OBJECTIVES

Objective: Understand basic networking concepts.

Computer networks link two or more computers so they can exchange data and share resources. Networks enable communications (electronically sending and receiving data) through the establishment of communications channels.

A computer network consists of two or more computers linked together to exchange data and share resources. Networks can be either LAN or WAN.

- LAN—local area network (small geographic area)
- WAN—wide area network (large geographic area)

To connect to a network, you need to have a network interface card (NIC) and an operating system that supports networks.

Objective: Discuss the advantages and disadvantages of networks.

Computer networks can reduce hardware costs, enable users to share applications, create the means to pool all of an organization’s mission-critical data, and foster teamwork and collaboration.

- Reducing hardware costs
- Enabling shared applications
- Building massive information resources
- Centralized data management
- Connecting people

The advantages of networks are balanced out by some disadvantages as well:

- Loss of autonomy
- Lack of privacy
- Security threats
- Loss of productivity

Objective: Distinguish between peer-to-peer and client/server local area networks (LANs).

In a peer-to-peer network (P2P) network, all the computers on the network are equals—that’s where the term peer-to-peer comes from—and there’s no file server. In file sharing, each computer user decides which, if any, files will be
accessible to other users on the network. Users may also choose to share entire directories, or even entire disks. They can also choose to share peripherals, such as printers and scanners.

P2P networks are easy to set up. People who aren’t networking experts set up networks all the time, generally to share an expensive laser printer or provide Internet access to all the workstations on the LAN (Figure 7.8). Peer-to-peer networks tend to slow down with heavy use, however, and keeping track of all the shared files and peripherals quickly becomes confusing. For this reason, peer-to-peer LANs are best used for simple networks connecting no more than 10 computers.

The typical corporate LAN is a client/server network, which includes one or more file servers, and networked workstations called clients (Figure 7.10). The file server on a client/server network is a high-capacity, high-speed computer with a large hard disk capacity. It contains the network operating system (NOS), the software required to run the network. The server also contains network versions of programs and large data files. Clients—all the computers that can access the server—send requests to the server. The client/server model works with any size or physical layout of LAN and doesn’t tend to slow down with heavy use.

Objective: Define topology and understand how the three LAN topologies differ.

The physical layout of a LAN is called its network topology. A topology isn’t just the arrangement of computers in a particular space; a topology provides a solution to the problem of contention, which occurs when two workstations try to access the LAN at the same time. Contention sometimes results in collisions, the corruption of network data caused by two workstations transmitting simultaneously.

A bus, illustrated in Figure 7.11, is a network configuration in which the network cable is a single bus or backbone to which each workstation is connected. The two ends of the bus have special connectors called terminators.

A star, shown in Figure 7.12, is a network in which all other devices are connected to a central device, typically a computer. This configuration easily allows new users to be added to the network.

A ring, illustrated in Figure 7.13, is a network configuration in which all devices are connected in a closed loop or ring. In this network, data only travels in one direction around the ring.

Objective: Explain the importance of network protocols.

Computer networks require physical media, but their most important component consists of the protocols that define how network devices can communicate with each other. A network requires many protocols to function smoothly. When a
computer sends a message over the network, the application hands the message down the **protocol stack**, where a series of protocols prepares the message for transmission through the network. At the other end, the message goes up a similar stack. Figure 7.14 illustrates how messages move through the protocol stack.

**Objective:** Name the most widely used LAN protocol and discuss its versions.

By far the most widely used LAN protocol is **Ethernet**. The various versions of Ethernet are used by approximately 80 percent of all LANs. Although early versions of Ethernet (called 10base2 and 10base5) used coaxial cable in bus networks, the most popular versions today are Ethernet star networks that use hubs and twisted-pair wire. Two versions are available: 10baseT (10 Mbps) and Fast Ethernet (100 Mbps, also called 100baseT). The hardware to create a 10baseT Ethernet for five PCs can cost as little as $200. Refer to Figure 7.15 to review the various LAN protocols.

There are wireless networks as well. They use the 802.11 standards. Take the following security precautions when using Wi-Fi:

- Use a firewall and update all antivirus and antispyware software.
- Change the router’s default network name and password.
- Turn off SSID broadcasting to avoid detection by hackers.
- Make sure your router’s software is the updated version.
- Turn on WPA to enable encryption.
- Turn on MAC (Media Access Control) address filtering so only authorized devices can obtain access.

