About the Presentations

•The presentations cover the objectives found in the opening of each chapter.

•All chapter objectives are listed in the beginning of each presentation.

•You may customize the presentations to fit your class needs.

•Some figures from the chapters are included. A complete set of images from the book can be found on the Instructor Resources disc.

Hands-on Networking Fundamentals, 2nd ed.

Chapter 1: Networking: An Overview

Objectives

- Explain what a network is

- Understand basic networking concepts and terms

- Explain the advantages of using a network in the home

- Discuss the advantages of using a network in an office
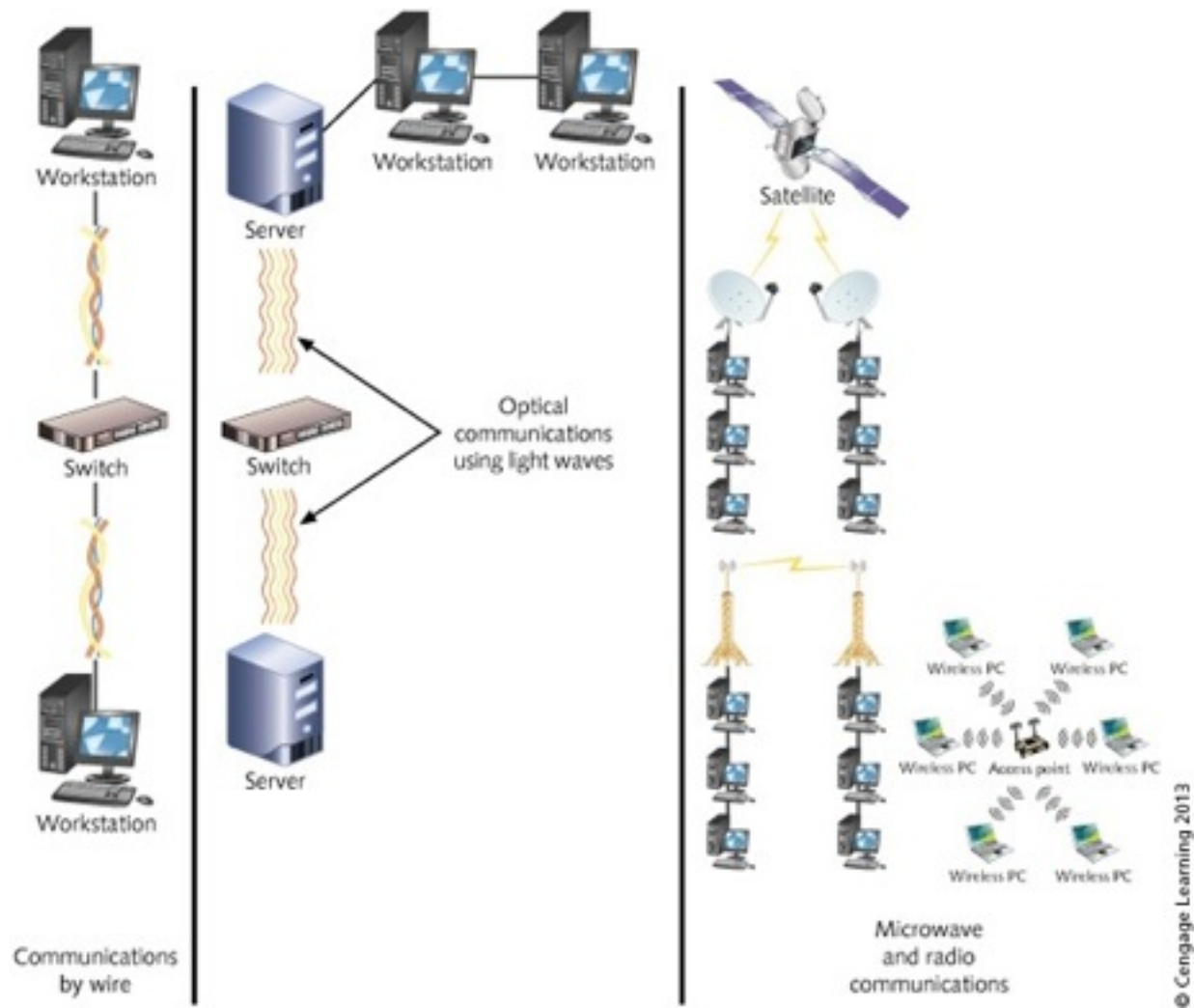
Objectives (continued)

- Determine boundaries between networks
- Describe network topologies
- Understand general network design concepts
- Design a simple LAN

What Is a Network?

- Three types of networks
  - Word-of-mouth communication
  - Cell phone or telephone
  - Computer
- Computer networks
  - A system of computers, print devices, network devices, and computer software
  - Devices are linked together via radio waves or communications cable
  - Carry data, voice, and video communications

What Is a Network? (continued)

- System components linked using various media
  - Copper wire
  - Fiber-optic cables
  - Radio waves
  - Infrared waves
  - Microwaves
- Advantages of computer networks
  - Ability to easily share information such as documents, pictures, printers, etc…
  - Ability to exchange e-mail anywhere in the world

Figure 1-1 Network commnications by wire, fiber-optics, and radio waves

Basic Networking Concepts

- The following section of the text will discuss:
  - Different network types
  - Different terms for various network elements
  - Processes about how networks should work

Understanding the Types of Networks

- Five types of networks
  - Personal area networks (PANs)
  - Local area networks (LANs)
  - Metropolitan area networks (MANs)
  - Campus area networks (CANs)
  - Wide area networks (WANs)
- Networks are typically classified according to their reach and complexity

