VERSION 5

Traditional

File

Services

NetWare 5™
NETWORK SOFTWARE

Novell.

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Overview of Traditional File System

NetWare® 5 ™ provides the traditional NetWare file systemcomponents and utilities, such as NetWare partitions, NetWare volumes, and file management utilities.

Note: You can also use the new Novell® Storage Services™ (NSS) file system to meet your file system needs. NSS™ volumes can be used along with traditional NetWare volumes. For information on this new file system and its advantages, see *Novell Storage Services (NSS)*.

The table at the end of this overview contains links to topics into which file system documentation is divided.

In that table, the column labeled Understanding presents entities into which the file system itself is divided. Explore the links in the Understanding column to find out about volumes, directories, and other aspects of the traditional NetWare® file system.

Then, to plan, set up, or otherwise take advantage of file system features, select the procedure you want to perform from one of the columns to the right of Understanding. For example, if you're setting up a NetWare directory structure, use the link under Understanding to find out about NetWare directories. Then, to find out how to create a directory or to view information about directories and files, look at the procedures in the Setting Up and Managing columns across from the directory link in the Understanding column.

Functionality pertaining to the NetWare file system continues to evolve. Consequently, there are sometimes a variety of ways in which a particular procedure can be performed. There are also various ways in which the file system itself can be viewed. NetWare clients, for example, provide access to file system features and functionalities that were once accessible only through NetWare utilities. Wherever possible, links have been provided in file system documentation to let you explore the variety of ways in which you can complete a task.

1 *Understanding*

The Understanding section of the file system documentation explains key aspects of the traditional NetWare® file system.

Information on volumes, directories, files, and other characteristics of the file system is presented to give you background needed for the set-up, managerial, and other procedures described elsewhere in file system documentation.

Volume

The volume is the highest level in the NetWare® file system. It is a logical entity that consists of a fixed amount of physical space on one or more hard disks. (A CD-ROM can also be mounted as a volume. See "Mounting a CD as a Volume" on page 27.)

A NetWare server is divided into one or more volumes. The first network volume is named SYS: and is created during NetWare installation. Using NWCONFIG, you can create a new volume on any hard disk that has a NetWare partition. A NetWare server supports up to 64 volumes. (See "Creating a Volume" on page 22.)

Note: NetWare also allows you to create Novell® Storage Services™ (NSS) volumes along with traditional NetWare volumes. For information on this new file system and its advantages, see *Novell Storage Services (NSS)*.

NetWare volumes are subdivided in two ways:

◆ **Physically**. Volumes are divided into volume segments; different segments of a volume can be stored on one or more hard disks. For information about volume segments, see "Understanding Volume Segments" on page 4.

◆ **Logically**. Volumes are divided into directories containing files or subdirectories by network supervisors and users who have the appropriate rights.

The file system is analogous to an office filing system, as illustrated in the following figure.

Figure 1-1
Volumes, Directories, and Files
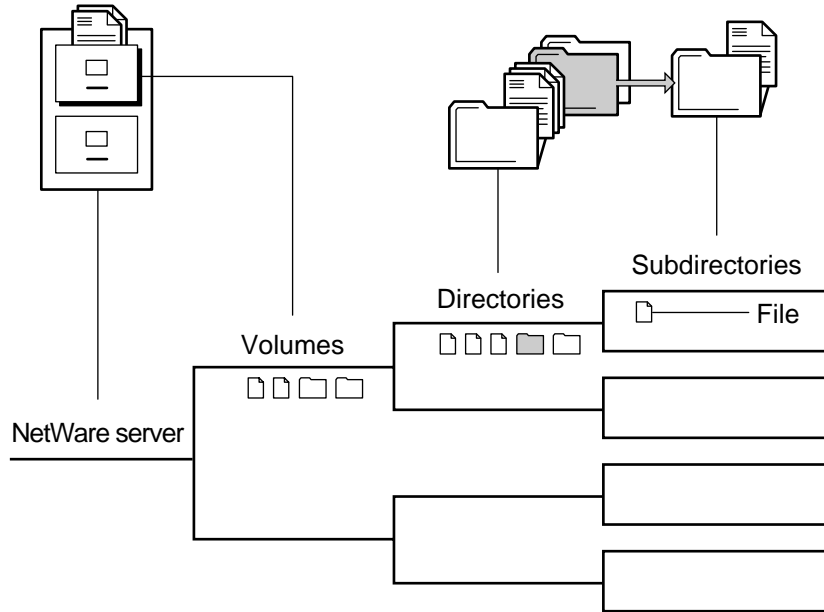
Directories appear at the volume level. Storing files at this level is possible, but not recommended for security reasons because granting rights to files at the root of the volume would necessitate granting rights to the entire volume.

When a volume is used as part of a directory path, either in NetWare documentation or on the screen (for example, when running the MAP command), the volume name is followed by a colon (:), as in SYS:PUBLIC.

Understanding Mounting a Volume

When you boot the NetWare server, each volume is "mounted," meaning that

◆ The volume becomes visible to the operating system

◆ The volume's FAT is loaded into memory

Each file block of data takes up one entry in the FAT.

Because of this, volumes with a smaller block size require more server memory to mount and manage.

However, if most of your files are small, a large block size wastes disk space.

◆ The volume's DET is loaded into memory

If a volume fails to mount, it might be because you have run out of RAM. This is because the FAT takes up cache buffers. (See "Mounting and Dismounting a Volume" on page 23.)

Note: The new file system, Novell Storage Services (NSS), mounts volumes more quickly and can mount any size volume with 1 MB of memory. NSS volumes can be used along with traditional NetWare volumes. For information about NSS and its advantages, see *Novell Storage Services (NSS)*.

Volume Objects in NDS

In NDS™, each volume is also a Volume object. Volume objects are leaf objects that represent a physical volume on the network.

When you create a volume with the NWCONFIG utility, NWCONFIG puts a Volume object in the same context as the NetWare server within the NDS tree. By default, NWCONFIG names the Volume object *servername_volumeobject*.

You can change the context of Volume objects with NetWare Administrator.

If you rename a volume, change the volume name on the server using the NWCONFIG utility, and change the volume object's name in the NDS using NetWare Administrator.

In the Volume object's properties, you can store information about which NetWare server the physical volume is located on and the volume name recorded when the volume was initialized at the server (for example, SYS:).

You can also store information such as the volume's owner, space use restrictions for users, or a description of its use.

You can also view statistical information on disk space availability, block size, directory entries, name space support, etc.

Understanding Volume Segments

A volume segment is a physical division of a volume. Different segments of a volume can be stored on one or more hard disks, allowing you to create large volumes.

A single hard disk can contain up to eight volume segments belonging to one or more volumes, and each volume can span up to 32 segments.

By placing segments of the same volume on multiple hard disks, different parts of the same volume can be read from or written to simultaneously, speeding up disk input and output. (See "Enhancing Disk Response Time With Spanning" on page 48.)

However, when you spread segments of a volume over several disks, you should protect the volumes against disk failure by mirroring; otherwise, if a single disk fails, one or more entire volumes shut down. (See "Protecting Data: Disk Mirroring and Duplexing" on page 62.)

You can add segments to a volume (with NWCONFIG.NLM), but removing a segment from a volume destroys the entire volume. (See "Changing Volume Size" on page 50.)

A volume's size can be increased by adding another hard disk to the NetWare server, by setting up a NetWare partition on the disk, or by adding a new NetWare partition to the existing volume as one or more new volume segments.

Directory

A directory is a place within a volume where you can store files or other directories. Directories within directories are called *subdirectories.* A directory can contain any number of files and subdirectories. For a list of directory attributes, see "Description of Directory and File Attributes" on page 39.

This section contains the following topics:

◆ "Directory Path" on page 5

◆ "Fake Root" on page 6

◆ "Directory Map Objects" on page 6

Directory Path

A directory or file is located by its *path*, which states where the directory or file is on a volume. A path includes the volume, directory, and any subdirectories leading to the file. The following figure shows how to specify a path. (Listing the server is optional.)

Figure 1-2
Directory Path Conventions

NetWare server \ Volume : Directory \ (Sub)directory \ Filename

Separate volume and directory with a colon (:).
Separate all others with a slash (\).
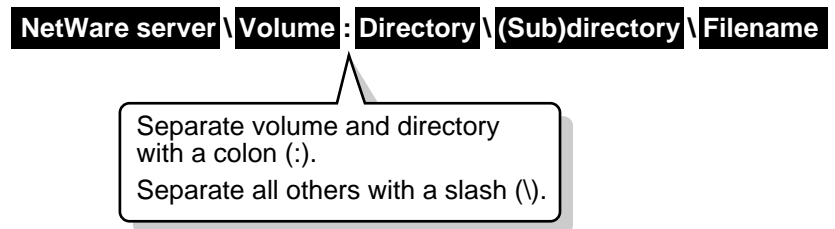
If your network uses more than one client operating system, keep in mind the conventions of the different systems. For example, NetWare allows 255 characters in a directory path (counting the drive letter and delimiters), but DOS permits only 127 characters.

Also, some applications restrict the number of characters in the directory path. For more information, check the application's documentation.

Fake Root

A fake root is a subdirectory that functions as a root directory.

Note: Fake roots work with the NetWare DOS Requester, with NetWare shells, and clients including Windows* 3.*x*, Windows 95*, and Windows NT*. Fake roots do *not* work for OS/2* clients. (Under OS/2, all mapped drives are roots, and search drives don't exist.)

Some applications require their executable files to be located in a root directory. However, for security, you should not assign users rights at the root or volume directory level.

NetWare allows you to map a drive to a fake root. This allows you to place applications in a subdirectory and assign rights to them there.

Thus, to use an application that must be installed at the root, load the files in a subdirectory and designate it as a fake root directory in the login script using MAP ROOT.