**Objective:** Identify the special components of a wide area network (WAN) that differentiate it from a LAN.

The special components that distinguish a WAN from a LAN are a point of presence and backbones. A **point of presence (POP)** is a WAN network connection point that enables users to access the WAN by a local analog telephone call (using a modem) or a direct digital hookup that enables a continuous direct connection. **Backbones** are the high-capacity transmission lines that carry WAN traffic.

Internet data can travel over any type of WAN because of Internet protocols. Collectively, Internet protocols are called **TCP/IP (Transmission Control Protocol/Internet Protocol)**.

**X.25** is the oldest packet-switching protocol; it is used by automated teller machines and credit card authorization devices.

New protocols that are designed for digital lines and faster data transfer rates include Switched Multimegabit Data Service (SMDS) and Asynchronous Transfer Mode (ATM).
Visit the Cisco Systems Web site (www.cisco.com). Cisco is the worldwide leader in networking equipment for the Internet.

**Objective:** Contrast circuit-switching and packet-switching networks and explain their respective strengths and weaknesses.

In **circuit switching**, the network creates a physical end-to-end circuit between the sending and receiving computers. Circuit switching works best when it is essential to avoid delivery delays. In a circuit-switching network, high-speed electronic switches handle the job of establishing and maintaining the connection.

In **packet switching**, an outgoing message is divided into data units of a fixed size, called **packets**. Each packet is numbered and addressed to the destination computer. The sending computer pushes the packets onto the network, where routers examine the packets. **Routers** are devices that examine each packet they detect. After reading the packet’s address, the router consults a table of possible pathways to the packet’s destination. If more than one path exists, the router sends the packet along the path that is most free of congestion. There’s no guarantee that the packets will arrive in the same order that they were sent, but that’s not a problem. Protocols on the receiving end put the packets in the correct order and decode the messages they contain. If any packets are missing, the receiving computer sends a message requesting retransmission.

Circuit switching creates a permanent end-to-end circuit that is optimal for voice and real-time data. Packet switching does not require a permanent switched circuit and can funnel more data through a medium with a given data transfer capacity. However, packet switching introduces slight delays that make the technology less than optimal for voice or real-time data.

**Objective:** Identify the options, components, configuration, and maintenance of a home area network (HAN).

Home networks can accommodate both wired and wireless communications.

Wired home networks typically use Cat-5 or Cat-6 Ethernet cable or a home’s electrical wiring. The simplest form of Ethernet network links different computers with a connecting switch or router. With an Ethernet network, each networked computer must have an Ethernet network adapter, also called a network interface card (NIC).

Wireless home networks rely on Wi-Fi radio signals. **Wi-Fi** is the wireless standard used for home networking.

For home Wi-Fi networks, each computer on the network broadcasts its information to another using radio signals. Wi-Fi networks use communications devices called network access points, also referred to as **wireless access points**, to send and receive data between computers that have wireless
adapters. In a home network, in addition to enabling communication between networked devices and other networks, wireless routers also act as network access points. Network access points enable you to move a notebook with a wireless adapter from room to room or to place computers in different locations throughout a house.

A P2P relationship exists among all the computers in a wireless network. All peripherals in a wireless network must be within the router’s range, which is usually 100–300 feet, depending on the building’s construction and thickness of the walls, floors, and ceilings.

Computer networks for homes and small businesses can be built using either wired or wireless technology. Wired Ethernet has been the traditional choice in homes. Wired LANs generally also require central devices like hubs, switches, or routers to accommodate more computers. In a wired network, a wire runs from the back of each computer to the router; the router serves as a communications point to connect the signal to the appropriate cable that goes to the intended destination.

To create a wireless network, you will need a wireless router, which will act as the hub of the service. Each node to be connected to the wireless network will need a wireless adapter that will connect to and communicate with the wireless router. Every device that connects to the wireless network will need a wireless adapter. Finally, connect your DSL or cable modem to your wireless router.

The good news is that there isn’t much to maintain with today’s home networking solutions. You may need to blow off dust and lint that accumulates on your router, wireless adapter, or modem. You may also need to use your operating system’s network utilities to refresh your network’s settings.

When something goes wrong, you should try to think of what might have caused the problem. Sometimes the solution is as simple as restarting your computer and/or unplugging the power source from your router and other peripherals and then plugging them back in. You may also need to restart each computer that is connected to your system.

**TEACHING NOTES**

I. Network Fundamentals

Define **network**. Explain that computer networks fall into two categories, LANs and WANs. Briefly define each category. Define **communication devices**.

