

Chapter 15: Advanced Networks



IT Essentials: PC Hardware and Software v4.1

Chapter 15 Objectives

- 15.1 Identify potential safety hazards and implement proper safety procedures related to networks
- 15.2 Design a network based on the customer's needs
- 15.3 Determine the components for your customer's network
- 15.4 Implement the customer's network
- 15.5 Upgrade the customer's network
- 15.6 Describe installation, configuration and management of a simple mail server
- 15.7 Describe preventive maintenance procedures for networks
- 15.8 Troubleshoot the network

Introduction

- To meet the expectations and needs of customers and network users, a technician must be familiar with networking technologies.
- A technician must understand the basics of how a network is designed and why some components affect the flow of data on a network.

Safety Procedures

- Wear clothing that will help protect you from unexpected or toxic materials you may encounter when pulling cable through ceilings and walls.
- Consider safety issues when using a ladder.
- Follow safety rules when working with cables.
- Use common sense when you take care of any problems. Call another person to assist you if need help.



Fiber-Optic Safety

- Fiber optics are useful for communications, but they have certain hazards:
 - Dangerous chemicals
 - Light that you cannot see that can burn your eyes
 - Tools with sharp edges that produce glass splinters

- Specific types of tools and chemicals are used when working with fiber-optic cable and must be handled safely.

• Chemicals	• Harmful light
• Tools	• Glass shards

CAUTION: Obtain proper training before you attempt to cut, strip, or splice fiber-optic cable.

Cable Safety

- Know the hazards before working with network cable and equipment.



- **WARNING:** When handling cable, always wear eye protection. Never touch the ends of any type of cable with bare skin.
- Copper cables can be dangerous to handle
 - Sharp ends
 - Cutting and crimping tools
 - Electricity

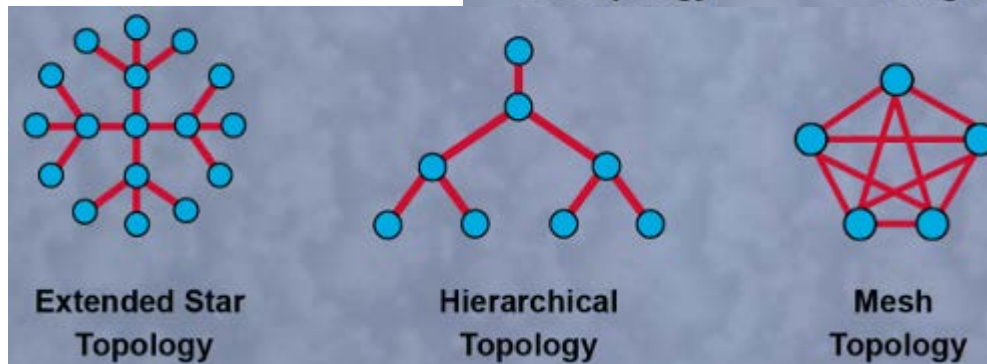
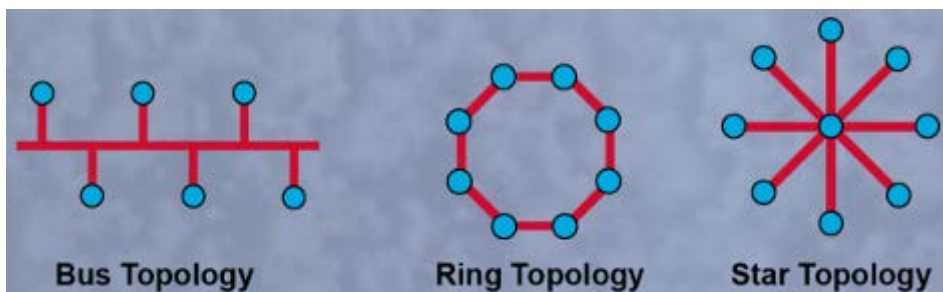
Network Design

- A network will work best if it is designed to meet the needs of your customer
- Analyze the environment
- Understand network options
- Interview the customer and other people involved
- List hardware and software to be used
- Consider future growth of the company and the network