Understanding the Types of Networks

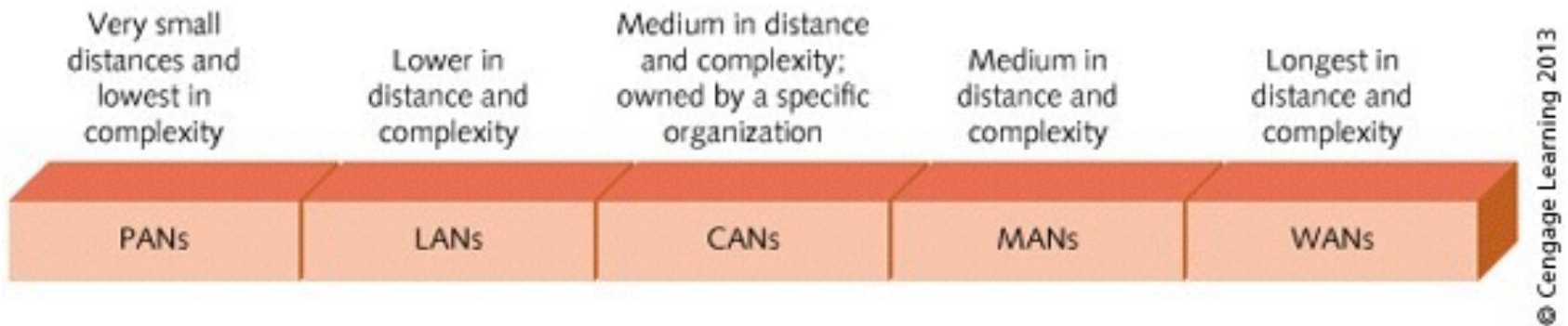| Very small distances and lowest in complexity	Lower in distance and complexity	Medium in distance and complexity; owned by a specific organization	Medium in distance and complexity	Longest in distance and complexity
PANs	LANs	CANs	MANs	WANs

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Figure 1-2 Comparison of PANs, LANs, CANs, MANs, and WANs

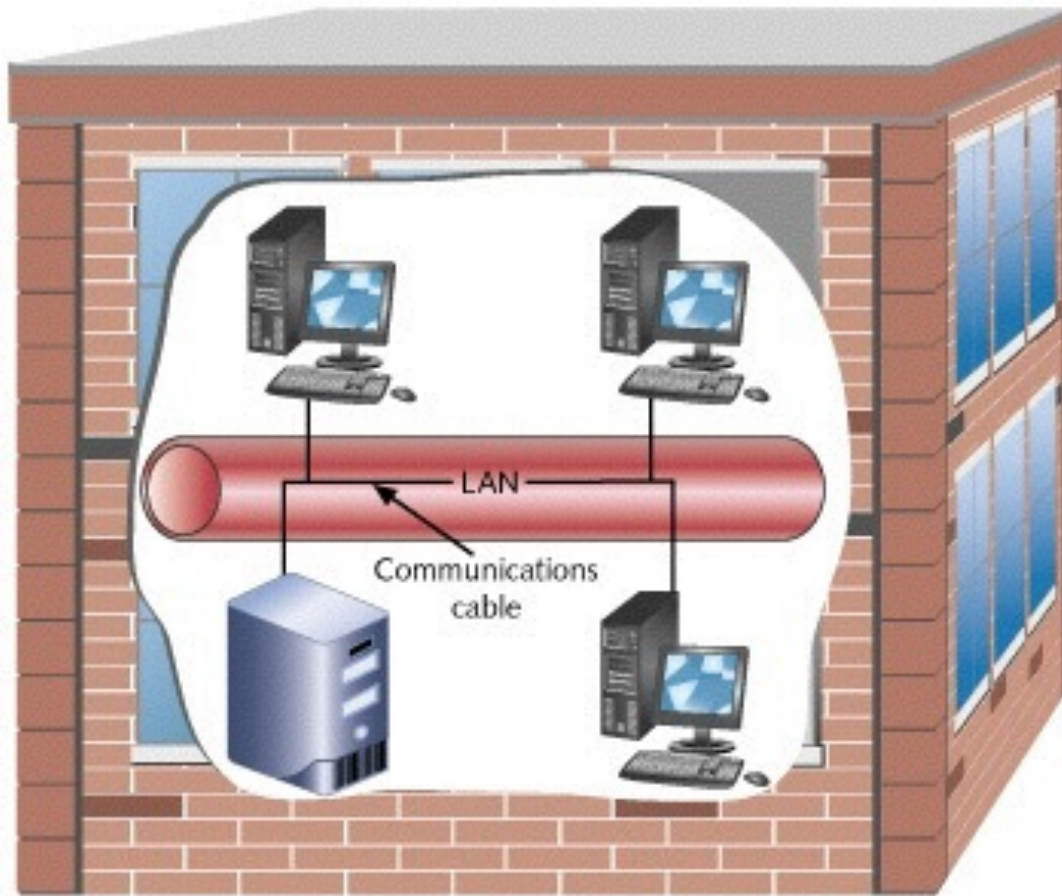# Understanding the Types of Networks

- PAN and wireless PAN(WPAN)
  - Usually consist of personal devices such as mobile computers, smartphones, and handheld devices.
  - Cabled PAN networks connect devices using short distance cables typically connected through a Universal Serial Bus (USB) port

Figure 1-3 A desktop PC, a smartphone, and a tablet PC forming a PAN

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Understanding the Types of Networks

