Network Operations

Terms you'll need to understand:

- √ Network operating system (NOS)
- √ Preemptive multitasking
- √ Cooperative multitasking
- √ Time slicing
- √ Client software
- √ Redirector
- √ Designator
- √ UNC naming
- √ Server software
- √ Windows NT Server
- √ Network services
- √ Network printing

Techniques you'll need to master:

- √ Understanding network operating systems
- √ Installing a network operating system
- √ Exploring and implementing network printing

Network operations have many components, including the types of services and applications provided, the process of installing and configuring these services, and devising and implementing a network management plan. Before you have an operational network, you must first perform a few necessary actions. First, you need to install a NOS. Then, you must enable a network resource or service, such as network printers, network shares, or networked applications. We discuss all of these issues in detail throughout this chapter.

Network Operating Systems

Prior to the invention of the network operating system, the functionality of network communication had to be added to an existing operating system. This addition usually came in the form of some sort of communication software packages or OS add-on used to extend the functionality of standalone operating systems to be shared with other users. For a system to communicate in a networked manner, the original OS and the NOS extensions had to be present on a single computer. Microsoft's LAN Manager is an excellent example of this type of technology. It was an add-on to MS-DOS, Windows 3.x, and OS/2 computers to enable networked communications.

It wasn't long before true NOSs—which were able to manage the activities on both standalone computers and network communications—replaced OS add-ons. Such network operating systems include Novell's NetWare and Microsoft's Windows NT.

It is important to understand that a computer's operating system is what controls the activities of that computer's hardware components. The OS controls things like memory, CPU, storage devices, and peripherals. The operating system governs interaction between a computer's hardware and software. This control is so precise that for applications to run correctly, they must be written within the control parameters of an OS, and are not portable to other OSs. For example, an application, such as Microsoft Excel written for Windows NT 4, will not function on an AS/400 computer.

A NOS's activities are broad, numerous, and complex. Therefore, NOSs require a lot of computing power. To get the most power out of a hardware configuration, many network operating systems, and some non-network operating systems, make use of a process called multitasking, which allows an operating system to run numerous processes—control more than one

task—simultaneously. A true multitasking OS is able to support as many simultaneous processes as there are CPUs. However, when a computer only has one CPU, multitasking can be simulated through a technique called time slicing.

Time slicing involves dividing CPU computing cycles (hundreds to millions of cycles per second) between multiple tasks. You do this by giving each task a certain amount of process cycles, then halting that task to make the next task active. This process repeats until each task is finished. Users perceive this process as multiple applications operating simultaneously, but in fact, humans just can't perceive the small increments of each time slice.

It is important to note that there are two types of multitasking:

Preemptive The operating system controls which processes are allowed access to the CPU and for how long. Once the assigned time slice expires, the current process is halted and the next process is given its computing time.

Cooperative The operating system cannot stop a process; once CPU control is given to a process, it retains control until the process is complete. During this time, no other process is allowed to access the CPU.

A true high-performance NOS employs preemptive multitasking. Otherwise, the NOS couldn't complete many time-dependent tasks and would fail to complete tasks repeatedly.

Client Software

To allow clients to access the network, client network software must be installed on computers that regular users will utilize. This software is referred to as the client because it is the NOS component that accesses resources located on a network server. Three of the most important components of client software are redirectors, designators, and UNC pathnames.

Redirectors

There are actually two types of redirectors in use on any network: the client redirector and the server redirector. Both redirectors operate at the Presentation layer of the OSI model. When a client makes a request for a network application or service, the redirector intercepts that request and examines it to determine if the resource is local (on the requesting computer) or remote (on the network). If the redirector determines that it is a local request, the redirector forwards the request to the CPU for immediate

processing. If the request is for the network, the redirector forwards the request across the network to the appropriate server. Basically, redirectors hide the complexity of accessing network resources from users. After a network resource is defined, users can access that resource without knowing its exact location.

