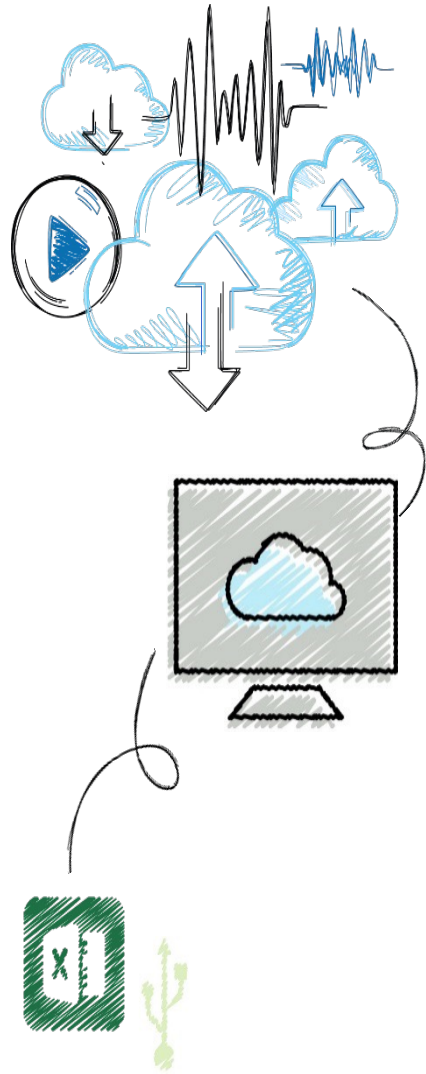


Principles of Information Systems, Thirteenth Edition

Chapter 6

Networks and Cloud Computing





Objectives

After completing this chapter, you will be able to:

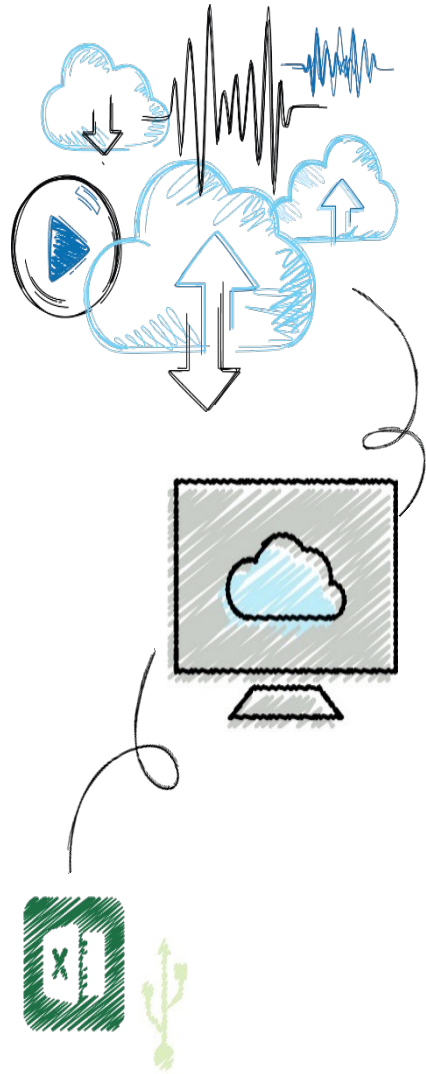
Identify and briefly describe four different network types

Identify and briefly discuss several types of both guided and wireless communications

Briefly describe how the Internet and the Web work, including various methods for connecting to the Internet

Outline the process and tools used in developing Web content and applications

List and describe several Internet and Web applications



Objectives

After completing this chapter, you will be able to (cont'd):

Explain how intranets and extranets use Internet technologies, and describe how the two differ

Define what is meant by the Internet of Things (IoT) and discuss several practical applications of IoT

Discuss how cloud computing can increase the speed and reduce costs of new product launches

Summarize three common problems organizations encounter in moving to the cloud



Network Fundamentals

- Computer network: the communications media, network devices, and software needed to connect two or more computers
- Organizations can use networks to share hardware, programs, and databases



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
 - Consist of:
 - Computer equipment owned by the user
 - Data communications equipment and telecommunications links provided by various carriers and service providers