For example, you might have an application in a FORM directory that must reside in the root directory of drive P:, but you don't want to put the application in the root directory for security reasons. You can map a fake root to the directory and map a search drive to it at the same time by adding the following line to the login script:

```
MAP ROOT S16:=P:= SYS:APPL\FORM
```

You can't use the DOS CD (change directory) command at the fake root to return to the original root. To change the fake root back to the original root, remap the drive.

Directory Map Objects

A Directory Map object represents a particular directory in a file system. Directory Map objects can point to directories that contain frequently-used files such as applications.

If you create a Directory Map object to point to an application, users can access the application by mapping a drive to the Directory Map object.

If the application's location in the directory structure changes, you can update the object instead of having to change all users' drive mappings.

For an example of how to use Directory Map Objects, see "Using Directory Map Objects" on page 62.

You can create a Directory Map object using NetWare Administrator. For instructions, see "Creating a Directory Map Object" on page 28.

Note: NetWare also provides the Application Launcher™ software to assist you in setting up and managing network applications through NDS — from a single administrative console, NetWare Administrator. Application Launcher, a component of Z.E.N.works™, improves ease of distribution, convenience of installation, and operational control for network applications.

Application Launcher lets you work with applications as objects in the NDS tree. This lets you distribute applications to users' Windows 3.*x*, 95, or NT workstations. For more information, see *Z.E.N.works Starter Pack*.

File

This section contains the following topics:

◆　"File Compression" on page 7

◆　"Salvageable Files" on page 8

◆　"File Purging" on page 9

For a list of file attributes, see "Description of Directory and File Attributes" on page 39.

File Compression

Use the following information as background for using file compression to optimize system performance:

◆　NetWare maintains the original version of a file during compression. When compression completes, NetWare replaces the original with the compressed version of the file, provided no errors occurred. If errors do occur during compression, NetWare leaves the original version intact.

◆　If you have a CD-ROM volume mounted as a volume, treat it as a read-only volume. Do not use file compression on it.

- Compression is a usually a low priority process thread because of compression's impact on performance. If you flag an item for immediate compression during peak system usage, performance may deteriorate. (See FLAG in *Utilities Reference*.)

- You do not need to separate application files from data files to be compressed. The SET command can be used to preclude compression of frequently used applications. (See SET in *Utilities Reference*.)

- Monitor compression activity via the SET command's compress screen parameter. (See SET in *Utilities Reference*.)

- Backup applications that use Novell's Storage Management Services™ (SMS) back up and restore compressed files as such. Other applications may decompress them.

Salvageable Files

Salvageable files are files saved by NetWare, after being deleted by users, that can be salvaged (recovered).

Salvageable files are usually stored in the directory from which they were deleted. If a user deletes that directory, the salvageable files are saved in a DELETED.SAV directory located in the volume's root directory.

The user can view a list of deleted files in a directory and recover files by using NetWare Administrator. (See "Salvaging Deleted Files" on for instructions, or see the help in NetWare Administrator.) Recovered files contain information about who deleted the files and when they were deleted.

Deleted files are saved until the user deliberately purges them or until the NetWare server runs out of disk allocation blocks on the volume.

File Purging

When the NetWare server runs out of blocks, it purges deleted files beginning with the files that were the first deleted. Purged files cannot be salvaged.

Files and directories can also be purged as they are deleted. You can do this one of two ways:

◆ Use the SET command (see SET in *Utilities Reference*) at the NetWare server to disable the salvageable file feature. You do this by setting the parameter named Immediate Purge of Deleted Files to ON. This increases performance, but at the cost of losing the salvageable file feature. The default for this parameter is OFF (this means that by default, files are salvaged when they are deleted instead of being purged immediately).

◆ Set the Purge attribute for individual files and directories. When a file is flagged with the Purge attribute, the file is purged when it is deleted.

When a directory is flagged with the Purge attribute, all files in that directory are purged when the directory is deleted. Such files and directories can't be recovered.

◆ Use NetWare Administrator or PURGE to manually purge individual files and directories. (See "Purging Files" on page 60 for instructions, or see NetWare Administrator or PURGE in *Utilities Reference* for a general description of those utilities.)

Drive mapping

A drive mapping is a pointer to a location in the file system, represented as a letter assigned to a directory path on a volume.

A *path* includes the volume, directory, and any subdirectories leading to the file.

A drive mapping assigns a letter to a path so that the letter can be used instead of the complete path name.

Drive mappings can be temporary or permanent:

◆ **Permanent mappings.** To make drive mappings permanent so you can use them every time you log in, place MAP commands in your login script, or use the mapping functionality of your client software to make them permanent, so they will be reconnected every time you log in.

◆ **Temporary mappings.** To map a drive so you can use it during your current session, use the NetWare MAP utility from a DOS prompt, or use the mapping functionality of your client software. If you use MAP from a DOS prompt, the mapping is only valid until you log out.

For instructions on creating mappings, see "Mapping Drives" on page 30.

NetWare recognizes these types of drive mappings:

◆ "Local Drive Mappings" on page 10

◆ "Network Drive Mappings" on page 11

◆ "Network Search Drive Mappings" on page 11

◆ "Fake Root" on page 6

◆ "Directory Map Objects" on page 6

Local Drive Mappings

Local drive mappings are paths to local media such as hard disk drives and floppy disk drives.

To change this default (for example, if you are using the NetWare DOS Requester, you need all of your drives mapped as DOS drives), use the DOS LASTDRIVE command in your workstation CONFIG.SYS file.

Network Drive Mappings

Network drive mappings point to volumes and directories on the network. Normally, drives F: through Z: are used for network mappings. Each user can map drive letters to different directories.

To create a network drive mapping, use the MAP command (see MAP in *Utilities Reference*).

Network Search Drive Mappings

Network search drive mappings point to directories containing files such as applications or files.

Search drive mappings enable the system to locate a program even if it isn't located in the directory you're working in.

Search drive mappings are numbered, although they also have drive letters. For example, search drive 1 (or S1) may also be known as network drive Z:.

You can map up to 16 network search drives (letters K: through Z:, starting with Z:). You can't map a search drive and a regular network drive to the same letter.

When you request a file and the system can't find it in your current directory, the system looks in every directory a search drive is mapped to.

The system searches, following the numerical order of the search drives, until either the program file is found or can't be located.

Note: Search drive mappings aren't supported on OS/2 workstations. The search functionality is provided with the OS/2 PATH, LIBPATH, and DPATH commands.

How NetWare Protects Network Data

NetWare protects data primarily by

◆ Maintaining duplicate file directories (see "Duplicate File Directories" in *NetWare Security Server*)

◆ Redirecting data from bad blocks to reliable blocks on the NetWare server's hard disk (see "Redirecting Bad Blocks" in *NetWare Server Disks and Storage Devices*)

◆ Allowing you to mirror and duplex disks (see "Protecting Data: Disk Mirroring and Duplexing" on page 62)

Security

Security is one of the most important aspects of file system organization. NDS rights and the file system's directory and file attributes allow you to determine who may access what, and whether that access amounts to being able to merely read a file or modify it.

A technical discussion of the security features of the file system appears in the help for NetWare Administrator.

To more fully utilize the capabilities described in the NDS area of this documentation, you may wish to organize your approach to designing an appropriately secure system by

1. Clustering directories and files according to who needs access to them. In other words, use the directory structure to reflect access requirements.

   For example, you can structure the hierarchy of directories in such a way as to take advantage of the inheritance aspect of rights.

Rights can be associated with volumes, directories, and files as a safeguard against deletion or modification by users (see "Description of Directory and File Rights" on page 34). Directory and file attributes can also be used to control what users can do (see "Description of Directory and File Attributes" on page 39).

2. Subdividing the user community into groups on the basis of related access requirements.

    Users grouped by role (relative to file access) can be assigned ownership of directories and files, and users whose roles vary can be assigned rights on the basis of equivalence.

    Users needing a particular kind of access to certain directories and files can be grouped so that appropriate access belongs to the group (and, consequently, to each member).

2 *Planning*

The single heading under Planning presents a simple example of a network directory structure. Based on the example and the accompanying information, you can begin to design a directory hierarchy suitable to your own needs.

Note: You can also use the new Novell® Storage Services™ (NSS) file system to meet your file system needs. NSS™ volumes can be used along with traditional NetWare® volumes. For information on this new file system and its advantages, see *Novell Storage Services (NSS)*.

Planning Directory Structures

This section gives some basic information and suggestions about organizing directories and files to facilitate network administration:

◆ "Directories Created During NetWare Installation" on page 15

◆ "Application Directories" on page 16

◆ "Data Directories" on page 19

◆ "Home or Username Directories" on page 19

Directories Created During NetWare Installation

During installation, the following directories pertaining to the file system are automatically created.

◆ **SYS:DELETED.SAV** contains files that have been deleted from deleted directories. Salvageable files are usually stored in the directory from which they were deleted. If a directory is deleted, the salvageable files from the deleted directory are moved to the deleted.sav directory. Deleted files can be salvaged if they have not yet been purged.

◆ **SYS:ETC** contains sample files to help you configure the server.

◆ **SYS:LOGIN** contains the programs necessary for users to log in to the network, such as LOGIN.EXE. An NLS subdirectory contains subdirectories for login message files for each supported language.

◆ **SYS:MAIL** may or may not contain subdirectories or files. If you upgrade your server from a previous version of the NetWare® operating system, existing users may still have directories here for their login scripts, but their login scripts will become properties of the new User objects. If you create new users after upgrading, the new users won't have directories in SYS:MAIL

◆ **SYS:SYSTEM** contains NetWare operating system files as well as NetWare utilities and programs for the network administrator. SYS:SYSTEM also has an NLS subdirectory, containing subdirectories for each supported language for message files.

◆ **SYS:PUBLIC** allows general access to the network and contains NetWare utilities and programs for network users. SYS:PUBLIC has subdirectories for Windows 95 and Windows NT, as well as a subdirectory called NLS, containing the message files for utilities.

Application Directories

For ease of management, you should keep application files in a directory apart from the data files. Since the application programs don't normally change, you can keep one set of application files on backup media and skip the application directories when you do network backups.