Determine a Network Topology

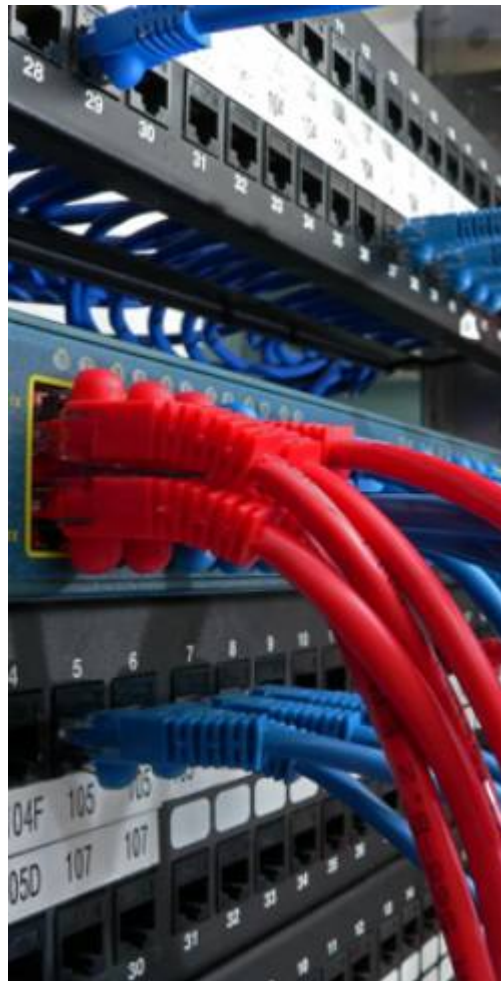
- A **site survey** is a physical inspection of the building that will help determine a basic logical topology, which is the flow of data and protocols.
- Considerations for topology choice:
 - Number and location of users
 - Cable and wireless types
 - Expandability



Protocol Ports

- In the design of a network, you must determine the protocols that are going to be used.
- Some protocols are proprietary and only work on specific equipment, while other protocols are open standards and work on a variety of equipment.
- Consider the following when selecting protocols:
 - The TCP/IP suite of protocols is required for every device to connect to the Internet. This makes it a preferred protocol for networking.
 - NetBEUI is a small, fast protocol that is useful in low security networks. However, it is not a good choice if there will be network growth.
 - IPX/SPX is a protocol that belongs to older versions of Novell Netware. Newer versions of Novell Netware use TCP/IP instead of IPX/SPX.
 - Apple Macintosh networks have abandoned the AppleTalk protocol for the TCP/IP suite of protocols.

Components of a Network



- The network topology chosen determines the type of:
 - Devices
 - Cables
 - Network interface
 - ISP connection

Select Cable Types

- Decide which cable type is the most beneficial and cost effective for the users and services that will connect to the network.
- Most networks today are wired using one or more kinds of types of twisted-pair copper cable: Cat5, Cat5e, Cat6, and Cat6A.
- Installing cables is expensive, but after a one-time **expense**, a wired network is normally inexpensive to maintain. Keep in mind that installing the highest-grade cable available ensures the network will be able to handle **future network speeds**.
- A **wireless** solution may be possible in places where cables cannot be installed. But to make a wireless network as **secure** as wired network requires the use of encryption.

ISP Connection Types

- Compare connection speeds, reliability, and cost before committing to a service agreement.

	Advantages	Disadvantages	Speed
POTS	Very common	Very slow speeds Cannot receive phone calls while connected	Max 56kbps
ISDN	Higher speeds than POTS	Still much slower than other broadband technologies	BRI – up to 128kbps PRI – up to 2.048Mbps
DSL	Low cost	Must be close to carrier	256kbps – 24Mbps
Cable	Very high speed	Slow upload speeds	384kbps – 27Mbps
Satellite	Available when DSL and cable are not	Significant lag, more expensive than other broadband technologies	9kbps – 24Mbps
Cellular	Available to mobile users	Limited market availability	20kbps and up