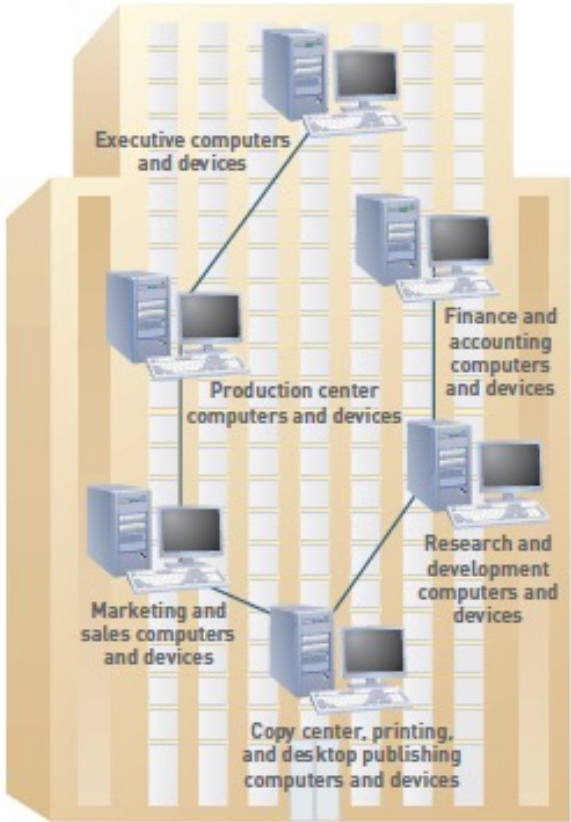


Network Types

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.





Client/Server Architecture

- A network architecture that consists of multiple servers dedicated to special functions, e.g., database management, printing, or communications
- A client is any computer that requests services from the servers on the network



Peer-to-Peer (P2P) Architecture

- A network architecture where computers or devices directly communicate and share resources with each other, without the need for a central server
- Examples:
 - BitTorrent
 - Cryptocurrency
 - Apple AirDrop



Channel Bandwidth

- Channel bandwidth: the rate at which data is exchanged
 - Usually measured in bits/sec



