Microsoft Network Client 2.2

NetWare Connectivity Guide

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Preface

The *NetWare® Connectivity Guide* explains how to install Novell® NetWare Connectivity on an MS-DOS® workstation running LAN Manager, and how to configure, administer, and troubleshoot NetWare Connectivity.

This manual assumes that you understand MS-DOS. If you are not familiar with MS-DOS, see your MS-DOS manual(s).

For an explanation of terms and concepts specific to local area networks and to the Microsoft® Windows NT™ operating system, LAN Manager, and NetWare, read the associated documentation.

How to Use This Manual

Turn to the part of this manual that contains the information you need.

Chapter 1, “Understanding NetWare Connectivity”

> Describes the features and benefits of NetWare Connectivity, and gives a brief description of how a user starts and runs NetWare Connectivity.

Chapter 2, “Installing and Configuring NetWare Connectivity”

> Explains how to install NetWare Connectivity on a workstation, how to set up the workstation, and how to minimize the amount of the workstation memory used by LAN Manager with NetWare Connectivity.

Chapter 3, “Troubleshooting”

> Explains how to correct errors that may occur on the workstation.

Appendix A, “Differences in Administering NetWare, Windows NT, and LAN Manager”

> Provides an overview of the major differences you will find between managing the three networks.

Finding Further Information

Additional user information can be found in the MS-DOS workstation client documentation that came with your network. Additional administrative information can be found in your network administration documentation.

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Understanding NetWare Connectivity

The NetWare Connectivity feature of LAN Manager for MS-DOS workstations allows a computer running MS-DOS to communicate with Microsoft Windows NT Advanced Servers, Windows NT workstations, LAN Manager servers and Novell NetWare servers simultaneously.

NetWare Connectivity makes it easy for you to add Windows NT workstations and Advanced Servers, and LAN Manager servers, to an existing NetWare network. By installing NetWare Connectivity on your network's workstations, your network will no longer have just “LAN Manager workstations” or “NetWare workstations”--instead, all the MS-DOS workstations that have LAN Manager and NetWare Connectivity can be multipurpose workstations, able to work with many types of servers.

With NetWare Connectivity, workstation users use LAN Manager commands and procedures to access resources on Windows NT computers and LAN Manager servers, and they use NetWare commands and procedures to access resources on NetWare servers.

Features of NetWare Connectivity

In addition to allowing users to access Windows NT computers, LAN Manager servers, and NetWare servers simultaneously, LAN Manager NetWare Connectivity provides these features:

- Efficient memory usage—you can load and unload the NetWare software while the computer is running
- Full compatibility with NetWare-specific applications and utilities
- Full support for the Microsoft Windows operating system
- Need for only one version of IPX.COM
- Need for only one network adapter in the workstation

Efficient Memory Usage

Using the NetWare Connectivity NWLOAD.BAT program, you can load the NetWare software only when it is needed, then unload it when you are finished. When NetWare is not being used, more memory is available for applications.

You can also bypass NWLOAD.BAT and start NetWare with the commands that NetWare users usually use. To do this, simply start IPX.COM and the NetWare shell directly. If you use this method, however, you cannot unload NetWare without rebooting the workstation.

You can use MS-DOS memory managers with LAN Manager and NetWare Connectivity. Memory managers load parts of the network software into areas of memory other than conventional memory, leaving more room for applications.

Support for Microsoft Windows

NetWare Connectivity includes full support for Microsoft Windows version 3.x. With NetWare Connectivity, you can use all the Microsoft Windows networking features that are available with either LAN Manager or NetWare running alone.

While using the Windows operating system with NetWare Connectivity, you can use the Windows File Manager and Print Manager to access resources on Windows NT computers, LAN Manager, and NetWare servers. You also have full network capability for all three networks while using any MS-DOS boxes you open from the Windows operating system. The Windows operating system recognizes and enables connections to both types of servers transparently.

Full Compatibility With NetWare-Specific Applications

With NetWare Connectivity, the workstation runs actual NetWare workstation software, not an emulation. Therefore, there are no compatibility concerns—the workstation can run all NetWare-specific applications and utilities. NetWare Connectivity also supports NetWare source routing on token-ring networks.

Applications written for the Novell NetBIOS will run on workstations running LAN Manager and NetWare Connectivity. However, the NetBIOS on workstations running LAN Manager and NetWare Connectivity is the LAN Manager NetBIOS, not the Novell NetBIOS. These two versions of NetBIOS do not interoperate, so NetBIOS applications running on workstations with NetWare Connectivity cannot interoperate with the same application running on NetWare-only workstations.

Need for Only One Version of IPX.COM

With Novell NetWare, a new version of IPX.COM must be generated for each type of network adapter used on the network. NetWare Connectivity does not require this. Instead, when you install NetWare Connectivity, you generate only one version of IPX.COM, and then use this version for all workstations running NetWare Connectivity, no matter what type of network adapters they use.

This is possible because LAN Manager uses the NDIS (Network Driver Interface Specification) standard for its network adapter drivers and protocol drivers. Any protocol driver that conforms to NDIS can be bound to any network adapter driver that also conforms to NDIS. The version of IPX.COM that NetWare Connectivity generates is NDIS-compliant, so it can be bound to any NDIS-compliant network adapter driver. All network adapter drivers shipped with LAN Manager are NDIS-compliant.

Need for Only One Network Adapter

Because NetWare Connectivity uses the NDIS standard, a workstation can access Windows NT computers, and LAN Manager and NetWare servers using only one network adapter. Both the NetWare IPX protocol and the workstation's LAN Manager protocol (such as NetBEUI) can be bound to the same network adapter driver.

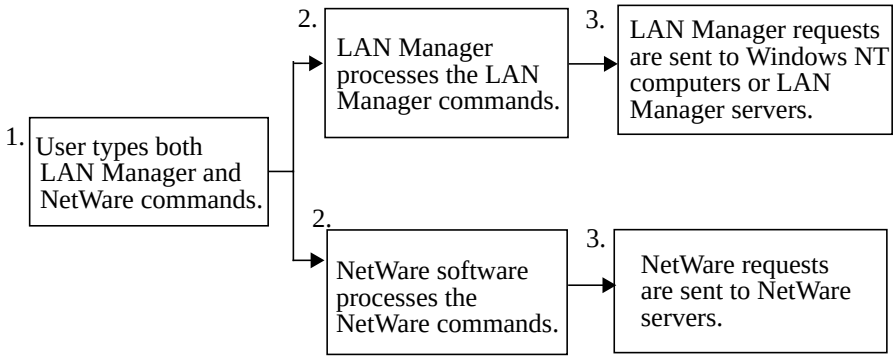
Using NetWare Connectivity

Following is a sample scenario using NetWare Connectivity: The user has the LAN Manager workstation software running whenever the computer is on, and starts NetWare Connectivity only to access a file or printer on the NetWare network. (If the workstation also runs the Windows operating system, the user should start NetWare Connectivity before starting the Windows operating system.)

The user starts NetWare with the **nwload** command. This command saves the current MS-DOS configuration, then starts the NetWare workstation software. The IPX.COM command starts the IPX protocol.

When NetWare Connectivity is running (and with the LAN Manager workstation still running), the user can access resources on Windows NT computers, LAN Manager servers and NetWare servers.

If the workstation has the Windows operating system, the user can use it to connect to directories and printers on both types of servers. If the workstation does not have the Windows operating system, the user uses LAN Manager commands to communicate with Windows NT computers and LAN Manager servers, and NetWare commands to communicate with NetWare servers. When the user types a command, LAN Manager processes the command if it is a Windows NT or LAN Manager command, and NetWare processes the command if it is a NetWare command, as shown in the following figure.



When finished with NetWare resources, the user can type **nwunload** to stop NetWare and unload it from memory. The **nwunload** command also restores the MS-DOS configuration that was saved when NetWare started. The **nwunload** command cannot be used when the Windows operating system is running on the workstation--the user must stop the Windows operating system temporarily before unloading NetWare.

When the user uses the **nwload** and **nwunload** commands to run NetWare, the memory required by NetWare is used only when NetWare is actually running. When NetWare is not running, that memory is free to be used by applications.

A user of a workstation with NetWare Connectivity can bypass **nwload** and **nwunload** and can run IPX.COM and the NetWare shell directly. However, in this case the NetWare software cannot be unloaded from memory until the workstation is rebooted.

You may prefer this method if the workstation has enough memory for running both LAN Manager and NetWare Connectivity constantly and if you want the user to always be able to access Windows NT, LAN Manager, and NetWare servers. This also lets experienced NetWare users start NetWare with the same commands they always have used on NetWare-only workstations.

Alternatively, the user can run the NetWare Connectivity software without also running the LAN Manager workstation software.

Files Used by NetWare Connectivity

A workstation running LAN Manager with NetWare Connectivity is a complete LAN Manager workstation; it has all the files typically found on a LAN Manager workstation. It also has additional files specific to NetWare Connectivity, including the following:

- NWLOAD.BAT
- NWUNLOAD.BAT
- IPX.COM
- NETx.COM, NETX.COM or NETX.EXE

The NWLOAD.BAT and NWUNLOAD.BAT files are copied from the distribution disks to the workstation's hard disk when you install NetWare Connectivity.

The IPX.COM file is generated during the installation of NetWare Connectivity, using files both from the LAN Manager distribution disks and from your Novell NetWare distribution disks. When installing NetWare Connectivity on several workstations, you may choose to generate the IPX.COM file only on the first workstation, and then copy it to your installation disks. This eliminates the step of generating IPX.COM during each subsequent installation.

The NETx.COM, NETX.COM or NETX.EXE file comes from the NetWare distribution disks and is copied to the hard disk when you install NetWare Connectivity.

System Requirements

To run LAN Manager NetWare Connectivity, a workstation must meet the following requirements. For more information about system requirements, see the *Installation Guide for Clients*.

- The workstation must run LAN Manager version 2.1 (or later), and use either LAN Manager Basic or LAN Manager Enhanced. You must install LAN Manager on the computer before you install NetWare Connectivity.
- If the Windows operating system will be used with NetWare Connectivity, the workstation must have Microsoft Windows version 3.0 or later.

For instructions on how to install NetWare Connectivity on a workstation, see Chapter 2, “Installing and Configuring NetWare Connectivity.”

A workstation with NetWare Connectivity can access resources on servers running any version of Windows NT, Windows NT Advanced Server, LAN Manager, or MS-NET, and the following versions of NetWare:

- NetWare 2.0a
- NetWare 2.15c
- NetWare 2.2
- NetWare 3.1 and NetWare 3.11

It is expected that servers running most other versions of NetWare will work with NetWare Connectivity, but they have not been tested.

Compatibility Issues

If you use the NetWare Toolkit for Windows (available on CompuServe) instead of the NetWare software bundled with the Microsoft Windows package, the workstation will be unable to receive NetWare broadcast messages. However, the workstation will work in all other ways.

The current release of LAN Manager does not support NetWare Connectivity on ArcNet networks. This is because the NDIS network adapter drivers for the Thomas-Conrad and SMC ArcNet network adapter cards are not compatible with NetWare Connectivity. Microsoft is working on the NDIS drivers for these cards and a fix will be made available as soon as possible.

2

Installing and Configuring NetWare Connectivity

This chapter describes how to install NetWare Connectivity on a LAN Manager workstation, how to configure it, and how to free up as much memory as possible for use by applications.

Installing NetWare Connectivity

You must install LAN Manager on a workstation before you can install NetWare Connectivity.

When you install NetWare Connectivity on the first workstation on your network, you must install it directly from the NetWare Connectivity distribution disk. Then you can install NetWare Connectivity on other workstations either directly from the distribution disk or over the network from a source directory on a server. If you are installing NetWare Connectivity on several workstations, installing over the network can save you time. You can copy the NDIS-compliant IPX.COM file you generate when you install the first workstation into the network directory you are using for installation. This way, you do not have to regenerate IPX.COM every time you install NetWare Connectivity on another workstation. For more information, see “Installing Over the Network,” later in this chapter.

Another installation method is to use an altered version of the NetWare Connectivity distribution disk. This method is not as fast as over-the-network installation, but it does not require you to prepare a server.

The following sections explain all these installation methods. Read the next section, “Before Installing,” before you use any of the methods.

Before Installing

Before you install NetWare Connectivity, you must make preparations if any of these situations applies to you:

- The computer runs MS-DOS 5.0 and the NetWare Connectivity disks do not contain either the NET5.COM file or the NETX.COM file.
- The computer runs MS-DOS 6.0.
- The computer runs Microsoft Windows.
- The computer runs Microsoft Windows over-the-net (where the Windows operating system is in a shared directory on a server).
- The computer runs an international version of Microsoft Windows.

See the following subsections for these situations.

Installing With MS-DOS 5.0

During installation you will be prompted for some NetWare files from your NetWare distribution disks. If you have workstations running MS-DOS 5.0, you need either the NET5.COM file, the NETX.COM file, or the NETX.EXE file (see "Using NETX.COM and NETX.EXE," later in this chapter for an explanation of the files). However, these files may not be on the NetWare distribution disks. If this is the case, you can find NET5.COM and NETX.COM on the MS-DOS 5.0 Upgrade disks (or obtain any of the three files from Novell); copy the appropriate one to the root directory of the disk you use for installing NetWare Connectivity.

If you find that a workstation does not have the NET5.COM or NETX.COM file after you install NetWare Connectivity (because this file was not on the disk used for installation), simply copy the file to the workstation. Copy it to the LANMAN.DOS\NETPROG directory on workstations that have LAN Manager Enhanced, and to the LANMAN.DOS\BASIC directory on workstations that have LAN Manager Basic.

If you are using NETX.EXE, rather than NETX.COM or NET5.COM, you must rename this file to NETX.COM prior to installing NetWare Connectivity, and then rename it back to NETX.EXE after installing NetWare Connectivity.

For more information about MS-DOS 5.0 features that relate to NetWare Connectivity, see the section "Using NetWare Connectivity with MS-DOS 5.0 and 6.0," later in this chapter.

Installing With MS-DOS 6.0

During installation, you will be prompted for some NetWare files from your NetWare distribution disks. If you have workstations running MS-DOS 6.0, you need the NETX.COM file or the NETX.EXE file (see "Using NETX.COM and NETX.EXE," later in this chapter for an explanation of these files). However, these files may not be on the NetWare distribution disks. If this is the case, you can find NETX.COM or NETX.EXE on CompuServe (or obtain them from Novell); copy the appropriate file to the root directory of the disk you use for installing NetWare Connectivity.

If you find that a workstation does not have the NETX.COM or NETX.EXE file after you install NetWare Connectivity (because this file was not on the disk used for installation), simply copy the file to the workstation. Copy it to

the LANMAN.DOS\NETPROG directory on workstations that have LAN Manager Enhanced, and to the LANMAN.DOS\BASIC directory on workstations that have LAN Manager Basic.

If you are using NETX.EXE rather than NETX.COM, you must rename this file to NETX.COM prior to installing NetWare Connectivity, and then rename it back to NETX.EXE after installing NetWare Connectivity.

For more information about MS-DOS 6.0 features that relate to NetWare connectivity, see the section "Using NetWare Connectivity with MS-DOS 5.0 and 6.0."

Installing With Microsoft Windows

The Microsoft Windows operating system uses a program called SHARE.EXE, which is specified in the AUTOEXEC.BAT file. While SHARE.EXE is loaded, the NetWare Connectivity installation program cannot install some drivers.

To stop using SHARE.EXE

1. Edit AUTOEXEC.BAT, adding rem to the beginning of the line that contains the SHARE.EXE file.
2. Reboot the computer.
3. Install NetWare Connectivity.

Once NetWare Connectivity is installed, you may remove rem from the line for SHARE.EXE in the AUTOEXEC.BAT file. If you are using Demand Protocol Architecture (DPA), also move the line for SHARE.EXE so that it comes before any LAN Manager entries.

The NetWare Connectivity installation program will edit the Windows configuration (if installed) to support dual network connectivity for LAN Manager and NetWare with the Windows operating system.

Installing With Over-the-Net Microsoft Windows

Some special steps must be taken when installing NetWare Connectivity on computers on which Microsoft Windows has been installed for over-the-net use (where the Microsoft Windows files reside on a server). Apply the following steps to each workstation that runs the Windows operating system over-the-net and runs NetWare Connectivity.

To install NetWare Connectivity with over-the-net Microsoft Windows

1 Before installing NetWare Connectivity on the workstation, copy the file DUALNET.DRV from the NetWare Connectivity install disk to the shared WINDOWS directory on the server.

You only have to do this once, regardless of how many workstations you install.

2 At the workstation, make sure the drive letter you are running the Windows operating system from off the net is between D and P.

NetWare uses drive letters Q through Z, so if you are running the Windows operating system off a higher drive letter (W for example), it will not work properly after NetWare connectivity is installed. If you are running the Windows operating system off a drive between Q and Z, you will need to re-install the Windows operating system using a drive letter between D and P.

3 Run **nwsetup** as usual — but when it asks if you want to install Windows operating system support, choose Cancel.

4 Go into the Windows desktop and run the Windows Setup program.

- From the Options menu, choose Change System Settings.
- In the Network box on the Change System Settings dialog box, change the network from Windows NT Advanced Server or LAN Manager to the appropriate NetWare driver.
- Select the OK button.
- From the Options menu, select Exit.
- Exit the Windows operating system.

If you go back into the Windows operating system before completing the following steps, you may get several error messages as the Windows operating system will not be able to load the NetWare program.

