Introduction to Information and Communication Technologies

Chapter 8

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Agenda

- Uses of Computer Communication
- Networks
- Network Communications Standards
- Communications Software
- Communications over the Telephone Network
- Communications Devices
- Home Networks
- Communications Channel
- Physical Transmission Media
- Wireless Transmission Media.

Communication

- Computer **communications** describes a process in which two or more computers or devices transfer data, instructions, and information.
- For successful communications, you need the following:
- A **sending device** that initiates an instruction to transmit data, instructions, or information.
- A communications device that connects the sending device to a communications channel.
- A **communications channel**, or transmission media on which the data, instructions, or information travel.
- A communications device that connects the communications channel to a receiving device.
- A **receiving device** that accepts the transmission of data, instructions, or information.

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PREVIOUSLY DISCUSSED USES OF COMMUNICATIONS
Internet — Worldwide collection of networks that links millions of businesses, government agencies, educational institutions, and individuals
Web — Worldwide collection of electronic documents on the Internet that users access through a Web browser
E-Mail — Transmission of messages and files via a computer network
Instant Messaging — Real-time one-on-one Internet communications service that notifies you when one or more people are online and then allows you to exchange messages, pictures, files, audio, and video
Chat Rooms — Real-time typed conversation among two or more people that takes place on a computer connected to a network that also may allow the exchange of messages, pictures, files, audio, and video
Newsgroups — Online areas in which users have written discussions about a particular subject
Internet Telephony — Conversation that takes place over the Internet using a telephone connected to a computer or mobile device
FTP — Internet standard that permits users to upload and download files to and from FTP servers on the Internet
Web Folders — Location on a Web server (also known as an HTTP server) to which users publish documents and other files
Video Conferencing — Real-time meeting between two or more geographically separated people who use a network to transmit audio and video data
Fax Machine or Computer Fax/Modem — Transmits and receives documents over telephone lines

USES OF COMPUTER COMMUNICATIONS

- Computer communications are everywhere. Many require that users subscribe to an Internet access provider.
- With other computer communications, an organization such as a business or school provides communications services to employees, students, or customers.
- The following pages discuss a variety of computer communications.

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USES OF COMPUTER COMMUNICATIONS

- **WIRELESS MESSAGING SERVICES:** Users can send and receive wireless messages to and from smart phones, cellular telephones, or PDAs using three techniques: text messaging, wireless instant messaging, and picture/video messaging.
- **Text Messaging** also called SMS (short message service), capability allows users to send and receive short text messages on a phone. Text messaging services typically provide users with several options for sending and receiving messages:
  - **Mobile to Mobile:** send a message from your mobile device to another mobile device
  - **Mobile to E-Mail:** send a message from your mobile device to an e-mail address anywhere in the world
  - **Web to Mobile:** send a message from a text messaging Web site to a mobile device or request that a Web site alert a mobile device with breaking news and other updates, such as sports scores, stock prices, and weather forecasts
  - **Mobile to Provider:** send a message by entering a four- or five-digit number assigned to a specific content or wireless service provider, followed by the message, such as a vote for a television program contestant

USES OF COMPUTER COMMUNICATIONS

- **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. Some wireless Internet service providers partner with IM services so you can use your smart phone or PDA to send and receive wireless instant messages. With a compatible IM service, users have these IM options:
- Mobile to Mobile: use a wireless instant messenger to communicate between two mobile devices
- Mobile to Personal Computer: use a wireless instant messenger to communicate between a mobile device and a personal computer
- Web to Mobile: send or forward messages from a personal computer's instant messenger to a mobile device

USES OF COMPUTER COMMUNICATIONS

- **PICTURE/VIDEO MESSAGING** With **picture messaging**, users can send pictures and sound files, as well as short text messages, to a phone, PDA, or computer. With **video messaging**, users can send short video clips in addition to all picture messaging services. Picture/video messaging service, also called MMS (multimedia message service), typically provides users these options for sending and receiving messages:
- Mobile to Mobile: send the picture/video from your mobile device to another mobile device
- Mobile to E-Mail: send the picture/video from your mobile device to an e-mail address anywhere in the world