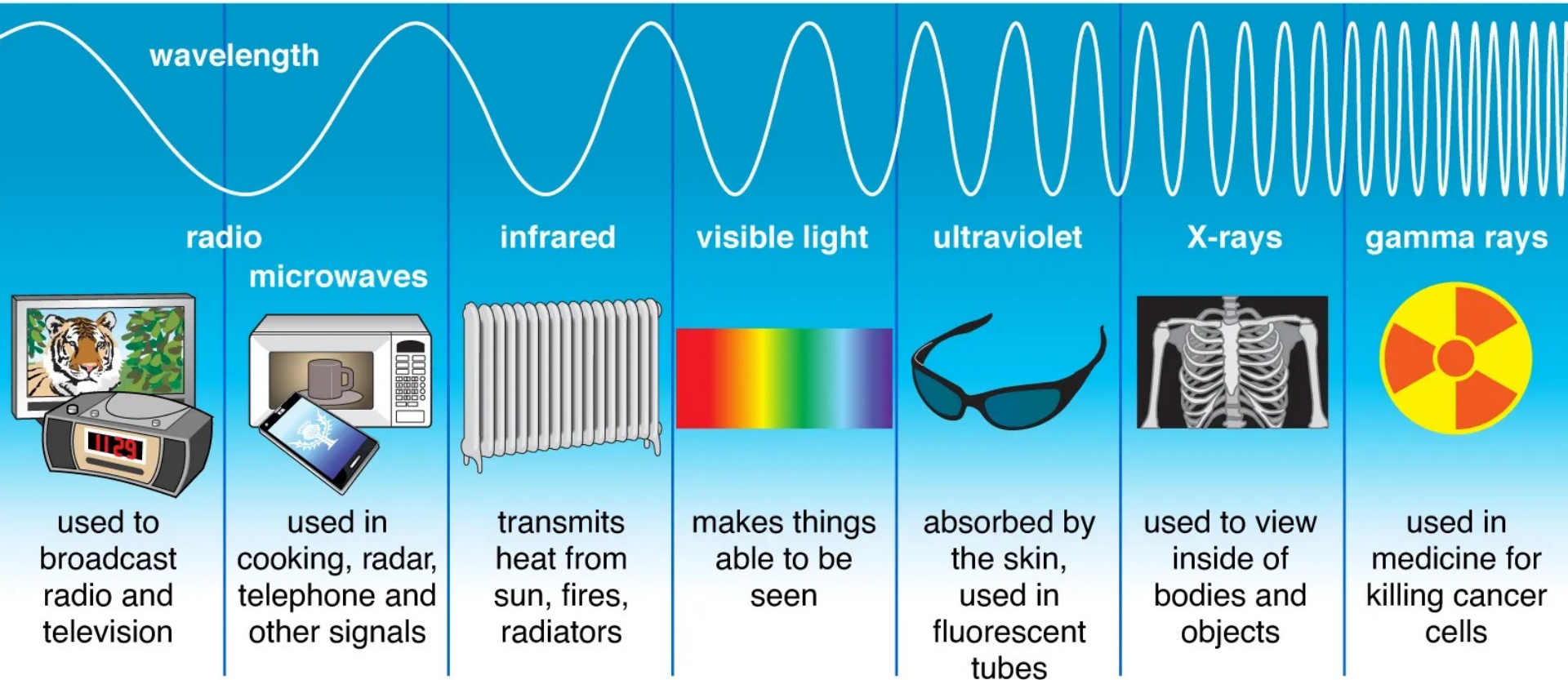
Communications Media

- Two broad categories
 - Wired (guided) transmission media: Signals are guided along a physical medium
 - Twisted-pair wire
 - Coaxial cable
 - Fiber-optic cable
 - Wireless transmission media: Signals are broadcast over airwaves as electromagnetic radiation
 - Mostly through radio waves
 - Infrared finds applications in remote controls and motion detection sensors
 - Note: Radio waves communications are regulated to prevent interference with other transmissions https://www.cst.gov.sa/ar/services/spectrum/Pages/about_spectrum.aspx



Electromagnetic Spectrum

Types of Electromagnetic Radiation



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Radio waves (الطيف الترددي)

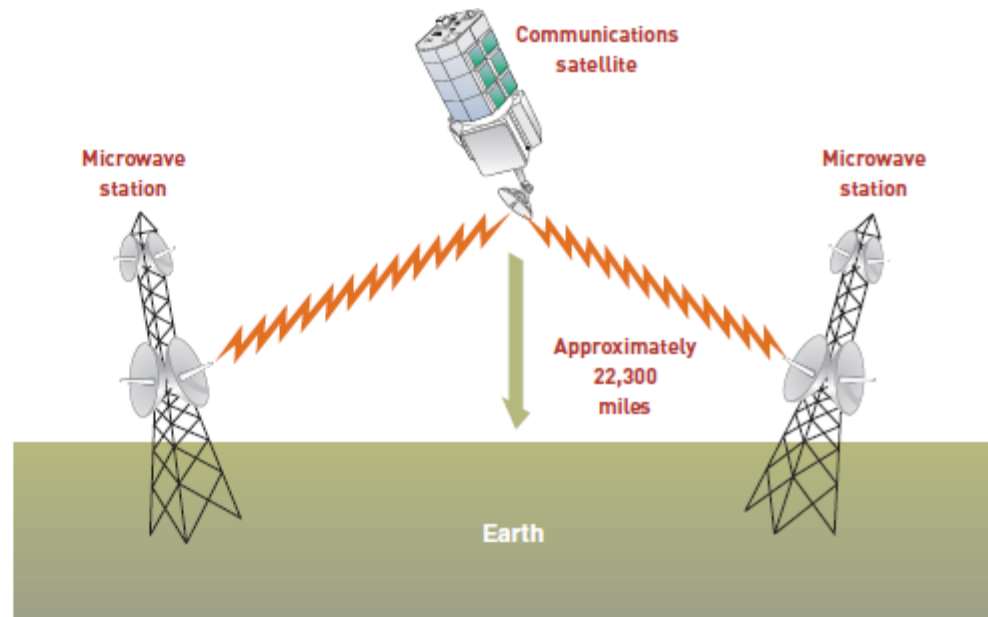


FIGURE 6.8

Satellite transmission

Communications satellites are relay stations that receive signals from one Earth station and rebroadcast them to another.



Radio waves (الطيف الترددي)

- Near field communication (NFC)
 - A short-range wireless communication technology designed for very close proximity communication (within a few centimeters)
 - Commonly used for contactless payments, access control
- Bluetooth
 - A short-range (~10 meters) wireless communication technology typically used for connecting devices like headphones, speakers, keyboards, and smartphones
- Wi-Fi
 - A wireless telecommunications technology brand owned by the Wi-Fi Alliance
 - A hotspot is a physical location where people can obtain Internet access, typically using Wi-Fi technology
 - IEEE 802.11 contains all standards that specify protocols for implementing wireless LANs, such as 802.11n and 802.11ac