5 In the local WINDOWS directory, modify the WIN.INI file by adding the **nwpopup** parameter to the load= line. The line will probably look like this:

```
load=winpopup nwpopup
```

6 In the local WINDOWS directory, modify the SYSTEM.INI file by changing the network.drv= line to:

```
network.drv=dualnet.drv
```

7 Add VDUALNET.386 and VLANMAN.386 to the network= line. Your network= line may look like this:

```
network=*vnetbios,  vipx.386,  vNetWare.386,  vdualnet.386,
vlanman.386
```

Installing With an International Version of Microsoft Windows

In certain instances, NetWare Connectivity needs to start the Microsoft Windows setup file. In doing so, it assumes that the filename is SETUP.EXE. In some international releases of Microsoft Windows, however, the filename is different, as shown in the table below. If you are using one of these versions, copy or rename the file to SETUP.EXE before installing NetWare Connectivity. You can rename the file back to what it was, or delete the copy, after NetWare Connectivity is installed.

Language	Name of Microsoft Windows Setup File	Language	Name of Microsoft Windows Setup File
Danish	INSTALL.EXE	Portuguese	CONFIG.EXE
Finnish	ASETA.EXE	Spanish	INSTALAR.EXE
French	INSTALL.EXE	Swedish	INSTALL.EXE
Norwegian	INSTALL.EXE	Turkish	KUR.EXE

Installing NetWare Connectivity on a Token-Ring Network

If your network is token-ring and you want to implement source routing (which is recommended), you must edit the PROTOCOL.INI file before or after you install NetWare Connectivity on any workstation.

On the NetWare Connectivity disk, the NW directory contains a PROTOCOL.INI file with sections for the NDIS-compliant IPX protocol. The PROTOCOL.INI file is configured for Ethernet networks.

To enable source routing

1 Edit the PROTOCOL.INI file in the NETWARE directory to change the second line from

```
load = ipxmark [u],ipx[u]
```

to

```
load = ipxmark [u],ipx[u],rout[u]
```

If you set up a server for over-the-network installation, be sure the PROTOCOL.INI file in the NW subdirectory of the source directory has this change to enable source routing.

2 Copy the ROUTE.COM file to the disk you will use for installation, in the directory containing the NWSETUP.EXE program.

You can obtain the ROUTE.COM file from Novell.

Installing Directly From the Distribution Disk

Installing NetWare Connectivity is a two-step process:

1 Use the NetWare Connectivity Setup program to copy the NetWare Connectivity files to the workstation and generate a copy of the IPX protocol that is NDIS-compliant.

If the workstation has Microsoft Windows version 3.0 or later, the NetWare Connectivity Setup program starts the Windows Setup program, which copies the files necessary for Windows operating system support of both LAN Manager and NetWare to the workstation.

2 Use the LAN Manager Setup program to bind the NDIS-compliant IPX protocol to a network adapter driver.

These steps are explained in detail in the following sections.

Copying NetWare Connectivity Files to the Workstation

To install NetWare Connectivity, you start the NetWare Connectivity Setup program and copy files from the NetWare Connectivity distribution disk to the workstation's hard disk.

To copy the NetWare Connectivity files to the workstation

1 Be sure that LAN Manager is already installed on the workstation.

2 Start the NetWare Connectivity Setup program in one of these two ways:

- Insert the NetWare Connectivity distribution disk in drive A, then type the following from the command line:

  ```
  a:nwsetup
  ```

- Start the LAN Manager Setup program, and then choose Install from the Connectivity menu.

You will be prompted to insert the NetWare Connectivity distribution disk and specify the disk drive containing the disk.

The NetWare Connectivity Installation dialog box appears.

3 To install NetWare Connectivity, choose the OK button.

NetWare Connectivity files are copied from the NetWare Connectivity distribution disk to the workstation's hard disk.

After the files are copied, a dialog box appears, prompting you to insert the Novell NetWare SHGEN-1 or WSGEN disk.

4 Remove the NetWare Connectivity disk from drive A, insert the SHGEN-1 or WSGEN disk in drive A, and choose the OK button.

The necessary NetWare files are copied to the workstation's hard disk, and the NDIS-compliant IPX.COM file is generated using object files from both the Novell NetWare and LAN Manager NetWare Connectivity disks.

Depending on the version of NetWare, the SHGEN-1 disk may not contain all the needed files. In this case, you will be prompted to remove that disk, insert the SHGEN-2 disk, and again choose the OK button.

Installing Microsoft Windows Support

After copying the NetWare Connectivity files to the workstation, the next step is to install network support for Microsoft Windows (if the workstation has Windows version 3.0 or later).

If the workstation does not have Microsoft Windows, skip to "Binding IPX to a Network Adapter," later in this chapter. If the workstation has a version of Microsoft Windows earlier than 3.0, a message box appears notifying you that Windows operating system support cannot be installed. If you see this message, choose the OK button, and skip to "Binding IPX to a Network Adapter," later in this chapter.

If the workstation has Microsoft Windows version 3.0 or later, the NetWare Connectivity Setup program copies Microsoft Windows support files to the workstation's hard disk and checks the workstation's hard disk for the Microsoft Windows network drivers.

- If the Setup program finds the Microsoft Windows drivers for both NetWare and LAN Manager, an Installation Complete dialog box appears.

Choose the OK button. The NetWare Connectivity Setup program stops, but you still must use the LAN Manager Setup program to bind the IPX protocol to a network adapter driver. For instructions, see the following section of this manual, "Binding IPX to a Network Adapter."

- If the Setup program does not find the Microsoft Windows drivers for both LAN Manager and NetWare, you must install the needed drivers. A NetWare Windows Driver Installation dialog box appears.

To install the Microsoft Windows network drivers

1 In the NetWare Windows Driver Installation dialog box, choose the OK button.

The Windows Setup program starts, and the Windows Setup main screen appears.

2 Press the UP ARROW key until the Network line is selected, and then press ENTER.

The second Windows Setup screen appears.

3 Select either Novell NetWare, LAN Manager Enhanced, or LAN Manager Basic (depending on which network drivers are needed). You may have to press the DOWN ARROW key a few times before the correct network appears in the list box. When you have selected the correct network, press ENTER.

You return to the Windows Setup main screen. The network you selected now appears in the Network line.

4 With the Accept the configuration shown above line selected, press ENTER.

You return to the NetWare Connectivity Setup program.

If Microsoft Windows drivers for both networks are needed, the Windows Support Installation dialog box appears again, and you must repeat steps 1 through 4 for the second network.

When all the drivers for both networks are installed, the Installation Complete dialog box appears.

5 Choose the OK button.

The NetWare Connectivity Setup program ends. You now must bind the IPX protocol to a network adapter driver. For instructions, see the following section.

Binding IPX to a Network Adapter

To bind the NDIS-compliant IPX protocol to a network adapter, you use the LAN Manager Setup program—not the NetWare Connectivity Setup program.

To bind IPX to a network adapter

1. If the LAN Manager Setup program is not already running, start it by changing directories to the LAN Manager directory (usually the C:\LANMAN.DOS directory) and typing:

   ```
   setup
   ```

2. From the Configuration menu, choose Network Drivers.

   The Workstation Configuration dialog box appears.

   The Workstation Configuration dialog box appears, listing the workstation's network adapters and protocols:

3. Select the network adapter to which you want to bind the IPX protocol, and then choose the Modify Config button or the Add/Remove Protocols button.

   The Network Protocols for network adapter card dialog box appears, listing each protocol installed on the workstation. The protocols bound to the network adapter you selected are indicated by marked check boxes.

4. Select the IPX/SPX NDIS Driver check box.

5. Choose the OK button.

   The Workstation Configuration dialog box appears again, now showing IPX as one of the protocols bound to the network adapter selected.

6. Choose the OK button.

   The Configuration Complete dialog box appears.

7. Choose the Save button.

   The configuration is saved. You are now finished installing NetWare Connectivity.

8. From the LAN Manager menu, choose Exit Setup to exit the LAN Manager Setup program.

Installing Over the Network

To install NetWare Connectivity over the network, you must first prepare a server to be a source server for the installation. To do this, you first set up a shared directory that contains the NetWare Connectivity files. Then you install NetWare Connectivity on each workstation by connecting to the shared directory and starting the NetWare Connectivity Setup program.

Preparing the Server

To prepare the server, you copy files from the NetWare Connectivity disks to a directory on the server and then share the directory.

To make installing NetWare Connectivity over the network even faster, you can copy an NDIS-compliant version of IPX.COM to the source server. This way, IPX.COM will not have to be generated from object files each time you install NetWare Connectivity on a workstation.

If you will be installing NetWare Connectivity on workstations that have Microsoft Windows version 3.0 or later, you can also copy the Microsoft Windows drivers for NetWare to the shared directory. This way, you will not have to use the Windows Setup program when installing NetWare Connectivity on any workstations—the Windows drivers for NetWare will be copied from the shared directory.

NOTE: If your network is token-ring, be sure the PROTOCOL.INI file on the source server has been altered for source routing. Also, copy the ROUTE.COM file to the server's source directory (the directory containing the NWSETUP.EXE program). For more information, see "Installing NetWare Connectivity on a Token-Ring Network," earlier in this chapter.

To prepare the source server

1. At the server, log on to the network with a user account that has administrative privilege on that server.
2. Create the directory that will serve as the source directory. For example, to create a C:\NWCONN directory on an OS/2 server, type:

   ```
   mkdir c:\nwconn
   ```

3. Share the directory, using the **net share** command.

   Be sure that permissions for the source directory are set so that everyone who needs access will have it.

4 Copy the contents of the NetWare Connectivity distribution disk to the server directory. The method you use depends on the operating system of the server:

- For a Windows NT computer or a LAN Manager OS/2 server, insert the NetWare Connectivity distribution disk in drive A of the server, and type:

  ```
  xcopy a:\ source /s
  ```

  where *source* is the source directory you created. For example, the following command copies the files to the C:\NWCONN directory:

  ```
  xcopy a:\ c:\nwconn /s
  ```

- For a server that cannot read MS-DOS formatted disks directly, such as a LAN Manager for UNIX Systems server, insert the NetWare Connectivity distribution disk in drive A of an MS-DOS or OS/2 workstation on the network.

  From the workstation, connect to the source directory you set up on the server and assign it a local drive letter. For example, if the source directory is on the SERVER1 server and has the sharename NWCONN, type:

  ```
  net use x: \\server1\nwconn
  ```

  Next, type:

  ```
  xcopy a:\ x: /s
  ```

5 If you have already installed NetWare Connectivity on a workstation directly from the distribution disk, copy the NDIS-compliant version of IPX.COM (generated during the previous installation of that workstation) to the source directory you are preparing (the directory containing the NWSETUP.EXE program). On the previously installed workstation, IPX.COM is in the LANMAN.DOS\NETPROG directory (if the workstation runs LAN Manager Enhanced), or in the LANMAN.DOS\BASIC directory (if the workstation runs LAN Manager Basic).

   Each subsequent workstation will copy the NDIS-compliant IPX.COM instead of generating it.

   You can also copy all versions of the NETx.COM, NETX.COM and NETX.EXE files that your network uses to the source directory you are preparing. This way, you will not have to use the NetWare distribution disks at all during installation. If you have a token-ring network that uses source routing, you should also copy ROUTE.COM to this directory.

6 If you will be installing NetWare Connectivity on workstations that have Microsoft Windows version 3.0 or later, copy the Microsoft Windows drivers for NetWare to the source directory. This way, when you install over the network you will not have to use the Windows Setup program.

Copy the NETWARE.DRV, VNETWARE.386, and VIPX.386 files from the Microsoft Windows distribution disks or from the WINDOWS directory of a workstation that has Windows operating system support for NetWare or NetWare Connectivity already installed. Copy these files to the source directory itself (the directory containing the NWSETUP.EXE program), not to the NW subdirectory of this directory.

The directory is now ready for use.

Installing Each Workstation

After you have prepared the source directory on a server, you can install NetWare Connectivity over the network.

To install NetWare Connectivity over the network

1. From the workstation, connect to the source directory you set up on the server and assign it a local drive letter.

   For example, if the source directory is on the SERVER1 server and has the sharename NWCONN, type:

   ```
   net use x: \\server1\nwconn
   ```

2. Start the NetWare Connectivity Setup program by typing:

   ```
   x:nwsetup
   ```

   The NetWare Connectivity Setup program starts.

3. Follow the instructions in "Copying NetWare Connectivity Files to the Workstation" (starting with step 3), "Installing Microsoft Windows Support," and "Binding IPX to a Network Adapter," earlier in this chapter.

   If you copied the NDIS-compliant IPX.COM or the Microsoft Windows drivers for NetWare to the source directory, you can skip the sections of installation that have to do with generating IPX.COM and using the Windows Setup program.

Installing With an Altered Distribution Disk

To simplify floppy-disk installation of NetWare Connectivity, you can copy extra files to the floppy disk you use to install NetWare Connectivity. Using this altered disk to install NetWare Connectivity, you can skip some steps of the installation process.

After you have installed NetWare Connectivity on one workstation using the original NetWare Connectivity distribution disk, you can copy the IPX.COM file generated during that installation to the floppy disk you use for installation. Copy the IPX.COM file to the directory containing the NWSETUP.EXE program. This way, when you use that disk to install NetWare Connectivity on other workstations, the Setup program will copy to the workstation the IPX.COM you already generated, instead of generating another copy of it. You will find the NDIS-compliant IPX.COM file in the LANMAN.DOS\NETPROG directory (if the workstation runs LAN Manager Enhanced), or in the LANMAN.DOS\REDIR directory (if the workstation runs LAN Manager Basic).

You can also copy all versions of the NETx.COM, NETX.COM, and NETX.EXE files that your network uses to the source directory you are preparing. This way, you will not have to use the NetWare distribution disks at all during installation. If you have a token-ring network that uses source routing, you should also copy ROUTE.COM to the NW subdirectory.

If the workstations you install NetWare Connectivity on have Microsoft Windows version 3.0 or later, you can copy the Microsoft Windows drivers for NetWare to your installation floppy disk. This way, you will not have to use the Windows Setup program when you install NetWare Connectivity. Copy the necessary Windows operating system files from your Microsoft Windows distribution diskettes or from the WINDOWS directory of a workstation that already has Windows operating system support for NetWare or NetWare Connectivity installed. Copy these files to the root directory of the disk (the directory containing the NWSETUP.EXE file):

- NETWARE.DRV
- VNETWARE.386
- VIPX.386

Deciding How the User Will Start the Workstation

You need to choose between the two ways a user can start NetWare Connectivity:

- The user can use the **nwload** command to start NetWare Connectivity, and then use **nwunload** to unload it when finished using it.

  Choose this method if you want the user to be able to unload NetWare when not using it, so that NetWare occupies memory only while being used. If you choose this method, tell the user to load and unload NetWare with nwload and nwunload. Make sure the user knows that the Windows operating system must not be running when they issue the **nwload** or **nwunload** command. If you want, you can add nwload to the AUTOEXEC.BAT file to have NetWare start when the computer starts.

  If the **net start workstation** command appears in AUTOEXEC.BAT, add the **nwload** command after it. If a command in AUTOEXEC.BAT starts the Windows operating system, add the **nwload** command before it.

  If you need to add **nwload** to AUTOEXEC.BAT, but it is not the last command in the file, use **call nwload** instead. The **call** command ensures that the rest of AUTOEXEC.BAT will run after **nwload** runs. For more information, see your MS-DOS manual(s).

- The user can start IPX.COM and NETx.COM, NETX.COM, or NETX.EXE directly, as on a NetWare-only workstation.

  Choose this method if the workstation has enough memory to run both LAN Manager and NetWare all the time, and the user will want both running all the time. This method also lets experienced NetWare users start NetWare using the commands they are accustomed to.

  You can put the **ipx** and **netx** commands into the workstation's AUTOEXEC.BAT file. If the **net start workstation** command appears in AUTOEXEC.BAT, add the **ipx** and **netx** commands after it. If a command in AUTOEXEC.BAT starts the Windows operating system, add the **ipx** and **netx** commands before it.

Note that NetWare cannot be started with either method while the Windows operating system is running. To start NetWare, the user must first exit the Windows operating system.

The information about NetWare Connectivity in the LAN Manager user documentation for MS-DOS assumes that **nwload** and **nwunload** will be used. If this is not the case, explain to the users how to start and stop NetWare Connectivity.

The following sections give more information about each way of starting NetWare Connectivity.

Using NWLOAD to Run NetWare Connectivity

The **nwload** command starts the NWLOAD.BAT file, which starts the NDIS-compliant version of IPX.COM, and the NetWare shell (the **netx** program), and logs the user into a NetWare server using NetWare's **login** utility.

If the user wants NetWare Connectivity to start when the workstation starts, you can add **nwload** to the end of the workstation's AUTOEXEC.BAT file. If the **net start workstation** command appears in AUTOEXEC.BAT, make sure that the **nwload** command appears after it. If a command in AUTOEXEC.BAT starts the Windows operating system, add the **nwload** command before it.

If you need to add nwload to AUTOEXEC.BAT, but it is not the last command in the file, use **call nwload** instead. The **call** command ensures that the rest of AUTOEXEC.BAT will run after **nwload** runs. For more information, see your MS-DOS manual(s).

If necessary, a workstation user could also start NetWare on the workstation without LAN Manager running by typing either **nwload** or the combination of the **ipx** and **netx** commands.

Using NETX.COM and NETX.EXE

NETX.COM and NETX.EXE are versions of the NetWare shell that run on any version of MS-DOS. A NetWare workstation can run NETX.COM or NETX.EXE instead of NET3.COM, NET4.COM, or NET5.COM. NetWare Connectivity supports the use of NETX.COM and NETX.EXE.

