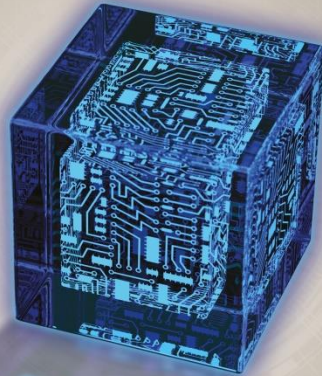


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MANAGEMENT INFORMATION SYSTEMS



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6

Data Communication: Delivering Information Anywhere and Anytime

Learning Objectives (1 of 2)

- Describe major applications of a data communication system
- Explain the major components of a data communication system
- Describe the major types of processing configurations
- Explain the three types of networks
- Describe the main network topologies

Learning Objectives (2 of 2)

- Explain important networking concepts, such as bandwidth, routing, routers, and the client/server model
- Describe wireless and mobile technologies and networks
- Discuss the importance of wireless security and the techniques used
- Summarize the convergence phenomenon and its applications for business and personal use

Data Communication

- Electronic transfer of data from one location to another
 - Enables an information system to deliver information
 - Improves the flexibility of data collection and transmission
 - Basis of virtual organizations
 - Provides e-collaboration

Why Managers Need to Know about Data Communication (1 of 3)

- Enhances decision makers' efficiency and effectiveness
- Enables organizations to use e-mail and electronic file transfer to improve efficiency and productivity

Why Managers Need to Know about Data Communication (2 of 3)

- Effects of data communication technologies
 - Online training for employees can be provided via virtual classrooms
 - Internet searches for information keep employees up to date
 - The Internet and data communication systems facilitate lifelong learning

Why Managers Need to Know about Data Communication (3 of 3)

- Boundaries between work and personal life are less clear-cut as data communication is more available in both homes and businesses
- Web and video conferencing are easier

Basic Concepts of a Data Communication System (1 of 2)

- Bandwidth
 - Amount of data that can be transferred from one point to another in a certain time period
- Attenuation
 - Loss of power in a signal as it travels from the sending device to the receiving device
- Broadband
 - Multiple pieces of data are sent simultaneously to increase the transmission rate

Basic Concepts of a Data Communication System (2 of 2)

- Narrowband
 - Voice-grade transmission channel capable of transmitting a maximum of 56,000 bps, so only a limited amount of information can be transferred
- Protocols
 - Rules that govern data communication
 - Error detection, message length, and transmission speed

Sender and Receiver Devices (1 of 4)

- Input/output device, or thin client
 - Used only for sending or receiving information
 - No processing power
- Smart terminal
 - Performs certain processing tasks but is not a full-featured computer

Sender and Receiver Devices (2 of 4)

- Intelligent terminal, workstation, or personal computer
 - Performs certain processing tasks without the main computer's support
- Netbook computer
 - Low-cost, diskless computer used to connect to the Internet or a LAN
 - Runs software off servers and saves data to servers

Sender and Receiver Devices (3 of 4)

- Minicomputers, mainframes, and supercomputers
 - Process data and send it to other devices
 - Receive data that has been processed elsewhere, process it, and then transmit it to other devices
- Smartphones mobile phones, MP3 players, and PDAs
 - Advanced capabilities, with a built-in keyboard or an external USB keyboard

Sender and Receiver Devices (4 of 4)

- Video game console
 - Receives instructions from a game player and produces a video display signal on a television screen or monitor

Modems (1 of 2)