When creating application directories, you should also consider issues related to ease of distribution, installation, and operational control for network applications. NetWare provides the Application Launcher™, a component of Z.E.N.works™, to assist you in setting up and managing network applications through NDS™ from a single administrative console. (For more information, see *Z.E.N.works Starter Pack*.)

Although applications can be accessed from local drives, installing them on the network provides convenient access. Several structures are possible for application directories:

◆ Create a separate volume for applications, with a separate directory for each application off the root. Make trustee assignments for each application (see "Setting Directory or File Attributes" on page 39). Then go into the system or profile login script and map a search drive to each application.

The following figure shows this type of directory structure:

Figure 2-1
Application Volume

```
                                        ┌─── SYSTEM
                            SYS         ├─── PUBLIC
                                        ├─── LOGIN
NetWare server ─────┤                   └─── MAIL

                            APPSVOL     ┌─── WORDPROC
                                        ├─── DBAPP
                                        └─── SPRDSHT
```
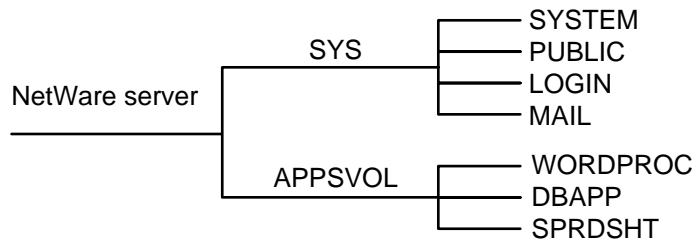
◆ Create a separate directory off volume SYS: for each application. Make trustee assignments for each application. Then go into the system or profile login script and map a search drive to each application.

The following figure shows this type of directory structure.

Figure 2-2
Application Directory off Volume SYS:

```
                            SYS         ┌─── WORDPROC
                                        ├─── DBAPP
NetWare server ─────┤                   └─── SPRDSHT
```
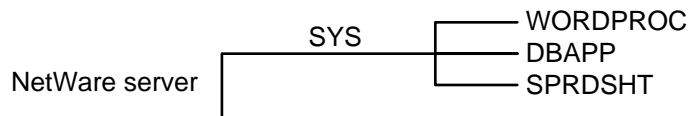
◆ Create a parent directory for applications, with subdirectories for each application. Make trustee assignments for each application. Then go into the system or profile login script and map a search drive to each application.

The following figure shows this type of directory structure.

Figure 2-3
Parent Directory for Applications
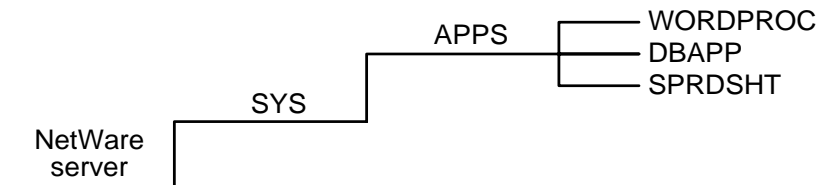
◆ Create a parent directory for applications in SYS:PUBLIC.

Because users generally have Read and File Scan rights in SYS:PUBLIC, you don't need to make trustee assignments or map a search drive. However, users can see and use all applications. Use this directory structure only if you want all users to have access to all applications.

The following figure shows this type of directory structure.

Figure 2-4
Application Directory in SYS:PUBLIC
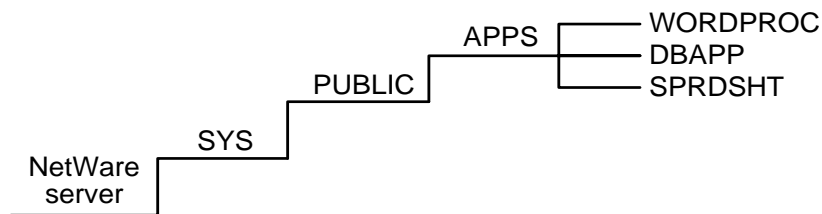
Installing applications in SYS:PUBLIC isn't recommended (unless a subdirectory is created for each application).

Upgrading a network is made more complicated by mixing NetWare utilities with application program files.

An application file might have the same filename as a NetWare utility file or another application's program file. If so, one file overwrites the other because two files with the same filename can't coexist in a directory.

Note: Some applications write files to the root. For security reasons you don't want users working at the root level. Therefore, use MAP ROOT to map a drive to a fake root—a directory or subdirectory in which the user can be assigned rights (see "Fake Root" on page 6).

Data Directories

These are work directories for groups and users to keep work files in. You can also create a directory to transfer files between directories on the network.

Although data can be created and stored in a home or user directory, when data is stored in a user's directory, no other user (except network administrators or managers assigned file rights) can access it.

So, to allow users to share data, create work directories and make trustee assignments for groups or users who need access to these directories.

Home or Username Directories

To provide personal workspace for users, create home or username directories.

You can create a parent directory in volume SYS: called HOME or USERS. Or, you can create a separate HOME or USERS volume. Then you can create a subdirectory for each user.

The name of each subdirectory should be the username. Usernames can be up to 47 characters, but DOS displays only 8 characters in a one-level directory name. The following figure shows this type of directory structure.

Figure 2-5
Home or Username Directories
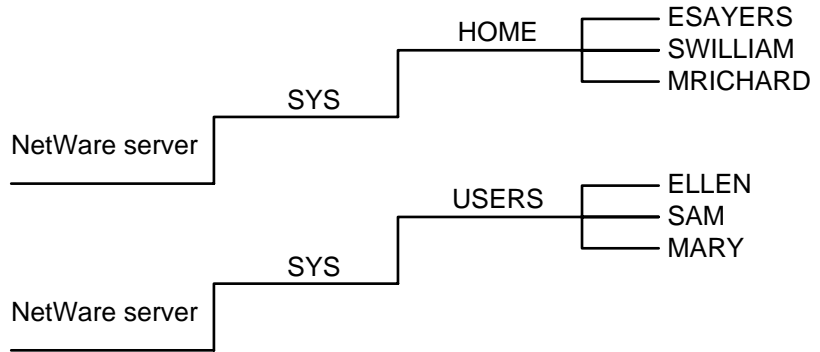
3 *Setting Up*

Setting Up is the most extensive of the sections pertaining to the traditional NetWare® file system. Procedures in this section of the documentation focus on specific tasks pertaining primarily to system administration. Procedures involve various utilities and applications that are described in more general terms elsewhere. For example, creating a volume involves NWCONFIG. While NWCONFIG is described in the reference documentation for utilities, the procedure in this file system documentation focuses on using NWCONFIG to accomplish a particular task.

The most productive use of file system documentation is to identify the task you want to complete and find an appropriate procedure. Then use links associated with the procedure to increase your understanding of other ways in which applications and utilities can be used.

Procedures in Setting Up focus primarily on volumes, directories, files, drives, and security. System administrators are concerned with all of these aspects of the file system. Users will be concerned primarily with drive mapping and some of the file and directory procedures.

Setting Up Volumes

This section contains the following topics:

Creating a Volume

Use NWCONFIG to create a volume on any hard drive having a NetWare partition. (See "NWCONFIG" in *Utilities Reference* for a general description of the command.)

A NetWare server can have up to 64 NetWare volumes. Only a SYS: volume is required.

Note: NetWare also allows you to create Novell® Storage Services™ (NSS) volumes, which can be used along with traditional NetWare volumes. For information on this new file system and its advantages, see *Novell Storage Services (NSS)*.

By default, creating a volume consumes all free space in the NetWare partition, unless you assign the new volume a size. By specifying a size, you can leave free space available for future volumes. If space is unavailable, you must add a drive or a magnetic/optical storage medium before attempting volume creation.

Prerequisites

❑ A NetWare partition with free space on the disk where you want to create the volume (for information about partitions, see "Partitioning Disks" in *NetWare Server Disks and Storage Devices* for concepts and "Creating NetWare Partitions" in *NetWare Server Disks and Storage Devices* for instructions)

❑ An existing volume SYS:

❑ Supervisor rights

Procedure

1. **At the server console prompt, type**

   `NWCONFIG`

2. **From the Installation Options menu, choose Disk Options and then NetWare Volume Options.**

   Existing volumes are listed.

3. **Press** Insert.

    The Volume Disk Segment List appears.

4. **Select any existing free space and press** Enter.

5. **Select Make This Segment a New Volume.**

6. **Type a new volume name in the box provided and press Enter.**

    The volume name can be up to 15 characters long (A through Z, 0 through 9, and underscore characters are allowed).

7. **Press** Enter.

    The newly created volume now appears in the Volume Disk Segment List.

8. **Enter a new volume size, expressed in megabytes (MB), and press** Enter.

9. **Press** Esc **or** F10 **to return to the volume segment list.**

10. **Press** Esc **or** F10 **to save changes.**

11. **Press** Esc **to save the volume settings.**

12. **Authenticate to the network with Supervisor rights to add the volume to the tree.**

13. **Select Mount All Volumes to mount the new volume.**

Mounting and Dismounting a Volume

By mounting a volume, you make its information available to network users. You can mount or dismount one or all volumes while the NetWare server is running. For a description of what takes place when you mount a volume, see "Understanding Mounting a Volume" on page 3.

You may want to leave rarely used volumes dismounted because each mounted volume takes up memory and reduces the memory available for file caching.

For instructions for CDs, see "Mounting a CD as a Volume" on page 27.

You can mount and dismount volumes in two ways:

◆ Using the MOUNT (see MOUNT in *Utilities Reference*) and DISMOUNT (see DISMOUNT in *Utilities Reference*) console commands.

◆ Using NWCONFIG as described in the following procedure. (See NWCONFIG in *Utilities Reference* for a general description of the command.)

1. **At the server console prompt, type**

   `NWCONFIG`

2. **Select Disk options.**

3. **Select NetWare Volume Options.**

4. **Select the volume you want to mount or dismount and press** Enter.