If you want to use NETX.COM or NETX.EXE on a workstation and have the user use the **nwload** and **nwunload** commands to start and stop NetWare Connectivity, you need to modify the NWLOAD.BAT and NWUNLOAD.BAT batch files.

To use NETX.COM or NETX.EXE

1 Edit the NWLOAD.BAT file to remove rem from these two lines, near the top of the file:

```
rem netx
rem goto LOGIN
```

2 Edit the NWUNLOAD.BAT file to remove rem from these two lines:

```
rem netx /u
rem goto IPXREL
```

After you make these changes, the **nwload** and **nwunload** commands will use NETX.COM or NETX.EXE.

Configuring and Personalizing NWLOAD.BAT

The default NWLOAD.BAT file serves the needs of most users. However, you can configure and personalize it. First, save the default NWLOAD.BAT file to have as a backup if something goes wrong with your changes.

Adding commands to NWLOAD.BAT ensures that they will be run when the user starts NetWare Connectivity, and ensures that the user will not have to remember to type the commands each time.

You can add commands to start applications that require NetWare. Because NetWare Connectivity runs Novell's own NetWare workstation software, all NetWare-specific applications can run on the workstation.

NOTE: NetWare NetBIOS applications will run on workstations running LAN Manager and NetWare Connectivity. They cannot interoperate with the same applications running on NetWare-only workstations and servers, however, because the LAN Manager NetBIOS (used with NetWare Connectivity) and the NetWare NetBIOS (used on NetWare-only workstations) cannot communicate with each other.

For more information about batch programs, see your MS-DOS manual(s).

Using IPX and NETX Commands to Run NetWare Connectivity

If the user will not need to unload NetWare Connectivity, you can have the user start NetWare Connectivity in the same way as a NetWare-only workstation, using the **ipx** and **netx** commands. Or you can put these commands in the AUTOEXEC.BAT file so that they will be run

automatically when the workstation starts. Add them toward the end of AUTOEXEC.BAT but before commands that start the Windows operating system.

You can also load the IPXNDIS.DOS device driver in the CONFIG.SYS file, then type **ipx** to run the IPX protocol. This method of running IPX is not demand loaded and occupies more memory.

You and the user should know an important difference between starting NetWare on a NetWare Connectivity workstation and on a NetWare-only workstation. The default network drive the NetWare Connectivity user uses to log in to a NetWare server will probably be different from that used on a NetWare-only workstation. With a NetWare-only workstation, the login drive is usually the F drive. With NetWare Connectivity, the drive will be the drive letter following the drive letter set as the **lastdrive** in the CONFIG.SYS file. The default (set when you install NetWare Connectivity) for **lastdrive** is **p;** in this case, the login drive must be the Q drive.

If you change **lastdrive**, use the appropriate login drive instead of the Q drive. For more information about **lastdrive**, see "Setting the LASTDRIVE Option," later in this chapter.

If you put the **login** command in the AUTOEXEC.BAT file, be sure to specify the correct drive letter. If the user will type the **login** command, be sure he or she knows which drive letter to use.

Using the Fixpath Utility

NetWare Connectivity includes a **fixpath** utility to ensure that a workstation's search path remains correct when both LAN Manager and NetWare are loaded. A problem occurs with the search path when NetWare is started on the workstation and the NetWare login script creates search-drive connections to NetWare servers, using commands such as the following:

```
map s9:=server/sys
```

This command not only creates the connection, but it also alters the user's MS-DOS search path. Elements already in the search path, such as the LANMAN.DOS\NETPROG directory, may be deleted from the path.

The fixpath utility runs after the user logs on to a NetWare server and has the login script run. The fixpath utility automatically restores the path that was present before NetWare was started.

If you use the nwload utility to start NetWare, fixpath will run automatically. However, if your LAN Manager directory is not C:\LANMAN.DOS, you must first edit the NWLOAD.BAT file (located in the NETPROG subdirectory of your LAN Manager directory). Near the bottom of NWLOAD.BAT is the following line:

```
c:\lanman.dos\netprog\fixpath.exe
```

Edit this line so that it shows the actual location of your LAN Manager directory. For example, if your LAN Manager directory is D:\NETWORK, edit this line so that it reads:

```
d:\network\netprog\fixpath.exe
```

If you don't use nwload, you can still run fixpath yourself after starting ipx and netx. To run fixpath yourself, type its full path. For example, if your LAN Manager directory is C:\LANMAN, type the following to run fixpath:

```
c:\lanman\netprog\fixpath
```

Setting the LASTDRIVE Option

On a workstation running both LAN Manager and NetWare Connectivity, the two systems share the drive letters available to be assigned to network directories. The letters up to and including the letter specified as **lastdrive** in the CONFIG.SYS file can be used for LAN Manager directories; the letters following the **lastdrive** letter can be used for NetWare directories.

NOTE: If the workstation runs the Microsoft Windows operating system, there is an exception to the drive letter restriction. While using the Windows File Manager to make network connections, the user can assign any drive letter (whether it is before or after **lastdrive**) to NetWare directories, but will be restricted to drive letters up to and including **lastdrive** for LAN Manager directories.

When NetWare Connectivity is installed, it sets the **lastdrive** entry in CONFIG.SYS to p. This provides about the same number of drive letters for LAN Manager as for NetWare.

If a workstation user will need to connect to more than ten LAN Manager or NetWare directories simultaneously, you might want to change **lastdrive**. If the user will connect to many LAN Manager directories, set **lastdrive** to a letter closer to Z. If the user will connect to many NetWare directories, choose a letter closer to A.

If you change **lastdrive**, and if the user uses the **nwload** command to start NetWare Connectivity, you must also edit the NWLOAD.BAT file. This is because the NetWare **login** command in NWLOAD.BAT must use the drive letter immediately following the drive letter set as **lastdrive**.

The line you must edit looks like this:

```
q:login %1
```

Change it so that it uses the drive letter immediately following the letter set as **lastdrive**. For example, if you change **lastdrive** to **u**, edit the NWLOAD.BAT line like this:

```
v:login %1
```

Also, if you change **lastdrive** on a workstation that does not run the Windows operating system, be sure to tell the user.

Minimizing the Amount of Memory Used

To minimize the amount of memory used by LAN Manager and NetWare Connectivity on computers that have more than 640K of memory, you can use memory managers to make the most efficient use of memory. Simply put, memory managers are programs that manage how other programs use memory. Memory managers can make available parts of memory that are not otherwise available.

For more information about using memory managers with LAN Manager, see the *Installation Guide for Clients*.

Areas of Memory

Before you read about ways of minimizing the amount of memory NetWare Connectivity uses, it is important to understand that memory on computers with MS-DOS is divided into the following areas:

- Conventional memory, the memory between 0K and 640K. This is the memory that programs typically use. If you use no memory managers, this is the only area of memory you can use.
- UMBs (upper memory blocks or upper memory), the area between 640K and 1024K. This area typically holds video buffers and other memory blocks. MS-DOS versions 5.0 and 6.0 include memory management commands that load programs into UMBs. With MS-DOS 3.x and 4.x, you can use UMBs only by using third-party memory managers such as Qualitas™ 386MAX™ and Quarterdeck Qemm™.
- Extended memory, the memory above 1024K, which is divided into two sections:
    - High memory area (HMA), the 64K block between 1024K and 1088K. Only one program at a time can use the HMA.
    - Extended memory blocks, the rest of extended memory. Some programs can use extended memory blocks directly, or you can use a memory manager that causes the extended memory blocks to emulate expanded memory.
- Expanded memory (also called EMS), which can exist physically or can be a section of extended memory emulating expanded memory through the use of a memory manager. If EMS is physically present, it is usually in the form of an extra card installed on the computer.

Minimizing Memory Use With MS-DOS 3.x and 4.x

On 80286-based or higher workstations, you can load the NetWare shell into the HMA. On 80386-based or higher workstations with expanded memory, you can load the NetWare shell into expanded memory (or a section of extended memory that is emulating expanded memory), as well as into the HMA.

By default, the LAN Manager **load** utility will load IPX.COM into UMBs if they are available. Otherwise, IPX.COM will be loaded into conventional memory.

The following instructions explain how to load the NetWare shell into the HMA and into expanded memory. Then you will find recommendations of ways to configure your workstation to use memory efficiently.

To load the NetWare shell into the HMA

1. Use the HIMEM.DOS memory manager included with LAN Manager (or the HIMEM.SYS included with Microsoft Windows—they are the same program). Load HIMEM.DOS using a device entry in the CONFIG.SYS file, as in the following example:

   ```
   device=c:\lanman.dos\drivers\dosutils\himem.dos
   ```

   This line must appear in CONFIG.SYS before all LAN Manager and NetWare network device drivers.

2. Use XMSNETx.COM instead of the standard NETx.COM, NETX.COM, or NETX.EXE. This is a special version of the NetWare shell that can be loaded into the HMA. You can get XMSNETx.COM from Novell, either on your NetWare distribution disks or by other means. Copy it to the LANMAN.DOS\NETPROG directory.

   If the user starts NetWare Connectivity using NWLOAD.BAT or AUTOEXEC.BAT, edit that file so that it specifies XMSNETx.COM instead of NETx.COM, NETX.COM, or NETX.EXE.

To load the NetWare shell into expanded memory

1. Load both the HIMEM.DOS and EMM386.DOS memory managers in CONFIG.SYS, using the following entries:

   ```
   device=c:\lanman.dos\drivers\dosutils\himem.dos
   ```

   ```
   device=c:\lanman.dos\drivers\dosutils\emm386.dos
   ```

(Instead of EMM386.DOS, which is included with LAN Manager, you could use EMM386.SYS, which is included with Microsoft Windows. They are the same program.)

These entries must appear in CONFIG.SYS before all LAN Manager and NetWare network device drivers.

2 Use EMSNETx.COM instead of the standard NETx.COM, NETX.COM, or NETX.EXE. This is a special version of the NetWare shell that can be loaded into expanded memory. You can get EMSNETx.COM from Novell, either on your NetWare distribution disks or by other means. Copy it from your Novell disk to the LANMAN.DOS\NETPROG directory (or anywhere else on your MS-DOS search path).

If the user starts NetWare Connectivity using NWLOAD.BAT or AUTOEXEC.BAT, edit that file so that it specifies EMSNETx.COM instead of NETx.COM, NETX.COM, or NETX.EXE.

Recommendations for MS-DOS 3.x and 4.x

The following example configuration file entries show ways of configuring LAN Manager Enhanced and NetWare to use memory efficiently on workstations running MS-DOS 3.x and 4.x.

The following entries are for 80386-based (or higher) computers using the HMA but no expanded memory, and for 80286-based computers using the HMA. This configuration loads the LAN Manager redirector into the HMA. (Only the CONFIG.SYS and LANMAN.INI entries that pertain to memory management are shown.)

- In the CONFIG.SYS file:

```
device=c:\lanman.dos\drivers\dosutils\himem.dos
```

- In the LANMAN.INI file:

```
[workstation]
  himem = yes
  lim = no
```

The following entries are for 80386-based computers using expanded memory and the HMA. This configuration loads the LAN Manager Enhanced redirector into the HMA, and the NetWare shell into expanded memory. (Only the entries that pertain to memory management are shown.)

- In the CONFIG.SYS file:

```
device=c:\lanman.dos\drivers\dosutils\himem.dos
device=c:\lanman.dos\drivers\dosutils\emm386.dos
```

- In the LANMAN.INI file:

```
[workstation]
  himem = yes
  lim = no
```

- In the NWLOAD.BAT (or AUTOEXEC.BAT) file:

```
emsnetx.com
```

The Netpopup service is automatically loaded into expanded memory whenever it is available.

Using NetWare Connectivity With MS-DOS 5.0 and 6.0

MS-DOS 5.0 and 6.0 provide commands that load programs into upper memory (UMBs). With MS-DOS 5.0 and 6.0, you can load drivers into UMBs by using the **devicehigh** command instead of the **device** command in the CONFIG.SYS file. You can also load programs into UMBs by using the **loadhigh** command from batch files or from the command line.

With MS-DOS 5.0 and 6.0, MS-DOS itself can also be loaded high into the HMA by putting the following line into CONFIG.SYS:

```
dos=high,umb
```

MS-DOS 5.0 and 6.0 also include the latest versions of the HIMEM and EMM386 memory managers.

With MS-DOS 5.0 and 6.0, both IPX.COM and the NetWare shell (NETX.COM or NETX.EXE) can be loaded into the UMBs. The NetWare shell can be loaded into the HMA or into expanded memory, just as it can in MS-DOS 3.x and 4.x.

Recommendations for MS-DOS 5.0 and 6.0

The following configuration file entries show ways to configure LAN Manager Enhanced and NetWare on workstations with MS-DOS 5.0 or 6.0. Remember that the amount of memory available in UMBs depends on the type of computer you have. Finding the best configuration may require some experimentation.

The following entries are for 80386-based (or higher) computers with extended memory but no expanded memory, and for 80286-based computers with extended memory. This configuration loads MS-DOS into UMBs and the HMA. (Only the CONFIG.SYS and LANMAN.INI entries that pertain to memory management are shown.)

- In the CONFIG.SYS file:

```
device=c:dos\himem.sys
dos=high,umb
```

- In the LANMAN.INI file:

```
himem = no
lim = no
```

The following entries are for 80386-based computers with expanded memory and UMBs. This configuration loads MS-DOS into UMBs and the HMA; NetBEUI, IPX, and the network adapter driver into UMBs; and the LAN Manager Enhanced redirector and Netpopup service, and the NetWare shell into expanded memory. (Only the entries that pertain to memory management are shown.)

- In the CONFIG.SYS file:

```
device=c:\dos\himem.sys
device=c:\dos\emm386.exe ram
dos=high,umb
device=c:\lanman.dos\drivers\protman\protman.dos
devicehigh=c:\lanman.dos\drivers\ethernet\ne3200\ne3200.dos
```

- In the LANMAN.INI file:

```
himem = no
lim = yes
```

- In the NWLOAD.BAT or AUTOEXEC.BAT file:

```
load ipx.com
emsnet5.com
```

NOTE: The LANMAN.DOS\DRIVERS\ETHERNET\NE3200\NE3200.DOS path and filename are used as an example. When setting up this configuration, replace this driver with the workstation's actual network adapter driver.

In this configuration, you can also load the NetWare shell into UMBs instead of into expanded memory. To do so, replace **emsnet5.com** (in NWLOAD.BAT or AUTOEXEC.BAT) with **loadhigh netx.com** or **loadhigh netx.exe**.

Other Ways to Save Memory

If you have followed the recommendations in this chapter, and you need even more memory, you can change some aspects of MS-DOS and LAN Manager. With each of these recommendations, there will be some loss of functionality or performance, but memory will be freed.

To free memory

- Do not run the LAN Manager Messenger or Netpopup services.
- Adjust LANMAN.INI buffers to use smaller and fewer buffers. The entries you can decrease include **numbigbuf**, **sizbigbuf**, **numworkbuf**, and **sizworkbuf**.
- Use LAN Manager Basic instead of LAN Manager Enhanced. This will save a considerable amount of memory, at a cost of some LAN Manager functionality.

Adjust CONFIG.SYS entries so that MS-DOS uses less memory. Decrease the **buffers** and **files** entries, or remove device drivers you may not use, such as SETVER.EXE and ANSI.SYS. (If you use a disk caching program such as Smartdrive you can usually set **buffers** to 5 or less.)

3

Troubleshooting

This chapter contains instructions for solving problems and errors that might occur on a workstation running NetWare Connectivity.

Only problems and errors specific to NetWare Connectivity are listed here. For other types of errors, see the following sources:

- For MS-DOS errors, see your MS-DOS manual(s).
- For LAN Manager workstation errors, see your *User's Guide for MS-DOS Clients*
- For Windows NT Advanced Server errors, see your Windows NT Advanced Server manual(s).
- For Windows NT errors, see your Windows NT manual(s).
- For LAN Manager server errors, see your LAN Manager manual(s).
- For NetWare errors, see your NetWare manual(s).

Solving Common Problems

This section lists common problems that may occur without producing an error number. For information on numbered errors, see “Error Messages,” later in this chapter.

Problems Starting NetWare Connectivity

“Invalid drive specification” appears when I try to start NetWare Connectivity.

- Be sure the **lastdrive** entry in the CONFIG.SYS file is not set to **z**. The **lastdrive** entry should be set to a letter near the middle of the alphabet, such as p.

  If you change the **lastdrive** entry, reboot the workstation so the change can take effect.

- If **lastdrive** is not **z**, and if you are using the **nwload** command to start NetWare Connectivity, edit NWLOAD.BAT. Halfway down NWLOAD.BAT you’ll find a line that logs the user in to the NetWare server; for example:

  ```
  q:login %1
  ```

  where q is the drive letter used for the login. This drive letter must be the letter following the drive letter specified as the **lastdrive** entry in the CONFIG.SYS file.

  For example, if **lastdrive** is **p**, use **q** in the **login** line of NWLOAD.BAT; if **lastdrive** is **f**, use **g** in the **login** line, and so forth.

“Bad command or file name” appears when I run NWLOAD.BAT or NETX.COM, NETxCOM, or NETX.EXE.

- Check your LANMAN.DOS\NETPROG directory (if your workstation is running LAN Manager Enhanced) or your LANMAN.DOS\BASIC directory (if your workstation is running LAN Manager Basic) to be sure that it contains either the NETX.COM or NETX.EXE files or one of the NET3.COM, NET4.COM, or NET5.COM files, whichever is appropriate for your version of MS-DOS. If you don’t find this file, copy it from your NetWare distribution disks.

