

Unit 5

Networking Operating Systems

Overview

Description

This unit contains two lessons.

The first lesson describes the characteristics of the four major Internetworking Systems, including Windows NT Server, Novell NetWare, UNIX/LINUX, and MAC OS Apple Share.

The second lesson discusses the criteria involved with network planning and management. It also explains the benefits of network planning and management. In addition, it covers examples of hardware and software used to manage networks.

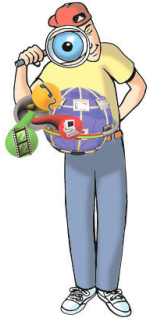
Unit Table of Contents

This unit contains the following two lessons:

| Lessons | Pages | Length |
|--|---------|---------|
| Lesson 5-1: Networking Operating Systems | 472-390 | 5 hours |
| Lesson 5-2: Network Maintenance and Management | 391-408 | 5 hours |

Lesson 5-1: Networking Operating Systems

At a Glance



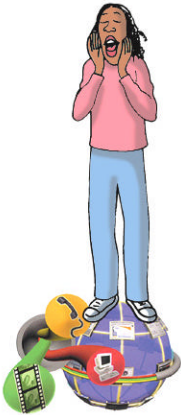
Computers have operating system software that allows them to function. Without operating system instructions, a computer is nothing more than a box with circuits. This is the same with networks. Without a Network Operating System, a network is nothing more than a number of computer devices connected together. In order to transmit information and communicate across a network, it is necessary to have a Network Operating System. There are several different Network Operating Systems, each with its own set of features and protocols. This lesson introduces you to several different Network Operating Systems.

What You Will Learn

After completing this lesson, you will be able to:

- Compare and contrast peer-to-peer and client/server network operating systems.
- Identify and describe four major network services.
- Identify network protocols associated with major network operating systems.
- List key differences among network operating systems.

Tech Talk



- **Driver**—Also referred to as a device driver. Software that allows communication between the computer and an input/output port or external device. For example, a driver allows a network operating system to communicate with the Network Interface Card.
- **File Servers**—Store files created by application programs.
- **Network Operating System**—A combination of software programs that instruct computers and peripherals to accept requests for services across the network and then provide those services.
- **Print Server**—Accept print jobs sent by anyone across the network.
- **User Account**—An account used by Windows NT Server Operating Systems and other NOS's that provides access to the network. Each user on the network has his/her own unique user name.
- **User Manager for Domains**—A Windows NT Server application program that is used to maintain individual and group user accounts.
- **Workgroup**—Group of devices logically networked together as a single unit. This simplifies network management by segmenting and organizing users into defined groups that can be managed as one. For example, everyone in the accounting department may be considered a workgroup. One change in security for the group changes security for all users.

Network Operating Systems

In order to transmit signals across a network, it is necessary for the computer to communicate with its modem or Network Interface Card. Network Operating Systems (NOS) provide the protocols necessary to achieve this goal, but each different type of modem or NIC needs to be able to communicate with the particular NOS. It is therefore necessary to install the special software that comes with the interface device. This software is often referred to as a driver. Computers made today usually come with both the interface and necessary drivers installed. Occasionally, you must install the modem or NIC yourself. It is necessary to install the correct driver for that interface device. Failure to so install the driver means that the device will be unable to communicate over the network or with the computer it is installed in.

Network Operating Systems not only allow communication across a network, they also allow a network administrator to organize resources, control access, and ensure that the network is operating efficiently.

Sharing of network resources can be peer-to-peer or client/server. Which one is the best is dependent on the end goal of the network.

In peer-to-peer networking there is a complete sharing of resources, both hardware and software. All systems act as both users of resources and providers of resources, but no one system is dedicated to a single function. Peer-to-peer networks are generally best suited to small networks and usually are less expensive than client/server networks.

Client/server networks dictate that systems are most often dedicated to a single function. They are either users of network resources or providers of resources. Client/server networks are typically more expensive and robust than peer-to-peer networks and generally support the building of larger networks.

Discussion of Internetworking Operating Systems will cover the four major systems currently in use: Windows, Novell, UNIX/LINUX, and Mac.

