Communications and Networks

Communications

- Computer **communications** describe a process in which two or more computers or devices transfer data, instructions and information.

- Even the smallest computers and devices can communicate directly with one another, often via the Internet.

Communications

- A **sending device** initiates an instruction to transmit data, instructions, or information.
- A communications device connects the sending device to a communications channel.
- A **communications channel**, or transmission media, is where the data, instructions, or information travel.
- A communications device connects the communications channel to a receiving device.
- A **receiving device** accepts the transmission of data, instructions, or information.

Communications

Uses of Computer Communications

- Blogs
- Chat Rooms
- E-Mail
- Fax
- FTP (file transfer protocol)
- Instant Messaging
- Internet
- Newsgroups
- RSS
- Video Conferencing
- VoIP
- Web
- Web 2.0
- Web Folders
- Wikis

Wireless Messaging Services

- Users can send and receive wireless messages to and from smart phones, cell phones, handheld game consoles, and other mobile devices through text messaging, picture/video messaging, and wireless instant messaging.

Text Messaging

- A mobile device with **text messaging**, also called **SMS** (short message service), capability allows users to send and receive short text messages on a phone or other mobile device or computer.
  - Mobile to Mobile
  - Mobile to E-Mail
  - Web to Mobile
  - Mobile to Provider

Picture/Video Messaging

- With **picture messaging**, users can send pictures and sound files as well as short text messages to a phone or other mobile device, or a computer.
- With **video messaging**, users can send short video clips, usually about 30 seconds in length, in addition to all picture messaging services.
- Mobile devices with picture/video messaging, also called *MMS (multimedia message service)*, typically have a digital camera built in.
  - Mobile to Mobile
  - Mobile to E-Mail

Wireless Instant Messaging

- Wireless instant messaging (IM) is a real-time Internet communications service that allows wireless mobile devices to exchange messages with one or more mobile devices or online users.
  - Mobile to Mobile
  - Mobile to Personal Computer
  - Web to Mobile

Wireless Internet Access Points

- A **wireless Internet access point** is used at home, work, school, or in public locations, for people to connect wirelessly to the Internet using mobile computers and devices.
- A *hot spot* is a wireless network that provides Internet connections o mobile computers and devices.
  - Wi-Fi hot spots provide wireless network connections to users in public locations, such as airports.
  - WiMAX hot spots are wider than Wi-Fi, often covering entire cities.
  - Bluetooth hot spots provide location-based services, such as coupons or menus.

Cybercafés

- A **cybercafé**, or Internet café, is a coffeehouse, restaurant, or other location that provides personal computers with Internet access to its customers.
- Some are free, some are by the hour.
- Some are also wireless hot spots.

Global Positioning System

- A **global positioning system** (**GPS**) is a navigation system that consists of one or more earth-based receivers that accept and analyze signals sent by satellites in order to determine the receiver's geographic location.
- A *GPS receiver* is a handheld, mountable, or embedded device that contains an antenna, a radio receiver, and a processor.
- Many smart phones have GPS capability.
- The most used application of GPS is to assist people with determining their location and giving directions to a destination.

Groupware

- **Groupware** is a software that helps groups of people work together on projects and share information.
- It is a common component of *workgroup computing,* which includes network hardware and software that enables group members to communicate.

Voice Mail

- **Voice Mail** functions much like an answering machine and allows someone to leave a voice message for one or more people.
- A *voice mailbox* is a storage location on a hard disk in the voice mail system.
- With *visual voice mail* users can view message details such as the length of the message and message contents.

Collaboration

- Many programs provide a means to **collaborate**, or work online, with other users connected to a server.
- *Collaborative software* includes tools that enable users to share documents via online meetings and communicate with other connected users.
  - When an *online meeting* takes place on the Web, it is called a **Web conference**.
- A *document management system,* provides for storage and management of a company's documents.

Web Services

- *Web services* describe standardized software that enables programmers to create applications that communicate with other remote computers of the Internet.