- If you use the **nwload** command to start NetWare and the workstation uses the NETX.COM or NETX.EXE files instead of the NET3.COM, NET4.COM, or

NET5.COM files, be sure you have modified NWLOAD.BAT to use NETX.COM or NETX.EXE. This modification involves removing rem from the following two lines, making these lines commands instead of comments:

```
rem netx
rem goto LOGIN
```

If this is the problem, you should also check the NWUNLOAD.BAT file. You must remove rem from the following two lines in NWUNLOAD.BAT:

```
rem netx /u
rem goto IPXREL
```

When I try to start NetWare, a message appears saying that ROUTE or ROUTE.COM cannot be loaded.

- The file ROUTE.COM, required for NetWare source routing on token-ring networks, did not get installed on the workstation. Copy this file to the LANMAN.DOS\NETPROG directory if the workstation is running LAN Manager Enhanced, or the LANMAN.DOS\BASIC directory if the workstation is running LAN Manager Basic. You can get this file from Novell.
- If your network is not token-ring, then the PROTOCOL.INI file is incorrectly trying to load ROUTE.COM. To correct this, modify the PROTOCOL.INI file so that it does not load ROUTE.COM. You should also modify the PROTOCOL.INI file in the LANMAN.DOS\DRIVERS\PROTOCOL\IPX directory in the same way so that the problem does not recur when you change configurations.

  If this problem happens on many workstations and your network is not token-ring, check the disk you use for installation. It may have the PROTOCOL.INI file meant for token-ring networks. For more information, see Chapter 2, “Installing and Configuring NetWare Connectivity.”

“A File Server could not be found” appears when I try to start NetWare Connectivity.

- Check the computer’s physical connection to the network. Check that the network cable is correctly attached to the workstation.
- Check that a NetWare file server is running.

Problems Using NetWare Connectivity

While in the Microsoft Windows File Manager, "Can't connect to net drive" appears when I try to connect to a Windows NT or LAN Manager directory.

- You are trying to connect a drive letter that comes after the drive specified as the **lastdrive** to a Windows NT or LAN Manager directory. With NetWare Connectivity, you can assign only drive letters up to and including **lastdrive** to Windows NT or LAN Manager directories. Use a drive letter that occurs earlier in the alphabet.

  The **lastdrive** is set in the CONFIG.SYS file.

The workstation has a local drive letter assigned to a Windows NT or LAN Manager directory, but when I use that drive letter it refers to a NetWare directory instead.

- The drive letter has been assigned to a Windows NT or LAN Manager directory and a NetWare directory simultaneously. End one of those connections, and then reconnect using a drive letter that is not being used.

  To prevent problems, do not assign the same drive letter both to a Windows NT or LAN Manager directory and to a NetWare directory. When connecting to Windows NT or LAN Manager directories, use only drive letters up to and including the letter specified in the **lastdrive** entry in the CONFIG.SYS file (the default is **p**). For connecting to NetWare directories, use letters that come after the **lastdrive** letter.

The workstation is connected to a Windows NT or LAN Manager directory, but I can't find any files or subdirectories in that directory.

- Check the local drive letter assigned to that directory to see if it is also assigned to a NetWare directory. To check, type:

  ```
  map
  ```

  If the drive letter has been assigned twice, end the connection to one of the directories, and then reconnect to that directory using a different drive letter.

  To prevent problems, do not assign the same drive letter both to a Windows NT or LAN Manager directory and a NetWare directory. When connecting to Windows NT or LAN Manager directories, use only drive letters up to and

including the letter specified in the **lastdrive** entry in the CONFIG.SYS file (the default is **p**) for LAN Manager directories, When connecting to NetWare directories, use letters that come after the **lastdrive** letter.

- This problem can also occur if the server in question is running user-level security and the user does not have R permission to the directory. (This problem is not related to NetWare Connectivity.)

  For more information about user-level security and directory permissions, see the LAN Manager administrative documentation.

Cannot Find LAN Manager DLL Error Message

If you see the following message when starting the Microsoft Windows operating system, your workstation has a search path problem:

```
Cannot find LAN Manager DLL:
NETAPI.DLL (Enhanced) or MSNET.DRV (Basic).
Check the PATH to ensure that it is correct.
```

The problem is that NetWare changed your search path when you logged on to a NetWare server, and your LANMAN\NETPROG directory was deleted from the search path.

To correct the problem do one of the following:

- If you use **nwload** to start NetWare, check NWLOAD.BAT to ensure that the command to start the **fixpath** utility is near the bottom of the file and that the command to start this utility specifies the correct location of FIXPATH.EXE.
- If you don't use **nwload** to start NetWare, you can run **fixpath** yourself after you start NetWare. To run **fixpath**, type its full path. For example, you might type:

  `c:\lanman\netprog\fixpath`

  For more information about using **fixpath**, see "Using the Fixpath Utility," earlier in this document.

After installing NetWare Connectivity on a workstation with the Microsoft Windows operating system, the workstation may hang or crash when you start an MS-DOS box from within the Windows operating system.

(This problem also occurs on NetWare-only workstations.) You can solve the problem in one of two ways.

- Edit the [netware] section of the SYSTEM.INI file in your WINDOWS directory. In this file, set **nwsharehandles** to **true**. The NetWare Connectivity Setup

program sets **nwsharehandles** to **true** by default, so unless you change your SYSTEM.INI file you should never have the problem of MS-DOS boxes that hang or crash.

- If you want **nwsharehandles** to be **false**, you can solve the hanging problem by creating a .PIF file for your MS-DOS boxes, so that the MS-DOS boxes start in background mode.

To create a .PIF file for your MS-DOS boxes

1. Start the Windows operating system.
2. In the Accessories program group, choose PIF Editor.
3. Complete the PIF Editor dialog box:
   - In the Program Filename box, type the path to the COMMAND.COM file, such as:

     `c:\command.com`

     – Or –

     `c:\dos\command.com`
   - In the Window Title box, type:

     `ms-dos prompt`
   - uIn the Start-up Directory box, type:

     `c:\windows`
   - Near the bottom of the dialog box, select the Background box.
4. From the File menu of the PIF Editor dialog box, choose Save.
5. In the Filename box in the Save As dialog box, type **`msdosbox.pif`** and then choose the OK button.
6. From the File menu, choose Exit to close the PIF Editor dialog box.
7. Go to the program group from which you currently launch MS-DOS boxes, and select the MS-DOS box program item.
8. From the Program Manager File menu, choose Properties.
9. Complete the Program Item Properties dialog box:
   - In the Description box, type:

     `ms-dos prompt`

- In the Command Line box, type:

  `c:\windows\msdosbox.pif`

10 Choose the OK button.

The MS-DOS box program item will now launch MS-DOS boxes in background mode.

The Net Stop Workstation command does not work.

You cannot stop the Workstation service while NetWare is loaded with the **nwload** command.

When you stop the Workstation service using the **net stop workstation** command, LAN Manager performs the following actions, in this order:

1 Logs you off from the network.

2 Unloads each currently loaded protocol. The protocols are unloaded in the reverse order of their loading (the last one loaded is the first one unloaded).

3 Stops the Workstation service.

If the unloading of any protocol in step 2 is not successful, the process stops at that point. In this case, any remaining protocols are left loaded, and the Workstation service does not stop.

With NetWare Connectivity, one of the protocols is IPX. IPX cannot be unloaded if the NetWare shell (NETx.COM) is running, so if you type **`net stop workstation`** with the NetWare shell running, the command will fail.

For example, if you use the following series of commands, the **net stop workstation** command fails because it cannot unload IPX (because the NetWare shell is running):

```
net start workstation
load netbeui
nwload
net stop workstation
```

The following series of commands will work, however:

```
net start workstation
load netbeui
nwload
nwunload
net stop workstation
```

If you don't want **net stop workstation** to automatically unload IPX and stop NetWare, you can bypass the **load ipx** command (which is in the NWLOAD.BAT file), and load IPX by using the following commands (instead of **load ipx**):

```
ipxmark
ipx
```

Then, when you want to unload IPX, use the following command (instead of **unload ipx**):

```
ipxrel
```

If you use these commands, **net stop workstation** will not try to unload IPX, because IPX was not loaded with the **load ipx** command.

The workstation has a printer devicename assigned to a printer on a NetWare server, but the print jobs I send do not print on that printer.

- Check the printer devicename to see if it is also assigned to a printer on a LAN Manager server. To check, type:

  ```
  net use
  ```

  If you also need to check your connections to NetWare printers, type:

  ```
  capture
  ```

  If you find that the devicename is assigned to both a NetWare printer and a LAN Manager printer, end one of those connections, and then reconnect to that printer using a different devicename.

"DOS Error 15 has occurred. SYS0015: The system cannot find the drive specified." appears when I try to connect to a LAN Manager directory.

- You are trying to assign a drive letter above the letter set as lastdrive to the directory. When connecting to LAN Manager directories, you can assign only drive letters up to and including the lastdrive letter.

Error Messages

Error messages with “IPX” numbers (such as IPX00010) are NetWare Connectivity errors. These messages are listed here, along with tips for solving the problems causing each error.

Messages with “NET” numbers are LAN Manager errors. On workstations running LAN Manager Enhanced, you can use the **net helpmsg** command to get help about “NET” errors. For example, to see more information about error NET2141, you would type:

```
net helpmsg 2141
```

NetWare Connectivity Errors

IPX00010: Cannot load the IPXNDIS.DOS driver or cannot read PROTOCOL.INI.

- Check that the CONFIG.SYS file has a device entry loading the IPXNDIS.DOS driver; for example:

  ```
  device=c:\lanman.dos\drivers\protocol\ipxndis\ipxndis.dos
  ```

  If the **device** entry is missing, add it.

- Check that the IPXNDIS.DOS driver is installed in the directory specified by the **device** entry loading it. If it is not there, copy it from another workstation that runs NetWare Connectivity, and then reboot the computer. If this is not possible, reinstall NetWare Connectivity on the computer.

- Check that the IPX driver is bound to a network adapter driver. To do so, use the LAN Manager Setup program. (For more information, see Chapter 2, “Installing and Configuring NetWare Connectivity.”)

  If you change the workstation’s configuration, reboot the workstation before loading NetWare Connectivity again.

- Be sure the PROTOCOL.INI file is in the LANMAN.DOS directory. If it is not, use the LAN Manager Setup program to again specify the network drivers you are using. This will re-create the PROTOCOL.INI file. Now reboot the workstation.

- Check the CONFIG.SYS file to be sure Protocol Manager (the PROTMAN.DOS file) is loaded. CONFIG.SYS should contain a **device** entry loading

PROTMAN.DOS, similar to this:

```
device=c:\lanman.dos\drivers\protman\protman.dos /i:c:\lan-
man.dos
```

This **device** entry must appear before all device entries that load protocol drivers (such as IPXNDIS.DOS) and network adapter drivers.

IPX00011: Cannot release environment space. Proceeding to unload NetWare Connectivity.

- No action is required. The workstation will have about 256 bytes less environment space available, however. If this loss of environment space is a problem and this continues to occur, contact your technical support personnel.

  The *environment space* is an amount of memory set aside by MS-DOS to store the values of various variables, including the search path. To allocate more environment space on the workstation, add the **/e** option to the **shell** entry in CONFIG.SYS, and then reboot the workstation so the change can take effect. For more information, see your MS-DOS manual(s).

IPX00012: Cannot locate PATH entry. After you unload NetWare Connectivity, your search path may be incorrect.

- If the workstation has a search path specified by a **path** entry in the AUTOEXEC.BAT file (or another batch file), NetWare Connectivity cannot read it. Check the syntax of CONFIG.SYS to be sure the **path** entry is correct.

IPX00014: NetWare Connectivity is already loaded.

- No action is required.

IPX00015: NetWare Connectivity does not support this version of MS-DOS.

- Install a different version of MS-DOS. NetWare Connectivity supports versions 3.1 and later.

IPX00020: You cannot load this program while the Windows operating system is running.

- Close the Microsoft Windows operating system and try again.

  You cannot use **nwload**, **nwunload**, or **ipx** commands while the Windows operating system is running.

IPX00021: NWUNLOAD cannot be completed. NetWare Connectivity may still be using memory.

- If the workstation can still run the programs it needs to, no action is required. Otherwise, reboot the workstation.
- This message also appears if you start NetWare by typing **ipx** and **netx** directly (bypassing **nwload**), and then try to use **nwunload**.
- If this error occurs often when you use **nwload** and **nwunload**, contact your technical support personnel.

IPX00022: Other TSRs loaded after NetWare Connectivity loaded. Unload these before unloading NetWare Connectivity.

- Unload the other terminate-and-stay-resident programs (TSRs), and then try unloading NetWare Connectivity again.

  To prevent this problem, don't load other TSRs after you load NetWare Connectivity.

IPX00023: Cannot unbind IPX from network adapter driver. NetWare Connectivity cannot unload.

- Reboot the workstation and try again. If the problem persists, the network adapter driver may not be compatible with NetWare Connectivity.

IPX00026: Cannot restore the saved PATH entry because there is not enough environment space.

- To restore the search path after you run NetWare Connectivity, increase the amount of environment space on the workstation. To do so, add the **/e** option to the **shell** entry in the CONFIG.SYS file, and then reboot the workstation so the changes can take effect. For more information, see your MS-DOS manual(s).

IPX00027: NetWare Connectivity is not loaded.

- To load NetWare Connectivity, type **nwload** or the combination of **ipx** and **netx**.

IPX00028: Cannot unload IPX because it is not an NDIS version.

- The IPX protocol that is currently running is a monolithic version for Novell NetWare rather than the NDIS-compliant version for NetWare Connectivity. You can't unload it without rebooting the computer.

  To prevent this problem, be sure to use only the NDIS-compliant version of IPX.COM.

IPX0100: Unknown error.

- Contact your technical support personnel.

IPX0101: Cannot open Protocol Manager.

- Check CONFIG.SYS to be sure Protocol Manager (the PROTMAN.DOS file) is loaded. CONFIG.SYS should contain a **device** entry loading PROTMAN.DOS, similar to the following:

  ```
  device=c:\lanman.dos\drivers\protman\protman.dos /i:c:\lanman.dos
  ```

  This entry must appear before all **device** entries that load protocol drivers (such as IPXNDIS.DOS) and network adapter drivers.

  If CONFIG.SYS has such an entry, be sure it specifies the correct path of the PROTMAN.DOS file.

IPX0102: Cannot bind IPX to the network adapter driver.

- Check the CONFIG.SYS and PROTOCOL.INI files.
  - In CONFIG.SYS, check that the correct network adapter driver is being loaded by a **device** entry.
  - In PROTOCOL.INI, check that the correct network adapter driver is specified in the bindings entry in the [IPX] section.
- If the problem persists, use the LAN Manager Setup program to remove and then to reinstall both the IPX protocol and the network adapter driver that IPX is bound to. This procedure recreates PROTOCOL.INI

IPX0103: Cannot load network adapter card driver.

- Check PROTOCOL.INI to be sure the [IPX] section has a **bindings** entry that specifies a network adapter driver. Also check the CONFIG.SYS file to be sure that there is a **device** entry loading that network adapter driver.

IPX0104: The network adapter card driver cannot load because it is incompatible with the computer's network adapter card.

- Use the correct driver for the computer's adapter.

IPX0105: The network adapter card failed.

- Have the network adapter checked and serviced.

IPX0106: The PROTOCOL.INI file is not correct.

- Check the [IPX] section of the PROTOCOL.INI file for errors.
- If you can find no error in PROTOCOL.INI, use the LAN Manager Setup program to remove and then to reinstall both the IPX protocol and the network adapter that IPX is bound to. This procedure automatically re-creates PROTOCOL.INI.

IPX0107: NetWare Connectivity doesn't support this network adapter card driver.

- Check the interrupt settings on your network adapter.
- Be sure you are using a network adapter driver that conforms to NDIS standards.

IPX0108: Cannot initialize IPX shell driver.

- If the workstation has a search path specified by a path entry in the AUTOEXEC.BAT file (or another batch file), NetWare Connectivity cannot read it. Check the syntax of CONFIG.SYS to be sure the path entry is correct.
- Try again. If the problem persists, contact your technical support personnel.

IPX0109: IPX cannot bind to network adapter card driver.

- Check the CONFIG.SYS and PROTOCOL.INI files.
    - In CONFIG.SYS, check that the correct network adapter driver is being loaded by a **device** entry.
    - In PROTOCOL.INI, check that the correct network adapter driver is specified in the **bindings** entry in the [IPX] section.
- If the problem persists, use the LAN Manager Setup program to remove and then to reinstall both the IPX protocol and the network adapter driver that IPX is bound to.

IPX0110: Network adapter card has a bad connection.

- Check the connection, including the adapter's connection and the network cable attached to the adapter. If necessary, replace the network adapter or cable.

IPX0113: Novell's IPX can bind to only one network adapter card driver.

- Use the LAN Manager Setup program to specify that IPX be used with only one network adapter. This single-adapter requirement is a limitation of Novell's IPX.

IPX0115: Protocol Manager isn't loaded correctly in CONFIG.SYS or isn't installed.

- Check the CONFIG.SYS file to be sure Protocol Manager (the PROTMAN.DOS file) is loaded. CONFIG.SYS should contain a device entry loading PROTMAN.DOS, similar to the following:

  ```
  device=c:\lanman.dos\drivers\protman\protman.dos /i:c:\lan-
  man.dos
  ```

  This entry must appear before all **device** entries that load protocol drivers (such as IPXNDIS.DOS) or network adapter drivers.

- If CONFIG.SYS has such an entry, be sure it specifies the correct path of the PROTMAN.DOS file.

IPX0116: Not enough memory.

- Free additional memory by stopping other terminate-and-stay-resident (TSR) programs or other processes, and then try again.