Using Figure 7.4, indicate that a **NIC (network interface card)** is necessary to enable a computer to work with a network. When a NIC is installed and a computer is connected to a network, the computer is called
a workstation. Any device connected to a network (including a computer) is called a **node**. Explain that every node on the network has its own unique numeric address and that this addressing scheme is important to understand when we learn about the Internet.

**Teaching Tips**

If you have a NIC in your box of demonstration hardware, pass it around the room so students can see firsthand what one looks like.

Explain that each computer on the LAN must have system software installed that enables it to “talk” with the other computers on the network. Explain that most modern operating systems contain this type of software in their standard installations.

II. Advantages and Disadvantages of Networking

Summarize the five major gains realized by having a computer network:

1. *Reduced hardware costs.* Give examples of various resources that can be shared in a network environment, such as printers, scanners, and speedy processors.

2. *Application sharing.* Give examples of the network versions of software applications, such as Microsoft Office, which are distributed from the file server to each user's workstation.

3. *Sharing information resources.* Give examples of the power of a database when it is readily accessible and updated in real time.

4. *Centralized data management.* Discuss the advantages of storing data on a network.

5. *Connecting people.* Define the term groupware and give examples of how shared applications, such as calendars, can benefit organizations.

**Teaching Tips**

If your campus is currently using a groupware application such as Microsoft Exchange or GroupWise as an administrative tool, take time to demonstrate the use of shared calendars, distributed lists, and shared resources. Discuss new Web-based options such as Google Docs.

The advantages of networks are balanced out by some disadvantages as well:
1. **Loss of autonomy.** When you become a part of a network, you become a part of a community of users. Sometimes this means that you have to give up personal freedoms for the good of the group. For example, a network administrator may impose restrictions on what software you can load onto network computers.

2. **Lack of privacy.** Network membership can threaten your privacy. Network administrators can access your files and may monitor your network and Internet activities.

3. **Security threats.** Because some personal information is inevitably stored on network servers, it is possible that others may gain unauthorized access to your files, your user names, and even your passwords.

4. **Loss of productivity.** As powerful as networks are, they still fail. Access to resources is sometimes restricted or unavailable because of viruses, hacking, sabotage, or a simple breakdown. Data loss can be minimized by using good backup practices, but waiting for your data to be restored is an inconvenience or, worse yet, a direct threat to your ability to produce work on time.

III. **Local Area Networks (LANs)**

Explain that what sets the local area network (LAN) apart from other types of networks is that it is limited in geographic reach to about 1 mile. Most LANs are located within one building. Networks for home use are typically LANs. The speed of LANs continues to increase as technology improves.

Use Figure 7.7 to illustrate a common LAN setup. Ask students how it compares with the setups they have at home.

A. **Peer-to-Peer Networks**

   **Peer-to-peer (P2P) networks** are the simplest types of networks in that all computers are equal—there is no file server. These simple LANs can be set up by using operating system software such as Windows or Mac OS with no additional software. These are the easiest LANs to set up and are often used in the home to connect two or three computers. Use Figure 7.8 to help describe the components of a peer-to-peer network.

B. **Client/Server Networks**

   **Client/server networks** are used for connecting many computers together and require one or more file servers and a
**network operating system (NOS)** in addition to the operating system on each client computer. Use Figure 7.10 to help describe the components of a client/server network.

C. Virtual Private Network (VPN)

Many businesses use a virtual private network (VPN) to provide their employees and customers with quick, secure access to corporate information. A VPN operates as a private network over the Internet, making data accessible to authorized users in remote locations through the use of secure, encrypted connections and special software.

D. LAN Topologies

Define **topology** as the physical layout of a LAN.

**Teaching Tips**

As with the discussion on switching and routing techniques, this may be too detailed for some of your students. If time is short, display graphical representations of **bus**, **star**, and **ring topologies** as shown in Figures 7.11–7.13 and briefly describe the benefits of each.

E. LAN Protocols

Using the analogy of manners and etiquette, explain to students that a **protocol** is a set of standards or code of behavior that specifies network functions. Define **modulation protocols**. Introduce the term **protocol suite** as a collection of protocols that dictate the overall design of a network, called the **network architecture**.

1. Network Layers

   Using the metaphor of a layer cake, explain a protocol stack and how a message moves through the stack. Refer to Figure 7.14 to reinforce the concept.

2. LAN Technologies

   Refer to Figure 7.15 to illustrate discussion on popular LAN technologies. Focus your discussion on **Ethernet**, the most popular LAN standard for businesses, and **Wi-Fi**, a wireless LAN standard that offers Ethernet speeds without physical connections.
Emphasize the importance of safeguarding data when using Wi-Fi. Ask students what they can do to prevent others from “sharing” their wireless access and discuss if it is ethical to “borrow” access from another site without paying for it.

