compressed files on the specified volume, `VOL1`. Log the results in the specified location of `/var/log/compfix.log`.
`compfix -f /media/nss/VOL1/dir1/dir2/myfile.xxx`	Fixes an individual compressed file, `myfile.xxx`. Log the results in the default location of `./compfix.log`.

Command	Description
`compfix -F VOL1 --logpath=/var/log/compfix.log`	Fixes all fixable corrupted compressed files on the specified volume, `VOL1`. Log the results in the specified location of `/var/log/compfix.log`.
`compfix -b /media/nss/VOL1/dir1/dir2/myfile.xxx`	Checks whether an individual compressed file, `myfile.xxx`, is eligible for the next background compression process. Log the results in the default location of `./compfix.log`.
`compfix -C VOL1 --logpath=/var/log/compfix.log`	Clears the Cannot Compress (Cc) attribute for files in the specified volume, `VOL1`. Logs the results in the specified location of `/var/log/compfix.log`.

B.3 metamig

The NSS File System Metadata Migration Utility (METAMIG) for Linux allows you to save and restore NSS file system trustee, user quota, and directory quota metadata.

- Section B.3.1, “Syntax,” on page 429
- Section B.3.2, “Arguments,” on page 429
- Section B.3.3, “Options,” on page 430
- Section B.3.4, “Examples,” on page 431

B.3.1 Syntax

METAMIG is located in the `/opt/novell/nss/sbin/metamig` directory.

```
metamig [OPTIONS]
metamig save volume [SOPTIONS]
metamig restore volume [ROPTIONS]
```

B.3.2 Arguments

The first argument indicates the action to be taken on the specified NSS volume. Possible actions are `Save` and `Restore`.

Argument	Description
`save`	Saves the indicated metadata to `stdout`.
`restore`	Restores the indicated metadata to `stdin`.

The second argument specifies the NSS volume name to be saved or restored.

The third argument specifies the path to a file. This is the file to be created on save, or the file to be restored from on restore.

B.3.3 Options

Several option types are available:

- "General Options" on page 430
- "SOptions (Save)" on page 430
- "ROptions (Restore)" on page 430
- "Mask" on page 431

General Options

The following options are general options available to actions related to save or restore.

Option	Description
`-v, --version`	Displays the program version information.
`-h, --help`	Displays the help screen.

SOptions (Save)

The following options are options available to actions related to save.

Option	Description
`-m, --meta=`*`mask`*	The types of metadata to be saved. If a value is not specified, it defaults to `all`. For information, see Mask.
`-n, --ncp`	Saves the trustee metadata from the NCP Trustee database instead of parsing the volume to generate the data. Use this option only if you are confident that the NCP Trustee database is available and current. For example, if the NCP Server has been turned off and its database is not yet resynchronized with the volume, do not use this command option until the database is again current.

ROptions (Restore)

The following options are options available to actions related to restore.

Option	Description
`-m, --meta=`*`mask`*	The types of metadata to be restored. If a value is not specified, it defaults to `all`. For information, see Mask.
`-f, --filter=`*`regexp`*	A filter that restores only files and directories that match the specified regular expression. Use a regular expression to specify one or more files and directories to be restored. For example, to set criteria to restore only files with names that start with the letter “a”, use this option:--filter=.*\\a.* Please refer to a programming textbook or search the Internet for information about how to construct regular expressions.
`-t, --tree=`*`treename`*	If this value is specified, this setting overrides the saved directory treename.
`-d, --details`	Displays all actions taken.
`-w, --inputfilefromnetware`	Specify this option if the input file is generated by TRUSTEE.NLM on the NetWare 6.5 SP8 server.

Mask

The mask is a string of characters with each character representing a type of NSS file system metadata. Use the mask to specify values for the meta parameter in SOptions (Save) and ROptions (Restore).

Option	Description
`t`	Trustees
`u`	User quotas
`d`	Directory quotas
`a`	All metadata

B.3.4 Examples

To save the user quota data and directory quota data for a volume called `VOL1` in the `/backup/volquotas` file, enter

```
metamig save VOL1 -m ud >/backup/volquotas
```

To restore the user quota data from the file `/backup/volquotas` to `VOL1`, enter

```
metamig restore VOL1 -m u </backup/volquotas
```

B.4 ndir

The `ndir` command is a legacy MS-DOS utility that allows you to view file attributes and compression information for all files in a directory. NDIR requires the NetWare Core Protocol (NCP) protocol, so if you are using the command for NSS volumes on Linux, NCP Server must be configured and running.

NDIR is a client-side application, not a server-side application. Install the Novell Client for Windows on your workstation, then use the *Novell Map Network Drive* option in the client menu to map a local drive letter to the volume or directory. Open a DOS Command Prompt window, go to the mapped drive, then issue the `ndir` command from the command line.

B.4.1 Syntax

At the MS-DOS command prompt on your Windows workstation, navigate to the mapped drive for the NSS volume, then enter

```
ndir path /option
```

The path is optional if you want the information for all directories in the mapped drive.

Help Options

Help Option	Description
`ndir /?`	Displays a list of help options.
`ndir /? for`	Displays help on display format.
`ndir /? sort`	Displays help on sorting features.
`ndir /? res`	Displays help on search filters (restrictions).
`ndir /? at`	Displays help on attribute filters.
`ndir /? opt`	Displays help on other options.
`ndir /? syn`	Displays help on syntax.
`ndir /? all`	Displays all help screens.

Compression and File Attributes Options

Command	Description
`ndir path /R`	Displays the trustee rights, inherited rights filter, and file attributes for all files in the specified volume or directory.
`ndir path /COMP`	Displays the compression information for all files in the specified volume or directory. It shows the amount of disk space saved by compressing data.
`ndir path /COMP /VOL`	Displays the compression information for the specified volume or directory. It also shows the disk space saved on the volume.

Example

```
C:\>ndir z: /comp /vol
Statistics for fixed volume <servername/vol>:
Space statistics are in KB (1024 bytes).
Total volume space:                          4,027,620  100.00%
Space used by 50,548 entries:                1,134,036   28.16%
Deleted space not yet purgeable:                     0    0.00%
                                           ------------ --------
Space remaining on volume:                   2,893,584   71.84%
Space available to <username>:               2,893,584   71.84%
Maximum directory entries:                 2,147,483,647
Available directory entries:               2,147,433,099  100.00%
Space used if files were not compressed:             0
Space used by compressed files:                      0
                                           ------------
Space saved by compressing files:                    0    0.00%
Uncompressed space used:                     2,069,352
Name spaces loaded: MAC, NFS, OS/2
```

B.5 nsscon

The NSS Console (NSSCON, `nsscon`) utility for OES Linux provides a command line interface in a console environment familiar to NetWare administrators. Use it to issue NSS commands and to monitor NSS activity through console messages.

Unlike NSS utilities, the NSS commands cannot be issued directly at the Linux terminal console. Therefore, you start the `nsscon` utility, then enter the usual NSS commands from the `nsscon` prompt. You can issue any NSS command that is valid for use on Linux at the nsscon command prompt. For information about NSS commands, see Appendix A, "NSS Commands," on page 387.

The Linux install creates symlinks in the `/opt/novell/nss/sbin` folder for common NSS utilities, including `nsscon`. Symlinks allow the path to the `nsscon` to become part of the `root` user's path, which allows you to run it by entering `nsscon` at the system prompt.

The NSSCON utility uses a device file (/dev/nsscmd), which is set up to allow access only for the root user. Thus, only root can run nsscon. If you want to give access to a group of local users to run nsscon, use the chmod command on /dev/nsscmd to change the POSIX permissions for that group.

- Section B.5.1, "Adding /opt/novell/nss/sbin to the PATH Environment Variable," on page 434
- Section B.5.2, "Starting nsscon," on page 434
- Section B.5.3, "Using nsscon in a Script," on page 434

B.5.1 Adding /opt/novell/nss/sbin to the PATH Environment Variable

You can add /opt/novell/nss/sbin to the PATH environment variable:

1. At a shell prompt, log in as the root user.
2. From a Bash shell, set the path with the command

   ```
   export PATH=$PATH:/opt/novell/nss/sbin
   ```

   This allows you to run nsscon by entering ./nsscon at the system prompt.

B.5.2 Starting nsscon

1. At a shell prompt, log in as the root user.
2. Use one of the following methods to start NSSCON:
   - At a shell prompt, load NSSCON when its path is symlinked by entering

     ```
     nsscon
     ```

   - At a shell prompt, load NSSCON by its absolute pathname by entering

     ```
     /opt/novell/nss/sbin/nsscon
     ```

   - At a shell prompt, load NSSCON when its path is in the PATH environment variable by entering

     ```
     ./nsscon
     ```

B.5.3 Using nsscon in a Script

Only one instance of nsscon can be run at a time. If nsscon is already running when a script tries to run it, nsscon returns an error.

To work around this issue, you can send NSS commands directly to NSS via the /dev/nsscmd device.

For example, if you use a script to put pools into maintenance, use the following syntax:

```
echo "/PoolMaintenance=mypool" >/dev/nsscmd
```

This causes NSS to place MYPOOL into maintenance state even if nsscon is already running. Note that you do not echo an "nss " in front of commands to /dev/nsscmd.

If nsscon is running, then the output of your command is displayed by nsscon immediately. Otherwise, the output is held by NSS until nsscon is run. In OES 2 Linux, NSS holds 400K worth of output before starting to throw the oldest away. In OES 1 Linux, NSS holds only 32K of output before wrapping output.

B.6 nssmu

The NSS Management Utility (NSSMU) is a server-based tool that allows you to manage disks, software raids, pools, volumes, and snapshots for the NSS file system. For information, see Section 9.2, "NSS Management Utility (NSSMU) Quick Reference," on page 103.

B.7 nssupdate

The NSS Update (`nssupdate`) utility is used to resize a pool to a larger size so that it can consume contiguous free space that follows the existing pool on a device.

You should not need to run this utility if you increase the size of a pool in the NSS-supported EVMS (Enterprise Volume Management System) environment. When working with NSSMU (NSS Management Utility) and the Storage plug-in for Novell iManager to manage NSS pools and volumes on EVMS-managed devices, NSS automatically makes any necessary changes to the pool's underlying structure.

You can use this tool to manually resize a pool if you are using the NSS file system on a device that is managed by a volume manager other than EVMS, such as LVM2 (Linux Volume Manager 2). After you have performed all steps to increase the size of the LVM2 device and partitions by using Linux tools, use the NSS Update utility to let NSS know to expand the pool size to the desired new size (specified in bytes).

B.7.1 Syntax

```
nssupdate -pool poolName -size sizeInBytes [-shared | -notshared]
```

Issue this command from a terminal console prompt as the `root` user.

B.7.2 Availability

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B.7.3 Options

-pool ***poolname***

Specifies the name of the pool you want to resize.

-size ***sizeInBytes***

Specifies the new maximum size of the pool in bytes.

The value for sizeInBytes cannot exceed the actual size of the device. You can enter any value larger than the pool's current size and up to the size of the device. The space you designate must already be free for consumption by the pool. Make sure you understand exactly what space is free on the device so that you do not inadvertently overwrite any metadata stored at the end of the device. The pool begins at the same sector location as it currently does, and the extension is based on space that follows its current end location on the device.

[-shared | -notshared]

Sets the share state of the pool. The -shared option sets the share state to *Shareable in a Cluster* so that the pool can be shared in a cluster environment that is using Novell Cluster Services (NCS) for Linux. The -unshared option sets the share state to *Not Shareable*.

These options are intended to be used when you are using NSS pools with Novell Cluster Services clusters. NCS requires that the devices be managed by EVMS. You cluster-enable the shared device by placing the Cluster Segment Manager on the device before creating the file system on it. For the NSS file system, you create the clustered pool on the shared device and manage it with NSS management tools, such as NSSMU or the Storage plug-in to Novell iManager.

IMPORTANT: The shared state is not viable for NSS on non-EVMS-managed devices, because NCS currently requires the Cluster Segment Manager and EVMS.

B.7.4 Example

Open a terminal console, then log in as the `root` user to use this command.

`nssupdate -pool puserdata -size 2147483648`

Resizes the pool named `puserdata` to 2 GB (where 1 GB is 1024E3 bytes or 1,073,741,824 bytes).

B.8 ravsui

Use the Rebuild and Verify Simple User Interface (RAVSUI) utility to rebuild or verify an NSS pool on Linux that is in a maintenance state. You must log in as the `root` user to run this utility. You must place the pool in maintenance mode before starting the rebuild or verify process.

B.8.1 Syntax

```
/opt/novell/nss/sbin/ravsui
ravsui [OPTION]... [ROPTION]... rebuild poolname
ravsui [OPTION]... [VOPTION]... verify poolname
```

Replace *`poolname`* with the name of the pool you want to rebuild or verify, such as `POOL1`. Poolnames are case sensitive on Linux.

B.8.2 Arguments

The first mandatory argument specifies the action to be performed as rebuild or as verify.

- The rebuild action checks the integrity of the data in the pool and rebuilds the pool. A rebuild process can take up to several hours, depending on the size of the pool. The rebuild argument can be combined with one or more OPTION and ROPTION options.
- The verify action checks the integrity of the data in the pool; it does not perform the repair. A verify process can take several minutes, depending on the size of the pool. The verify argument can be combined with one or more OPTION and VOPTION options.

The second mandatory argument *poolname* is the target of the action. Replace *poolname* with the name of an NSS pool to be rebuilt or verified. Poolnames are case sensitive on Linux.

B.8.3 Options

This section describes the OPTION, ROPTION, and VOPTION options available for the RAVSUI (`ravsui`) utility. Mandatory arguments for long options are also mandatory for short options.

- "OPTION" on page 437
- "ROPTION" on page 437
- "VOPTION" on page 438

OPTION

General options can be used for both rebuild and verify actions.

Option	Description
`-a, --attach`	Attach to a rebuild or verify that it is running.
`-D, --log-kernel=MASK`	Controls the amount of log output from the kernel.
	Default: 0x70
`-d, --log-application=LEVEL`	Controls the amount of log output from the application.
	Default: 0x60
`-h, --help`	Displays this help information and exits.
`-P, --path=PATH`	Specifies the Linux path where the log file is written that contains the results of the rebuild or verify action.
	Default: `/var/opt/novell/log/nss/rav/`
`-v, --version`	Displays version information and exits.

ROPTION

ROPTIONs can be used only for the rebuild action.

Option	Description
`-i, --iv-prune`	Prunes an internal volume.
`-l, --loss-file-limit=LIMIT`	Specifies the maximum number of files per volume to quietly prune. **Default:** 100
`-p, --purge-deleted-files`	Purges deleted files.
`-r, --rezid=ZID`	Specifies the threshold to cause a reZID of a volume. **IMPORTANT**: For NSS on Linux, a rebuild automatically causes a reZID of a volume if the rebuild finds a ZID over 2 billion. This checks all blocks in the system. Rebuilding can take several minutes to several hours, depending on the number of objects in the pool. For all systems, reZID adds a third pass to the rebuild, which increases the time to rebuild a volume by about 50%. For more information about reZID, see Section 16.3, “ReZIDing Volumes in an NSS Pool,” on page 200. **Default:** 0xeffffffff
`-u, --unknown-loss-prune`	Prunes if losses unknown.

VOPTION

VOPTIONs can be used only for the verify action.

Option	Description
`-q, --quick`	Skips cross-tree validations.

B.8.4 Files

/opt/novell/nss/sbin/ravsui

The Rebuild and Verify Simple User Interface (RAVSUI, `ravsui(8)`) utility file.