- If you can, free more conventional memory by loading MS-DOS and/or LAN Manager into other areas of memory. For more information, see Chapter 2, "Installing and Configuring NetWare Connectivity."

  If you get this error, you may be able to load NetWare by following the steps in Chapter 2, but you still may run into more memory problems when you start applications. It may be necessary to add more memory to the computer.

IPX0117: You must use the IPXNDIS.DOS device driver or type LOAD IPX.

- To run the IPX protocol, you must use either the **nwload** or **load ipx** command to start it, or load the IPXNDIS.DOS driver in CONFIG.SYS.

  If you normally don't use the **nwload** or **load ipx** commands, but instead type **ipx**, check your CONFIG.SYS file. It should contain a **device** command loading IPXNDIS.DOS.

- If CONFIG.SYS does contain such a **device** line, be sure that the IPXNDIS.DOS file is located in the path specified by the line in CONFIG.SYS.

IPX0119: IPXNDIS.DOS driver isn't loaded correctly in CONFIG.SYS.

- In CONFIG.SYS, check that there is a **device** entry loading IPXNDIS.DOS, such as the following:

  ```
  device=c:\lanman.dos\drivers\protocol\ipxndis\ipxndis.dos
  ```

- Check that the IPXNDIS.DOS driver is installed on the hard disk in the path specified by the **device** entry loading it.

  If the problem persists, use the LAN Manager Setup program to remove and then to reinstall both the IPX protocol and the network adapter driver that IPX is bound to.

A

Differences in Administering NetWare, Windows NT, and LAN Manager

When you have a network running Novell NetWare and Windows NT, Windows NT Advanced Server, or LAN Manager, you need to know how to administer all your systems. To help you become familiar with administering these networks, and to help experienced administrators of one system learn the others, this appendix gives an overview of the basic differences between the systems.

This appendix concentrates on the basic differences that you will encounter in day-to-day management of the network, such as how people are designated as administrators and operators, how network device drivers work, how users connect to network resources, and how network security works. You will find this information useful as you work with users who have LAN Manager-only or NetWare-only workstations, as well as those with workstations running LAN Manager with the NetWare Connectivity feature.

Although the systems also differ in terms of underlying architecture and advanced features, those differences are not covered here.

For more information on any specific topic, see your Windows NT Advanced Server, Windows NT, LAN Manager, and NetWare manual(s).

Administrators and Supervisors

The Windows NT or LAN Manager administrator and the NetWare supervisor are equivalent concepts. These are the people responsible for setting up and managing the network; they are allowed to configure the network and access all network resources.

How people are given this status varies. With NetWare, there is a single user account with the username supervisor. Several people can have supervisor status on a server—they can all use the supervisor account to log in, or the original supervisor can designate these people as supervisors by giving their user accounts security equivalence to the supervisor account. When an account is given security equivalence to another account, the user gains all the access rights of the other account.

With LAN Manager, you give administrator status (called *admin privilege*) to a user by giving the user's account the admin privilege level. Each LAN Manager user account has one of three privilege levels—admin, user, or guest. All users whose accounts have admin privilege are administrators, and have full administrative power on the server.

With Windows NT, you give administrator status to a user by assigning the user to the Administrators group. Each Windows NT user account is assigned one or more of eight or more groups — administrator, user, guest, server operator, account operator, print operator, backup operator, or replicator. All users in the administrators group are administrators, and have full administrative power over the system.

Operators and Managers

NetWare, Windows NT, and LAN Manager all allow for *operators* (also called *managers*), users who have authority to perform a limited number of administrative tasks. Operators have more power on the network than regular users, but less than full administrators or supervisors.

With NetWare, you designate people as operators or managers by using commands in menu utilities; each type of operator is specified by a different command. With LAN Manager, you make someone an operator by giving

him or her *operator privileges* in his or her user account. With Windows NT, you make someone an operator by putting them in one of the operator groups.

The following table shows the types of operators in each system, explains the abilities of each type, and shows similarities to the other system, if any.

Table 1 Differences in Admin NetWare, Windows NT, and LAN Manager

NetWare	Windows NT	LAN Manager	Abilities
File-server console operator	Server operator	Server operator	Can perform some server management tasks, such as stopping services on the server or shutting it down entirely, and can view information about the server and the connections to it.
Print server operator	None	None	Can manage a print server, a workstation that controls printer queues that send print jobs to printers attached to the print server or to other workstations. With Windows NT and LAN Manager, all network printers are attached to regular servers so there are no separate print servers or print server operators.
Queue operator	Print operator	Print operator	Can manage printer queues and print jobs, changing the order of jobs or deleting them. With Windows NT and LAN Manager, print operators can also create and delete printer queues. With NetWare, different queue operators can be assigned for different queues; with Windows NT Advanced Server and LAN Manager, a print operator can manage all printer queues on a server or in a domain. (For information about domains, see “Domains,” later in this appendix.)

Table 1 Differences in Admin NetWare, Windows NT, and LAN Manager

NetWare	Windows NT	LAN Manager	Abilities
File-server console operator	Server operator	Server operator	Can perform some server management tasks, such as stopping services on the server or shutting it down entirely, and can view information about the server and the connections to it.
User account manager	Account operator	Accounts operator	Can manage and modify user accounts. With NetWare, user account managers can manage only the users assigned to them by the supervisor. With LAN Manager, accounts operators can manage all user accounts on the server or in the domain, and can also create new accounts. With Windows NT, account operators can manage all the server's user and group accounts except the user accounts of Administrators or the local groups of Administrators, Server Operators, Account Operators, Print Operators or Backup Operators. They cannot assign user rights.
Workgroup manager (NetWare 386 only)	None	None	Responsible for a workgroup of people. The workgroup manager can create user accounts for these users, modify and delete those accounts, and create and manage printer queues for the group. The workgroup manager can manage only the user accounts he or she creates. Windows NT and LAN Manager have no equivalent, although some of the workgroup manager's tasks are similar to the tasks of account(s) operators and print operators.
None	None	Comm operator	Can manage communication-device queues and requests, changing the order of requests or deleting them. There is no NetWare equivalent. Windows NT and LAN Manager for UNIX Systems do not support communication-device queues or comm operators.

NetWare, Windows NT, and LAN Manager also provide a way for you to give a person limited administrative powers over some network directories. In all three systems, you do this by assigning the person a certain permission (called trustee right in NetWare) for the directory.

With NetWare, you assign the S (Supervisory) permission. With Windows NT, you can assign Change permission, which allows a user to read, add and change files in a directory. With LAN Manager, you assign P (Change Permissions). In each system, this permission lets the user grant permissions to other users for the directory. With NetWare, when you grant S permission to a user for a directory, the user will have the S permission for all subdirectories in the directory tree under that directory as well; with Windows NT, you can limit change permission to a single file or directory; with LAN Manager, you can limit P permission to a single directory.

With Windows NT, user rights control the specific rights of administrators, server operators, backup operators and print operators.

For more information about permissions, see “Controlling Access to Network Directories,” later in this appendix.

Administrative Tools and Commands

NetWare has a variety of menu utilities for network administration, described in the following table:

Menu utility	Functions
syscon	Add and modify user accounts and groups, assign trustee rights (permissions) for resources, set the login scripts, and manage NetWare's resource-use accounting system.
filer	Manage shared directories and files.
fconsole	Monitor the use of the server, including checking who is using the server, checking statistics on server performance, and shutting down the server if necessary.
printdef	Define the properties of printers on the network.
printcon	Define print job configurations, which contain information about the printer and paper types to be used for a certain set of print jobs.
pconsole	Manage the printers and printer queues on a server.

To do almost all these tasks with LAN Manager, you use a single tool: the Net Admin interface, which is started from MS-DOS or OS/2 with the **net admin** command. If you are using Microsoft Windows, you can use NetAdmin, the Windows-based version of the Net Admin interface. The only exceptions are some of the printer settings, which involve other tools:

- On a LAN Manager for OS/2 server, use the OS/2 Printer Installer and Print Manager when you define printers and create printer queues.
- On a LAN Manager for UNIX Systems server, use the UNIX system administrative interface when you define printers.

NOTE: One basic difference between NetWare and LAN Manager is the function of the ESC key in the administrative utilities. In a NetWare menu utility, if you type information into a dialog box and then press ESC, the information is saved. If you do the same thing in LAN Manager, the information is not saved. In a LAN Manager dialog box, you must press ENTER or choose the OK button or the Done button to save information you type.

Windows NT workstations and Advanced Servers cannot be managed from LAN Manager workstations. From a Windows NT Advanced Server or from a Windows NT workstation with the Resource Kit, you use a variety of tools from the Main and Administrative Tools group windows to manage the network:

Program	**Network Administration Function**
Main group:	
File Manager	Manage files and directories, share files on the network and connect to shared directories on other computers.
Control Panel	Configure hardware devices and the network, and customize the fonts, color and desktop.
Print Manager	Connect to, configure and share printers, and control printing of documents.
Clipbook Viewer	Store clippings from data files and share that information over the network.
Administrative Tools group:	
User Manager for Domains	Manage user accounts and groups, and define security policies and trust relationships. Windows NT uses the User Manager; Windows NT Advanced Server uses the User Manager for Domains.
User Profile Editor	Create customized user profiles containing Windows NT configuration information. (Not useful for LAN Manager workstations.)
Server Manager	Administer domains and computers.

Backup	Back up and restore files on a tape drive for NTFS, FAT, or HPFS file systems.
Event Viewer	View and manage event logs for system, security and application events.
Disk Administrator	View and manage hard disk partitions and other disk resources.
Performance Monitor	Measure CPU use and other data on systems performance.

With Windows NT, LAN Manager, and NetWare, most tasks can also be done using a command. The following table lists administrative commands and shows which commands perform equivalent functions in each system. (For a table showing users' equivalent commands, see the MS-DOS client documentation.) You can also see this table of equivalent commands online, using the **net help netware** command.

The table doesn't show the effects of every option of each command. For more information about the options of Windows NT Advanced Server commands, see the Windows NT manuals; for information about LAN Manager commands, see the LAN Manager administrative documentation; for information about NetWare command options, see your NetWare manual(s).

NetWare command	Windows NT command	LAN Manager command	Explanation and example

broadcast	**net send /users**	**net send /users**	Sends a broadcast message to all users currently using the server. The NetWare command is a console command, meaning that it can be performed only by a supervisor working at the server itself; the Windows NT and LAN Manager command can be performed from a remote workstation as well.
			
			`broadcast The server PRODUCT will be shut down in 5 minutes`
			
			`net send /users "The server PROD-UCT will be shut down in 5 minutes"`

NetWare command	Windows NT command	LAN Manager command	Explanation and example

flag	**attrib**	**attrib** (OS/2)
		chmod (UNIX)
			Sets the file attributes (or OS/2 file flags) of a file. Note that attrib and chmod are operating system commands.
			`flag data.txt ro`
			`attrib +r data.txt`
			`chmod a+r data.txt`

grant	None (Use File Manager)	**net access /add** or **net access / grant**	Grants permissions (trustee rights) to users.
			`grant r for sys:public\data1992 to terryn`
			`net access c:\public\data1992 /grant terryn:r`

makeuser	**net user**	**net user**	Creates, modifies, and deletes user accounts. Makeuser is actually a menu utility; NetWare has no command-line command to create user accounts.
			`makeuser`
			`net user /add terryn password`

queue	None (Use Print Manager)	**net print**	Displays the jobs currently in a printer queue. Options of these commands also let you manage the jobs in a queue, deleting them, changing their printing order, or purging the entire queue. The NetWare command can be issued only from the server itself; the LAN Manager command has no such limitation.
			`queue laser1 jobs`
			`net print laser1`

NetWare command	Windows NT command	LAN Manager command	Explanation and example

queue and **printer**	None (Use Print Manager)	**net share**	Creates a printer queue, assigns it to a printer, and makes it available to users. The NetWare command can be issued only from the server itself; the LAN Manager command has no such limitation.
			`queue laser1 create`
			`printer 1 add laser1`
			`net share laser1=lpt1`

revoke	None (Use File Manager)	**net access / revoke**	Revokes a user's permissions (trustee rights) for a specified resource.
			`revoke all for sys:public\data1992 from terryn`
			`net access c:\public\data1992 /revoke terryn`

tlist	None (Use File Manager)	**net access**	Displays the permissions (trustee rights) for a directory.
			`tlist sys:public\data1992`
			`net access c:\public\data1992`

userlist	**net session**	**net session**	Displays a list of users currently using the server.
			`userlist`
			`net session`

None	**at**	**at**	Schedules a Windows NT, LAN Manager, or operating system command to be run at a later time; either once, daily, weekly, or monthly. Use this command to set up a time-consuming process to happen at night when no one is using the server, or to be sure that regular maintenance commands are always done at the right times. `at 23:00 /every:f archive`

NetWare command	Windows NT command	LAN Manager command	Explanation and example
None	None (Use User Manager [for Domains])	**net accounts**	Sets the server's security settings, which control how many characters users' passwords must have and how often users must change their passwords. For more information, see "User Accounts," later in this appendix. `net accounts /minpwlen:8`
None	None	**net run**	Runs a program remotely on the server while you are working at a workstation. You can use this command from a workstation to run large programs on the server, taking advantage of the server's more powerful processor. Using this command also improves performance of applications that use data stored on the server—the data the program uses doesn't need to be moved to the workstation. `net run sort`
None	None (Use File and Print Manager)	**net share**	Makes a server resource available to network users. The resource can be a directory (and its subdirectories and files), a printer queue, or a comm queue. (Windows NT and LAN Manager for UNIX Systems do not support comm queues.) `net share data1992=c:\year1992`
None	**net statistics**	**net statistics**	Displays performance statistics for a server or workstation. With NetWare, you can view statistics only from the fconsole menu utility. With LAN Manager, you can use either the **net statistics** command or the Net Admin interface. `net statistics server`

Network Device Drivers and Protocols

NetWare and LAN Manager workstations use different schemes for network device drivers. With NetWare, all workstations use an IPX.COM file. This is a monolithic driver, meaning that the single file serves as both a protocol (the IPX/SPX protocol) and a network adapter driver. Because IPX.COM is dependent on the network adapter, a different version of IPX.COM must be generated when installing each type of network adapter.

LAN Manager supports a variety of network device drivers. LAN Manager supports monolithic drivers (although none are shipped with LAN Manager), as well as separate protocol drivers and network adapter drivers. LAN Manager and Windows NT support the network driver interface specification (NDIS) standard, which defines standards for communication between protocols and network adapter drivers. Any protocols and network adapter drivers that conform to NDIS can be used together. All protocols and network adapter drivers shipped with LAN Manager conform to NDIS.

The use of NDIS and separate protocols and network adapter drivers lets each computer on the network use the same protocol driver regardless of the type of network adapter used. Generating different versions of the same protocol driver is not necessary.

Connecting to Resources

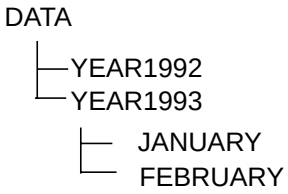
NetWare and LAN Manager also differ in how workstation users connect to network directories and printers, in the format of directories' network paths, and in what network directories are set up automatically when a server is installed.

Connecting to Network Directories

Connecting from a workstation to a network directory is similar for NetWare and LAN Manager workstations. The workstation user assigns a local drive letter to the network directory. With NetWare, the workstation user uses the **map** command; with LAN Manager, the user uses the **net use** command or the Microsoft Windows File Manager. In both types of workstations, the user can connect to network directories using command-line commands and logon script commands.

One difference lies in exactly which of the server's directories the user can assign a drive letter to. With NetWare, the user can assign a drive letter to a directory anywhere in the file server's directory tree (as long as the user has access rights to the directory). With LAN Manager, the user can assign drive letters only to certain directories: the directories that the administrator has shared. The user can still access subdirectories of shared directories but cannot assign a drive letter directly to those subdirectories.

In the following illustration, DATA is the shared directory. Users can connect to DATA and assign a drive letter to it. Users can also access the YEAR1992, YEAR1993, and JANUARY directories, but cannot assign drive letters directly to them. For example, if the user assigns drive F to DATA, the YEAR1992 directory would be referenced as F:\YEAR1992.



A Windows NT or LAN Manager server administrator can share two or more directories in the same directory tree. For example, both the DATA and JANUARY directories in this example could be shared.

Network Paths

A network path is the full name of a network file or directory. NetWare has different formats for network paths than Windows NT and LAN Manager.

NetWare uses this format:

servername\volume:directory\subdirectory\filename

For example:

```
product\sys:public\terryn\file.doc
```

Windows NT and LAN Manager use this format:

\\servername\sharename\subdirectory\filename

For example:

```
\\product\public\terryn\file.doc
```

For a LAN Manager for UNIX Systems server, the servername ends with a .serve extension.

The sharename is a name you assign to a shared directory when you share it. This name distinguishes the shared directory from other shared directories on the server. The sharename can be the same as the name of the directory, or it can be different (but no two shared directories on a single server can have the same sharename). For example, in the previous illustration, when you share the DATA directory, you could give it the sharename DATA or use a different sharename.

Search Drives

With NetWare, a user can have search drive connections in addition to regular connections. Search drives are the network drives NetWare searches when the user requests an application that isn't in the current directory. This allows the user to use applications and utilities in one directory while working in another.

To implement search drive capability in LAN Manager workstations, use the MS-DOS **path** command. This creates a search path (also called a path) for the user, which is a list of directories MS-DOS searches when the user starts an application or batch program.