- LAN
    - Interconnects computers, printers, other equipment that share hardware and software resources in close physical proximity
    - Service area might be within a house, a small office, a floor in a building, or an entire building
    - Example: a university chemistry department where computers in each office and lab are connected via cable or wireless devices
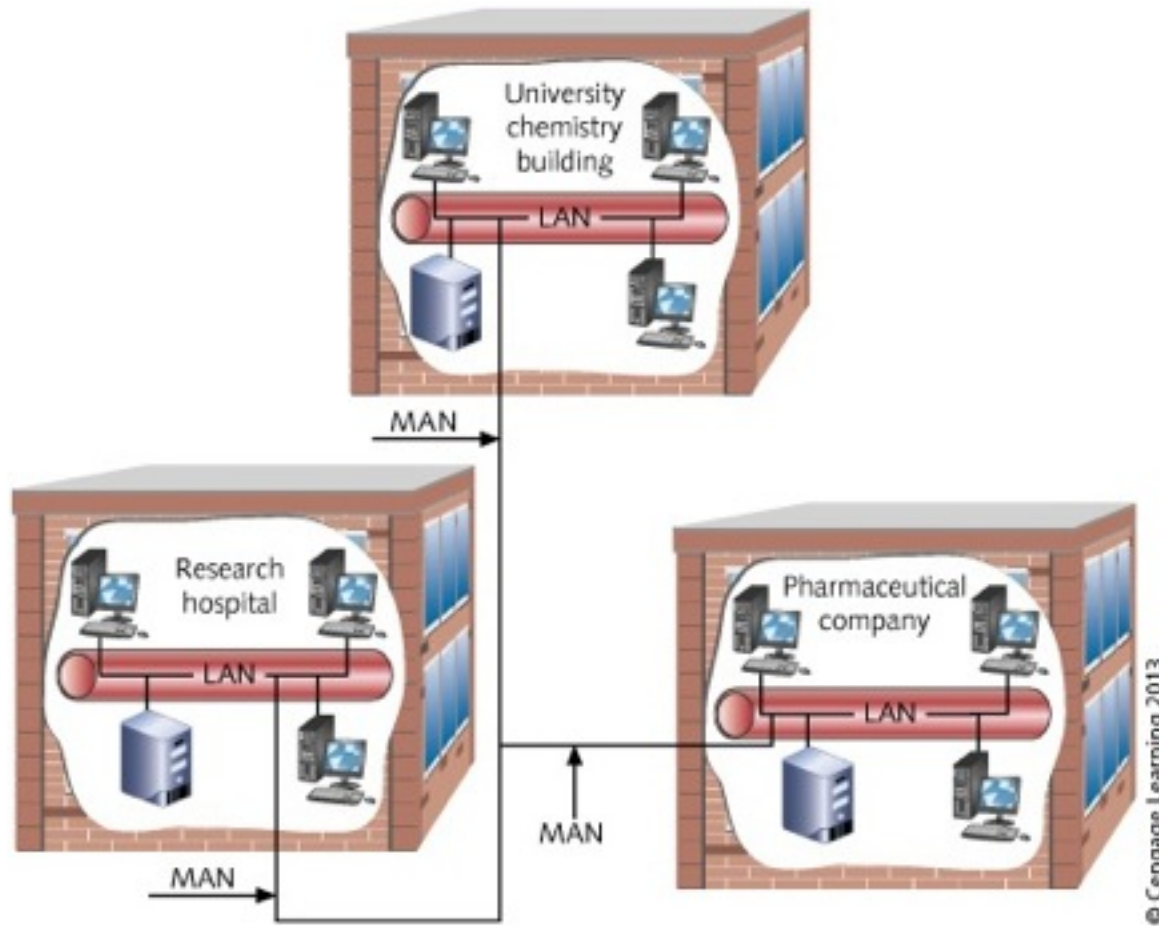
Figure 1-4 LAN in a chemistry building

Understanding the Types of Networks

- MAN (metropolitan area network)
  - Spans a greater distance than a LAN
    - Up to 48 kilometers (about 30 miles)
  - Usually consists of more complicated networking equipment than a LAN
  - Links multiple LANs within city or metropolitan region
    - Typically uses fiber-optic/wireless connections
  - Individual LANs that compose a MAN may belong to the same organization or to several different organizations

Figure 1-5 MAN joining three buildings in different locations within the same city

Understanding the Types of Networks

- CAN – Campus Area Network
  - Similar to a MAN
    - Joins multiple LANs in a specific area
    - Difference is that all of the LANs and the buildings housing the LANs are owned by one organization
- WAN (wide area network)
  - Composed of two or more LANs, MANs, or CANs
  - Connected across a distance greater than 48 km (30 miles)
  - May have constituent LANs and MANs on different continents