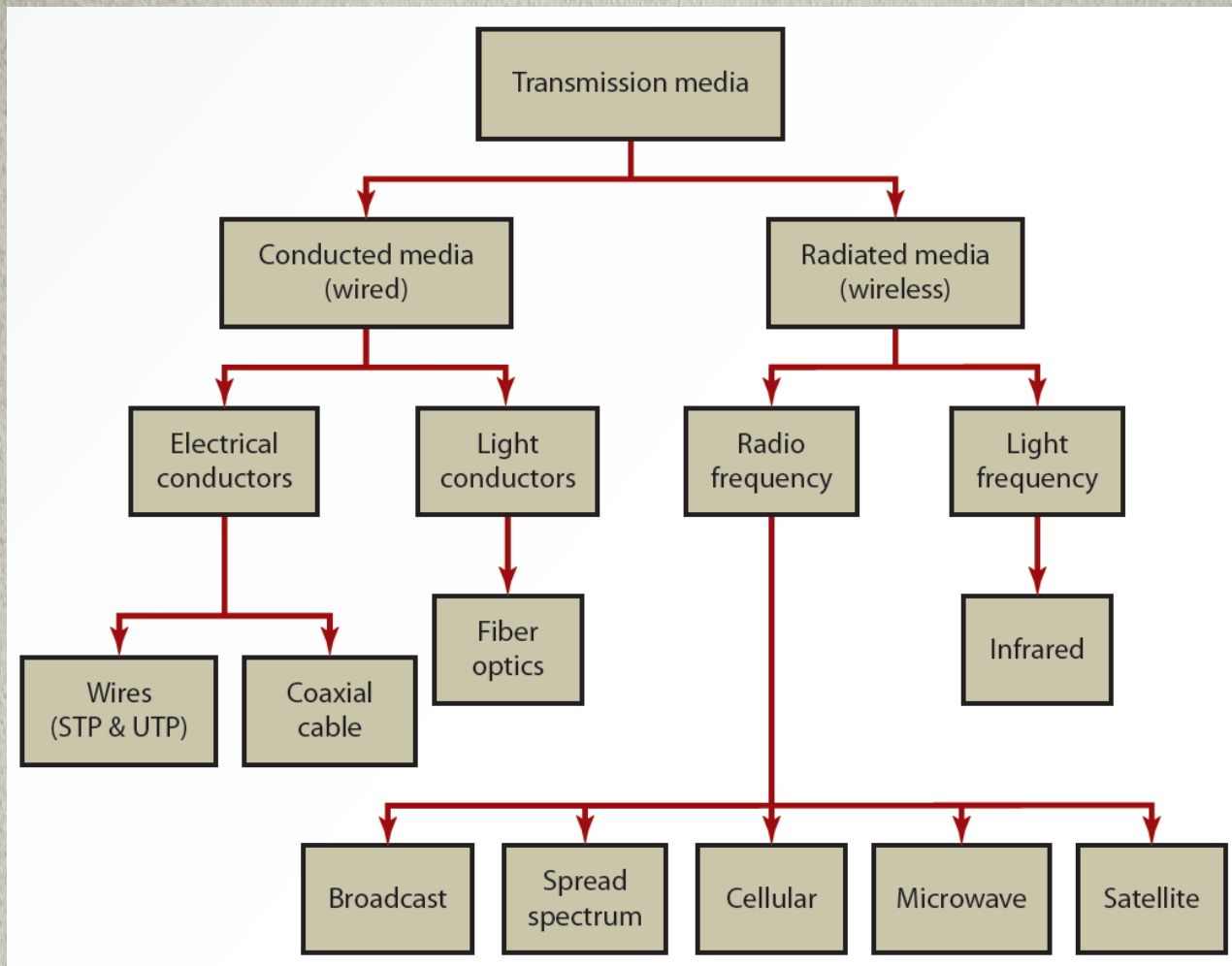
- Devices that connect a user to the Internet
 - Short for modulator-demodulator
 - Not required for all Internet connections

Modems (2 of 2)

- Dial-up
 - Analog modem is necessary to convert a computer's digital signals to analog signals
- Digital subscriber line (DSL)
 - High-speed service that uses ordinary phone lines
- Cable modems
 - Use the same cable that connects to TVs for Internet connections

Communication Media

- Connect sender and receiver devices
 - Can be conducted (wired or guided) or radiated (wireless)
 - Can be a point-to-point or a multipoint system



Processing Configurations

- Data communication systems can be used in several different configurations
 - Depending on users' needs, types of applications, and responsiveness of the system
- During the past 60 years, three types of process configurations have emerged
 - Centralized, decentralized, and distributed

Centralized Processing (1 of 2)

- Processing is done at one central computer
 - Used in early days of computer technology
 - Data-processing personnel were in short supply
 - Hardware and software were expensive

Centralized Processing (2 of 2)

- Advantage
 - Ability to exercise tight control on system operations and applications
- Disadvantage
 - Lack of responsiveness to users' needs

Decentralized Processing

- Each user, department, or division has its own computer for performing processing tasks
 - Advantage
 - Responsive to users
 - Disadvantages
 - Lack of coordination among organizational units
 - High cost of having many systems
 - Duplication of efforts

Distributed Processing (1 of 2)

- Maintains centralized control and decentralized operations
 - Some advantages
 - Accessing unused processing power
 - Computer power can be added or removed
 - Distance and location are not limiting
 - More compatible with growth
 - Fault tolerance is improved
 - Resources can be shared to reduce costs

Distributed Processing (2 of 2)

- Disadvantages
 - More security and privacy challenges
 - Incompatibility between various pieces of equipment
 - Managing the network is challenging

Open Systems Interconnection Model (1 of 2)

- Seven-layer architecture for defining how data is transmitted from computer to computer in a network
 - Standardizes interactions between network computers exchanging information
- Layers in the architecture
 - Application: serves as the window through which applications access network services
 - Presentation: formats message packets

Open Systems Interconnection Model (2 of 2)

