IS101 Principles of Information Systems

Networks and Cloud Computing

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Textbook: Stair, R., & Reynolds, G. (2016). *Principles of information systems* (13th ed.). Cengage Learning.

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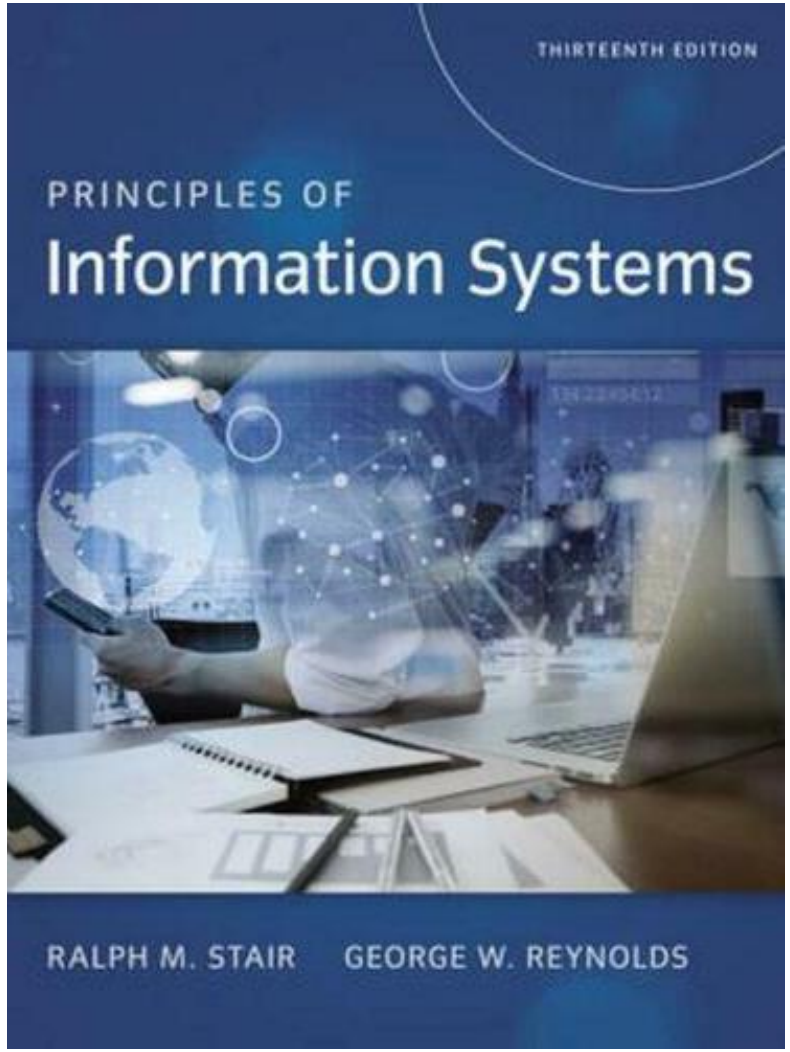


Chapter 6: Networks and Cloud Computing

Principles of information systems

Thirteen Edition

Network Fundamentals

Network Topology

- The shape or structure of a network, including the arrangement of the communications links and hardware devices on the network

Three most common network topologies

1. Star network (central hub)
2. Bus network (common backbone)
3. Mesh network (multiple access points)

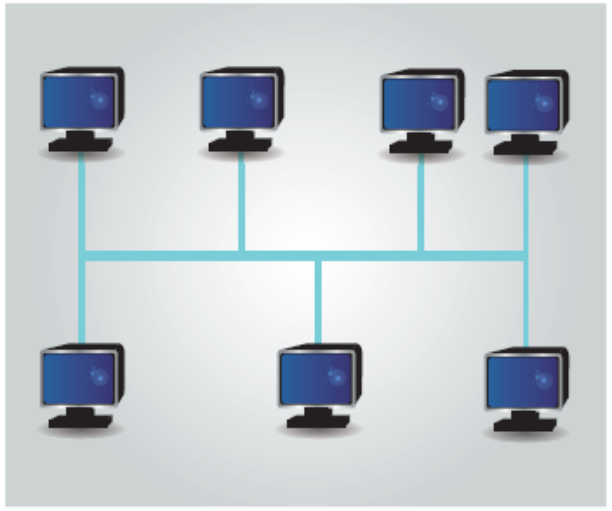


FIGURE 6.2
Bus network
In a bus network, all network devices are connected to a common backbone that serves as a shared communications medium.

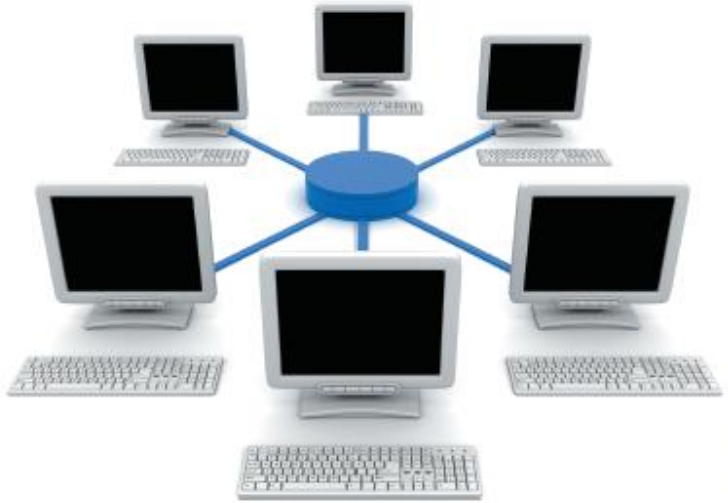


FIGURE 6.1
Star network
In a star network, all network devices connect to one another through a single central hub node.

FIGURE 6.3
Mesh network
Mesh networks use multiple access points to link a series of devices that speak to each other to form a network connection across a large area.

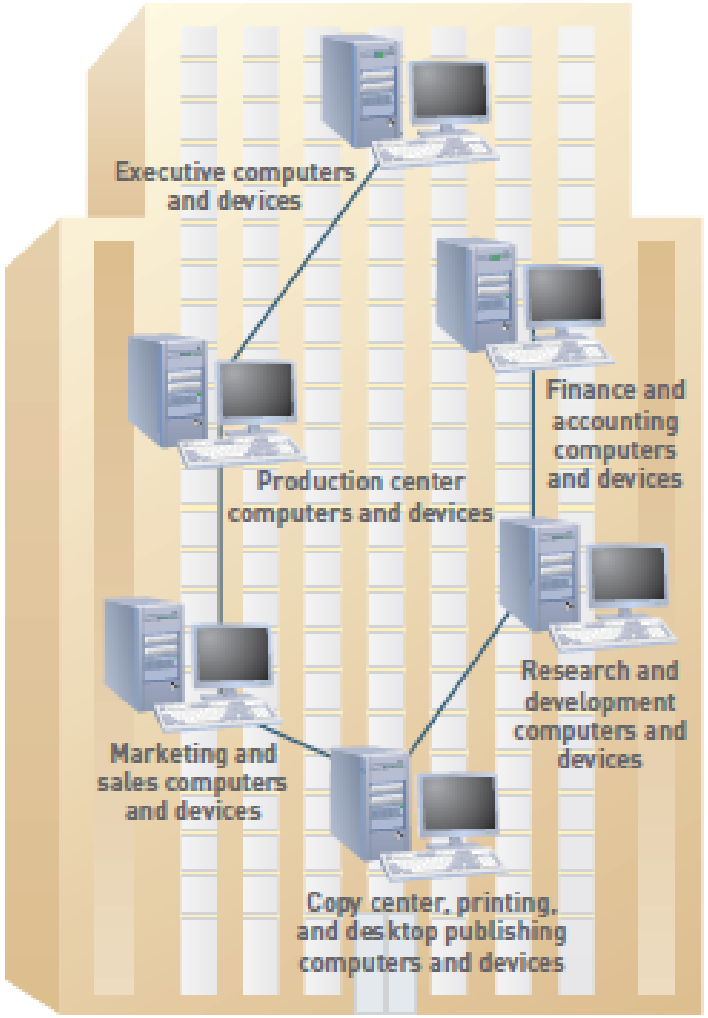
Network Types

- A personal area network (**PAN**) supports the interconnection of information technology close to one person
- A local area network (**LAN**) connects computer systems and devices within a small area (e.g., an office or a home)
- A metropolitan area network (**MAN**) connects users and their devices in an area that spans a campus or city
- A wide area network (**WAN**) connects large geographic regions

FIGURE 6.4

Typical LAN

All network users within an office building can connect to each other's devices for rapid communication. For instance, a user in research and development could send a document from her computer to be printed at a printer located in the desktop publishing center. Most computer labs employ a LAN to enable the users to share the use of high-speed and/or color printers and plotters as well as to download software applications and save files.



