



Chapter 7

TELECOMMUNICATIONS, THE INTERNET, AND WIRELESS TECHNOLOGY

VIDEO CASES

Case 1: Traveling the Internet and Wireless Technology

Case 2: Unified Communications Systems With Virtual Collaboration: IBM and Forterra

Instructional Video 1: AT&T Launches Managed Cisco Telepresence Solution

Instructional Video 2: CNN Telepresence



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Learning Objectives

- **What are the principal components of telecommunications networks and key networking technologies?**
- **What are the main telecommunications transmission media and types of networks?**
- **How does the Internet and Internet technology work and how do they support communication and e-business?**
- **What are the principal technologies and standards for wireless networking, communication, and Internet access?**
- **Why are radio frequency identification (RFID) and wireless sensor networks valuable for business?**



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Hyundai Heavy Industries Creates A Wireless Shipyard

- **Problem:** Shipbuilding space is too large (4.2 sq mi) and complex to track inventory in real-time, limiting efficiency
- **Solution:** High-speed wireless network built by KT Corp, using radio sensors, notebooks, mobiles, Web cams
- **Illustrates:**
 - Powerful capabilities and solutions offered by contemporary networking technology
 - Use of radio sensor technologies to track inventory



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Telecommunications and Networking in Today's Business World

- **Networking and communication Trends**
 - **Convergence:**
 - Telephone networks and computer networks converging into single digital network using Internet standards
 - E.g. cable companies providing voice service
 - **Broadband:**
 - More than 60% U.S. Internet users have broadband access
 - **Broadband wireless:**
 - Voice and data communication as well as Internet access are increasingly taking place over broadband wireless platforms



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Telecommunications and Networking in Today's Business World

- **What is a computer network?**
 - **Two or more connected computers**
 - **Major components in simple network**
 - Client computer
 - Server computer
 - Network interfaces (NICs)
 - Connection medium
 - Network operating system
 - Hub or switch
 - **Routers**
 - Device used to route packets of data through different networks, ensuring that data sent gets to the correct address



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COMPONENTS OF A SIMPLE COMPUTER NETWORK

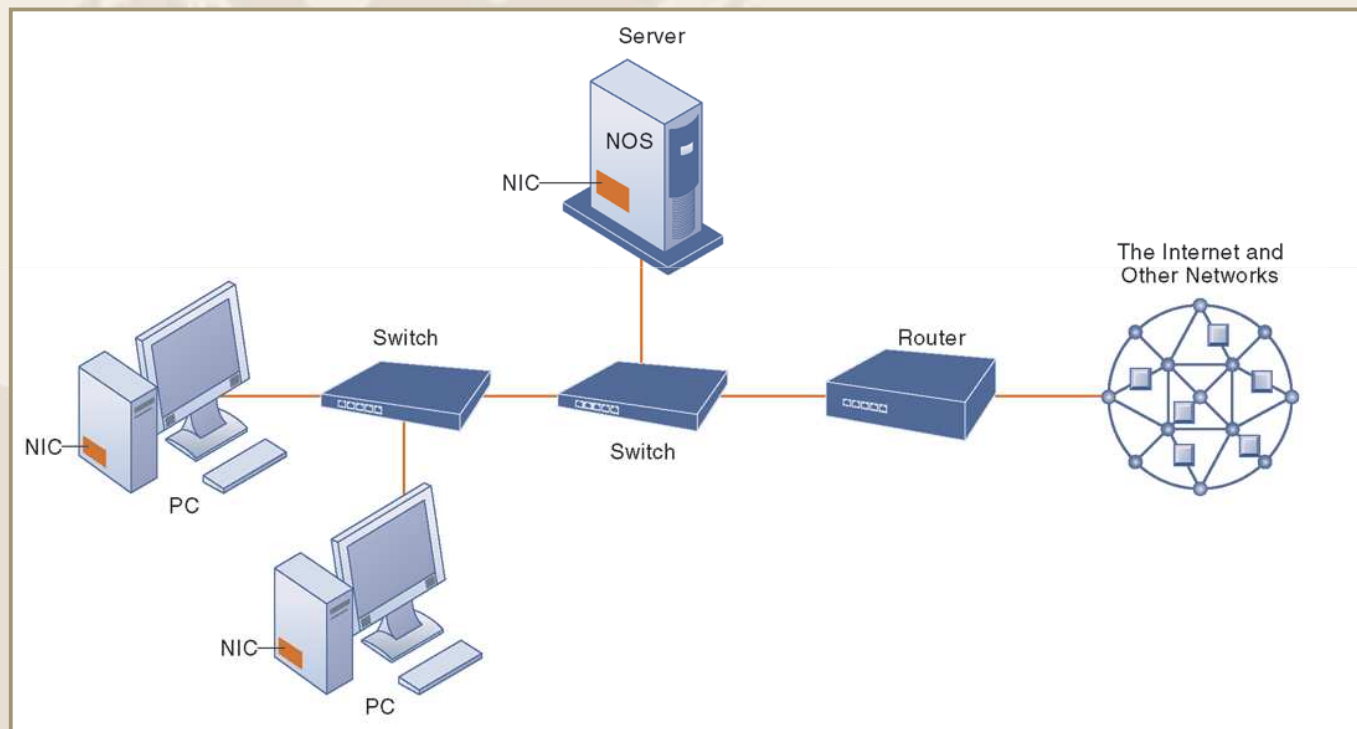


FIGURE 7-1

Illustrated here is a very simple computer network, consisting of computers, a network operating system residing on a dedicated server computer, cable (wiring) connecting the devices, network interface cards (NICs), switches, and a router.



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Telecommunications and Networking in Today's Business World

- **Components of networks in large companies**
 - **Hundreds of local area networks (LANs) linked to firmwide corporate network**
 - **Various powerful servers**
 - Web site
 - Corporate intranet, extranet
 - Backend systems
 - **Mobile wireless LANs (Wi-Fi networks)**
 - **Videoconferencing system**
 - **Telephone network**
 - **Wireless cell phones**



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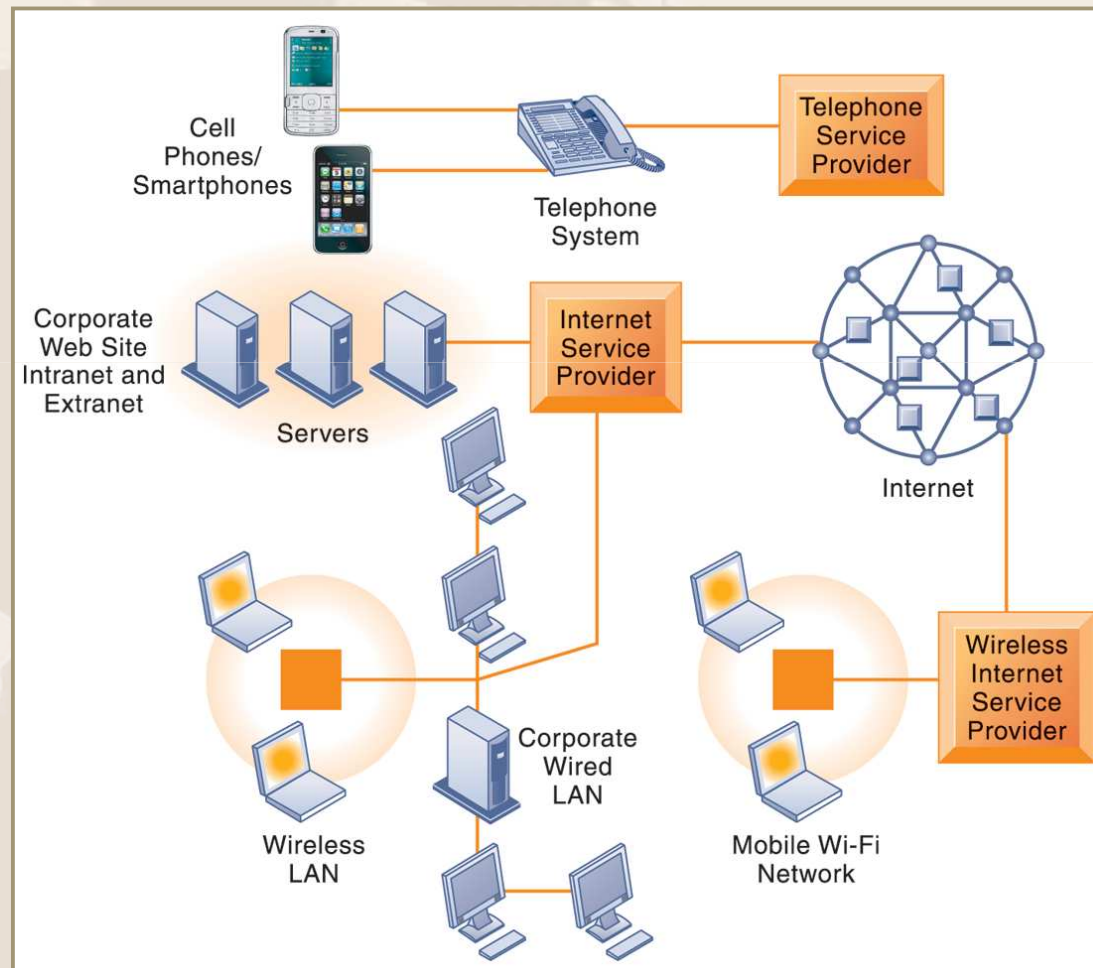
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Telecommunications and Networking in Today's Business World

CORPORATE NETWORK INFRASTRUCTURE

Today's corporate network infrastructure is a collection of many different networks from the public switched telephone network, to the Internet, to corporate local area networks linking workgroups, departments, or office floors.