/var/opt/novell/log/nss/rav/

The default location of the log file for the RAVSUI utility's rebuild or verify actions. The path is the directory where the file is stored and does not include the filename itself. You can specify a different path for the log file by using the -P=PATH option.

B.8.5 Note

Before you run the RAVSUI utility to perform a pool verify or pool rebuild, you must put the pool into maintenance mode.

Log in as the `root` user, then open a terminal console.

At a terminal prompt, enter

```
nsscon
```

In nsscon, enter

```
nss /PoolMaintenance=poolname
```

Replace *`poolname`* with the name of the pool you plan to rebuild or verify, such as `POOL1`.

If you do not place the pool in maintenance mode before starting the utility, you receive NSS Error 21726:

```
NSS error: PoolVerify results
   Status: 21726
     Name: zERR_RAV_STATE_MAINTENANCE_REQUIRED
   Source: nXML.cpp[1289]
```

B.8.6 Example

Log in as the `root` user, then open a terminal console.

At a terminal prompt, enter

```
nsscon
```

At the `nsscon` prompt, put the pool that you want to verify (such as `POOL1`) in maintenance mode by entering

```
nss /PoolMaintenance=POOL1
```

At the terminal prompt, start the RAVSUI utility to verify the pool by entering

```
ravsui -q verify POOL1
```

This command checks the integrity of the data in `POOL1` in the current tree. It skips cross-tree validations.

B.9 ravview

The Rebuild and Verify View (RAVVIEW) utility displays specified rebuild or verify log files in human-readable format. The log files are generated by the Rebuild and Verify Simple User Interface (RAVSUI, `ravsui(8)`) utility.

You must log in as the `root` user to run this utility. If the specified pool is active when you run the utility, the ZIDs of files that appear in the log are converted to their `/pathname/filename` format so that they are more easily understood by the reader.

B.9.1 Syntax

```
/opt/novell/nss/sbin/ravview
ravview [OPTION]... rtf filename
ravview [OPTION]... [NOPTION]... rtfn poolname
ravview [OPTION]... [VOPTION]... vbf filename
ravview [OPTION]... [NOPTION]... [VOPTION]... vbfn poolname
```

Poolnames and filenames are case sensitive on Linux.

B.9.2 Arguments

The first mandatory argument specifies the type of log file you want to view. This can be rtf, rtfn, vbf, or vbfn. The second argument specifies information about the log you want to view.

IMPORTANT: In the raw log files, files that were acted upon are identified by their ZIDs, not the path and filename. If the pool that was rebuilt or verified is active when you view its log, the utility converts each ZID to display the path and filename instead.

First Argument	Description	Second Argument
rtf	Specifies that you want to view a rebuild text file. You must specify the filename of the log you want to view. The utility displays any messages that occurred during the rebuild.	*filename*
rtfn	Specifies that you want to view the newest rebuild text file in a specified path for a specified poolname. Specify the path to the logs by using the -P=PATH option. The utility displays any messages that occurred during the rebuild.	*poolname*
vbf	Specifies that you want to view a verify binary file. You must specify the filename of the log you want to view. The utility converts the binary file into a human-readable format.	*filename*
vbfn	Specifies that you want to view the newest verify binary file in a specified path for a specified poolname. Specify the path to the logs by using the -P option. The utility converts the binary file into a human-readable format.	*poolname*

Replace *filename* with the path and name of the log file for the rebuild or verify process that you want to view.

Replace *poolname* with the name of the NSS pool that was rebuilt or verified.

B.9.3 Options

This section describes the OPTION, VOPTION, and NOPTION options available for the RAVVIEW utility. Mandatory arguments for long options are mandatory for short options too.

OPTION

General options can be used for viewing rebuild or verify logs. Use them in combination with any of the rtf, rtfn, vbf, or vbfn arguments.

Option	Description
`-h, --help`	Displays help information and exits.
`-V, --verbose=LEVEL`	Controls the amount of output.
`-v, --version`	Displays version information and exits.

VOPTION

VOPTIONs are available only for viewing the verify binary files. Use them in combination with the vbf or vbfn arguments.

Option	Description
`-a, --actions`	Displays action information.
`-H, --histograms`	Displays histograms.
`-o, --object-details`	Displays object details.

NOPTION

NOPTIONS are available for viewing the newest log for a specified pool. Use this option in combination with the rtfn and vbfn arguments.

Option	Description
`-P, --path=PATH`	Specifies the path to RAV files. **Default:** `/var/opt/novell/log/nss/rav/`

B.9.4 Files

/opt/novell/nss/sbin/ravview

The Rebuild and Verify View utility file.

/var/opt/novell/log/nss/rav/

The default location of the log file for the Rebuild and Verify Simple User Interface (RAVSUI, `ravsui(8)`) utility's rebuild or verify actions. The path is the directory where the file is stored and does not include the filename itself.

You can specify a different path for the log file by using the -P=PATH option. This should be the same path that you used when you ran the RAVSUI utility.

B.9.5 Note

In the raw log files, files that were acted upon are identified by their ZIDs, not the path and name of the file. If the pool that was rebuilt or verified is active when you view its log, the RAVVIEW utility converts each ZID to display the path and filename instead.

B.9.6 Example

Log in as the `root` user, then open a terminal console.

At the terminal prompt, start NSSCON by entering

```
nsscon
```

View the newest rebuilt text file for POOL1 by entering

```
ravview -V -P=/var/opt/novell/log/nss/rav/ rtfn POOL1
```

In this command, the RAVVIEW utility uses the newest rebuild log in the `/var/opt/novell/log/nss/rav/` directory for `POOL1`.

B.10 refreshids

Use this command to force a reset of the NSS ID caches on your OES 2 Linux server.

B.10.1 Syntax

Issue the command as the `root` user in a terminal console on the OES 2 Linux server where the NSS volume exists.

```
refreshids
```

```
refreshids --help
```

B.11 rights

The Trustee Rights Utility (`rights`) for Linux allows you to specify trustee rights for directories and files in the NSS file system. This utility does not provide support for trustees on Linux file systems. It is also not meant to be used to set trustees for NSS volumes on NetWare. The trustee information is saved in the file and directory metadata in the NSS volume and works seamlessly with NetWare if the volume is moved to a NetWare server.

- Section B.11.1, “Syntax,” on page 442
- Section B.11.2, “Options,” on page 443
- Section B.11.3, “Example,” on page 446
- Section B.11.4, “See Also,” on page 446

B.11.1 Syntax

```
rights [OPTIONS]
```

```
rights [TOPTIONS] trustee username
rights [DOPTIONS] delete username
rights [IOPTIONS] irf
rights [EROPTIONS] effective username
rights [SOPTIONS] show
```

B.11.2 Options

ACTIONS

The first argument indicates the action to be taken.

Option	Description
`trustee`	Adds or modifies a trustee on a file or directory.
`delete`	Removes a trustee from a file or directory.
`irf`	Sets the inherited rights filter on a directory.
`effective`	Displays a user's effective rights.
`show`	Displays the trustees and inherited rights filter.

OPTIONS

Option	Description
`-v, --version`	Displays the program version information.
`-h, --help`	Displays the help screen.

TOPTIONS

Option	Description
`-r, --rights=MASK`	Specifies the rights to be given to this trustee. For more information, see "MASK" on page 445. If the No Rights (n) option is assigned, the trustee is removed. If rights are not specified, the default assignment is Read and File Scan rights.
`-f, --file=`*`filename`*	Specifies the name of file or directory to assign trustees to. *Filename* is the path for the file or directory. For example: `-f /users/`*`username/userfile.sxi`* `--file=/designs/topsecret` If a file or directory is not specified, the current directory is used.
`-S, --softlink`	Do not follow link option.

DOPTIONS

Option	Description
`-f, --file=`*`filename`*	Specifies the name of file or directory to delete trustees from. *Filename* is the path for the file or directory. If a file or directory is not specified, the current directory is used.
`-S, --softlink`	Do not follow link option.

IOPTIONS

Option	Description
`-r, --rights=MASK`	Specifies the rights to be passed through the filter. For more information, see "MASK" on page 445. If rights are not specified, the default assignment is All Rights.
`-f, --file=`*`filename`*	Specifies the name of the directory where the filter is to be applied. *Filename* is the path for the directory. If a directory is not specified, the current directory is used.
`-S, --softlink`	Do not follow link option.

EROPTIONS

Option	Description
`-f, --file=`*`filename`*	Specifies the name of file or directory where effective rights are to be calculated. *Filename* is the path for the file or directory. If a file or directory is not specified, the current directory is used.
`-S, --softlink`	Do not follow link option.

SOPTIONS

Option	Description
`-f, --file=`*`filename`*	Specifies the name of the file or directory to display a list of trustees for that file or directory. If a file or directory is not specified, the current directory is used.
`-S, --softlink`	Do not follow link option.

USERNAME

The username is the Fully Distinguished Name of a Novell eDirectory object, including the tree name. Use the *`username.context.treename`* format, such as

joe.engineer.acme_tree

If you use special characters in a username, you must escape those special characters in the command line.

For example, the $ (dollar sign) is a special character reserved to the shell and must be escaped. For the bash shell, the command could be written in one of two ways on the command line:

```
rights -f /media/nss/DATA/stuff -r none \$j\$o\$e.engineer.acme_tree
```

```
rights -f /media/nss/DATA/stuff -r none '$j$o$e.engineer.acme_tree'
```

If you are using another shell, the special characters might need a different escape technique. In this case, please refer to the shell documentation for this information.

MASK

The mask is a string of characters, with each character representing certain rights. The following table lists the rights, the letter to use for each right, and what the right is used for.

Right	Letter	Description
Supervisor	s	Has all rights to the file or directory. Also can grant or revoke the Access Control right.
Read	r	Grants the right to open and read files in the directory.
Write	w	Grants the right to open and write to files in the directory.
Create	c	Grants the right to create files and subdirectories. The user can also salvage (undelete) deleted files.
Erase	e	Grants the right to erase files and directories. The user can also purge deleted files.
Modify	m	Grants the right to modify the content of files and directories, and change file attributes.
File Scan	f	Grants the right to display and search on file and directory names in the file system structure.
Access Control	a	Grants the right to add and remove trustees, and change trustee rights to files and directories.
No Rights	none	Revokes all rights.
All Rights	all	Grants all rights except Supervisor (rwcemfa)

B.11.3 Example

```
rights -f /designs/topsecret -r rwfc trustee joe.engineer.acme_tree
```

This command assigns Read, Write, File Scan, and Create rights to the `/designs/topsecret` directory for user `Joe` in the engineer context of the `acme_tree` eDirectory tree.

B.11.4 See Also

For information about setting file system directory and file attributes, see "attrib" on page 423.

B.12 volumes (NCP Console Utility)

Use this utility at the ncpcon (NCP Console utility) prompt (Linux) to list mounted volumes or information about a specified volume. For information about the NSS `volumes` command, see Section A.37.1, "Volumes Command," on page 419.

- Section B.12.1, "Syntax," on page 447
- Section B.12.2, "Using volumes," on page 447
- Section B.12.3, "Using volume name," on page 447

B.12.1 Syntax

Command	Description
`volume` *name* `nvpcon volume` *name*	Displays details about the specified volume. Linux is case-senstive, so make sure that you enter the volume name in all caps, such as `volume VOL1`
`volumes` `ncpcon volumes`	Displays general information about all mounted volumes.

B.12.2 Using volumes

When you execute `volumes` at the ncpcon prompt, a list of the mounted volumes is displayed.

For example, on Linux, a simple list of volumes is displayed:

```
Mounted Volumes
        SYS
        USERS
        TEST
        _ADMIN
        VOL1
5 volumes mounted.
```

B.12.3 Using volume name

When you execute `volume` *name*, the screen displays detailed information about the specific volume.

The following is an example of the output on Linux in response to entering `volume USERS` at the ncpcon prompt, or entering `ncpcon volume USERS` at the terminal console prompt:

```
            Volume: USERS
           Status: online mounted NSS "user quotas" "directory quotas" salvageable
      Mount point: /media/nss/USERS
Shadow Mount point: (null)
         Capacity: 8.83 GB
               ID: 4
             GUID: 9a894a30-70a3-01dd-80-00-32b3b21ae612
        Pool Name: POOL1
```

B.13 quota

Use this utility to set or get the userspace quota and directory quota on NSS volumes and files.

- Section B.13.1, “Syntax,” on page 448
- Section B.13.2, “Options,” on page 448
- Section B.13.3, “Examples,” on page 449

B.13.1 Syntax

Command	Description
`quota <USERQUOTAOPTIONS>`	It is used to set or get user space quota on NSS volumes and files.
`quota <DIRECTORYQUOTAOPTIONS>`	It is used to set or get directory quota on NSS volumes and files.

B.13.2 Options

Usage Options

Option	Description
`-h, --help`	Displays the help information.
`-v, --version`	Displays the program version information.

USERQUOTAOPTIONS

Option	Description
`-U, --userquota`	To set the user quota options.
`s, --size=quota (in KB/MB/GB)`	Storage space allowed for the specified user. The default unit is MB.
`-V, --volumename=volumename`	Name of the volume for which quota has to be set.
`-u, --username`	Specify the user name.
`-g, --getquotas`	Gets the user quota.

DIRECTORYQUOTAOPTIONS

Option	Description
`-D, --directoryquota`	To set the directory quota options.
`-s, --size=quota (in Multiples of 4KB/MB/GB)`	Size of the quota. The default unit is KB.
`-d, --directoryname`	Directory name.
`-g, --getquotas`	Gets the directory quota.

B.13.3 Examples

```
quota -U -V VOL1  -u wwrun.novell -s 30GB
```

This example is for user quota.

```
quota -D -d /media/nss/VOL/test -s 4GB
```

This example is for directory quota.

```
quota -g -V VOL1
```

This example is for viewing user quota.

```
quota -g -d /media/nss/VOL/test
```

This example is for viewing directoryquota.

B.14 nssraid

Use this utility to view the status of the NSS RAID 1 (mirror) devices, segment information, to restart and stop the remirror process of the NSS RAID 1 devices, and to delete a single disk mirror RAID 1 device.

- Section B.14.1, “Syntax,” on page 449
- Section B.14.2, “Options,” on page 449
- Section B.14.3, “Example,” on page 450

B.14.1 Syntax

nssraid status | remirror | abort | *delete <RAID_name>*

B.14.2 Options

Usage Options

Option	Description
`nssraid status`	Display the status of all the NSS RAID 1 devices.
`nssraid status <RAID_name>`	Display segment information of the NSS RAID 1 device.
`nssraid remirror <RAID_name>`	Restart remirror process on NSS RAID 1 device.
`nssraid abort <RAID_name>`	Stop remirror process on NSS RAID 1 device.
`nssraid delete <RAID_name>`	Deletes a single disk mirror RAID 1 device.

B.14.3 Example

To stop remirroring mirror the NSS RAID 1 device, MYRAID1, enter

```
nssraid abort MYRAID1
```

B.15 ncsinit

Use this utility to initialize a device and to set the device to a shared state.

- Section B.15.1, "Syntax," on page 450
- Section B.15.2, "Options," on page 450
- Section B.15.3, "Example," on page 450

B.15.1 Syntax

ncsinit [-f -z -u] <*full_disk_path*>

B.15.2 Options

Usage Options

Option	Description
`-f`	Forces initialization. Initializes the device even if the device is already initialized.
`-z`	Adds zero to the end of the specified device for upto a maximum of 32 sectors.
`-u`	Undo the initialization if the device is already initialized. Need to run evms_activate to re-scan the device. **NOTE**: -u and -z options can not be used together.