   The Volume Information screen appears.

5. **Using the arrow keys, highlight the Status field.**

   Depending on the status of the volume, this field displays Mounted, Not Mounted, or New, not mounted.

6. **(Conditional) If the status is New, not mounted, press** Esc **and then** F10 **to save volume changes to disk before the volume can be mounted.**

7. **Press** Enter **to display a menu of available actions.**

8. **Depending on what you want to do, select either Mount or Dismount and press** Enter.

   NetWare mounts or dismounts your volume.

   Note: If a volume fails to mount, you may not have enough RAM installed to accommodate the volume, especially if you add name space support to the volume. See "Storing Non-DOS Files on a Volume" on page 25.

Storing Non-DOS Files on a Volume

By default, NetWare volumes support DOS naming conventions. To store non-DOS files (such as for Macintosh* or UNIX* files) on a NetWare volume, you must load the appropriate name space NetWare Loadable Module™ (NLM) program and add the name space support to that volume.

Note: Each name space added to a traditional NetWare volume requires additional server memory. If you add name space support to a volume and do not have enough memory, that volume cannot be mounted.

If insufficient memory is an issue, consider using Novell Storage Services (NSS) volumes, since NSS uses only 1 MB of memory to mount any size volume no matter how many name spaces the volume supports. See *Novell Storage Services (NSS).*

This section contains the following topics:

◆ "Calculating Memory Required for Name Space Support" on page 26

◆ "Adding a Name Space" on page 26

◆ "Removing Name Space Support" on page 27

The following name space NLM programs are included with NetWare:

◆ MAC.NAM (Macintosh).

◆ LONG.NAM (OS/2, Windows 95, Windows NT). NWCONFIG now adds the long name space, by default, to volumes created. (See NWCONFIG in *Utilities Reference.*)

◆ NFS.NAM (NFS).

In addition, an FTAM name space module is available from third-party providers.

Calculating Memory Required for Name Space Support

If you are using traditional NetWare volumes, use the following formula to calculate the additional memory required for each added name space on a non-DOS volume:

```
0.032 x volume_size(in MB)/block_size(in MB)
```

Round the result to the next highest megabyte.

For example, adding Macintosh name space to a 100 MB volume with a block size of 4 KB would require 1 MB of additional memory, as shown:

```
0.032 x 100 MB / 4 = 0.8 MB
```

Adding a Name Space

Prerequisites

❑   A mounted volume

❑   Sufficient memory

Procedure

1.   Load the appropriate name space NLM™ by typing

```
LOAD [path]name_space
```

For example, to load the name space module for Macintosh support, type

```
LOAD MAC.NAM
```

2.   Add name space support to the volume by typing

```
ADD NAME SPACE name to volume_name
```

Replace *name* with the name space NLM. Replace *volume_name* with the name of the volume that will store the non-DOS files.

For example, to add the Macintosh name space to the MACVOL volume, type

ADD NAME SPACE MAC TO MACVOL

Note: You only need to add a name space to a volume once. You don't need to add it each time the server comes up. The name space module autoloads each time the server comes up.

To verify that the name space has been added, you can view a list of all added name spaces by typing

VOLUMES

3. **To see a list of current volumes and name spaces, type**

   VOLUME

Removing Name Space Support

Once a name space is added to a volume, the name space can be removed either by deleting the volume and re-creating it or by using VREPAIR (see VREPAIR in *Utilities Reference*).

Mounting a CD as a Volume

The CDROM.NLM utility lets the NetWare server use a CD-ROM disc as a volume.

In NetWare 5, mounting CD-ROMs is done automatically when the CD-ROM NLM is loaded. The CD-ROMs are mounted as Read-Only NSS volumes. See CDROM in *Utilities Reference* for a general description of the utility and a listing of what is supported.

Warning: Treat the CD-ROM as a read-only volume. Do not enable block suballocation or use file compression on the volume.

Creating a Directory

Create directories in NetWare Administrator or in your desktop application.

To create a directory, you must have the Create right for the directory to which the new directory will be added.

Creating a root directory requires that you select the volume object instead of selecting a parent directory.

For some ideas for directory structures, see "Planning Directory Structures" on page 15.

Creating a Directory Map Object

A Directory Map object represents a particular directory in a file system. Directory Map objects can point to directories that contain frequently used files such as applications.

If you create a Directory Map object to point to an application, users can access the application by mapping a drive to the Directory Map object.

You can create a Directory Map object using NetWare Administrator. For an example of how you could use Directory Map objects to reduce maintenance of login scripts, see "Using Directory Map Objects" on page 62.

Prerequisites

❑   The Create object right to the container where the Directory Map object will be created

Procedure

1.   **In NetWare Administrator, select the Organization or Organizational Unit object where you want to create the Directory Map object.**

     For information about moving around in the browser and selecting objects, choose Help from the menu bar.

2. **Choose Create from the Object menu.**

3. **Choose Directory Map from the New Object dialog box.**

4. **Choose OK.**

5. **Enter the name for the Directory Map object in the space provided.**

6. **In the Volume field, enter the name of the volume this Directory Map object will point to.**

   You can type in the complete name of the Volume object, or you can choose the browser button to the right of the Volume field to browse for the Volume and directory path.

7. **If you did not use the browse button, enter the path of the directory this Directory Map object will point to.**

   If the Directory Map object will point to the root of the specified volume, leave the Path field blank.

8. **(Optional) To define additional properties immediately after creating the Directory Map object, choose Define Additional Properties.**

9. **(Optional) To create another Directory Map object immediately after this one, choose Create Another Directory Map.**

10. **Choose Create.**

    The Directory Map object is created

    If you chose Create Another Directory Map, the Create dialog appears.

    If you chose Define Additional Properties, the identification screen appears.

Mapping Drives

Mapping Drives in Windows 95

See "Common Networking Tasks" in *Novell Client for Windows 95.*

Mapping Drives in Windows NT

See "Connecting to Network Drives" in *Novell Client for Windows NT.*

Mapping Drives in Windows 3.1*x*

See "Mapping a Network Drive" in *Novell Client for DOS and Windows 3.1x.*

Search Drives in OS/2

OS/2 workstations do not use search drives. OS/2 PATH, DPATH, and LIBPATH settings in CONFIG.SYS are used instead.

Mapping Drives in DOS

Use the MAP command to map drives to network directories. (See MAP in *Utilities Reference* for a general description of the command.)

Use the MAP command to map search drives. Search drive mappings enable the system to locate a program even if it isn't located in the directory the user is working in.

A maximum of 16 NetWare search drives is allowed. You can't map a search drive and a regular network drive to the same letter.

When you map a search drive, use a search drive number (an S followed by a number). This search drive number assigns the next available drive letter to the mapping, starting with Z and working backwards through the English alphabet.

The letter assigned to the search drive is put into the DOS path statement. If you already have search drives in the path statement, the command MAP S1: overwrites the first one in the path. To prevent search drive assignments from overwriting existing DOS PATH letters, use the INSERT option when assigning search drives. For example:

```
MAP INS S16:=path
```

To ensure that users can access NetWare utilities and applications, you should consider mapping search drives so that the first search drive (S1:) maps to the SYS:PUBLIC directory, which contains the NetWare utilities for DOS and MS Windows workstations.

The order in which mappings are listed is important because the order of items in the list is the order in which the directories are searched. The system searches, following the numerical order of the search drives, until the program file either is found or can't be located. The list can include a combination of local and network directories.

To avoid inadvertently changing the order of any search drives that must be mapped to a specific drive letter, you can map all remaining search drives with the number S16:, which assigns the next lowest search number available each time it is used.

If you have an application that requires a particular drive letter, you can use the following command to map the search drive, replacing *drive* with the drive letter:

```
MAP S16:=drive:=path
```

If you map a search drive using a number already assigned to a search drive, NetWare makes the old search drive a network drive. The letter assigned to the old search drive remains assigned as the converted drive mapping. The new search drive takes the next unused letter in the alphabet.

Distributing Applications on the Network

You can install various types of network applications, such as word processing or spreadsheet programs, to make them available to users. When installing applications, keep the following in mind:

◆ You need the Create right in the directory where you will be installing the application.

◆ Follow the instructions in the application's documentation for installing the application onto a network.

◆ Make sure the application is designed for network (multiuser) use, and that you observe any licensing restrictions on the number of users who can access the application.

◆ To allow users to access network-based applications, map search drives to the directories that contain these applications. To make these search drives permanent, place them in login scripts, which are executed when users log in.

◆ If the application requires that it be installed at the root of a volume, but you would rather install it in a subdirectory for security reasons, you can map the directory to a fake root. (See "Fake Root" on page 6.)

◆ You can create a Directory Map object that points to an application directory.

Directory Map objects are useful in login scripts. Instead of mapping a drive to a specific directory path, you map a drive to a Directory Map object that points to a directory. (See "Directory Map Objects" on page 6.)

Then, if you change the directory path, you need to change only the Directory Map object's definition.

◆ NetWare provides the Application Launcher™ software to assist you in setting up and managing network applications through NDS — from a single administrative console, NetWare Administrator. Application Launcher, a component of Z.E.N.works™, improves ease of distribution, convenience of installation, and operational control for network applications. For more information, see *Z.E.N.works Starter Pack*.

- Keeping program files separate from data files can simplify application management. Because program files seldom change, for example, you can keep a backup of program files separate from a data file backup so that network backup procedures need focus only on data directories.

  Data directories for shared data files also provide for single-point backup and management of shared files.

Security: Rights to Files and Directories

File system security includes assigning trustee rights. To set up rights, see the following:

- "Description of Directory and File Rights" on page 34

- "Adding a Trustee to a Directory or File" on page 34

- "Deleting a Trustee from a Directory or File" on page 35

- "Modifying a Trustee's Rights to a Directory or File" on page 36

- "Viewing/Modifying the Inherited Rights Filter for Directories and Files" on page 38

For information on how to use Windows 95 to set rights, see Common Networking Tasks in *Novell Client for Windows 95*.