FIGURE 7-2





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Telecommunications and Networking in Today's Business World

- **Key networking technologies**
 - **Client/server computing**
 - Distributed computing model
 - Clients linked through network controlled by network server computer
 - Server sets rules of communication for network and provides every client with an address so others can find it on the network
 - Has largely replaced centralized mainframe computing
 - The Internet: Largest implementation of client/server computing



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- **Key networking technologies (cont.)**
 - **Packet switching**
 - Method of slicing digital messages into parcels (packets), sending packets along different communication paths as they become available, and then reassembling packets at destination
 - Previous circuit-switched networks required assembly of complete point-to-point circuit
 - Packet switching more efficient use of network's communications capacity



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PACKED-SWITCHED NETWORKS AND PACKET COMMUNICATIONS

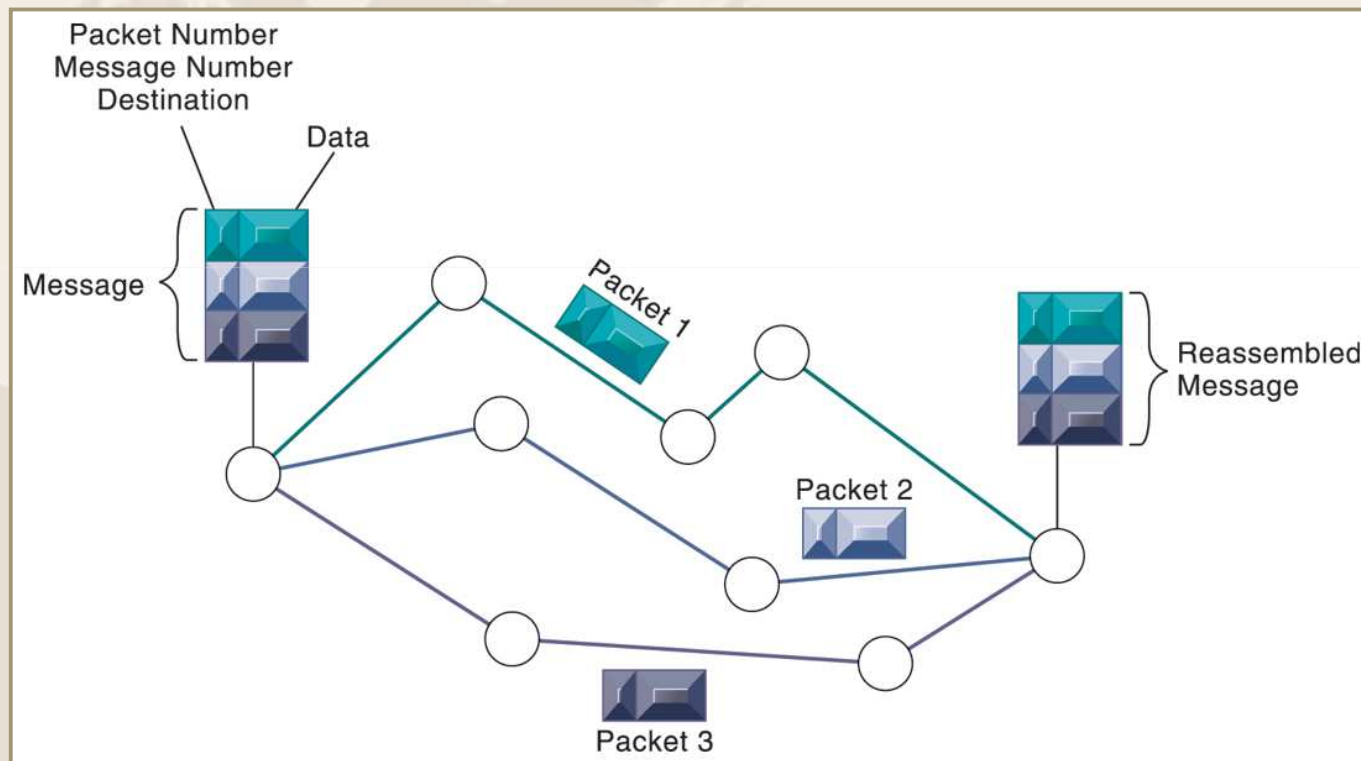


FIGURE 7-3

Data are grouped into small packets, which are transmitted independently over various communications channels and reassembled at their final destination.



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- **Key networking technologies (cont.)**
 - **TCP/IP and connectivity**
 - **Connectivity between computers enabled by protocols**
 - **Protocols:** Rules that govern transmission of information between two points
 - **Transmission Control Protocol/Internet Protocol (TCP/IP)**
 - Common worldwide standard that is basis for Internet
 - **Department of Defense reference model for TCP/IP**
 - Four layers
 1. Application layer
 2. Transport layer
 3. Internet layer
 4. Network interface layer



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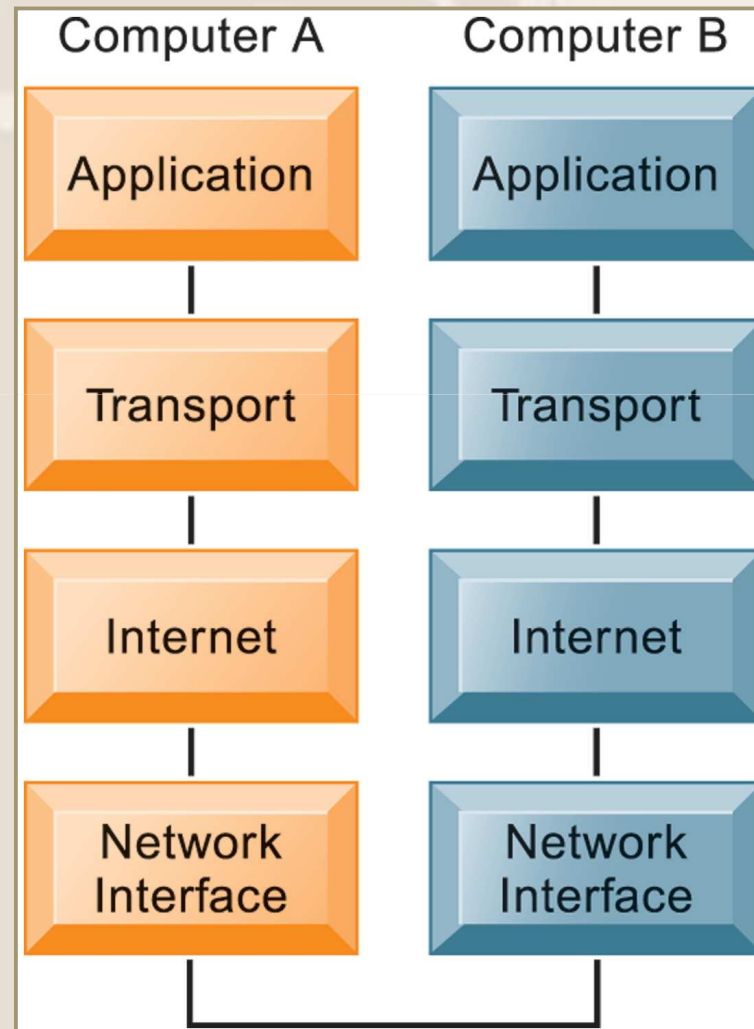
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THE TRANSMISSION CONTROL PROTOCOL/ INTERNET PROTOCOL (TCP/IP) REFERENCE MODEL

This figure illustrates the four
layers of the TCP/IP reference
model for communications

FIGURE 7-4





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- **Signals: digital vs. analog**
 - **Modem: Translates digital signals into analog form**
- **Types of networks**
 - **Local-area networks (LANs)**
 - Campus-area networks (CANs)
 - Peer-to-peer
 - Topologies: star, bus, ring
 - **Metropolitan and wide-area networks**
 - Wide-area networks (WANs)
 - Metropolitan-area networks (MANs)



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FUNCTIONS OF THE MODEM

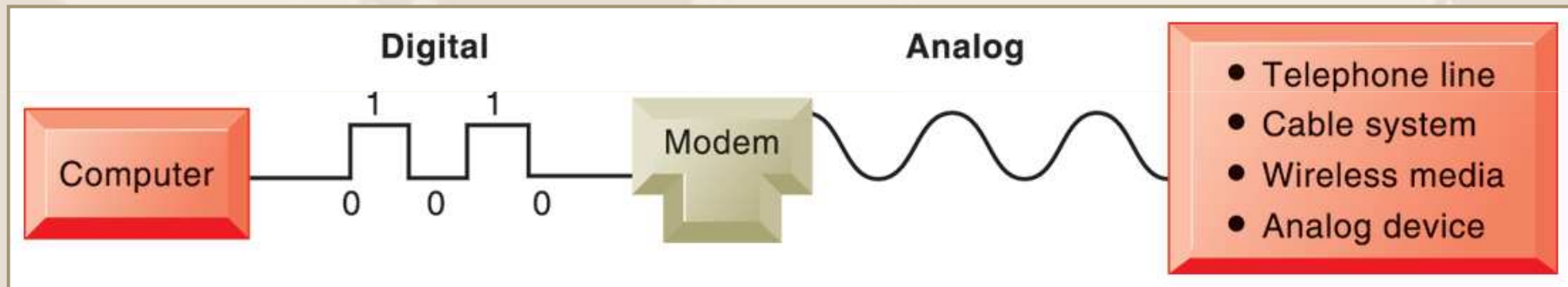


FIGURE 7-5

A modem is a device that translates digital signals into analog form (and vice versa) so that computers can transmit data over analog networks such as telephone and cable networks.