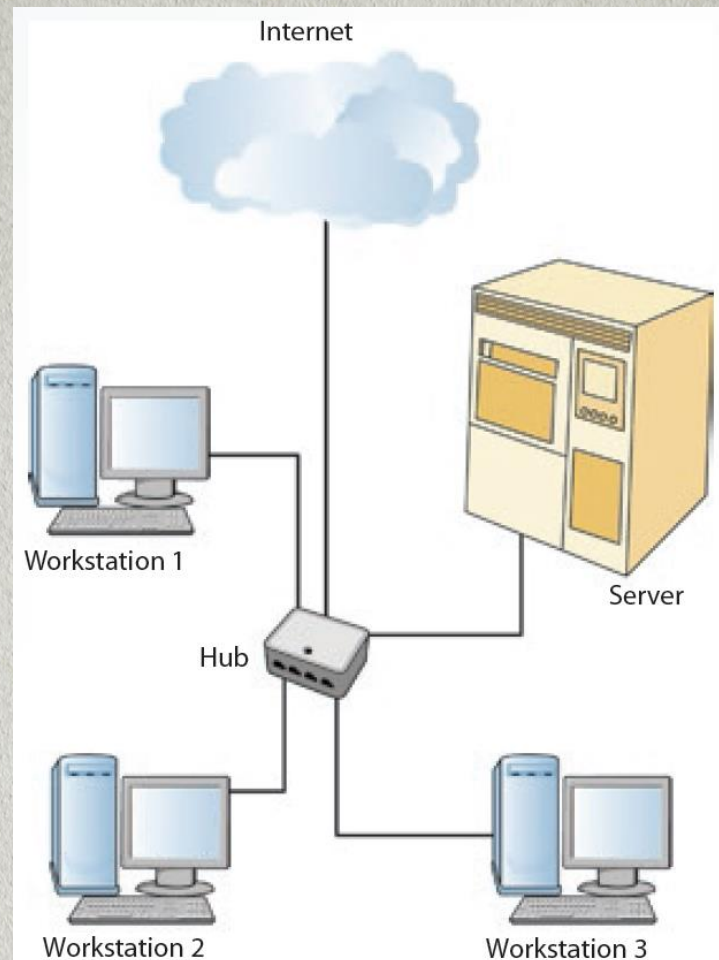
- Session: establishes a communication session between computers
- Transport: generates the receiver's address and ensures the integrity of messages
- Network: routes messages
- Data link: oversees the establishment and control of the communication link
- Physical: defines the physical medium used for communication

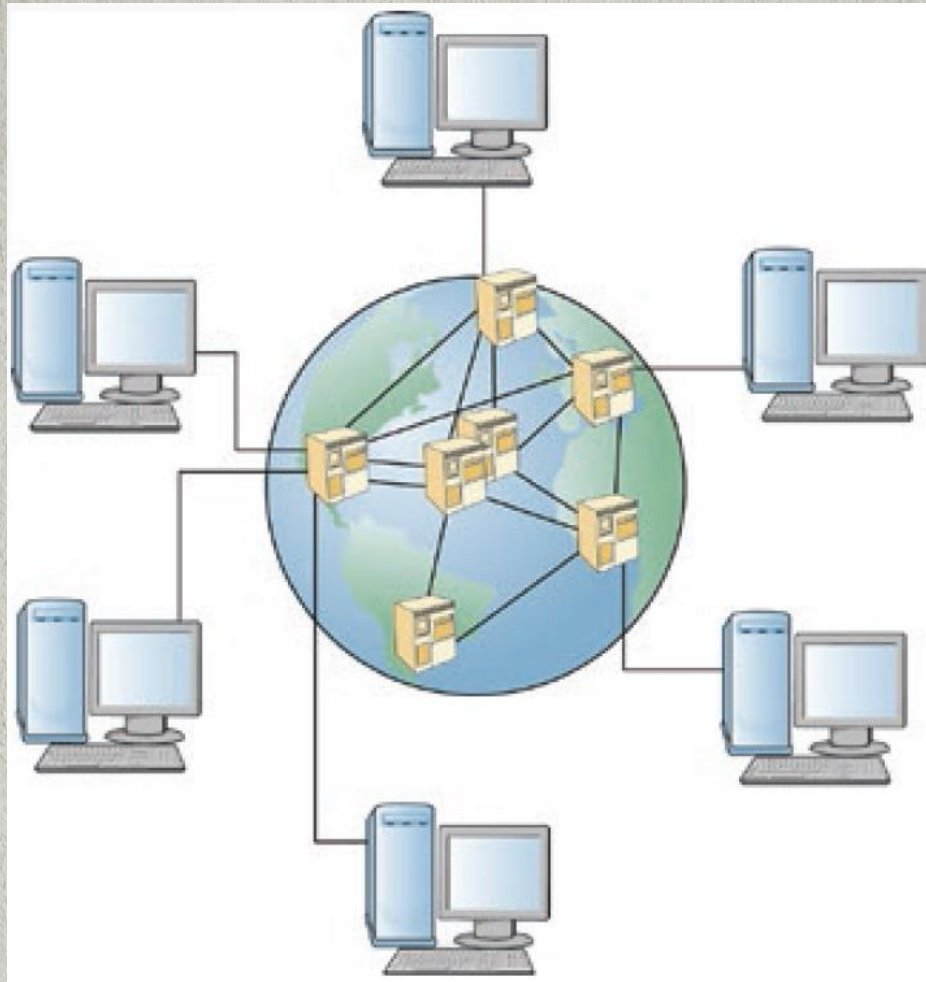
Types of Networks (1 of 2)

- Network Interface Card (NIC)
 - Hardware component that enables computers to communicate over a network
 - Known as an adapter card
 - Operates at the OSI model's Physical and Data Link

Types of Networks (2 of 2)