Communications Media

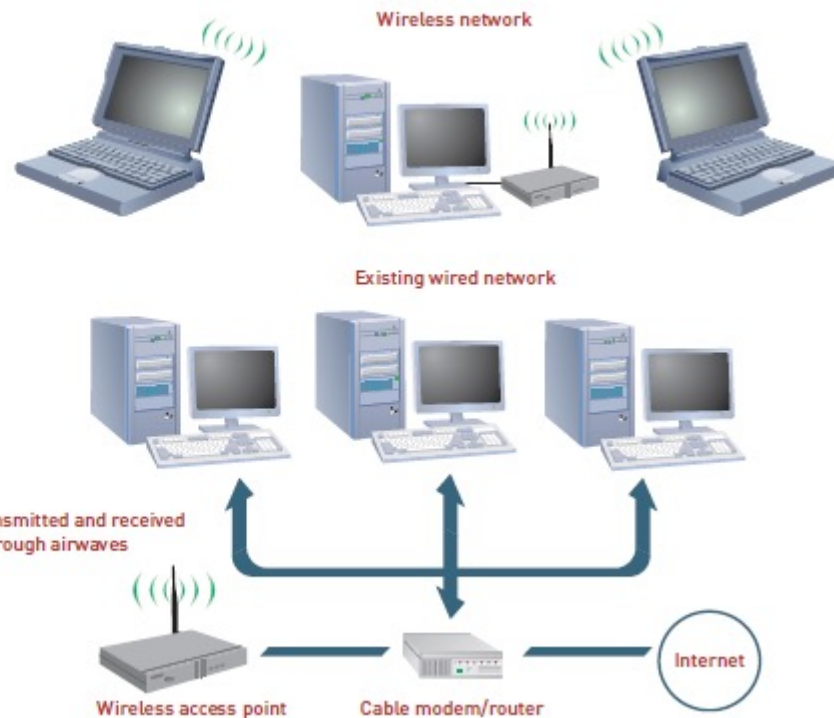


FIGURE 6.7

Wi-Fi network

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.



Communications Media

- Historical perspective
 - 1G (first generation) of wireless communications standards: originated in the 1980s; based on analog communications
 - 2G (second generation) employed fully digital networks; superseded 1G networks in the early 1990s
 - 3G supports wireless voice and broadband speed data communications in a mobile environment at speeds of 2 to 4 Mbps
 - 4G wireless provides increased data transmission rates
 - 3 to 20 times the speed of 3G networks for mobile devices
 - 4G networks are based on Long Term Evolution (LTE)
 - 5G Wireless Communications
 - Higher data transmission rates
 - Lower latency



Communications Hardware

TABLE 6.4 Common communications devices

Device	Function
Router	Forwards data packets across two or more distinct networks toward their destinations through a process known as routing; often, an Internet service provider (ISP) installs a router in a subscriber's home that connects the ISP's network to the network within the home
Gateway	Serves as an entrance to another network, such as the Internet



Communications Software

- Mobile device management (MDM) software
 - Manages and troubleshoots mobile devices remotely, pushing out applications, data, patches and settings
 - A central control group can maintain group policies for security, control system settings, ensure malware protection is in place for mobile devices used across the network, and make it mandatory to use passwords to access the network



The Internet and World Wide Web

- The Internet is international in scope with users on every continent
- Internet sites have a profound impact on world politics
- Internet censorship
 - The control or suppression of the publishing or accessing of information on the Internet



How the Internet Works

- Internet backbone: It comprises high-speed, long-distance communication links
- IP protocol: IP (Internet Protocol) enables efficient routing of communication traffic between networks and hosts
- IP Address: A unique numerical identifier that pinpoints a computer's location on the Internet
 - Necessary for facilitating data routing
 - For IPv4, the numerical identifier is 32-bit. Example: 192.168.31.1
 - Why does it require 32 bits?



How the Internet Works



What is your address?

157.42.20.132



No, your local address?