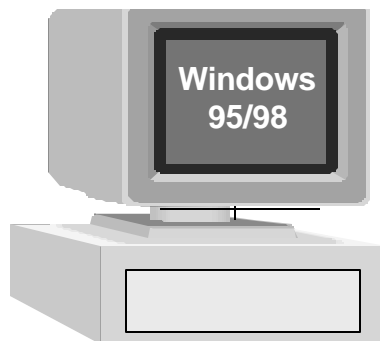
Windows for Workgroups/Windows 95/Windows NT Server

Windows for Workgroups/Windows 95

Windows for Workgroups, introduced in the early 90s and Windows 95, introduced in 1995 are considered peer-to-peer networking systems and do not have the capabilities of true internetworking operating systems. They are, however, inexpensive and more than adequate for small workgroups wanting to share resources, use email, and connect to the Internet.

Windows for Workgroups and Windows 95 both offer peer-to-peer network protocols (Windows NT will be discussed later). The protocols used by these operating systems allow users to share files and devices over LANs. Both offer NetBEUI, Microsoft's small network protocol. They also offer TCP/IP, and IPX/SPX protocols to access the network through either a dial-up connection/modem, or directly through a NIC.

Windows 95



NetBEUI protocols, while not routable, are more than adequate to meet small LAN needs. NetBEUI protocols are easy to use and do not require in-

depth networking knowledge. NetBEUI software identifies computer devices by name and it is certainly easier to remember that a computer's name is Juanita or Justin than 141.252.20.2 or 141.252.10.1. Each device name in a network must be unique. NetBEUI software installed on each of the networked computers is all that is necessary to configure devices in order to share resources and create a network. If a small company does want to connect to the Internet, the necessary software and protocols are available with these operating systems.

Shared resources on Windows for Workgroups/95 networks are accessed by a password that protects the resource and there is only one level of access; either you have access or you don't have access. Also user-by-user passwords are not part of the protocols unless Windows NT is present. What this means is that anyone connected to the network who knows the password of the resource has access to that resource. This can create security issues since there is no way to prevent a user from access once s/he knows the password. As the network grows, it is usually more difficult to keep resource passwords secure. Since there is no central control, managing these peer-to-peer networks becomes an issue when the network becomes too large.

Windows NT Server

Windows NT Server was first introduced in the mid-90s and is capable of managing workgroups just like Windows for Workgroups/95. It is a client/server networking operating system that uses routable protocols, making it a true Internetworking Operating System enabling network administrators to connect LANs to WANs. Windows NT Server also provides services for OS/2 and Novell NetWare clients and is able to run on various microprocessors such as Intel Pentium, DEC Alpha, RISC, MIPS, and PowerPC based systems.

Windows NT Server has all of the advantages mentioned for the other Windows operating systems, plus, it contains several other features making it more robust. The security on Windows NT allows a network administrator to not only provide passwords for resources but also to individuals or groups. This operating system does require the use of a more powerful server computer whose sole function is to act as administrator of the NOS program. Having a server where all access data is stored makes managing Windows NT Server Operating Systems efficient.

Windows NT Server has more than one level of security beyond access/no access. This NOS offers:

- no access.
- access that restricts the user to read only capabilities.
- access that allows read and write usage.

- access that allows you to change access permissions for network users.

Each user who wishes to access services on the network must have a password and a user account set up within the domain. A domain is a security model where the database of user accounts is stored on one or more computers known as domain controllers. What this does is centralize control of the network. The network administrator creates, deletes, and manages these accounts and passwords using the User Manager for Domains program that comes with Windows NT Server.

For security reasons, companies often have two servers capable of authenticating passwords, one that acts as the Primary Domain Controller (PDC) and the other as the Backup Domain Controller (BDC). The PDC is a computer on the network that maintains a database of users and security policies for the domain. This database contains the names of users and the resources they may access. User access may be defined for individual files or for entire directories. Note that although the PDC is often a server computer, this is not necessary. Network services can be implemented on one computer and the PDC functions on another.

A BDC maintains a copy of the PDC database. This backup database prevents network disruption in the event of failure of the PDC. If a failure occurs, the backup domain controller can be easily switched to the PDC.