- Local area network (LAN)
 - Connects workstations and peripheral devices that are in close proximity
- Wide area network (WAN)
 - Spans several cities, states, or countries and is owned by different parties
- Metropolitan area network (MAN)
 - Designed to handle data communication for multiple organizations in a city and nearby cities as well

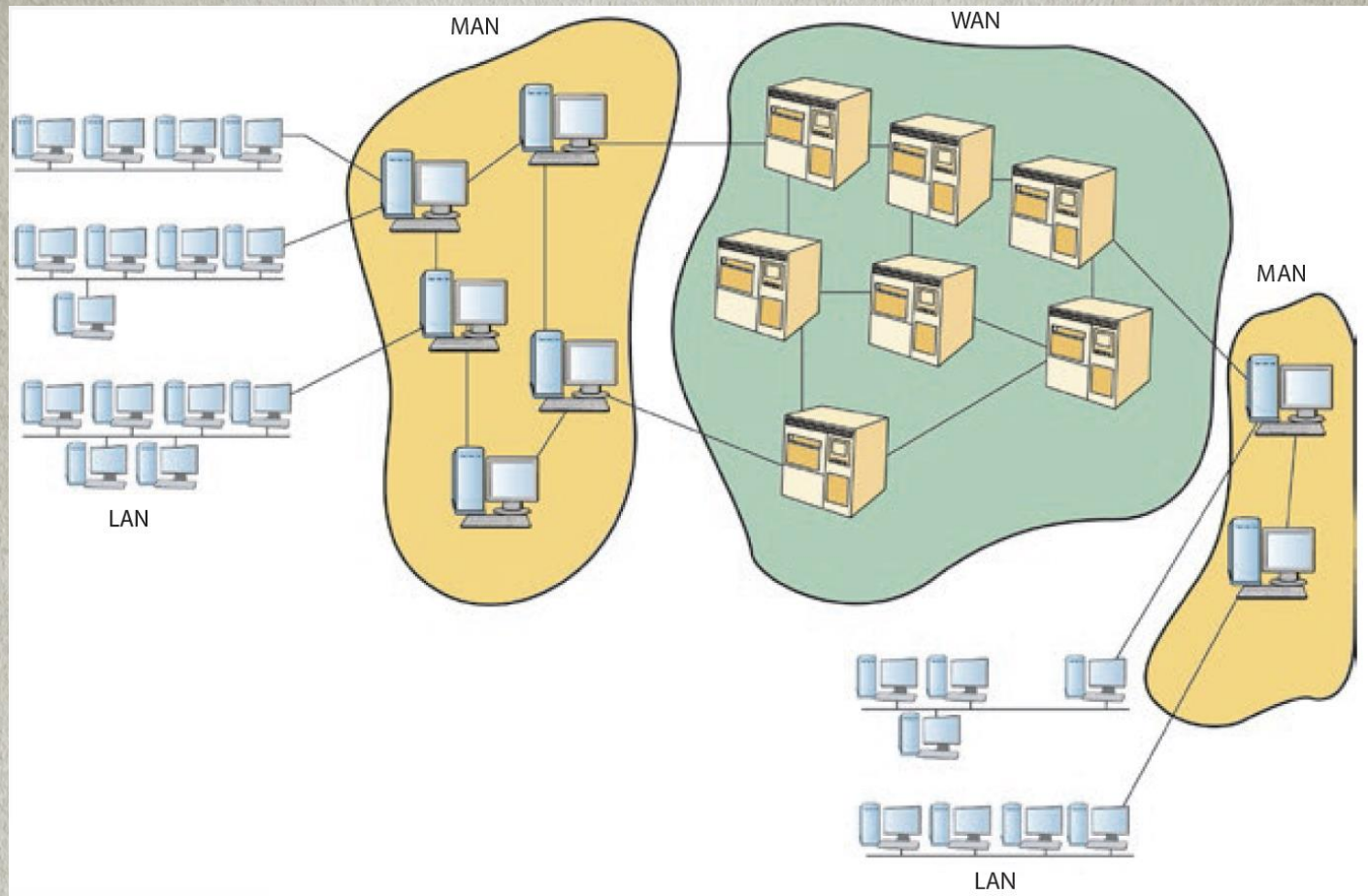




Exhibit

6.5

A Metropolitan Area Network



Network Topologies

- Represent a network's physical layout, including the arrangement of computers and cables
- Common topologies
 - Star
 - Ring
 - Bus
 - Hierarchical
 - Mesh

Star Topology (1 of 2)

- Consists of a central computer and a series of nodes
 - Advantages
 - Cable layouts are easy to modify
 - Centralized control makes detecting problems easier
 - Nodes can be added to the network easily
 - Effective at handling short bursts of traffic

Star Topology (2 of 2)

- Disadvantages
 - If the central host fails, the entire network becomes inoperable
 - Increases cost as many cables are required

Ring Topology

- No host computer is required; each computer manages its own connectivity
 - Each node is connected to two other nodes: upstream and downstream neighbors
 - Transmission is in one direction
 - Needs less cable than star topology
 - Diagnosing problems and modifying the network are difficult

