



MIS 14e Ch07



Chapter 7

Telecommunications, the Internet, and Wireless Technology

Video cases:
Case 1: Telepresence Moves Out of the Boardroom and Into the Field
Case 2: Unified Communications Systems: Virtual Collaboration with Lotus Sametime



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Chapter 7: Telecommunications, the Internet, and Wireless Technology

LEARNING OBJECTIVES

1. What are the principal **components of telecommunications networks** and key networking technologies?
2. What are the **different types of networks**?
3. How do the **Internet and Internet technology** work and how do they support communication and e-business?
4. What are the principal **technologies and standards for wireless networking, communication, and Internet access**?

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Wireless Technology Makes Dundee Precious Metals Good as Gold

- **Problem:** Inefficient manual processes; large production environment
- **Solutions:** Deploy Wi-Fi network, RFID and AeroScout tracking to monitor materials, staff in real time, optimize transportation, and expedite communication
- **Demonstrates use of technology in production to increase efficiency and lower costs and improve safety**

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1. Components of Networks and Key Networking Technology

- **Networking and Communication Trends**
 - **Convergence:**
 - Telephone networks and computer networks converging into single digital network using Internet standards
 - **Broadband:**
 - More than 74 percent U.S. Internet users have broadband access
 - **Broadband wireless:**
 - Voice, data communication are increasingly taking place over broadband wireless platforms

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1. Components of Networks and Key Networking Technology

- **Computer network**
 - **Two or more connected computers**
 - **Major components in simple network**
 - Client and server computers
 - Network interfaces (NICs)
 - Connection medium
 - Network operating system
 - Hubs, switches, routers
 - **Software-defined networking (SDN)**
 - Functions of switches and routers managed by central program

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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, cabling (wiring) connecting the devices, network interface cards (NIC), switches, and a router.

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1. Components of Networks and Key Networking Technology

- **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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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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1. Components of Networks and Key Networking Technology

- **Key digital 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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1. Components of Networks and Key Networking Technology

- **Key digital 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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Packet-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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1. Components of Networks and Key Networking Technology

- Key digital networking technologies (cont.)
 - TCP/IP and connectivity
 - **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
 - » Application layer
 - » Transport layer
 - » Internet layer
 - » Network interface layer

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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

```
graph TD; subgraph Computer_A [Computer A]; direction TB; A1[Application] --- A2[Transport] --- A3[Internet] --- A4[Network Interface]; end; subgraph Computer_B [Computer B]; direction TB; B1[Application] --- B2[Transport] --- B3[Internet] --- B4[Network Interface]; end; A4 --- B4;
```

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2. LEARNING OBJECTIVES

1. What are the principal components of telecommunications networks and key networking technologies?
2. What are the **different types of networks**?
3. How do the Internet and Internet technology work and how do they support communication and e-business?
4. What are the principal technologies and standards for wireless networking, communication, and Internet access?

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2. Different Types of Networks

- **Signals: Digital versus analog**
 - Modem: translates digital signals into analog form (and vice versa)
- **Types of networks**
 - Local area networks (LANs)
 - Ethernet
 - Client/server vs. peer-to-peer
 - Wide area networks (WANs)
 - Metropolitan area networks (MANs)
 - Campus area networks (CANs)

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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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2. Different Types of Networks

- **Physical transmission media**
 - Twisted pair wire (CAT5)
 - Coaxial cable
 - Fiber optics cable
 - Wireless transmission media and devices
 - Satellites
 - Cellular systems
- **Transmission speed**
 - Bits per second (bps)
 - Hertz
 - Bandwidth

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3. LEARNING OBJECTIVES

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3. The Internet and Internet Technology

- **The Internet**
 - World's most extensive network
 - Internet service providers (ISPs)
 - Provide connections
 - Types of Internet connections
 - Dial-up: 56.6 Kbps
 - Digital subscriber line (DSL/FIOS): 385 Kbps–40 Mbps
 - Cable Internet connections: 1–50 Mbps
 - Satellite
 - T1/T3 lines: 1.54–45 Mbps