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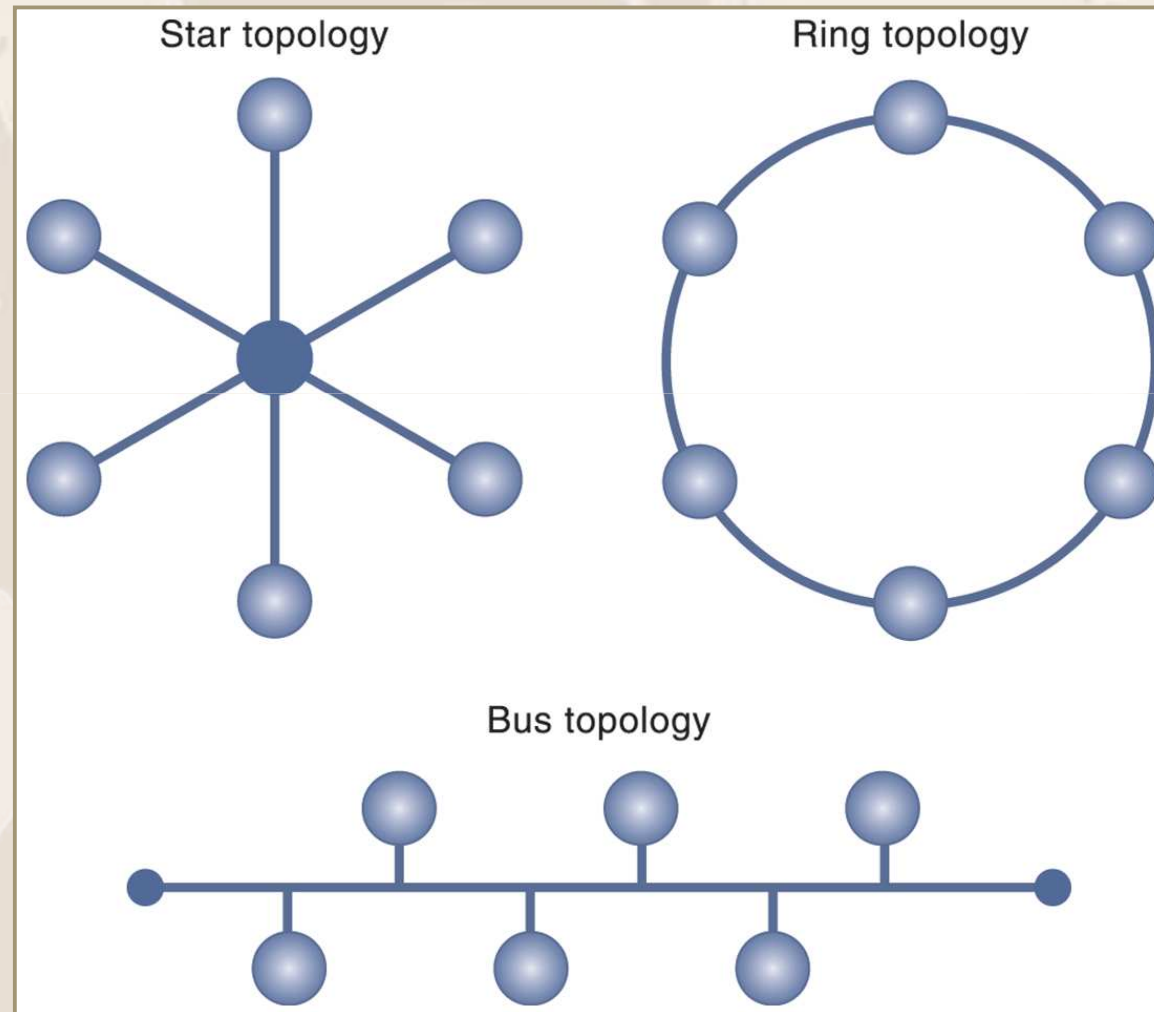
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NETWORK TOPOLOGIES

The three basic network topologies are the star, bus, and ring.

FIGURE 7-6





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- **Physical transmission media**
 - Twisted wire (modems)
 - Coaxial cable
 - Fiber optics and optical networks
 - Dense wavelength division multiplexing (DWDM)
 - **Wireless transmission media and devices**
 - Microwave
 - Satellites
 - Cellular telephones
 - Transmission speed (hertz, bandwidth)



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Telecommunications and Networking in Today's Business World

BP'S SATELLITE TRANSMISSION SYSTEM

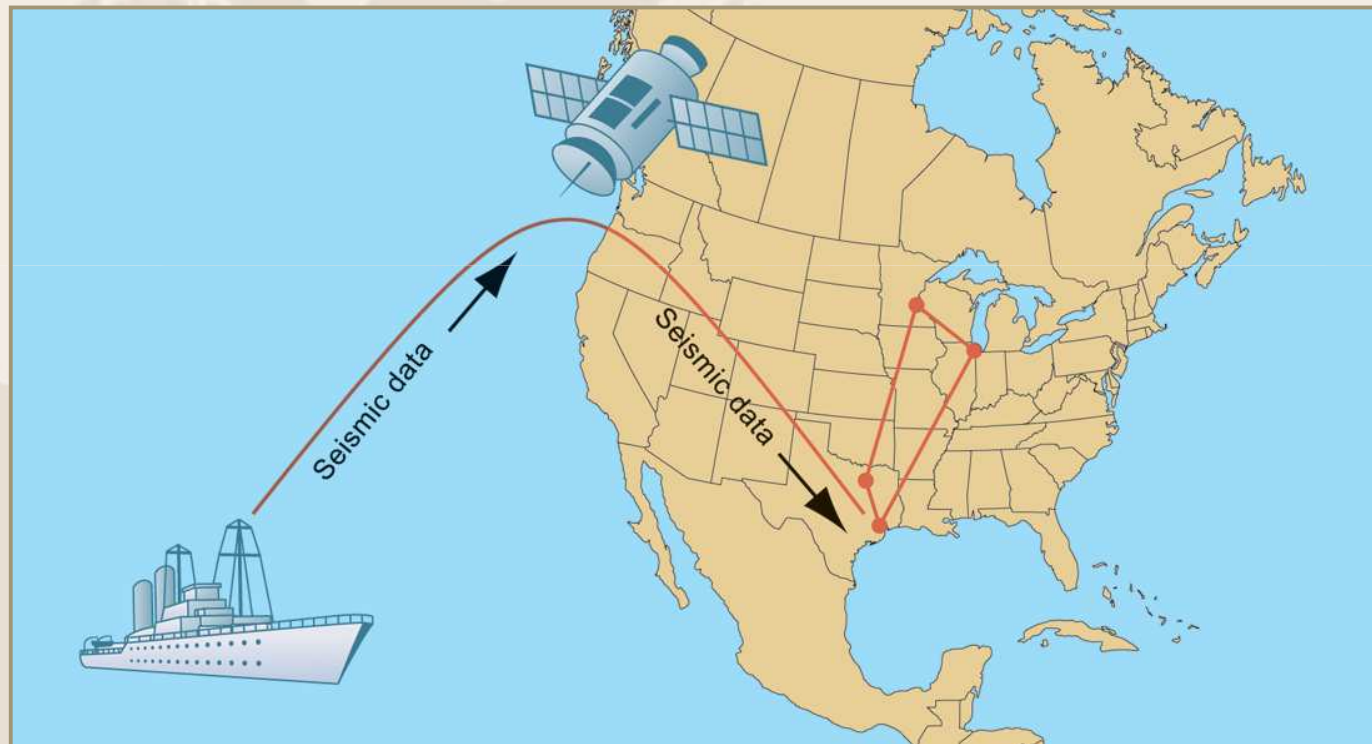


FIGURE 7-7

Communication satellites help BP transfer seismic data between oil exploration ships and research centers in the United States.