USES OF COMPUTER COMMUNICATIONS

- **Wireless Internet Access Points** At home, work, school, and in many public locations, people connect wirelessly to the Internet through a **wireless Internet access point** using mobile computers or other devices. Two types of wireless Internet access points are hot spots and 3G networks.
- A **hot spot** is a wireless network that provides Internet connections to mobile computers and other devices. Through the hot spot, mobile users check e-mail, browse the Web, and access any service on the Internet.
- Two popular hot spot technologies are Wi-Fi and WiMAX.
- In general, Wi-Fi hot spots have an indoor range of 100 feet and an outdoor range of 300 feet. Wi-Fi hot spots provide wireless network connections to users in public locations such as airports, train stations, hotels, schools, shopping malls, bookstores, libraries, restaurants, and coffee shops.
- The coverage range for WiMAX hot spots, by contrast, can extend to more than 30 miles and cover entire cities
- A **3G network** uses cellular radio technology to provide users with high-speed Internet connections, as long as they are in the network's range. Users access the 3G network through a cellular phone or notebook computer.

USES OF COMPUTER COMMUNICATIONS

- **Cybercafés** When mobile users travel without their notebook computer or Internet-enabled mobile device, they can visit a cybercafé to access e-mail, the Web, and other Internet services. A **cybercafé**, or Internet cafe, is a coffeehouse, restaurant, or other location that provides personal computers with Internet access to its customers
- 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 include a screen display that shows an individual's location on a map.
- The data obtained from a GPS, however, can be applied to a variety of other uses:
- creating a map, ascertaining the best route between two points, locating a lost person or stolen object, monitoring the movement of a person or object, determining altitude, and calculating speed. Many vehicles use GPSs to provide drivers with directions or other information.

USES OF COMPUTER COMMUNICATIONS

- **Collaboration** Many software products provide a means to **collaborate**, or work online, with other users connected to a server.
- Two methods of collaboration include collaborative software and document management systems.
- **Collaborative software** includes tools that enable users to share documents via online meetings and communicate with other connected users. An online meeting allows users to share documents with others in real time. That is, all participants see the document at the same time. As someone changes the document, everyone in the meeting sees the changes being made. E-g Zoom cloud meeting.
- A **document management system** provides for storage and management of a company's documents, such as word processing documents, presentations, and spreadsheets. Users then access these documents, depending on their needs. A document management system can track all changes made to a document. It also can store additional information such as the document's creation date, the user who created the document, a summary of the document, and any keywords associated with the document.

USES OF COMPUTER COMMUNICATIONS

- **Groupware** is software that helps groups of people work together on projects and share information over a network. Groupware is a component of a broad concept called workgroup computing, which includes network hardware and software that enables group members to communicate, manage projects, schedule meetings, and make group decisions.
- **Voice mail**, which functions much like an answering machine, allows someone to leave a voice message for one or more people. Unlike answering machines, however, a computer in the voice mail system converts an analog voice message into digital form. Once digitized, the message is stored in a voice mailbox. A voice mailbox is a storage location on a hard disk in the voice mail system. Some voice mail systems can send digital voice mail files to e-mail addresses.
- **Web services** describe standardized software that enables programmers to create applications that communicate with other remote computers over the Internet or over an internal business network.

Network

- A **Network** is a collection of computers and devices connected together via communications devices and transmission media. Many businesses network their computers together to facilitate communications, share hardware, share data and information, share software, and transfer funds.
- A network can be internal to an organization or by connecting to the Internet. Instead of using the Internet or an internal network, some companies hire a value-added network provider for network functions.
- A **value-added network** (**VAN**) is a third-party business that provides networking services for a fee.
- Networks usually are classified as a local area network, metropolitan area network, or wide area network. The main differentiation among these classifications is their area of coverage.

LAN, MAN and WAN

- A **local area network** (**LAN**) is a network that connects computers and devices in a limited geographical area such as a home, school computer laboratory, office building, or closely positioned group of buildings.
- Each computer or device on the network, called a node, often shares resources such as printers, large hard disks, and programs. Often, the nodes are connected via cables.
- A **wireless LAN** (**WLAN**) is a LAN that uses no physical wires. Very often, a WLAN communicates with a wired LAN for access to its resources.
- 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 MAN typically includes one or more LANs, but covers a smaller geographic area than a WAN.
- A **wide area network** (**WAN**) is a network that covers a large geographic area using a communications channel that combines many types of media such as telephone lines, cables, and radio waves. A WAN can be one large network or can consist of two or more LANs connected together. The Internet is the world's largest WAN.