With Windows NT Server networks can connect to other domains. There are four basic domain models:

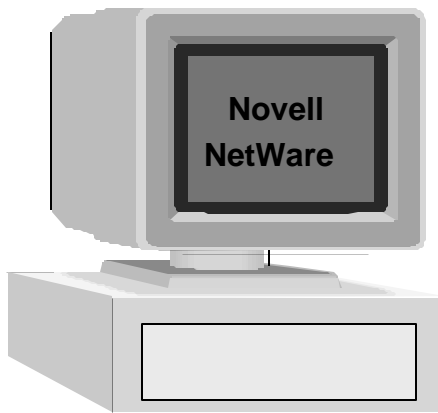
- **Single Domain Model**—In the single domain model, there is only one defined set of security and user accounts. This means that all management functions are centralized.
- **Master Domain Model**—In this model, there is one master domain server that has the defined set of security and user account data of all other domain servers. However, each of these has only the specific security data for one domain. A user on one domain cannot get permissions not found on her/his domain server. This improves on the single domain model since it allows segmentation of networks, which increases security measures, yet still allows centralized management of network user accounts and accessibility.
- **Multiple Master Domain Model**—The Multiple Master Domain Model has several master domain servers, each with their own specific domains. In this model, network management becomes somewhat decentralized and network administrators cannot maintain the entire network from one central domain server.

- **Multiple Trust Domain Model**—This model is really a peer-to-peer relationship among domain servers, therefore it becomes decentralized and security is essentially the same as with Windows for Workgroups and Windows 95.

Novell NetWare

Novell NetWare Operating Systems, also a client/server based NOS, is not domain based but binary based. It has evolved over time from NetWare 2.X, now obsolete, which was designed for small workgroup environments to NetWare 5.X that is aimed at global enterprise network environments. NetWare is optimized for managing, sharing, translating, and synchronizing information throughout the network-computing environment.

Novell NetWare



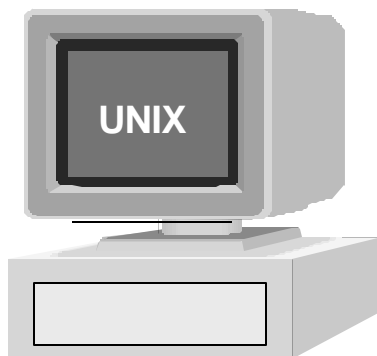
Novell NetWare 4.X features NetWare Directory Services (NDS), which allows a user to logon from anywhere on the network and access the same resources regardless of where the user logs on. This product has become Novell's migration strategy for the future.

Novell NetWare does not actually provide a computer operating system for client workstations; it supplies an operating system for a dedicated server computer, and networking support to existing client workstation operating systems.

UNIX/LINUX

UNIX is the oldest network operating system still being widely used today. It can be used on either peer-to-peer or client/server networks. LINUX is basically a free version of UNIX, which is developed cooperatively by a community of expert programmers. Various computer manufacturers have released proprietary versions of UNIX which run on their particular hardware platforms. Because of differences in processor hardware and variations from UNIX standards, each company's operating system has its own "flavor". End user applications for UNIX must be individually compiled for each different hardware platform and operating system variant. The networking components in UNIX have been under development for many years, and are based on the collaborative efforts of many developers. Consequently, UNIX networking is extremely reliable. This is why many companies use UNIX to provide their primary networking services and interface to the Internet. In spite of the rise in popularity of Web and Internet services deployed on Windows NT, for security and reliability UNIX is a popular choice in commercial and university environments. Networking under UNIX is based on the TCP/IP protocol, which has only been integrated into the Microsoft Windows network operating systems in recent years. The early work, which established the Internet, was based on UNIX platforms. Most of the TCP/IP services used in UNIX are also commonly used on

UNIX



Microsoft Windows operating systems, with a few exceptions:

1. **Network File System (NFS)**—NFS provides hard disk sharing over TCP/IP networks. It is the primary file and directory sharing protocol used in UNIX. NFS clients are available for Microsoft Windows operating systems, but are generally used for interoperability with UNIX hosts.
2. **Remote login services (RLOGIN and TELNET)**—UNIX has always been a truly multi-user multi-session operating system. Multitasking of applications and processes is extremely robust; much more so than under Windows NT. In addition many users can run private sessions simultaneously under UNIX, by logging in to a host using a character-based terminal or emulated terminal over a serial or network connection. RLOGIN and TELNET protocols support logging in over network connections.
3. **Graphical user interface windowing system (X Windows)**—X Windows is a completely distributed graphical user interface system. Using X-Windows, a user can execute an application on one computer, and let that application interact with a user on a different computer, using a network connection. X Windows allows computers to share their video displays, keyboards and pointing devices with applications running on other computers. There is no requirement that the application execution and display hosts even have the same type of hardware or run the same operating system, as long as the client application and the display server support the X Windows protocol. Windows NT has recently included support for graphical session-based terminal servers that offer some similar functionality to X Windows, but with much less flexibility. In addition, X Windows server software is available for Microsoft Windows operating systems, allowing applications running on UNIX hosts to be displayed on computers running Microsoft Windows operating systems.

MAC OS AppleShare

AppleShare provides network services for the Mac OS operating systems. AppleShare supports file and printer sharing over several types of physical networks by using one of the AppleTalk transport protocols: LocalTalk, EtherTalk, TokenTalk or FDDITalk. As the Internet has grown in popularity, TCP/IP software has been developed for the Apple Macintosh computers, along with the standard TCP/IP client applications like Web Browsers and FTP file transfer clients.

AppleShare's peer-to-peer networking is used in small or moderately sized workgroup settings, but has not been adopted widely in large-scale corporate LAN environments.

Check Your Understanding

- ◆ What are the advantages and disadvantages of Windows for Workgroups/95?

- ◆ What are some of the features added to Windows NT Server that are not supplied for Windows for Workgroups/95?

- ◆ What are some differences between NetWare and Windows NT Server?

- ◆ How has the popularity of the Internet affected network support in Mac OS and the Microsoft Windows operating systems?

- ◆ Which family of operating systems has traditionally supported TCP/IP and internetworking?

Try It Out

Administering a Network Operating System



In this activity, you will create users that will be able to log on and access specified information stored on the server. You need a Windows NT Server installed as part of your network to complete this activity. You will use User Manager for Domains for this lab.

Materials Needed

- Windows NT Server and administrative privileges

Create a User

1. To start the User Manager for Domains, click Start and select Programs. Select Administrative Tools and go to User Manager for Domains.
 - a. You will see a list of the default user accounts created by Setup.
 - b. Select New User from the User menu. The New User dialog box is displayed.
 - c. You will need to enter a user name. The name can be up to 20 characters and you can use upper and lower case letters, punctuation, and numbers. You cannot use any of these characters in a user name : “ / \ [] ; : | = , * ? < >
 - d. Enter the individual's full name.
 - e. If you wish, you can enter a description for the new user. You may choose to use the persons title or department.
 - f. Enter a password and enter the password again in the Confirm Password box. This ensures you enter the password the way you desired.

Associate a User with a Group

1. Select Groups at the bottom of the New User window.
2. To add the user to a group, select the appropriate group in the Not Member of box and click Add. This will move the group to the Member of box. Repeat this step for each group for which you wish the user to be a member.
 - a. You can experiment by associating the user with different groups to see what information that user has access to.

- b. You can also create user accounts and group membership for each person in your classroom.

Logon from a Workstation

You can now logon as a user from any Windows 95, 98 or NT 4 Workstation connected on the same network. The computer must also have the same network protocol as the server. NetBEUI is normally installed on all computers on a Windows network. (The students will have to edit their network configuration properties to allow for logon to a domain and list the specific domain that they are creating users for in the previous steps before this logon exercise will work)

1. Turn on a Windows computer and wait for the initial logon screen.
2. Enter the user name and password you created in the previous section.

You should be able to see the Windows NT Server from either Windows Explorer or Network Neighborhood. Open either of these programs and use it to see what folders and files you have access to on the server. Try changing group membership on the server and see what happens to folder and file access from the client.

Rubric: Suggested Evaluation Criteria and Weightings

| Criteria | % | Your Score |
|---|------------|------------|
| Ability to locate on-line help resources | 25 | |
| Independent trouble-shooting skills | 25 | |
| Successful completing of administration tasks | 50 | |
| TOTAL | 100 | |

Stretch Yourself

Comparing Network Operating Systems



Materials Needed

- Internet connection

Construct a chart to compare the features the major network operating systems. Identify features from the administrator's and the end user's perspective. Search the Internet or other library resources for more information about how the operating systems are used.