- Used by businesses to provide a means for departments to communicate with each other, suppliers, and venders.

- A *mashup* is a Web application that combines services from two or more sources, creating a new application.

Networks

- A **network** is a collection of computers and devices connected together via communications devices and transmission media.

- A network can be internal to an organization or span the world by connecting to the Internet.

Networks

Reasons Businesses Use a Network

facilitate communications

share hardware

transfer funds

share software

share data and information
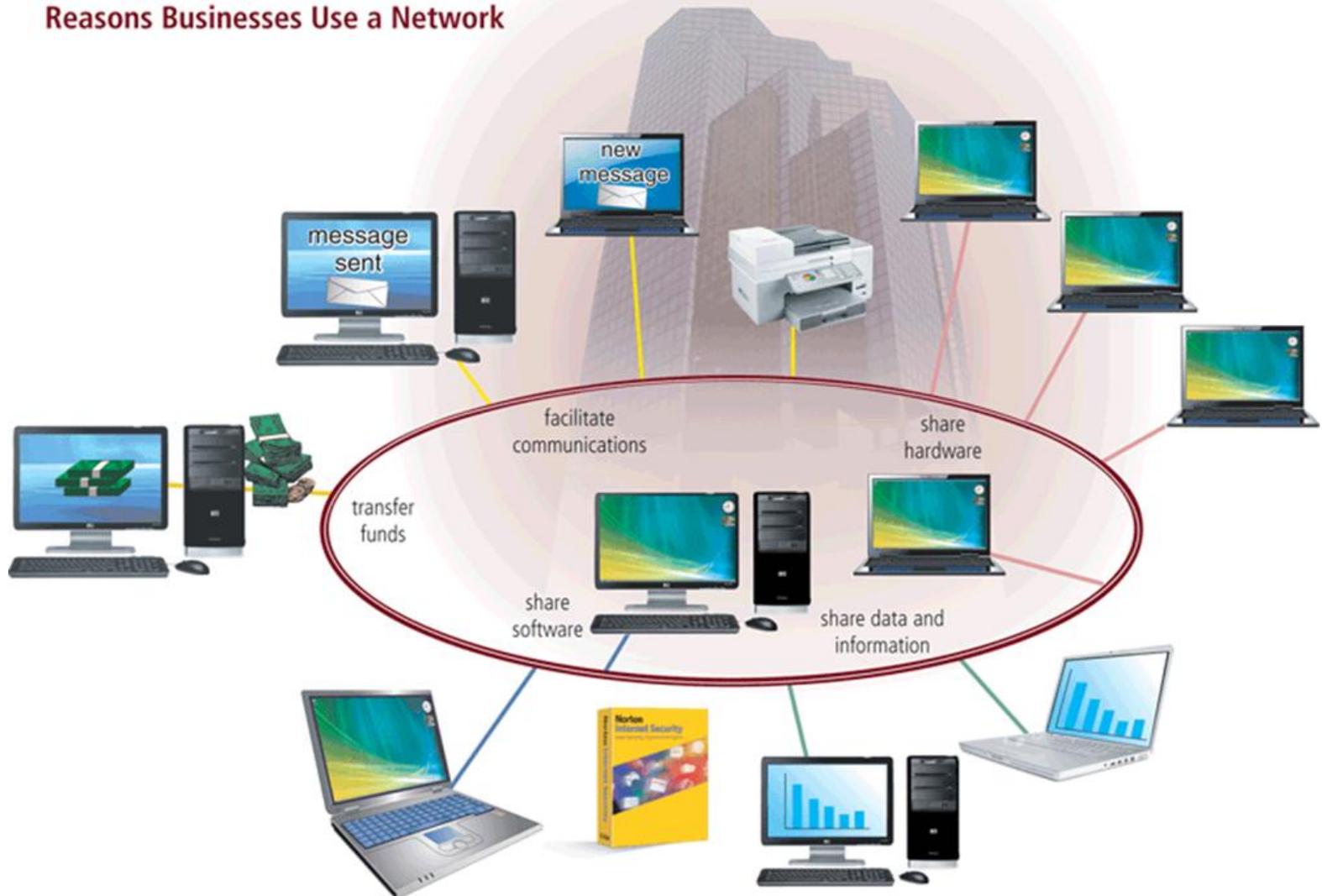
Networks

- Facilitating communications
  - People can communicate efficiently via e-mail, IM, chat rooms, blogs, wikis, social networks, and so on.
- Sharing hardware
  - Each computer on the network has access to network hardware.
- Sharing data and information
  - Any authorized computer can access data stored on other computers on the network.

Networks

- Sharing software
  - Users on a network have access to software on that network.
  - A *network license* is a legal agreement that allows multiple users to access the software on a server simultaneously.
  - A *site license* is a legal agreement that permits users to install the software on multiple computers.
- Transferring funds
  - *Electronic funds transfer* allows users connected to a network to transfer money from one bank account to another.

LANs, MANs, and WANs

- A **local area network** (LAN) is a network that connects computers and devices in a limited geographical area, such as a home.
- Each computer or device on the network, called a *node*, often shares resources such as printer, hard disks, and programs.
- A **wireless LAN** (WLAN) is a LAN that uses no physical wires.
- Very often, a WLAN communicates with a LAN for access to its resources.

LANs, MANs, and WANs

LANs, MANs, and WANs

- A *metropolitan area network* (MAN) is a high-speed network that connects local area networks in a metropolitan area such as a city or town and handles the bulk of communications activity across that region.