NETWORK ARCHITECTURES

- **CLIENT/SERVER** On a **client/server network**, one or more computers act as a server; the other computers on the network request services from the server.
- A **server** controls access to the hardware, software, and other resources on the network and provides a centralized storage area for programs, data, and information. The **clients** are other computers and mobile devices on the network that rely on the server for its resources. For example, a server might store a database of customers. Clients on the network (company employees) access the customer database on the server. Some servers, called dedicated servers, perform a specific task.
- Most client/server networks require a person to serve as a network administrator because of the large size of the network.

NETWORK ARCHITECTURES

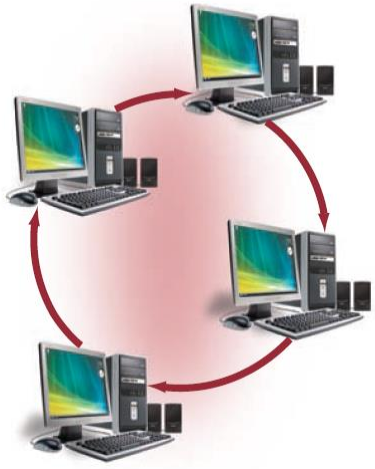
- One type of **peer-to-peer network** is a simple, inexpensive network that typically connects fewer than 10 computers.
- Each computer, called a peer, has equal responsibilities and capabilities, sharing hardware (such as a printer), data, or information with other computers on the peer-to-peer network.
- Each computer stores files on its own storage devices. Thus, each computer on the network contains both the network operating system and application software.
- Another type of peer-to-peer, called **Internet P2P**, describes an Internet network, on which users access each other's hard disks and exchange files directly.
- Examples of networking software that support P2P are BitTorrent

Network Topologies

- A **bus network** consists of a single central cable, to which all computers and other devices connect. The bus is the physical cable that connects the computers and other devices.
- The bus in a bus network transmits data, instructions, and information in both directions. When a sending device transmits data, the address of the receiving device is included with the transmission so the data is routed to the appropriate receiving device.
- Bus networks are popular on LANs because they are inexpensive and easy to install. One advantage of the bus network is that computers and other devices can be attached and detached at any point on the bus without disturbing the rest of the network.
- Another advantage is that failure of one device usually does not affect the rest of the bus network. The greatest risk to a bus network is that the bus itself might become inoperable. If that happens, the network remains inoperative until the bus is back in working order.

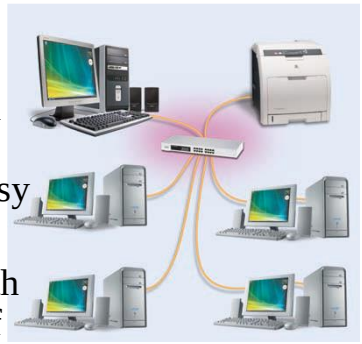
Network Topologies

- **RING NETWORK** a cable forms a closed loop (ring) with all computers and devices arranged along the ring.
- Data transmitted on a ring network travels from device to device around the entire ring, in one direction. When a computer or device sends data, the data travels to each computer on the ring until it reaches its destination.
- If a computer or device on a ring network fails, all devices before the failed device are unaffected, but those after the failed device cannot function. A ring network can span a larger distance than a bus network, but it is more difficult to install. The ring topology primarily is used for LANs, but also is used in WANs.



Network Topologies

- **STAR NETWORK** all of the computers and devices (nodes) on the network connect to a central device, thus forming a star.
- Two types of devices that provide a common central connection point for nodes on the network are a hub and a switch. All data that transfers from one node to another passes through the hub/switch. Star networks are fairly easy to install and maintain.
- Nodes can be added to and removed from the network with little or no disruption to the network. On a star network, if one node fails, only that node is affected. The other nodes continue to operate normally.
- If the hub/switch fails, however, the entire network is inoperable until the device is repaired.