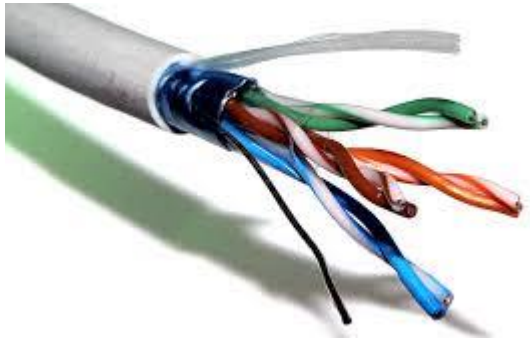
Communications Media

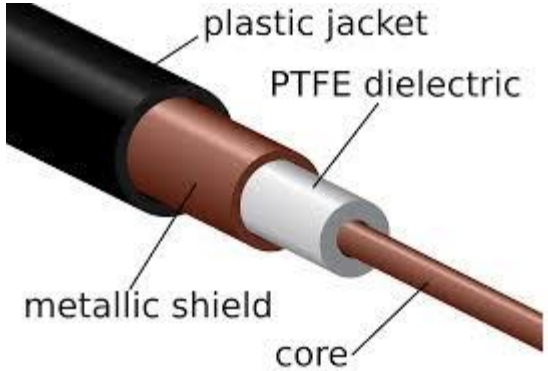
Two broad categories of communication media

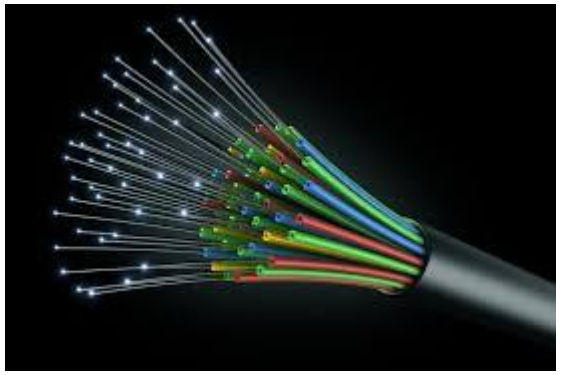
1. **Guided (wired) transmission media**: signals are guided along a solid medium

TABLE 6.1 Guided transmission media types

Media Form	Description	Advantages	Disadvantages
Twisted-pair wire	Twisted pairs of copper wire, shielded or unshielded; used for telephone service	Widely available	Limitations on transmission speed and distance
Coaxial cable	Inner conductor wire surrounded by insulation	Cleaner and faster data transmission than twisted-pair wire	More expensive than twisted-pair wire
Fiber-optic cable	Many extremely thin strands of glass bound together in a sheathing; uses light beams to transmit signals	Diameter of cable is much smaller than coaxial cable; less distortion of signal; capable of high transmission rates	Expensive to purchase and install







2. Wireless communication

- Transfer of information between two or more points not connected by an electrical conductor
- Signals **sent within a range of frequencies of the electromagnetic spectrum**

- Fundamental properties of light
  - Frequency and wavelength

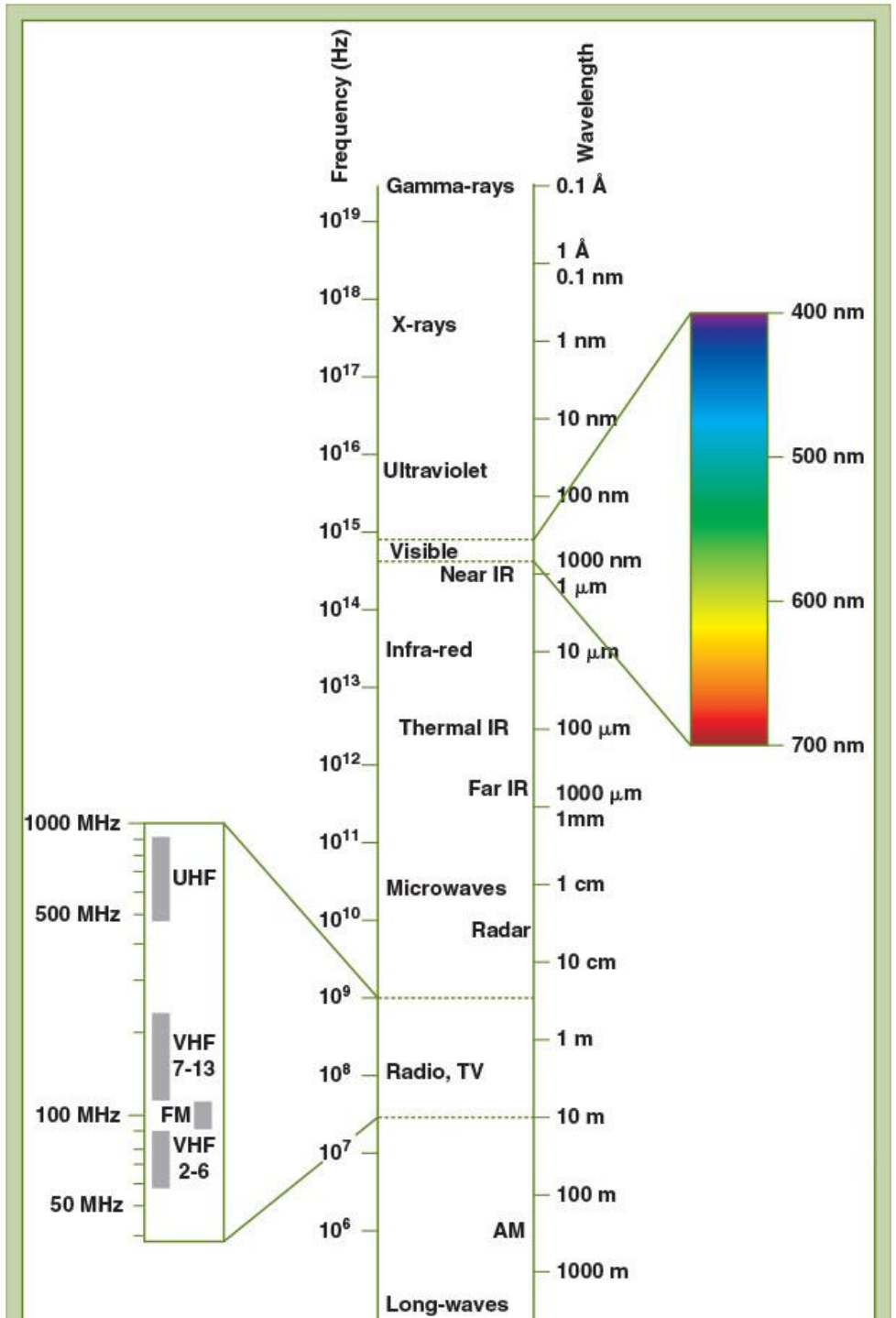
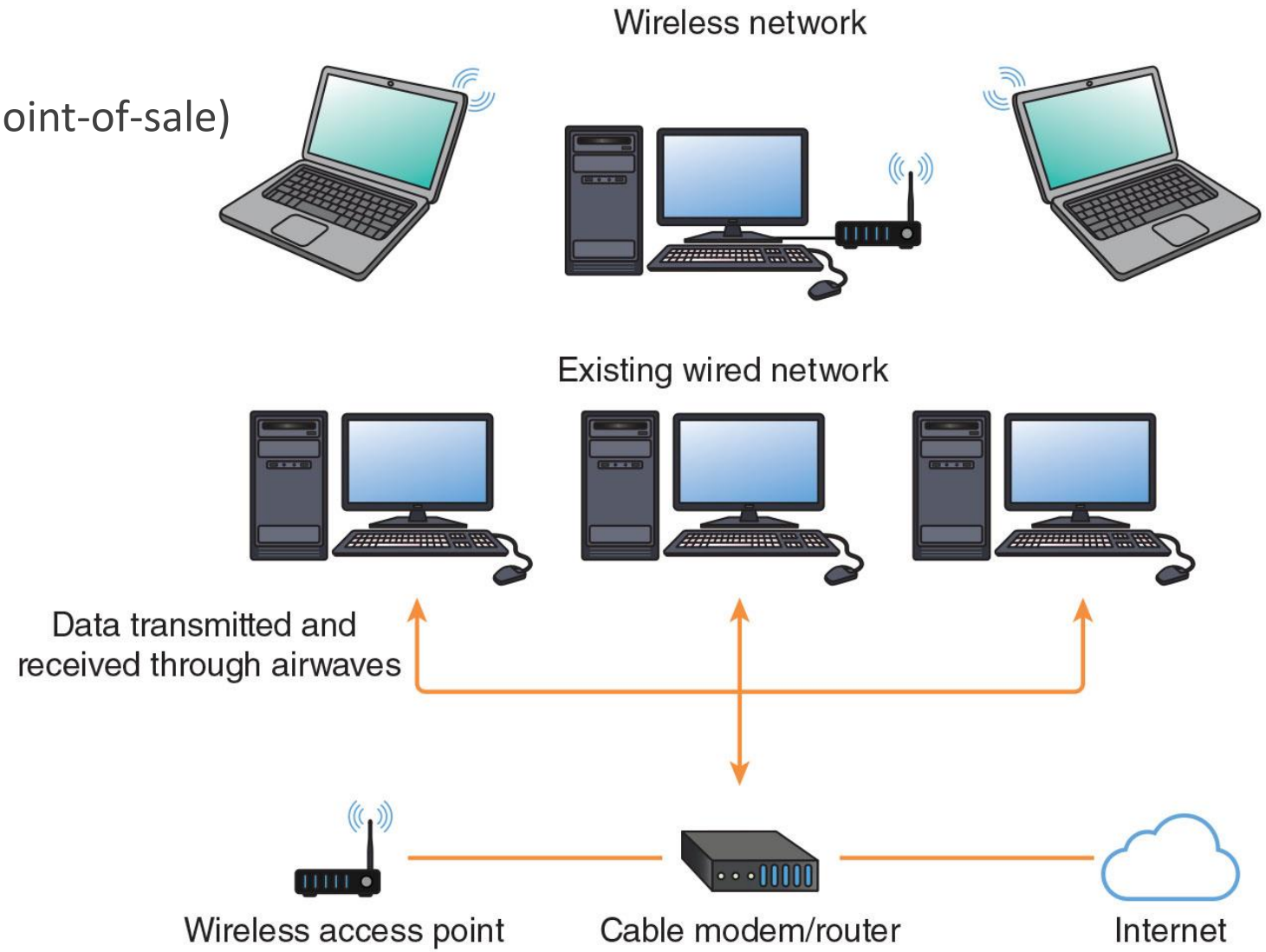