Designators

A designator is a piece of software that manages the assignment of drive letters to both local and remote network resources or shared drives, which aids in network-resource interaction. When an association is made between a network resource and a local drive letter (also known as mapping a drive), the designator keeps track of the assignment of that drive letter to the network resource. Then, when users or applications access the drive, the designator substitutes the resource's network address for the drive letter before the request is sent to the redirector.

UNC Pathnames

Redirectors and mapping network drives are not the only methods used for network-resource access. Most modern NOSs, including Windows NT and Windows 98, also recognize Universal Naming Convention (UNC) names. UNC naming is a standard way to name network resources. These names take the form of \\servername\sharename.

UNC-aware applications and command-line activities use a UNC name in place of drive-letter mapping.

Server Software

For a computer to act as a network server, you must install a specific portion of the network operating system that enables the machine to both host resources and distribute those resources to network clients. Although a client computer only requires a redirector, a server is much more complex. Many software pieces work together to give a computer the ability to share its resources with others.

An important issue for network servers is the ability to restrict access to network resources. This is called network security. It provides the means to control which resources users can access, the extent of that access, and how many users can access that resource simultaneously at any given time. This control provides privacy and protection, and maintains an efficient networking environment.

In addition to providing control of network resources, a server does the following:

- Provides logon authentication for users
- Manages users and groups
- Stores management, control, and auditing tools for network administration
- Provides fault tolerance for protection of network integrity

Combined Client/Server Software

A number of NOSs, including Windows NT, have software components that enable the capabilities of both the client and the server on a computer. This enables computers to host and use network resources, and can be found predominantly on peer-to-peer networks. In general, this type of NOS is not as powerful and robust as a full-fledged NOS. The main benefit of a combined client/server NOS is that important resources located on a single computer can be shared with the rest of the network. A drawback is that, if a single computer hosts multiple resources that are accessed heavily, the computer takes a pretty serious performance hit. If this happens, you should consider transferring such resources to a dedicated server to improve overall performance.

Installing A NOS

Many important aspects of your network must be considered before you contemplate a NOS installation. Keeping the following issues in mind will both give you a better understanding of the final result of an operational network and make your installation run smoothly:

- Hardware compatibility
- Network media type
- Network size
- Network topology
- Server requirements
- Operating systems on clients and servers
- Network file system

- Network naming convention
- Network storage device organization

In the following section, we step through the installation of Windows NT Server to give you a better idea of how this process works.

Installing Windows NT Server

In comparison with other network operating systems, Windows NT Server 4 is relatively easy to install. With the proper preparation, the Windows NT Setup Wizard simplifies the installation process through the use of a graphical interface. Because this book is aimed at general networking topics, we don't provide information on each detailed step involved in the setup process. However, we do include the major installation steps to give you some insight into the architecture and simplicity of Windows NT Server 4.

The initial portion of the installation—bootstrapping—is the most difficult portion due to the many options from which you must choose. These options include the following:

- Complete baseline or use of existing OS Computers that don't already have an existing operating system installed require drive partitioning and a Windows NT-compatible CD-ROM; an existing OS may not require new partitioning and can use a non-Windows NT-supported CD-ROM.
- Floppy-assisted or floppy-less For computers without an existing OS, it's best to begin the setup with the three setup floppies; the floppy-less installation is simpler for systems with direct network access or direct access to a CD-ROM.
- Network or local If the computer has a network-compatible OS already installed, the Windows NT distribution files can be stored on a network-shared CD-ROM or directory; a local installation requires that the distribution files be accessed from a CD-ROM or copied to a local hard drive.

Regardless of the installation type you choose, all of these options require that WINNT.EXE (or WINNT32.EXE for NT OSs) be launched to start the setup process (the floppy-based installation launches this utility as part of the boot process).

The initial portion of the Windows NT Server installation process is text-based. At this time, Windows NT asks you how to configure hard

drives, format file systems, and name the system directory. After that, Windows NT copies the distribution files temporarily into a directory on the destination partition. After that, you reboot the computer and Windows NT enters the GUI portion of the setup.