- A **wide area network** (WAN) is a network that covers a large geographic area using a communications channel that combines many types of media.
- The Internet is the world's largest WAN.

Network Architectures

- *Network architecture* is the design of computers, devices, and media in a network and is categorized as either client/server or peer-to-peer.

Client/Server

- On a **client/server** network, one or more computers act as a server, and the other computers on the network request services from the server.

- A **server**, sometimes called a *host computer*, controls access to the hardware, software, and other resources on the network and provides centralized storage for data.

- The **clients** are other computers and mobile devices on the network that rely on the server for its resources.

Peer-to-Peer

- A *peer-to-peer network* is a simple, inexpensive network that connects computers, called *peers*, that have equal responsibilities and capabilities, sharing hardware and data over the network.

Internet Peer-to-Peer

- *P2P* describes an Internet network on which users access each other's hard disks and exchange files directly over the Internet, usually called a *file sharing network*.

- BitTorrent, Gnutella, Kazaa, and LimeWire

Network Topologies

- A **network topology** refers to the layout of the computers and devices in a communications network.

Star Network

- On a *star network*, all of the computers and devices connect to a central device (a *hub* or a *switch*), thus forming a star.
- Easy to set up and maintain.
- If one node fails, only that node is affected.

Star network
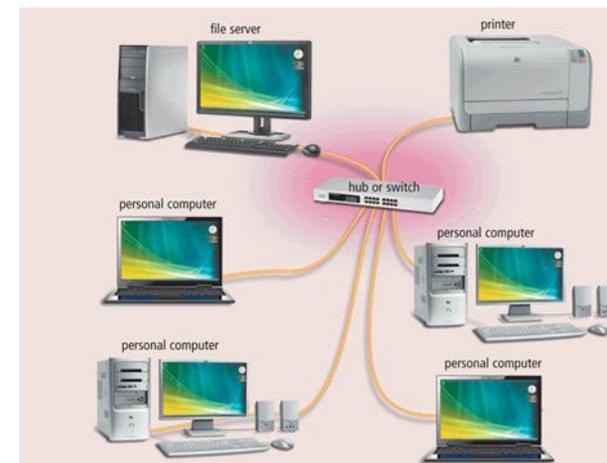
Bus Network

- A *bus network* consists of a single central cable, to which all computers and devices connect.
- The *bus* is the physical cable that connects the computers and other devices.
- Easy to install.
- Failure of one devices does not affect the rest of the network

Bus network

personal computer   personal computer

personal computer   personal computer   personal computer

Ring Network

- On a *ring network*, a cable forms a closed loop with all computers and deviecs arranged along the ring.