B.15.3 Example

Example for initializing and sharing the disk,

`ncsinit /dev/sda`, where sda is the device which is getting initialized and shared.

Example for reinitializing a disk that is already initialized,

`ncsinit -f /dev/sda`, where sda is the device which is getting reinitialized and shared.

C Using EVMS to Manage Devices with NSS Volumes

In order to get the full features for Novell Storage Services on Novell Open Enterprise Server 2 Linux servers, the devices you use for NSS volumes must be managed by the Enterprise Volume Management System (EVMS). This section describes how to configure EVMS services on Linux devices to allow you to use NSS.

- Section C.1, "Installing Linux with EVMS as the Volume Manager on the System Device," on page 451
- Section C.2, "Using Linux POSIX File Systems and NSS Pools and Volumes on the Same Device," on page 453
- Section C.3, "Viewing Free Space Available to EVMS-Managed Devices," on page 455
- Section C.4, "Making Devices Available to EVMS," on page 455
- Section C.5, "Additional EVMS Documentation," on page 462

C.1 Installing Linux with EVMS as the Volume Manager on the System Device

To use NSS on the same drive that contains the `/boot`, `swap`, and root (`/`) partitions, that drive must be managed by EVMS. The default volume manager in OES Linux is the Linux Volume Manager 2 (LVM2), not EVMS. Unless you modify the partitioning scheme during the operating system install, the system device is not managed by EVMS, and you cannot create NSS data volumes on that drive.

The simplest solution is to put your Linux system volumes on one device that is managed by LVM2 (the default configuration), then add devices that can be configured to use EVMS for your NSS pools and volumes.

Using EVMS to manage the system device allows you to later add NSS pools and volumes on any unparttioned free space on it. However, you must modify the partitioning scheme to use EVMS during the install. It is not possible to change the volume manager for the system device after the install.

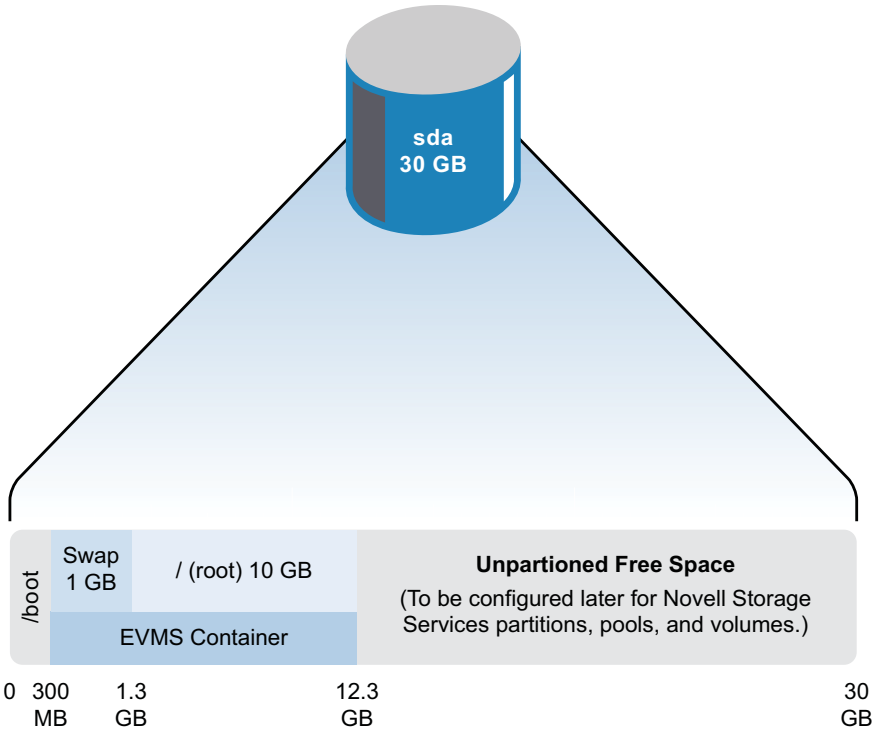
From the YaST Installations Settings page, you go to the Partitioner page, then do the following to set up the EVMS partitioning scheme. For detailed instructions, see "Installing with EVMS as the Volume Manager of the System Device" in the *OES 2 SP3: Installation Guide*.

- ❒ Delete the proposed LVM2-based partitioning solution.
- ❒ Create a boot partition of about 300 MB on the system disk with a `/boot` mount point.
- ❒ Create a system partition of 5 GB to 11 GB on the system disk where you will create the EVMS container for the `swap` and root (`/`) volumes.

- ❒ Do not partition the remaining space on the system device. This unpartitioned free space can be used after the install for NSS pools and volumes or for Linux POSIX file systems.
- ❒ Select EVMS Configuration, then select the system partition. This step ensures the device is managed by EVMS.
- ❒ Create an EVMS container for the system partition of type *Linux LVM2*.
- ❒ Create the `swap` volume of about 1 GB in size in the EVMS container.
- ❒ Create the / (root) volume of 4 GB to 10 GB in the EVMS container.

For example, Figure C-1 illustrates how a 30-GB device can be configured during the install to enable EVMS to be used as the volume manager. The `/boot` volume is placed at the beginning of the device. An EVMS container is created, then the `swap` and `/` (root) volumes are created in it. The remainder of the device is left as unpartitioned free space.

Figure C-1 *Example of a System Device Configured for EVMS and NSS*



IMPORTANT: Only the boot and system partitions are configured. The remainder of the device remains as unpartitioned free space where you can create NSS pools and volumes after the install.

C.2 Using Linux POSIX File Systems and NSS Pools and Volumes on the Same Device

You can use the free space on devices for NSS or Linux POSIX file systems by using EVMS to manage devices. Consider the guidelines below when working with EVMS-managed devices.

When you use NSS tools to create a pool on a new EVMS-managed device, the tools automatically carve out a partition with the DOS Segment Manager so that the device can be used later for either NSS or Linux POSIX file systems. Then the NetWare Segment Manager creates the NSS partition and pool.

IMPORTANT: Always use NSS tools (NSSMU and the Storage plug-in to iManager) to create NSS pools.

For EVMS-managed data devices, Linux POSIX file systems require that the Linux partitions be managed by the DOS Segment Manager (DOSSegMgr). Consider the following guidelines when working with evmsgui to create a Linux partition:

Scenario	To create the Linux partition in evmsgui:
Disk is not initialized.	1. Select *No* at the prompt to initialize. On a pure SLES system (no NSS), ignore this step. 2. Delete the disk object from the *Volumes* tab. 3. Add the DOS Segment Manager to the device. 4. Create the Linux partition as usual.
Free space is controlled by the DOS Segment Manager.	Create the Linux partition as usual.
Free space is controlled by the NetWare Segment Manager.	Do one of the following: ◆ If no partitions are on the device, remove the NetWare Segment Manager from the device, add the DOS Segment Manager, then create the partition as usual. **WARNING**: Changing the segment manager initializes the disk again (destroys existing data), so you only want to do this with disks that have no partitions on it, or if you do not want any of the partitions that are currently on the disk. ◆ If partitions exist, reboot the server to automatically give control of the device back to the DOS Segment Manager, then create the partition as usual.

If no partitions are on the device, do the following to add a DOS Segment Manager to a non-clustered device:

1 Log in as the `root` user, open a terminal console, then enter

```
evmsgui
```

WARNING: EVMS administration utilities (evms, evmsgui, and evmsn) should not be running when they are not being used. EVMS utilities lock the EVMS engine, which prevents other EVMS-related actions from being performed. This affects both NSS and Linux POSIX volume actions.

NSS and Linux POSIX volume cluster resources should not be migrated while any of the EVMS administration utilities are running.

2 If necessary, remove the NetWare Segment Manager:

2a Click the *Disks* tab, then locate and select the device, such as device `sdb`.

2b Right-click, then select *Remove segment manager from Object*.

This option appears only if there is an existing segment manager for the selected disk.

2c Select the listed segment manager, click *Remove*, then click *OK*.

WARNING: All data on the selected disk space is destroyed.

2d Click *Save*, then click *Save* again to save your changes.

3 Add the DOS Segment Manager.

3a From the evmsgui menu, click *Actions* > *Add* > *Segment Manager to Storage Object*.

3b On the Add Segment Manager to Storage Object page, choose *DOS Segment Manager*, then click *Next*.

3c On the Select Plugin Acceptable Objects page, choose the device where you want to add the segment manager, then click *Next*.

3d On the Configurable Options page, select the disk type (Linux is the default), click *Add*, then click *OK*.

3e Click *Save*, then click *Save* again to save your changes.

4 Create a segment for the DOS Segment Manager.

The DOS Segment Manager requires you to create a segment before creating an EVMS volume. Without a segment, the additional segment manager does not appear when you attempt to create an EVMS volume.

4a From the evmsgui menu, click *Actions* > *Create* > *Segment*.

4b On the Create Disk Segment page, select *DOS Segment Manager*, then click *Next*.

4c On the Select Plugin Acceptable Objects page, choose device where you want to add the segment, then click *Next*.

4d Specify the size of the segment, the partition type (such as Linux LVM), click *Create*, then click *OK*.

4e Click *Save*, then click *Save* again to save your changes.

For information about adding or changing segment managers when you are clustering a shared device with Novell Cluster Services, see "Creating Linux POSIX Volumes on Shared Devices" in the *OES 2 SP3: Novell Cluster Services 1.8.8 Administration Guide for Linux*.

C.3 Viewing Free Space Available to EVMS-Managed Devices

When creating an NSS pool on Linux, you can use free space only from devices managed by EVMS. If you use multiple volume managers, make sure that the devices you select for the pool are already managed by EVMS, or they are free unpartitioned devices. After you select free space from an unpartitioned device, NSS automatically sets up the device to be managed by EVMS.

The OES 2 Linux install uses LVM2 by default as the volume manager of the system device, but NSS requires EVMS. The Linux 2.6 kernel prevents multiple volume managers from managing the same device. If you use LVM2 and EVMS to manage different devices on the server, EVMS might display free space on the LVM-managed devices that EVMS cannot actually manage.

To avoid confusion, you can prevent display of space that is unavailable to EVMS. Edit the `/etc/evms.conf` file to add the device to the exclude list of the `sysfs_devices` section.

For example, in a typical OES 2 Linux install, the `sda` device contains the boot device and the root volume. Unless you have previously made EVMS the volume manager for that device, it is managed by LVM2 and cannot be used to create NSS pools. To prevent the display of space from `sda`, edit the `/etc/evms.conf` file as follows:

```
sysfs_devices {
...
exclude = [sda]
}
```

To exclude multiple devices (such as `/dev/sda` and `/dev/sdb`), use the following format:

```
exclude = [sda sdb]
```

C.4 Making Devices Available to EVMS

On your Linux system, if you've already installed Linux with a non-EVMS volume manager for one or more of the devices, use one of the following ways to make the devices available to EVMS:

- Section C.4.1, "Mounting Your System Device with EVMS," on page 455
- Section C.4.2, "Converting LVM2 Volumes to EVMS Volumes," on page 460
- Section C.4.3, "Patching the 2.6 Kernel (Unsupported)," on page 461

C.4.1 Mounting Your System Device with EVMS

If you did not configure EVMS as the root partition manager during installation, the following post-install work-around configures the device to be managed by EVMS. This enables you to create NSS data volumes on single disk systems.

The following procedures assume that you installed OES Linux with three partitions on a single SCSI device named `sda`:

```
/dev/sda1  reiserfs /boot
/dev/sda2  swap     swap
/dev/sda3  reiserfs /
```

IMPORTANT: Make sure to modify the following procedures as necessary for your specific setup.

- "Disabling boot.lvm and boot.md" on page 456
- "Enabling the boot.evms Service" on page 456
- "Editing the /etc/init.d/boot.evms Script" on page 456
- "Editing the /etc/fstab File" on page 457
- "Editing the Boot Loader File" on page 458
- "Forcing the RAM Disk to Recognize the Root Partition" on page 459
- "Rebooting the Server" on page 460
- "Verifying that EVMS Manages the Boot, Swap, and Root Partitions" on page 460

Disabling boot.lvm and boot.md

Disable `boot.lvm` (handles devices for Linux Volume Manager) and `boot.md` (handles multiple devices in software RAIDs) so they do not run at boot time. In the future, you want `boot.evms` to run at boot time instead.

1. In YaST, click *System* > *System Services (Runlevel)* > *Expert Mode*.
2. Select *boot.lvm*.
3. Click *Set/Reset* > *Disable the Service*.
4. Select *boot.md*.
5. Click *Set/Reset* > *Disable the Service*.
6. Click *Finish*, then click *Yes*.

   The changes do not take affect until the server is restarted. Do not reboot at this time.
7. Continue with "Enabling the boot.evms Service" on page 456.

Enabling the boot.evms Service

Enable the `boot.evms` service so that it boots devices when you restart the server.

1. In YaST, click *System* > *System Services (Runlevel)* > *Expert Mode*.
2. Select *boot.evms*.
3. Click *Set/Reset* > *Enable the Service*.

   The *B runlevel* option is automatically selected.
4. Click *Finish*, then click *Yes*.

   The changes do not take affect until the server is restarted. Do not reboot at this time.
5. Continue with "Editing the /etc/init.d/boot.evms Script" on page 456.

Editing the /etc/init.d/boot.evms Script

1. Open the `/etc/init.d/boot.evms` script in a text editor.
2. Add the following lines to the Stop section:

```
mount -n -o remount,rw /
echo -en "\nDeleting devices nodes"
rm -rf /dev/evms
mount -n -o remount,ro /
```

For example, the Stop section looks like this after the edit:

```
stop)
    echo -n "Stopping EVMS"
    mount -n -o remount,rw /
    echo -en "\nDeleting devices nodes"
    rm -rf /dev/evms
    mount -n -o remount,ro /
    rc_status -v
  ;;
```

3 Save the file.

The changes do not take affect until the server is restarted. Do not reboot at this time.

4 Continue with "Editing the /etc/fstab File" on page 457.

Editing the /etc/fstab File

When you boot the system, the kernel reads the `/etc/fstab` file to identify which file systems should be mounted and then mounts them. This file contains a table of file system information about the `/boot`, `swap`, and root (`/`) partitions plus other partitions and file systems you want to mount.

You must edit the `/etc/fstab` file to modify the mount location of these three partitions so they are mounted under the `/dev/evms` directory. For example, change /dev/ *sda1* to /dev/evms/*sda1*.

Although the `/boot` partition is not managed by EVMS, the `boot.evms` script forces EVMS to scan all the partitions at boot time, including the `/boot` partition, and it activates `/boot` under the `/dev/evms` directory. Therefore, this makes `/boot` a partition that is discovered by EVMS at startup, and requires that the device's path be listed under `/dev/evms` in the `fstab` file so it can be found when booting with `boot.evms`.

Make sure to replace *sda1*, *sda2*, and *sda3* with the device names you used for your partitions.

IMPORTANT: When working in the `/etc/fstab` file, do not leave any stray characters or spaces in the file. This is a configuration file, and it is highly sensitive to such mistakes.

---

1 Open the `/etc/fstab` file in a text editor.

2 Locate the line that contains the `/boot` partition.

For example, if your `/boot` partition uses device *sda1* and the *Reiser* file system, look for a line similar to this:

```
/dev/sda1 /boot reiser defaults 1 1
```

3 In the *Device Name* column, modify the mount location of the `/boot` partition from `/dev` to `/dev/evms` so it can be managed by EVMS. Modify only the device name by adding `/evms` to the path:

```
/dev/evms/sda1 /boot reiser defaults 1 1
```

4 Repeat Step 2 and Step 3 to edit the Device Name entry in the lines for the `swap` and root (`/`) partitions.

For example, change `/dev/sda2` to `/dev/evms/sda2` , and change `/dev/sda3` to `/dev/evms/sda3`.