For Windows NT, see NetWare File Security in *Novell Client for Windows NT*.

Description of Directory and File Rights

Trustee rights determine the access users have to directories and files. These rights can be given to NDS object such as User objects, Group objects, Organizational Role objects, or container objects.

The following table contains a list and description of rights. For more information about rights, see the help in NetWare Administrator.

Table 3-1
Trustee Rights

Right	Allows you to
Access Control	Add and remove trustees and change rights to directories and files.
Create	Create subdirectories and files.
Erase	Delete directories and files.
File Scan	View directory and file names in the file system structure.
Modify	Rename directories and files, and change file attributes.
Read	Open and read files, and open, read, and execute applications.
Supervisor	Grant and exercise all rights listed in this table.
Write	Open, write to, and modify a file.

Adding a Trustee to a Directory or File

You can add a trustee to a directory or file using NetWare Administrator or RIGHTS. The NetWare Administrator procedure is documented in this section. (See NetWare Administrator or RIGHTS in *Utilities Reference* for a general description of these utilities.)

Using NetWare Administrator to Add a Trustee

Prerequisites

❏ The Access Control right to the directory or file you want to add the trustee to

Procedure

1. **In NetWare Administrator, select the directory or file that you want to add a trustee to.**

   For information about moving around in the browser and selecting objects, choose Help from the menu bar.

2. **From the Object menu, choose Details.**

3. **From the Identification page, choose Trustees of this Directory.**

4. **From the Trustees of this Directory page, choose Add Trustee.**

5. **Select a trustee from the list of available objects.**

   If the object does not appear in the list, browse the Directory tree to find the object that you want to make a trustee of the directory or file.

6. **Choose OK.**

7. **To grant rights to the trustee, check the appropriate checkboxes below the trustee.**

8. **To return to the browser, choose OK.**

Deleting a Trustee from a Directory or File

You can delete a trustee from a directory or file using NetWare Administrator or RIGHTS.EXE. The NetWare Administrator procedure is documented in this section. (See NetWare Administrator or RIGHTS in *Utilities Reference* for a general description of these utilities.)

Using NetWare Administrator to Delete a Trustee

Prerequisites

❑ The Access Control right to the directory or file you want to delete the trustee from

Procedure

1. **In NetWare Administrator, select a directory or file that you want to delete a trustee from.**

   For information on moving around in the browser and selecting objects, choose Help from the menu bar.

2. **From the Object menu, choose Details.**

3. **From the Identification page, choose Trustees of This Directory.**

4. **From the Trustees list, select a trustee you want to delete.**

5. **Choose Delete Trustee.**

6. **To delete that object as a trustee, choose Yes.**

7. **To return to the browser, choose OK.**

Modifying a Trustee's Rights to a Directory or File

You can modify trustee rights to a directory or file through NetWare Administrator or RIGHTS.EXE. The NetWare Administrator procedure is documented in this section. (See NetWare Administrator or RIGHTS in *Utilities Reference* for a general description of these utilities.)

Using NetWare Administrator to Modify a Trustee's Rights

Prerequisites

❏ The Access Control right to the directory or file for which you want to change the trustee's rights

Procedure

1. **In NetWare Administrator, select the directory or file for which you want to change trustee rights.**

   For information on moving around in the browser and selecting objects, choose Help from the menu bar.

2. **From the Object menu, choose Details.**

3. **From the Identification page, choose Trustees of this Directory.**

4. **From the Trustees list, select a trustee.**

5. **Grant or revoke rights by checking the checkboxes below the trustee.**

6. **Choose OK to save the trustee rights.**

Viewing/Modifying the Inherited Rights Filter for Directories and Files

You can view and modify the Inherited Rights Filter (IRF) for a directory or file using NetWare Administrator. Both procedures are documented in this section. (See NetWare Administrator in *Utilities Reference* for a general description of this utility.) For more information about IRFs, see the help in NetWare Administrator.

Prerequisites

❏   The Access Control right to the directory or file for which you want to view or modify the IRF

Procedure

1.   **In NetWare Administrator, select a directory or file.**

For information on moving around in the browser and selecting objects, choose Help from the menu bar.

2.   **From the Object menu, choose Details.**

3.   **From the Identification page, choose Trustees of This Directory.**

4.   **Under Inheritance Filter, check the checkboxes for the rights that you want to allow to be inherited for that directory or file.**

5.   **Choose OK.**

The Trustees dialog reappears.

6.   **To return to the browser, choose OK.**

Setting Directory or File Attributes

To set up attributes and change owners for a directory or file, see the following:

◆   "Description of Directory and File Attributes" on page 39

◆   "Changing Attributes of a Directory or File" on page 41

◆   "Changing the Owner of a Directory or File" on page 42

For information on how to use Windows 95 to set directory or file attributes, see Common Networking Tasks in *Novell Client for Windows 95*.

Description of Directory and File Attributes

Directory and file attributes assign properties to individual directories or files. Some attributes are meaningful only when applied at the file level, but some apply to both the directory and the file levels.

Be careful when assigning directory and file attributes. The attribute applies to *all* users.

For example, if you assign the Delete Inhibit attribute to a file, no one, including the owner of the file or the network administrator, can delete the file. But any trustee with the Modify right can change the attribute to allow deletion.

Table 3-2
Directory and File Attributes

Attribute	Description	Applies to
A	Archive Needed identifies files that have been modified since the last backup. This attribute is assigned automatically.	Files only
Ci	Copy Inhibit prevents Macintosh users from copying a file. This attribute overrides Read and File Scan trustee rights.	Files only
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.	Directories and files

Table 3-2 *continued*
Directory and File Attributes

Attribute	Description	Applies to
Di	Delete Inhibit means that the directory or file cannot be deleted. This attribute overrides the Erase trustee right.	Directories and files
Dm	Don't Migrate prevents directories and files from being migrated from the server's hard disk to another storage medium.	Directories and files
Ds	Don't Suballocate prevents data from being suballocated.	Files only
H	The Hidden attribute hides directories and files so they can't be listed using the DIR command.	Directories and files
I	Index allows large files to be accessed quickly by indexing files with more than 64 File Allocation Table (FAT) entries. This attribute is set automatically.	Files only
Ic	Immediate Compress sets data to be compressed as soon as a file is closed. If applied to a directory, every file in the directory is compressed as each file is closed.	Directories and files
N	Normal indicates the Read/Write attribute is assigned and the Shareable attribute is not. This is the default attribute assignment for all new files.	Directories and files
P	Purge flags a directory or file to be erased from the system as soon as it is deleted. Purged directories and files cannot be recovered.	Directories and files
Ri	Rename Inhibit prevents the directory or file name from being modified.	Directories and files
Ro	Read Only prevents a file from being modified. This attribute automatically sets Delete Inhibit and Rename Inhibit.	Files only
Rw	Read/Write allows you to write to a file. All files are created with this attribute.	Files only
Sh	Shareable allows more than one user to access the file at the same time. This attribute is usually used with Read Only.	Files only
Sy	The System attribute hides the directory or file so it can't be seen by using the DIR command. System is normally used with operating system files, such as DOS system files.	Directories and files

Table 3-2 *continued*
Directory and File Attributes

Attribute	Description	Applies to
T	Transactional allows a file to be tracked and protected by the Transaction Tracking System (TTS).	Files only
X	The Execute Only attribute prevents the file from being copied, modified, or backed up. It does allow renaming. The only way to remove this attribute is to delete the file. Use the attribute for program files such as .EXE or .COM. Make a copy of a file before you flag it as Execute Only, so you can replace the file if it becomes corrupted.	Files only

Changing Attributes of a Directory or File

You can change the attributes of a directory or file with NetWare Administrator or FLAG. The NetWare Administrator procedure is documented in this section. (See NetWare Administrator or FLAG in *Utilities Reference* for a general description of these utilities.)

For a list of attributes, see "Description of Directory and File Attributes" on page 39.

Using NetWare Administrator to Change Directory or File Attributes

Prerequisites

❑ The Modify right to the directory or file whose attributes you want to change

Procedure

1. **In NetWare Administrator, select a directory or file.**

   For information on moving around in the browser and selecting objects, choose Help from the menu bar.

2. **From the Object menu, choose Details.**

3. **From the Identification page, choose Attributes.**

4. **Check the checkboxes for the attributes that you want to set or reset for this directory or file.**

5. **To close the object dialog box and save the new attributes, choose OK.**

Changing the Owner of a Directory or File

You can change the owner of a directory or file using NetWare Administrator.

Using NetWare Administrator to Change the Owner of a Directory or File

Prerequisites

❏   The Modify right to the directory or file for which you want to change the owner

Procedure

1. **In NetWare Administrator, select the directory or file for which you want to change the owner.**

    For information on moving around in the browser and selecting objects, choose Help from the menu bar.

2. **From the Object menu, choose Details.**

3. **From the Identification page, choose Facts.**

4. **To change the owner of this directory or file, click on the browser button to the right of the Owner field.**

5. **Choose the object that you want to make the new owner of this directory or file.**

6. **When the correct user is displayed in the Object Name field, choose OK.**

    The new owner appears in the Owner field of the object dialog box.

7. **To save any changes, choose OK.**

4 *Optimizing*

Information on file system optimization focuses exclusively on tasks for the network administrator. Procedures in this section pertain primarily to disk space utilization, and affect performance only as space utilization affects network performance.

Note: If your network needs to support large volumes and files, or large numbers of volumes, directories, and files, consider using Novell® Storage Services™ (NSS), the new file system. You can use NSS™ volumes, either alone or along with the traditional NetWare® file system, to improve file system performance. See *Novell Storage Services (NSS)*.

Saving Disk Space with File Compression

◆   "Enabling File Compression" on page 43

◆   "Disabling File Compression" on page 44

◆   "Setting File Compression Attributes" on page 45

◆   "Suspending File Compression" on page 47

Enabling File Compression

By default, file compression is enabled at the volume level when a volume is created. If you do not enable file compression when you create a volume, you can subsequently enable it using the SET utility. Once file compression is enabled for a volume, you can turn it on or off for individual files and directories by setting compression attributes with NetWare Administrator or FLAG.EXE. For background information, see "File Compression" on page 7.