- When one node sends data, it travels to each computer until it reaches its destination.

Ring network

Intranets

- An *intranet* is an internal network that uses Internet technologies.
- It is a small version of the Internet that exists within an organization.

Network Communications Standards

- A *network standard* defines guidelines that specify the way computers access the medium to which they are attached, types of medium used, the speeds used on different types of networks, and the types of physical cable and/or wireless technology used.

- A standard that outlines characteristics of how two network devices communicate is called a *protocol*, which defines data format, coding schemes, error handling, and sequencing techniques.

Ethernet

- **Ethernet** is a network standard that specifies no central computer or device on the network should control when data can be transmitted.

- Based on a bus topology, but can be wired in a star pattern.

Token Ring

- The **token ring** standard specifies that computers and devices on the network share or pass a special signal, called a token, in a unidirectional manner and in a present order.
- A *token* is a special series of bits that function like a ticket. Only one token exists per network and only the holder has permission to transmit data.
- Based on ring topology, but can be used in star.

TCP/IP

- Transmission Control Protocol/Internet Protocol (**TCP/IP**) is a network standard, specifically a protocol that defines how messages are routed from one end of a network to the other, ensuring data arrives correctly.

- The messages are divided into small pieces, called *packets*, providing addresses for each packet, checking for errors, sequencing and regulating the flow of messages along the network.

Wi-Fi

- Computers with wireless capability can communicate via radio waves using **Wi-Fi** (wireless fidelity), which identifies any network based on the 802.11 standards.
- **802.11** is a series of network standards that specifies how two wireless devices communicate over the air.

802.11 Series of Standards	
Standard	**Transfer Rates**
802.11	1 or 2 Mbps
802.11a	Up to 54 Mbps
802.11b	Up to 11 Mbps
802.11g	54 Mbps and higher
802.11n	108 Mbps and higher

Bluetooth

- **Bluetooth** is a network standard, specifically a protocol, that defines how two Bluetooth devices use short-range radio waves to transmit data.

- Rates up to 3 Mbps.

- Range from 10 meters and up to 100 meters with additional equipment.

- Examples: desktops, mobile computers, smart phones, keyboards, mice, printers.

UWB

- **UWB**, which stands for **ultra-wideband**, is a network standard that specifies how two UWB devices use short-range radio waves to communicate at high speeds.
- At distances of 10 meters, transfer rate is 110 Mbps.
- Examples: transferring video from a digital video camera, printing from a digital camera, and downloading media to a portable media player.

IrDA

- The **IrDA** standard is used by devices to transmit data wirelessly to each other via infrared (IR) light waves.

- Rates of 115 Kbps to 4 Mbps.

- Requires a *line-of-sight transmission*, meaning the sending devices and the receiving device must be in line with each other so that nothing obstructs the path of the light wave.

RFID

- **RFID** (radio frequency identification) is a standard, specifically a protocol, that defines how a network uses radio signals to communicate with a tag placed in or attached to an object, animal, or person.
- The RFID tag (transponder) is an antenna and a memory chip with information to be transmitted via radio waves.
- Can be passive or active.
- Range from 5 inches to 15 feet.

WiMAX

- **WiMAX** (Worldwide Interoperability for Microwave Access), or **802.16**, is a network standard that specifies how wireless devices communicate over the air in a wide area.
- Properly equipped devices can communicate with the WiMAX tower, up to 30 miles away.
- Similar to Wi-Fi, it connects users to internet hot spots.

WAP

- The **Wireless Application Protocol** (**WAP**) is a standard, specifically a protocol, that specifies how some mobile devices such as smart phones can display the content of Internet services such as the Web, e-mail, and chat rooms.