The graphical portion of the Windows NT setup is controllable through the use of a mouse or keystrokes (Tab, arrows, and Enter). Here, you define computer and domain names, enter the CD key, select the server type (PDC, BDC, or member server), assign a password to the Administrator account, and select environment and desktop components. Setup then copies some files from the temporary folder it created to the destination folder you defined. After that, you move on to the network phase of the Windows NT setup.

During the networking portion of the Windows NT setup, Windows NT's communication components are installed and configured. It is here that you install NIC drivers, select which protocols to install, configure those protocols, and configure network bindings information. After completing this portion, setup then copies numerous files to the final destination folder and deletes the temporary folder.

After these files are moved, you define the time zone and display settings, then reboot. Once the computer is rebooted and the Administrator logs in, the Windows NT Server installation is complete.

Network Services

Network services are the basic resources that are required on all networks and are the foundation of network applications. Networks simply would not exist without them. As we've already mentioned, the main reason to implement a network is to share resources. The two most common network services are printers and directory shares. Although these are the most commonly implemented resources, the range of possible network services is extremely broad. There are many applications and resources that you can add to any NOS to extend its usefulness.

As discussed, all hardware devices require the use of a driver to communicate with an operating system. You can think of a network service as either a driver for software or the network itself. There's usually some kind of administrative tool for the installation and removal of network services included in a NOS. For example, Windows NT Server has the Network applet (located in the Control Panel). By using the Services tab of the Network applet, you can quickly and easily add and remove all of the Microsoft bundled network services and any services that a third-party vendor distributes.

Once a network service is in place, you can control its operation parameters in two ways. First is through a global services administrative tool—such as Windows NT's Services applet—where you can start and stop all the active network services, and modify basic operational parameters. Second, in some cases, the installation of a network service will add a new administrative tool for the exclusive management of the new service, such as RAS for Windows NT.

Network Printing

Network printing is the capability of network clients to access and utilize a printer hosted by a networked print server (assuming that clients have the correct access permissions). It's important to know that the redirector also takes part in network printing by intercepting print requests, interpreting them, and sending them to the proper print server or network-attached printer.

To begin, you must first install a printer on a server or as a direct network-attached device. After you have installed the printer and it is properly functioning, the logical representation of the printer within the NOS can be shared, which is as simple as adding the print resource to the list of available network resources.

In addition to requiring proper access permissions to a printer, most networked client workstations require the installation of local printer drivers, although, in some cases, workstations are able to access the printer drivers from the print server itself. Either way, you must install a new, shared logical printer that points to the printer share. After you have created this logical device, network clients can send print jobs to the printer by directing applications to print to the defined redirected port. The redirector then takes over by taking care of the complicated network communications involved with sending the print job to the remote printer.

Each NOS has a different method for setting up such shared resources, but it is generally straightforward. Just keep in mind that you need to know which clients require local access to print drivers, as opposed to those that can access them directly from the server. Also, you must manage users so that those who need it have proper access permissions to the shared printer.

Implementing Networked Applications

Network applications are specially designed applications that allow multiple, simultaneous users on numerous computers connected over a network to access and use them. In the early days of networking, the older, single-user applications were enhanced to allow for multiple-user access. But it wasn't long before new applications that could only exist as network applications were developed.

Most network applications operate differently. There are three types of architectures within network applications:

- **Centralized** The application operates on a server, and all clients interact with the central application through client-side user-interface terminals.
- **Client/server** Various portions of the application reside on both the server and the client, which allows the activities of multiple users to be processed on the server.
- **File-system sharing** The application resides on each client, and all clients share a database file or a storage directory for centralized storage of application information.

Network applications not only provide improved communication, but they are also easier to manage than standalone applications, especially on large networks. For example, rather than having to update software on each workstation, you can update some software on a server, and that information is automatically disseminated to workstation computers across the network. Network applications also save money: Standalone applications require that you purchase a complete version per user, whereas networked applications are able to host multiple users with the purchase of multiple-user licenses. However, there are drawbacks to networked applications as well. If performance over the network is poor or bandwidth is limited, the performance of that application is degraded accordingly. Also, networked applications are often unusable if the network is inoperable. These limitations, however, do not weigh as heavily when compared to the headaches associated with managing multiple, standalone applications.