Bus Topology (1 of 2)

- Connects nodes along a network segment
 - Ends of the cable are not connected
 - Terminator: hardware device used at each end of the cable to absorb the signal

Bus Topology (2 of 2)

- Advantages
 - Easy to extend and reliable
 - Wiring layout is simple and uses the least amount of cable of any topology; keeps costs down
 - Best for handling steady traffic
- Disadvantages
 - Fault diagnosis is difficult
 - Bus cable can be a bottleneck when network traffic is heavy

Hierarchical Topology (1 of 3)

- Combines computers with different processing strengths in different organizational levels
- Used by traditional mainframe networks
 - Mainframe computer is at the top
 - Front-end processors (FEPs) are at the second level

Hierarchical Topology (2 of 3)

- Controllers and multiplexers are at the third level
 - Controller: hardware and software device that controls data transfer from a computer to a peripheral device
 - Multiplexer: hardware device that allows several nodes to share one communication channel
- Terminals and workstations are at the bottom level

Hierarchical Topology (3 of 3)

- Advantage
 - Offers a greater deal of network control and lower cost than star topology
- Disadvantages
 - Network expansion may pose a problem
 - Traffic congestion at the root and higher-level nodes

Mesh Topology

- Every node is connected to every other node
 - Known as plex or interconnected
- Advantage
 - Highly reliable
- Disadvantage
 - Expensive and difficult to maintain and expand

Major Networking Concepts

- Important networking concepts
 - Protocols
 - TCP/IP
 - Routing
 - Routers
 - Client/server model

Protocols

- Agreed-on methods and rules that electronic devices use to exchange information
 - Deal with hardware connections, control data transmission, and file transfers
 - Specify the format of message packets sent between computers

Transmission Control Protocol/Internet Protocol (1 of 2)

- Industry-standard suite of communication protocols that enables interoperability
 - Allows the linking of devices running on many different platforms
 - Transmission Control Protocol (TCP)
 - Operates at the OSI model's Transport layer
 - Establishes a link between hosts
 - Ensures message integrity and sequences and acknowledges packet delivery
 - Regulates data flow

Transmission Control Protocol/Internet Protocol (2 of 2)

- Internet Protocol (IP): operates at the OSI model's Network layer
 - Responsible for packet forwarding
 - Divided into network address and node address

Routing (1 of 2)

- Packet
 - Collection of binary digits sent from computer to computer over a network
 - Includes message data and control characters for formatting and transmitting
- Routing
 - Process of deciding which path data takes
 - Determined by the type of network and the software used to transmit data

Routing (2 of 2)

- Routing table: generated automatically by software
 - Determines the best possible route for a packet
- Decision about selecting a route to follow on a network
 - Centralized routing: one node is in charge of selecting the path for all packets
 - Distributed routing: relies on each node to calculate its own best possible route

Routers (1 of 2)

- Network connection device containing software that connects network systems and controls their traffic flow
 - Choose the best path for packets based on distance or cost
 - Prevent network jams that delay packet delivery
 - Handle packets of different sizes

Routers (2 of 2)

- Static router
 - Requires the network routing manager to give it information about which addresses are on which network
- Dynamic router
 - Can build tables that identify addresses on each network
 - Used more often now, particularly on the Internet

Client/Server Model (1 of 2)

- Software runs on the local computer and communicates with the remote server to request information or services
 - Server: remote computer on the network that provides information or services in response to client requests
 - Advantage: scalability (i.e., ability to grow)