Communications Software

- **Communications software** consists of programs that
  - Help users establish a connection to another computer or network
  - Manage the transmission of data
  - Provide an interface for users to communicate with one another

Communications Over the Telephone Netowrk

- The *public switched telephone netowrk (PSTN)* is the worldwide telephone system that handles voice-oriented telephone calls.

- This mostly digital network is an integral part of computer communications.

Dial-Up Lines

- A **dial-up line** is a temporary connection that uses one or more analog telephone lines for communications.

Dedicated Lines

- A **dedicated line** is a type of always-on connection that is established between two communication devices.

- ISDN, DSL, FTTP, T-carrier, and ATM

ISDN Lines

- *ISDN (Integrated Services Digital Network)* is a set of standards for digital transmission of data over standard copper telephone lines.

DSL

- **DSL** (Digital Subscriber Line) transmits at fast speeds on existing standard copper telephone wiring.

- *ADSL (Asymmetric digital subscriber line)* is a type of DSL that supports faster transfer rates when receiving than sending.

FTTP

- **FTTP**, or **Fiber to the Premises**, uses fiber-optic cable to provide extremely high-speed Internet access to a user's physical permanent location.
- As the cost of installing fiber decreases, it is becoming more popular.

T-Carrier Lines

- A **T-carrier line** is any of several types of long-distance digital telephone lines that carry multiple signals over a single communications line.

- The most popular is the *T1 line.*

- A *T3 line* is equal to the speed of 28 T1 lines and are quite expensive.

ATM

- **ATM** (Asynchronous Transfer Mode) is a service that carries voice, data, video, and multimedia at very high speeds.

Communications Devices

- A **communications device** is any type of hardware capable of transmitting data between a sending and receiving device.

Dial-Up Modems

- A *dial-up modem* is a communications device that can convert digital signals to analog signals, and back, so that data can travel along an analog phone line.
- Usually the form of an adapter card that you insert into the motherboard.

Digital Modems: ISDN, DSL, and Cable

- A *digital modem* is a communications device that sends and receives data to and from a digital line.

- An *ISDN modem* sends digital data from a computer to an ISDN line and back.

- A **DSL modem** sends digital data from a computer to a DSL line and back.

- A **cable modem**, or *broadband modem*, is a digital modem that sends and receives digital data over the cable television network.

Wireless Modems

- A **wireless modem** uses the cell phone network to connect to the Internet wirelessly from a notebook computer, smart phone, or mobile device.
- Some smart phones can function as a wireless modem when connected to a computer.

Network Cards

- A **network card**, sometimes called a *network interface card (NIC)*, is a communications device that enables a computer or device that does not have built-in networking capability to access a network.
- *Wireless network cards* often have an antenna and provide wireless data transmission.

network card for desktop computer, for wired network communications

ExpressCard module, for wireless network communications

Wireless Access Points

- A *wireless access point* is a central communications device that allows computers and devices to transfer data wirelessly among themselves or to a wired network.

Router

- A *router* is a communications device that connects multiple computers or other routers together.
- Can be used on any size network.
- To prevent unauthorized users from accessing files, many routers are protected by a built-in *hardware firewall*.
- Some support wireless communication, eliminating the need for a separate wireless access point.