See NetWare Administrator or FLAG in *Utilities Reference* for a general description of those utilities.

Important: Do not use file compression on a CD-ROM volume.

It isn't necessary to separate applications from data for file compression, because the SET parameter named Days Untouched Before Compression can eliminate the compression of applications that are used regularly. This parameter specifies the number of days that must pass without access to a file before the file can be compressed. The parameter uses the date the file was last accessed to gauge whether a file should be compressed or not.

To avoid the overhead of uncompressing files that don't compress well, the system calculates the compressed size of a file before actually compressing it. If no disk space will be saved by compression, or if the size difference does not meet the value specified by the SET parameter named Minimum Percentage Compression Gain, the file is not compressed.

For a file to be uncompressed, there must be enough free space on the volume to accommodate the uncompressed file size.

For instructions on setting file compression for volumes, directories, and files, see "Setting File Compression Attributes" on page 45.

Disabling File Compression

File compression is enabled and disabled at the volume level.

If you do not enable file compression when you create a volume, you can subsequently enable it using the SET utility. Once enabled, however, file compression cannot be disabled on the volume unless you re-create the volume.

You can temporarily suspend file compression using the SET command's Enable File Compression parameter. (See SET in *Utilities Reference* for a general description of the SET command.)

Setting File Compression Attributes

To set file compression attributes for a volume (including enabling compression), use NWCONFIG or SET (see NWCONFIG in *Utilities Reference* or "Using SET to Set File Compression Attributes for Volumes" on page 45).

To set file compression attributes for a directory or file, use NetWare Administrator (see "Using NetWare Administrator to Set File Compression for a Directory or File" on page 46), or FLAG (see FLAG in *Utilities Reference*).

To view file compression attributes for a directory or a file, use NetWare Administrator or FLAG.

Using SET to Set File Compression Attributes for Volumes

Use SET to set file compression attributes for an entire volume. File compression SET parameters do not affect volumes on which compression is disabled.

Important: Do not use file compression on a CD-ROM volume.

To change SET parameters, execute the SET command at the server console prompt.

The following list identifies SET command parameters that affect file compression. The settings apply to all files and directories in compression-enabled volumes on the server. For the function and range of values associated with each SET parameter, see SET in *Utilities Reference*.

◆ Compression Daily Check Stop Hour

◆ Compression Daily Check Starting Hour

◆ Minimum Compression Percentage Gain

◆ Enable File Compression

◆ Maximum Concurrent Compressions

◆ Convert Compressed to Uncompressed Option

- ◆ Decompress Percent Disk Space Free To Allow Commit

- ◆ Decompress Free Space Warning Interval

- ◆ Deleted Files Compression Option

- ◆ Days Untouched Before Compression

Using NetWare Administrator to Set File Compression for a Directory or File

Use NetWare Administrator to set file compression attributes for individual directories or files. The attributes are Immediate Compress (IC) and Don't Compress (DC).

Note: Compression is a usually a low priority process thread because of compression's impact on performance. If you flag an item for immediate compression during peak system usage, performance may deteriorate.

Prerequisites

❑ File compression enabled for the volume

❑ Modify right to the file or directory

Procedure

1. **In NetWare Administrator, select the file or directory for which you want to set compression attributes.**

2. **From the Object menu, choose Details.**

3. **Choose Attributes.**

4. **From File Attributes, choose Immediate Compress or Don't Compress.**

5. **Choose OK.**

Suspending File Compression

Use SET command's Enable File Compression parameter to temporarily suspend file compression for a volume. (See SET in *Utilities Reference.*)

The MONITOR command can also be used to change file compression parameters. (See MONITOR in *Utilities Reference.*)

While file compression is suspended, files that would have been compressed are queued and compressed when compression is re-enabled.

Saving Disk Space With File Purging

Purging files frees disk space on the NetWare server's hard disk. For background information, see "File Purging" on page 9.

Use NetWare Administrator to purge files manually (see "Purging Files" on page 60) or use PURGE . (See PURGE in *Utilities Reference.*)

To purge files automatically, use the SET command. (See SET in *Utilities Reference.*)

Saving Disk Space with Block Suballocation

Use block suballocation to enhance use of disk space.

Block suballocation divides any partially used disk block into suballocation blocks of 512 bytes. These suballocation blocks can be used by files to share what would otherwise be unavailable space.

You can set block suballocation only when creating a NetWare volume.

Enhancing Disk Response Time With Spanning

For a heavily used volume, you can improve disk response time by distributing volume segments across two or more disks. For background information, see "Understanding Volume Segments" on page 4.

If one of the disks fails, the entire volume becomes unavailable. Therefore, you should mirror or duplex drives containing spanned volumes. (See "Mirroring and Duplexing" in *NetWare Server Disks and Storage Devices* for concepts and "Mirroring and Duplexing Partitions" in *NetWare Server Disks and Storage Devices* for instructions.)

If a disk containing a spanned volume fails, the entire volume must be restored from a backup across all segments before you can use it again.

The most effective way to distribute volume segments is to do so equally across the disks. Do not simply fill up a disk, add another, add another, etc.

Optimizing File Caching

See "Changing Disk and Directory Caching for Faster Writes" in *NetWare Server Disks and Storage Devices.*

5 *Managing*

Procedures in the Managing section of file system documentation pertain to network administrators and users. Procedures for viewing directory and file information, copying, moving, and other routine functions are of interest to users as well as system administrators. Procedures pertaining to volume management and the protection of network data necessarily belong to network administration.

Managing Volumes

Note: If your network needs to support large volumes and files, or large numbers of volumes, directories, and files, consider using Novell® Storage Services™ (NSS), the new file system. NSS™ mounts volumes more quickly, using only 1 MB of RAM, and NSS gives you more options for gathering free space to use for volumes. NSS can be used along with the traditional NetWare® file system. See *Novell Storage Services (NSS)*.

Changing Volume Size

To increase the size of a volume, add new segments using the procedure in this section. For background information, see "Understanding Volume Segments" on page 4.

Note: To reduce the size of the volume, you must delete the entire volume, and then re-create the volume. You can add segments to a volume without destroying data, but removing any segment from a volume destroys all of the data on the volume. Before deleting a volume, back up all data on the volume. See "Deleting a Volume" on page 51.

A volume can have multiple segments spanning multiple hard disks. This arrangement allows you to add a hard disk when you need to expand a volume.

Keep the following requirements in mind if you plan to expand volumes:

◆ The maximum number of segments allowed per volume is 32.

◆ The maximum number of segments you can create on one hard disk is 8.

◆ The maximum number of volumes allowed is 64.

Prerequisites

❏ An existing NetWare partition with free space (for information about partitions, see "Partitioning Disks" in *NetWare Server Disks and Storage Devices* for concepts and "Creating NetWare Partitions" in *NetWare Server Disks and Storage Devices* for instructions)

Procedure

1. **At the server console prompt, type**

   `NWCONFIG`

2. **From the Installation Options menu choose Disk Options and then NetWare Volume Options.**

3. **Press** Insert **or** F3 **to view existing volume segments.**

4. **Select a segment that has free space (no volume assignment) and press** Enter**.**

   Note: If no free space exists, you can't add a segment to a volume.

5. **To add this segment to an existing volume, select Make This Segment Part of Another Volume and press** Enter**.**

   A list of existing volumes appears.

6. **Select the volume you want to add this segment to, and press** Enter**.**

   The Volume Disk Segment List appears with the new segment listed, showing the name of the volume you assigned the segment to.

7. **(Optional) If you want to modify the size of the segment being added, select the new segment and press** Enter**. The Status column for the segment being added shows the letter N, for New.**

   7a. **In the Disk Segment Size field, type the size (in megabytes), of the segment to be added to the volume. Then press** Enter**.**

   7b. **Press** F10 **or** Esc **to save changes and return to the Volume Disk Segment list.**

8. **Verify the segment size and the volume it will be added to in the Volume Disk Segment List. Then press** Esc **or** F10**.**

9. **To save volume assignments to disk, press** F10 **and Yes to verify.**

Deleting a Volume

This procedure tells you how to delete an entire volume.

Warning: Deleting one volume segment deletes all existing data on the volume! You cannot delete only part of a volume.

1. **Back up the data stored on the volume you want to delete.**

2. **Dismount the volume you want to delete.**

3. **At the server console prompt, type**

   `NWCONFIG`

4. **From the Installation Options menu, choose Disk Options and then NetWare Volume Options and press** Enter**.**

   A list of existing volumes is displayed.

5. **From the list of existing volumes, select the volume you want to delete and press** Delete**.**

   A warning similar to the following appears:

   ```
   Volume volume_name may contain valuable data that
   will be lost if you confirm "Yes" in the box that
   follows this message and if you save volume
   changes on exit from the volumes list.
   <Press ENTER to continue>
   ```

6. **Press** Enter **if you want to continue.**

7. **When the Delete Existing Volume? prompt appears, select Yes and press** Enter**.**

Renaming a Volume

Important: Do not change the name of volume SYS: to another name. A volume called SYS: is mandatory.

1. **Dismount the volume you want to rename.**

2. **At the server console prompt, type**

   `NWCONFIG`

3. **From the Installation Options menu, choose Disk Options and then NetWare Volume Options and press** Enter**.**

   All existing volumes are listed.

4. **Select the volume whose name you want to change and press** Enter**.**

   The Volume Information screen is displayed.

5. **Use the arrow keys to highlight the Name field, and press** Enter**.**

6. **Backspace to erase the old name; then type in a new name and press** Enter**.**

7. **Press** Esc **twice; then press** F10 **to save the volume information.**

   If you have not dismounted the volume it is automatically dismounted now.