127.0.0.1



**I mean, your physical
address!**

00:A0:C9:4F:73:2E



How the Internet Works

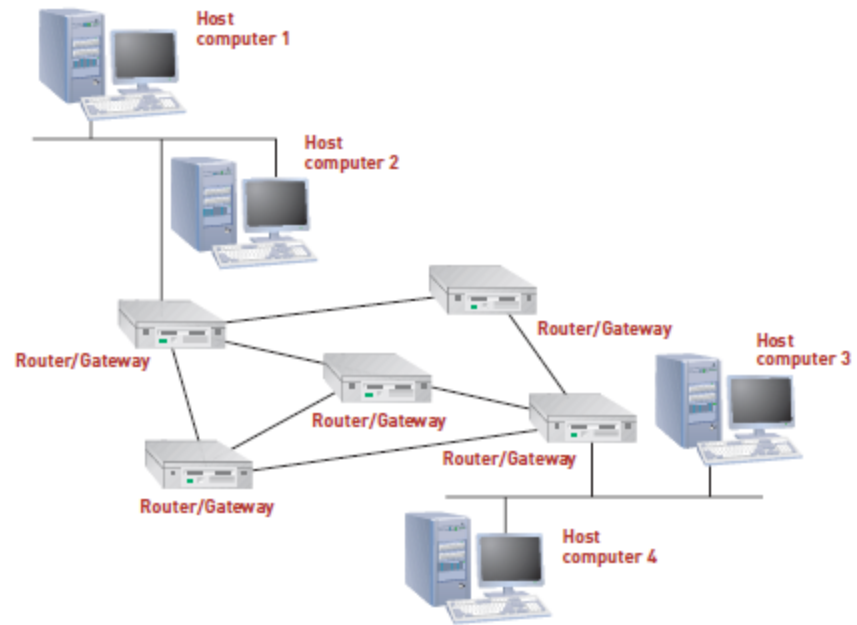


FIGURE 6.10

Routing messages over the Internet

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



How the Internet Works

- Uniform Resource Locator (URL): a Web address that specifies the exact location of a Web page using letters and words that map to an IP address and a host location
- Internet Corporation for Assigned Names and Numbers (ICANN) is responsible for managing IP addresses and Internet domain names



How the Internet Works

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

Source: Domain Count Statistics for TLDs, <http://research.domaintools.com/statistics/tld-counts/>.



Accessing the Internet

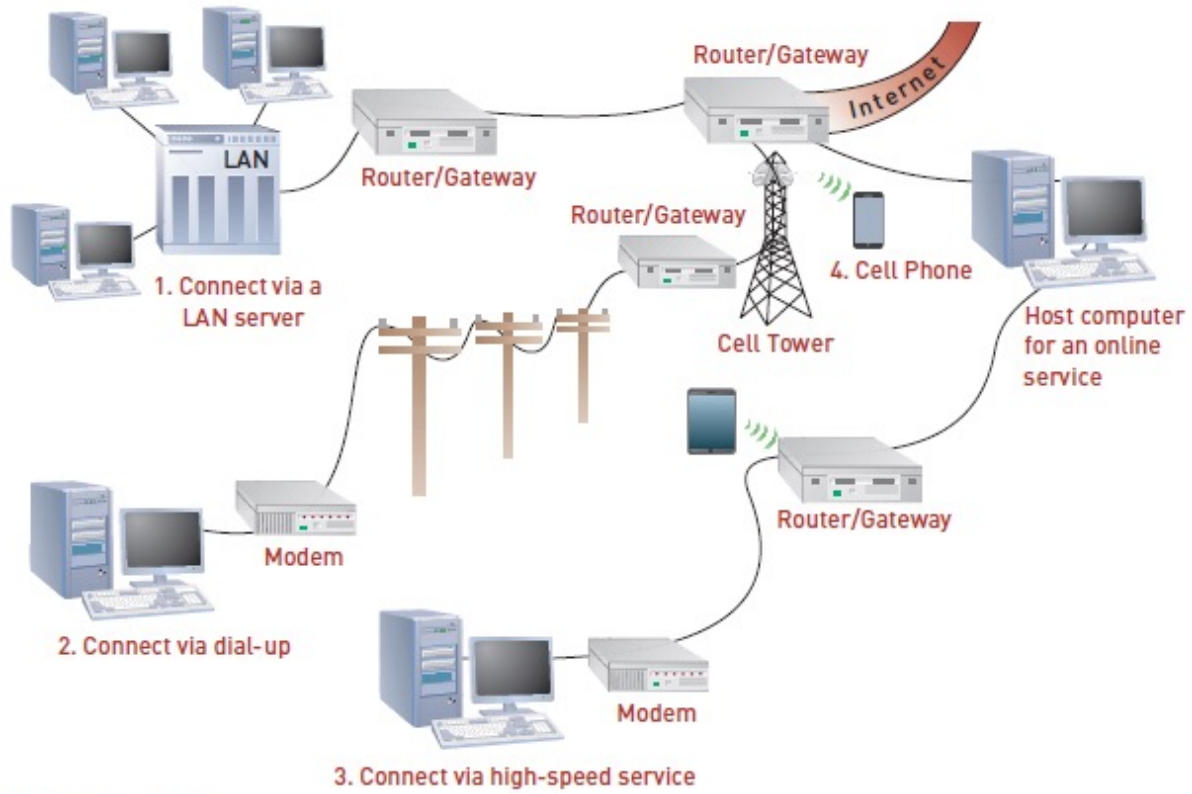


FIGURE 6.11
Several ways to access the Internet

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



Accessing the Internet

- Wired Connection
 - DSL
 - Fiber
- Wireless Connection
 - Cellular networks
 - Wi-Fi
 - Satellite connections
 - Example: Starlink
- Net neutrality
 - The principle that Internet service providers (ISPs) should be required to treat all Internet traffic running over their networks the same