Understanding the Types of Networks

- Enterprise network – another way to classify a network
  - Usually consists of several LANs that compose a MAN, CAN, or WAN
  - Connects different kinds of users across one or more organizations
  - Provides a variety of resources in order to fulfill business, research, educational tasks
  - Example: a university network that connects academic, accounting, student services, human resources, and other resources
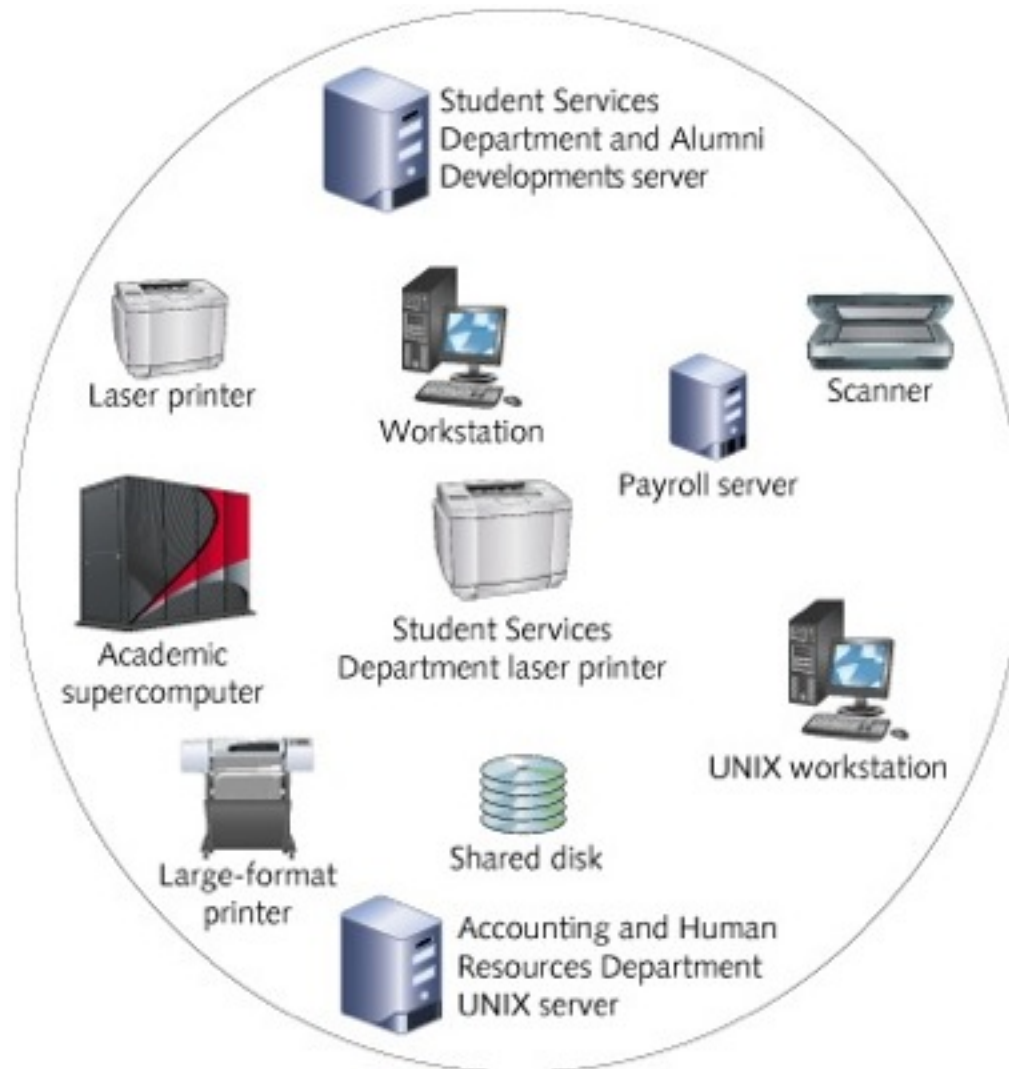
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Figure 1-6 Resources in an enterprise network

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Using Basic Networking Terms

- Node (or station): any device connected to a network
  - Personal computer, server, mainframe, supercomputer, printer, fax, DVD/CD-ROM, disk array, network device
- Nodes are connected through communications media
  - Wire cabling, fiber-optic cables, radio or infrared waves
  - Media allows transmission of signals to and from nodes
- Three network nodes important to users:
  - Workstations
  - Hosts
  - Servers

Using Basic Networking Terms

- Workstation - computer
  - Has CPU (central processing unit) and operating system
  - Runs local applications such as Microsoft Office
  - Runs network applications to access data on a server or mainframe
  - May fulfill roles as client and host
  - Client: workstation accessing data or software on another computer
- Host – the computer accessed for data or software by a client workstation

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Using Basic Networking Terms

- Servers
  - Powerful computers offering multiuser access
  - Holds software applications and data files
  - Host from two to as many as several thousand users
  - Network operating system must be installed
    - Example: Microsoft Windows Server operating system
  - Users who visit a website are accessing a server
- Network nodes attach to media through a NIC
- NIC (network interface card)
  - Board installed in computer or network device
  - Attached to communication media by connector or antenna

Using Basic Networking Terms

- Protocol – "languages" used by computers and network devices in order to communicate with one another
  - Internet Protocol (IP) is the main protocol used for network communications
  - IP is explained in greater detail in Chapter 3

Understanding Network Concepts in Historical Context

- Why study the history of networking?
  - Shows how networking practices and concepts have evolved
  - Provides social, political, technical context
- LANs/WANs rooted in telegraph and telephone systems
- Driving forces in networking technology
  - Interpersonal communication
  - Business transactions
  - Entertainment products

Using a Network in a Home

- Many homes now have two or more computers or other devices that can be networked together
- Three prominent uses of home networks
  – Sharing files and printers
  – Accessing the Internet and entertainment resources
  – Connecting home resources
    • Computers, entertainment devices, appliances

Connecting Computers for Sharing Files and Printers

- A home network can be used to:
  - Transfer files from computer to another (such as a laptop from work to a desktop at home)
  - Back up files from one computer to another
- Three common ways to share printers
  - Connect a printer to a computer and make it a shared network printer
    - Limitation: no one can use printer if computer is off
  - Attach printer directly to network using built-in NIC
  - Use a network device called a print server to connect one or more printers to the network