**Teaching Tips**

To learn more about Ethernet, check out Charles Spurgeon’s Ethernet Web site at [www.ethermanage.com/ethernet/ethernet.html](http://www.ethermanage.com/ethernet/ethernet.html). The site covers all the Ethernet technologies in use today and includes a practical guide for do-it-yourselfers.

F. Wi-Fi

Wi-Fi is a wireless LAN standard that offers Ethernet speeds through the use of radio waves instead of wires. Wi-Fi networks, though wireless, still need a central server or access point. In other words, with Wi-Fi technology, computers can communicate with each other, but to access the Internet or to communicate across distances, a central access point is required. Wireless routers sold for home use contain a **wireless access point** inside the router.

IV. Wide Area Networks (WANs)

Remind students that a LAN is limited in geographic reach to about 1 mile. Explain that if you need to link computers separated by 2 miles or thousands of miles, you would use a **WAN (wide area network)**.

A. **Point of Presence (POP)**

Explain that to obtain data to carry, the WAN must be accessible from a local connection, much like the telephone in your house enables you to connect to telephones all over the world.

B. **Backbones**

Discuss that **backbones** are the high-capacity transmission lines that carry WAN traffic. Some are regional, whereas others are continental or transcontinental in scope. The main purpose of a backbone is to carry huge amounts of data traffic.

As an illustration, explain how data travels between the Internet and the students’ computers at school.

C. **WAN Protocols**
Ask students to recall that one of the components of a network is the protocol used for communications. Because WANs are networks, they also use protocols.

1. The Internet Protocols

Discuss the Internet Protocols—obviously focusing on the Internet Protocol (IP) and the Transmission Control Protocol (TCP). Also define Internet address, or IP address. Explain why addresses are necessary for proper flow of information.

2. Circuit and Packet Switching

Describe the two basic technologies responsible for routing messages to their correct destination: circuit switching and packet switching.

Teaching Tips

Use a postal analogy to describe how packet switching works. Liken the distribution of messages on a network to the mail system. Suppose that a message to be sent is like a letter being dropped off at the local post office. The letter would be opened and cut into little pieces. Then each piece would be put into a separate envelope, addressed to the recipient, and reposted. The postman then collects the mail, including our letter, which is in a number of different envelopes. The envelopes are taken to the post office and added to all the other mail to be sorted. Our envelopes may end up in different bags, and the bags may be put on different trucks. Now our envelopes travel to the same destination, taking a variety of routes. Eventually all the envelopes (packets) begin arriving at the recipient’s local post office. They are progressively collected until all the envelopes are received. Once all the envelopes are received, the post office opens the envelopes and pieces our message back together. The restored document is then given to the recipient, who is able to read it. The local post office is the ISP, the postal system is the carrier, the sender is the publisher, and the recipient is the reader.

Teaching Tips

Encourage students to visit www.cisco.com, the Cisco Systems Web site. Cisco is the worldwide leader in networking equipment for the Internet.
Teaching Tips

Note that X.25 is the oldest packet-switching protocol and is used by ATM and credit card authorization machines. Newer technologies, such as Switched Multimegabit Data Service (SMDS) and Asynchronous Transfer Mode (ATM), are enabling much faster transfer rates.

D. WAN Applications

WANs enable companies to use many of the same applications that we use on the Internet, such as e-mail, conferencing, document exchange, and remote database access. Emphasize the concept that a company-wide WAN, rather than the Internet, is used for providing these applications because a WAN can be made more secure.

1. LAN-to-LAN Connections

WANs are often used to connect LANs that are located in separate geographic locations.

2. Transaction Acquisition

Computers such as point-of-sale (POS) terminals collect data and relay the information to central computers through WANs.

Teaching Tips

Lead students in a discussion about how the use of WANs has made it easier for businesses to manage business and meet customer needs. Ask if anyone has gone into a retail store for a certain item, only to have the item unavailable at that location. The salesperson then looks up the item on the company-wide WAN and finds one at a store nearby. Are there other examples of when a shared database can save users the time and energy needed to track down an item? Discuss the possibilities of sharing a system-wide database in a university or state library system.

V. Home Networks

A home area network (HAN) is a personal and specific use of network technology that provides connectivity between users and devices located in or near one residence.
A. Wired Home Networks

The Ethernet has become the standard network of choice for home networks that are still using a wired system. Ethernet standards detail the types of wires that must be used and how fast data can travel across the network.