How the Web Works

- 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
- 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



How the Web Works

- Hyperlink: highlighted text or graphics in a Web document that, when clicked, opens a new Web page
- Web browser: Web client software used to view Web pages
 - Examples: Microsoft Edge, Firefox, Chrome, and Safari
- Web site: a collection of pages on one particular topic, accessed under one Web domain



How the Web Works

- Hypertext Markup Language (HTML): the standard page description language for Web pages
 - Tells the browser how to display font characteristics, paragraph formatting, page layout, image placement, hyperlinks, and the content of a web page
- Demo: <https://youtu.be/guvsH5OFizE?si=ewxjewZ1OQk1QF6L&t=253> (4:13 to 5:54)
- Extensible Markup Language (XML): a markup language designed to transport and store data on the web
- Cascading Style Sheets (CSS): a file or portion of an HTML file that defines the visual appearance of content in a web page



How the Web Works

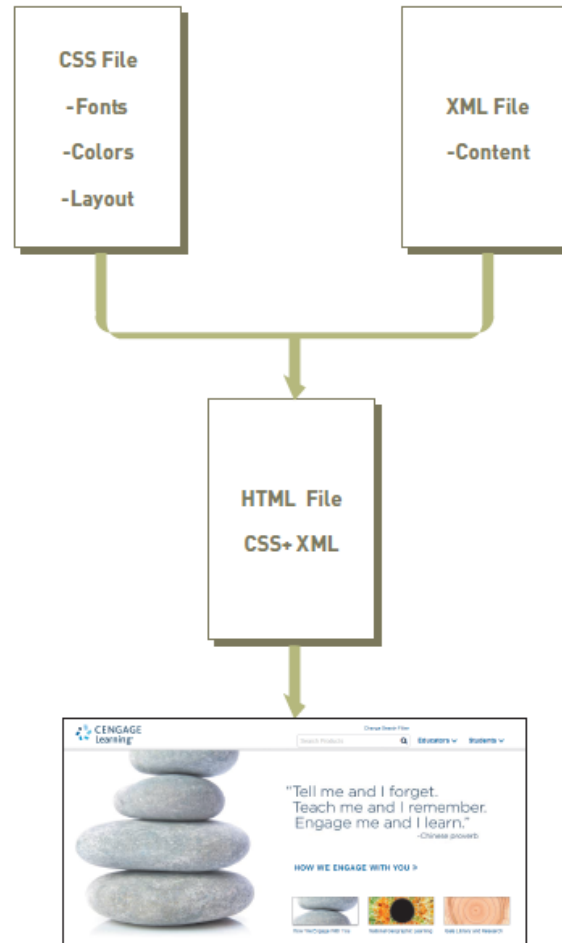


FIGURE 6.14
XML, CSS, and HTML
Today's Web sites are created using XML to define content, CSS to define the visual style, and HTML to put it all together.



How the Search Engines Work

- <https://www.youtube.com/watch?v=0eKVizvYSUQ>



Web Programming Languages

- Server-side programming languages include:
 - Java
 - ASP.NET
 - PHP
 - Python
 - Ruby on Rails
- Client-side programming/scripting languages include:
 - JavaScript: Used for creating responsive web pages that react to user interactions
 - HTML: For structuring web content
 - CSS: For styling and formatting web pages



Data Representation Formats

- Two widely used formats for representing structured data:
 - XML (Extensible Markup Language)
 - JSON (JavaScript Object Notation) is more concise and widely used for data interchange in modern web development

```
<person>
  <name>John Doe</name>
  <age>30</age>
  <email>john@example.com</email>
</person>
```

Example of XML

```
{
  "person": {
    "name": "John Doe",
    "age": 30,
    "email": "john@example.com"
  }
}
```

Example of JSON



Intranets and Extranets

- Intranet: an internal corporate network accessible only to authorized users within the organization
- Extranet: a network based on web technologies that links resources of a company's intranet with its customers, suppliers, or other business partners
- Both intranets and extranets are built using Internet and World Wide Web standards and technologies