FIGURE 6.6 The electromagnetic spectrum

The range of all possible frequencies of electromagnetic radiation.

Wireless examples:

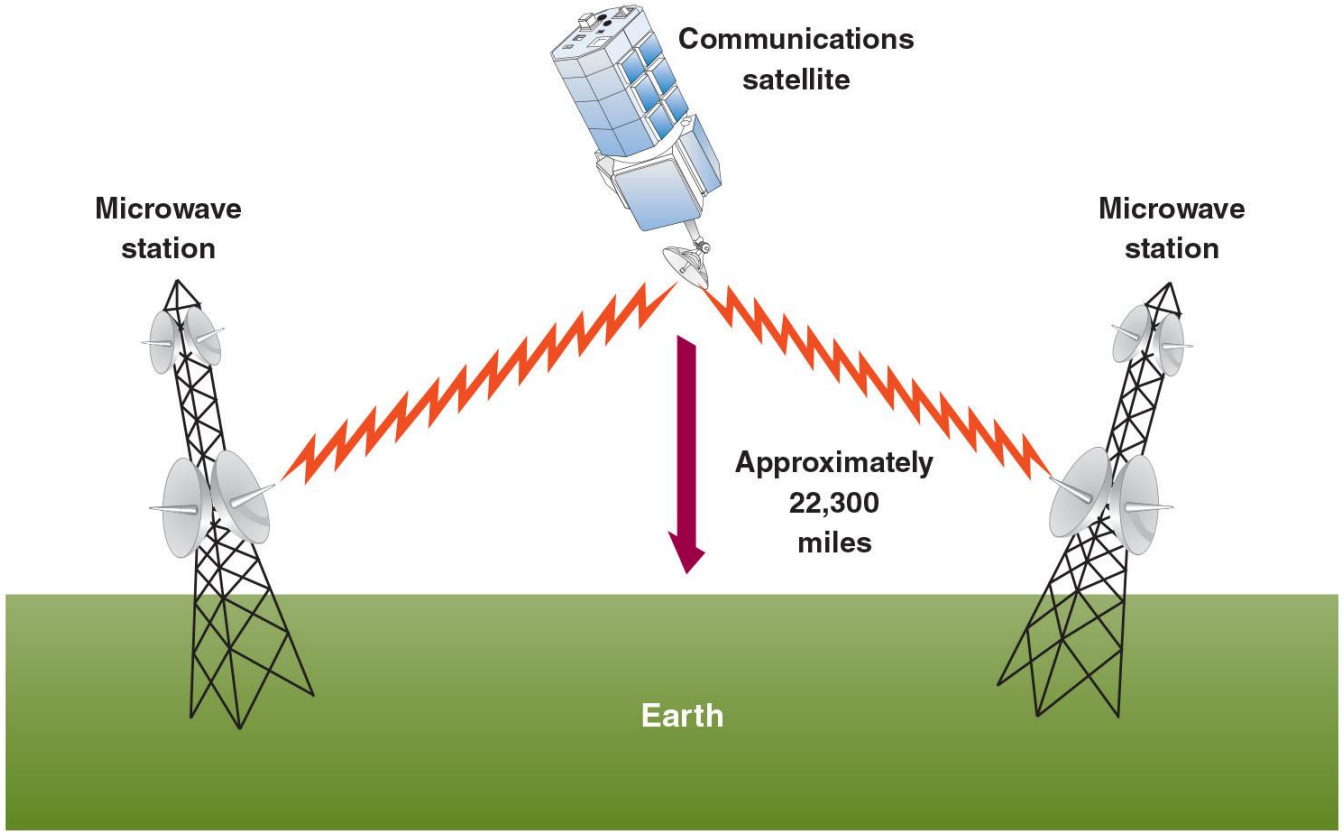
- Near filed communication (NFC; e.g. point-of-sale)
- Bluetooth
- Wi-Fi



In a Wi-Fi network, the user's computer, smartphone, or cell phone has a **wireless adapter** that **translates** data into a radio signal and **transmits** it using an antenna.