5 Save the file.

The changes do not take affect until the server is restarted. Do not reboot at this time.

6 Continue with "Editing the Boot Loader File" on page 458.

Editing the Boot Loader File

When you boot the system, the kernel reads the boot loader file for information about your system. For Grub, this is the `/boot/grub/menu.1st` file. For LILO, this is the `/etc/lilo.conf` file.

You must edit the boot loader file to modify the mount location of partitions so they are mounted under the `/dev/evms` directory. For example, change /dev/*sda1* to /dev/evms/*sda1*. Make sure to replace the path for all lines that contain device paths in the files. You can modify the boot loader file by editing fields in YaST, or use a text editor to modify the file directly.

IMPORTANT: When working in the boot loader file, do not leave any stray characters or spaces in the file. This is a configuration file, and it is highly sensitive to such mistakes.

To modify the boot loader file in the YaST Control Center:

1 Log in as the `root` user.

2 In Yast, select *System* > *Boot Loader*.

3 Modify the boot loader image so that the root file system is mounted as `/dev/evms/` instead of `/dev/`.

3a Select the boot loader image file, then click *Edit*.

3b Edit the device path in the *Root Device* field.

For example, change the *Root Device* value from

`/dev/sda2`

to

`/dev/evms/sda2`

Replace *`sda2`* with the actual device on your machine.

3c Edit any device paths in the *Optional Kernel Command Line Parameter* field.

3d Click *OK* to save the changes and return to the Boot Loader page.

4 Modify the failsafe image so that the failsafe root file system is mounted as `/dev/evms/` instead of `/dev/`.

4a Select the failsafe image file, then click *Edit*.

4b Edit the device path in the *Root Device* field.

4c Check the *Other Kernel Parameters* field and make changes if needed.

4d Click *OK* to save the change and return to the Boot Loader page.

5 Click *Finish*.

6 Continue with "Forcing the RAM Disk to Recognize the Root Partition" on page 459.

To edit the boot loader file in a text editor:

1 Log in as the `root` user.

2 Open the boot loader file in a text editor.

For Grub, this is the `/boot/grub/menu.1st` file. For LILO, this is the `/etc/lilo.conf` file.

3 Locate the line that contains the `root=` parameter.

   For example, if your root file system uses device *sda1*, look for a line similar to this:

   ```
   kernel (hd0,0)/vmlinuz root=/dev/sda1 vga=0x31a  splash=silent showopts
   ```

4 Modify the mount location from `/dev` to `/dev/evms` so it can be managed by EVMS.

   For example, after the change, the line looks like this:

   ```
   kernel (hd0,0)/vmlinuz root=/dev/evms/sda1 vga=0x31a  splash=silent showopts
   ```

5 Repeat Step 3 and Step 4 to locate other lines in the file that need to be similarly modified.

6 Save the file.

   The changes do not take affect until the server is restarted. Do not reboot at this time.

7 Continue with "Forcing the RAM Disk to Recognize the Root Partition" on page 459.

Forcing the RAM Disk to Recognize the Root Partition

Although you modified the `/etc/fstab` file so that everything now mounts from the `/dev/evms` path, the RAM disk still tries to load the root (`/`) partition from the `/dev` path because the `/initrd` file was configured during the install without using EVMS. You must force the RAM disk to update its information.

1 At a terminal prompt, enter the EVMS NCurses command:

   ```
   evmsn
   ```

2 Review the output to verify that EVMS shows only the `/boot` and `swap` partitions as active in EVMS.

   You should see the following devices mounted (with your own partition names, of course) for these two partitions:

   ```
   /dev/evms/sda1
   ```

   ```
   /dev/evms/sda2
   ```

3 Edit `/sbin/mkinitrd` to change the `root_evms` parameter from

   ```
   root_evms=
   ```

   to

   ```
   root_evms=1
   ```

   then save the file.

4 At a terminal prompt, enter

   ```
   /sbin/mkinitrd
   ```

   This forces `initrd` to get the updated `/dev/evms` path information for the root (`/`) partition.

5 Edit `/sbin/mkinitrd` to change the `root_evms` parameter from

   ```
   root_evms=1
   ```

   to

   ```
   root_evms=
   ```

   then save the file.

The changes do not take affect until the server is restarted. You reboot in the next task.

6 Continue with "Rebooting the Server" on page 460.

Rebooting the Server

1 Reboot the server to apply the post-install configuration settings.

2 Continue with "Verifying that EVMS Manages the Boot, Swap, and Root Partitions" on page 460.

Verifying that EVMS Manages the Boot, Swap, and Root Partitions

1 At a terminal prompt, enter the EVMS NCurses command:

```
evmsn
```

2 Review the output to verify that EVMS shows the `/boot`, `swap`, and root (`/`) partitions as active in EVMS.

You should see the following devices mounted (with your own partition names, of course) for these three partitions:

```
/dev/evms/sda1
/dev/evms/sda2
/dev/evms/sda3
```

Everything should now mount from the `/dev/evms` structure. You can now use the Storage plug-in to iManager to create and manage NSS pools and volumes, or use NSSMU and other NSS commands and utilities as desired.

C.4.2 Converting LVM2 Volumes to EVMS Volumes

The following instructions were modified from Converting to EVMS (http://evms.sourceforge.net/convert.html) at the EVMS Project Web site.

1 Open a terminal console, then log in as the `root` user.

2 Enter the following command to run the EVMS GUI:

```
evmsgui
```

3 In the Volume panel, review the names that EVMS reports for your existing volumes to find the volume that represents your `/boot`, `swap`, and root (`/`) volumes, then write down the names for future reference.

All storage objects that EVMS manages or activates (such as the `/boot` partition when using the `boot.evms` script) are mounted under `/dev/evms`. For example:

Storage Object	Mount Location
A disk segment of disk `sda` called `/dev/sda5`	`/dev/evms/sda5`
A software RAID device called `/dev/md1`	`/dev/evms/md/md1`
An LVM2 volume called `/dev/lvm_group/lvm_volume`	`/dev/evms/lvm/lvm_group/lvm_volume`

4 In a text editor, edit the `/etc/fstab` file to use the EVMS volume names.

For example, change the following entry for an LVM2 volume from this

```
/dev/system / reiserfs defaults 1 2
```

to this

```
/dev/evms/lvm/system / reiserfs defaults 1 2
```

IMPORTANT: Make sure not to leave any stray characters or spaces in the line.

With these changes, each time your system boots, your file systems are mounted using the EVMS volume manager.

5 Update the boot scripts by doing the following:

- The command `evms_activate` must be run from your boot scripts in order to automatically activate your volumes so their file systems can be mounted.

  The `evms_activate` command discovers all EVMS volumes and activates kernel devices for all volumes that are not yet active. If EVMS volumes are listed in the `/etc/fstab`, `evms_activate` should be run before `/etc/fstab` is processed.

- If you run software-RAID (`md`) or LVM2 tools during your boot scripts, remove or disable those commands.

6 Update the boot loader.

To mount your root file system using EVMS, you must install the EVMS `init-ramdisk` image and update your boot-loader configuration. For information about updating the boot loader, see "Editing the Boot Loader File" on page 458.

7 Reboot your system.

When your system boots, the kernel loads the `init-ramdisk`, which runs the EVMS tools to activate your volumes and mount your root fleshiest. Then your boot scripts run the EVMS tools once more to make sure your `/dev/evms/` directory correctly reflects the current state of your volumes. Finally, the remaining EVMS volumes are mounted as specified in your `/etc/fstab` file. Everything else on your system should start up as you would normally expect.

C.4.3 Patching the 2.6 Kernel (Unsupported)

Apply the BD-Claim Patch, which is a reversal of the patch that prevents Device-Mapper and the kernel's built-in partitions from using the same disk at the same time. This patch is not supported by the kernel community, and in fact removes functionality that they specifically added. However, it allows you to share your disks between EVMS and the kernel's built-in partitioning code, if that's the choice you want to make for your system.

WARNING: Adding this patch makes your server an unsupported configuration with respect to Novell Support.

See BD-Claim Patch (http://evms.sourceforge.net/install/kernel.html#bdclaim) for more information.

C.5 Additional EVMS Documentation

For information about using EVMS on SUSE Linux Enterprise Server 10 and OES 2 Linux servers, see the *SLES 10 SP3: Storage Administration Guide*.

For more information about the Enterprise Volume Management System, see the following open source documentation:

- EVMS Project at SourceForge.net (http://sourceforge.net/projects/evms/)
- *EVMS GUI User Guide* (http://evms.sourceforge.net/user_guide/#assignseggui)
- EVMS GUI Screen Shots (http://evms.sourceforge.net/gui_screen/)

D Using NSS on Devices Managed by Non-EVMS Volume Managers

The Novell Storage Services file system can exist on devices managed by any volume manager. However, when using non-EVMS volume managers, some of the NSS features are not available because the NSS management tools require EVMS to carry out related commands.

WARNING: The LVM-based NSS configurations described in this appendix are untested and are not supported by Novell Support. Also, some key features, such as clustering with Novell Cluster Services, are not available on non-EVMS managed volumes. For more information see Section D.1.2, "NSS Limitations for Non-EVMS Volume Managers," on page 464.

These instructions are only for those who are willing to assume the risks and limitations described. Everyone else should follow the instructions located in Chapter 3, "Installing and Configuring Novell Storage Services," on page 39, and use EVMS as their NSS volume manager.

This section describes the following:

- Section D.1, "FAQs About Using EVMS with NSS," on page 463
- Section D.2, "Guidelines for Using NSS with Non-EVMS Volume Managers," on page 464
- Section D.3, "Creating and Mounting NSS Pools and Volumes Using Linux Commands," on page 465
- Section D.4, "Configuring Default Mount Settings for NSS Pools and Volumes," on page 469
- Section D.5, "Expanding NSS Pools on Non-EVMS-Managed Devices," on page 471

D.1 FAQs About Using EVMS with NSS

- Section D.1.1, "Why Should I Use EVMS with NSS?," on page 463
- Section D.1.2, "NSS Limitations for Non-EVMS Volume Managers," on page 464

D.1.1 Why Should I Use EVMS with NSS?

Using EVMS with NSS allows you to take advantage of the full range of capabilities of NSS and the NSS management tools, including the Storage plug-in to Novell iManager 2.7, the NSS Management Utility (NSSMU), the NSS Console Utility (NSSCON), and other NSS utilities and commands. NSS tools require EVMS for management functions related to devices, software RAIDS, partitions, pool snapshots, and creating pools.

For information about limitations for NSS on devices managed by non-EVMS volume managers, see "NSS Limitations for Non-EVMS Volume Managers" on page 464.

D.1.2 NSS Limitations for Non-EVMS Volume Managers

The basic NSS file system works on devices that are managed by any volume manager. However, the following NSS capabilities are unavailable or have limited availability for devices managed by a non-EVMS volume manager:

- **NSS Management Tools:** The following NSS management tools are affected:
  - **iManager:** The storage-related plug-ins for Novell iManager require that EVMS be used as the volume manager of any devices where you want to create and manage NSS file systems. The tool does not work with devices managed by non-EVMS volume managers.

    For information about storage-related plug-ins, see Section 9.1, "Novell iManager and Storage-Related Plug-Ins," on page 87.
  - **NSSMU:** NSSMU requires EVMS to manage partitions, manage devices, create and manage software RAIDs, create and manage pool snapshots, and create and mirror pools.

    If you create the pool with `mkfs` at the command line on a non-EVMS device, you can only create a Pool object using the *Pools* > *Update NDS* option, and create and manage both non-encrypted and encrypted volumes for the pool using the *Volumes* page.

    For information about NSSMU on Linux, see Section 9.2, "NSS Management Utility (NSSMU) Quick Reference," on page 103.
  - **Command Line:** EVMS is required for NSS command line commands and utilities.
- **NSS Software RAIDS:** NSS requires EVMS to create and manage software RAID devices. However, you can optionally create software RAIDs for your device using the Linux Device Mapper utility.
- **NSS Pool Snapshots:** NSS requires EVMS to create and manage pool snapshots.
- **Cross-Platform Compatibility:** NSS pools that are created on devices managed by non-EVMS volume managers cannot be moved to a NetWare server.
- **Clusters:** Novell Cluster Services (NCS) for Linux requires EVMS for clustering. Pools created on devices managed by non-EVMS volume managers cannot be used in NCS clusters. Third-party clustering systems that integrate with third-party cluster volume managers should be able to work with NSS volumes.

To use NSS with a non-EVMS volume manager, create partitions and pools with the Linux `mkfs` command, then use NSSMU to manage the volumes. For information, see Section D.3, "Creating and Mounting NSS Pools and Volumes Using Linux Commands," on page 465.

D.2 Guidelines for Using NSS with Non-EVMS Volume Managers

If you use a volume manager other than EVMS to manage devices, some capabilities of NSS are not available. However, you can create and manage NSS pools and volumes on those devices by using the guidelines in this section.

- Section D.2.1, "Guidelines for the Server Install," on page 465
- Section D.2.2, "NSS Management Considerations," on page 465

D.2.1 Guidelines for the Server Install

Partition Setup

Make sure to leave unformatted free disk space so that you can create partitions for NSS after the install by using the Linux `mkfs` command.

Software Setup

NSS is not installed by default. To add NSS to the Software list at install time, open the Software setup option, search for the NSS package, select the NSS check box, then click Accept.

You can optionally install NSS after the initial install by using the *Software Updates* feature in YaST.

D.2.2 NSS Management Considerations

If you want to create NSS pools and volumes on devices managed by non-EVMS volume managers, consider the following management differences:

- Use the volume manager's tools or Linux commands and utilities to manage devices, software RAID devices, and partitions. The NSS tools, utilities, or commands that manage devices, software RAID devices, partitions, and pool snapshots require EVMS.
- Use the Linux `mkfs` command to create an NSS pool, then use NSSMU create its storage objects in Novell eDirectory. You cannot create pools with NSS tools, utilities, or commands without EVMS. For information, see Section D.3.1, "Using the Linux mkfs Command to Create NSS Pools," on page 466.
- Manage existing NSS pools and create and manage NSS volumes with NSSMU. For information, see Section 9.2, "NSS Management Utility (NSSMU) Quick Reference," on page 103.
- File system management tools are unaffected; they should work regardless of the volume manager that is managing the device.

  For information, see the following:

OES 2 SP3: File Systems Management Guide

  - Section 9.4, "Novell NetStorage," on page 107
  - Section 9.6.2, "Novell Client for Windows XP/2003 and Vista," on page 112

D.3 Creating and Mounting NSS Pools and Volumes Using Linux Commands

Use the following procedure to create and mount an NSS pool and volume.

- Section D.3.1, "Using the Linux mkfs Command to Create NSS Pools," on page 466
- Section D.3.2, "Creating a Partition," on page 466
- Section D.3.3, "Creating and Mounting an NSS Pool," on page 467
- Section D.3.4, "Creating and Mounting an NSS Volume," on page 468

D.3.1 Using the Linux mkfs Command to Create NSS Pools

The Linux `mkfs` command is used to build a file system on Linux. This section describes how to use the Linux `mkfs` command to create an NSS file system pool.

IMPORTANT: Be very careful with this command. The `mkfs` command destroys any existing data on the specified device or partition.