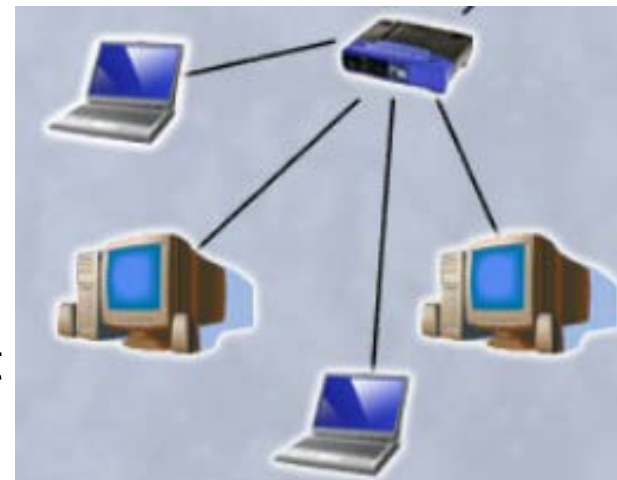
Select Network Interface Cards (NICs)

- Before purchasing a NIC, you should research the speed, form factor, and capabilities that the card offers.
- Most network interfaces for computers are either integrated into the motherboard, an expansion card that fits into an expansion slot or a USB network adapter.
 - For wired NICs, you should check if they are backward-compatible.
 - For wireless NICs, the selection should be based on the type of wireless network that is installed.



Select Network Device

- Hub
 - Sends all traffic received out all ports
 - Regenerates traffic that passes through it
- Switch
 - Filter and segment network traffic by sending only to the destination device
 - Higher dedicated bandwidth provided to each network device
- Router
 - Connects networks together (example: connects a home network to the Internet)
 - Wireless routers also act as a firewall
- ISP equipment
 - A cable or DSL modem



Installation Checklist

- Careful planning will help ensure an easier and faster network installation.
 - All parts are in
 - Installation scheduled
 - Backups are available
 - Access to needed passwords
 - Extra supplies handy
 - Install components
 - Test components

Network Installation

- Once you have determined the location of all network devices, you are ready to install the network cables.
- These steps outline the process for physically creating a network:
 1. To install cable in ceilings and behind walls, perform a **cable pull**. Terminate each end of every cable. Label the ends of every cable.
 2. Test the cables for shorts or interference.
 3. Install NICs in network devices. Configure client software and IP address information on all devices.
 4. Install switches and routers in a secured, central location.
 5. Install patch cables from wall connections to devices. Check NICs for link lights on all devices.
 6. Test the network for connectivity. Configure and test network applications.

Configure the customer's Internet and network resources.

- After the network has been set up and tested, you should configure a web browser, such as:
 - Temporary internet files
 - Default Browser
 - File Sharing
 - Printer Sharing

Network Upgrades

- You must be able to upgrade, install, and configure components when a customer asks for increased speed or new functionality to be added to a network.

Network Upgrade Methods

- Type of media
- Type of NIC
- Additional functionality

Install and Configure Wireless Adapter

- Before purchasing a wireless adapter, make sure it is compatible with other wireless equipment that is already installed on the network.
- To install a PCI wireless adapter:
 1. The adapter must be the correct form factor to fit the computer
 2. Remove the case cover
 3. Install the NIC into an open PCI slot or PCI express slot
 4. Configure device drivers
 5. Enter network address information



Install and Configure Wireless Router

1. Position wireless router for maximum coverage.
2. Connect the wireless router to the existing network. Connect a DSL or cable modem to the wireless router. Connect one computer to any of the remaining ports to access the configuration web pages.
3. Turn on the broadband modem and plug in the power cord to the router. When the modem finishes establishing connection to the ISP, the router automatically communicates with the modem to receive network information from the ISP: IP address, subnet mask, and DNS server addresses.

Install and Configure Wireless Router (Continued)

- The following steps are specific to the Linksys WRT300N router:
- 4. Turn on the computer that is connected to the router and open a web browser. In the Address field, enter **192.168.1.1** to go to the default address for router configuration and management.
- 5. A security window opens prompting you for authentication to access the router configuration screens. The user name field should be left empty. Enter **admin** as the default password.
- 6. Click **Save Settings** at the bottom of each screen after making any changes.