Wireless examples (continued):

- Communications satellite
  - Receives weak signal, amplifies it, and retransmits it to the next microwave transmission tower → placed 30 miles apart and in high locations (line of "sight" must be unobstructed)



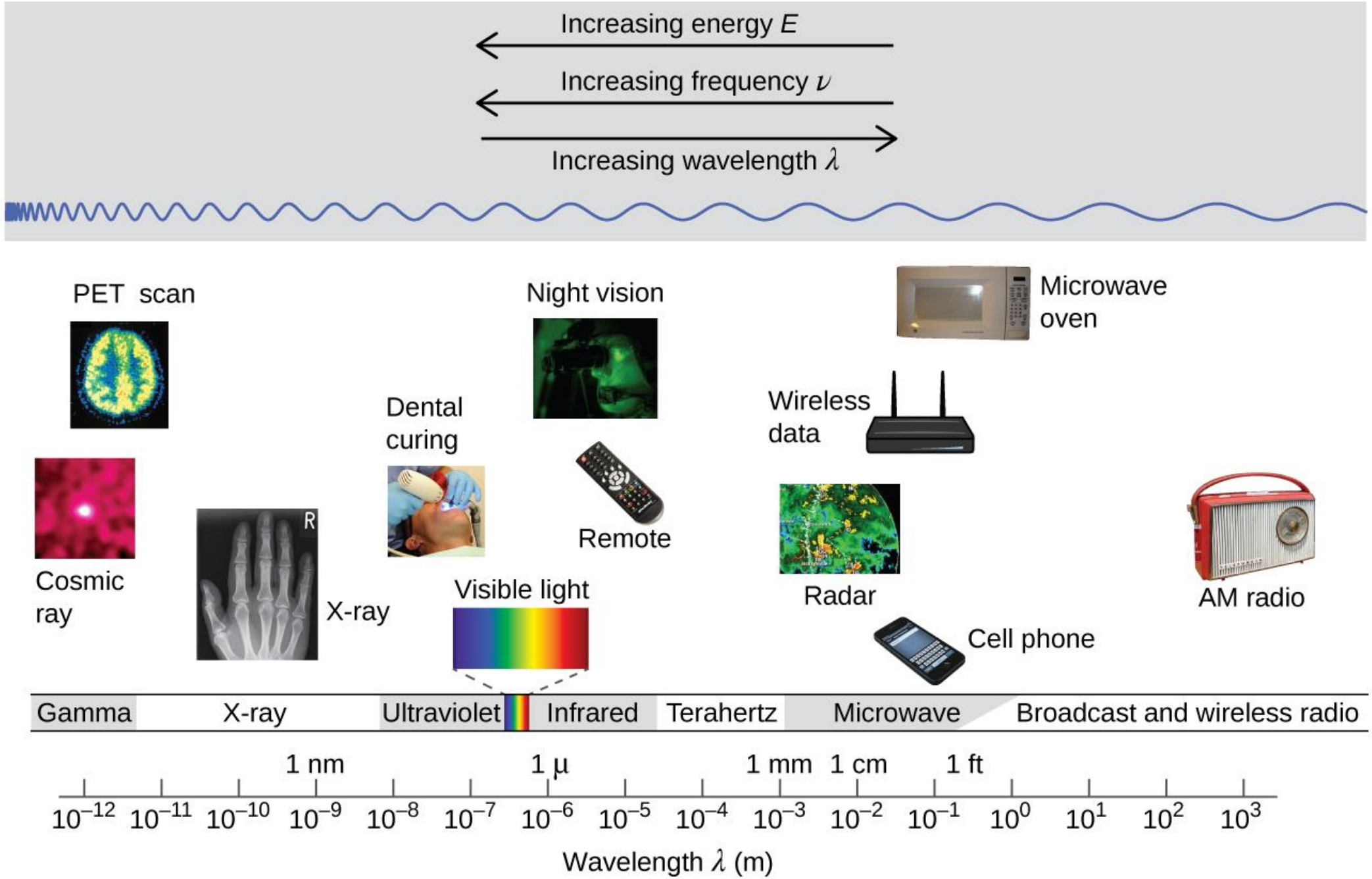
Satellite transmission

New 5G smartphones paired with 5G networks will be able to offer VR experience

5G video

TABLE 6.2 Frequency ranges used for wireless communications

Technology	Description	Advantages	Disadvantages
Radio frequency range	Operates in the 3 KHz–300 MHz range	Supports mobile users; costs are dropping	Signal is highly susceptible to interception
Microwave—terrestrial and satellite frequency range	High-frequency radio signal (300 MHz–300 GHz) sent through the atmosphere and space (often involves communications satellites)	Avoids cost and effort to lay cable or wires; capable of high-speed transmission	Must have unobstructed line of sight between sender and receiver; signal is highly susceptible to interception
Infrared frequency range	Signals in the 300 GHz–400 THz frequency range	Lets you move, remove, and install devices without expensive wiring	Must have unobstructed line of sight between sender and receiver; transmission is effective only for short distances


Increasing energy E
Increasing frequency ν
Increasing wavelength λ
PET scan
Night vision
Microwave oven
Dental curing
Wireless data
Remote
Cosmic ray
X-ray
Visible light
Radar
AM radio
Cell phone
Gamma
X-ray
Ultraviolet
Infrared
Terahertz
Microwave
Broadcast and wireless radio
1 nm
1 μ
1 mm
1 cm
1 ft
10^{-12} 10^{-11} 10^{-10} 10^{-9} 10^{-8} 10^{-7} 10^{-6} 10^{-5} 10^{-4} 10^{-3} 10^{-2} 10^{-1} 10^{0} 10^{1} 10^{2} 10^{3}
Wavelength λ (m)

The INTERNET

Internet video

The Internet

- The **infrastructure** on which the Web exists
- Made up of **computers**, **network hardware** such as **routers** and **fiber-optic cables**, **software**, and the **TCP/IP protocols**

Terms:

- **Transmission Control Protocol/Internet Protocol (TCP/IP):** communication standard enables computers to route communications traffic from one network to another
- **IP address**: a 64-bit number that identifies a computer on the Internet e.g.: 69.32.133.79