8. **When prompted, answer Yes to mount the volume with the new name.**

9. **To set the Volume object name and context in NDS, you are prompted to log in to the Directory.**

10. **After you log in, verify that the displayed context and Volume object name are correct.**

    Note: Renaming a volume with NWCONFIG creates a Volume object with the new name. It does not delete the Volume object with the old name.

11. **Use NetWare Administrator to delete the old Volume object from the Directory tree.**

Repairing a Volume

Typically, you can't mount a volume if it has even minor damage. Occasionally, however, a damaged volume mounts, but causes errors in the process.

Use VREPAIR to correct volume problems or to remove name space entries from File Allocation Tables (FATs) and Directory Entry Tables (DETs). (See VREPAIR in *Utilities Reference* for a general description of the command.)

Note: If you need to repair an NSS volume, see "Rebuild NSS Volumes" in *Novell Storage Services (NSS)*.

You can run VREPAIR on a damaged volume while other volumes are mounted. Following are typical instances when VREPAIR can help:

◆ A hardware failure either prevented a volume from mounting or caused a disk read error.

   Note: Although VREPAIR can't fix hardware problems, VREPAIR can sometimes fix related volume damage.

◆ A power failure caused a corrupted volume.

◆ The server console displays a mirroring error when the server boots. This mirroring refers to the two copies of FATs and DETs that the operating system keeps (if disks are mirrored, NetWare keeps four copies).

If a volume fails to mount as the server is booting, VREPAIR loads automatically and attempts to repair the volume.

When VREPAIR autoloads, it uses the default options. If you want to use an alternate option, load VREPAIR manually and set the alternate option before running VREPAIR.

Note: If you don't want VREPAIR to automatically repair a volume that won't mount, use the SET parameter named Automatically Repair Bad Volumes to change the default.

Prerequisites

❑ The volume you want to repair must be dismounted.

❑ If the volume to be repaired has name space support, the corresponding VREPAIR name space module (*V_namespace.NLM*) must be located in either the SYS:SYSTEM directory or in a search path directory.

   Example modules include V_MAC.NLM and V_LONG.NLM.

Procedure

1. **At the server console prompt, type**

   VREPAIR [*volume name***] [***logfile name***]**

   (Optional) Replace *volume name* with the name of the volume to repair. If there is only one volume that is dismounted, you don't need to specify this parameter, since VREPAIR will attempt to repair that volume.

   (Optional) If you want to save the error log, replace the *logfile name* with the name of the file you want VREPAIR to create. VREPAIR creates a log of errors it finds. VREPAIR displays the errors on screen and will write them to a file if you specify a filename.

   When you load VREPAIR, an Options menu is displayed.

2. **Accept the default options, or select alternate options, as appropriate.**

   The first time you try to repair a volume, accept the default options. If the default options fail to repair the volume, select alternate options.

   2a. **To accept the default options, continue with Step 3.**

   2b. **To set alternate options at the Options menu, choose Set VRepair Options by typing**

      2 Enter

3. **To begin the repair process, choose Repair A Volume from the Options menu.**

   ◆ If more than one volume is dismounted, select the volume to repair from those listed.

   ◆ If only one volume is dismounted, VREPAIR assumes it is the volume that needs repairing and begins the repair.

   As the volume is being repaired, the server console screen displays a message indicating VREPAIR activity.

4. **(Optional) Modify error log settings after the repair has started.**

   If VREPAIR finds many errors during the repair process, you might want to change some of the run-time error settings. To modify these settings after the repair has started, press F1 to display the Current Error Settings menu.

   ◆ Select Option 1 if you do not want VREPAIR to pause after each error.

   ◆ Select Option 2 if you want VREPAIR to log errors in a text file.

   ◆ Select Option 3 to stop the repair of the volume.

   ◆ Select Option 4 to continue with a volume repair after you have stopped it.

5. **When the repair is complete, answer Y when prompted to write repairs to the disk.**

6. **If VREPAIR has found errors, run VREPAIR again by repeating Step 2 through Step 6. Repeat until VREPAIR finds no errors.**

   If you are unable to mount the volume after running VREPAIR several times, you must delete the volume, re-create the volume using NWCONFIG, and then restore the data from backups.

Viewing Volumes

You can view Volume objects in NetWare Administrator (see NetWare Administrator in *Utilities Reference*.). You can also view statistical information on disk space availability, block size, directory entries, name space support, etc.

MAP lists a NetWare server's volume names. (See MAP in *Utilities Reference*.)

In addition, the DOS DIR command lists the volume name for the specified network drive (for example, Volume in drive F: is SYS:).

This corresponds to the DOS or OS/2 volume label shown by the DIR command for local disks (floppy disks or workstation hard disks). A local disk can be given a volume label during formatting or with the DOS or OS/2 LABEL command.

Viewing Directory and File Information

You can see extended information about a directory or file using NetWare Administrator (see NetWare Administrator in *Utilities Reference*). The procedure for using NetWare Administrator is documented in this section.

You can see file information such as

◆ Owner and trustees

◆ Attributes, effective rights, and the Inherited Rights Filter (IRF)

◆ Name space

◆ File size

◆ Creation, access, archive, and modify dates

You can see directory information such as

◆ Owner and trustees

◆ Creation date and time

◆ Attributes, effective rights, and the IRF

◆ Disk space limitations

Prerequisites

❏ The File Scan right to the file or directory you want to see information about

Procedure

1. **In NetWare Administrator, select the file or directory you want to see information about.**

   For help moving around in the browser and selecting objects, choose Help from the menu bar.

2. **Choose Details from the Object menu.**

3. **Select an Information page to view for this file or directory.**

4. **If you have made any changes on any pages, choose OK to save changes and return to the browser.**

   If you haven't made any changes, choose Cancel to return to the browser.

Copying or Moving Directories and Files

You can copy and move files and directories, as you do objects, in NetWare Administrator. You can also perform these tasks from your desktop application.

The destination can be in another browser containing the same tree or a different tree.

To copy or move files, you must have File Scan rights to the source directory, and you must have the Create right to the destination directory.

To move files, you must also have the Erase right to the source directory, because moving files includes deleting them from the source directory.

Salvaging and Purging Files

Files deleted from the NetWare server remain on the disk until the deleted files are purged. Deleted files can be salvaged any time before they are purged.

Purging frees the space used to store the deleted files on the server's hard disk. If a disk runs out of free space, NetWare automatically purges first the files that were deleted first. Instructions for salvaging and purging are in the following sections:

◆ "Salvaging Deleted Files" on page 59

◆ "Purging Files" on page 60

Salvaging Deleted Files

Files deleted from the NetWare server can be recovered unless they have been purged. For background information, see "Salvageable Files" on page 8.

You can salvage files by using the NetWare Administrator procedure documented in this section.

Prerequisites

❏ The Create right to the directory from which the file was deleted. (If the directory has also been deleted, then the deleted file is in the Deleted Directories area, which is the DELETED.SAV directory. To salvage a file from there, you need the Supervisor right to the DELETED.SAV directory.)

Procedure

1. **In NetWare Administrator, select the directory containing the files or directories you want to salvage.**

2. **From the Tools menu, choose Salvage.**

3. **From the Source list, select the source directory (current or deleted).**

   If the source is a deleted directory, NetWare Administrator looks in the DELETED.SAV directory on the SYS: volume. If you salvage files from deleted directories, the list of files takes a long time to appear.

4. **Specify the deleted files you want listed by entering a file specification (such as wildcards) in the Include field.**

   For example, to see a list of deleted batch files in the current directory, you would type *.BAT in the Include field.

   If you leave the field blank or type *.* you get a list of all deleted files in the selected directory.

5. **Choose List to display the filenames you included.**

6. **(Optional) Specify how you want the files to be listed by selecting a sort option from the Sort Options drop box.**

   For example, you can sort by deletion date, deletor, etc. The default listing is by filename.

7. **Select the files you want to salvage.**

8. **Choose Salvage.**

   If you salvage files from an existing directory, the files are restored to that directory. If you salvage files from a deleted directory, the files are restored in the root directory.

9. **To return to the browser, choose Close.**

Purging Files

Purging files frees disk space on the NetWare server's hard disk. For background information, see "File Purging" on page 9.

Warning: Purged files *cannot* be salvaged.

To purge individual files or directories manually, use NetWare Administrator or PURGE. (See NetWare Administrator or PURGE in *Utilities Reference*.)

To purge files automatically, use the SET command. (see SET in *Utilities Reference*)

Prerequisites

❏   The Erase right to the deleted file or directory you want to purge. If the file is in the Deleted Directories area, you need the Supervisor right to the file

Procedure

1. **In NetWare Administrator, select the directory containing the files or directories to be purged.**

2. **From the Tools menu, choose Purge.**

3. **Select the source directory (current or deleted) from the Source drop box.**

4. **Enter a file specification (such as wildcards) in the Include field to specify files to be listed.**

   For example, to see a list of deleted batch files in the current directory, you would type *.bat in the Include field.

   If you leave the field blank or type *.* you get a list of all deleted files in the current directory.

5. **Choose List to display the filenames you specified.**

6. **(Optional) Specify how you want the filenames to be listed by selecting a sort option from the Sort Options drop box.**

   For example, you can sort by deletion date, deletor, etc. The default listing is by filename.

7. **Select the files to be purged.**

   Warning: If no files are selected, then *all* deleted files are purged.

8. **Choose Purge.**

9. **To return to the browser, choose OK.**

Protecting Data: Disk Mirroring and Duplexing

NetWare allows you to protect your data with disk mirroring or duplexing.

Mirroring stores the same data on separate disks on the same controller channel; duplexing stores the same data on separate disks on separate controller channels.

Duplexing is the preferred method since two channels rarely fail simultaneously.

Do not mirror a partition on a disk to another partition on the same disk. Doing so is not fault tolerant, even though mirroring allows it.

With multiple partitions on a disk, any partition can be mirrored to any other disk. This provides considerable flexibility in protecting partitions.

