Chapter 9
Communications and Networks
Chapter 9 Objectives

- Discuss the components required for successful communications
- Identify various sending and receiving devices
- Describe uses of computer communications
- List advantages of using a network
- Differentiate among client/server, peer-to-peer, and P2P networks
- Describe the various network communications standards
- Explain the purpose of communications software
- Describe various types of lines for communications over the telephone network
- Describe commonly used communications devices
- Discuss different ways to set up a home network
- Identify various physical and wireless transmission media
What are computer communications?

- Process in which two or more computers or devices transfer data, instructions, and information
What is needed for successful communications?

- **Sending device** — initiates instruction to transmit data, instructions, or information
- **Communications device** — connects the sending device to the communications channel
- **Communications channel** — media on which data, instructions, or information travel
- **Communications device** — connects the communications channel to the receiving device
- **Receiving device** — accepts transmission of data, instructions, or information
What are some uses of communications technology?

- Internet
- Web
- E-Mail
- Instant Messaging
- Chat Rooms
- Newsgroups
- Blogs
- Wikis
- RSS
- VoIP
- FTP
- Web Folders
- Video Conferencing
- Fax Machine or Computer Fax/Modem
What are wireless messaging services?

Text messaging (SMS - short message service) allows users to send and receive short text messages on a phone or other mobile device

- Mobile to mobile, Mobile to email, Web to mobile,
- Mobile to Provider: send message by entering common short code (CSC): 4–5 digit number eg. Television voting
  (Administered by Common Short Code Administration)

Wireless instant messaging allows wireless mobile devices to exchange messages (Mobile to Mobile, Mobile to Computer)

Picture/video messaging (MMS - Multimedia Messaging Service) allows users to send graphics, pictures, video clips, sound files, and short text messages (Mobile to Mobile, Mobile to Email)
Uses of Computer Communications

- **Wireless Internet access point** allows wireless connection to Internet in public location
  - Wireless Network card, USB network adapter, ExpressCard module, PC Card
  - Hot spot – wireless network
    - Wi-Fi
    - WiMAX
    - Bluetooth

- **Mobile Internet**
  - 3G and 4G networks

- **Cybercafé** is a coffee house, restaurant etc. that provides computers with Internet access
What is a global positioning system (GPS)?

**Step 1.**
GPS satellites orbit Earth. Every thousandth of a second, each satellite sends a signal that indicates its current position to the GPS receiver.

**Space Segment:**
24 geostationary satellites

**Control Segment:**
control & monitor satellites

**User Segment:**
GPS receiver devices

**Step 2.**
A GPS receiver (such as in a car, a wearable device, a smart phone, a handheld device, or a collar) determines its location on Earth by analyzing at least 3 separate satellite signals from the 24 satellites in orbit.
Collaborative software (Groupware) is software that allows people to work together and share information over a network. Examples include Microsoft Office Live Meeting, Adobe Acrobat Connect, Document Management Software, Project Management Software, and Google Docs.
What are **voice mail** and web services?

- **Voice mail** is voice message converted to digital form
- **Voice mailbox** – storage locations
Web Services:

Converts your application into web-application so that you can publish your functions and messages in internet or internal networks.

Communicates with XML
Windows application can connect with UNIX server.

Mashup: Web-application that combines services from two or more sources
What is a network?

- Collection of computers and devices connected via communications devices and transmission media

- Advantages
  - Facilitating Communication
  - Sharing Hardware
  - Sharing Data / Information
    - XML (extensible markup language)
  - Sharing software
    - Network License
  - Transferring funds (Electronic Funds Transfer – EFT)
    - credit card purchase from Web, transfer of fund from one account to other

- Value-added Network (VAN)
  - Third-party that provides services in your network eg. storage, email, data and information transfer
LAN, MAN, WAN
Depending on area of coverage

- **A Local Area Network (LAN)**: a network in limited geographical area such as home or office building
  - Individual computers known as nodes
  - **Wireless LAN (WLAN)**

- **Metropolitan area network (MAN)**
  - High-speed network that connects LANs in city or town
  - Smaller area than WAN
What is a **wide area network (WAN)**?

- Network that covers large geographic area using many types of media
- Internet is world’s largest WAN
- Communication channels
  - Telephone lines,
  - Cables,
  - Radio waves
Networks

Network Architecture:
Design of computers, devices and media in network

What is a **client/server network**?