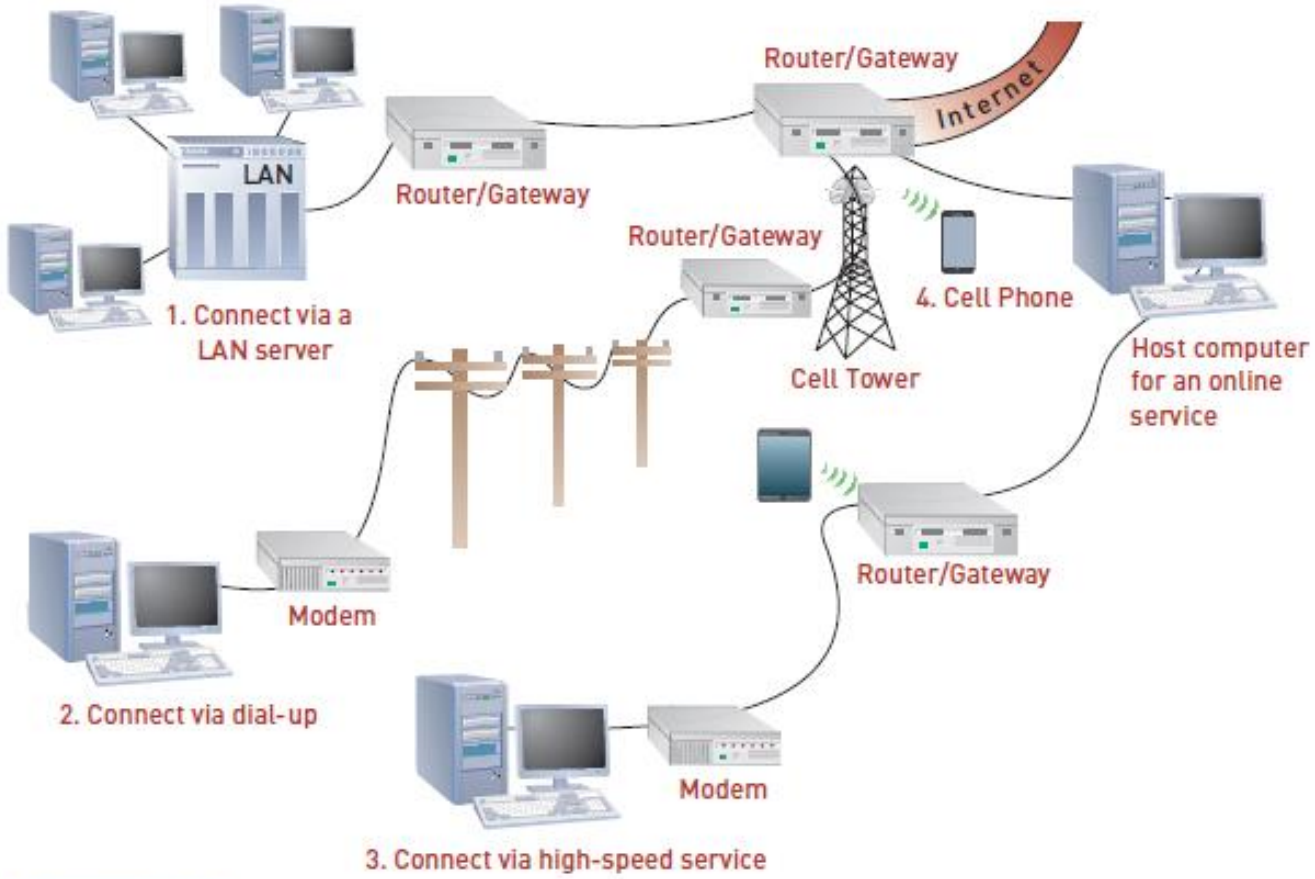


FIGURE 6.11

Several ways to access the Internet

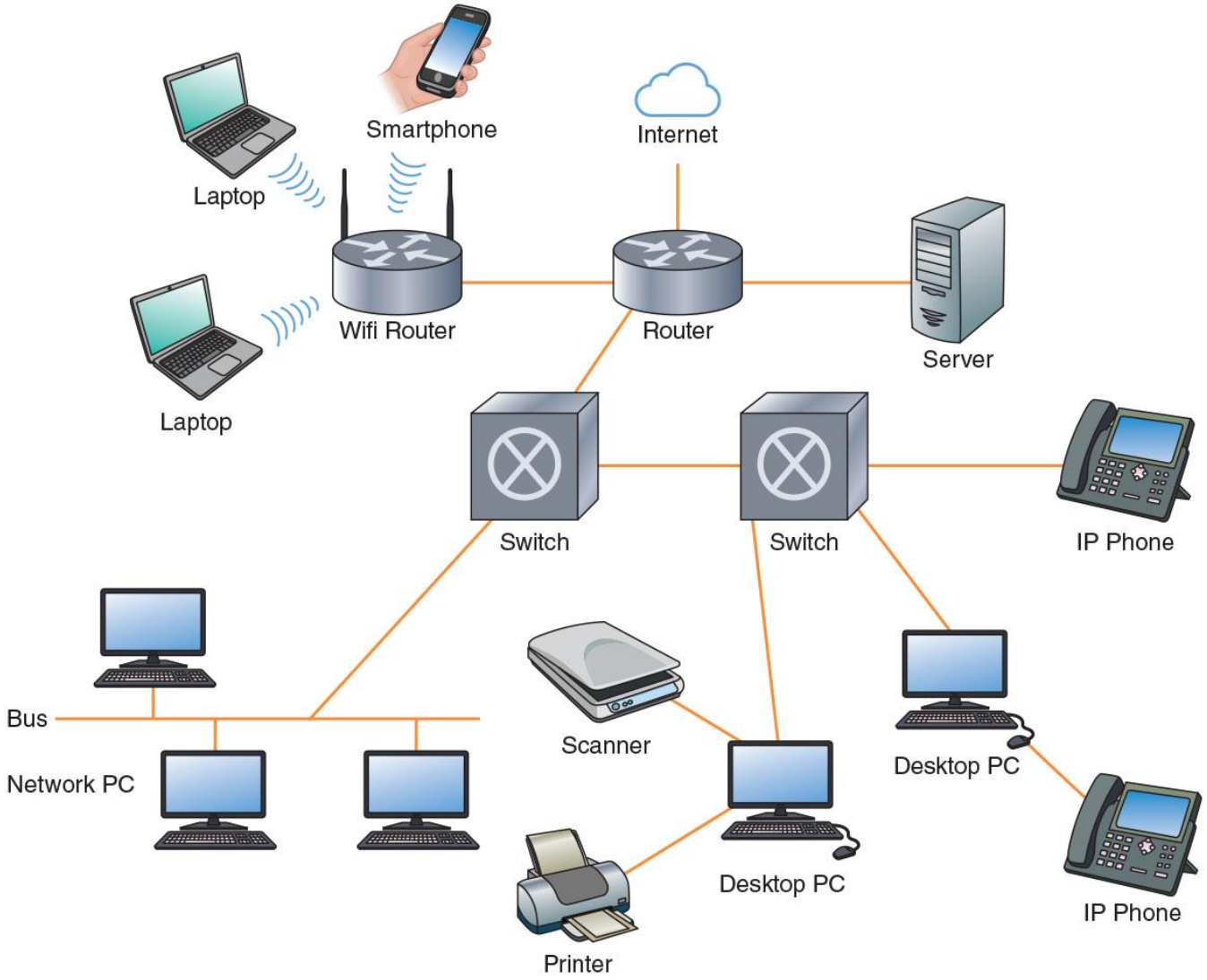
Users can access the Internet in several ways, including using a LAN server, telephone lines, a high-speed service, or a wireless network.

Terms (continued):

- **Network interface card (NIC):**
  - Specific MAC (Media Access Control) address (e.g. 00:1B:44:11:3A:B7) is “burned” into a NIC’s read only memory (ROM)

- **Switch**
  - Keeps a record of the MAC address of all the devices connected to it
  - Determines port a frame of data should be directed to

- **Router**
  - Directs data packets to other networks until each packet reaches its destination

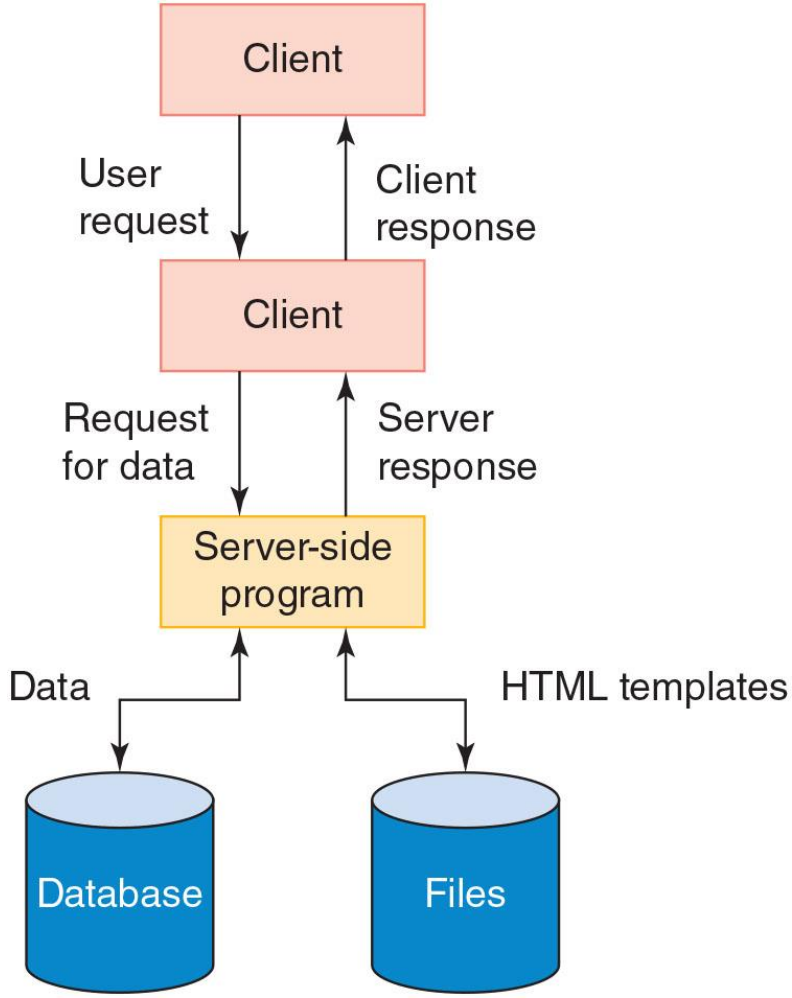


Data is transmitted from one host computer to another on the Internet.