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The Global Internet

- **What is the Internet?**
- **Internet Addressing and Architecture**
 - **The Domain Name System**
 - Hierarchical structure
 - Top-level domains
 - **Internet Architecture and Governance**
 - No formal management: IAB, ICANN, W3C
 - **The Future Internet: IPv6 and Internet2**



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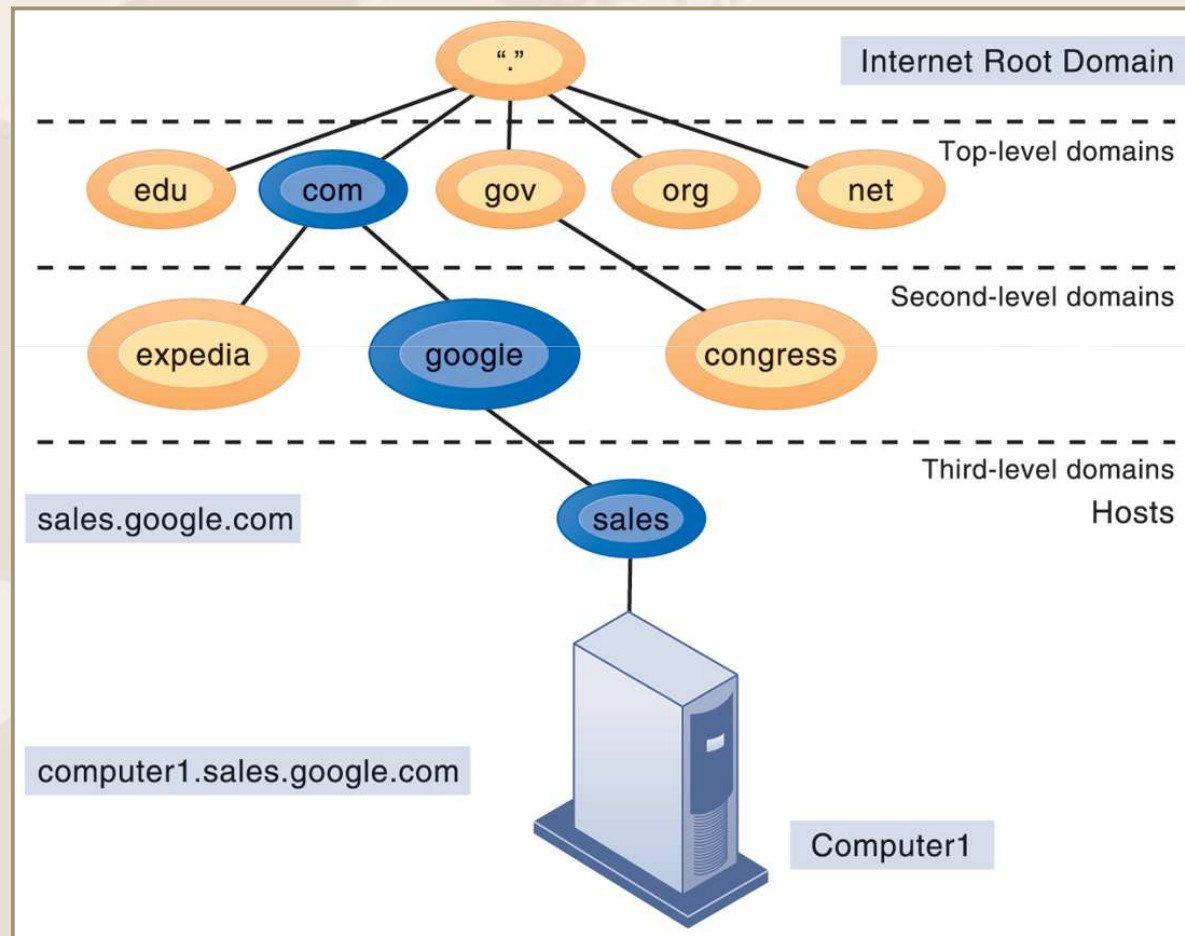
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THE DOMAIN NAME SYSTEM

Domain Name System is a hierarchical system with a root domain, top-level domains, second-level domains, and host computers at the third level.

FIGURE 7-8





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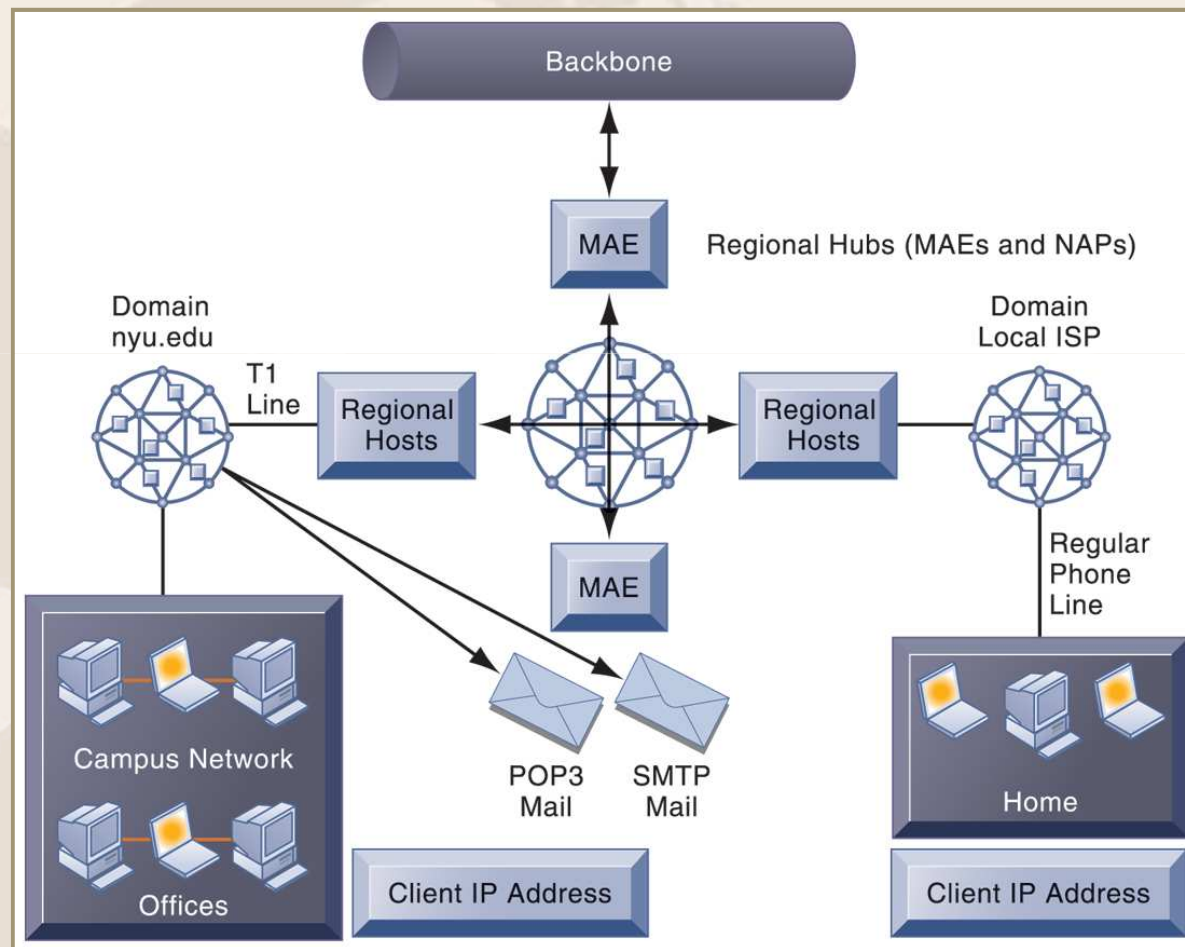
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INTERNET NETWORK ARCHITECTURE

The Internet backbone connects to regional networks, which in turn provide access to Internet service providers, large firms, and government institutions. Network access points (NAPs) and metropolitan area exchanges (MAEs) are hubs where the backbone intersects regional and local networks and where backbone owners connect with one another.

FIGURE 7-9





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The Global Internet

THE BATTLE OVER NET NEUTRALITY

Read the Interactive Session and discuss the following questions

- **What is network neutrality? Why has the Internet operated under net neutrality up to this point in time?**
- **Who's in favor of net neutrality? Who's opposed? Why?**
- **What would be the impact on individual users, businesses, and government if Internet providers switched to a tiered service model?**
- **Are you in favor of legislation enforcing network neutrality? Why or why not?**



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The Global Internet

- **Internet services**
 - **E-mail**
 - **Chatting and instant messaging**
 - **Newsgroups**
 - **Telnet**
 - **File Transfer Protocol (FTP)**
 - **World Wide Web**
 - **VoIP**
 - **Virtual private network (VPN)**



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CLIENT/SERVER COMPUTING ON THE INTERNET