Syntax

`mkfs [ -t fs-type ] [ fs-options ] filesys`

Option or Parameter	Description

`-t fs-type`	Specifies the type of file system to be built, such as nsspool or nssvol. For example:
	`-t nsspool`
	`-t nssvol`

`fs-options`	File-system-specific options to be passed to the real file system builder.
	When creating an NSS pool, use this fs-option:
	`-n poolname`
	Replace *poolname* with the actual name of the pool you want to create.
	When creating an NSS volume, use this fs-option:
	`-n volname`
	Replace *volname* with the actual name of the volume you want to create.

`filesys`	When using nsspool as the fs-type, replace *filesys* with the device name (*devname* such as `/dev/hda1` or `/dev/sdb2`). When using nssvol as the fs-type, replace *filesys* with the pool name (*poolname* such as `POOL2`).

Examples

`mkfs -t nsspool -n poolname devname`

`mkfs -t nssvol -n volname poolname`

D.3.2 Creating a Partition

Use the following procedure to create a `/dev/partition` device, such as `/dev/hda2` or `/dev/sda5`.

1. Log in to the server as the `root` user, or use the `su` command to become `root`.
2. Go to the *YaST > System Partitioner*, then select *Create a Partition*.
3. Select a device with free space available.
4. Create a partition. The name is automatically specified, such as *hda2* or *sda5*.

5 If you do not want to use all of the available free space, specify the amount of space to use.

Make sure the partition size is sufficient for the NSS pool you want to create later; the partition size determines the pool size.

6 Select *Unformatted*.

7 Do not specify the mount point; leave the *Mount Point* field blank.

8 Click *OK* to create the partition.

9 Continue with Section D.3.3, "Creating and Mounting an NSS Pool," on page 467.

D.3.3 Creating and Mounting an NSS Pool

1 Log in to the server as the `root` user, or use the `su` command to become `root`.

2 At a system command prompt, enter

```
mkfs -t nsspool -n poolname devname
```

Replace *poolname* with the name you want to use, such as `POOL2`. Replace *devname* with the device you created in Section D.3.2, "Creating a Partition," on page 466.

IMPORTANT: Do not use ampersand (&) and pound (#) characters in pool and volume names; it creates problems in the `/etc/fstab` file. For information about other naming conventions, see "Naming NSS Storage Objects" on page 61.

For example, enter

```
mkfs -t nsspool -n POOL2 /dev/hda2
```

where `POOL2` is the pool name and `/dev/hda2` is the device name.

3 If the location where you want to mount the NSS pool does not already exist, create the mount point. At the server command prompt, enter

```
mkdir /mnt/pooldir
```

The /mnt directory is the default location for mounting devices. If you are using a different location, replace /mnt with that path. Replace *pooldir* with the name (path) you want to use, such as `POOL2`. If you want to make it a hidden directory, begin the directory name with a period, such as `.POOL2`.

For example, enter

```
mkdir /mnt/.POOL2
```

where `/mnt/.POOL2` is the mount point for your pool.

4 Mount the NSS pool. At a system command prompt, enter

```
mount -t nsspool devname mountpoint -o name=poolname
```

For example, enter

```
mount -t nsspool /dev/hda2 /mnt/.POOL2 -o name=POOL2
```

5 Use NSSMU to create a Storage object in eDirectory for the newly created pool.

5a At a terminal prompt, enter

```
nssmu
```

5b From the NSSMU menu, select *Pools*.

5c Select the pool from the *Pools* list, then press *F4* (NDS Update).

6 Continue with Section D.3.4, "Creating and Mounting an NSS Volume," on page 468.

D.3.4 Creating and Mounting an NSS Volume

1 Log in to the server as the `root` user, or use the su command to become `root`.

2 Make sure the pool where you want to create the volume is mounted.

For information, see Section D.3.3, "Creating and Mounting an NSS Pool," on page 467.

3 Create an NSS volume. At the system console, enter

```
mkfs -t nssvol -n volname poolname
```

Replace *volname* with the name you want to use, such as NSSV1. Replace *`poolname`* with the NSS pool where the volume will reside, such as `POOL2`. This is the pool you created in Section D.3.3, "Creating and Mounting an NSS Pool," on page 467.

IMPORTANT: Do not use ampersand (&) and pound (#) characters in pool and volume names; it creates problems in the `/etc/fstab` file. For information about other naming conventions, see "Naming NSS Storage Objects" on page 61.

For example, enter

```
mkfs -t nssvol -n NSSV1 POOL2
```

4 If the location where you want to mount the NSS volume does not already exist, create the directory path. At the server command prompt, enter

```
mkdir /media/nss/volname
```

The `/media/nss` path is the default location for NSS volumes. If you are using a different location, replace /media/nss with that path. Replace *volname* with the name of the volume you created in Step 3.

For example, enter

```
mkdir /media/nss/NSSV1
```

5 Mount the NSS volume. At a system command prompt, enter

```
mount -t nssvol VOL volmountpoint -o name=volname
```

For example, enter

```
mount -t nssvol VOL /media/nss/NSSV1 -o name=NSSV1
```

D.4 Configuring Default Mount Settings for NSS Pools and Volumes

Whenever you create NSS pools and volumes from the command line, their mount information is not added by default to the `/etc/fstab` configuration file. After creating the pool and volume, make sure to edit the `/etc/fstab` configuration file to add entries for them.

- Section D.4.1, "Understanding Entries in the /etc/fstab Configuration File," on page 469
- Section D.4.2, "Adding NSS Pool and Volume Mount Information to /etc/fstab," on page 470

D.4.1 Understanding Entries in the /etc/fstab Configuration File

The `/etc/fstab` file is a configuration file that contains information about all the devices and partitions on your Linux computer. Each line is an entry that describes where and how to mount one device or one partition. The following table describes the field information needed for NSS pools and volumes.

Table D-1 *Options in the /etc/fstab File*

Column in /etc/fstab	Description	Examples
Device name	The location of the device or partition you want to mount.	`/dev/hda3` `/dev/sdb1`
Mount point	The default location where the device or partition is to be mounted if the mount point is not otherwise specified in a mount command.	`/mnt/.pool2` `/media/nss/NSSV1`
File system type	The file system type of the device or partition.	`nsspool` `nssvol`

Column in /etc/fstab	Description	Examples

Mount options	Lists the comma-delimited mount options for the device or partition. Use a comma without spaces between options.
	
	auto or noauto: Use auto if you want the volume to mount automatically after a system reboot. Use noauto if you want the device to be mounted only when you explicitly issue the mount command. Do not use the auto command for encrypted NSS volumes; they require a password to be entered on the first mount after a system reboot.
	
	rw: Use rw to mount the device as read-write.
	
	name=<poolname | volname>: Specify the *poolname* or *volname* of the partition to be mounted.
	
	noatime: Use noatime for volumes when you want a file's access time (atime) to not be updated for reads.
	
	nodiratime: Use nodiratime for volumes when you want a directory's access time to not be updated for enumerations.
		`noauto,rw,name=POOL2`
		
		`noauto,rw,name=NSSV1`
		
		`name=POOL2,NSSV1,noatime,nodiratime`
		
		`name=NSSV1,noatime,nodiratime`

Dump option number	Designates if the file system should be dumped with the Linux Dump utility. A value of 0 indicates that Dump should ignore this file system. Set this value to 0 for NSS pools and volumes.	`0`
File system check number	Designates if the file system should be checked with the Linux fsck utility. A value of 0 indicates that fsck should ignore this file system. Set this value to 0 for NSS pools and volumes.	`0`

D.4.2 Adding NSS Pool and Volume Mount Information to /etc/fstab

For information about completing the fields for an entry in the `/etc/fstab` file, see Section D.4.1, "Understanding Entries in the /etc/fstab Configuration File," on page 469.

1. Log in as the `root` user, or use the `su` command to become `root`.
2. In a text editor, open the `/etc/fstab` configuration file.

   IMPORTANT: When working in `/etc/fstab`, make sure not to leave any stray characters or spaces in the file. This is a configuration file, and it is highly sensitive to such mistakes.

3. Locate the area in `/etc/fstab` where partitions are defined, then add a line defining the mount information for the NSS pool.

   `devname mountpoint fstype mountoptions dump# fsck#`

For example, suppose you created `POOL2` on device `/dev/hda2` and mounted it at `/mnt/.POOL2`. In the `/etc/fstab` file, the line to add would be

```
/dev/hda2 /mnt/.POOL2 nsspool noauto,rw,name=POOL2 0 0
```

If you want to mount an NSS pool automatically after a system reboots, make sure to use the auto command.

4 Locate the area in `/etc/fstab` below where you entered pool information, then add a line defining the mount information for the NSS volume.

```
devname mountpoint fstype mountoptions dump# fsck#
```

Make sure to place the NSS volume entry after its pool entry to ensure that the pool is mounted before the volumes in it.

For example, suppose you created volume `NSSV1` and mounted it at `/media/nss/NSSV1`. In the `/etc/fstab`, the line to add would be

```
NSSV1 /media/nss/NSSV1 nssvol noauto,rw,name=NSSV1 0 0
```

If you want to mount a non-encrypted NSS volume automatically after a system reboots, make sure to use the auto command on both the pool it is in and the volume.

5 Save the `/etc/fstab` file to accept your changes.

D.5 Expanding NSS Pools on Non-EVMS-Managed Devices

After using Linux utilities to move the pool to a larger device and to increase the partition size to the size of the device, use the NSS Update utility to increase the pool size up to the size of the new device. For instructions see, Section B.7, “nssupdate,” on page 435.

E Comparison of NSS on NetWare and NSS on Linux

This section compares features and capabilities of Novell Storage Services on NetWare 6.5 SP8 and Novell Open Enterprise Server 2 SP3 Linux servers.

Feature Description	NSS for NetWare 6.5 SP8	NSS for OES 2 SP3 Linux
Management interfaces	Novell iManager	Novell iManager
	NSSMU for NetWare	NSSMU for Linux
		EVMS (`evmsgui`)
	Utilities in the server console (NSSMU, RIGHTS, FLAG)	Utilities in the terminal console (NSSMU, RIGHTS, NSSCON, ATTRIB, RAVSUI, RAVVIEW, quota, nssraid, ncsinit, `nbackup(1)` (http://www.novell.com/documentation/oes/smsadmin/data/nbackup.1.html))
	RIGHTS in the server console	NSS commands in the NSS Console (NSSCON)
	Novell Remote Manager for NetWare	Novell Remote Manager for Linux (for Dynamic Storage Technology shadow volumes and for managing NCP Server connections to NSS volumes)
	Novell NetStorage for NetWare	Novell NetStorage for Linux
File system trustees, trustee rights, and inherited rights filter to control access to directories and files	Files and Folders plug-in to iManager	Files and Folders plug-in to iManager
	Novell Remote Manager for NetWare	
	Novell NetStorage for NetWare (via Web browser only, not WebDAV)	Novell NetStorage for Linux (via Web browser only, not WebDAV)
	Novell Client	Novell Client
	RIGHTS utility for NetWare	RIGHTS utility for Linux

Feature Description	NSS for NetWare 6.5 SP8	NSS for OES 2 SP3 Linux
File system directory and file attributes to control functions available for directories and files	Files and Folders plug-in to iManager Novell NetStorage for NetWare Novell Client Novell Remote Manager for NetWare	Files and Folders plug-in to iManager Novell NetStorage for Linux Novell Client
Directory quotas management (requires the Directory Quotas attribute for the volume)	Files and Folders plug-in to iManager Novell NetStorage for NetWare Novell Remote Manager for NetWare	Files and Folders plug-in to iManager Novell NetStorage for Linux
User space quota management (requires the User Space Quotas attribute for the volume)	Storage plug-in to Novell iManager	Storage plug-in to Novell iManager (OES 1 SP1 and later)
Default mount location for NSS pools	Not applicable	`/opt/novell/nss/mnt/.pools/poolname`
Default mount location for NSS volumes	Server root	`/media/nss/volumename`
Default mount location for devices managed by EVMS	Not applicable	`/dev/evms/`
File system type (as recognized and reported by the operating system)	nss	nssvol
File access protocols	NCP Native File Access Protocols (AFP, CIFS, and NFS)	NCP Novell AFP for Linux (beginning in OES 2 SP1) Novell CIFS for Linux (beginning in OES 2 SP1) CIFS/Samba using Novell Samba Linux NFS (version 3) Linux NFS and Samba requires users to be Linux-enabled with Linux User Management. The service must also be enabled.
Interface	64-bit	64-bit
Character format	Unicode	Unicode
Maximum device size recognized (physical or logical)	2 TB	2 TB
Maximum software RAID device size (combined total for all member segments)	2 TB	2 TB

Feature Description	NSS for NetWare 6.5 SP8	NSS for OES 2 SP3 Linux
Minimum software RAID segment size	12 MB per segment	12 MB per segment
Maximum partition size	2 TB Valid Range: 10 MB to 2 TB	2 TB Valid Range: 10 MB to 2 TB
Maximum number of partitions per pool	No practical limit	No practical limit
Maximum pool size (created by using at least 4 partitions of up to 2 TB each)	8 TB	8 TB
Minimum pool size	10 MB	10 MB
Maximum size of a volume	Up to 8 TB, depending on the pool size and available space in the pool.	Up to 8 TB, depending on the pool size and available space in the pool.
Maximum file size	Up to 8 TB, depending on the volume size and available space in the volume.	Up to 8 TB, 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 name spaces are loaded. **NOTE**: NSS can support this. You are limited by the browser and application ability, of course.	Up to 8 trillion, regardless of how many name spaces are loaded. **NOTE**: NSS can support this. You are limited by the browser and application ability, of course.
Maximum number of files open concurrently	1 million	1 million
Maximum number of volumes per server	255 plus the `sys:` volume. You can mount NSS volumes beyond 256, but they are not visible or accessible through the normal Netware APIs.	No practical limit on the number of NSS data volumes.
Time to mount a volume	Requires only a few seconds, thanks to journaling.	Requires only a few seconds, thanks to journaling.
Volume name space	Accommodates all name spaces (DOS, Macintosh, Long, and UNIX). Long is the default name space. In OES 1 SP1 and later, the Lookup Name Space attribute allows you to set the default name space used when mounting volumes. Directory names and filenames are case insensitive.	Accommodates all name spaces (DOS, Macintosh, Long, and UNIX). Long is the default name space. The Lookup Name Space attribute allows you to set the default name space used when mounting volumes. Directory names and filenames are case insensitive with the Long name space.
Minimum server memory required to activate a volume	Requires only 4 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.	Requires only 4 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.