The WORLD WIDE WEB

The World Wide Web (Web)

- Consists of **server and client software**, the **hypertext transfer protocol (http), standards**, and **markup languages** that combine to deliver information and services over the Internet



Client/Server Architecture

- **Domain name system (DNS)**: Domain names must adhere to strict rules

TABLE 6.5 Number of domains in U.S. top-level domain affiliations—Winter 2015

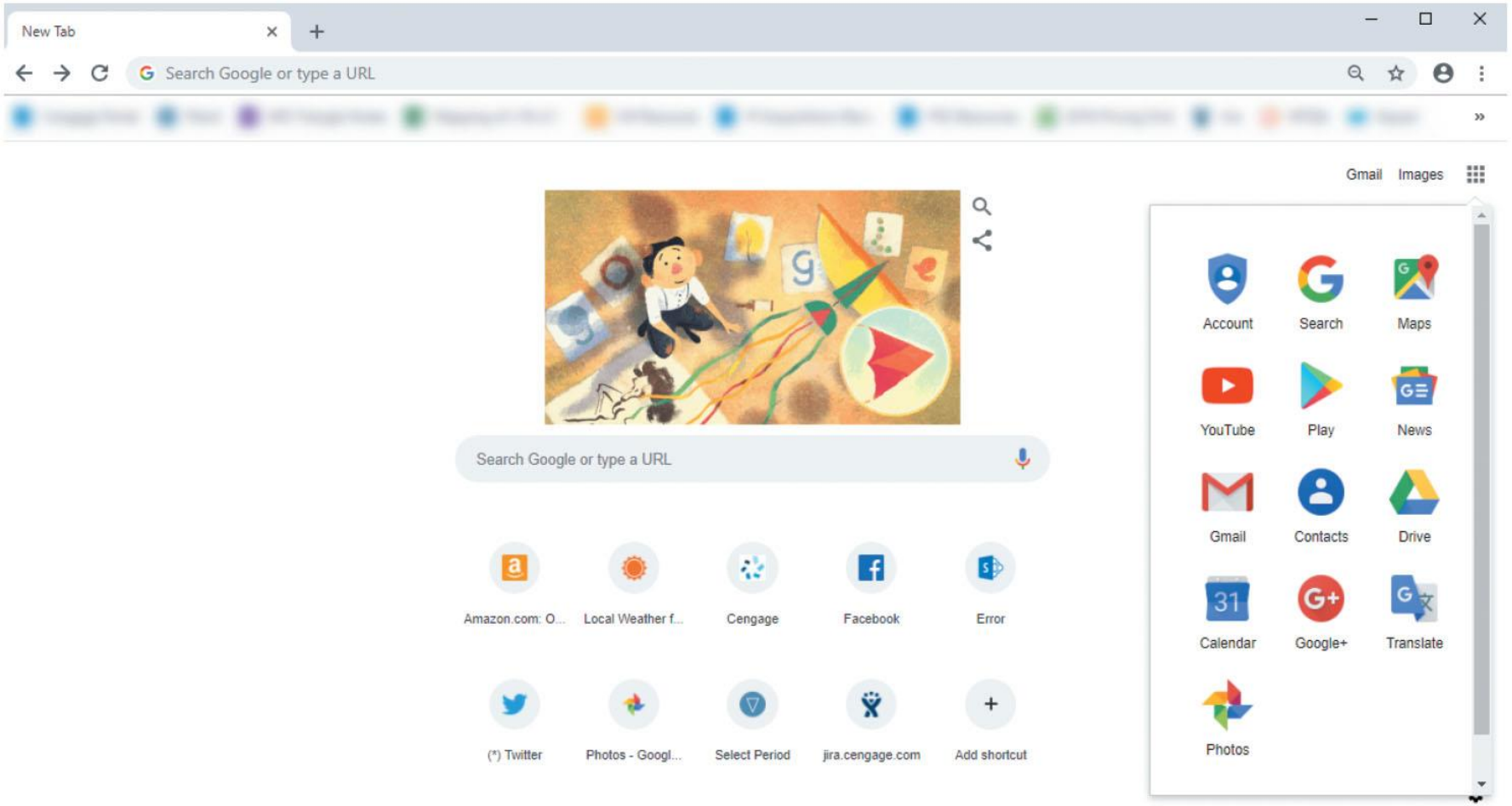
Affiliation ID	Affiliation	Number of Hosts
Biz	Business sites	2,428,269
Com	All types of entities including nonprofits, schools, and private individuals	123,743,892
Edu	Post-secondary educational sites	7,446
Gov	Government sites	5,503
Net	Networking sites	15,805,152
Org	Nonprofit organization sites	10,984,293

- **Web site**: a collection of pages on one particular topic, accessed under one Web domain

- **Uniform Resource Locator (URL)**: a Web address that specifies the exact location of a Web page using letters and words

Web browser: Web client software used to view Web pages

Examples: Internet Explorer, Firefox, Chrome, and Safari



Google Chrome: Web browsers such as Google Chrome let you access Internet resources such as email and other online applications.

CSS - Cascading Style Sheet → visual style
XML - Extensible Markup Language → content
HTML - Hypertext Markup Language → assemble