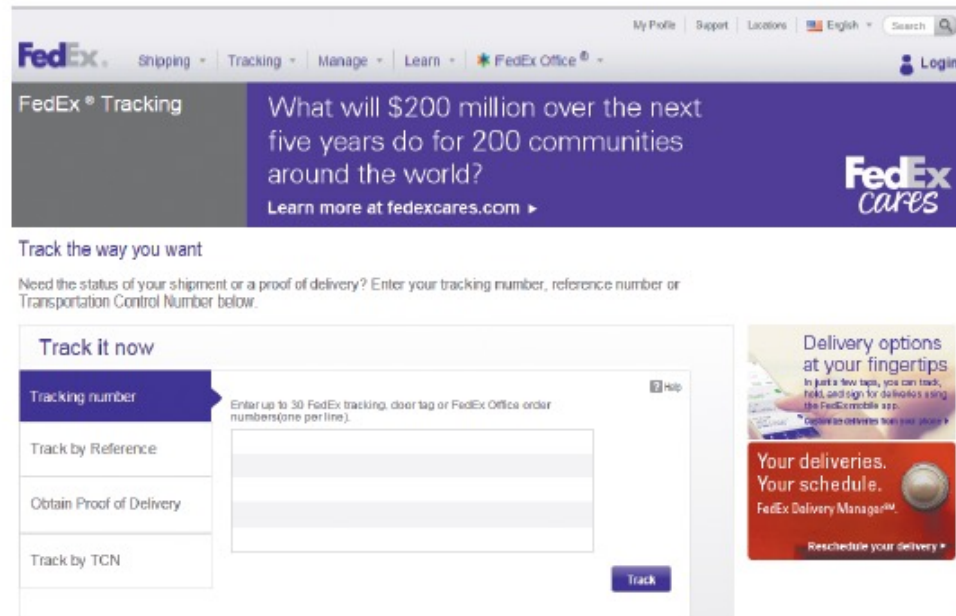


FIGURE 1.5

Extranets

When you sign in to the FedEx site (www.fedex.com) to check the status of a package, you are using an extranet.



Intranets and Extranets

- How to access Intranets and Extranets from the Internet?
 - A virtual private network (VPN) connection
 - VPN is a secure connection between two points on the Internet
 - A secure VPN provided by the company
 - A login page that allows authorized users to access the network from outside the organization's premises
 - To improve the security of this method, two-factor authentication might be applied



The Internet of Things (IoT)

- 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



The Internet of Things (IoT)

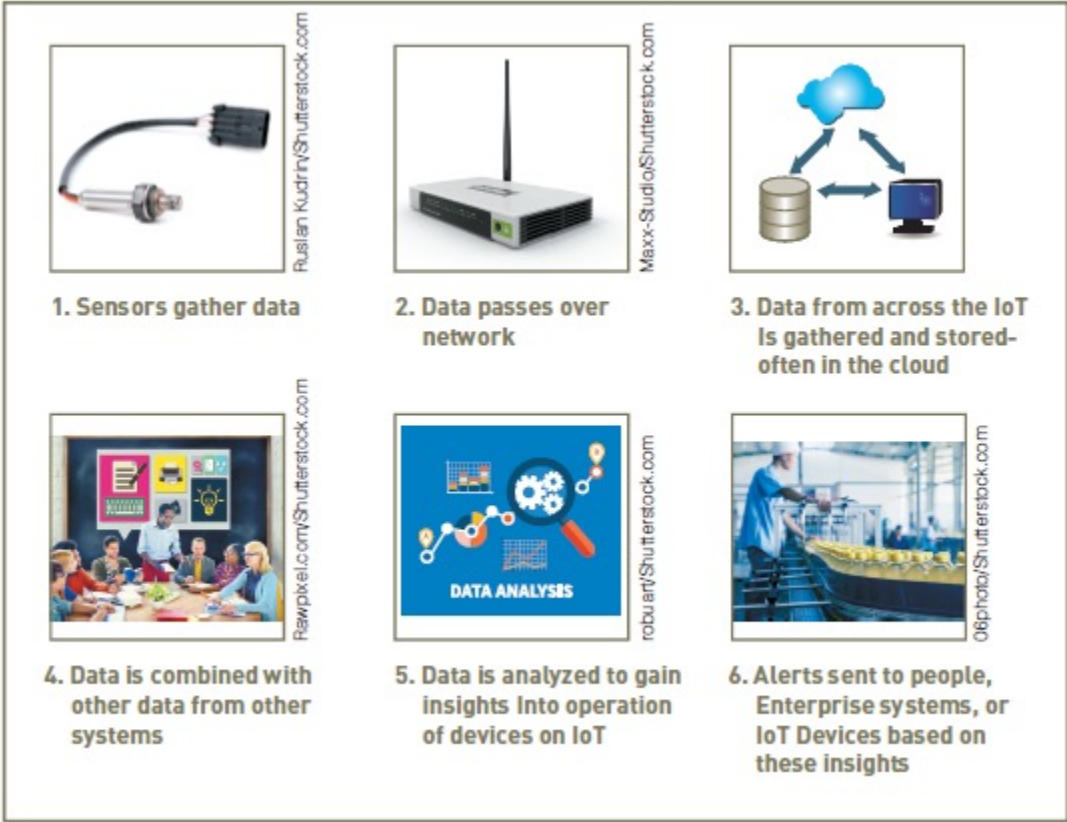


FIGURE 6.25

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.