Feature Description	NSS for NetWare 6.5 SP8	NSS for OES 2 SP3 Linux
File access time	Same for each file, regardless of its location on the volume.	Same for each file, regardless of its location on the volume.
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.	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.
Repair of corrupted pools and volume	Ongoing journaling of the file system; if the pool metadata structure is corrupted, use the NSS verify and rebuild functions.	Ongoing journaling of the file system; if the pool metadata structure is corrupted, use the RAVSUI utility to verify and rebuild the volume.
Time to repair corrupted volume	From a few seconds to several hours, depending on the volume size.	From a few seconds to several hours, depending on the volume size.
Multiple connection paths to storage media	Yes, Media Manager multipath I/O	Use a native Linux multiple path I/O solution.
Software RAID support	RAID 0 (striping) RAID 1 (mirroring) RAID 5 (striping with parity) RAID 0+1 (mirroring RAID 0 devices) RAID 5+1 (mirroring RAID 5 devices)	RAID 0 (striping) RAID 1 (mirroring) RAID 5 (striping with parity) For OES 2 SP2 and later, NSSMU supports: RAID 0+1 (mirroring RAID 0 devices) RAID 5+1 (mirroring RAID 5 devices)
Volume encryption	Yes	Yes, for OES 1 SP1 and later You must mount encrypted volumes only from NSSMU on the first mount after a system reboot so that you can enter the password. The NSSCON utility does not support entering a password from the command line.
Data shredding	Yes, up to 7 times	Yes, up to 7 times
File compression	Yes	Yes
Data migration	Yes	Yes
Directory quotas	Yes	Yes
User space quotas (user space restrictions)	Yes	Yes, for OES 1 SP1 and later

Feature Description	NSS for NetWare 6.5 SP8	NSS for OES 2 SP3 Linux
Salvage or purge deleted files, directories, or volumes	Yes	Yes
Transaction Tracking System (TTS)	Yes	Not supported. If you need content tracking and trustee support, use NCP volumes on Linux reiser, XFS, or ext3 file systems, then set the file system's journaling mode to the Journaling option.
Read ahead blocks	Yes	Yes
File save time	Provides 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.	Provides the group write options and timers. For information, see Section 27.3, "Configuring or Tuning Group I/O," on page 352.
File-level snapshot (make a temporary snapshot copy of an open file for backup)	Yes	No
Modified File List	Yes	Yes
Pool snapshot (retain point-in-time version of a pool using block-level copy on write)	Yes; allows backup of block-level changes only, without deactivating the volume. Uses a brief freeze-release process to capture information for last remaining open files.	Yes, for OES 2 Linux and later. The stored-on pool must be on a separate partition. Pool snapshots are not supported for clustered NSS pools on Linux.
Backup systems support	*OES 2 SP3: Storage Management Services Administration Guide for Linux* *NW 6.5 SP8: SBCON Administration Guide*	*OES 2 SP3: Storage Management Services Administration Guide for Linux* For an overview of backup resources on Linux, see Chapter 26, "Managing Backup and Restore for Data and Trustee Information," on page 345.
Distributed File Services for moving and splitting NSS volumes	Yes	Yes, for OES 2 Linux and later
Novell Archive and Version Services	Yes	Yes, for OES 2 Linux and later
Device maintenance support	Activate and deactivate devices by pool.	Activate and deactivate devices by pool.
CD and DVD device recognition	Automatic process with full support for UDF, ISO 9660, and Macintosh HFS formats. Use CDs and DVDs as read-only NSS volumes.	No; use Linux POSIX file system options instead.

Feature Description	NSS for NetWare 6.5 SP8	NSS for OES 2 SP3 Linux
CD and DVD image files	Activate as read-only NSS volumes.	No; use Linux POSIX file system options instead.
Ability to access DOS partitions on the NetWare server	Load `dosfat.nss` to treat the partition as a standard NSS volume	No; use Native Linux file system options instead.
Operating system version detection	Default process	Default process
Cache balancing for NSS cache buffers	Yes; for information, see Tuning NSS Performance on NetWare.	Yes; for information, see "Tuning NSS Performance on Linux" on page 349.
Tuning I/O write behavior	Set I/O tuning parameters for NSS on NetWare. For information, see Setting the File and Buffer Flush Timers.	Set group I/O write parameters for NSS on Linux. For information, see "Configuring or Tuning Group I/O" on page 352.
Dynamic Storage Technology (DST) For information about NSS volume attributes and features that are supported in DST shadow volumes, see "Using NSS Volumes in DST Shadow Volumes" in the *OES 2 SP3: Dynamic Storage Technology Administration Guide*.	DST supports using NetWare iSCSI target devices to store NSS volumes in the shadow volume pair. The target devices are attached to the OES 2 Linux server by using the Linux iSCSI initiator software. For information, see "iSCSI Block Storage Devices" in the *OES 2 SP3: Dynamic Storage Technology Administration Guide*.	DST supports NSS volumes on OES 2 Linux servers as the primary or secondary volume in the shadow volume. For information, see the *OES 2 SP3: Dynamic Storage Technology Administration Guide*.

F Comparison of NSS on Linux and NCP Volumes on Linux POSIX File Systems

This section compares features and capabilities of the Novell Storage Services file system on Novell Open Enterprise Server 2 Linux to those of NCP volumes on Linux POSIX file systems such as Ext3, XFS, and Reiser. For information, see "Managing NCP Volumes" in the *OES 2 SP3: NCP Server for Linux Administration Guide*.

For information to help you choose from among the numerous Linux file system offerings, see the following:

- *File System Primer* (http://wiki.novell.com/index.php/File_System_Primer)
- *SUSE Linux Enterprise Server 10 File Systems Features Overview* (http://www.novell.com/linux/filesystems/features.html)

Feature Description	NSS on OES 2 SP3 Linux	NCP Volumes on Linux POSIX File Systems
Management interfaces	Novell iManager Storage plug-in NSSMU for Linux Novell iManager with various storage-related plug-ins. For information, see Section 9.1, "Novell iManager and Storage-Related Plug-Ins," on page 87. EVMS (`evmsgui`) NSS utilities in a terminal console NSS commands in the NSS Console (NSSCON) Novell Remote Manager for Linux (browse only)	YaST > Partitioner for managing devices Novell Remote Manager for Linux (Managing Shares) NCP commands in the NCP Console (NCPCON) YaST EVMS (`evmsgui`) for managing Linux devices and volumes. Various Linux commands and utilities in a terminal console.
File system trustees and trustee rights to control access to directories and files	Yes, works with or without concurrent running of NCP Server.	Yes, requires NCP Server to enforce the rights and access on the extended attributes.

Feature Description	NSS on OES 2 SP3 Linux	NCP Volumes on Linux POSIX File Systems
File access protocols	NCP CIFS/Samba using Novell Samba Linux NFS (version 3) Linux NFS and Samba requires users to be Linux-enabled with Linux User Management. The service must also be LUM enabled. Novell AFP for Linux (beginning in OES 2 SP1) Novell CIFS for Linux (beginning in OES 2 SP1)	NCP CIFS/Samba using Novell Samba
File system directory and file attributes to control functions available for directories and files	Files and Folders plug-in to iManager Novell NetStorage Novell Client Novell Remote Manager for Linux. See "Viewing Key NSS Directory and File Attributes as Linux POSIX Permissions" in the *OES 2 SP3: File Systems Management Guide*.	Not applicable. Use POSIX file and directory attributes.
Directory quotas	Yes, requires the Directory Quotas attribute to be enabled. Novell NetStorage Novell Client	No
User space quotas (user space restrictions)	Yes, for OES Linux SP1 and later	Yes, if the Linux file system being used under the NCP share supports user quotas and the Linux file system resides on a local, iSCSI, or Fibre Channel drive. All users of the NCP volume must be LUM enabled. Manage the user quotas using the Linux file system tools.
Default mount location for NSS pools	`/opt/novell/nss/mnt/.pools/poolname`	Not applicable.

Feature Description	NSS on OES 2 SP3 Linux	NCP Volumes on Linux POSIX File Systems
Volume name space	Long is the default name space, which is case insensitive. You can specify the UNIX name spaces on mounting the NSS volume to make its directory names and filenames case sensitive. Using UNIX name space slows performance compared to using Long. For example: `mount ns=`*`namespace`* Valid name space values are dos, mac, long, or unix.	UNIX; no support for case insensitive names.
Salvage for deleted volumes, directories, and files	Yes	No
Volume encryption	Yes, for OES Linux SP1 and later	Yes, for Reiser
File compression	Yes	No
Data shredding (secure deletion)	Yes, up to 7 times	No
Online resizing of volumes and pools	Yes	Yes, depending on the file system
Multiple I/O paths to storage media For information, see "Managing Multipath I/O for Devices" in the *SLES 10 SP3: Storage Administration Guide*.	No; NSS-specific multipath I/O tools as are not available on Linux. Use the Linux Device Mapper driver support for mutlipath I/O on devices where you plan to create NSS file systems.	Use the Linux Device Mapper driver support for mutlipath I/O on devices. (NCP is not required to make this work.)
Software RAID support	RAID 0, 1, and 5.	RAID 0, 1, 4, 5 and 6. RAID 0+1 can be created using the Linux `mdadm(8)` command as a complex RAID using the RAID 0+1 option, or as a nested RAID. For information, see the *SLES 10 SP3: Storage Administration Guide*.
Pool snapshot (retain point-in-time version of a pool using block-level copy on write)	Yes, using iManager or NSSMU.	Depends on the file system. EVMS supports device snapshots for the devices it manages. (NCP is not required to make this work.)
Hard links	Yes; enhanced hard links support is available in OES 2 and later. For information, see Chapter 24, "Managing Hard Links," on page 321.	Yes

Feature Description	NSS on OES 2 SP3 Linux	NCP Volumes on Linux POSIX File Systems
Backup support	Yes, using Novell Storage Management Services for Linux. For information, See Chapter 26, “Managing Backup and Restore for Data and Trustee Information,” on page 345.	No. Use third-party solutions.
Data migration from NSS volumes on NetWare	Yes	Yes
Novell Archive and Version Services	Yes. For information, see the *OES 2 SP3: Novell Archive and Version Services 2.1 Administration Guide for Linux*.	No
Novell Distributed File Services For information, see the *OES 2 SP3: Novell Distributed File Services Administration Guide for Linux*.	Yes, for OES 2 Linux and later. NSS volumes on OES 2 Linux can contain junctions or be a junction target. NSS volumes on OES 1 Linux can be a junction target, but junctions are not supported in the volume.	Only as targets of junctions in OES 2 and later. DFS does not support junctions on NCP volumes.
Dynamic Storage Technology For information, see the *OES 2 SP3: Dynamic Storage Technology Administration Guide*.	Yes	Not available in the initial OES 2 release.
Novell Cluster Services for Linux For information, see the *OES 2 SP3: Novell Cluster Services 1.8.8 Administration Guide for Linux*.	Yes For information, see “Creating Cluster-Enabled Pools and Volumes”.	Yes; cluster the Linux POSIX file system, then create the NCP volume on it. For information, see “Creating Linux POSIX Volumes on Shared Devices”.
Novell Transaction Tracking System (TTS)	No	Use the Journal mode for Linux POSIX file systems that support journaling.
Operating system version detection	Default process	Default process
Device maintenance support	Activate and deactivate devices by pool.	Activate and deactivate devices using Linux tools.
Cache balancing for NSS cache buffers	You can specify a minimum cache buffer size. For information, see “Tuning NSS Performance on Linux” on page 349.	Integrated with the Linux file system cache.

Feature Description	NSS on OES 2 SP3 Linux	NCP Volumes on Linux POSIX File Systems
CD and DVD device recognition	No; not managed by NSS. Use Linux services to mount CDs and DVDs as Linux volumes.	Yes, default
Ability to access DOS partitions as on a NetWare server	No; not managed by NSS. Use Linux services instead.	Yes, using Linux services.
Default mount location for NSS volumes	`/media/nss/volumename`	Not applicable.
Default mount location for devices managed by EVMS	`/dev/evms/`	`/dev/evms/`
Interface	64-bit	64-bit
Character format	Unicode	UTF-8
Maximum device size recognized (physical or logical)	2 TB	For a 32-bit OS: ◆ 4 TB for Ext2 or Ext3 ◆ 16 TB (minus 1 Byte) for Reiser For a 64-bit OS: ◆ 2 to 32 TB for Ext2 or Ext3, depending on the block size ◆ 16 TB (minus 1 Byte) for Reiser
Maximum software RAID size (combined total of all member segments)	2 TB	See Maximum device size recognized.
Minimum software RAID segment size	12 MB per segment	Depends on the file system.
Maximum partition size	2 TB Valid Range: 10 MB to 2 TB	Up to 16 TB, depending on the file system and block size as noted above.
Maximum number of partitions (logical or physical devices) per pool	No practical limit	Not applicable.
Maximum pool size	8 TB (using 4 or more partitions of up to 2 TB each)	Up to the partition size, depending on the file system.
Minimum pool size	10 MB	Not applicable.
Maximum size of a volume	Up to 8 TB, depending on the pool size and available space in the pool. Volume quotas can be overbooked. For information, see Section 18.2, “Guidelines for NSS Volumes,” on page 227.	Up to the partition size, depending on the file system.

Feature Description	NSS on OES 2 SP3 Linux	NCP Volumes on Linux POSIX File Systems
Maximum file size	Up to 8 TB, depending on the volume size and available space in the volume.	2 GB to 2 TB for Ext2 or Ext3, depending on the block size. Up to 8 TB for Reiser.
Maximum number of files per volume (In practice, how many files be managed is limited only by the file browser's and application's ability to list and access the files.)	Up to 8 trillion (10E12), regardless of how many name spaces are loaded. Up to 4 billion (10E9) files in a single directory.	Up to 8 trillion (10E12), regardless of how many name spaces are loaded.
Maximum number of files open concurrently	1 million (10E6)	Millions (10E6), depending on the file system
Maximum number of volumes per server	Unlimited NSS data volumes, but only 255 can be mounted at a time	Unlimited
Time to mount a volume	Requires 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).	Depends on the file system; from a few seconds to a few minutes.
Time to repair corrupted volume	Up to several hours, depending on the volume size.	Up to several hours, depending on the volume size

G NSS Nomenclature

This section describes the nomenclature used for key Novell Storage Services media objects in Novell Open Enterprise Server 2. This information can help you better understand the nature of error messages you might receive when using NSS. The table identifies the media object, defines it, and indicates the version of NetWare or OES where the media object first appeared.

NOTE: All ZLSS (NSS Journaled Storage System) file blocks are 4 KB in size.