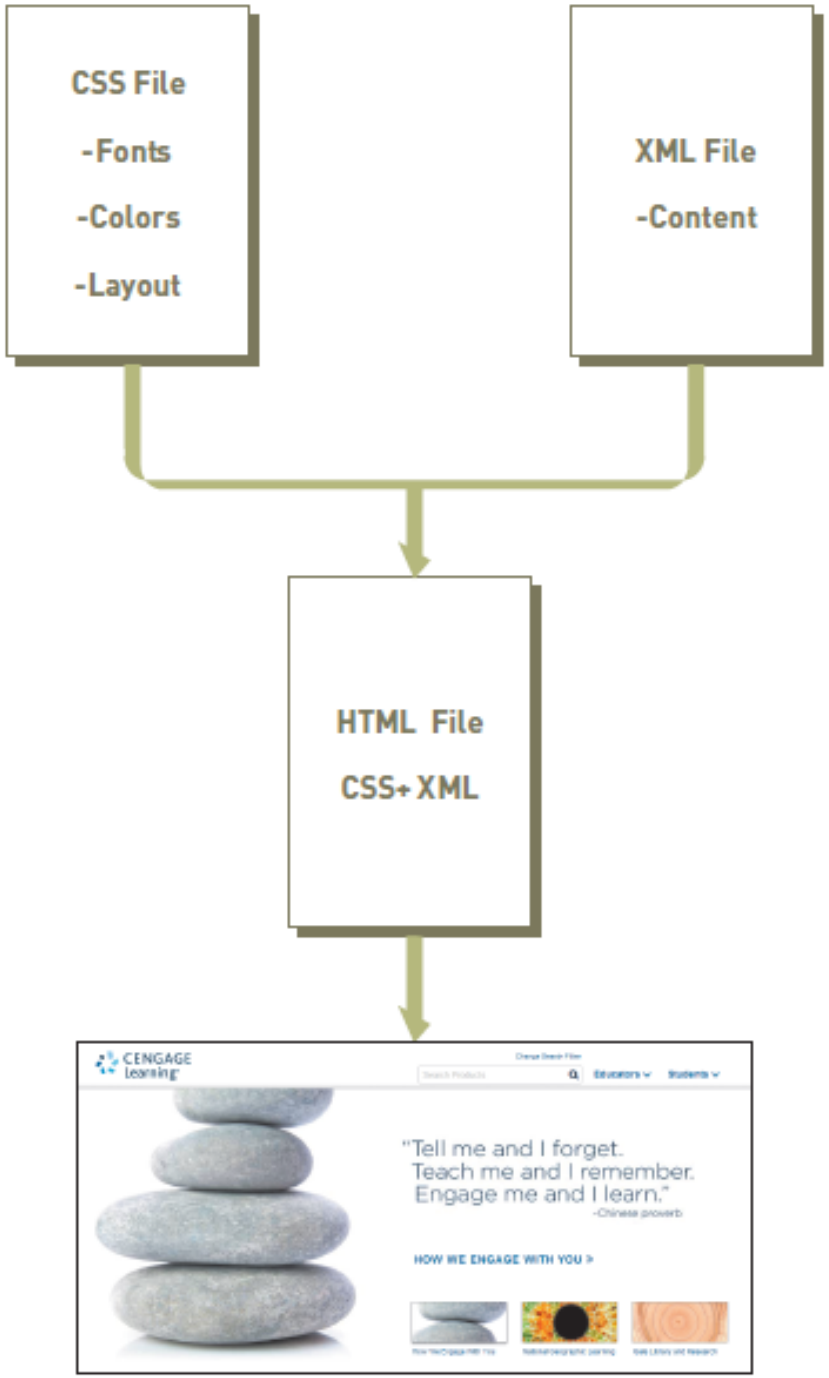


FIGURE 6.14
XML, CSS, and HTML
Today's Web sites are created using XML to define content, CSS to define the visual style, and HTML to put it all together.

Web

The original Web—**Web 1.0**

- One-directional resource: published information was for viewing only

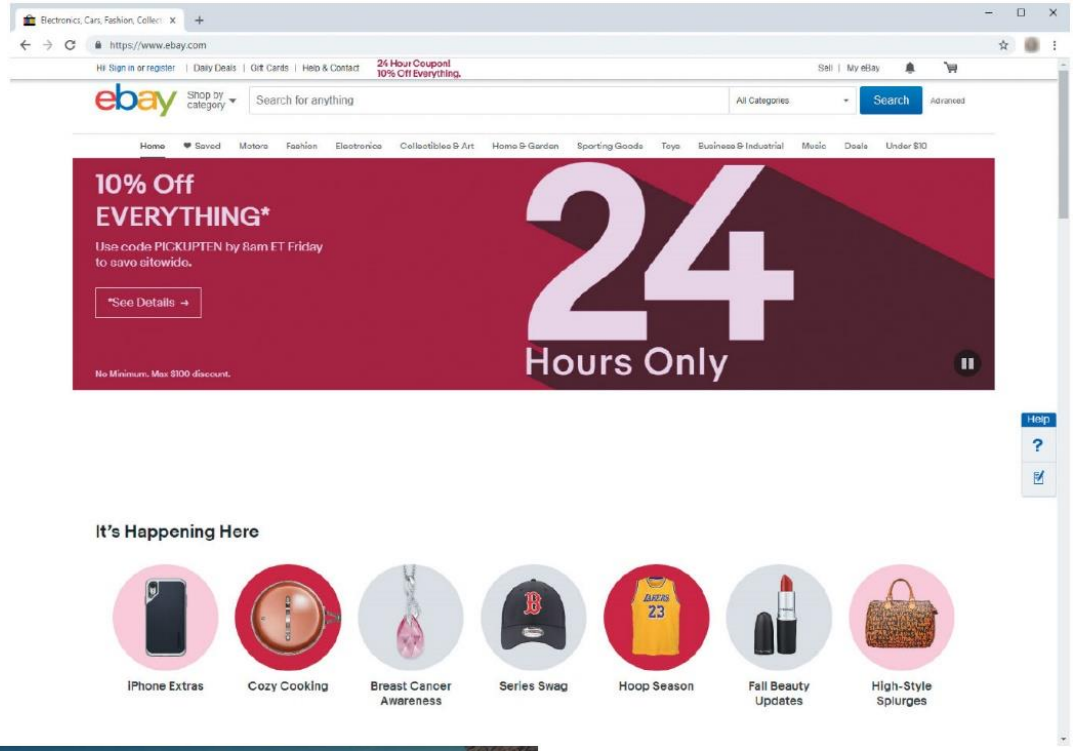
Web 2.0 and the social Web

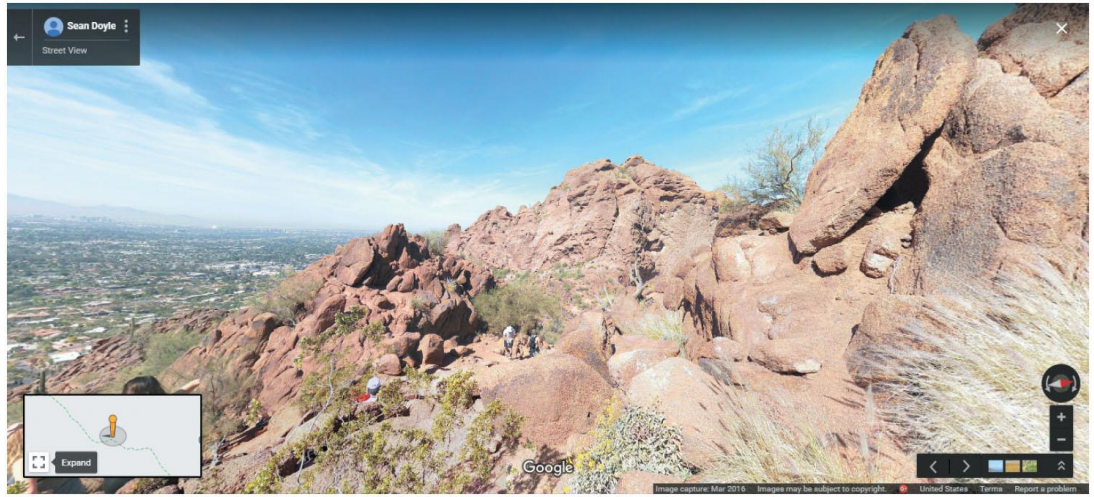
- Both viewing and creating content

Web 3.0: Semantic Web (looking for the meaning, personalized answers → “training” computer overtime)

Web Applications

- News
- Education and training
- Job opportunities
- Search engine (optimization)
- Instant messaging
- Conferencing
- Microblogging, blogging, and podcasting
- Online media and entertainment (music, gaming, movies, video, television)
- Shopping
- Travel, geolocation, navigation





The INTERNET of THINGS

IoT video

Internet of Things (IoT): A network of physical objects (things) embedded with sensors, processors, software, and network connectivity capability to enable them to exchange data with the manufacturer of the device, device operators, and other connected devices

Sensor - a device that is capable of sensing something about its surroundings such as pressure, temperature, humidity, pH level, motion, vibration, or level of light