Install and Configure Wireless Router (Continued)

- Configurations that can help secure and increase the speed of a wireless network includes:
 - **802.11 Protocol Selection:** Include 802.11a, 802.11b, 802.11g, and 802.11n
 - **Static IP Address Configuration:** Allow firewalls to be configured to permit specific traffic or connections between specific devices
 - **SSID Setting:** Disable SSID broadcasting to provides protection from automatic discovery
 - **Firmware Update:** Improve performance, fix bugs, or update security features

Test Network Connection

- Open a web browser and see if the Internet is available.
- To troubleshoot a wireless connection, you can use the Windows GUI or CLI.
 - The **Connection Status** screen displays the number of packets that have been sent and received, and also is used to repair the connection.
 - **Ipconfig** command to verify that the connection has a valid IP address.
 - **Ping** command to test connectivity between devices.
 - **Tracert** command that traces the route that packets take from your computer to a destination address.
 - **Net** command to manage network computers, servers, and resources like drives and printers.
 - **Nslookup** command for testing and troubleshooting DNS servers.

E-mail Protocol Comparison

- An e-mail system uses e-mail client software on the users' devices, and e-mail server software on one or more e-mail servers.

Protocol	Advantages	Disadvantages	Port	Send Mail	Retrieve Mail
SMTP	<ul style="list-style-type: none"> Delivers e-mail from one server to another Can send mail directly to the destination 	<ul style="list-style-type: none"> Client upload only 	25	Yes	No
POP	<ul style="list-style-type: none"> Simple Supports intermittent connections 	<ul style="list-style-type: none"> Download only Cannot manage the mail on the server 	110	No	Yes
IMAP	<ul style="list-style-type: none"> Simple More features than POP Stores mail on server Faster than POP Allows simultaneous access by multiple clients 	<ul style="list-style-type: none"> Requires more disk space and CPU resources 	143	No	Yes

E-mail Server Setup

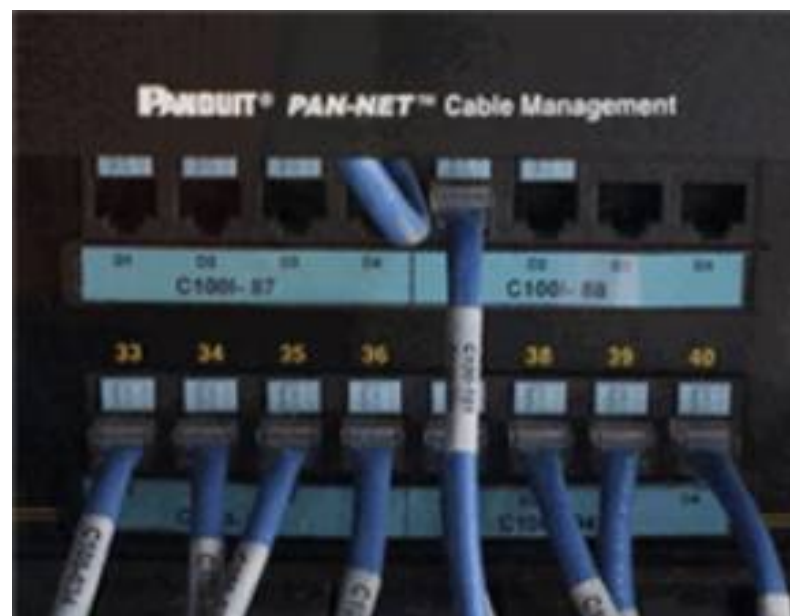
- To install and set up an e-mail server, such as Microsoft Exchange, you must first make sure that the network has all of the proper qualifications in place and that it is properly configured.
- Active directory servers, global catalog servers, and domain name servers (DNS) servers must all be in place and functioning before Exchange can be installed and work properly.
- Test the environment before installing Exchange.
- Set up the services required and install Exchange on a dedicated set of servers away from the main network.
- Keep the installation of Exchange separated from your production network until you are sure that it is functioning properly.

E-mail Installation

1. Add Internet Information Services (IIS) using the Add/Remove Windows Components wizard before initiating the installation of the Exchange server.
2. Insert the Exchange installation media and begin the New Exchange installation wizard.
3. The wizard will verify that Exchange is ready to be installed.
4. Once Exchange is installed, the Microsoft Management Console provides access to many settings. The Exchange System Manager is used to manage the options of the server.
5. Use the Active Directory Users and Computer (ADUC) console to configure a user's mailbox.