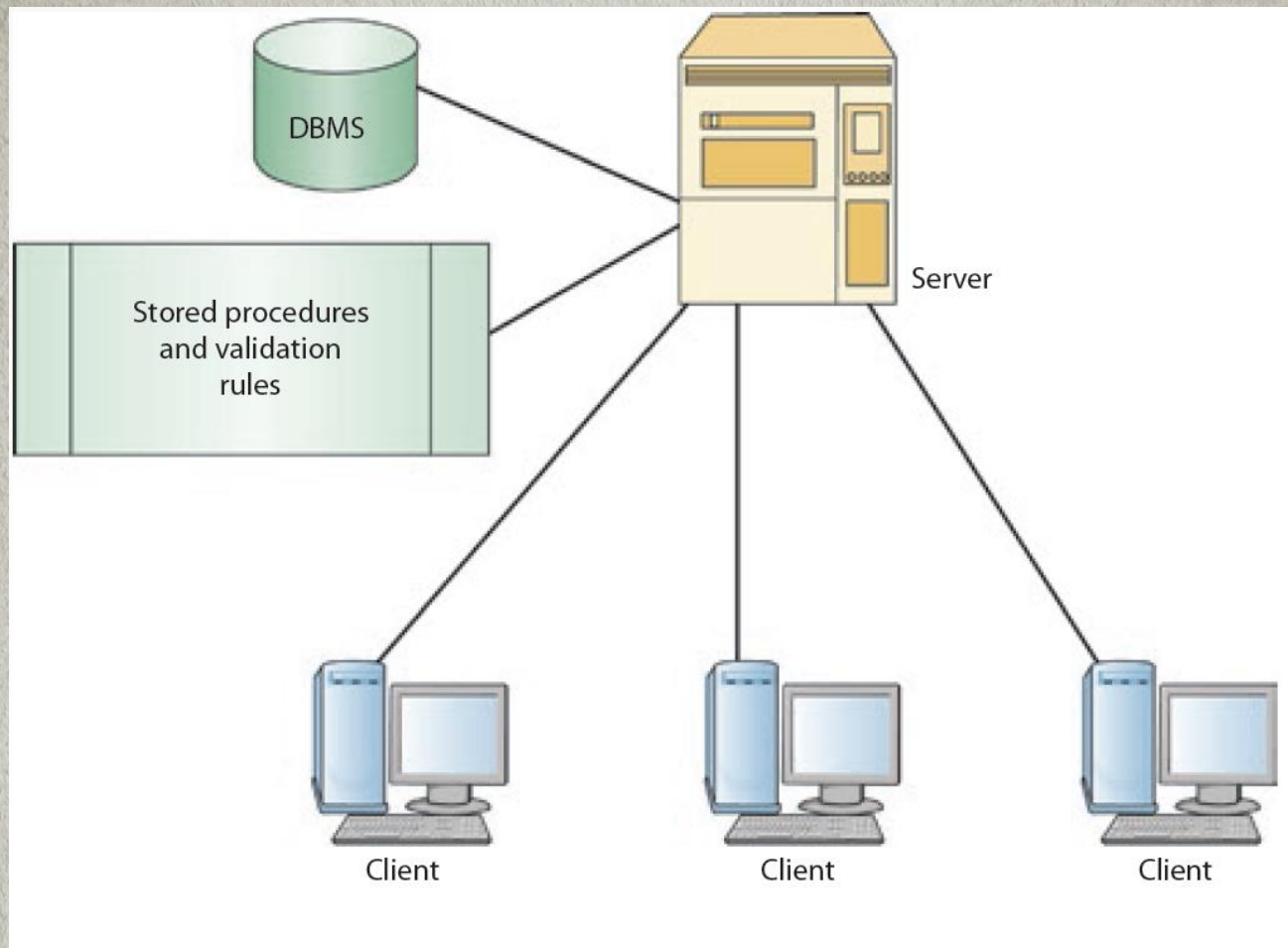
Client/Server Model (2 of 2)

- Levels of logic
 - Presentation: how data is returned to the client
 - Application: software processing requests for users
 - Data management: data management and storage operations

Two-Tier Architecture

- Client communicates directly with the server
 - Effective in small workgroups
- Advantages
 - Application development speed, simplicity, and power
- Drawback
 - Changes in application logic require modifications of clients, resulting in upgrade and modification costs