Network Communications Standards

- A **network standard** defines guidelines that specify the way computers access the medium to which they are attached, the type(s) of medium used, the speeds used on different types of networks, and the type(s) of physical cable and/or the wireless technology used.
- A standard that outlines characteristics of how two network devices communicate is called a **protocol**.
- The following sections discuss some of the more widely used network communications standards for both wired and wireless networks including Ethernet, token ring, TCP/IP, 802.11 (Wi-Fi), Bluetooth, UWB, IrDA, RFID, WiMAX, and WAP.

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Network Communications Standards

- **Ethernet** is a network standard that specifies no central computer or device on the network (nodes) should control when data can be transmitted; that is, each node attempts to transmit data when it determines the network is able to receive communications. Ethernet is based on a bus topology.
- If two computers on an Ethernet network attempt to send data at the same time, a collision occurs, and the computers must attempt to send their messages again.
- 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 preset order.
- A token is a special series of bits that function like a ticket. The device with the token can transmit data over the network. Only one token exists per network. This ensures that only one computer transmits data at a time. Token ring is based on a ring topology

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Network Communications Standards

- **TCP/IP** Short for Transmission Control Protocol/Internet Protocol, **TCP/IP** is a network standard, specifically a protocol, that defines how messages (data) are routed from one end of a network to the other. TCP/IP describes rules for dividing messages into small pieces, called packets; providing addresses for each packet; checking for and detecting errors; sequencing packets; and regulating the flow of messages along the network.
- **802.11 (WI-FI)** Developed by IEEE, **802.11** also known as **Wi-Fi** (**wireless fidelity**) and wireless Ethernet, is a series of network standards that specifies how two wireless devices communicate over the air with each other. Using Wi-Fi, computers or devices that have the appropriate wireless capability communicate via radio waves with other computers or devices. The Wi-Fi standard uses techniques similar to the Ethernet standard to specify how physically to configure a wireless network.

Network Communications Standards

- **Bluetooth** is a standard, specifically a protocol, that defines how two Bluetooth devices use short-range radio waves to transmit data. To communicate with each other, Bluetooth devices often must be within about 10 meters (about 33 feet) but can be extended to 100 meters with additional equipment.
- **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 with each other. For optimal communications, the devices should be within 2 to 10 meters (about 6.5 to 33 feet) of each other. Examples of UWB uses include wirelessly transferring video from a digital video camera, printing pictures from a digital camera, downloading media to a portable media player, or displaying a slide show on a projector.

Network Communications Standards

- **IRDA** Some computers and devices use the **IrDA** specification to transmit data wirelessly to each other via infrared (IR) light waves. Infrared requires a line-of-sight transmission; that is, the sending device and the receiving device must be in line with each other so that nothing obstructs the path of the infrared light wave.
- **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, an animal, or a person. The tag consists of an antenna and a memory chip that contains the information to be transmitted via radio waves. Through an antenna, an RFID reader reads the radio signals and transfers the information to a computer or computing device. Readers can be handheld or embedded in an object such as a doorway or tollbooth.

Network Communications Standards

- **WiMAX** (Worldwide Interoperability for Microwave Access), also known as **802.16**, is a newer network standard developed by IEEE that specifies how wireless devices communicate over the air in a wide area. Using the WiMAX standard, computers or devices with the appropriate WiMAX wireless capability communicate via radio waves with other computers or devices via a WiMAX tower.
- The WiMAX tower, which can cover up to a 30-mile radius, connects to the Internet or to another WiMAX tower.
- The WiMAX standard provides wireless broadband Internet access at a reasonable cost over long distances to business and home users. The WiMAX standard, similar to the Wi-Fi standard, connects mobile users to the Internet via hot spots.
- **Wireless Application Protocol** (**WAP**) is a standard, specifically a protocol, that specifies how some wireless mobile devices such as smart phones and PDAs can display the content of Internet services such as the Web, e-mail, chat rooms, and newsgroups.