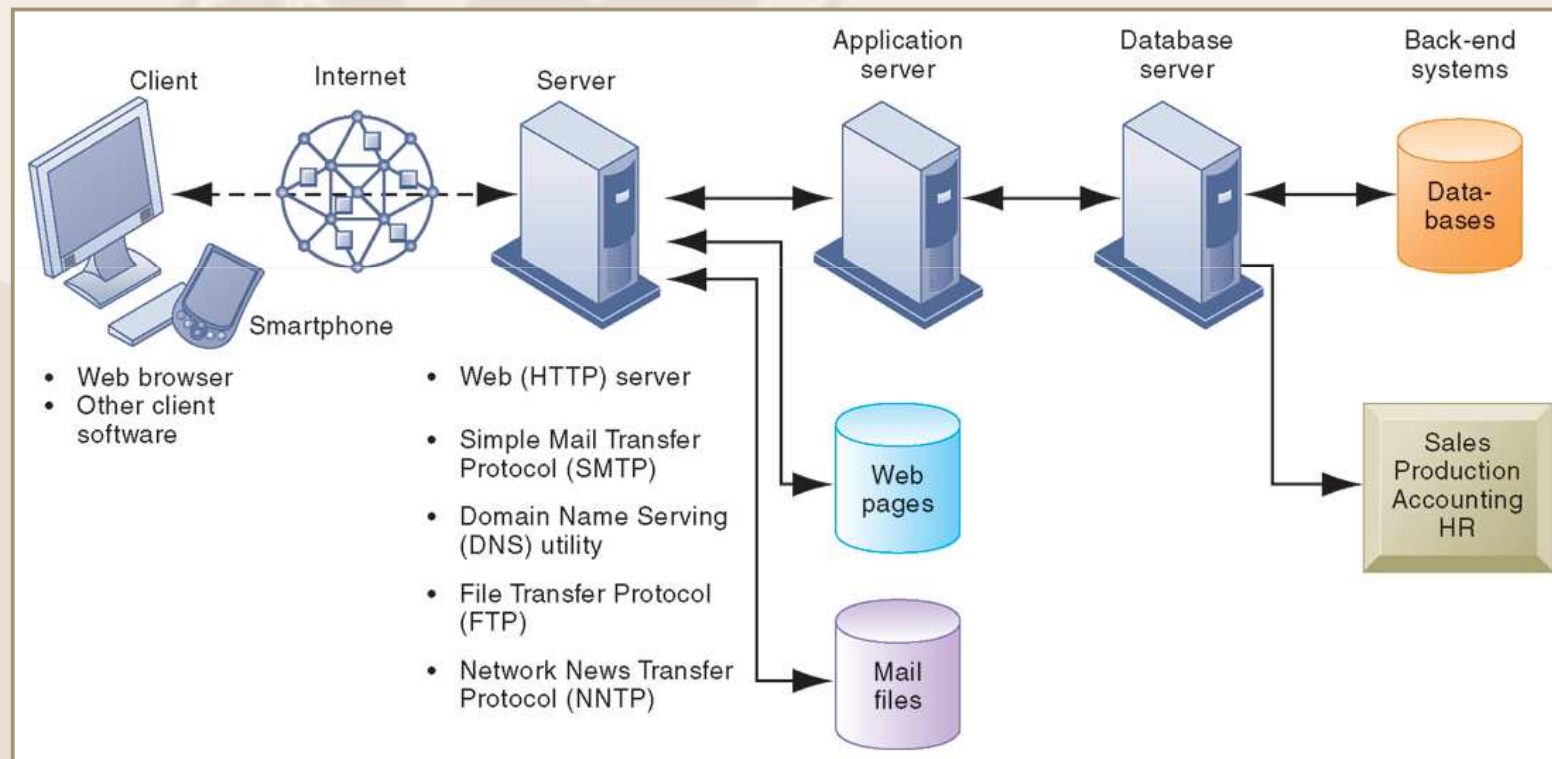


FIGURE 7-10

Client computers running Web browser and other software can access an array of services on servers over the Internet. These services may all run on a single server or on multiple specialized servers.



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HOW VOICE OVER IP WORKS

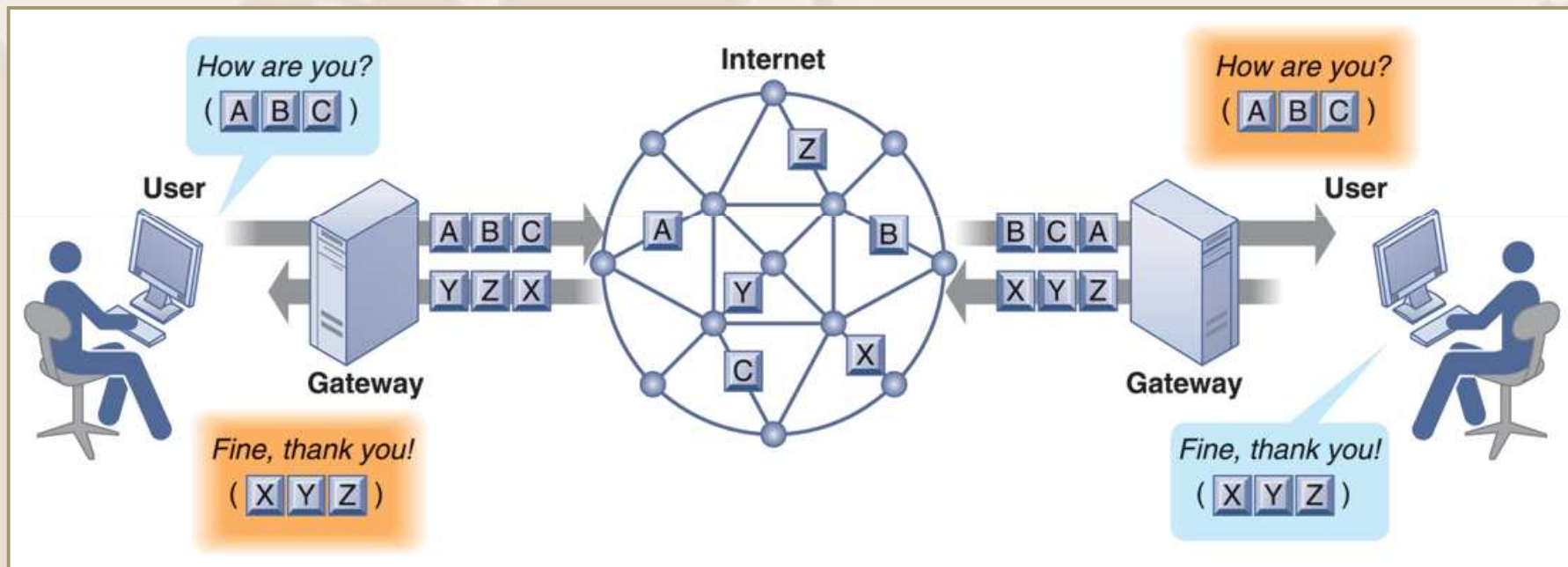


FIGURE 7-11

An VoIP phone call digitizes and breaks up a voice message into data packets that may travel along different routes before being reassembled at the final destination. A processor nearest the call's destination, called a gateway, arranges the packets in the proper order and directs them to the telephone number of the receiver or the IP address of the receiving computer.



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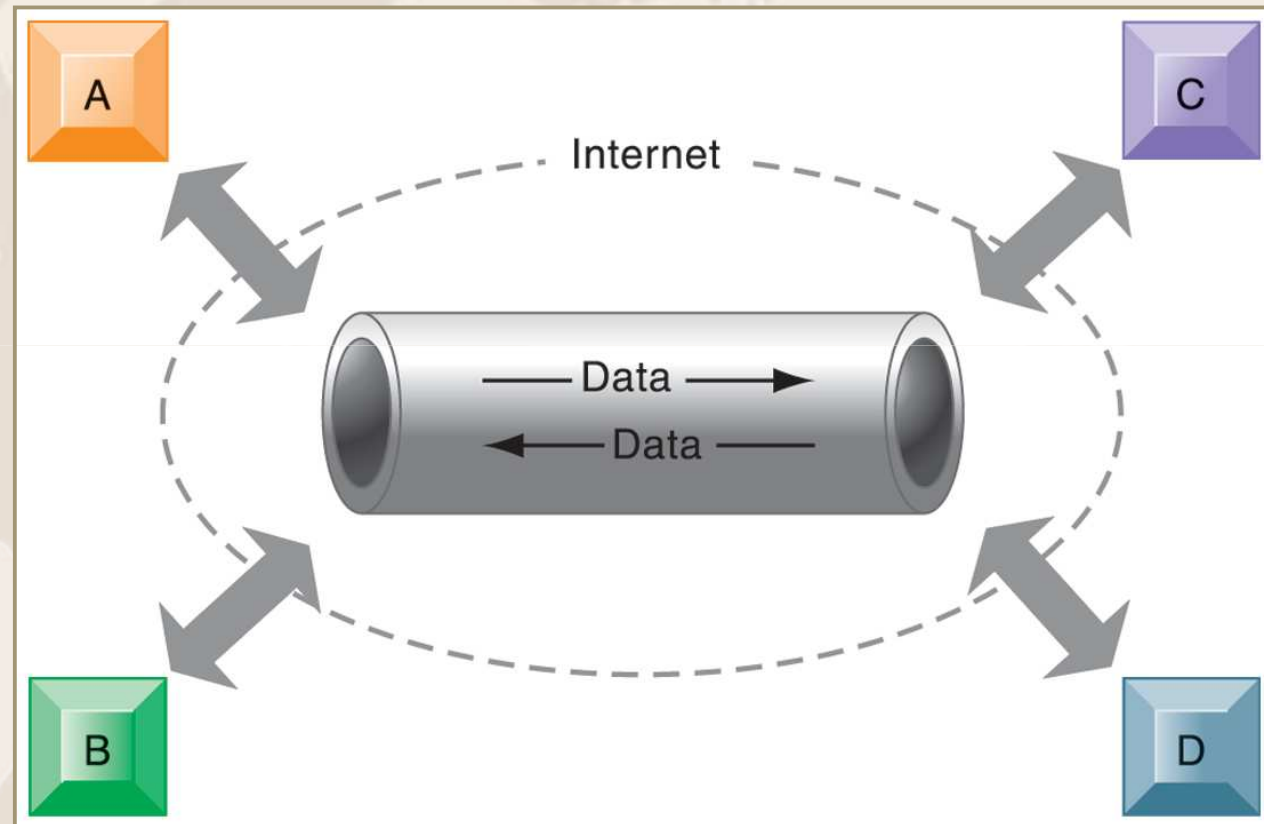
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A VIRTUAL PRIVATE NETWORK USING THE INTERNET

This VPN is a private network of computers linked using a secure “tunnel” connection over the Internet. It protects data transmitted over the public Internet by encoding the data and “wrapping” them within the Internet Protocol (IP). By adding a wrapper around a network message to hide its content, organizations can create a private connection that travels through the public Internet.