Preventive Maintenance

- Check the condition of cables, network devices, servers, and computers to make sure that they are kept clean and are in good working order.
- Develop a plan to perform scheduled maintenance and cleaning at regular intervals.
- If you notice equipment is failing, damaged, or making unusual sounds, then inform the network administrator to prevent unnecessary network downtime.
- Educate network users by demonstrating to them how to properly connect, disconnect, and move cables.



Troubleshooting Process

- Step 1** Identify the problem
- Step 2** Establish a theory of probable causes
- Step 3** Determine an exact cause
- Step 4** Implement a solution
- Step 5** Verify solution and full system functionality
- Step 6** Document findings

Step 1 - Identify the Problem

- **Hardware/Software information**
 - Manufacturer, model, OS, network environment, connection type
- **Open-ended questions**
 - When did the problem start?
 - What problems are you experiencing?
 - Is there anything else you can tell me about the problem?
 - What other users are having problems?
 - Can you describe your network configuration?
- **Closed-ended questions**
 - Has any network equipment changed?
 - Have any peripherals been added to your computer?
 - Have any other computers been added to the network?
 - Have you rebooted your computer?

Step 2 - Establish a Theory of Probable Causes

- Problem may be simpler than the customer thinks.

- Create a list of the most common reasons why the error would occur:
 - Incorrect IP information
 - Examine the network equipment LEDs
 - Incorrect wireless configuration
 - Disable network connection
 - Verify the wireless router configuration
 - Verify the network equipment settings

Step 3 - Determine the Exact Cause

- Testing your theories of probable causes one at a time, starting with the quickest and easiest.
 - Restart the network equipment.
 - Examine the network equipment LEDs.
 - Renew the IP address.
 - Reconnect all of the network cables.
 - Verify the wireless router configuration.
 - Ping the local host.
 - Ping the default gateway.
 - Ping an external website.
 - Verify the network equipment settings.
- If the exact cause of the problem has not been determined after you have tested all your theories, establish a new theory of probable causes and test it.

Step 4 - Implement a Solution

- Sometimes quick procedures can determine the exact cause of the problem or even correct the problem.
- If a quick procedure does not correct the problem, you might need to research the problem further to establish the exact cause.
- Divide larger problems into smaller problems that can be analyzed and solved individually.

Step 5 - Verify Solution and System Functionality

- Verifying full system functionality and implementing any preventive measures if needed. Ensures that you have not created another problem while repairing the computer.
 - Reboot all of the network equipment.
 - Reboot any computer that experienced network problems.
 - Validate all LEDs on the network equipment.
 - Use the **ipconfig/all** command to display IP addressing information for all network adapters.
 - Use the **ping** command to check network connectivity to an external website.
 - Use the **nslookup** command to query your DNS server.
 - Use the **net view** command to show the available shared resources on a network.
 - Print to both a shared and a local printer.
- Have the customer verify the solution and system functionality.

Step 6 - Document Findings

- Discuss the solution with the customer
- Have the customer confirm that the problem has been solved
- Document the process
 - Problem description
 - Solution
 - Components used
 - Amount of time spent in solving the problem

Common Problems and Solutions

- Network problems can be attributed to hardware, software, networks, or some combination of the three. You will resolve some types of problems more often than others, while other problems may require more in-depth troubleshooting skills.

Apply Troubleshooting Skills

- It is time to apply your listening and diagnostic skills.



Chapter 15 Summary

- Many safety hazards are associated with network environments, devices, and media. You should follow proper safety procedures at all times.
- Make network design decisions that will meet the needs and the goals of your customers.
- Select network components that offer the services and capabilities necessary to implement a network based on the needs of the customer.

Chapter 15 Summary (Continued)

- Plan network installations based on the needed services and equipment.
- Upgrading a network may involve additional equipment or cabling. Discuss how upgrading can help to enhance the future usability of the network.
- Plan for an e-mail installation before deployment. Consult a specialist to make sure that the installation and configuration of an e-mail server goes smoothly.

Chapter 15 Summary (Continued)

- Prevent network problems by developing and implementing a comprehensive preventive maintenance policy.
- Follow a logical methodology to troubleshoot advanced network problems.

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