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3. The Internet and Internet Technology

- **Internet addressing and architecture**
 - Each device on Internet assigned Internet Protocol (IP) address
 - 32-bit number, e.g. 207.46.250.119
- **The Domain Name System (DNS)**
 - Converts IP addresses to domain names
 - Hierarchical structure
 - Top-level domains

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The Domain Name System

The 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 7-6

Internet Root Domain
 Top-level domains
 Second-level domains
 Third-level domains
 Hosts

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3. The Internet and Internet Technology

- **Internet architecture and governance**
 - **Network service providers**
 - Own trunk lines (high-speed backbone networks)
 - **Regional telephone and cable TV companies**
 - Provide regional and local access
 - **Professional organizations and government bodies establish Internet standards**
 - IAB
 - ICANN
 - W3C

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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 7-7

Backbone
 Regional Hubs (MAEs and NAPs)
 Regional Hosts
 Domain Local ISP
 Regular Phone Line
 Domain nyu.edu
 T1 Line
 Campus Network
 Offices
 POP3 Mail
 SMTP Mail
 Client IP Address
 Home
 Client IP Address

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Interactive Session: Organizations

The Battle over Net Neutrality p302
Read the Interactive Session and discuss the following questions

1. What is network neutrality? Why has the Internet operated under net neutrality up to this point in time?
2. Who's in favor of network neutrality? Who's opposed? Why?
3. What would be the impacts on individual users, businesses, and government if Internet providers switched to a tiered service model for transmission over land lines as well as wireless?

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Interactive Session: Organizations

The Battle over Net Neutrality (cont.)
Read the Interactive Session and discuss the following questions

4. It has been said that net neutrality is the most important issue facing the Internet since the advent of the Internet. Discuss the implications of this statement.
5. Are you in favor of legislation enforcing network neutrality? Why or why not?

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3. The Internet and Internet Technology

- **The Future Internet: IPv6 and Internet 2**
 - **IPv6**
 - New addressing scheme for IP numbers
 - Will provide more than a quadrillion new addresses
 - Not compatible with current IPv5 addressing
 - **Internet2**
 - Advanced networking consortium
 - Universities, businesses, government agencies, other institutions
 - Developed high-capacity 100 Gbps testing network
 - Testing leading-edge new technologies for Internet

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3. The Internet and Internet Technology

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

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Client/Server Computing on the Internet

Figure 7-8 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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3. The Internet and Internet Technology

- **Voice over IP (VoIP)**
 - Digital voice communication using IP, packet switching
 - Providers
 - Cable providers
 - Google, Skype
- **Unified communications**
 - Communications systems that integrate voice, data, e-mail, conferencing
- **Virtual private network (VPN)**
 - Secure, encrypted, private network run over Internet
 - PPTP
 - Tunneling

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How Voice over IP Works

Figure 7-9 A 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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A Virtual Private Network Using the Internet

Figure 7-10 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.

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Interactive Session: Management

Monitoring Employees on Networks—Unethical or Good Business? p307
 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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3. The Internet and Internet Technology

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

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3. The Internet and Internet Technology

- **Search engines**
 - Started as simpler programs using keyword indexes
 - Google created page ranking system
- **Mobile search: 50 percent of all searches in 2014**
- **Search engine marketing**
- **Search engine optimization (SEO)**
- **Search engine algorithms**
 - Google's Hummingbird (2013)
 - Sentence evaluation
 - Knowledge graph

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Top U.S. Web Search Engines

Google is the most popular search engine, handling nearly 70 percent of Web searches in the United States and around 90% in Europe.