**Teaching Tips**

Ask students under what circumstances someone might have a wired network in the home.

**Home Ethernet Networks**

The simplest form of home Ethernet network links different computers with a connecting switch or router. Devices connected by a switch can communicate only with other devices on the same network, whereas devices connected by a router can access other networks, including the Internet.

B. Wireless Home Networks

Wi-Fi is the wireless standard used for home networking. Home Wi-Fi networks are wireless networks in which each computer on the network broadcasts its information to another using radio signals. Wi-Fi networks use communications devices called network access points, also referred to as wireless access points, to send and receive data between computers that have wireless adapters.

**Teaching Tip**

Ask students why they think wireless networks are more popular than wired networks in the home.

C. Setting Up a Home Network

Setting up any network, including one for your home, goes much more smoothly if you can follow a series of steps.

1. **Planning**

   As with any type of project, you must first come up with a plan based on your specific home networking needs. You can determine your specific requirements by visiting your local home electronics store or by reading recommendations on the Web.
**Teaching Tips**

Demonstrate the Home Network Interactive Advisor at this Web site:
http://compnetworking.about.com/od/homenetworking/homeadvisor.htm. Then, explain to students how this site can be a useful tool for planning a home network.

2. Configuring a Wired Network

Each computer on a wired network must have a NIC; a wire runs from the back of each computer (from the NIC) to the router. Peripherals such as printers and scanners are usually plugged into the router as well.

3. Configuring a Wireless Network

A wireless router acts as a hub of service for a wireless network. Each node that will connect to the network will need a wireless adapter. Then, a DSL or cable modem can be connected to the router. The network configuration option from within the operating system must be set up.

**Teaching Tips**

Ask students if anyone has helped set up a home network before. If so, what role did he or she play?

4. Maintenance and Support

You should set up a regular maintenance schedule for both your computer and your network. The good news is that there isn’t much to maintain with today’s home networking solutions. You may need to blow off dust and lint that accumulates on your router, wireless adapter, or modem. You may also need to use your operating system’s network utilities to refresh your network’s settings.

D. The Future of Home Networking

*Convergence* is the future of home networking systems. You may be skeptical, but someday you may be able to use home networks to control household appliances, prepare food, or maintain a home’s appearance. Networked home security systems already help protect us from intrusion or damage from natural events.

**Teaching Tips**
Ask students how they think home networks will change over the next 10 years. How will they be different? What improvements will there be? What new features might exist?
<table>
<thead>
<tr>
<th>Protocol Name</th>
<th>Data Transfer Rate</th>
<th>Physical Media</th>
<th>Topology</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ethernet (10Base-T)</td>
<td>10 Mbps</td>
<td>Twisted-pair cable</td>
<td>Star</td>
</tr>
<tr>
<td>Fast Ethernet (100Base-T)</td>
<td>100 Mbps</td>
<td>Twisted-pair or fiber-optic cable</td>
<td>Star</td>
</tr>
<tr>
<td>Gigabit Ethernet</td>
<td>1,000 Mbps</td>
<td>Fiber-optic cable</td>
<td>Star</td>
</tr>
<tr>
<td>10 Gigabyte Ethernet</td>
<td>6.375 Gbps</td>
<td>Fiber-optic cable</td>
<td>Star</td>
</tr>
<tr>
<td>IBM Token Ring Network</td>
<td>4–16 Mbps</td>
<td>Twisted-pair cable</td>
<td>Ring</td>
</tr>
</tbody>
</table>
KEY TERMS

**backbone**—A high-speed, high-capacity medium that transfers data over hundreds or thousands of miles in a wide area network (WAN) such as the Internet. A variety of physical media are used for backbone services, including microwave relay, satellites, and dedicated telephone lines.

**bus topology**—The physical layout of a local area network in which the network cable is a single conduit that forms a bus, or line; every node, whether it is a computer or peripheral device, is attached to that bus. At the ends of the bus, connectors called terminators signify the end of the circuit.

**circuit switching**—One of two fundamental architectures for a wide area network (WAN); the other is packet switching, in which high-speed electronic switches create a direct connection between two communicating devices. The telephone system is a circuit-switching network.

**client**—In a client/server network, any type of computer: a PC, Mac, desktop, notebook, or even handheld device that is connected to a network and contains the software that enables it to send requests to the server.

**client/server network**—A computer network in which some computers are dedicated to function as servers, making information available to clients that make requests.