Media Object	Definition	Version Where First Used
Area Seed	To improve performance for OES 2 Linux, metadata blocks use an area seed logic to make sure that related metadata blocks are physically stored near each other. For information about configuring area size, see Section 27.3.1, "Viewing the Metadata Area Size," on page 353.	OES 2 Linux (not available on NetWare)
Beast B-Tree	The Balanced Tree (B-Tree) that tracks all the file's metadata. This includes when the file was created, who created the file, the size of the file, and the location of the file's data.	NetWare 5.0
Checkpoint	Four blocks (one in each Superblock) that track where to start playing the journal if the server crashes. The checkpoint contains the metadata of the Journal.	NetWare 5.0
Directory B-Tree	Used to implement an NSS volume's Directory Quota feature.	NetWare 5.0 Support Packs
Entry ID (EID)	An eDirectory entry within the FLAIM database (the underlying database for Directory Services 8.35 and later, including all eDirectory versions). EIDs are 32 bits and are unique for each server. EIDs are used within eDirectory to reference objects on a specific server. They are unique for each object for each server, meaning that object CN=Admin.O=EMA_CORP potentially has a different EID on server FS1 than on server FS2. This can be demonstrated with `dsbrowse.nlm`, a tool you can use to examine the local eDirectory database on the NetWare server. If you examine an object on one server and compare it with the same object on another server, the EID between the two instances of the object are probably dissimilar.	NetWare 6.0
Epoch File Log (EFL) B-Tree	Tracks files that change during an administrator-specified interval of time called an epoch. This feature is used by Novell Archive and Version Services.	NetWare 6.5

Media Object	Definition	Version Where First Used
Globally Unique ID (GUID)	A globally unique identifier within eDirectory. The scope of this uniqueness is within one tree, although no actual checking is done to ensure this. GUIDs are 128 bits and are unique for each object. GUIDs allow an object to be referenced no matter which server you are accessing.	NetWare 5.0
Journal	The file used to quickly make the file system consistent after a server crash. The journal is sometimes referred to as a zlog.	NetWare 5.0
Logged Pool Data Block	The block that tracks information about the pool, including the number of used blocks and salvageable blocks. Holds some of the items found in the zPoolInfo_s portion of the zInfo_s structure.	NetWare 6.0
Logged Volume Data Block	The block that tracks the number of files, used blocks, and compressed files of a volume. Holds some of the items found in the zVolumeInfo_s portion of the zInfo_s structure.	NetWare 5.0
Modified File List (MFL) B-Tree	Tracks files and folders that have the Archive attribute set by the user. The Archive flag indicates that the file or folder needs to be backed up. NSS uses this list to quickly find files that need to be backed up during scheduled backups. This Archive file-and-folder attribute is unrelated to Novell Archive and Version Services.	NetWare 6.0
Multiple Server Access Protection (MSAP)	The block used to reduce accidental use of a pool by more than one server at a time. A single copy of this block is stored in the second Superblock.	NetWare 6.0 Support Packs
Name Tree B-Tree	The B-Tree that tracks the directory structure of a volume.	NetWare 5.0
Pool Data Block	The block that tracks persistent pool configurable items. For example, a pool's features are stored here. Holds some of the items found in zPoolInfo_s portion of the zInfo_s structure.	NetWare 6.0
Purge Log	Tracks transactions over an extended period so they can be completed after a crash. For example, the log records file deletes and truncates that need to be completed after a crash.	NetWare 5.0
Purge Tree B-Tree	Used to store information about all salvageable files. This tree is used when the file system needs to autopurge files to create free blocks.	NetWare 5.0
Snapshot	Used by the Media Manager to track pool snapshots. The object tracks which snapshots exist on a pool and where all blocks of a snapshot are stored. The root of this object resides in the first Superblock. All other blocks are allocated from a file on the internal volume.	NetWare 6.5
Superblock	There are four Superblocks of 16 blocks each. The four Superblocks are replicas that reside in four fixed locations within the pool. The Superblock is used by the Checkpoints, Superblock Header, Snapshot, and Multiple Server Access Prevention.	NetWare 5.0
Superblock Header	Four blocks (copies of each other, one in each Superblock) used to locate all other ZLSS media objects. These are the first blocks that the file system reads when a volume is loaded. Starting with NetWare 6.0, these blocks are read when a pool is loaded.	NetWare 5.0

Media Object	Definition	Version Where First Used
User B-Tree	Used to implement an NSS volume's User Quota feature. Starting with NetWare 6.0, the B-Tree also stores Novell eDirectory information related to User Quota.	NetWare 5.0 Support Packs
Volume Data Block	The block that tracks configurable items in NSS volumes such as the volume's attributes and the high and low watermarks for salvage. It holds some of the items found in zVolumeInfo_s portion of the zInfo_s structure.	NetWare 5.0
ZID	A numeric ID within the NSS file system, used to reference an object with the object store (also known as the "beast tree"). ZIDs are 64 bits and are unique for each volume. The number of ZIDs is limited to 4 billion (4xE9) because of 32-bit limitations from the client. ZIDs are not reused, so if your processes create and delete lots of files in a volume, the numbering of ZIDs might approach this limit. and cause files not to be allowed to be created. If this occurs, you should rebuild the pool to renumber the files, referred to as "reZIDing". For more information, see Section 16.3, "ReZIDing Volumes in an NSS Pool," on page 200.	NetWare 6.0

H Documentation Updates

This section contains information about documentation content changes made to the *OES 2: Novell Storage Services File System Administration Guide* since the initial release of Novell Open Enterprise Server 2. 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.

This document was updated on the following dates:

- Section H.1, "July 2012 (OES 2 SP3 July 2012 Patch)," on page 489
- Section H.2, "August 2011 (OES 2 SP3 August 2011 Patch)," on page 489
- Section H.3, "December 2010 (OES 2 SP3)," on page 490
- Section H.4, "November 2009 (OES 2 SP2)," on page 490
- Section H.5, "December 2008 (OES 2 SP1)," on page 495
- Section H.6, "June 27, 2008," on page 503
- Section H.7, "May 14, 2008," on page 505
- Section H.8, "February 22, 2008," on page 506
- Section H.9, "January 14, 2008," on page 507
- Section H.10, "December 14, 2007," on page 509
- Section H.11, "November 14, 2007," on page 510

H.1 July 2012 (OES 2 SP3 July 2012 Patch)

Location	Change
"ROPTION" on page 437	-w, --inputfilefromnetware is added.

H.2 August 2011 (OES 2 SP3 August 2011 Patch)

Location	Change
All	Guide content revised to reflect support for SLES 10 SP4 as the base platform for OES 2 SP3.

H.3 December 2010 (OES 2 SP3)

Location	Change
Section 5.5.1, “Administrator User and Root User Roles for NSS,” on page 62	New note is added.
Section 9.2, “NSS Management Utility (NSSMU) Quick Reference,” on page 103	New key s is added to manage pools.
Section 13.2.4, “Choosing a Software RAID Solution,” on page 153	Value for valid name support for RAID 0 and RAID 5 is modified.
Section 15.6, “Deleting a Pool,” on page 183	Warning is added.
Section A.24, “Opportunistic Locking Commands,” on page 410	Updated.
“Configuring I/O Scheduler for OES2 NSS on XEN Virtual Machine” on page 73	Added.

H.4 November 2009 (OES 2 SP2)

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

- Section H.4.1, “Upgrading the NSS Media Format,” on page 491
- Section H.4.2, “Planning NSS Storage Solutions,” on page 491
- Section H.4.3, “Using NSS in a Virtualization Environment,” on page 491
- Section H.4.4, “Cluster-Enabling Shared NSS Devices and Pools with Novell Cluster Services,” on page 491
- Section H.4.5, “Management Tools for NSS,” on page 492
- Section H.4.6, “Managing Devices,” on page 492
- Section H.4.7, “Managing NSS Software RAID Devices,” on page 493
- Section H.4.8, “Managing NSS Pools,” on page 493
- Section H.4.9, “Managing NSS Volumes,” on page 494
- Section H.4.10, “Managing Hard Links,” on page 494
- Section H.4.11, “Troubleshooting the NSS File System,” on page 494
- Section H.4.12, “NSS Commands,” on page 495
- Section H.4.13, “NSS Utilities,” on page 495

H.4.1 Upgrading the NSS Media Format

Location	Change
Section 4.3, “Upgrading the Media Format Automatically for New NSS Volumes,” on page 53	The commands are updated.

H.4.2 Planning NSS Storage Solutions

Location	Change
Section 5.4.2, “Number of Characters Allowed,” on page 59	Updated the table for the maximum number of characters allowed from NSSMU and iManager for RAID 1, RAID 0+1, and RAID 5+1.

H.4.3 Using NSS in a Virtualization Environment

Location	Change
Section 6.1.3, “Guest Server Issues,” on page 75	The XenBlkBarriers commands are modified.

H.4.4 Cluster-Enabling Shared NSS Devices and Pools with Novell Cluster Services

Location	Change
Section 8.2, “Guidelines for Cluster-Enabling NSS,” on page 83	A new "Cluster-Enabling an Existing NSS Pool and Its Volumes" paragraph is added.

H.4.5 Management Tools for NSS

Location	Change
"Prerequisites for Using the Storage-Related Plug-Ins" on page 91	A new prerequisites "Web Browser Character Encoding Setting" is added.
Section 9.2, "NSS Management Utility (NSSMU) Quick Reference," on page 103	The table is updated.

H.4.6 Managing Devices

Location	Change
Section 10.6, "Initializing a Disk," on page 122	Added steps to initialize a disk from NSSMU.
Section 10.7.3, "Configuring the Device's Share State," on page 124	Updated steps to configure the device's share state from NSSMU.

H.4.7 Managing NSS Software RAID Devices

Location	Change
Section 13.2.4, “Choosing a Software RAID Solution,” on page 153	Updated the table for RAID 0+1 and RAID 5+1.
Section 13.9, “Creating a Software RAID 0+1 with NSSMU,” on page 162	Modified the section for RAID 0+1 and for the availability on Linux.
Section 13.10, “Creating a Software RAID 5+1 with NSSMU,” on page 162	Modified the section for RAID 5+1 and for the availability on Linux.
Section 13.14, “Replacing a Failed Segment in a Software RAID,” on page 166	Updated the table for RAID 0+1 and RAID 5+1.

H.4.8 Managing NSS Pools

Location	Change
Section 15.13, “Updating eDirectory Pool Objects,” on page 191	Updated the steps for updating eDirectory from NSSMU and added a new note to the section.
Section 15.14, “Updating eDirectory for Shared Pool,” on page 191	Added a new section.

H.4.9 Managing NSS Volumes

Location	Change
Section 18.1.1, “Volume Attributes,” on page 222	The section is Lookup Namespace modified.
Section 18.10, “Configuring the Name Space for an NSS Volume,” on page 236	The section is modified for Lookup Namespace.

H.4.10 Managing Hard Links

Location	Change
Section 24.4, “Creating a Hard Link Using Ln on an NSS Volume,” on page 327	The command is modified.

H.4.11 Troubleshooting the NSS File System

Location	Change
Section 29.4.3, “eDirectory Error 601 When Creating NSS Volume,” on page 369	This is a new entry.
Section 29.17, “NFS Volume Mount Failure Blocks the Mounting of Other File Systems,” on page 373	This is a new entry.

H.4.12 NSS Commands

Location	Change
Section A.15, “LAF Audit Log Messages Commands,” on page 404	The commands are updated.
Section A.26, “Pool Management Commands,” on page 411	The Pool Status commands are updated.
Section A.31, “Read Ahead Blocks and Allocate Ahead Blocks Commands,” on page 413	The Allocate Ahead Blocks commands and range are updated.

H.4.13 NSS Utilities

Location	Change
Section B.1, “attrib,” on page 423	-S and -r options are added.
Section B.2, “compfix,” on page 426	COMPFIX for Linux is updated.
Section B.11, “rights,” on page 442	RIGHTS for Linux is updated.
Section B.13, “quota,” on page 447	This is a new entry.
Section B.14, “nssraid,” on page 449	This is a new entry.
Section B.15, “ncsinit,” on page 450	This is a new entry.

H.5 December 2008 (OES 2 SP1)

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

- Section H.5.1, “Comparison of NSS on Linux and NCP Volumes on Linux POSIX File Systems,” on page 496
- Section H.5.2, “Comparison of NSS on NetWare and NSS on Linux,” on page 497
- Section H.5.3, “Cross-Platform Issues for NSS,” on page 497

- Section H.5.4, “Installing and Configuring Novell Storage Services,” on page 497
- Section H.5.5, “Management Tools for NSS,” on page 498
- Section H.5.6, “Managing Backup and Restore for Data and Trustee Information,” on page 498
- Section H.5.7, “Managing Files and Folders on NSS Volumes,” on page 498
- Section H.5.8, “Managing NSS Pool Snapshots,” on page 498
- Section H.5.9, “Managing NSS Pools,” on page 499
- Section H.5.10, “Managing NSS Software RAID Devices,” on page 499
- Section H.5.11, “Managing NSS Volumes,” on page 500
- Section H.5.12, “Managing Space Quotas for Volumes, Directories, and Users,” on page 500
- Section H.5.13, “Migrating NSS Devices from NetWare to OES 2 Linux,” on page 501
- Section H.5.14, “NSS Commands,” on page 501
- Section H.5.15, “NSS Utilities,” on page 501
- Section H.5.16, “Planning for NSS Storage Solutions,” on page 502
- Section H.5.17, “Salvaging and Purging Deleted Volumes, Directories, and Files,” on page 502
- Section H.5.18, “Securing Access to NSS Volumes, Directories, and Files,” on page 502
- Section H.5.19, “Troubleshooting the NSS File System,” on page 503
- Section H.5.20, “Using EVMS to Manage Devices with NSS Volumes (Linux),” on page 503
- Section H.5.21, “Using NSS in a Virtualization Environment,” on page 503
- Section H.5.22, “What’s New,” on page 503

H.5.1 Comparison of NSS on Linux and NCP Volumes on Linux POSIX File Systems

Location	Change
“File access protocols” on page 480	This entry is new.
“User space quotas (user space restrictions)” on page 480	For NCP volumes on Linux: Yes, if the Linux file system being used under the NCP share supports user quotas and the Linux file system resides on a local, iSCSI, or Fibre Channel drive. All users of the NCP volume must be LUM enabled. Manage the user quotas using the Linux file system tools.
“Volume name space” on page 481	For NSS on OES 2 SP1 Linux, the default name space used when mounting NSS volumes is changed from UNIX to Long. This improves performance over using UNIX.
“Software RAID support” on page 481	NSS management tools on Linux do not support creating nested RAID 0+1 and RAID 5+1.

H.5.2 Comparison of NSS on NetWare and NSS on Linux

Location	Change
"File access protocols" on page 474	Novell AFP for Linux (beginning in OES 2 SP1) Novell CIFS for Linux (beginning in OES 2 SP1)
"Volume name space" on page 475	For NSS on OES 2 SP1 Linux, the default name space used when mounting NSS volumes is changed from UNIX to Long. This improves performance as compared to using UNIX.
"Software RAID support" on page 476	NSS management tools on Linux do not support creating nested RAID 0+1 and RAID 5+1.

H.5.3 Cross-Platform Issues for NSS

Location	Change
Section 7.5.1, "Storage-Related Plug-Ins for Novell iManager 2.7," on page 81	The support matrix was updated to include Novell CIFS for Linux and Novell AFP for Linux in OES 2 SP1.
Section 7.5.5, "Management Capabilities for Software RAIDs," on page 82	NSSMU for Linux does not support creating nested RAID 0+1 and 5+1 devices.

H.5.4 Installing and Configuring Novell Storage Services

Location	Change
"EVMS Requirements" on page 40	**IMPORTANT**: If you move devices that contain NSS pools cross-platform (such as reassigning SAN-based devices from a NetWare server to an OES 2 Linux server), NSS recognizes the pools and automatically uses EVMS to manage the devices.
Section 3.5, "Updating NSS on OES 2 Linux," on page 45	This section is new.

H.5.5 Management Tools for NSS

Location	Change
Section 9.1.1, “Understanding Storage-Related Plug-Ins,” on page 88	The DFS, CIFS, and AFP features have been separated from the NSS `.npm` file, and now have `.npm` files of their own.

H.5.6 Managing Backup and Restore for Data and Trustee Information

Location	Change
Section 26.2, “Using the Event File List to Refine the Backup,” on page 346	This section is new.

H.5.7 Managing Files and Folders on NSS Volumes

Location	Change
Section 25.2.1, “Prerequisites,” on page 332	A folder must be empty before you can delete it.
Section 25.7, “Viewing or Modifying File or Folder Properties,” on page 336	The Copy Inhibit attribute works only for clients using Macintosh operating systems to access NSS volumes on NetWare. If the directory quota exceeds the volume quota, the volume quota is enforced.

H.5.8 Managing NSS Pool Snapshots

Location	Change
Section 17.2.1, “Differences Between Snapshots on Linux and NetWare,” on page 206	This section is new.

H.5.9 Managing NSS Pools

Location	Change
Section 15.2, “Creating a Pool,” on page 176	Added information about using Novell CIFS for Linux and Novell AFP for Linux when cluster-enabling pools on OES 2 SP1 Linux and later.