6.7 A Two-Tier Client/Server Architecture



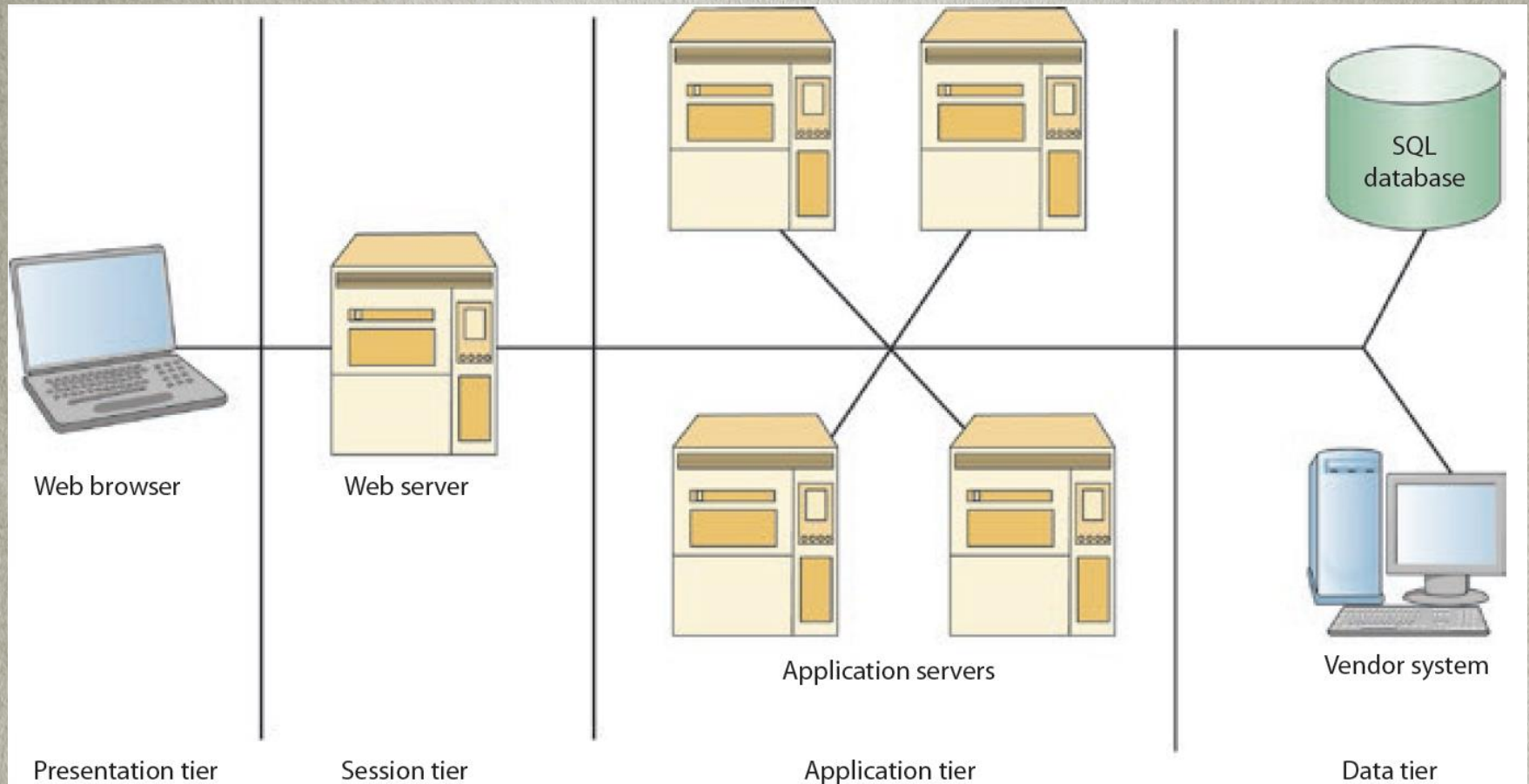
N-Tier Architectures

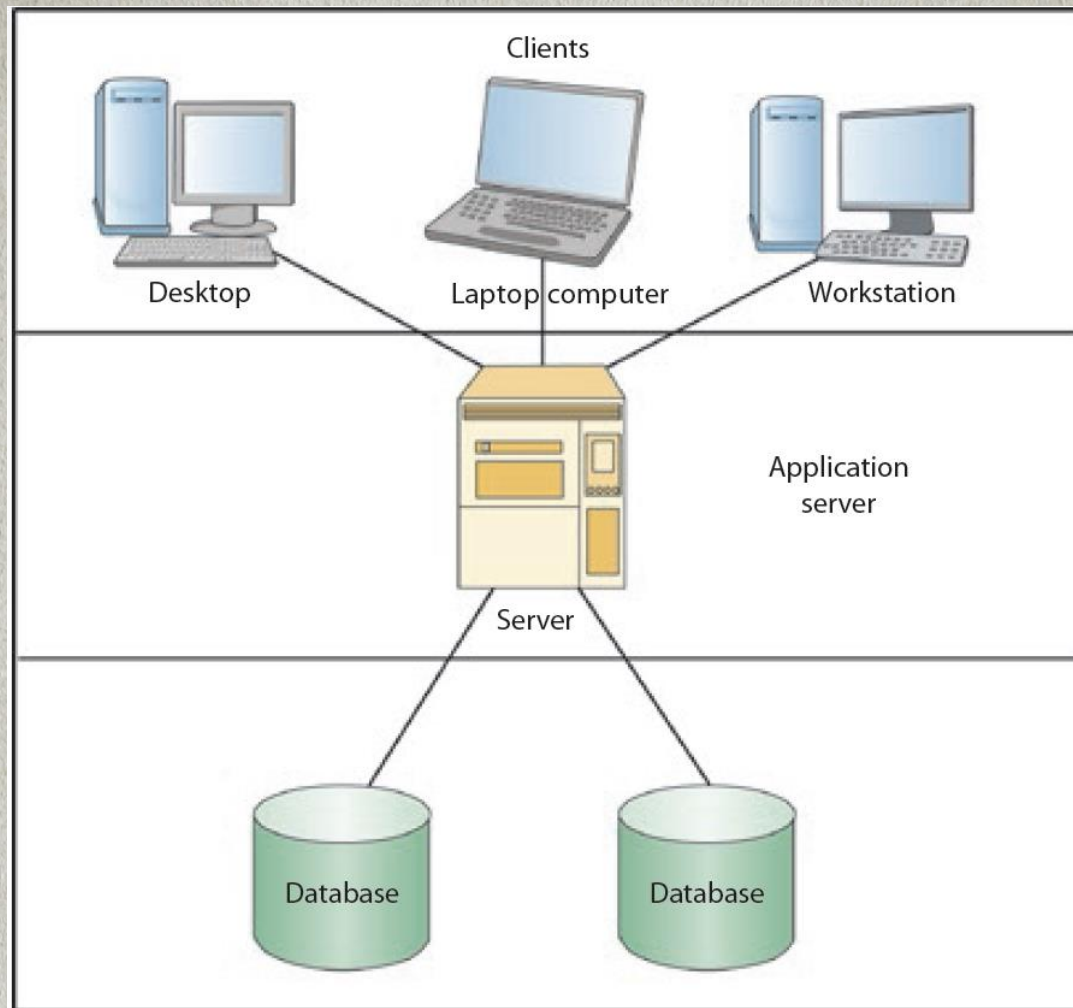
- Attempt to balance the workload between client and server
 - Remove application processing from client and server and place it on a middle-tier
 - Example: three-tier architecture
- Advantage
 - Improved network performance
- Drawbacks
 - Consist of more network traffic
 - Testing software is difficult