- One or more computers act as **server (host)** and other computers, or **clients**, access server
- Servers – control resources
- Clients – rely on servers for resources
- **Dedicated servers**
  - File server, Print server, Database servers, Network Server, Web Server
- Efficient for 10 or more computers
What is a peer-to-peer network?

- Simple network that connects fewer than 10 computers
- Each computer, or peer, has equal capabilities
- Ideal for small business and home
What is Internet peer-to-peer (P2P)?

- Sometimes called a file sharing network
- Enables users to connect to each other’s hard disks and exchange files directly
What is a bus network?

- All computers and devices connect to central cable or bus

- Advantages:
  - Devices can be attached at any point without disturbing other devices.
  - Failure of one device does not affect the network

- Disadvantage:
  - Total network depends upon the bus

Example of network topology (layout of devices in network)

- Popular topologies are bus, ring, and star

Networks : Topology
What is a ring network?

- Cable forms closed loop (ring), with all computers and devices arranged along ring
- Data travels from device to device around entire ring, in one direction
- Advantages:
  - Can span larger distance than a bus network
- Disadvantages:
  - Failure of a device affects the network performance.
  - Data might have to travel through redundant path
What is a star network?

- All devices connect to a central device (hub or switch)
- All data transferred from one computer to another passes through hub or switch

Advantages:
- Nodes can be added to the network with no disturbance to the network
- Failure of a node does not affect the network

Disadvantage:
- Whole network depends on the hub / switch
  (might need backup hubs / switch)
What is an intranet?

- Internal network that uses Internet technologies (Small version of the internet Web, email, chat rooms, video conferencing, groupware, project management)
- Makes information accessible to employees
- Typically includes connection to Internet
- Extranet allows customers or suppliers to access part of company’s intranet
Network Communication Standards

Network standards defines:
- Way devices access the medium
- Speed on different types of networks
- Types of network technology (cable / wireless)

Protocols
- Rules on how devices communicate with each other
- Data format used
- Coding Scheme
- Error Handling
- Sequencing techniques etc.

Hardware / Software Vendors try to meet these guidelines

ANSI, IEEE
- Standardizing Organization
Ethernet

- Standard that defines how devices are connected to LAN (bus or star network)
- Device can transmit data only when the network is available to receive data.
- If two devices attempt to send at same time collision occurs and should be retransmitted
- Use cable to transmit data
- Original Ethernet – 10 Mbps
- Fast Ethernet – 100Mbps
- Gigabit Ethernet – 1Gbps
- 10-Gigabit Ethernet – 10Gbps
- 40-Gigabit Ethernet, 100-Gigabit Ethernet
Token Ring
- Standard for LAN (ring, star)
- Computers share / pass a special signal – token in unidirectional manner
- Token – series of bits and functions like a ticket
- Whoever has the token can transmit the data
- Supports up to 72 devices
- Using special kind of wiring up to 260 devices
- Data rate – 4 Mbps, 16 Mbps, 100 Mbps and 1Gbps
What are **TCP/IP**

- **TCP/IP (Transmission Control Protocol/Internet Protocol)** technology transmits data by breaking it up into small pieces, or **packets**

- Packet – source, destination, sequence information, packet size etc.
  - Checking and detecting error
  - Sequencing
  - Flow Control

Packet switching: breaking a message, sending it through best route, reassambling
IEEE 802.11, (Wireless Fidelity Wi-Fi) is a family of standards for wireless LANs

- How two wireless device communicate
- Radio waves
- Also known as wireless Ethernet
- Can communicate with Ethernet network
- Coverage
  - 100 ft. in closed area
  - 300 ft. in open area

<table>
<thead>
<tr>
<th>Standard</th>
<th>Transfer Rates</th>
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</thead>
<tbody>
<tr>
<td>802.11</td>
<td>1 or 2 Mbps</td>
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<tr>
<td>802.11a</td>
<td>Up to 54 Mbps</td>
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<tr>
<td>802.11b</td>
<td>Up to 11 Mbps</td>
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<tr>
<td>802.11g</td>
<td>54 Mbps and higher</td>
</tr>
<tr>
<td>802.11n</td>
<td>108 Mbps and higher</td>
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</table>
Bluetooth
- *Short-range radio waves* transmit data between Bluetooth devices
- Transfer rates: 3 Mbps
- Coverage: 33 ft (10 m) up to 100 m with additional equipments
- smart phones, headsets, keyboards, digital cameras
- bluetooth adapter