FIGURE 7-12





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MONITORING EMPLOYEES ON NETWORKS: UNETHICAL OR GOOD BUSINESS?

Read the Interactive Session and discuss the following questions

- **Should managers monitor employee e-mail and Internet usage? Why or why not?**
- **Describe an effective e-mail and Web use policy for a company.**
- **Should managers inform employees that their Web behavior is being monitored? Or should managers monitor secretly? Why or why not?**



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The Global Internet

- **The World Wide Web**
 - **HTML (Hypertext Markup Language):**
 - Formats documents for display on Web
 - **Hypertext Transfer Protocol (HTTP):**
 - Communications standard used for transferring Web pages
 - **Uniform resource locators (URLs):**
 - Addresses of Web pages
 - E.g. <http://www.megacorp.com/content/features/082602.html>
 - **Web servers**
 - Software for locating and managing Web pages



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The Global Internet

- **The World Wide Web (cont.)**
 - **Search engines**
 - Started in early 1990s as relatively simple software programs using keyword indexes
 - Today, major source of Internet advertising revenue via search engine marketing, using complex algorithms and page ranking techniques to locate results
 - **Shopping bots**
 - Use intelligent agent software for searching Internet for shopping information



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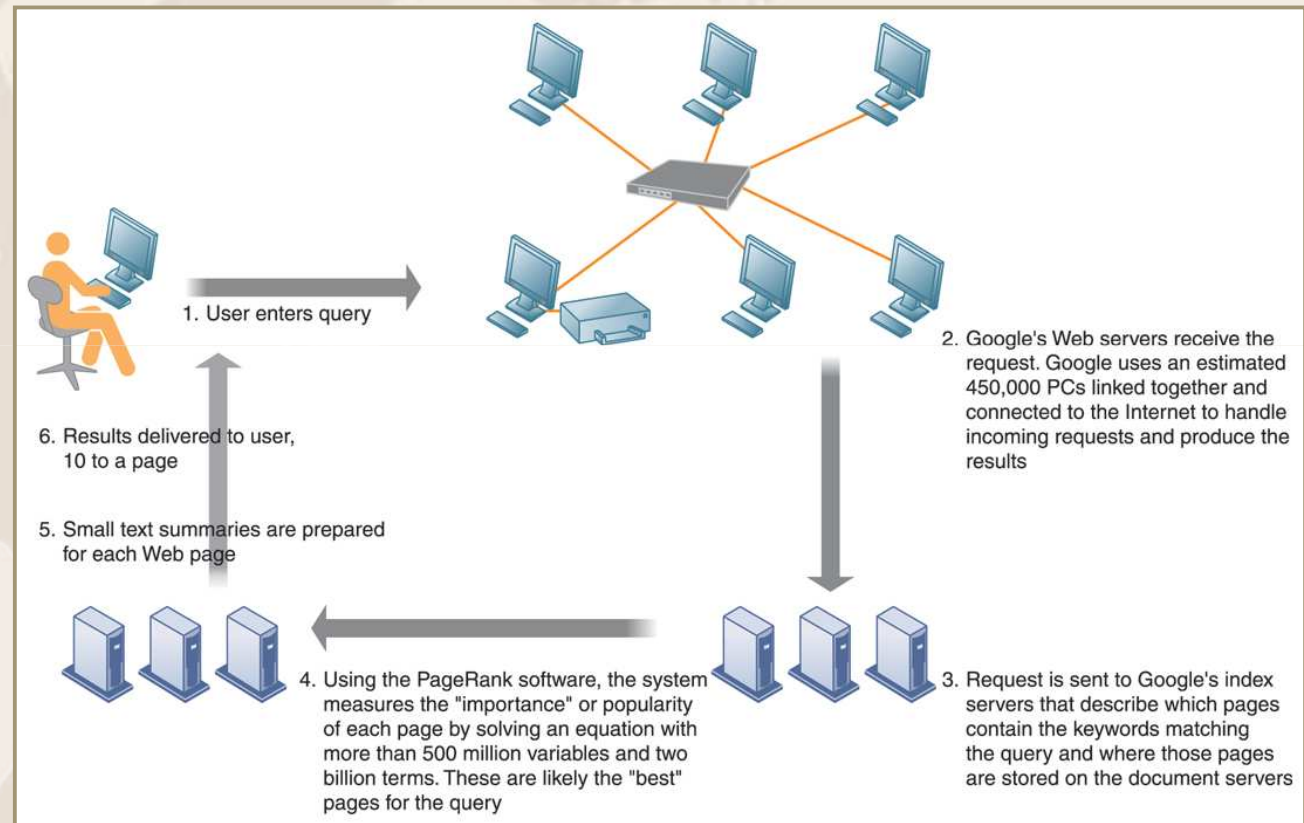
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HOW GOOGLE WORKS

The Google search engine is continuously crawling the Web, indexing the content of each page, calculating its popularity, and storing the pages so that it can respond quickly to user requests to see a page. The entire process takes about one-half second.

FIGURE 7-13





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TOP U.S. WEB SEARCH ENGINES

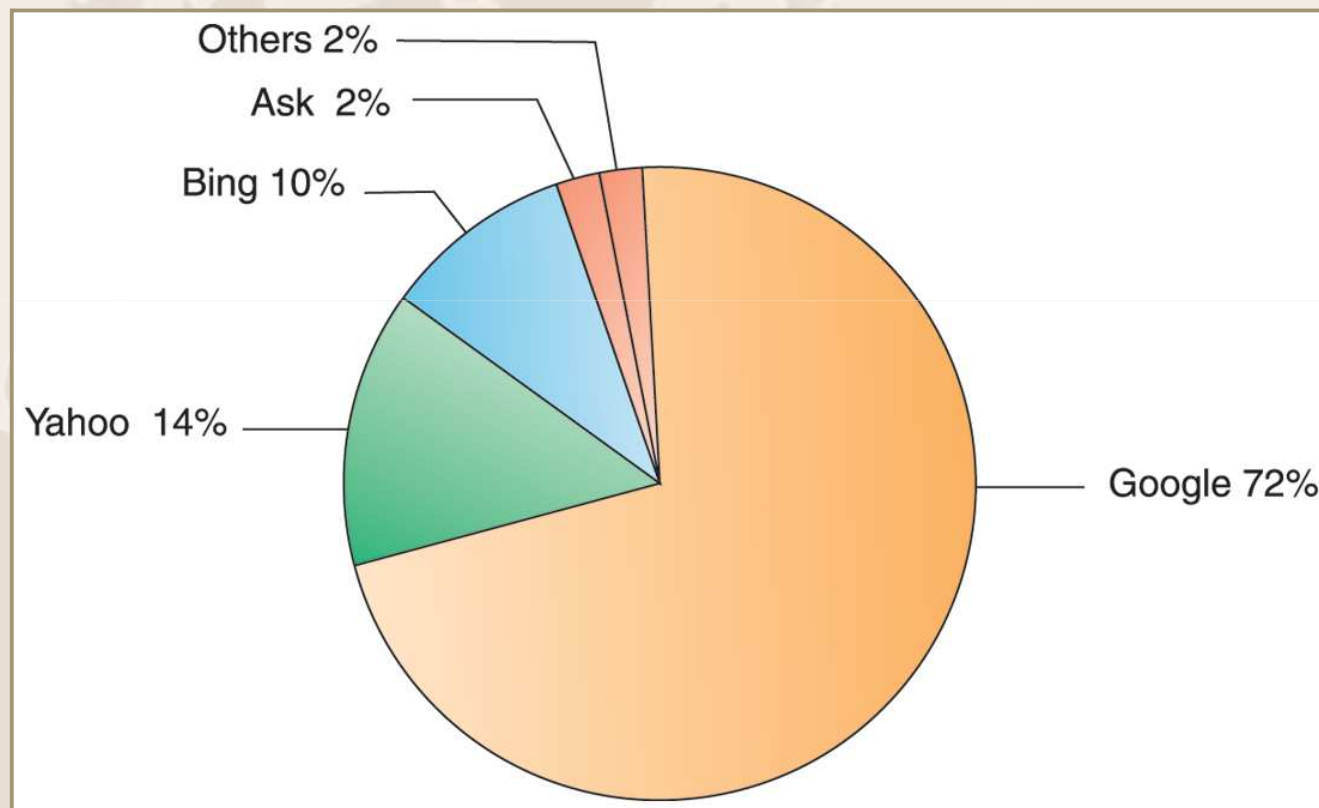


FIGURE 7-14

Google is the most popular search engine on the Web, handling 72 percent of all Web searches.