To put a network directory in a user's search path, assign a local drive letter to that directory, and then add it to the **path** command. For example, to add the \\SALES\PUBLIC\TOOLS directory to a workstation's path, assign the drive letter M: to \\SALES\PUBLIC, and then add M:\TOOLS to the **path** command, as in the following example:

```
path=c:\lanman.dos\netprog;c:\;c:\dos;m:\tools
```

The **path** command usually appears in the workstation's AUTOEXEC.BAT file or in the user's logon script.

You can add the directory to the **path** command before assigning the local drive letter to the directory, if necessary. For example, you could put M:\TOOLS into path in the AUTOEXEC.BAT file, and then connect local drive M: to \\SALES\PUBLIC later, in a logon script.

Initially Installed Directories

When you set up a NetWare server, four directories are created automatically:

- The SYSTEM directory contains commands and utilities that only the supervisor can use.
- The PUBLIC directory contains the commands and utilities that all NetWare users use.
- The LOGIN directory holds the programs used for logging in.
- The MAIL directory contains some information for user accounts, including the logon script files.

When you install LAN Manager for OS/2 on a server and start it for the first time, it automatically shares the following resources:

- The PUBLIC directory is for public storage; it is initially empty.
- The ADMIN$ resource is a special administrative resource for remote administration. All sharenames that end in a dollar sign ($) are hidden; they do

not appear when a user uses the **net view** command to examine server resources.

- The IPC$ resource supports interprocess communication.
- The C$ resource is an administrators-only connection to the root of the C drive. If the server has a D drive, then it shares a D$ resource, and so on.

In addition to those shared by LAN Manager for OS/2, LAN Manager for UNIX Systems creates and shares the following directories:

- The DOSUTILS and OS2UTILS directories contain utilities for MS-DOS and OS/2 workstations, including utilities for manipulating UNIX system filenames not conforming to MS-DOS conventions.
- The PRINTLOG directory accumulates printer fault or error messages generated by the UNIX system.
- The LIB directory contains header files and link-time libraries needed to create LAN Manager applications.
- The USERS directory contains users' home directories. (Shared only when the Netlogon service is running.)
- The NETLOGON directory contains logon scripts. (Shared only when the Netlogon service is running.)
- The REPL$ directory contains directories to be replicated. (Shared only when the Replicator service is running.)

When you install Windows NT and start it for the first time, it automatically shares the following resources:

- The NETLOGON directory contains logon scripts.
- The ADMIN$ resource is a special administrative resource for remote administration. All sharenames that end in a dollar sign ($) are hidden; they do not appear when a user uses the **net view** command or the File Manager to examine server resources.
- The C$ resource is an administrators-only connection to the root of the C drive. If the server has a D drive, then it shares a D$ resource, and so on.
- The IPC$ resource supports interprocess communication.

Another difference between NetWare, Windows NT Advanced Server, and LAN Manager is the location of user commands and utilities. With NetWare, user commands are located in the PUBLIC directory on the server. When a

user logs in, a connection is made to the PUBLIC directory, giving the user access to those commands. With Windows NT and LAN Manager, the user commands and utilities are usually located on the workstation itself.

With LAN Manager for UNIX Systems, the USERS directory, containing the user's home directories is automatically shared. With Windows NT, the directories that contain the user's home directories are not shared.

Connecting to Network Printers

In both systems, a user connects to a printer by assigning a printer port (such as LPT1) to the network printer. With NetWare, the user does this with the **capture** command; with LAN Manager, the user uses the **net use** command from MS-DOS, or the Microsoft Windows Control Panel/Printers program.

Using Logon Scripts

With NetWare, Windows NT, and LAN Manager, a logon script can be run whenever a user logs on. The logon script (called a log-in script in NetWare) is a file that runs automatically whenever a user logs on. The logon script is most often used to set up network connections and the rest of the user's environment.

When a user logs on to a NetWare server, two log-in scripts are run: the system log-in script (a single script run for all users of the server) and an individualized script (different for each user).

With Windows NT and LAN Manager, only one logon script is run when a user logs on. The logon script for a particular user is defined in that user's account. You can create individualized scripts for each user, or you can create one standard script that will be run for all users, if you want consistency or simpler administration. In Windows NT, logon scripts are always run when a user logs on. In LAN Manager, logon scripts are run only if the Netlogon service is running on the network. For more information about the Netlogon service, see "Logging On," later in this appendix.

With Windows NT, any one of a domain's servers may authorize a user's logon attempt, so logon scripts for all user accounts in a domain must exist on every Windows NT Advanced Server in the domain. This is handled automatically by the Replication service.

NetWare logon scripts are sets of commands in NetWare's script language, and are interpreted and executed by the LOGIN.EXE utility when the user logs on. Windows NT and LAN Manager logon scripts, however, are usually MS-DOS or OS/2 batch programs (but they can also be executable files). Batch-file logon scripts can include LAN Manager commands and any operating system commands that are allowed in batch files.

Network Security

NetWare has only one mode of security; LAN Manager has two: user-level security and share-level security. NetWare's security scheme is similar to LAN Manager user-level security mode. Windows NT Advanced Server builds on the security features available with LAN Manager user-level security — its security is a superset of LAN Manager's user-level security.

Each LAN Manager server uses only one of these security modes, but servers that have user-level security can be on the same network and in the same domain with servers that have share-level security.

With LAN Manager user-level security and Windows NT Advanced Server security, users have accounts on all the servers they need to access. When a user tries to access a resource on a server, the server first compares the password the user types with the password in the user's account. If the passwords match, the server checks the permissions for the resource (permissions are similar to NetWare trustee rights). If the permissions specify that the user can access the resource, access is granted.

With LAN Manager share-level security, users don't have accounts. Instead, the administrator gives each resource a different password when sharing the resource. When users want to access a resource, they just need to know the password of that resource.

User-level security is the more powerful security mode, and is used most often on LAN Manager networks. Information in this appendix about LAN Manager security is about user-level security.

When using LAN Manager for UNIX Systems, access to resources is also subject to the UNIX system security restrictions. For details about the interaction of LAN Manager for UNIX systems security with operating system security, see the LAN Manager administrative documentation.

Both Windows NT Advanced Server and LAN Manager have a major administrative feature that NetWare does not. With Windows NT Advanced Server and LAN Manager, servers and workstations are grouped into domains. For an explanation of domains and the differences between

domains in Windows NT Advanced Server and LAN Manager, see "Domains," later in this appendix. Note that Windows NT networks that do not have a Windows NT Advanced Server do not support domains.

User Accounts

Windows NT, LAN Manager, and NetWare all have user accounts, records of each user that contain information about the user and restrictions on how the user can use the network.

With LAN Manager for UNIX Systems, users also have accounts on the UNIX operating system. For details about the interaction of LAN Manager user accounts with operating system user accounts, see the LAN Manager administrative documentation.

For the most part, user accounts on Windows NT workstations, Windows NT Advanced Servers, LAN Manager servers, and NetWare servers contain the same information. The following types of information are kept in user accounts on all three systems:

- Username
- The user's full name
- Password
- Account expiration date
- The user's home directory
- The user's logon script
- Days and times the user can use the server
- Workstations the user can use

With NetWare, user accounts can also contain the following:

- Groups the user is a member of. In LAN Manager and Windows NT, users can be members of groups, but this information is not stored in the user account.
- Maximum amount of server disk space the user can use. Unlike LAN Manager, NetWare enforces this limit, preventing users from using more space than is allowed. In LAN Manager, the administrator can be alerted when a user uses more than the allotted space.
- Accounting information, which keeps track of each user's network resources.

Both Windows NT Advanced Server and LAN Manager use the auditing function to track how resources are used, rather than information from the user account. See "Auditing Resource Use," later in this appendix.

Privilege level and operator privileges can be simulated by using security equivalence.

With Windows NT, user accounts can also contain the following:

- The user's privilege level, which specifies the user as an administrator, server operator, account operator, print operator, backup operator, user, or guest.
- The user's profile, containing a record of the user's desktop environment and settings of those aspects of the environment that the user can change.
- A unique security identifier (SID), which identifies the account. Internal processes in Windows NT refer to the SID, rather than the account, so replacing a deleted account with an account with the same name creates a completely new account.
- The account conditions, which control password aging and account disabling.

Windows NT Advanced Server user accounts can be set up as global accounts or local accounts. Regular user accounts are global accounts. Local accounts, typically used in mixed LAN Manager and Windows NT Advanced Server networks, cannot be used to log on to a Windows NT Advanced Server, and can only be used in one domain.

Windows NT also divides users into local and global groups to provide an easy way for administrators to grant multiple users access to resources. With LAN Manager, user accounts can also contain the following:

- The user's privilege level, which specifies the user as an administrator, regular user or guest.
- Whether the user has any operator privileges.

Windows NT, NetWare, and LAN Manager handle restrictions on users' passwords differently. With NetWare, the minimum password length, password aging, and unique password settings are part of individual user accounts and can be set differently for each user. With Windows NT, some aspects of password control are set in the account condition for each user account, and some are set for entire domains. With LAN Manager, these settings (called security settings) are set once, and these values apply to all users of the server.

With Windows NT, you can group users who have similar jobs or resource needs into both global groups and local groups; groups make granting rights and resource permissions easier, as you just need to take one action of giving a right or permission to a group to give that right or permission to all the present and future users of the group.

Logging On

The concept of logging on is different with NetWare, Windows NT, Windows NT Advanced Server, and LAN Manager.

With NetWare, a user logs on to a single server at a time. When the user logs on, that server checks its user accounts, and allows the user to log on only if the server has an account with that user's name and password.

With Windows NT and LAN Manager, users don't log on individually to each server. Logging on works in one of two ways, depending on how the network is set up:

- For Windows NT Advanced Server, and for LAN Manager networks running the Netlogon service on the network, a user logs on to a *domain*, a number of servers that the administrator has grouped together. Grouping servers together into domains provides several benefits, discussed in the following section, "Domains."

  When a user logs on to a domain, one of the servers in the domain checks the user's name and password. If the user's name and password match a user account on the server, the logon is successful. If the user's name and password don't match an account, the logon is denied. This is similar to NetWare's logon scheme, except that the logon is to an entire domain, and once the logon is approved, the user can access all servers in the domain.

- In LAN Manager, if the Netlogon service is not being used, the user logs on to the entire network. The user's name and password are not checked at logon time, so no logon attempts ever fail. Even though the name and password aren't checked at logon, the network is still secure because the name and password are checked whenever the user tries to access a shared resource.

  With this scheme, a user receives the following message when logging on:

  ```
  You were logged on STANDALONE as username; no server has con-
  firmed your account.
  ```

  This means that the user's name and password were not checked at logon.

NOTE: If a user logs on to a network using the Netlogon service, and if the user types the correct name and password, the "You were logged on STANDALONE" message may still appear. In this case, this message means that none of the servers in the domain that are capable of checking logons are operating.

If you want LAN Manager logons to work like NetWare logons (with names and passwords checked at logon time), use the Netlogon service.

Another difference between networks is how the servers on other parts of the network are accessed. With NetWare, users must log on to each server they want to use. With LAN Manager, once a user is logged in to one domain, the user can access all servers in the network, even those in other domains. With Windows NT Advanced Server, once a user is logged in to one domain, they only have access to domains following their trust relationships. (See the following section on domains for a discussion of trust relationships.)

Domains

In networks with Windows NT Advanced Servers or LAN Manager servers, servers and workstations are grouped into domains. All servers within a domain can be set up to use copies of the same user accounts database, which contains the user accounts and groups (the user accounts database is similar to the NetWare bindery). All changes made to the domain-wide user accounts database affect all servers that use copies of that database.

Centralizing the administration of the user accounts database greatly lessens the time necessary for administration. When a change needs to be made to user or group information—such as adding or deleting a user or a group, or modifying a user's account—you do it only once for the entire domain, instead of once at each server. The server at which you alter the information updates the other servers in the domain.

With Windows NT Advanced Server, simplified administration using domains is always available. With LAN Manager, simplified administration using domains is possible only if the Netlogon service is running on the domain's servers. The Netlogon service enables the servers to use multiple copies of the same user accounts database, and to keep these copies synchronized.

In LAN Manager, a domain can include a *primary domain controller*, which stores the master copy of the domain's user accounts database, and one or more backup domain controllers, member servers, and workstations. Windows NT Advanced Server simplifies the types of computers in a domain. One server is called the *domain controller*, where the master copy of the user account database is stored. The domain controller has a similar functionality to a LAN Manager primary domain controller, and a server is similar to a backup domain controller in LAN Manager. In a Windows NT Advanced Server domain, any Advanced Server can process logon requests (there is no equivalent to LAN Manager member servers).

The concept of a server differs in each network. Under Windows NT, the distinction between servers and workstations is not based on whether computers can share resources; under Windows NT, all computers can share resources. A workstation is a computer that an individual user uses to run applications to do work. A server is a computer that processes requests made by other computers — for example, to access centrally shared information.

Windows NT Advanced Server Domains	**LAN Manager Domains**
Contain a domain controller and servers. (All servers act as backup domain controllers.)	Contain a primary domain controller, backup controller, member servers, and standalone servers.
Must use an account and password to log on to a local Windows NT Advanced Server computer.	Local security is optional and only supported on LAN Manager servers.
Support trust relationships between domains.	No recognition of trust relationships.

Windows NT Advanced Server trust relationships between the domains on your network enable user accounts and global groups to be used in domains other than the domain where these accounts are located. This makes administration easier, because you need to create each user account only once on your entire network, and it can be given access to any computer on your network — not just the computers in one domain. For more information on trust relationships, see the Windows NT Advanced Server manuals.

Controlling Access to Network Directories

The basic concept of how to control users' access to network directories is similar in NetWare and LAN Manager, but many of the details differ. Some of the details are different even between NetWare 286 and NetWare 386.

The following table shows how file access is determined. The rules listed apply only to regular users—not to NetWare supervisors and Windows NT and LAN Manager operators and administrators.

NetWare 286	NetWare 386	Windows NT	LAN Manager
1. Do the user's trustee rights for the directory that contains the file permit the action? If yes, continue to step 2. If no, don't allow access.	1. Do the user's trustee rights for the file permit the action? If yes, skip to step 3. If no, continue to step 2.	1. Do the user's permissions for the file permit the action? If yes, continue to step 2. If no, don't allow access.	1. Do user's group or user permissions permit the action? If yes, continue to step 2. If no, don't allow access.
2. Does the directory's maximum rights mask permit the action? *If yes, continue to step 3. If no, don't allow access*.	2. Do both the user's effective rights for the parent directory and the inherited rights mask of the current file or directory permit the action? *If yes, continue to step 3. If no, don't allow access*.	2. If accessing from the network, do the share permissions allow access? *If yes, allow access. If no, don't allow access.*	2. Do the file flags permit the action? *If yes, permit the action. If no, don't allow access*.
3. Do the file's attributes permit the action? If yes, permit the action. If no, don't allow access.	3. Do the file's attributes permit the action? If yes, permit the action. If no, don't allow access.	3. If accessing locally, do the file and directory permissions permit the action? If yes, allow access. If no, don't allow access.	

NetWare 286

With NetWare 286, the supervisor can assign a user *trustee rights* for a directory. Trustee rights control what actions the user can take with the files in the directory, such as reading the files, writing to them, and deleting them.

The following table shows the trustee rights in NetWare 286:

Trustee Right	Description
S (Search)	Lets the user list the files in the directory with the MS-DOS **dir** command and NetWare commands.
R (Read)	Lets the user read the contents of files.
W (Write)	Lets the user write to files, changing their contents.
O (Open)	Lets the user open existing files in order to read them or write to them.
C (Create)	Lets the user create new files or subdirectories in the directory.
D (Delete)	Lets the user delete files and subdirectories in the directory.
P (Parental)	Lets the user set trustee rights and maximum rights masks for the directory and its subdirectories.
M (Modify)	Lets the user modify the attributes of files in the directory (file attributes are discussed later in this section). M permission also allows the user to rename files and subdirectories in this directory.

NOTE: For a user to be able to read or write to a file, the user must also have O permission in addition to R or W permission. A user must be able to open a file to be able to read it or write to it.

In addition to setting trustee rights for individual users, the supervisor can also set the *maximum rights mask* for each directory. The maximum rights mask controls what all users can do with the files in the directory. The rights the supervisor sets in the maximum rights mask come from those listed here, just as the trustee rights given to each user.

For a user to perform a certain action to a file, that user (or a group to which the user belongs) must have the necessary trustee rights for that directory, and the directory's maximum rights mask must allow the action. The rights that appear in both the user's trustee rights and the maximum rights mask are the user's *effective rights*, and they define what the user can actually do with the directory and its files. For example, suppose *annakn* is given SRWO

trustee rights for a directory, and the directory's maximum rights mask includes only SC. In this case, *annakn* would have effective rights of S for the directory, because this is the only right that appears in both lists.

There is a final level to file security in NetWare 286. Each file is assigned *attributes*, which further control how it can be used. Each file in a directory can have its attributes set differently. There are many different attributes files can have, and several of them affect file access.

NetWare 386

File access works the same in NetWare 386 as it did in NetWare 286, with the exceptions detailed here.

The types of access rights you can assign are different. The complete set of NetWare 386 access rights (including some which are the same as those in NetWare 286) are shown in the following table.

Access Rights	Description
R (Read)	Lets a user open and read a file.
W (Write)	Lets a user open and write to a file.
C (Create)	Lets a user create new files and subdirectories.
E (Erase)	Takes the place of the NetWare 286 D (Delete) right, and lets the user delete files and subdirectories.
F (File Scan)	Lets the user list the files and subdirectories in this directory.
A (Access Control)	Lets the user modify trustee rights and the inherited rights mask for files and subdirectories.
S (Supervisor)	Lets the user have all rights to the directory or file, overriding inherited rights masks on the directory or file. The user can also grant supervisor rights for this directory or file to other users.
M (Modify)	Lets the user change the name and attributes of the directory or file.