The Internet of Things (IoT)

- Examples of using sensors and the IoT to monitor and control key operational activities:
 - Agriculture
 - A farmer deploys IoT-enabled soil moisture sensors and weather stations across their fields. These sensors collect data on soil conditions and weather patterns, allowing the farmer to make informed decisions about irrigation, fertilization, and crop health.
 - Predictive Maintenance
 - An airline employs IoT sensors on its aircraft engines. These sensors collect data on engine performance during flights and transmit it to maintenance teams on the ground. Predictive analytics help identify maintenance needs before they become critical, ensuring safer and more reliable flights.
 - Monitoring parking spaces



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



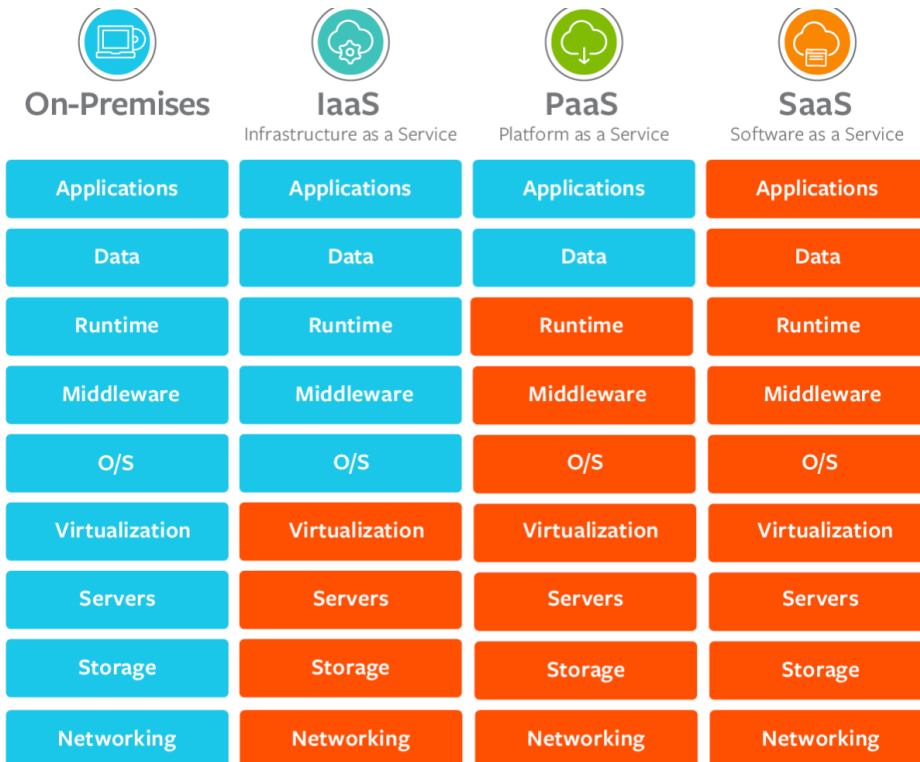
Public Cloud Computing

- A service provider owns and manages the infrastructure with cloud user organizations (tenants) accessing slices of shared hardware resource via the Internet
- Public cloud computing can be a faster, cheaper, and more agile approach to building and managing your own IT infrastructure
- However, data security is a key concern
 - Because when using a public cloud computing service, you are relying on someone else to safeguard your data



Public Cloud Computing

- Cloud computing can be divided into three main types of services:
 - Infrastructure as a service (IaaS)
 - Software as a service (SaaS)
 - Platform as a Service (PaaS)





Private Cloud Computing

- Private cloud environment
 - A single tenant cloud
 - Organization often implement due to concerns that their data will not be secure in a public cloud



Hybrid Cloud Computing

- Hybrid cloud
 - Composed of both private and public clouds integrated through networking
 - Organizations typically use the public cloud to run applications with less sensitive security requirements
 - Runs more critical applications on the private portion of the hybrid cloud



Summary

- Together, the Internet and the World Wide Web provide a highly effective infrastructure for delivering and accessing information and services
- Organizations are using the Internet of Things (IoT) to capture and analyze streams of sensor data to detect patterns and anomalies in order to have a considerable impact on the event outcome
- Cloud computing provides access to state-of-the-art technology at a fraction of the cost of ownership and without the lengthy delays that can occur when an organization tries to acquire its own resources