**collision**—In local area networks (LANs), a garbled transmission that results when two or more workstations transmit to the same network cable at exactly the same time. Networks have means of detecting and preventing collisions.

**communications device**—Any hardware device that is capable of moving data into or out of the computer, including modems, routers, switches, wireless access points, network interface cards, and other computers.

**congestion**—In a packet-switching network, a performance interruption that occurs when a segment of the network experiences an overload: too much traffic flooding the same network path.

**contention**—In a computer network, a problem that arises when two or more computers try to access the network at the same time. Contention can result in collisions, which can destroy data or require frequent and costly retransmissions.

**contention management**—In a computer network, the use of one of several techniques for managing contention and preventing collisions.
**Ethernet**—A set of standards that defines local area networks (LANs) capable of operating at data transfer rates of 10 Mbps to 6 Gbps. About 90 percent of all LANs use one of several Ethernet standards.

**file server**—In client/server computing, a computer that has been set aside (dedicated) to make program and data files available to users on a network who have been granted access.

**gigaPoP (gigabits per second points of presence)**—A point of presence (POP) that provides access to a backbone service capable of data transfer rates exceeding 1 Gbps (1 billion bits per second).

**home network (home area network or HAN)**—A personal and specific use of network technology that provides connectivity between users and devices located in or near one residence.

**hot spot**—A public wireless access location.

**hub**—A simple broadcast device used as the central wiring mechanism in a star topology network layout. It does not manage traffic and usually results in frequent collisions.

**Internet address (IP address)**—The unique 32-bit address assigned to a computer that is connected to the Internet. It is represented in four parts, which are separated by periods (such as 128.254.108.7).

**Internet Protocol (IP)**—One of the two core Internet standards (the other is the Transmission Control Protocol, TCP), IP defines the standard that describes how an Internet-connected computer should break data down into packets for transmission across the network and how those packets should be addressed so that they arrive at their destination. IP is the connectionless part of the TCP/IP protocols.

**latency**—In a packet-switching network, a signal delay that is introduced when many routers examine packets en route to their destination.

**local area network (LAN)**—A computer network that connects computers in a limited geographic area, such as a building or group of clustered buildings.

**logical address**—An identifier assigned to a network node by the software in use.

**modulation protocol**—In modems, the communications standard that governs how the modem translates between the computer’s digital signals and the analog tones used to convey computer data over the Internet so that the message is received and understood by the destination modem.

**network**—A group of two or more computer systems linked together to enable communications by exchanging data and sharing resources.
**network administrator**—A computer professional who installs, maintains, and supports computer networks, interacts with users, handles security, and troubleshoots problems. Also called a network engineer.

**network architecture**—The overall design of a computer network that specifies its functionality at every level by means of protocols.

**network interface card (NIC)**—An expansion board that fits into a computer’s expansion slots, or an adapter built into the motherboard, that provides the electronic components to make the connection between a computer and a network.

**network layers**—Separate divisions within a network architecture with specific functions and protocols to allow engineers to make changes within a layer without having to redesign the entire network.

**network operating system (NOS)**—An operating system needed to enable data transfer and application use over a local area network (LAN).

**network topology**—The physical layout of a local area network (LAN), such as a bus, star, or ring topology, that determines what happens when, for example, two clients try to access the LAN or transmit data simultaneously.

**node**—Any device connected to a network. A node can be any computer, peripheral device (such as a printer or scanner), or communication device (such as a modem).

**packet**—In a packet-switching network, a unit of data of a fixed size—not exceeding the network’s maximum transmission unit (MTU) size—that has been prepared for network transmission. Each packet contains a header that indicates its origin and its destination.

**packet switching**—One of two fundamental architectures for a wide area network (WAN); the other is a circuit-switching network. In a packet-switching network, such as the Internet, no effort is made to establish a single electrical circuit between two computing devices. For this reason, packet-switching networks are often called connectionless. Instead, the sending computer divides a message into packets, each of which contains the address of the destination computer, and dumps them onto the network. They are intercepted by devices called routers, which send the packets in the appropriate direction. The receiving computer assembles the packets, puts them in order, and delivers the received message to the appropriate application. Packet-switching networks are highly reliable and efficient, but they are not suited to the delivery of real-time voice and video.

**peer-to-peer (P2P) network**—A computer network design in which all the computers on the network are equals, or peers. There is no file server. File sharing is decided by each computer user. A user may choose to share a few files, an entire directory, or even an entire disk. Users also can choose to share peripherals, such as printers and scanners. P2P is best used when connecting 10 computers or fewer.