Exhibit

6.8

An N-Tier Architecture





Wireless and Mobile Networks (1 of 2)

- Wireless network
 - Uses wireless instead of wired technology
- Mobile network
 - Network operating on a radio frequency (RF)
 - Consists of radio cells, each served by a fixed transmitter, known as a cell site or base station

Wireless and Mobile Networks (2 of 2)

- Advantages
 - Mobility, flexibility, and ease of installation
 - Low cost
- Disadvantages
 - Limited throughput and range
 - In-building penetration problems
 - Vulnerability to frequency noise
 - Security

Wireless Technologies

- Wireless LANs
 - Alternative to wired LANs
 - Characterized by having one owner and covering a limited area
- Wireless WANs
 - Cover a broader area than WLANs

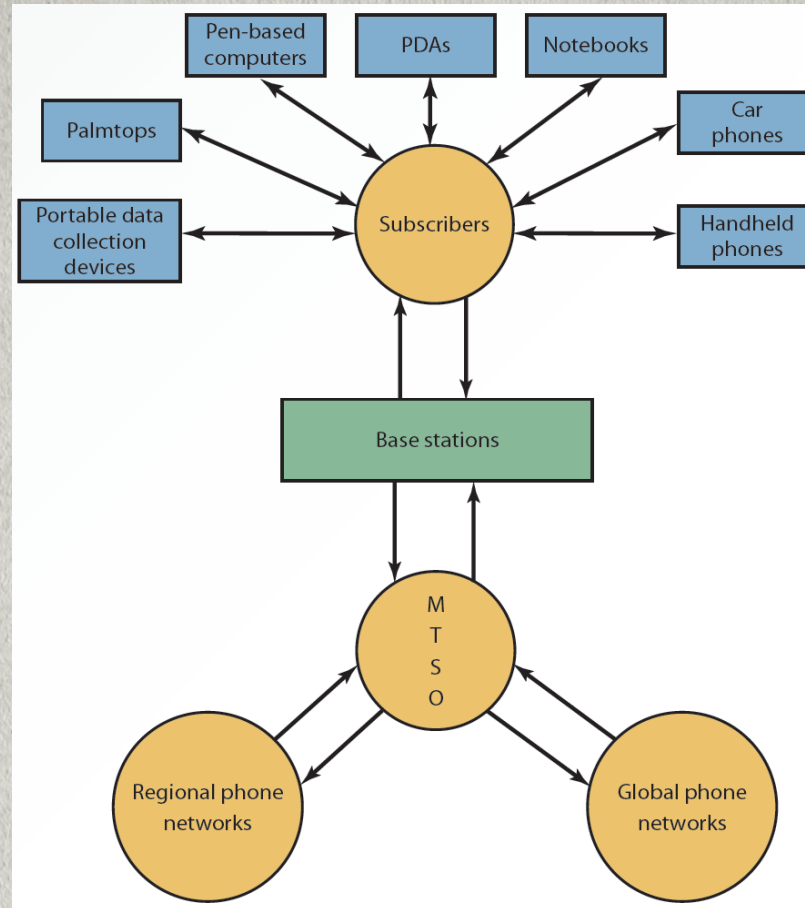
Mobile Networks (1 of 2)

- Consist of a three-part architecture
 - Base stations
 - Mobile telephone switching offices (MTSOs)
 - Subscribers
- Technologies developed to improve efficiency and quality
 - Time Division Multiple Access (TDMA)
 - Increases efficiency by 300 percent; allows carrying three calls on one channel

Mobile Networks (2 of 2)

- Code Division Multiple Access (CDMA)
 - Transmits multiple encoded messages over a wide frequency and then decodes them at the receiving end

Mobile Network Architecture



Wireless Security

- Techniques for improving security
 - SSID (Service Set Identifier)
 - WEP (Wired Equivalent Privacy)
 - EAP (Extensible Authentication Protocol)
 - WPA (Wi-Fi Protected Access)
 - WPA2 or 802.11i

Convergence of Voice, Video, and Data (1 of 2)

- Convergence
 - Integrating voice, video, and data so that multimedia information can be used for decision making
 - Possible because of a combination of:
 - Technological innovation
 - Changes in market structure
 - Regulatory reform

Convergence of Voice, Video, and Data (2 of 2)

- Applications of convergence
 - E-commerce
 - Increased availability of entertainment options
 - Increased availability and affordability of video and computer conferencing
 - Consumer products and services

Summary (1 of 2)

- Data communication systems improve the flexibility of data collection and transmission
- Communication media, or channels, connect sender and receiver devices
- OSI standardizes interactions between network computers exchanging information

Summary (2 of 2)

- The three major types of networks are local area networks, wide area networks, and metropolitan area networks
- Network topology represents a network's physical layout
- Wireless and mobile networks have the advantages of mobility, flexibility, ease of installation, and low cost