Communications Software

- **Communications software** consists of programs that
  - help users establish a connection to another computer or network;
  - manage the transmission of data, instructions, and information;
  - provide an interface for users to communicate with one another.
- The first two are system software and the third is application software. Chapter 3 presented a variety of examples of application software for communications: e-mail, FTP, Web browser, newsgroup/message boards, chat rooms, instant messaging, video conferencing, and Internet telephony.
- Some communications devices are preprogrammed to accomplish communications

COMMUNICATIONS OVER THE TELEPHONE NETWORK

- The telephone network is an integral part of computer communications. Data, instructions, and information are transmitted over the telephone network using dial-up lines or dedicated lines.
- A **dial-up line** is a temporary connection that uses one or more analog telephone lines for communications. A dial-up connection is not permanent.
- Using a dial-up line to transmit data is similar to using the telephone to make a call. A modem at the sending end dials the telephone number of a modem at the receiving end.
- When the modem at the receiving end answers the call, a connection is established and data can be transmitted.
- Using a dial-up line to connect computers costs no more than making a regular telephone call.

COMMUNICATIONS OVER THE TELEPHONE NETWORK

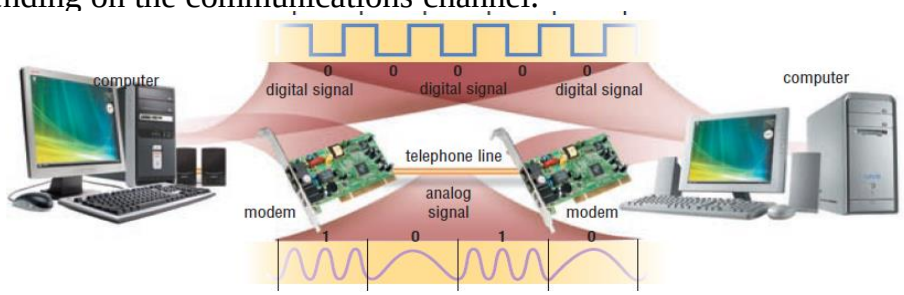
- A **dedicated line** is a type of always-on connection that is established between two communications devices (unlike a dial-up line where the connection is reestablished each time it is used). The quality and consistency of the connection on a dedicated line are better than a dial-up line because dedicated lines provide a constant connection.
- Five types of digital dedicated lines are ISDN lines, DSL, FTTH and FTTB, T-carrier lines, and ATM.
- **ISDN LINES** For the small business and home user, an ISDN line provides faster transfer rates than dial-up telephone lines. Not as widely used today as in the past, **ISDN** (Integrated Services Digital Network) is a set of standards for digital transmission of data over standard copper telephone lines.
- **DSL** is a popular digital line alternative for the small business or home user. **DSL** (Digital Subscriber Line) transmits at fast speeds on existing standard copper telephone wiring. To connect to DSL, a customer must have a special network card and a DSL modem. ADSL is one of the more popular types of DSLs. ADSL (asymmetric digital subscriber line) is a type of DSL that supports faster transfer rates when receiving data (the downstream rate) than when sending data (the upstream rate)

COMMUNICATIONS OVER THE TELEPHONE NETWORK

- **FTTH** (**Fiber to the Home**) and **FTTB (Fiber to the Building)** use fiber-optic cable to provide extremely high-speed Internet access to home or small business users. With FTTH or FTTB service, an optical terminal at your house or business receives the signals and transfers them to a router connected to your computer.
- A **T-carrier line** is any of several types of long-distance digital telephone lines that carry multiple signals over a single communications line. T-carrier lines provide very fast data transfer rates.
- The most popular T-carrier line is the **T1 line**. Businesses often use T1 lines to connect to the Internet. Many Internet access providers use T1 lines to connect to the Internet backbone.
- A **T3** line is equal in speed to 28 T1 lines. T3 lines are quite expensive. Main users of T3 lines include large companies, telephone companies, and Internet access providers connecting to the Internet backbone. The Internet backbone itself also uses T3 lines.
- **ATM** (Asynchronous Transfer Mode) is a service that carries voice, data, video, and multimedia at extremely high speeds. Telephone networks, the Internet, and other networks with large amounts of traffic use ATM. Some experts predict that ATM eventually will become the Internet standard for data transmission, replacing T3 lines.