Search Engine	Market Share
Google	68%
Microsoft	18%
Yahoo	10%
Ask	2%
Others	2%

Figure 7-11

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How Google Works

The diagram illustrates the Google search process in six steps: 1. User enters query. 2. Google's Web servers receive the request, Google uses several million PCs linked together and connected to the Internet to handle incoming requests and produce the results. 3. Request is sent to Google's index servers that describe which pages contain the keywords matching the query and where those pages are stored on the document servers. 4. Using the PageRank software, the system measures the "importance" or popularity of each page by solving an equation with more than 500 million variables and two billion terms. These are likely the "best" pages for the query. 5. Small text summaries are prepared for each Web page. 6. Results delivered to user, 10 to a page.

Figure 7-12 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.

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3. The Internet and Internet Technology

- **Social search**
 - Effort to provide more relevant results by including pages visited by user's social network
 - Google +1, Facebook Like
- **Semantic search**
 - Anticipating what users are looking for rather than simply returning millions of links
- **Intelligent agent shopping bots**
 - Use intelligent agent software for searching Internet for shopping information

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3. The Internet and Internet Technology

- **Web 2.0**
 - Second-generation services
 - Enabling collaboration, sharing information, and creating new services online
 - Features
 - Interactivity
 - Real-time user control
 - Social participation (sharing)
 - User-generated content

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3. The Internet and Internet Technology

– **Web 2.0 services and tools**

- **Blogs:** chronological, informal Web sites created by individuals
 - RSS (Really Simple Syndication): syndicates Web content so aggregator software can pull content for use in another setting or viewing later
 - Blogosphere
 - Microblogging
- **Wikis:** collaborative Web sites where visitors can add, delete, or modify content on the site
- **Social networking sites:** enable users to build communities of friends and share information

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3. The Internet and Internet Technology

- **Web 3.0: The “Semantic Web”**
 - A collaborative effort led by W3C to add layer of meaning to the existing Web
 - Goal is to reduce human effort in searching for and processing information, making Web more intuitive
 - Increased communication and synchronization with computing devices, communities
 - Internet of Things
 - Visual Web
 - Increased cloud computing, mobile computing

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3. Technologies and Standards for Wireless Networking

- **Cellular systems**
 - **Competing standards**
 - CDMA: United States only
 - GSM: Rest of world, AT&T, T-Mobile
 - **Third-generation (3G) networks**
 - 144 Kbps
 - Suitable for e-mail access, Web browsing
 - **Fourth-generation (4G) networks**
 - Up to 100 Mbps
 - Suitable for Internet video

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3. Technologies and Standards for Wireless Networking

- **Wireless computer networks and Internet access**
 - **Bluetooth (802.15)**
 - Links up to 8 devices in 10-m area using low-power, radio-based communication
 - Useful for personal networking (PANs)
 - **Wi-Fi (802.11)**
 - Set of standards: 802.11
 - 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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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 one another 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 6-15

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An 802.11 Wireless LAN

Mobile laptop computers equipped with wireless 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 forward the data to the wired network.

Figure 7-14

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4. LEARNING OBJECTIVES

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4. Technologies and Standards for Wireless Networking

- **Wireless computer networks and Internet access**
 - **Wi-Fi (cont.)**
 - Hotspots: one or more 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

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4. Technologies and Standards for Wireless Networking

- **Radio frequency identification (RFID)**
 - Use tiny tags with embedded microchips containing data about an item and location
 - Tag antennas to transmit radio signals over short distances to special RFID readers, which send data over network to computer for processing
 - **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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How RFID Works

A microchip holds data including an identification number. The rest of the tag is an antenna that transmits data to a reader.

Has an antenna that constantly transmits. When it senses a tag, it wakes it up, interrogates it, and decodes the data. Then it transmits the data to a host system over wired or wireless connections.

Processes the data from the tag that have been transmitted by the reader.

Figure 7-15 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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4. Technologies and Standards for Wireless Networking

- **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
 - Used to monitor building security, detect hazardous substances in air, monitor environmental changes, traffic, or military activity
 - 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
 - Major sources of "Big Data" and fueling "Internet of Things"

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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 7-16


Internet

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