Router
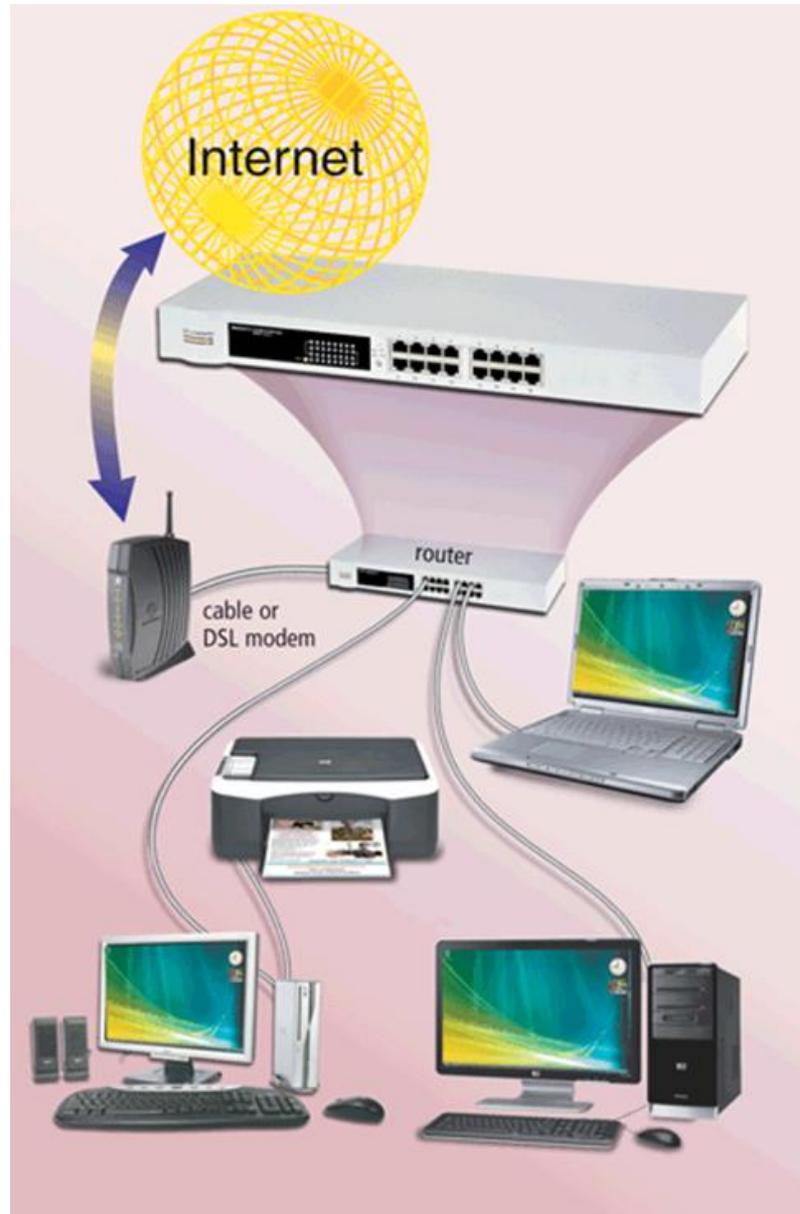
Hubs and Switches

- A hub or switch is a device that provides a central point for cables in a network.
- They receive data from many direction and forward to the correct destination.
- Hubs are generally used in larger networks, while switches are used for smaller ones.

hub or switch

hub or switch

Home Networks

- Many home users are connecting multiple computers and devices together in a **home network**.
  - Connect to the Internet
  - Share a single Internet connection
  - Access files on other computers
  - Share peripherals
  - Play games
  - Connect game consoles to the Internet
  - VoIP

Wired Home Networks

- Ethernet
  - This may involve running cables through walls.
- Powerline Cable Network
  - A network that uses the same lines that bring electricity into the house.
- Phoneline Network
  - An easy-to-install and inexpensive network that uses existing telephone lines in the house.

Wireless Home Networks

- Most home networks use a Wi-Fi network to send signals through the air at distances of up to 1,500 feet.
- Good for mobility.
- Don't need to run cables through walls.

Communications Channel

- The transmission media on which data travels in a communications system.
- The amount of data that can travel over a communications channel is called **bandwidth**. (higher = better)
- **Latency** is the time it takes a signal to travel from one location to another on a network. (lower = better)
- **Transmission media** consist of materials or substances capable of carrying one or more signals.

Communications Channel

- **Broadband** media transmit multiple signals simultaneously.
  - ◦ DSL and Cable are examples.
- *Physical transmission media* use wire, cable, or other tangible materials.
- *Wireless transmission media* send signals through the air using radio, microwave, and infrared signals.