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The Global Internet

- **Web 2.0**
 - **Four defining features**
 1. Interactivity
 2. Real-time user control
 3. Social participation
 4. User-generated content
 - **Technologies and services behind these features**
 - Cloud computing
 - Blogs/RSS
 - Mashups & widgets
 - Wikis
 - Social networks



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The Global Internet

- **Web 3.0 – the Semantic Web**
 - Effort of W3C to add meaning to existing Web
 - Make searching more relevant to user
- **Other visions**
 - More “intelligent” computing
 - 3D Web
 - Pervasive Web
 - Increase in cloud computing, SaaS
 - Ubiquitous connectivity between mobile and other access devices
 - Make Web a more seamless experience



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The Wireless Revolution

- **Cellular systems**
 - **Competing standards for cellular service**
 - CDMA: United States
 - GSM: Rest of world, plus AT&T and T-Mobile
 - **Third-generation (3G) networks**
 - Suitable for broadband Internet access
 - 144 Kbps – 2Mbps
 - **4G networks**
 - Entirely packet-switched
 - 100 Mbps – 1Gbps



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The Wireless Revolution

- **Wireless computer networks and Internet access**
 - **Bluetooth (802.15)**
 - Links up to 8 devices in 10-m area
 - Useful for personal networking (PANs) and in business to transmit data from handheld devices to other transmitters
 - **Wi-Fi (802.11)**
 - Set of standards: 802.11a, 802.11b, 802.11g, 802.11n
 - Used for wireless LAN and wireless Internet access
 - Use access points: Device with radio receiver/transmitter for connecting wireless devices to a wired LAN



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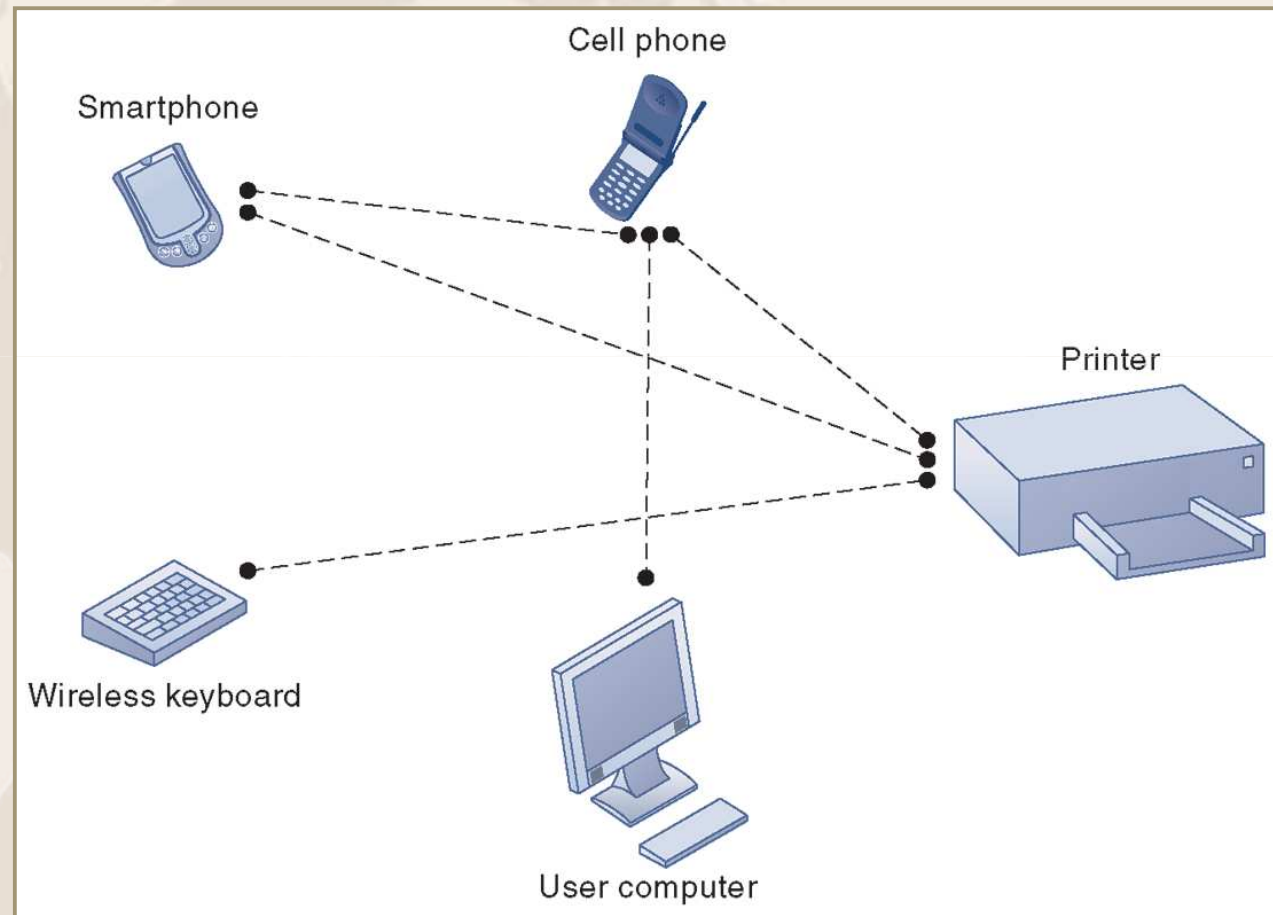
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The Wireless Revolution

A BLUETOOTH NETWORK (PAN)

Bluetooth enables a variety of devices, including cell phones, PDAs, wireless keyboards and mice, PCs, and printers, to interact wirelessly with each other within a small 30-foot (10-meter) area. In addition to the links shown, Bluetooth can be used to network similar devices to send data from one PC to another, for example.

FIGURE 7-15





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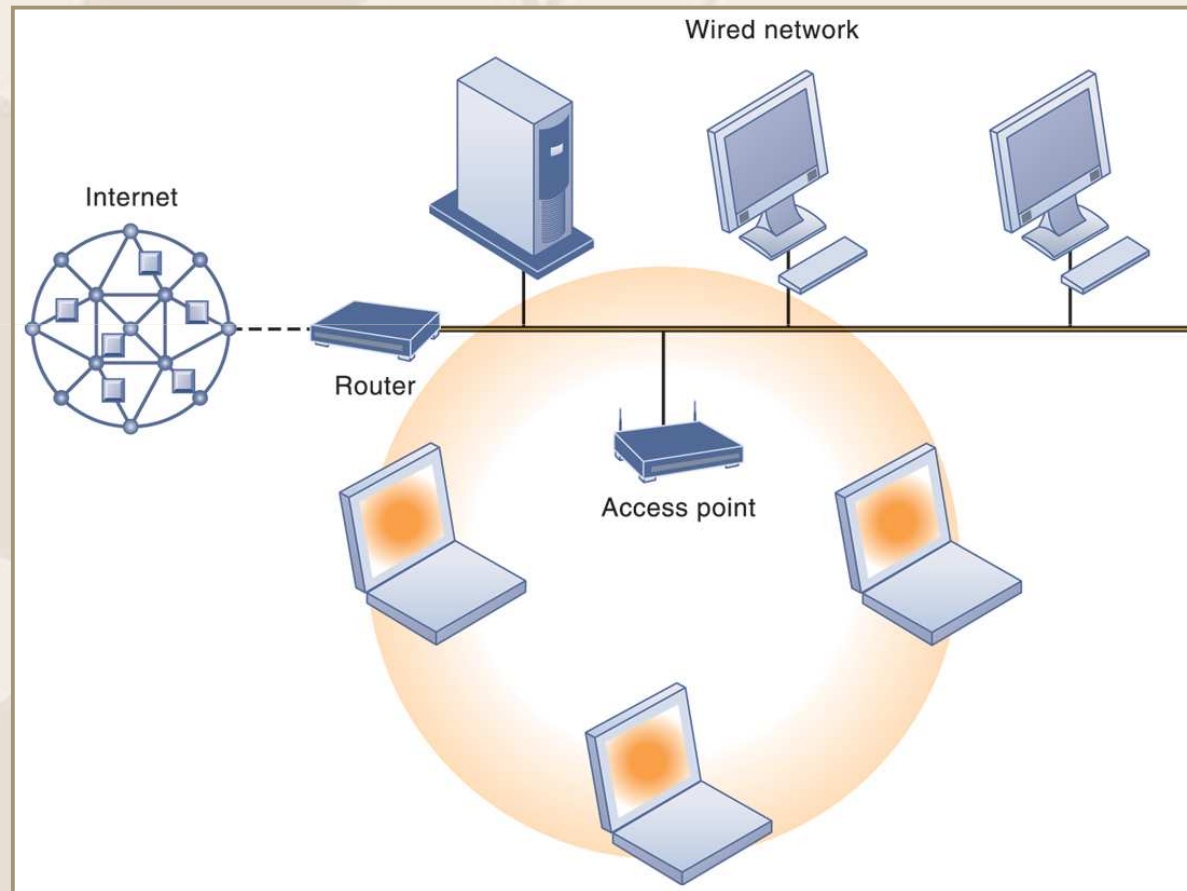
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The Wireless Revolution

AN 802.11 WIRELESS LAN

Mobile laptop computers equipped with network interface cards link to the wired LAN by communicating with the access point. The access point uses radio waves to transmit network signals from the wired network to the client adapters, which convert them into data that the mobile device can understand. The client adapter then transmits the data from the mobile device back to the access point, which forwards the data to the wired network.