Rubric: Suggested Evaluation Criteria and Weightings

| Criteria | % | Your Score |
|--|------------|------------|
| Completeness of information, and relevance of research | 50 | |
| Clear presentation of information | 25 | |
| New insights drawn from building comparison | 25 | |
| TOTAL | 100 | |



For Network Wizards

Comparison of Network Operating Systems

Materials Needed

- None

If you have access to computers with differing network operating systems, try to get them to communicate over the network. Even if you don't have this kind of access yourself, see if your school's system administrator will describe how differing operating systems are networked together at your school. What protocols are used? Is file and printer sharing supported across operating systems? Are standard TCP/IP applications supported like Web browsing and FTP file transfer clients?

Create a comparison chart of the features of the major operating systems.

Rubric: Suggested Evaluation Criteria and Weightings

| Criteria | % | Your Score |
|--|------------|------------|
| Clear articulation of goals | 25 | |
| Accurate survey of available operating systems and expert support | 40 | |
| Successful cross-platform communication or documentation of school's current cross platform communications | 35 | |
| TOTAL | 100 | |

Summary

In this unit, you learned the following:

- Identify and describe four major network services.
- Identify network protocols associated with these network operating systems.
- List major differences among local operating systems.
- Compare and contrast peer-to-peer to client/server network operating systems.
- Add a new Operating System to the networked environment.

Review Questions**Name** _____**Lesson 5-1: Networking Operating Systems****Part A**

1. The main function of a Windows NT Domain is to
 - a. Provide shared disk space to a network
 - b. Control user credentials and security access for a network from a single location
 - c. Provide shared printer resources to a network
 - d. Connect to the Internet

2. List four major network services

Part B

1. Which protocol is not supported by Windows 95?
 - a. NetBEUI
 - b. IPX/SPX
 - c. TCP/IP
 - d. AppleTalk

2. Which protocol supports remote login sessions?
 - a. TELNET
 - b. X-Windows
 - c. RIP
 - d. SPX/IPX

3. Which protocol is not involved with file sharing?
 - a. NFS
 - b. AppleTalk

- c. NetBEUI
- d. SPX/IPX
- e. X Windows

Part C

1. A network operating system
 - a. Supports application development
 - b. Support a single network protocol
 - c. Supports resource administration and network communication
 - d. Only supports servers
 - e. Does not require software drivers

2. Which processor does Windows NT not support?
 - a. Intel Pentium
 - b. DEC Alpha
 - c. IBM RISC
 - d. Sun SPARC

3. Windows 95
 - a. Can connect WAN's
 - b. Provides centralized security
 - c. Is a peer-to-peer Network Operating System
 - d. Is too expensive for small workgroups
 - e. Can not connect users with the Internet

4. Which of these network operating system provides the best security:
 - a. Windows for Workgroups
 - b. Windows 95
 - c. Windows NT Workstation

- d. Windows NT Server

Part D

1. Peer-to-peer networks
 - a. Allow workstations to share and access resources
 - b. Are optimized for sharing resources from a single computer with many users
 - c. Do not share their own resources
 - d. Allow workstations to share their resources with others, but not access others' resources

2. Client/server networks
 - a. Share and access resources equally
 - b. Are purely database applications
 - c. Do not provide access security
 - d. Only support a single networking protocol
 - e. Support dedicated server computers which are optimized to share resources with many users

Scoring

Rubric: Suggested Evaluation Criteria and Weightings

| Criteria | % | Your Score |
|--|------------|------------|
| Part A: Identify and describe four major network services. | 25 | |
| Part B: Identify network protocols associated with these network operating systems. | 25 | |
| Part C: List major differences among local operating systems. | 25 | |
| Part D: Compare and contrast peer-to-peer to client/server network operating systems | 25 | |
| TOTAL | 100 | |
| Try It Out: Add a new Operating System to the networked environment. | 100 | |
| Stretch Yourself | 100 | |
| Network Wizards | 100 | |
| FINAL TOTAL | 400 | |

Resources

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