Physical Transmission Media

- **Twisted-pair cable** consists of one or more twisted-pair wires (to reduce **noise**, or electrical disturbance) bundled together.

- **Coaxial cable**, often referred to as *coax*, consists of a single copper wire surrounded by at least three layers: insulation, braided metal, plastic coating.

- **Fiber-optic cable** consists of dozens or hundreds of thin strands of glass or plastic (*optical fiber*) that use light to transmit signals.

Physical Transmission Media

Twisted-pair cable
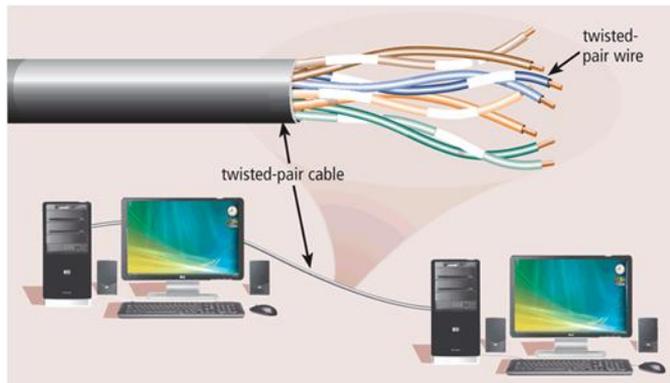
Coaxial cable
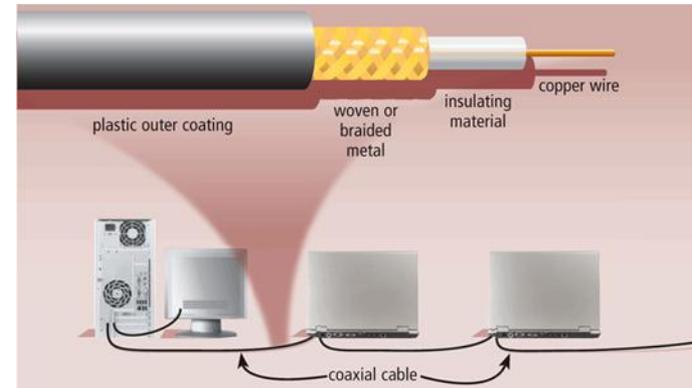
Fiber-optic cable
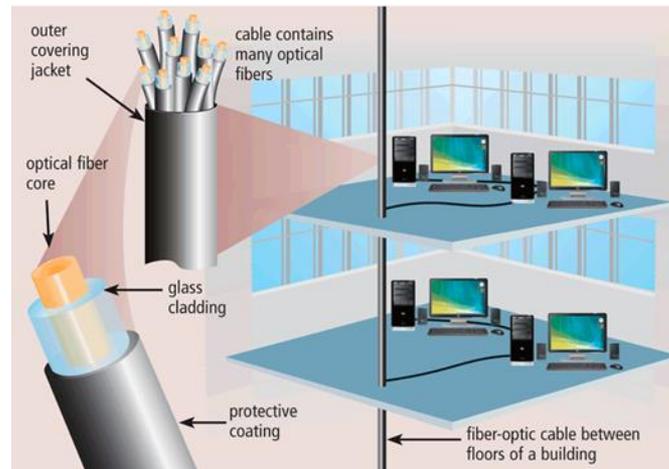
Wireless Transmission Media

- Infrared uses IR light waves.
- **Broadcast radio** is a wireless transmission medium that distributes radio signals through the air over long distances, such as between cities, and short distances such as within an office.
  - Includes Bluetooth, UWB, Wi-Fi, and WiMAX.
- **Cellular radio** is a form of broadcast radio that is used widely for mobile communications, specifically wireless modems and cell phones.

Wireless Transmission Media

- **Microwaves** are radio waves that provide a high-speed signal transmission.
  - *Fixed wireless* involves sending signals from one *microwave station* to another.
- **Communications Satellite** is a space station that receives microwave signals from an earth-based station, amplifies the signals, and broadcasts the signals over a wide area to earth-based stations.