Practice Questions

Question 1

Multitasking is:

- ❍ a. The installation of more than one protocol.
- ❍ b. The method of computing in which multiple processes operate simultaneously by sharing the CPU.
- ❍ c. The act of binding two or more services to a single protocol.
- ❍ d. The activity of accessing a directory shared over a network link.

Answer b is the correct choice. Multitasking is the process of allowing multiple processes to operate simultaneously. Most NOSs allow for the installation of multiple protocols. Therefore, answer a is incorrect. Answer c is incorrect; binding services has nothing to do with multitasking. Finally, answer d is incorrect because accessing shared resources is a common task for any NOS.

Question 2

When a NOS/OS maintains control of the CPU by assigning specific time slices to processes, it is called cooperative multitasking.

- ❍ a. True
- ❍ b. False

The answer is b, false. In cooperative multitasking, once CPU control is given to a process, it retains control until the process is complete. During this time, no other process is allowed to access the CPU.

Question 3

What is the function of a redirector?

- ❍ a. Maintains a group appointment list
- ❍ b. Maps directory shares to local drive letters
- ❍ c. Associates protocols, NICs, and services in order of priority
- ❍ d. Forwards requests to local or remote resource hosts

Answer d is the correct choice. A redirector intercepts network requests, analyzes them, and forwards them to the correct hosts. Answer a is incorrect; a networked scheduling application would manage group appointments. Answer b is incorrect; you can map drives through most server-based tools. Answer c is incorrect because associating priorities is a services-management process.

Question 4

Which of the following has the proper format for a UNC name?

- ❍ a. (sharename)->servername
- ❍ b. \\servername\sharename
- ❍ c. sharename://servername/path
- ❍ d. servername, sharename

Answer b is the only correct answer. The proper syntax of UNC naming is \\servername\sharename.

Question 5

What are printer shares and directory shares considered to be?

- ❍ a. Groupware
- ❍ b. Network applications
- ❍ c. Network services
- ❍ d. Network protocols

Answer c is the correct choice. Printer shares and directory shares are network services. Printer and directory shares are not groupware. Therefore, answer a is incorrect. Likewise, they are not network applications. Therefore, answer b is incorrect. Answer d is incorrect because these are not network protocols.

Question 6

Which of the following issues must you address before setting up a NOS? [Check all correct answers]

- ❑ a. Responsibilities of the server
- ❑ b. Naming conventions
- ❑ c. Client applications
- ❑ d. Organization of storage devices

All of these answers are correct; you must consider all of these factors before installing a NOS. The "trick" to this question is that you must understand and select each correct answer. If not all correct answers are selected, you get the whole thing wrong!

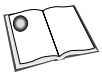
Question 7

The Universal Naming Convention (UNC) provides a way for networked computers to identify each other's resources. Which of the following is included in a UNC name?

- ❍ a. Domain name
- ❍ b. Share name
- ❍ c. User name
- ❍ d. Workgroup name

Answer b is the only correct answer. UNC names are in the form of \\servername\sharename.

Need To Know More?



Chellis, James, Charles Perkins, and Matthew Strebe: *MCSE: Networking Essentials Study Guide, 2nd Edition*. Sybex Network Press, San Francisco, CA, 1998. ISBN 0-7821-2220-5. Chapter 6, "Configuring the Network Server," discusses the concepts covered in this chapter.

Microsoft Press: *Networking Essentials, 2nd Edition*. Redmond, WA, 1997. ISBN 1-57231-527-X. Unit 5, Lesson 15, "Network Operating System Setup," discusses the topics covered in this chapter in great detail.

Search the TechNet CD (or its online version through www.microsoft.com) using the keywords "NOS," "installation," and "network services."