Figure 1-8 Sharing a printer on a wireless home network

Using Internet and Entertainment Resources

- Several methods for sharing an Internet connection
- Internet Connection Sharing (ICS) using Windows 7
  - Configure Internet sharing:
    - Create Internet connection with a Windows 7 computer
    - Connect that computer to your home network
    - Configure ICS in Windows 7 to allow that computer to act as a host so that other devices can access the Internet
  - Can also be set up in Windows Server 2008 R2
- Mac OS X Snow Leopard and Lion also offer a means to share an Internet connection
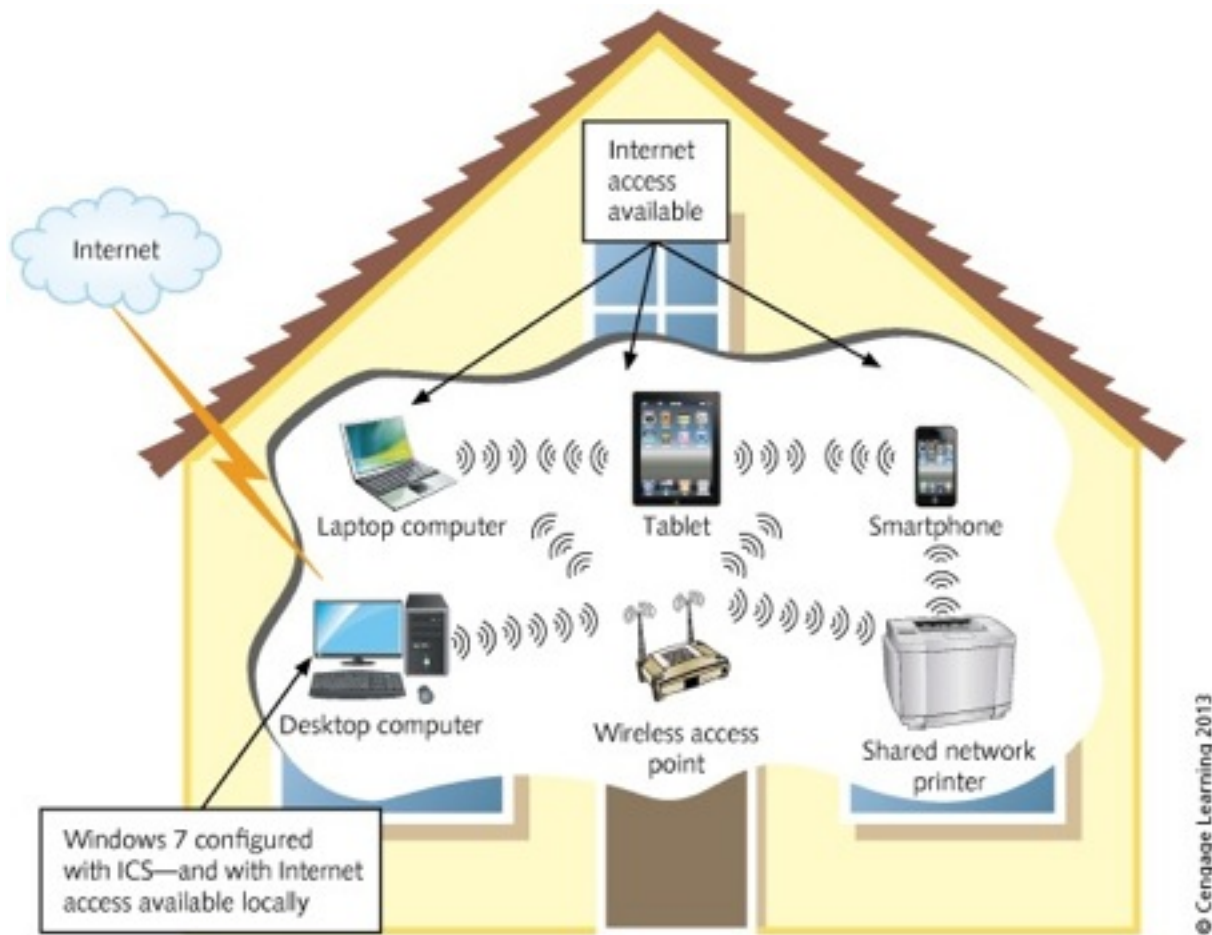
Figure 1-9 Using ICS in Windows 7

Using Internet and Entertainment Resources

- Some digital video devices and TVs come with a NIC
  - When connected to a network they can access video files or DVDs
- TVs with a NIC can connect to the Internet and play streaming videos and movies
- Smartphones and small tablets have wireless NICs that connect to wireless networks
  - iPhone and iPad use iOS operating system
  - Smartphones and tablets not made by Apple typically run the Android operating system

Connecting Home Resources

- Home appliances can be network devices
  - Example: refrigerators with digital message boards
    - Enable you to display messages from the Internet on the refrigerator message board
- Other control features enhanced in home networks
  - Temperature settings
  - Turning music on/off
  - Managing lighting systems

Using a Network in an Office

- In the following sections you will learn more about the following:
  - Using a network to save time and money
  - Using a network as a business strategy
  - Connecting office resources

Using a Network to Save Time and Money

- Two ways networks save time and money
  - Share information without leaving office
  - Telecommute to office via home network
- Example: An accountant's meeting with a client
  - Tax information is entered on networked computer
  - Tax documents can then be sent to shared printer
  - Editing and compiling can be done by an associate
  - Tax document returned to accountant
    - Meeting continues uninterrupted
  - Bill generated after meeting concludes

Using a Network as a Business Strategy

- The following two business strategy examples show how companies can benefit from a well-planned network (both strategies involve companies that sell specialty foods)

- Scenario 1:
  - Customer places order over the Internet
  - Order is manually transcribed to piece of paper
  - Data-entry clerk enters the order so a bill is generated
  - Data-entry clerk hand delivers order to inventory clerk
  - Inventory clerk prepares item for delivery
  - Usually takes 3 to 5 business days to be shipped

Using a Network as a Business Strategy

- Scenario 2 – A company that is fully networked
  - Customer places order over the Web
  - Order automatically entered into processing server
  - Order-processing server generates bill
  - Order-processing server sends data to processing area
  - Inventory automatically adjusted for order
  - Item sent out to customer same day as order came in
- The company in scenario 2 handles more volume and will most likely get more future orders due to their efficiency

Connecting Office Resources

- Advantages to networking office equipment
  - Same as for networking home devices, but multiplied
- Example of printer sharing in office of 28 people
  - Instead of 28 printers, only 3 or 4 printers are needed (centrally located)
  - Benefits
    - Save space for other activities
    - Reduce cost of providing print capability to office workers
    - Reduce cost of maintenance and cartridge replacement