**physical address**—An identifier embedded in the hardware of a network node.
point of presence (POP)—A wired or wireless access connection point in a wide area network. ISPs that provide connectivity to the largest WAN, the Internet, are likely to have POPs in many cities and towns, but rural areas may not be so lucky.

protocol—In data communications and networking, the standard or set of rules that enable network-connected devices to communicate with each other.

protocol stack—In a computer network, a means of conceptualizing network architecture as vertical layers connected by protocols. Data is moved down the stack from its initial level, or transmitting node, to the lowest, physical hardware level that sends it over the network. When the data arrives at its destination, it moves back up the stack through the layers in reverse order, eventually arriving at the receiving node.

protocol suite—In a computer network, the collection of network protocols, or rules, that define the network’s functionality.

ring topology—The physical layout of a local network in which all nodes are attached in a circle, without a central host computer. This topology, which is no longer used frequently, employs a unit of data called a token that travels around the ring. A node can transmit only when it possesses the token, thus avoiding collisions.

router—A complex device, or in some cases software, used to connect two or more networks. Routers have the capability to determine the best path to route data and locate alternative pathways so that the data reaches its destination.

server—A computer or device with software that manages network resources. Common servers manage files, e-mail, printers, and databases.

star topology—The physical layout of a local network in which a central wiring device, which can be a hub switch or computer, manages the network. A new user is added by simply running a cable to the hub or switch and plugging the new user into a vacant connector.

switch—A device that filters and forwards data between computers, printers, and other network nodes, enabling them to talk to each other. A switch is used only to move data between nodes within a single network.

TCP/IP—The two most important Internet protocols. See Transmission Control Protocol and Internet Protocol.

terminator—Special connectors that signify the end of a circuit in bus topology.

token—A special unit of data that travels around the ring in a ring topology layout of a network. A node can transmit only when it possesses the token, thus preventing collisions.

Transmission Control Protocol (TCP)—One of two basic Internet protocols (the other is Internet Protocol, IP). TCP is the protocol (standard) that permits two Internet-connected computers to establish a reliable connection.
**virtual private network (VPN)**—A network that operates as a private network over the Internet, making data accessible to authorized users in remote locations through the use of secure, encrypted connections and special software.

**wide area network (WAN)**—A data network that uses long-distance transmission media to link computers separated by a few miles or even thousands of miles. The Internet is the largest WAN—it connects millions of LANs all over the globe using a variety of physical media, such as microwave relay, satellites, and phone lines.

**Wi-Fi**—A wireless LAN standard that offers Ethernet speeds through the use of radio waves instead of wires.

**wireless access point (AP or WAP)**—A node on a network that acts as a receiver and transmitter of wireless radio signals between other nodes on a network. A WAP can also act as a join or bridge connecting wireless clients to a wired network.

**wireless LAN**—A local area network that connects its nodes through the use of radio signals spread over a seemingly random series of frequencies for greater security.

**X.25**—A packet-switching network protocol optimized for use on noisy analog telephone lines.
Wide Area Networks

Discussion Questions: Be prepared to discuss the following questions in class.

1. How do LANs and WANs differ in terms of equipment components? What role does a POP play in a network? Would you use a LAN or WAN in your home?

2. A router is a network device that is responsible for forwarding a packet to its destination. Your text describes how a router operates: “After reading the packet’s address, the router consults a table of possible pathways that the packet can take to get to its destination.”
   - If networks are constantly expanding and adding new pathways, how do the tables in the network routers get updated?
   - A packet can usually take multiple pathways. How does the router determine which pathway is the best option?
   - Research and define the most common types of routers.

3. LANs and WANs that make up the Internet connect to the Internet backbone.
   - What is the purpose of a backbone?
   - When you are requesting a Web page to be displayed on the Internet, the data request must be processed between the various components of the Internet. Describe the flow of data that might occur when you try to access the Amazon.com site.
   - What is the importance of TCP/IP?
   - What are some practical examples of why a business might use a WAN?
ASSIGNMENTS
NETWORKS: COMMUNICATING AND SHARING RESOURCES

Local Area Networks

Short Answer Questions: Submit your written answers to the instructor.

1. A virtual private network (VPN) is an important tool for many businesses.
   - What are the advantages to employees if they have access to a VPN?
   - What security risks must be considered when implementing and using a VPN?
   - Describe how a VPN works.

2. Peer-to-peer (P2P) networks are popular today.
   - What are the benefits to joining a P2P network? What kind of information can be shared?
   - What are the drawbacks to joining a P2P?
   - What extra precautions should one take if joining a P2P?