For conceptual information, see "Mirroring and Duplexing" in *NetWare Server Disks and Storage Devices.* For instructions, see "Mirroring and Duplexing Partitions" in *NetWare Server Disks and Storage Devices.*

Using Directory Map Objects

A Directory Map object represents a particular directory in the file system. (See "Directory Map Objects" on page 6.)

If you create a Directory Map object to point to an application, users can access the application by mapping a drive to the Directory Map object.

Directory Map objects can be especially useful in login scripts by indicating directories that contain applications or other frequently used files. For instructions on creating Directory Map Objects, see "Creating a Directory Map Object" on page 28.

Here's an example of how you could use a Directory Map object to reduce maintenance of login scripts.

If you have a directory that contains a word processor, you will probably map a search drive to that directory in any login scripts you create. If you should later upgrade to the word processor and rename the directory, you would have to change the mapping in every login script where that search mapping appears.

By using a Directory Map object, you could avoid having to make changes to the login scripts.

First, using NetWare Administrator, you could create a Directory Map object called CURRENT_WPR that points to the word processor directory (SYS:PUBLIC\WPR\80).

Then, in a MAP command (see MAP in *Utilities Reference*) in your login scripts, map a search drive to the Directory Map object, rather than to the specific directory:

MAP INS S2:=.CURRENT_WPR.SALES.NOVELL_US

When users log in, their search drive is mapped to the CURRENT_WPR Directory Map object, which points to the directory containing WPR8.0.

Later, if you upgrade to WPR9.0 and change the directory's name to SYS:PUBLIC\WPR\90, you would change only the Directory Map object to indicate the new path.

You would not have to change the MAP command in the login script because the MAP command still indicates the correct Directory Map object.

6 *Troubleshooting*

This section presents various troubleshooting procedures focused primarily on resolving problems with volumes.

Resolving File I/O Errors

To resolve a file I/O error, try one or more of the following:

◆ Check to see that the volume (especially volume Sys) is mounted. To check volumes, type VOLUME at the server console prompt.

◆ If the volume is out of disk space, error messages will appear on the console screen indicating that the volume is almost out of disk space. Check the console screen.

◆ Type DIR at a DOS workstation to see how much space remains.

To increase the amount of free space, do one or more of the following:

◆ Delete extraneous files (if you can log in from a workstation).

◆ Type SET IMMEDIATE PURGE OF DELETED FILES = ON at the console prompt, and retry the action.

◆ If you have an additional disk, increase the size of the volume by creating an additional segment of the volume on the disk.

Resolving Volume I/O Errors

To resolve a volume I/O error, try one or more of the following:

◆ Make sure *all* devices that contain the volume are online. (Volumes can span multiple devices.)

◆ Load and execute VREPAIR.

◆ Load NWCONFIG and select Standard Disk Options > Volume Options. Make sure the volume is visible.

If you have tried all of the above without success, contact your Novell Authorized Reseller℠ representative or disk drive manufacturer.

Resolving Problems when Server "Hangs" after Mounting Last Volume

To diagnose problems when the server hangs after mounting the last volume, identify whether the following conditions exist:

◆ The server network board is not initializing when the server is brought up because the board is not installed or seated correctly.

◆ The server network board is not configured correctly.

To resolve problems when the server hangs after mounting the last volume, perform the following actions or ensure that the following conditions exist:

◆ Run CONFIG at the server console to see what settings appear on the screen. Check the network board configurations of the boards in the server. Make sure the settings match.

◆ Make sure that all server and workstation network boards are seated properly and that cabling and connections are attached securely.

◆ Make sure that the terminators on cables have the right ohm rating and are installed correctly. The IBM* PC Cluster sends a broadcast message during initialization and hangs if the network is not cabled or terminated properly.

- Check the network boards in all workstations for correct node address settings.

Resolving Problem when No Volumes Mount

Volume Sys is the backout volume for TTS™ (Transaction Tracking System™). Volume Sys also contains the NetWare system files and the NLM programs.

If volume Sys does not mount when the server is booted, then the autoexec.ncf file does not execute, LAN drivers do not load, TTS can't be enabled, and the volume does not become part of the NDS tree.

To diagnose problems when no volumes mount, identify if the following conditions exist:

- Volume Sys is corrupted.

- The hard disk containing volume Sys has failed.

- The cable or power to the external hard disks has malfunctioned.

To resolve problems when no volumes mount, perform the following actions:

- Run VREPAIR on volume Sys (VREPAIR autoloads from the DOS partition).

- Check the cabling and power to the external hard disks. Replace any faulty components.

- Replace the hard disk containing volume Sys.
    - Load NWCONFIG to create the partitions and volume Sys.
    - Restore the data from a backup copy.

Resolving Problems when Only Some Volumes Mount

To diagnose problems when only some volumes mount, identify whether the following conditions exist:

◆　The server does not have enough RAM.

◆　The disk driver for external drives may not be loaded.

To resolve problems when only some volumes mount, perform the following actions:

◆　Add more RAM.

◆　At the server console, type MODULES to see which drivers are loaded.

Resolving Disk Error Problems when a Volume Is Mounting

To diagnose problems when disk errors occur while a volume is mounting, identify whether the following conditions exist:

◆　The server does not have enough memory to mount the volume.

◆　The operating system is experiencing directory sector mismatching. This mismatching can be caused if the media is defective or if the server is turned off without the DOWN command.

To resolve problems when disk errors while a volume is mounting, perform the following actions:

◆　Load MONITOR and check the status of the available cache buffers. If the cache buffers are fewer than 20%, add more memory to your server.

◆　Minor errors usually correct themselves through normal network use. For example, if a FAT entry is wrong, the entry is updated and corrected the next time it is written to. If errors do not correct themselves, run VREPAIR.

◆ Some problems may be corrected automatically by TTS.

Resolving Memory Errors when a Volume Is Mounting

To diagnose problems when memory errors while a volume is mounting, identify whether the following conditions exist:

◆ Volumes take more memory to mount than they require after being mounted because the mounting process performs consistency checks (for example, the duplicate copies of all the tables are checked).

◆ Volumes and directory entries grow dynamically. Thus, if your server is using most of the RAM (file cache buffers are close to 20% of the memory) and you dismount a volume, you may not be able to remount the volume unless additional memory is available.

◆ Each additional name space support that you add to a volume increases the size of the FATs and DETs. Adding name space support can cause the tables to grow so large that the server does not have enough RAM to mount the volume.

To resolve problems when memory errors while a volume is mounting, perform the following actions or ensure that the following conditions exist:

◆ Load MONITOR and check the status of the available cache buffers. If the cache buffers are fewer than 20%, add more RAM to your server.

◆ Free up memory by unloading resources.

◆ Streamline the directory structure. Every subdirectory takes at least one directory block (by default, a 4 KB block of memory). Thus, subdirectories with only one file require as much memory as directories with 32 files.

If you combine directories so that most directories have about 32 files, and then purge the deleted subdirectories and files, you will free up memory.

◆ Calculate how much memory you need and add memory to the server. View the current volume size with NWCONFIG.

- For a more accurate assessment of available RAM, load MONITOR, select Available Options > System Resources. Note the Cache Buffers settings in the Server Memory Statistics window.

  If the percentage is below 20%, add more memory.

- Remove the recently added name space support.

  Warning: This is a destructive step that destroys all the extended file information. Before taking this step, try to free up enough memory so that the volume mounts and you can back up the data.

  Have all users log out, and then unload all modules except the volume's disk drivers. Dismount any mounted volumes.

  To remove the name space, load VREPAIR and select two options: Write All Directory and FAT Entries Out to Disk and Remove Name Space Support From The Volume. Then run VREPAIR on the volume that would not mount.

Resolving Volume Mounting Problems Because of Corrupted Directory Entry Tables or File Allocation Tables

To diagnose problems when mismatches exist in the duplicate copies of the File Allocation Table (FAT) and Directory Entry Table (DET), identify whether the following conditions exist:

- A power failure has occurred and the server has not been brought down gracefully.

- A hard disk fails.

- A disk channel error occurs.

- A volume is not dismounted with the DISMOUNT command.

- Directory information in cache is not completely written to disk.

To resolve problems when mismatches in the duplicate copies of the FAT and DET exist, perform the following actions:

◆ Run VREPAIR.

◆ Add a UPS system so that the server is brought down automatically when a power failure occurs.

◆ Replace faulty disks or controllers.

◆ Use NWCONFIG to unmirror the hard disks (select the hard disk you think is least reliable and delete it from the mirroring list). Then run VREPAIR on the volume and mount the volume.

   If the volume still does not mount or the data shows some corruption, read the next suggestion before remirroring the hard disks.

◆ If the volume resides on mirrored hard disks, salvage the data on both hard disks.

   Use NWCONFIG to unmirror the hard disks and to salvage the orphaned (Out Of Sync) hard disk as a new volume. Run VREPAIR on both the old and the new volumes.

   Mount both volumes and compare the files. Use NWCONFIG to delete the volume that has the least useful information; rename the salvaged volume, if necessary. Then use NWCONFIG to remirror the hard disks.

Resolving Volume Mounting Problems Because of Name Space Module

Once a volume has been configured to support more than the DOS naming convention, the name space loadable module must be loaded before the volume can be mounted.

To diagnose problems when a volume cannot mount because the name space module is not loaded, identify whether the following conditions exist:

◆ The command to load the name space module is not in the startup.ncf file.

◆ The module to load the name space has not been copied to the boot directory of the server.

To resolve problems when a volume cannot mount because of the name space module is not loaded, perform the following actions:

◆ Load the name space module; then mount the volume. Copy the name space module to the server boot directory and add the load command to the startup.ncf file. The module then loads automatically whenever the server is booted.

◆ Delete the name space configuration from the volume.

   Warning: This is a destructive step that destroys all the extended file information.

   Back up all non-DOS files. Then load VREPAIR and select both the Remove All Name Space Entries and the Write Changes Immediately to Disk options. Then run VREPAIR on the volume.

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