Connecting Office Resources

- Resources shared when connected to a network
  - Files
  - Printers
  - DVD/CD-ROMs
  - Network storage through disk arrays
  - Centralized tape or DVD/CD backups of critical files
  - Fax machines
  - Specialty printers, such as large-format printers
  - Network conferencing devices
  - Internet connectivity
  - Internet telephony

Identifying Network Boundaries

- Distinguish network types using four properties
  - Communications medium
  - Protocol
  - Topology
  - Network type (private versus public)
- Communications medium
  - Often a LAN ends where there is a change in medium
    - Boundary 1: fiber-optic cables linking wire-cable LANs
    - Boundary 2: medium change from fiber-optics to microwaves or radio waves

Identifying Network Boundaries

- Protocols
  - Specify the formatting of the data and how it will be transmitted
    - Units of data are called packets or frames
  - Change/addition to protocol often signals LAN boundary
  - Example: a wired network differs from a wireless network in the way data is transferred

Identifying Network Boundaries

- Topology
  - Two components:
    - Physical layout of network cables and devices
    - Logical path followed by network packets or frames
  - In a wired network – physical layout is the actual path of the cable
  - In a wireless network – path is related to the placement of antennas on network devices
  - The logical path is the direction in which packets/ frames flow
    - May or may not fully match the physical layout

Identifying Network Boundaries

- **Network types**
  - Often change at network boundary
  - Example: beginning/end points of public and private networks
- Private networks owned and operated by organization
- Public networks offer services to public
- Virtual private network (VPN)
  - Private network tunnels through larger network
  - Restricted to designated member clients

Network Topologies

- Topology: physical layout combined with logical path
- Cable plant: pattern of physical layout
  - Wired networks: pattern of cabling laid in office, building, or campus
  - Wireless networks: types of antennas, devices, and the direction of transmission
- Decentralized network layout
  - Cable running between each station on network
  - Analogy: mountain climbers connected by a rope
- Centralized network layout
  - Each station physically connected to central device
  - Analogy: star with workstation as its points

Network Topologies

- Main topologies: bus, ring, star, mesh, and tree
- Hybrid topologies: star-bus, star-ring
- Selecting topology for network
  - Consider intended purpose for the network
    - Demand for network services
    - Number and kinds of applications used
    - Network traffic (number and frequency of frames to transmit)
    - Connection to other networks
    - Security needs
- Network topology influences network growth potential

Bus Topology

- Bus topology
  - Consists of cables connecting PCs or file servers together like a chain
  - Terminator attached to each end of bus cable segment
    - There is a beginning and an end to each segment
- When transmitting a packet across a bus:
  - It is detected by all nodes on the segment
  - Given time limit to reach destination or it is considered late
- IEEE (Institute of Electrical and Electronics Engineers)
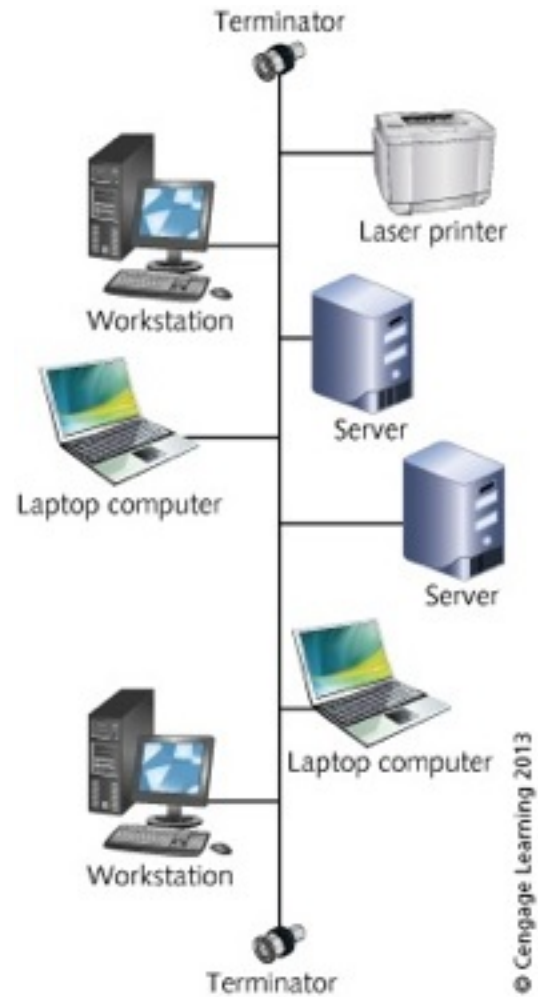 - Develops standards for network cabling, transmission

Figure 1-15 Bus topology

Bus Topology

- Terminator signals end of physical segment
  - Functions as a resistor that absorbs signal
  - Prevents signal reflection back on to the cable path
- Advantages of bus design
  - Requires less cable than other topologies
  - Easy to extend bus with a workstation
- Disadvantages of bus topology
  - High management costs
    - Single defective node can take down entire network
  - Can become quickly congested with network traffic

Ring Topology

- Ring topology: continuous data path with no beginning or ending point
  - Workstations attached to cable at points around ring
- Transmitting data across ring topology
  - Goes around ring to reach destination
  - Continues until ends at source node
- Advantages to ring topology
  - Easier to manage than bus
  - Suited to transmitting signals over long distances
- Disadvantages to ring topology
  - More expensive to implement than bus
  - Has become outdated so there are fewer equipment options