FIGURE 7-16





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The Wireless Revolution

- **Wireless computer networks and Internet access**
 - **Wi-Fi (cont.)**
 - Hotspots: Access points in public place to provide maximum wireless coverage for a specific area
 - Weak security features
 - **WiMax (802.16)**
 - Wireless access range of 31 miles
 - Require WiMax antennas
 - Sprint Nextel building WiMax network as foundation for 4G networks



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The Wireless Revolution

- **Radio frequency identification (RFID)**
 - Use tiny tags with embedded microchips containing data about an item and location, and antenna
 - Tags transmit radio signals over short distances to special RFID readers, which send data over network to computer for processing
 - **Active RFID:** Tags have batteries, data can be rewritten, range is hundreds of feet, more expensive
 - **Passive RFID:** Range is shorter, also smaller, less expensive, powered by radio frequency energy



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The Wireless Revolution

- **Radio frequency identification (RFID) (cont.)**
 - **Common uses:**
 - Automated toll-collection
 - Tracking goods in a supply chain
 - **Requires companies to have special hardware and software**
 - **Reduction in cost of tags making RFID viable for many firms**



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The Wireless Revolution

HOW RFID WORKS

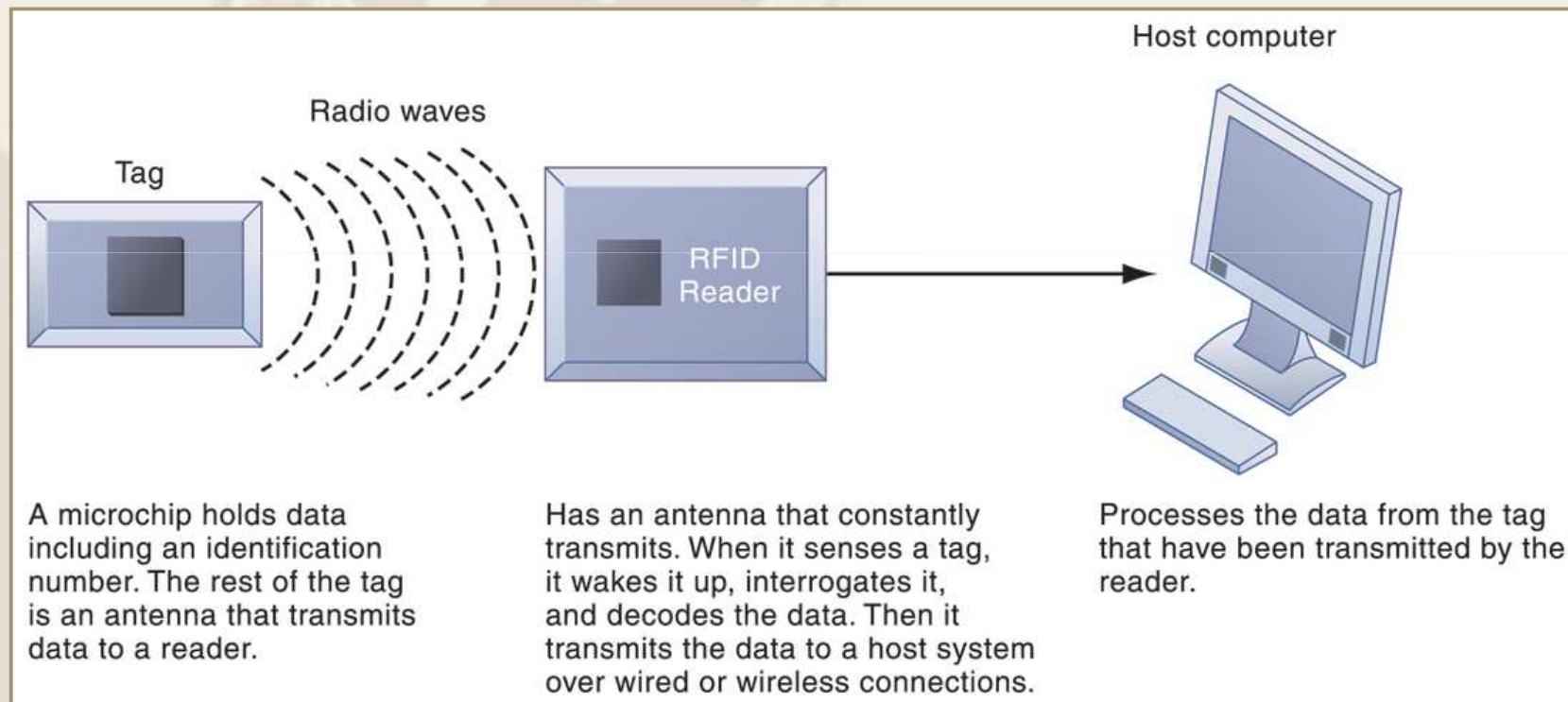


FIGURE 7-17

RFID uses low-powered radio transmitters to read data stored in a tag at distances ranging from 1 inch to 100 feet. The reader captures the data from the tag and sends them over a network to a host computer for processing.



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The Wireless Revolution

- **Wireless sensor networks (WSNs)**
 - **Networks of hundreds or thousands of interconnected wireless devices embedded into physical environment to provide measurements of many points over large spaces**
 - Devices have built-in processing, storage, and radio frequency sensors and antennas
 - Require low-power, long-lasting batteries and ability to endure in the field without maintenance
 - **Used to monitor building security, detect hazardous substances in air, monitor environmental changes, traffic, or military activity**



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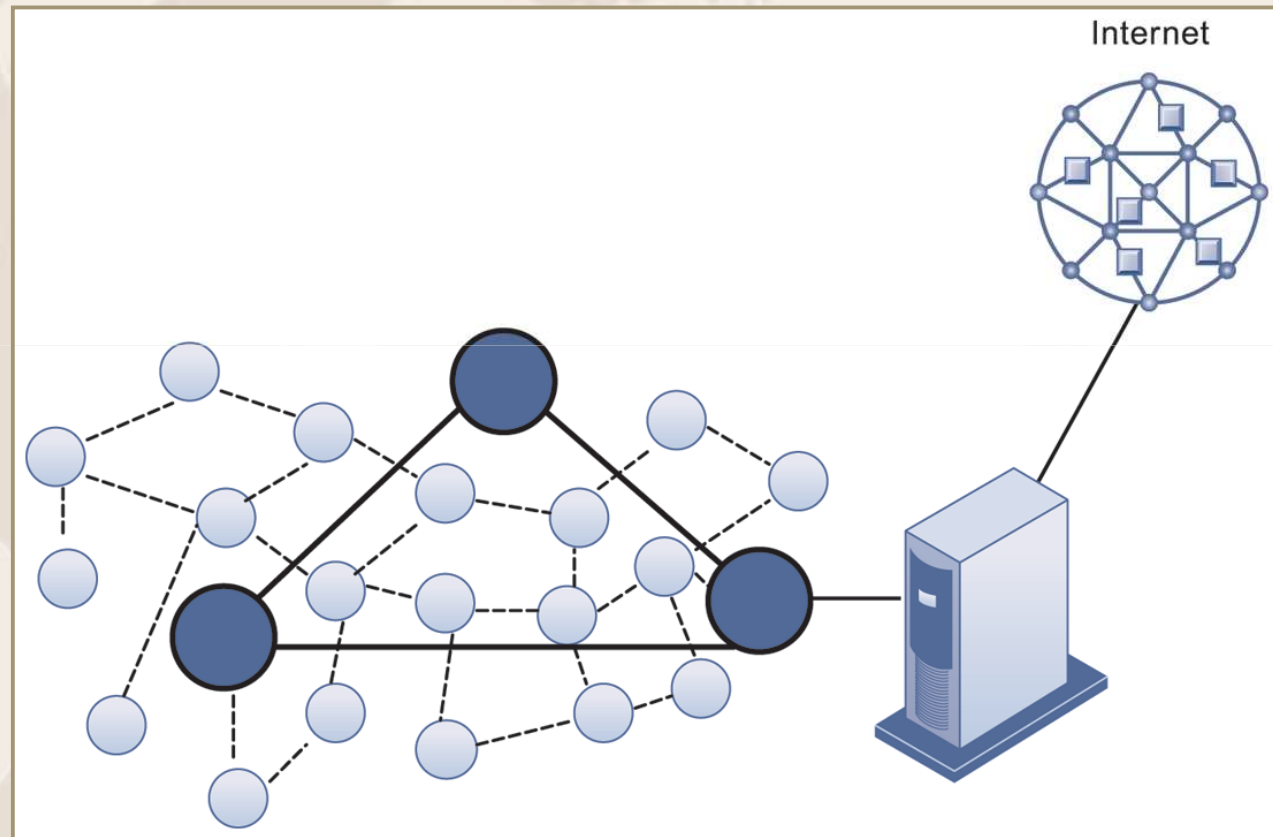
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A WIRELESS SENSOR NETWORK

The small circles represent lower-level nodes and the larger circles represent high-end nodes. Lower level nodes forward data to each other or to higher-level nodes, which transmit data more rapidly and speed up network performance.

FIGURE 7-18





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