UWB (ultra-wideband)
- *short-range radio waves*
- Coverage / Rate
  - 10m (33 feet) – 110 Mbps, 2m (6.5 feet) - 480 Mbps
- suitable for audio / video / picture files transfer
IrDA (Infrared data association)
- Use Infrared(IR) waves
- 115Kbps – 4 Mbps
- device must be in line of sight

RFID (radio frequency identification)
- radio waves
- specifies how a device communicates with a tag placed on person, animals, objects
- RFID tag (transponder) – memory chip + antenna.
- RFID reader (transceiver) reads the radio signal broadcast by the antenna
- Coverage 5 inches – 15 feet
WiMAX (Worldwide Interoperability for Microwave Access) IEEE 802.16
- WiMAX towers can cover up to 30 miles radius
- Fixed WiMAX Rate of transfer : 40Mbps
- Mobile WiMAX Rate : 15Mbps

WAP (Wireless Application Protocol)
- used by devices such as smart phones to display Websites, e-mail, chat rooms, instant messengers etc.
What is the public switched telephone network (PSTN)?

- Worldwide telephone system that handles voice-oriented telephone calls
- Can be used for data communication as well
What is a **dial-up line**?

- Temporary connection using telephone line for communications
  - Costs no more than making regular call
  - dial-up modem
What is a **dedicated line**?

- **Always-on connection between two communications devices**
  - Five types of digital dedicated lines are ISDN line, DSL, FTTP, T-carrier line, and ATM
What are examples of communications devices?

Common types are dial-up modems, ISDN and DSL modems, cable modems, wireless modems, network cards, wireless access points, routers, and hubs.
Communications Devices

Dial-up modem

- A dial-up modem converts digital signals to analog signals and vice versa
- Usually in the form of an adapter card

• DSL Modem / ISDN Modem
  - Send and receive digital data from DSL (Digital Subscriber Line) / ISDN (Integrated Service Digital Network) line

• Cable Modem
  - Sends and receives data over cable television (CATV) network
  - Much faster than dial-up modem or ISDN
  - Sometimes called a broadband modem

• Wireless Modem
  - Allows access to the Web wirelessly from a notebook computer, a smart phone, or other mobile device
What is a hub or switch?

- Device that provides central point for cables in network
What is a router?

- Connects computers and transmits data to correct destination on network
- Routers forward data on Internet using fastest available path
- Some routers have a built-in firewall
**What is a communications channel?**

- Transmission media on which data travels in communications system

**Transmission media:**
- Physical transmission media / Wired
  - Telephone lines, optical fiber, twisted-pair cable, coaxial cables etc.
- Wireless transmission media
  - Wi-Fi, WiMAX, Bluetooth, IR

**Latency** : time taken by a signal to travel from one location to other in a network.

**Bandwidth** : Amount data that can travel over a media
Physical Transmission Media

What are **twisted-pair cable and coaxial cable**?

- **Twisted-pair cable** is used for telephone systems and network cabling
- Separately insulated wires are twisted together in a pair
- Twisting reduce the noise (disturbances)

- **Coaxial cable** is often used for cable television wiring
- Single Copper wire in center
- Insulation
- Woven or braided metal
- Outer cover
What is fiber-optic cable?

- Hundreds of thin strands of glass or plastic
- Capable of carrying significantly more data at faster speeds than wire cables
- Less susceptible to interference (noise) and, therefore, more secure
- Faster transmission
- Smaller size (thinner and lighter)
- Disadvantage: Costly and difficult to install
Wireless transmission media

- Infrared
- Broadcast Radio
  - Bluetooth, Wi-Fi, WiMAX
- Cellular Radio
  - High-frequency radio waves
  - 1G – analog signal
  - 2G – digital; transmission rate: 9.6 Kbps to 19.2 Kbps
  - 3G – 144 Kbps – 2.4 Mbps
  - 4G – 15 Mbps
  - 3G allows watching television and video, video conference etc.
- Communication Satellite
Communication Satellites

- Space station that receives microwave signals from earth-based station, amplifies signals, and broadcasts signals back to any number of earth-based stations
- Earth-based station – microwave station, GPS receivers
- Uplink – transmission from earth-based station to satellite
- Downlink
- Weather forecasting, GPS, TV broadcasting, Internet, Telephone
Communications terminology and applications

Various communications devices, media, and procedures

How to join computers into a network

Chapter 9 Complete