H.5.10 Managing NSS Software RAID Devices

Location	Change
Section 13.5, “Creating Software RAID Devices with iManager,” on page 157 and Section 13.6, “Creating Software RAID Devices with NSSMU,” on page 160	**IMPORTANT**: Unallocated partitions (that is, partitions that are not mirrored and do not contain pools or other file systems), are deleted in order to present the unused space as free space for use by the RAID. No data loss occurs by this action.
Section 13.9, “Creating a Software RAID 0+1 with NSSMU,” on page 162	NSS management tools on Linux do not support creating nested software RAID 0+1 device.
Section 13.10, “Creating a Software RAID 5+1 with NSSMU,” on page 162	NSS management tools on Linux do not support creating nested software RAID 5+1 device.
Section 13.12, “Increasing the Size of a Software RAID Device,” on page 163	**IMPORTANT**: If the software RAID device is shared in a cluster, connect to the node where the RAID is currently active to manage the RAID and increase the size of the RAID. A device must be the same size or larger than the segment size being used in the RAID. You might need to add or initialize a new device, then try again. While restriping, the new device is considered a failed device until it is completely resynchronized. While expanding a RAID 5 device, if one of the drives goes down (either one of the existing segments or the newly added segment), the pool deactivates. If you remove any device from a RAID 5 other than the one that was just added for restripe, it considers that as a two-disk error, and deactivates the RAID and the pool.
Section 13.13, “Restriping a Software RAID 0 or 5 Device,” on page 165	When expanding a RAID 5 on Linux, if the newly added drive goes down during the restripe, the restriping continues without the new partition and puts the RAID in a degraded state with one partition missing. If the same partition comes back online, it finishes the restripe. If the partition has completely failed, after the degraded restriping is complete, you can add a new replacement partition, and the RAID restripes to fix it.

Location	Change
Section 13.14, “Replacing a Failed Segment in a Software RAID,” on page 166	**IMPORTANT**: If a second segment fails before the restriping is completed for the first drive replacement, this is considered a two-drive failure. You must recover data from a backup copy.

H.5.11 Managing NSS Volumes

Location	Change
Section 18.2.1, “Guidelines for Sizing Volumes,” on page 227	Added information about how NSS reports space usage to management tools.
Section 18.2.3, “Guidelines for NSS Volumes in a Cluster,” on page 227	This section is new.
“Lookup Namespace” on page 225	For OES 2 SP1 Linux and later, Long is the default name space instead of UNIX. For Linux, NCP tools can be used only when Long or UNIX is set as the primary name space. The UNIX name space supports some special characters that are not allowed in the Long name space, such as characters 0x01 through 0x07 and 0x10 through 0x1f. If you need to use these special characters in filenames, choose UNIX as the primary name space.

H.5.12 Managing Space Quotas for Volumes, Directories, and Users

Location	Change
Section 22.1, “Understanding Space Quotas,” on page 293	For OES 2 SP1, it is no longer necessary to restart eDirectory after enabling or disabling the Directory Quotas attribute.
Section 22.4.6, “Configuring User Space Quotas on Volumes After Upgrading or Migrating from OES 1 Linux,” on page 306	You cannot use the Linux `chown` command to change the creator field for the NSS file system. It changes the root user’s view of who is reported as the owner user in the Linux path, but the change has no effect on the NSS metadata.

H.5.13 Migrating NSS Devices from NetWare to OES 2 Linux

Location	Change
Section 11.1.1, “Media Format,” on page 129	This section was modified for clarity.

H.5.14 NSS Commands

Location	Change
Section A.5.5, “UnplugAlways Command for the Read Queue,” on page 392	The `/(no)unplug` option is new for OES 2 SP1.
Section A.22, “noatime and atime Commands,” on page 407	Added clarification about the volume ID value in the cluster examples.
Section A.26.1, “Pool Status,” on page 411	Added a definition for `/ZLSSPoolIOErrors`.
Section A.29, “POSIX Permission Mask Command,” on page 412	The `/PosixPermissionMask` option is new for OES 2 SP1 Linux.
Section A.37.1, “Volumes Command,” on page 419	Added an example of the output from the `volumes` command.

H.5.15 NSS Utilities

Location	Change
Section B.8, “ravsui,” on page 436	This section was updated for clarity.
Section B.9, “ravview,” on page 439	This section was updated for clarity.
Section B.12, “volumes (NCP Console Utility),” on page 446	This section was updated for clarity.

H.5.16 Planning for NSS Storage Solutions

Location	Change
Section 5.1.6, “Storage Features,” on page 57	This section is new.
Section 5.2, “Compatibility and Interoperability Issues for NSS,” on page 58	This section is new.
“Linux-Enabled eDirectory Users” on page 64	In OES 2 SP1 and later, the modifier is reported as the user instead of as the `root` user or nobody user.
“File Access for Users” on page 66	This section is new.
Section 5.7, “Antivirus Support for NSS,” on page 69	This section is new.
Section 5.9, “NSS Support for Memory Mapped Files,” on page 69	This section is new.

H.5.17 Salvaging and Purging Deleted Volumes, Directories, and Files

This chapter was revised for clarity.

H.5.18 Securing Access to NSS Volumes, Directories, and Files

Location	Change
“eDirectory Users” on page 64	Moved to the planning section.
“Linux-Enabled eDirectory Users” on page 64	Users who access NSS via Samba, NFS, or third-party AFP protocols must be Linux-enabled in order for user quotas to work for them. Moved to the planning section.
Section 5.5.5, “How NSS Uses Novell Linux User Management,” on page 65	Moved to the planning section.
Section 5.6, “File Access for Users,” on page 66	In OES 2 SP1 Linux and later, users can also access NSS volumes using Novell CIFS, Novell AFP, and Domain Services for Windows. Moved to the planning section.

H.5.19 Troubleshooting the NSS File System

Location	Change
Section 29.8, “NSS Takes Up to 10 Minutes to Load When the Server Is Rebooted,” on page 370	This section is new.
Section 29.11, “Server Hangs When Using an NSS Volume as a Netatalk Share,” on page 371	This section is new.

H.5.20 Using EVMS to Manage Devices with NSS Volumes (Linux)

Location	Change
“Using Linux POSIX File Systems and NSS Pools and Volumes on the Same Device” on page 453	This section is new.

H.5.21 Using NSS in a Virtualization Environment

Location	Change
“Using RAIDs” on page 72	Updated with support status for using software RAIDs in a Xen-based virtualization environment.

H.5.22 What’s New

Location	Change
Section 2.5, “What’s New for NSS (OES 2 SP1),” on page 33	This section is new.

H.6 June 27, 2008

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

- Section H.6.1, “Managing Devices,” on page 504
- Section H.6.2, “Managing Space Quotas for Volumes, Directories, and Users,” on page 504

- Section H.6.3, “NSS Commands,” on page 504
- Section H.6.4, “Salvaging and Purging Deleted Volumes, Directories, and Files,” on page 504
- Section H.6.5, “Using NSS in a Virtualization Guest Server Environment,” on page 505

H.6.1 Managing Devices

Location	Change
“Enabling Write-Through Cache Management on SCSI Devices and RAID Controllers” on page 126	This section was moved here from the Troubleshooting section. It was revised for clarity.

H.6.2 Managing Space Quotas for Volumes, Directories, and Users

Location	Change
“Configuring User Space Quotas on Volumes After Upgrading or Migrating from OES 1 Linux” on page 306	Updated to reflect the OES 1 Linux to OES 2 Linux migration scenario where users were not Linux-enabled on OES 1.

H.6.3 NSS Commands

The command section titled “POSIX Rights for Files Command (Linux)” was removed. The /InitialUNIXRights option was not released in the FCS version.

H.6.4 Salvaging and Purging Deleted Volumes, Directories, and Files

Location	Change
“Understanding the NSS Salvage System” on page 309	After the deleted data enters a Purge state by manually starting a purge or by autopurging, deleted files can longer be salvaged (do not return to a Salvageable state).
Section 23.4, “Viewing, Salvaging, or Purging Deleted NSS Volumes in a Pool,” on page 315	**Pause Purge/Restart Purge:** *Pause Purge* disables autopurging for the selected volumes so that purging does not begin automatically for a deleted volume when its Purge Delay time elapses. During the purge delay or while autopurging is disabled, the deleted volume is salvageable. *Restart Purge* enables autopurging for the selected volumes. The deleted volume is purged when the purge delay time elapses. This option does not make it possible to salvage a deleted volume that has already entered a Purge state.

H.6.5 Using NSS in a Virtualization Guest Server Environment

Location	Change
"Running NSS on the Host Server Is Not Supported" on page 71	Updated with information about using clustered NSS pools and volumes in a virtualization environment.

H.7 May 14, 2008

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

- Section H.7.1, "Installing and Configuring Novell Storage Services," on page 505
- Section H.7.2, "Managing Devices," on page 505
- Section H.7.3, "NSS Commands," on page 506
- Section H.7.4, "NSS Utilities," on page 506

H.7.1 Installing and Configuring Novell Storage Services

Location	Change
"EVMS Requirements" on page 40	NSS requires EVMS version 2.5.5-24.54.5 or later. This mandatory update is available in the SUSE Linux Enterprise Server Support Pack 1 patch channel as of March 21, 2008. It is also available in the SLES 10 SP2 release. **WARNING**: The 54.5 or later version is required to prevent and avoid data corruption from occurring when you update EVMS while NSS volumes are mounted.

H.7.2 Managing Devices

Location	Change
"Device Size Limit" on page 115	Changed "disk partitioner" to "the storage vendor's or third-party disk carving tool".

H.7.3 NSS Commands

Location	Change
Section A.23, “noatime and nodiratime Support for Linux open, mount, nfsmount, and /etc/fstab,” on page 408	The noatime option disables the updating of access time for both files and directories so that reading a file does not update their access times (atime). Typically, you need to use only the `noatime` option so that atime is not updated for the accessed file and its directory when the file is accessed.
Section A.22.2, “Using noatime in a Cluster Load Script,” on page 408	This section is new.

H.7.4 NSS Utilities

Location	Change
Section B.5, “nsscon,” on page 433	This section was reorganized for clarity.
Section B.5.3, “Using nsscon in a Script,” on page 434	This section is new.

H.8 February 22, 2008

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

- Section H.8.1, “Installing and Configuring Novell Storage Services,” on page 506
- Section H.8.2, “Management Tools for NSS,” on page 507
- Section H.8.3, “NSS Utilities,” on page 507
- Section H.8.4, “Troubleshooting the NSS File System,” on page 507

H.8.1 Installing and Configuring Novell Storage Services

Location	Change
“EVMS Requirements” on page 40	**NOTE**: The following data corruption problem that arose after the OES 2 Linux release can be easily resolved by upgrading to OES 2 SP1 Linux. **WARNING**: Data corruption can occur if NSS pools and volumes are mounted when you install EVMS updates. ◆ Possible Data Corruption Can Occur If NSS Pools Are Mounted During an EVMS Update ◆ EVMS Updates Are Mandatory to Prevent Data Corruption for NSS Pools and Volumes

H.8.2 Management Tools for NSS

Location	Change
"EVMS" on page 91	**NOTE**: The following data corruption problem that arose after the OES 2 Linux release can be easily resolved by upgrading to OES 2 SP1 Linux. **WARNING**: Data corruption can occur if NSS pools and volumes are mounted when you install EVMS updates. ◆ Possible Data Corruption Can Occur If NSS Pools Are Mounted During an EVMS Update ◆ EVMS Updates Are Mandatory to Prevent Data Corruption for NSS Pools and Volumes
"Understanding Storage-Related Plug-Ins" on page 88	This section was edited for clarity.

H.8.3 NSS Utilities

Location	Change
"nsscon" on page 433	NSSCON can be used for all NSS commands listed in Appendix A, "NSS Commands," on page 387.

H.8.4 Troubleshooting the NSS File System

Location	Change
"eDirectory Error 672 When Creating an NSS Pool" on page 368	Run `nssAdminInstall` at a Linux terminal console as the `root` user.

H.9 January 14, 2008

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

- Section H.9.1, "Managing Files and Folders," on page 508
- Section H.9.2, "Management Tools for NSS," on page 508
- Section H.9.3, "Preface," on page 508
- Section H.9.4, "Securing Access to NSS Volumes, Directories, and Files," on page 508
- Section H.9.5, "What's New for NSS," on page 509

H.9.1 Managing Files and Folders

Location	Change
"Viewing or Modifying File or Folder Properties" on page 336	This information was moved from the Securing Access section.
"Viewing or Modifying File Ownership" on page 340	This information was moved from the Securing Access to NSS Volumes, Directories, and Files section.

H.9.2 Management Tools for NSS

Location	Change
"Deleted Files" on page 102	Salvage and purge of deleted files and directories is available only for NSS volumes where the volume's Salvage attribute is enabled.
"Properties" on page 102	Directory quotas management is available only for NSS volumes where the volume's Directory Quotas attribute is enabled.

H.9.3 Preface

Location	Change
"Additional Documentation" on page 22	The "Storage and File Systems" section in the *OES 2 SP3: Planning and Implementation Guide* describes considerations for choosing a storage solution and system-wide caveats for implementing the different storage solutions. *OES 2 SP3: Storage and File Services Overview* describes typical requirements for system storage, and identifies the various storage products and services in Novell Open Enterprise Server 2 that address those requirements.

H.9.4 Securing Access to NSS Volumes, Directories, and Files

Location	Change
"Configuring File System Trustees, Trustee Rights, Inherited Rights Filters, and Attributes" on page 259	General information about files and folders was moved to "Viewing or Modifying File or Folder Properties" on page 336. File ownership information was moved to "Viewing or Modifying File Ownership" on page 340.

H.9.5 What's New for NSS

Location	Change
Section 2.6, "What's New for NSS (OES 2)," on page 34	Directory quotas management is available only for NSS volumes where the volume's Directory Quotas attribute is enabled. Salvage and purge of deleted files and directories is available only for NSS volumes where the volume's Salvage attribute is enabled.

H.10 December 14, 2007

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

- Section H.10.1, "Installing and Configuring Novell Storage Services," on page 509
- Section H.10.2, "Managing Backup and Restore for Data and Trustee Information," on page 509
- Section H.10.3, "Management Tools for NSS," on page 509
- Section H.10.4, "NSS Commands," on page 510

H.10.1 Installing and Configuring Novell Storage Services

Location	Change
"Upgrading from OES 1 Linux to OES 2 Linux" on page 46	This section is new. It addresses read performance problems you might experience for NSS volumes after upgrading from OES 1 Linux to OES 2 Linux.

H.10.2 Managing Backup and Restore for Data and Trustee Information

Location	Change
"Using Extended Attributes (xAttr) Commands" on page 346	Procedures were added for enabling and disabling support for the Linux `xattr` API.

H.10.3 Management Tools for NSS

Location	Change
"Understanding Storage-Related Plug-Ins" on page 88	Added the paths and filenames of all storage-related plug-in files.

H.10.4 NSS Commands

Location	Change
"Read Ahead Blocks and Allocate Ahead Blocks Commands" on page 413	A note was added to address read performance problems you might experience for NSS volumes after upgrading from OES 1 Linux to OES 2 Linux.

H.11 November 14, 2007

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

- Section H.11.1, "Comparison of NSS on NetWare and NSS on Linux," on page 510
- Section H.11.2, "Extended Attributes (XAttr) Commands (Linux)," on page 510

H.11.1 Comparison of NSS on NetWare and NSS on Linux

Location	Change
Appendix E, "Comparison of NSS on NetWare and NSS on Linux," on page 473	Added an entry for Dynamic Storage Technology.

H.11.2 Extended Attributes (XAttr) Commands (Linux)

Location	Change
"Using the Linux cp Command to Copy Files with Extended Attributes" on page 399	When you enable listxattr on OES 2, the Linux cp command requires that you use the --preserve=all option when you also want to copy the extended attributes. You must issue the command as the root user. `cp --preserve=all /path/file1 /newpath/file1`
Section A.10.3, "Additional Information," on page 400	Added a link to the listxattr tool in Novell Cool Solutions.