Figure 1-16 Ring topology

Star Topology

- Star topology: multiple nodes attached to central device (hub, switch, router)
  - Cable segments radiate from center like a star
  - Example: workstations/servers connected to a switch
- Advantages of star topology
  - Start-up costs are much lower than other topologies
  - Easier to manage, defective nodes quickly isolated
  - Easier to expand by connecting nodes or networks
  - Offers better equipment and high-speed options
  - Cabling and connectors are less expensive
- Disadvantages of star topology
  - Failure of central device may cause network failure
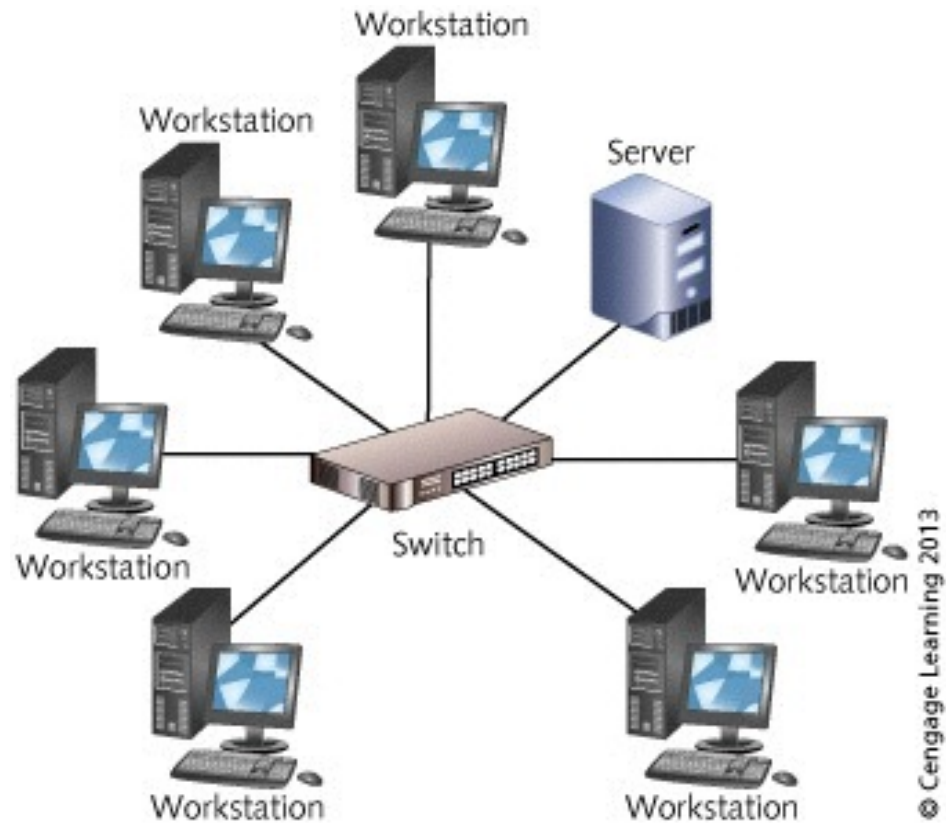 - Requires more cable than bus

Figure 1-17 Star topology

Star-Bus Hybrid Topology

- Star-bus (star-wired) topology
  - Each radiating finger is separate logical bus segment
  - Each segment terminated at both ends
- Advantages of star-bus topology
  - No exposed terminators
  - Easily connect switches/routers to expand network
  - Connection between central devices is a backbone
    - Backbone enables high-speed communication
  - Central devices have built-in intelligence to help detect problems
  - Many equipment and high-speed options available

Star-Ring Hybrid Topology

- Star-ring (star-wired) topology
  - Hub or access unit acts as linking device
  - Transmission of signal uses logical communication of ring
  - No need for built-in terminators

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Mesh Topology

- Mesh topology
  - Every node is connected to every other node in network
  - Provides fault tolerance
    - Fault tolerance: built-in protection against failure
    - If link breaks, nodes can still communicate
  - Alternate communication paths increase as number of nodes increase
- Mesh topology is used less on cabled LANs
  - Expensive to implement
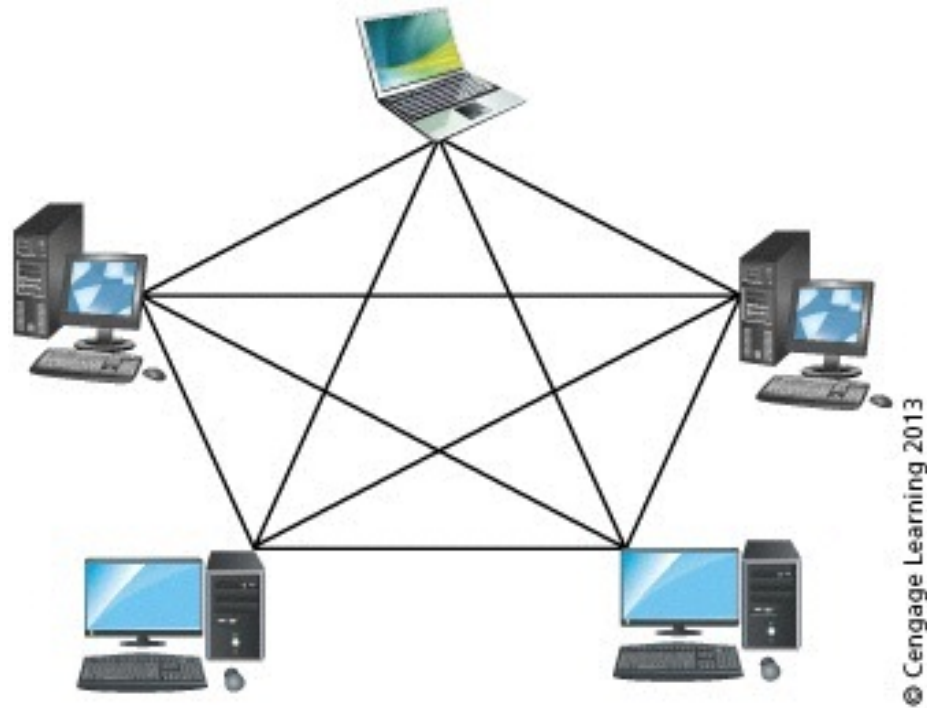- Often used in MANs and WANs due to reliability