3. Draw the three LAN topologies—star, bus, and ring—and explain how an outage or failure on a segment of the network would affect the entire network (i.e., would network traffic still be able to flow?). Based on these three scenarios, rank the topologies by ability to withstand a failure, starting with the most resilient.
1) Which of the following is NOT a name for the injury caused by prolonged keyboard use?
   A) Carpal tunnel syndrome
   B) Ergonomic injury
   C) Repetitive strain injury
   D) Cumulative trauma disorder

2) A(n) ________, or mid-range server, satisfies the computer needs for a small corporation or organization.

3) A ________, often used for collaboration, is a collection of Web pages designed to enable anyone with access to contribute or modify its content.

4) Saving a revised document to disk is an example of the computer's ability to perform the ________ function.
   A) input
   B) processing
   C) output
   D) storage

5) Users connect to networks on PCs called:
   A) requesters.
   B) clients.
   C) resources.
   D) remote users.

6) The most current operating systems are Microsoft Windows Vista and Mac OS X Snow Leopard.

7) The prices of personal computers have ________ and yet they have become more ________.
   A) dropped, slow
   B) risen, powerful
   C) dropped, powerful
   D) risen, complex

8) Professional workstations are used by the following types of professionals EXCEPT:
   A) engineers.
   B) architects.
   C) casual end users.
   D) financial analysts.

9) Online social network sites include all of the following EXCEPT:
   A) MySpace.
   B) Facebook.
   C) Yahoo.
   D) Twitter.

10) A floppy disk drive is an example of:
    A) newly developed technology.
    B) legacy technology.
    C) standard technology.
    D) modified technology.
11) Typing a document into the computer is an example of:
   A) input.
   B) processing.
   C) output.
   D) storage

12) When an entire job category is made obsolete by advances in technology, it is called:
   A) technological replacement.
   B) structural unemployment.
   C) robotics.
   D) automation.

13) _______ have the portability of a notebook but not the functionality.
   A) Laptops
   B) Netbooks
   C) Minibooks
   D) Tablets

14) If you have borrowed software from a friend and installed it on your own computer, you have engaged in digital ________.

15) _______ is a portable, wireless, paperback-sized e-book reading device which includes a text-to-speech function.
   A) Digital e-book
   B) Netbook
   C) Wiki
   D) Kindle 2

16) Which of the following computers would be used in a large corporation to complete huge processing needs, such as airline reservations?
   A) Minicomputer
   B) Mainframe
   C) Supercomputer
   D) Server

17) Which of the following is NOT an advantage of using computers?
   A) Information overload
   B) Speed
   C) Memory
   D) Storage

18) A computer system:
   A) is a collection of unrelated components that have been designed to work together.
   B) refers to the operations in the information-processing cycle.
   C) is a collection of related components that have been designed to work independently of each other.
   D) can be broken down into the two major components of hardware and software.

19) The device that combines the capabilities of a handheld computer with mobile phone capabilities and Web access is known as a ________.
   A) mobile computer
   B) multiphone
   C) smartphone
   D) minicomputer
20) In regard to maintaining a safe working environment for your hardware, which of the following statements is FALSE?
   A) The use of surge protectors avoids overloads.
   B) Hardware should be placed securely to prevent accidents.
   C) Cables, cords, and wires do not need to be securely fastened.
   D) Hardware should have plenty of space around it to prevent overheating.

21) The disparity in computer ownership and Internet access is known as the ________
   A) disparity ratio.
   B) non-computerized syndrome.
   C) digital divide.
   D) None of the above

22) What type of systems are those essential to an organization's viability?
   A) Mission-sensitive
   B) Profitability-critical
   C) Mission-critical
   D) Customer-centric

23) What type of systems are the ones on which human lives depend?
   A) Safety-critical
   B) Life-and-death-critical
   C) Mission-critical
   D) Health-dependent

24) More than ________ computers, monitors, and TVs become obsolete each year.
   A) 10 million
   B) 100 million
   C) 10 billion
   D) 100 billion

25) Which of the following items can contribute to e-waste when not properly disposed of?
   A) Computer monitors
   B) Cell phones
   C) Televisions
   D) All of the above
1) B
2) minicomputer
3) wiki
4) D
5) B
6) FALSE
7) C
8) C
9) C
10) B
11) A
12) B
13) B
14) piracy
15) D
16) B
17) A
18) D
19) C
20) C
21) C
22) C
23) A
24) B
25) D