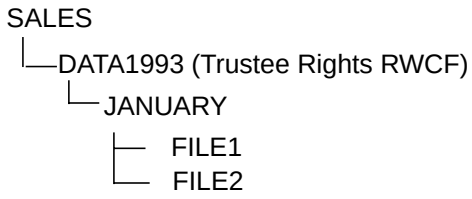
You can assign users different trustee rights for each file in a directory.

You can set rights masks differently for each file in a directory; and these rights masks are called *inherited rights masks* instead of maximum rights masks. They also work a little differently.

The inherited rights mask of a file or directory affects only users who have not been assigned trustee rights for that file or directory. If a user has been assigned trustee rights for a particular file or directory, those trustee rights are the user's effective rights—the inherited rights mask doesn't matter.

However, if a user doesn't have trustee rights for a file or directory, the user's effective rights are the rights that appear in both the user's effective rights for the parent directory and the file or directory's inherited rights mask.

The following illustration shows how this works. Suppose *alexsm* has been assigned trustee rights of RWCF for the DATA1993 directory, but has not been assigned trustee rights for JANUARY. The effective rights of *alexsm* for DATA1993 are RWCF, no matter what the inherited rights mask of DATA1993 is. However, his effective rights for JANUARY are the rights that appear in both the effective rights for DATA1993 (RWCF), and the rights in the inherited rights mask for JANUARY.



LAN Manager

LAN Manager file security works much the same as NetWare security except that there are no rights masks for directories or files. You grant permissions to users, and permissions work the same as NetWare trustee rights. And because there are no rights masks, the permissions you grant to users are the users' effective rights.

With LAN Manager, as with NetWare 386, you can assign permissions differently for each file.

The set of permissions you can grant to LAN Manager users is slightly different than those available in NetWare:

Permissions	Description
R (Read)	Lets the user open and read a file. If the file is a program, the user can also run it.
W (Write)	Lets the user open and write to a file, changing its contents.
C (Create)	Lets the user create files and subdirectories.
D (Delete)	Lets the user delete files and subdirectories.
X (Execute)	Lets the user run a program, but not read it or copy it. Unlike the NetWare file attribute, you can remove this permission from a file after you set it.
A (Change Attributes)	Lets the user change the *file flags*. File flags are similar to NetWare's file attributes.
P (Change Permissions)	Lets the user grant permissions for the file or directory to other users.
Y (Yes)	Serves as a shortcut to RWCDA permissions. When you give a user Y permission, you are granting RWCDA permissions.
N (No or None)	Prevents a user from using the file or directory in any way. Usually, you can prevent a user from accessing a file or directory simply by not giving the user any permissions to it; however, you must use N permission to prevent a specific user from accessing a file or directory while granting access to the file or directory to a group the user belongs to. For example, suppose *terryn* is a member of the group *accountants*. To let all members of *accountants* except *terryn* read a file, you can grant *accountants* R permission to the file but give *terryn* N permission to it.

Y permission is equivalent to RWCDA permissions, and X permission is a subset of R permission; a user with R permission can read, copy and execute a program, but a user with X permission can only execute it. (Because X is a subset of R, when you grant a user R permission, LAN Manager also shows the user as having X permission).

LAN Manager also has file flags, similar to NetWare's file attributes. As in NetWare, file flags take precedence over permissions; if you grant a user W (Write) permission for a file, but the file has the Read-Only flag set, the user cannot write to the file.

If the LAN Manager server's operating system (such as the UNIX operating system) has its own file security then access to resources is also subject to those security restrictions. For details about the interaction of LAN Manager security with operating system security, see the LAN Manager administrative documentation.

Windows NT

Windows NT security is similar to LAN Manager file security, with the following differences.

Windows NT File Security	LAN Manager File Security
Support ownership of files and directories. Owners can grant and deny access.	No ownership concept.
Recognize local and global groups.	No local groups.
User and group permissions are cumulative. Deny access takes precedence over grant access.	Individual user permissions take precedence over groups.
File and directory permissions apply to local and network users.	Permissions only apply to network users.
Administrators may be denied access to files, directories, and other resources which they do not own (they may take ownership, however, which creates an audit trail).	Administrators have access to all resources.

The standard permissions for directories and files and their meanings are shown in the following tables, along with what individual permissions each standard permission represents. In the first column of the first table (for directory permissions), the first set of individual permissions applies to

individual permissions for the directory itself, and the second set of individual permissions applies to new files subsequently created in the directory.

NTFS directory permission (individual permissions)	Meaning
No Access (None) (None)	User cannot access the directory in any way, even if the user is a member of a group that has been granted access to the directory.
List (RX) (Not Specified)	User can only list the files and subdirectories in this directory and change to a subdirectory of this directory. User cannot access new files created in this directory.
Read (RX) (RX)	User can read the contents of files in this directory and run applications in the directory.

NTFS directory permission (individual permissions)	Meaning
Add (WX) (Not Specified)	User can add files to the directory but cannot read the contents of current files or change them.
Add & Read (RWX) (RX)	User can add files to the directory and read current files but cannot change files.
Change (RWXD) (RWXD)	Use can read and add files and change the contents of current files.
Full Control (All) (All)	User can read and change files, add new ones, change permissions for the directory and its files, and take ownership of the directory and its files.

NTFS file permission (individual permissions)	Meaning
No Access	User cannot access the file in any way, even if the user is a member of a group that has been granted access to the file.
Read (RX)	User can read the contents of the file and run it if it is an application.
Change (RWXD)	User can read, modify, and delete the file.
Full Control (All)	User can read, modify, delete, set permissions for, and take ownership of the file.

Auditing Resource Use

The Windows NT and LAN Manager auditing systems are similar to NetWare's accounting system, except that in LAN Manager, you can't automatically charge users for their use of resources.

With Windows NT and LAN Manager, you can audit the way network resources are used. Auditing a resource causes an entry to be written to a log file whenever the resource is used in a particular way. The entry includes information on how the resource was used, by whom, and when.

With Windows NT and LAN Manager, you can specify the types of events you want audited in great detail. Some events pertain to a server or the whole network, while others are specific to each file and directory shared on the server. You can specify auditing differently for each file. For example, for one file you could audit only failed deletion attempts, and for another file audit both successful and failed attempts to change permissions. With Windows NT and LAN Manager, the server and network events you can audit include the following:

- Successful and failed attempts to log on to the network
- Successful and failed attempts to begin using any resources on a particular server
- Successful and failed attempts to use a particular resource
- Changes to the user accounts database

With Windows NT, you can also audit:

- Logoff attempts and breaking network connections
- Use of users rights
- Security policy changes
- Restart, shutdown and audit log maintenance
- Process tracking

With LAN Manager, for each shared file and directory, you can audit failed and successful attempts to do the following:

- Open the file
- Write to the file
- Delete the file
- Change the permissions for the file

With Windows NT, you can audit successful and failed attempts of the following types of directory access:

- Displaying names of files in the directory
- Displaying directory attributes
- Changing directory attributes
- Creating subdirectories and files
- Going to the directory's subdirectories
- Displaying the directory's owner and permissions
- Deleting the directory
- Changing directory permissions
- Changing directory ownership

You can audit successful and failed attempts of the following types of file access:

- Displaying the file's data
- Displaying the file attributes
- Displaying the file's owner and permissions
- Changing the file
- Changing file attributes
- Running the file
- Deleting the file
- Changing the file's owner or permissions

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access permissions See permissions.

account policy With Windows NT computers, controls the way passwords must be used by all user accounts of an individual computer. With Windows NT Advanced Servers, controls the way passwords must be used by all user accounts of a domain.

accounts operator The LAN Manager operator privilege that allows a user (with user privilege) to create, remove, and modify user accounts (except those with admin privilege) and groups. The NetWare equivalent is the user accounts manager. The Windows NT equivalent is the account operator. See also comm operator, operator privilege, print operator, server operator, user account manager.

admin privilege The privilege level that allows a person to issue all types of administrative commands on a server and to use all the resources shared by the server, regardless of access permissions. User accounts with admin privilege are part of the special user group admins. See also administrator, permissions, privilege level.

administrative privilege See admin privilege.

administrator The person responsible for managing the local area network. The administrator typically configures the network, maintains the network's shared resources and security, assigns passwords and privileges, and helps users. The NetWare equivalent is the supervisor. See also admin privilege, operator privilege, supervisor.

attribute Special property assigned to MS-DOS files and directories that controls what actions affect them. There are many types of attributes that can be assigned to file and directories. The OS/2 equivalent is the file flag. In Windows NT, rights and permissions control what actions affect files and directories. See also file flag, permissions, rights.

audit entry A record in the audit trail indicating that a user performed a specific action. The audit entry records the action, the user, and the date and time. See also audit trail, auditing.

audit trail A file that contains audit entries. See also audit entry, auditing.

auditing Tracking activities of users by recording selected types of events in the security log of a server or a workstation. See also audit entry, audit trail.

authentication Validation of a user's logon information. When a user logs on to an account on a Windows NT workstation, the authentication is performed by that workstation. When a user logs on to an account on a Windows NT Advanced Server domain, that authentication may be performed by any server of that domain. See also server, trust relationships.

broadcast message A message sent to all users on the local area network or to all users in a domain.

built-in groups The default groups

provided with Windows NT and Windows NT Advanced Server. Built-in groups have been granted useful collections of rights and built-in abilities.

In most cases, a built-in group will provide all the capabilities needed by a particular user. For example, if a domain user account belongs to the built-in administrators group, logging on with that account gives a user administrative capabilities over the domain and the servers of the domain. To provide a needed set of capabilities to a user account, assign it to the appropriate built-in group. In NetWare and LAN Manager, operator privileges provide a similar way to grant multiple users the same capabilities. See also group, User Manager, User Manager for Domains.

client A computer that accesses shared network resources provided by another computer. See also client-server applications, server.

client-server applications Applications that use the capabilities of both your workstation (the client) and the server to perform a task. The client portion of the application is typically optimized for user interaction, whereas the server portion provides the centralized multi-user functionality.

comm operator The operator privilege that allows a user (with user privilege) to create, share, and modify communication-device queues and requests. Windows NT, Windows NT Advanced Server, and LAN Manager for UNIX Systems do not support comm operators. See also accounts operator, operator privilege, print operator, server operator.

comm queue A queue that stores communication- device requests, and then sends them, one by one, to one or more communication devices such as modems. Windows NT, Windows NT Advanced Server and LAN Manager for UNIX Systems do not support comm queues.

communication device A piece of hardware attached to a serial port of a computer. Examples include modems, serial printers, and image scanners.

CONFIG.SYS A configuration file run when a computer boots that customizes the way the MS-DOS or OS/2 operating system runs. See also LANMAN.INI, PROTOCOL.INI.

configuration registry A Windows NT database repository for information about a computer's configuration.

connection The software link between a workstation and a shared resource on a server. A connection can be made from the workstation by assigning a local devicename to a resource shared on a server. A connection also can be made when the resource is accessed by using a network path from a command-line command or an application.

control menu A menu that contains commands you can use to manipulate a window.

conventional memory The first 640K

of memory on MS-DOS computers. If you use no memory managers, this is the only memory that programs can use. See also expanded memory, extended memory (EMS), extended memory blocks, high memory area (HMA), memory manager, upper memory blocks (UMBs).

demand protocol architecture (DPA) An architecture that allows protocol drivers to be loaded to memory and unloaded when needed. With NetWare Connectivity, demand protocol architecture is used to load and unload the IPX protocol without requiring the workstation to be rebooted.

device driver Software that enables a computer to recognize and use a specific piece of hardware (device). Although a device may be installed on your system, the network cannot recognize the device until you have installed and configured the appropriate driver.

directory replication The copying of a master set of directories from a Window NT Advanced Server (called an export server) to specified servers or workstations (called import computers) in the same or other domains. Replication simplifies the task of maintaining identical sets of directories and files on multiple computers, because only a single master copy of the data must be maintained. Files are replicated when they are added to an exported directory, and every time a change is saved to the file.

disk resource A shared disk device, including a drive, a partition, a directory tree, or a single directory.

domain In LAN Manager and Windows NT Advanced Server networks, a collection of servers and workstations that share a common domain database. Each domain has a unique name. Domains are not available with NetWare or Windows NT. See also domain controller, primary domain controller, trust relationship.

domain controller For a Windows NT Advanced Server domain, the server that maintains the security policy and the master database for a domain and authenticates domain logons. The equivalent in LAN Manager domains is the primary domain controller. See also primary domain controller, trust relationship.

DPA See demand protocol architecture (DPA).

drive mapping With NetWare, a connection between a workstation and a network directory, where one of the workstation's drive letters is assigned to the network directory. With Windows NT and LAN Manager, this is called a connection. See also connection.

driver See device driver.

effective rights With NetWare, the set of rights that actually define what actions a user can take with a file. Effective rights are determined by the trustee rights assigned to the user and the file or directory's maximum rights mask (NetWare 286) or inherited rights mask (NetWare 386). With Windows NT and

LAN Manager, the equivalent are the permissions assigned to the user. Windows NT also has rights, which apply to the system as a whole, rather than to individual files or directories. See also inherited rights mask, maximum rights mask, rights, trustee rights.

EMS See expanded memory (EMS).

environment space Any part of memory used by MS-DOS to store the values of certain variables, including the search path.

expanded memory (EMS) Memory configured for the Lotus/Intel/Microsoft (LIM) 4.0 expanded memory specification (EMS). Physical expanded memory comes in the form of a card installed on the computer. On 80386-based (and higher) computers, extended memory can emulate expanded memory. See also conventional memory, extended memory, extended memory blocks, high memory area (HMA), upper memory blocks (UMBs).

extended memory The area of memory above 1024K. The first 64K of extended memory is the high memory area (HMA); the rest is made of extended memory blocks. See also conventional memory, expanded memory (EMS), extended memory blocks, high memory area (HMA), upper memory blocks (UMBS).

extended memory blocks The area of the extended memory above the HMA (above 1088K). See also conventional memory, expanded memory, extended memory (EMS), high memory area (HMA), and upper memory blocks (UMBs).

FFAT See file allocation table (FAT).

file allocation table (FAT) A table or list maintained by some operating systems to keep track of the status of various segments of disk space used for file storage.

fconsole A NetWare menu utility used by supervisors to monitor the use of a server. With LAN Manager, these functions are done using the Net Admin interface. With Windows NT, these functions are done using the Server Manager, Event Monitor, and Performance Monitor.

file attribute See attribute.

file flag Special property assigned to an OS/2 file that controls what actions affect the file. There are several types of file flags. See also attribute.

file-server console operator A NetWare operator who can perform some server management tasks, such as starting and stopping processes on the server, viewing connection information, and shutting down the server. The Windows NT Advanced Server and LAN Manager equivalent is the server operator. See also operator privilege, server operator.

filer A NetWare menu utility used by users to view information about network directories and files; and used by supervisors to create and manage network directories, and to set access

rights for them. In LAN Manager, these functions are done using the Net Admin interface. In Windows NT, these functions are done using File Manager.

global account For Windows NT Advanced Server, a normal user account in a user's home domain. Most user accounts are global accounts. If there are multiple domains in the network, it is best if each user in the network has only one user account, in only one domain, and each user's access to other domains is accomplished through the establishment of domain trust relationships. See also local account.

global group For Windows NT Advanced Server, a group that can be used in its own domain, servers and workstations of the domain, and trusting domains. In all those places it can be granted rights and permissions and can become a member of local groups. However, it can only contain user accounts from its own domain. Global groups provide a way to create handy sets of users from inside the domain, available for use both in and out of the domain.

Global groups cannot be created or maintained on Window NT workstations. However, for Windows NT workstations that participate in a domain, domain global groups can be granted rights and permissions at those workstations, and can become members of local groups at those workstations. See also group, local group.

group With LAN Manager user-level security, a set of users (with user accounts) who share common permissions for one or more resources. A group is used like a username when assigning permissions for resources. Individually assigned user permissions take precedence over those assigned through groups.

In Windows NT User Manager, an account containing other accounts, which are called members. The permissions and rights granted to a group are also provided to its members, making groups a convenient way to grant common capabilities to collections of user accounts. For Windows NT, groups are managed with User Manager. For Windows NT Advanced Server, groups are managed with User Manager for Domains. See also built-in groups, global group, local group, user account, user-level security.

group memberships The Windows NT groups to which a user account belongs. Permissions and rights granted to a group are also provided to its members. In most cases, the actions a user can perform in Windows NT are determined by the group memberships of the user account the user is logged on to. See also group.

group name A unique name identifying a local group or a global group to Windows NT. A group's name cannot be identical to any other group name or user name of its own domain or workstation. See also global group, local group.

high memory area (HMA) The 64K of

memory between 1024K and 1088K. You can use memory managers to load programs into the HMA. Only one program at a time can use the HMA. See also conventional memory, expanded memory (EMS), extended memory, extended memory blocks, memory manager, upper memory blocks (UMBs).

high-performance file system See HPFS.

home directory A directory on a server assigned to a user to provide the user with private storage space on the server.

HPFS High-performance file system (HPFS); primarily used with the OS/2 operating system version 1.2 or later. It supports long filenames but does not provide security.

HPFS file system See HPFS.

inherited rights mask With NetWare 386, a set of rights, defined for a directory or file, that control what can happen to that directory or file. If a user has no assigned trustee rights for a file or a directory, the user's effective rights are a combination of effective rights in the parent directory and the inherited rights mask of the file or directory. There is no Windows NT Advanced Server or LAN Manager equivalent. See also effective rights, permissions, rights, trustee rights.