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Figure 1-19 Mesh topology

Tree Topology

- Tree topology (expanded star)
  - Consists of a trunk (or bus) with limbs and branches (star)
- Advantage of the tree topology:
  - Can segregate network traffic so that communications in one limb of the tree can be isolated from other limbs
    - Important for highly secure networks
- Disadvantage of the tree topology:
  - On cabled networks, may require more cable
  - If main trunk is down, connected limbs can not communicate with one another

Network Design Introduction

- Step 1: Understand protocols, access methods, topologies
  - Example: Telecommunications-based WAN vs. satellite-based WAN
- Step 2: Understand physical equipment used
  - Example: Different media is used for backbone and internal network nodes
- Step 3: Understand basic network design principles
  - Structured wiring and networking techniques
  - Designing for multimedia and client/server applications
  - Taking advantage of LAN and WAN characteristics

Network Design Introduction

- Step 4: Assess characteristics of the planned network
  – Types of computers used as well as location
  – Software applications used and resources required
  – Patterns in organization relative to network use
  – High and low network use periods
  – How to simplify troubleshooting and maintenance
  – Determine security need for the network
  – Anticipate how growth will affect network resources

Putting It All Together: Designing a Simple LAN

- Scenario: Small law office with 4 attorneys & 1 secretary
- Four components of solid design
  - Star-bus hybrid topology
  - Switch connecting computes in middle of star layout using network cable (see figure on upcoming slide)
  - Ability to share certain information on network
  - Ability to share printers on network

Putting It All Together: Designing a Simple LAN

- Rationale for the design:
  - Star-bus economical to implement and maintain
  - Using cable instead of wireless due to sources of interference and building construction
  - Use of switch satisfies need for fast communication
  - Resource sharing using peer-to-peer network instead of using a server
    - Clients decide which files to share
    - Printers can be shared
  - Network will be simple and easy to maintain
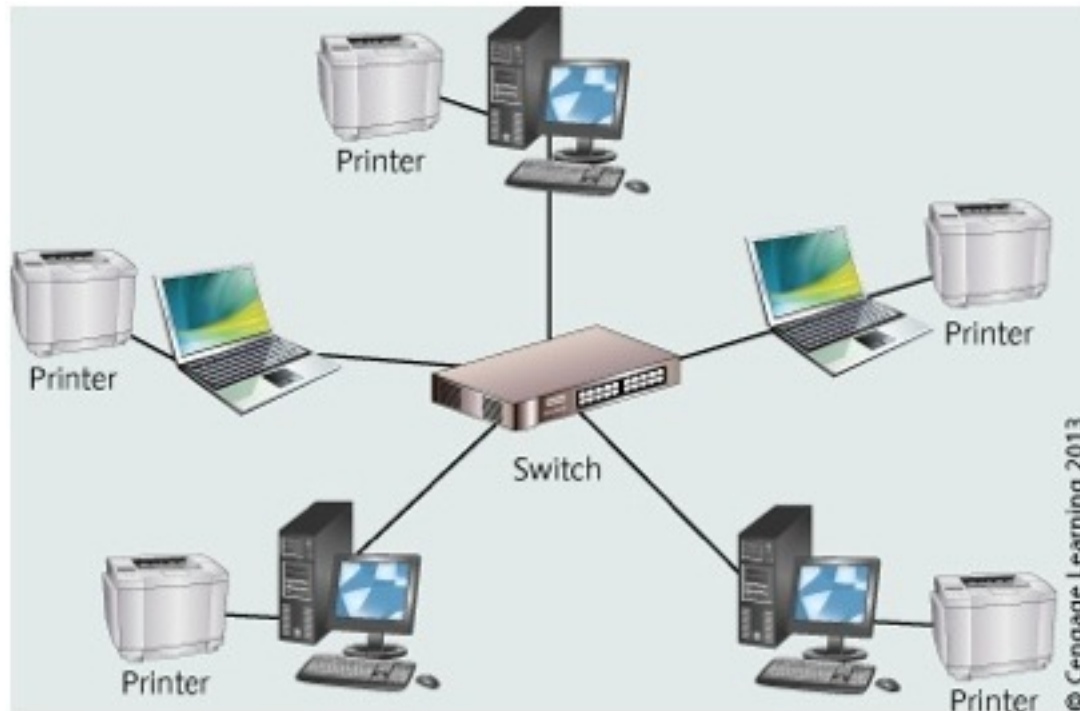 - Internet access easily added

Figure 1-22 Designing a network for a small law office

Summary

- A computer network consists of computers, printers, network devices, and software shared through a system of wired & wireless connections.

- Five main network types: PANs, LANs, MANs, CANs, and WANs.

- Networks consist of nodes, such as workstations and servers. The cable or radio waves that link nodes compose the communications media and are connected through network interface cards (NICs).

Summary

- Networks offer advantages for homes that have two or more computers – file and printer sharing and Internet connectivity.

- Networks in offices enable businesses and organizations to be more productive and to develop business strategies for optimal effectiveness.

- Ways to determine network boundaries include examining communications media, protocols, topologies, and network types.

Summary

- Networks are designed in terms of topologies. The basic network topologies are bus, ring, star, mesh, and tree. Two other topologies are hybrid: star-bus and star-ring.

- To design networks effectively, you need to understand protocols, topologies, network equipment, design principles, and how to assess the networking needs of an organization.