COMMUNICATIONS DEVICES

- A **communications device** is any type of hardware capable of transmitting data, instructions, and information between a sending device and a receiving device.
- One type of communications device that connects a communications channel to a sending or receiving device such as a computer is a modem.
- Computers process data as digital signals. Data, instructions, and information travel along a communications channel in either analog or digital form, depending on the communications channel.



COMMUNICATIONS DEVICES

- The communications device that performs conversion is a **modem**, sometimes called a dial-up modem. The word, modem, is derived from the combination of the words, modulate, to change into an analog signal, and demodulate, to convert an analog signal into a digital signal.
- A modem usually is in the form of an adapter card that you insert in an expansion slot on a computer's motherboard.
- If you access the Internet using ISDN or DSL, you need a communications device to send and receive the digital ISDN or DSL signals. An **ISDN modem** sends digital data and information from a computer to an ISDN line and receives digital data and information from an ISDN line. A **DSL modem** sends digital data and information from a computer to a DSL line and receives digital data and information from a DSL line. ISDN and DSL modems usually are external devices.

COMMUNICATIONS DEVICES

- A **cable modem** is a digital modem that sends and receives digital data over the cable television (CATV) network. With more than 100 million homes wired for cable television, cable modems provide a faster Internet access alternative to dial-up for the home user and have speeds similar to DSL.
- **Wireless modem** that allows access to the Web wirelessly from a notebook computer, a PDA, a smart phone, or other mobile device.
- A **network card** is an adapter card that enables a computer or device that does not have networking capability to access a network. The network card coordinates the transmission and receipt of data, instructions, and information to and from the computer or device containing the network card.
- A network card follows the guidelines of a particular network communications standard, such as Ethernet or token ring. An Ethernet card is the most common type of network card.
- A **router** is a communications device that connects multiple computers or other routers together and transmits data to its correct destination on the network.

HOME NETWORKS

- Many home users are connecting multiple computers and devices together in a **home network**.
- Each networked computer in the house has the following capabilities:
  - Connect to the Internet at the same time
  - Share a single high-speed Internet connection
  - Access files and programs on the other computers in the house
  - Share peripherals such as a printer, scanner, external hard disk, or DVD drive
  - Play multiplayer games with players on other computers in the house
  - Connect game consoles to the Internet
  - Subscribe to and use Internet telephony
- An intelligent home network extends the basic home network to include features such as lighting control, thermostat adjustment, and a security system.

COMMUNICATIONS CHANNEL

- A **communications channel** consists of one or more transmission media. **Transmission media** consist of materials or substances capable of carrying one or more signals. When you send data from a computer, the signal that carries the data may travel over various transmission media.
- The amount of data, instructions, and information that can travel over a communications channel is called the **bandwidth.**
- **Baseband** is a communication technique that transfer digital signal without changing its modulation. Baseband media transmit only one signal at a time.
- By contrast, **broadband** media transmit multiple signals simultaneously. Broadband media transmit signals at a much faster speed than baseband media.

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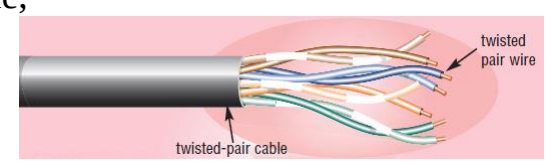
PHYSICAL TRANSMISSION MEDIA

- Physical transmission media used in communications include twisted-pair cable, coaxial cable, and fiber-optic cable.
- **Twisted-Pair Cable:** One of the more commonly used transmission media for network cabling and telephone systems is twisted-pair cable.
- **Twisted-pair cable** consists of one or more twisted-pair wires bundled together. Each twisted-pair wire consists of two separate insulated copper wires that are twisted together. The wires are twisted together to reduce noise. **Noise** is an electrical disturbance that can degrade communications.