IPX.COM The network driver used by computers running NetWare. With NetWare, IPX.COM is a monolithic driver, and a different version is needed for each type of network adapter. With LAN Manager NetWare Connectivity, only one IPX.COM version is needed. This IPX.COM is NDIS-compliant and can be used with any NDIS network adapter driver. See also network driver interface specification (NDIS).

IPXNDIS.DOS A device driver that implements the IPX protocol for computers running NetWare. The demand-loaded version used with the **nwload** command is generally preferable because of memory savings.

LAN Manager Screen
LAN Manager's menu-oriented interface, which includes four versions: the LAN Manager Screen for users (started with the **net** command), the Net Admin interface for OS/2 (started with the **net admin** command), the Net Admin interface for Microsoft Windows (started with the NetAdmin icon), and the console version of the Net Admin interface for OS/2 servers (started with the **net console** command).

LANMAN.INI The LAN Manager initialization file. The values in this file determine the option settings for computers on the local area network, although the **net start** and **net config** command options can temporarily override LANMAN.INI values. These values can be modified to suit the network requirements. See also CONFIG.SYS, PROTOCOL.INI.

local account For Windows NT Advanced Server, a user account provided in a domain for a user whose global account is not in a trusted domain.

Not required where trust relationships exist between domains. See also global account, user account.

local group For Windows NT, a group that can be granted permissions and rights only for its own workstation. However, it can contain user accounts from its own computer, and (if the workstation participates in a domain) user accounts and global groups both from its own domain and from trusted domains. Local groups provide a way to create handy sets of users from both inside and outside the workstation, to be used only at the workstation.

For Windows NT Advanced Server, a group that can be granted permissions and rights only for the servers of its own domain. However, it can contain user accounts and global groups both from its own domain and from trusted domains. Local groups provide a way to create handy sets of users from both inside and outside the domain, to be used only at servers of the domain. See also global group, group.

log-in script With NetWare, a program run automatically when a user logs on that sets up the user's environment. The Windows NT and LAN Manager equivalent is the logon script. See also logon script.

logon script A batch program containing LAN Manager and operating system commands used to configure workstations. When a user logs on, the user's logon script runs at the workstation. The NetWare equivalent is the log-in script. See also log-in script.

logon workstations In Windows NT Advanced Server, the workstations from which a user is allowed to log on.

makeuser A NetWare menu utility used by supervisors to create new users. In LAN Manager, this is done using the Net Admin interface or the **net user** command. On Windows NT workstations, this is done using the User Manager. On Windows NT Advanced Servers, this is done using the User Manager for Domains.

manager With NetWare, a person who can perform some limited administrative tasks. The Windows NT and LAN Manager equivalent are the various types of operators. See also operator, operator privilege.

maximum rights mask In NetWare 286, a set of access rights, defined for a directory, that controls what can happen to that directory and to the files and subdirectories in it. A user can perform an action on a file only if that particular right appears in both the directory's maximum rights mask and in the user's trustee rights for the directory. There is no Windows NT or LAN Manager equivalent. See also effective rights, permissions, rights, trustee rights.

media access control driver See network adapter driver.

memory manager A program that manages how other programs use memory and makes available parts of memory beyond conventional memory. Two memory managers provided with LAN Manager are HIMEM.DOS and

EMM386.DOS. See also conventional memory, expanded memory (EMS), extended memory, extended memory blocks, high memory area (HMA), upper memory blocks (UMBs).

monolithic driver A network device driver that performs both protocol and network adapter driver functions.

NDIS See network driver interface specification (NDIS).

NET.ACC A file containing a LAN Manager server's user accounts database and resource permissions. Only servers with user-level security have a NET.ACC file. The NET.ACC file is stored in the LANMAN\ACCOUNTS directory. See also user accounts database.

Net Admin interface See LAN Manager Screen.

NetBEUI The NetBIOS Extended User Interface network device driver. NetBEUI is the protocol driver supplied with LAN Manager. NetBEUI can bind with as many as eight network adapter drivers. For MS-DOS, the filename for the NetBEUI driver is NETBEUI.DOS. For OS/2 clients and LAN Manager servers, the filename for the NetBEUI driver is NETBEUI.OS2.

NetBIOS The network basic input/output system. A software module that links the operating system with local area network hardware and opens communications between workstations on the network.

Net Logon service For Windows NT Advanced Server, performs authentication of domain logons, and keeps the domain's database synchronized between the domain controller and the other Windows NT Advanced Servers of the domain. The equivalent in LAN Manager is the Netlogon service.

NETx.COM One of three versions of the NetWare workstation shell. The three versions are NET3.COM, which runs on workstations that have MS-DOS 3.x; NET4.COM, which runs on workstations that have MS-DOS 4.x; and NET5.COM, which runs on workstations that have MS-DOS 5.0. Every NetWare workstation must have either the file appropriate to its version of MS-DOS or the NETX.COM or NETX.EXE file, special versions of the shell that run with all versions of MS-DOS.

NETX.COM A special version of the NetWare workstation shell that runs with all versions of MS-DOS. Every NetWare workstation must have either the NETX.COM file, the NETX.EXE file or the NetWare shell appropriate to its version of MS-DOS (NET3.COM, NET4.COM, or NET5.COM).

NETX.EXE A special version of the NetWare workstation shell that runs with all versions of MS-DOS. Every NetWare workstation must have either the NETX.COM file, the NETX.EXE file or the NetWare shell appropriate to its version of MS-DOS (NET3.COM, NET4.COM, or NET5.COM).

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network adapter A printed circuit board, installed in a computer, that enables the computer to run LAN Manager software and join the local area network.

network adapter driver A network device driver that works directly with the network adapter, acting as an intermediary between the adapter and the protocol driver. See also device driver, protocol driver.

network device driver See device driver.

network driver See device driver.

network driver interface specification (NDIS) A Microsoft/3COM specification for the interface for local area network device drivers. All network adapter and protocol drivers shipped with LAN Manager conform to the NDIS. The IPX.COM generated by NetWare Connectivity also conforms to the NDIS.

network path The complete name of a directory or a file on a server, as seen from other network computers. Windows NT and LAN Manager network paths start with the name of the server and the sharename, and then follow the directory path down to the name of the directory or file. For example, \\SALES\PUBLIC\REPORTS\JAN.DAT. NetWare network paths start with the name of the server, then the volume name, and then follow the directory path. For example, SALES/SYS:/PUBLIC/REPORTS/JAN.DAT.

NT See Windows NT.

NT file system See NTFS.

NTFS An advanced file system designed for use specifically within the Windows NT operating system. It supports file system recovery, extremely large storage media, and various features for the POSIX subsystem. It also supports object-oriented applications by treating all files as objects with user-defined and system-defined attributes.

NWLOAD.BAT A batch program used to run NetWare Connectivity. NWLOAD.BAT saves the workstation's MS-DOS configuration, and then starts NetWare Connectivity by starting IPX.COM and NETx.COM. NetWare Support runs until the user stops it by running NWUNLOAD.BAT.

NWUNLOAD.BAT The batch program that stops NetWare Connectivity and unloads it from memory, and then restores the MS-DOS configuration saved when NetWare Connectivity was started.

operator A user who has certain limited administrative abilities. In LAN Manager, these abilities are granted by setting operator privileges in the user's account. In Windows NT, these abilities are set by the user's group, and the rights assigned to that group. See also accounts operator, comm operator, group, manager, operator privilege, print operator, rights, server operator.

operator privilege A privilege granted to a LAN Manager user that allows the

user to perform certain limited administrative tasks. The equivalent in Windows NT is determined by the user's group. See also accounts operator, comm operator, group, operator, print operator, server operator.

path A set of directory names and filenames that defines the location of a directory or file. A backslash (\) precedes each directory name and filename except the top-level one. (For example, the path REPORTS\ACCT\NORTH.DAT indicates that the NORTH.DAT file is in the ACCT subdirectory of the REPORTS directory.) An initial backslash indicates that the path begins at the drive's root directory. See also network path, search path.

pconsole A NetWare menu utility used by supervisors to create printer queues and to manage print jobs within existing printer queues. In LAN Manager, these tasks can be done using the Net Admin interface. In Windows NT, these tasks can be done using Print Manager.

permissions Settings that define the type(s) of action a user can take with a shared resource. With LAN Manager user-level security, each user is assigned permissions for each resource. With LAN Manager share-level security, each resource is assigned permissions, and all users who access the resource have those permissions. See also effective rights, rights, trustee rights.

primary domain controller The LAN Manager server that maintains the master copy of a domain's user accounts database. The primary domain controller also validates logon requests. In Windows NT Advanced Server domains, the equivalent is the domain controller. See also domain controller.

print job A document waiting in a printer queue.

print job configuration With NetWare, information about printer and paper types to be used for certain print jobs. With Windows NT and LAN Manager, you can set this information when you create a printer queue using Print Manager.

print operator With Windows NT and LAN Manager, an operator privilege that allows a user to create, share, and modify printer queues and control print jobs. The NetWare equivalent is the queue operator. See also operator privilege, queue operator.

print server operator A NetWare operator who can manage the printers attached to a special workstation called a print server. There is no Windows NT or LAN Manager equivalent because they have no special print servers; however, Windows NT and LAN Manager print operators can perform the same tasks on LAN Manager printer queues. See also operator privilege, print operator.

printcon A NetWare menu utility used by supervisors to create print job configurations, which contain information about printer and paper types to be used for print jobs. With Windows NT and LAN Manager, an administrator defines this type of

information when creating a printer queue. See also print job configuration.

printdef A NetWare menu utility used by supervisors to define information about network printers. With Windows NT and LAN Manager, an administrator defines this information when creating a printer queue.

printer queue A queue that stores print jobs and then sends them one by one to a printer or pool.

privilege See privilege level.

privilege level With LAN Manager user-level security, one of three settings—user, admin, or guest—assigned for each user account, that defines the range of actions a user can perform on the network. See also admin privilege.

protocol A set of rules and conventions for data exchange. See also protocol driver.

protocol driver A network device driver that implements a protocol, communicating between a network and one or more network adapter drivers. With NetWare Connectivity, IPX.COM is a protocol driver. See also network adapter driver.

Protocol Manager Software (PROTMAN.DOS on computers running MS-DOS) that coordinates communication among network device drivers and network adapters.

PROTOCOL.INI The Protocol Manager initialization file. This file, along with CONFIG.SYS and LANMAN.INI, controls the configuration of LAN Manager network device drivers. PROTOCOL.INI describes all protocol drivers and network adapter drivers and defines how to bind them together. See also CONFIG.SYS, LANMAN.INI.

queue operator With NetWare, an operator who manages printer queues and print jobs. The Windows NT and LAN Manager equivalent is print operator. See also operator privilege, print operator.

remote administration Administration of one computer by an administrator located at another computer and connected to the first computer across the network.

registry See configuration registry.

replication See directory replication.

resource Any part of a computer system or a local area network, such as a disk drive, directory, printer, or memory, that can be allotted to a program or a process while it is running. See also disk resource.

rights With NetWare, settings that affect what actions can be taken with a single file or all files in a directory. NetWare has several different rights, each of which controls one type of action. The Windows NT and LAN Manager equivalents are permissions. With Windows NT, rights

apply to the whole system, rather than a single file or directory. See also effective rights, inherited rights mask, maximum rights mask, permissions, rights, trustee rights.

script See log-in script, logon script.

search drive With NetWare, a network drive the workstation checks when a user requests to run a program. If a user requests to run a program that isn't in the user's current directory, NetWare looks for the program in the user's search drives. With LAN Manager, this can be done with the MS-DOS **path** command. See also search path.

search path A list of directories that are searched when a user requests to run a program not in the current directory. If the program is in any directory on the search path, the program will run.

security The method of controlling access to network resources, ensuring that resources are used only by authorized people. See also share-level security, user-level security.

security equivalence With NetWare, the act of giving one user the same access rights as another. There is no LAN Manager equivalent. With Windows NT, you can put users in the same group, so that they have the same rights as another user in that group.

security ID (SID) A unique name that identifies a logged-on user to the security system. Security IDs (SIDs) can identify one user, or a group of users.

security identifier See security ID.

security policies For a Windows NT workstation, the security policies consist of the Account, User Rights, and Audit policies, and are managed using User Manager.

For a Windows NT Advanced Server domain, the security policies consist of the Account, User Rights, Audit, and Trust Relationships policies, and are managed using User Manager for Domains.

security settings Settings that determine how user account passwords can be changed and what action occurs when users violate their logon hours.

server A computer on a local area network that controls access to resources such as files and printers. In Windows NT Advanced Server domains, refers to a computer that receives a copy of the domain's security policy and domain database, and authenticates network logons. See also client, domain controller.

server operator LAN Manager and Windows NT server operators can start and stop services, share resources, use the server's error log, and close users' sessions. The NetWare equivalent is file-server console operator. See also file-server console operator, operator privilege.

service A process that performs a specific system function and often provides an application programming interface (API) for other processes to

call.

session A link between a workstation and a server. A session consists of one or more connections to shared resources. See also connection.

Setup program The program that installs LAN Manager software on a workstation or a server. During installation, the Setup program is copied to the computer's hard disk for later use in managing the computer's configuration.

share To make resources, such as directories and printers, available to network users.

share-level security A type of LAN Manager security that limits access to each shared resource by requiring a password. Permissions are assigned to the resource rather than to the user. All users who know the password can use the resource within the bounds of the permissions assigned to the resource. See also user-level security.

shared directory A directory that network users can connect to.

shared network directory See shared directory.

shared resource A resource on a server that has been made available to network users. See also resource.

sharename The name given to a resource when it is shared on the local area network. Each shared resource is identified by its sharename. Each resource on a server must have a unique sharename.

sharing The act of making a server's resources available to local area network users. The procedure for sharing a resource depends on the type of resource. See also resource.

SID See security ID.

supervisor The person responsible for setting up, installing, and managing a NetWare network. The supervisor always has access to all resources on the NetWare network. The name supervisor is also the username of the account the supervisor uses to log on. The Windows NT and LAN Manager equivalent is the administrator. See also admin privilege, administrator.

synchronize To replicate the domain database from one Windows NT Advanced Server domain controller to one server of the domain, or to all the servers of a domain. This is usually performed automatically by the system, but can also be invoked manually by an administrator.

syscon A NetWare menu utility used by users to check their status on the server and to find other information, and used by supervisors to create users and groups, set trustee rights on network resources, and create log-in scripts. With LAN Manager, users and administrators use the Net Admin Interface for these tasks. With Windows NT, administrators use the Server Manager, User Manager and File Manager for

these tasks.

terminate-and-stay-resident program (TSR) A program that runs in the background, allowing other programs to be run at the same time.

trust See trust relationship.

trust relationship Links between Windows NT Advanced Server domains that enable pass-through authentication, in which a user has only one user account in one domain yet can access the entire network. User accounts and global groups defined in a trusted domain can be given rights and resource permissions in a trusting domain, even though those accounts don't exist in the trusting domain's database. A trusting domain honors the logon authentications of a trusted domain. See also global group, user account.

trustee rights With NetWare, settings that define the types of actions a user can take with a network file or directory. With NetWare 286, trustee rights can be set only on directories; with NetWare 386, they can also be set for individual files. The Windows NT and LAN Manager equivalent is permissions. See also effective rights, inherited rights mask, maximum rights mask, permissions, rights.

TSR See terminate-and-stay-resident program.

UMBs See upper memory blocks.

upper memory blocks (UMBs) The area of memory between 640K and 1024K. This area typically holds video buffers as well as other buffers, plus work areas that are related to peripheral devices. By using memory managers, you can load other programs into UMBs as well. See also conventional memory, expanded memory (EMS), extended memory, extended memory blocks, high memory area (HMA), memory manager.

user account A record on a server or in a domain that contains information about the user and identifies the user to LAN Manager or Windows NT. This includes such things as the user name and password required for the user to log on, the groups in which the user account has membership, and the rights and permissions the user has for using the system and accessing its resources. For Windows NT, user accounts are managed with User Manager. For Windows NT Advanced Server, use accounts are managed with User Manager for Domains. See also group.

user account manager A NetWare operator who can manage and modify user accounts. The LAN Manager equivalent is the accounts operator, and the Windows NT equivalent is the account operator. See also accounts operator, operator privilege.

user accounts database The LAN Manager NET.ACC file stored in the LANMAN\ACCOUNTS directory. This file contains the user accounts and groups that have been established. See also NET.ACC, group, user account.

user group See group.

Glossary

user-level security A type of security in LAN Manager in which a user account is set up for each user. Permissions are granted to each user for specific resources, defining exactly what actions each user can take with each resource. See also share-level security.

User Manager A Windows NT workstation tool used to manage the security for a workstation. Administers user accounts, groups, security policies.

User Manager for Domains A Windows NT Advanced Server tool used to manage security for a domain or an individual computer. Administers user accounts, groups, security policies.

user right See rights.

Windows NT The portable, secure, 32-bit, preemptive multitasking member of the Microsoft Windows operating system family.

Windows NT Advanced Server A superset of Windows NT, Windows NT Advanced Server provides centralized management and security, advanced fault tolerance and additional connectivity.

Workgroup manager A NetWare operator who can manage some network areas for a workgroup of users. A workgroup manager can create user accounts for those users, modify and delete those accounts, and create and manage printer queues for the group. Windows NT and LAN Manager have no direct equivalent, although some of the tasks that accounts operators and print operators can perform are similar. See also account(s) operator and print operator.

Workstation A computer from which a person uses word processing, spreadsheet, database, and other types of applications to accomplish work, taking advantage of resources shared on the local area network.

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