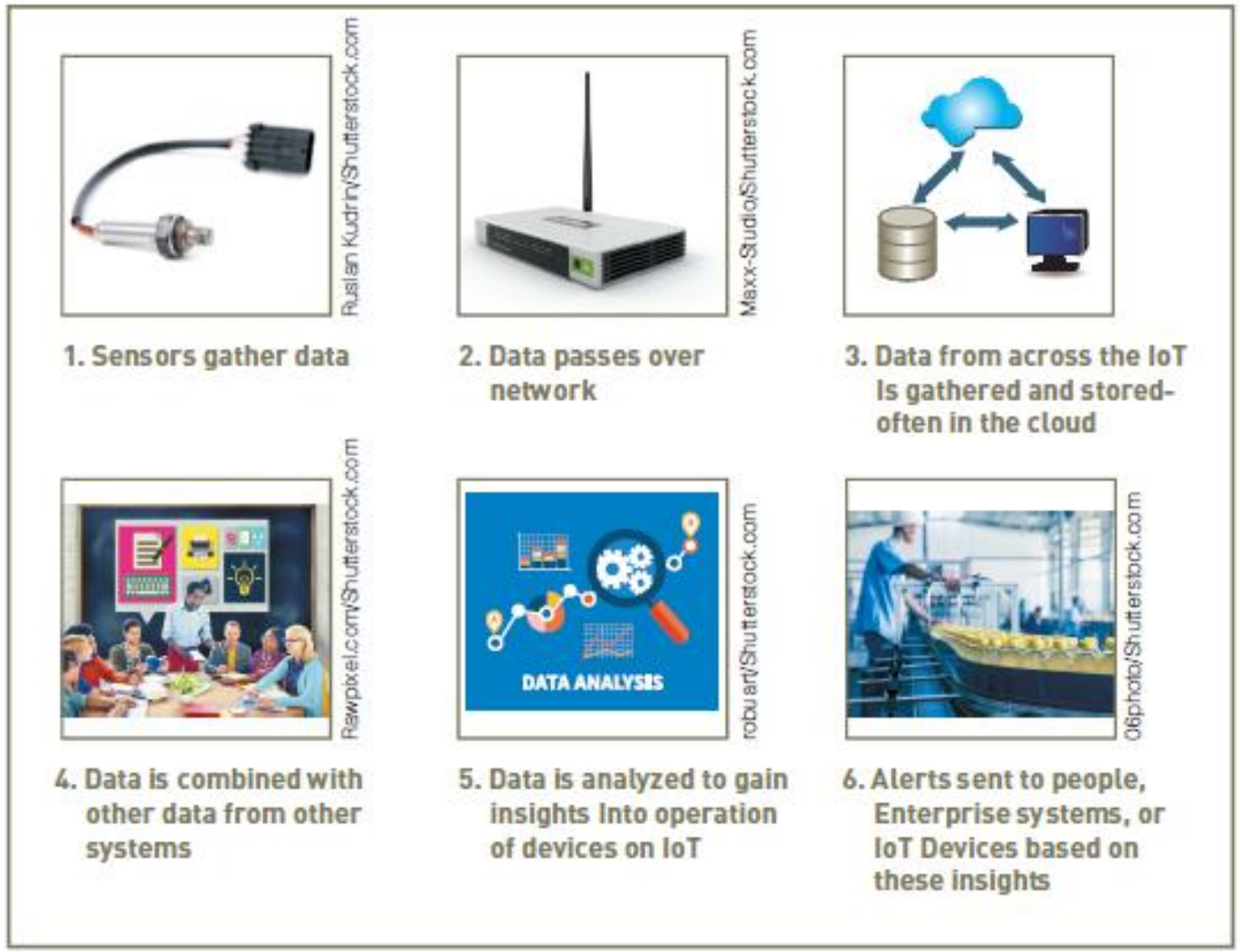


FIGURE 6.25
The Internet of Things
The IoT is a network of physical objects or "things" embedded with sensors, processors, software, and network connectivity capability to enable them to exchange data with the manufacturer of the device, device operators, and other connected devices.

Cloud Computing

- **Cloud computing**: a computing environment in which software and storage are provided as an Internet service and accessed with a Web browser

Advantages to businesses:

- Employees can access corporate systems from any Internet-connected computer
- Increased efficiency and reduce the costs of new product and service launches
- Businesses can save on system design, installation, and maintenance

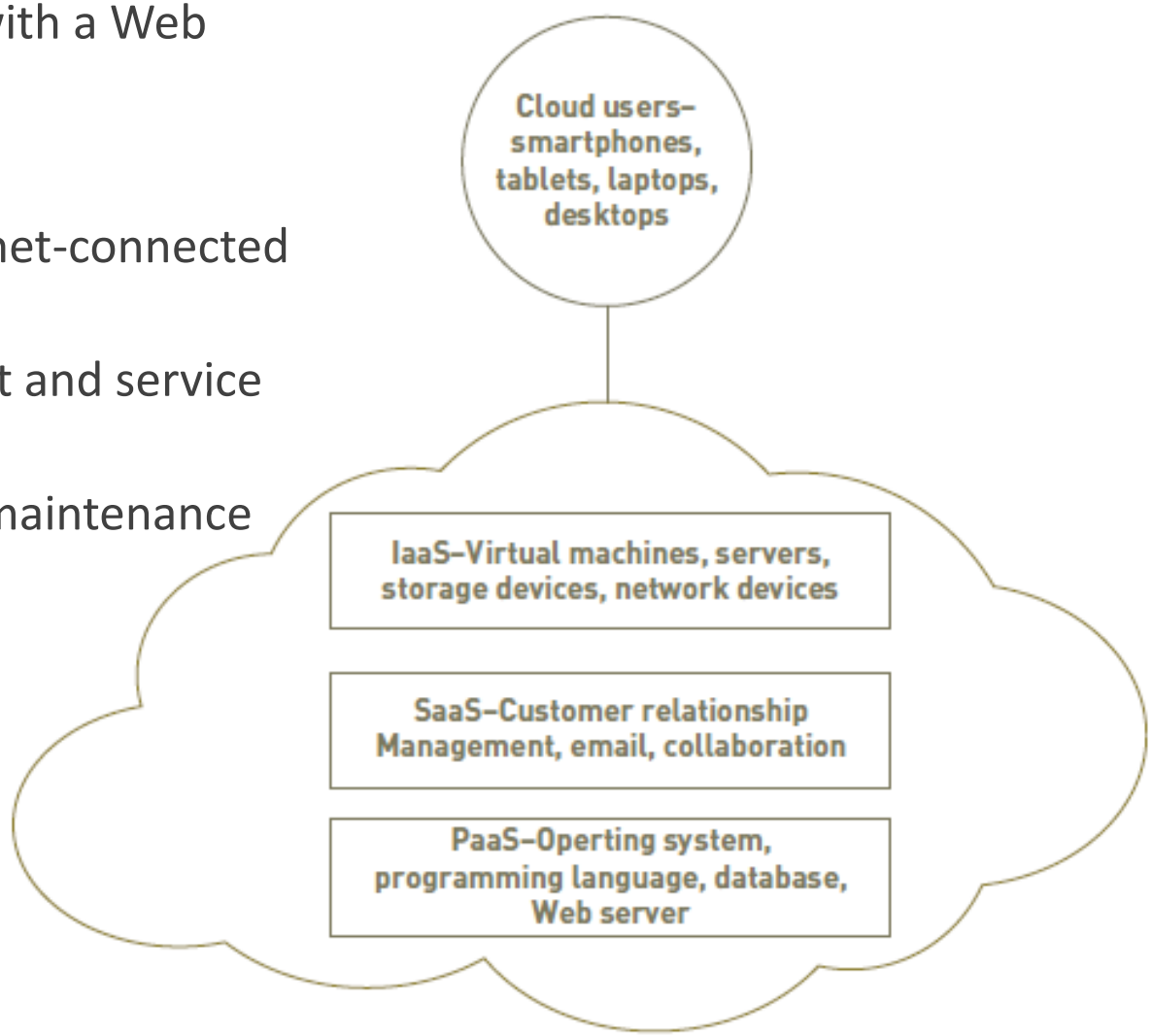


FIGURE 6.27
The cloud computing environment
Cloud computing can be divided into three main types of services: infrastructure as a service (IaaS), software as a service (SaaS), and platform as a service (PaaS).

Group exercises

Form groups and let every group focus on resolving one case

- Network-Management Software for a University (p. 253)
- Extranet to Support Craft Brewers (pp. 275-276)
- Manufacturer Weighs Converting to Internet of Things (p. 279)
- Should Heel Swaps Move to the Cloud? (p. 283-284)

Homework

STUDY LECTURES WEEK 1-6

TEST YOUR KNOWLEDGE FROM PREVIOUS LECTURES ON A RANDOM CASE STUDY FROM THE TEXTBOOK