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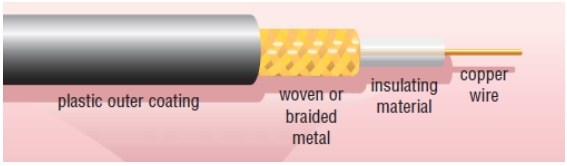
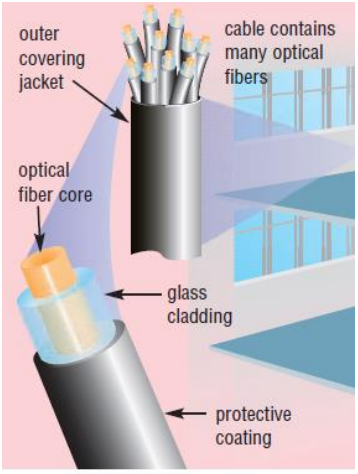
PHYSICAL TRANSMISSION MEDIA

- **Coaxial cable**, often referred to as coax (pronounced KO-ax), consists of a single copper wire surrounded by at least three layers:
  - an insulating material,
  - a woven or braided metal, and
  - a plastic outer coating.
- Cable television (CATV) network wiring often uses coaxial cable because it can be cabled over longer distances than twisted-pair cable.



PHYSICAL TRANSMISSION MEDIA

- **Fiber-Optic Cable:** The core of a **fiber-optic cable** consists of dozens or hundreds of thin strands of glass or plastic that use light to transmit signals. Each strand, called an optical fiber, is as thin as a human hair. Inside the fiber-optic cable, an insulating glass cladding and a protective coating surround each optical fiber. Fiber-optic cables have the following advantages over cables:
  - Capability of carrying significantly more signals than wire cables
  - Faster data transmission
  - Less susceptible to noise (interference) from other devices such as a copy machine
  - Better security for signals during transmission because they are less susceptible to noise
  - Smaller size (much thinner and lighter weight)
- Disadvantages of fiber-optic cable are it costs more than twisted-pair or coaxial cable and can be difficult to install and modify.



WIRELESS TRANSMISSION MEDIA

- **Infrared** is a wireless transmission medium that sends signals using infrared light waves.
- Mobile computers and devices, such as a mouse, printer, and smart phone, often have an IrDA port that enables the transfer of data from one device to another using infrared light waves.
- **Broadcast radio** is a wireless transmission medium that distributes radio signals through the air over long distances such as between cities, regions, and countries and short distances such as within an office or home.
- Bluetooth, Wi-Fi, and WiMAX communications technologies discussed earlier in this chapter use broadcast radio signals.

WIRELESS TRANSMISSION MEDIA

- **Cellular radio** is a form of broadcast radio that is used widely for mobile communications, specifically wireless modems and cellular telephones.
- A cellular telephone is a telephone device that uses high-frequency radio waves to transmit voice and digital data messages.
- Some mobile users connect their notebook computer or other mobile computer to a cellular telephone to access the Web, send and receive e-mail, enter a chat room, or connect to an office or school network while away from a standard telephone line.
- **Personal Communications Services** (**PCS**) is the term used by the United States Federal Communications Commission (FCC) to identify all wireless digital communications. Devices that use PCS include cellular telephones, PDAs, pagers, and fax machines.

WIRELESS TRANSMISSION MEDIA

- **Microwaves** are radio waves that provide a high-speed signal transmission. Microwave transmission, often called fixed wireless, involves sending signals from one microwave station to another (shown in Figure 8-1 on page 296). Microwaves can transmit data at rates up to 4,500 times faster than a dial-up modem.
- A microwave station is an earth-based reflective dish that contains the antenna, transceivers, and other equipment necessary for microwave communications. Microwaves use line-of-sight transmission. To avoid possible obstructions, such as buildings or mountains, microwave stations often sit on the tops of buildings, towers, or mountains.
- Microwave transmission is used in environments where installing physical transmission media is difficult or impossible and where line-of-sight transmission is available. For example, microwave transmission is used in wide-open areas such as deserts or lakes

WIRELESS TRANSMISSION MEDIA

- A **communications satellite** is a space station that receives microwave signals from an earth-based station, amplifies (strengthens) the signals, and broadcasts the signals back over a wide area to any number of earth-based stations.
- These earth-based stations often are microwave stations. Other devices, such as smart phones and GPS receivers, also can function as earth-based stations.
- Transmission from an earth-based station to a satellite is an uplink. Transmission from a satellite to an earth-based station is a downlink.
- Applications such as air navigation, television and radio broadcasts, weather forecasting, video conferencing, paging, global positioning systems, and Internet connections use communications satellites

THE END