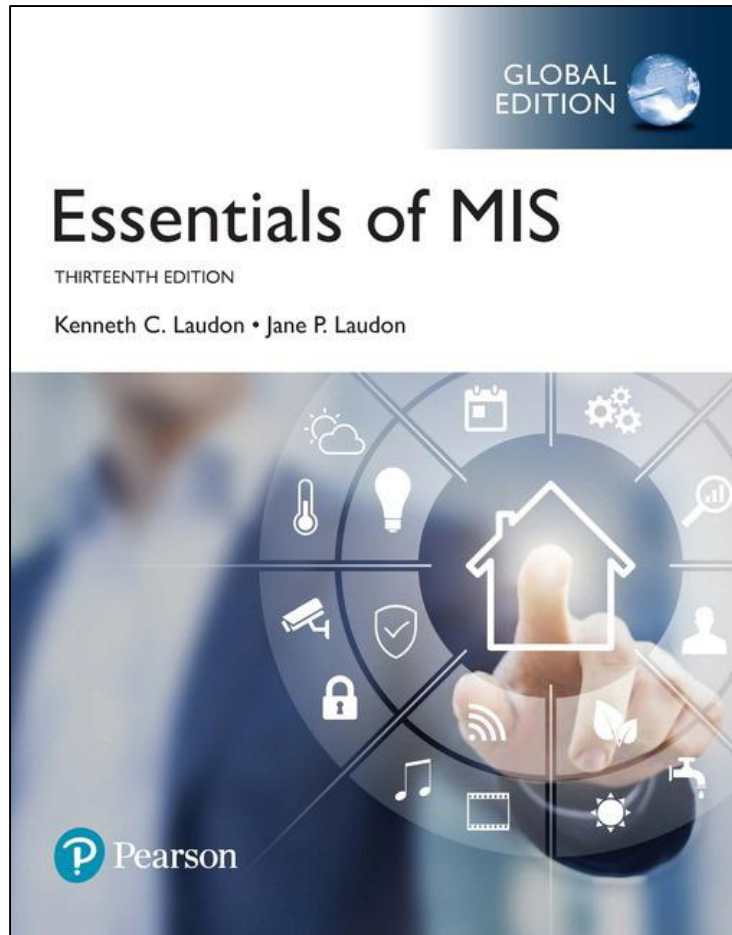


# Essentials of Management Information Systems

Thirteenth Edition



## Chapter 7

Telecommunications, the Internet, and Wireless Technology

# Learning Objectives

**7.1** What are the principal components of telecommunications networks and key networking technologies?

**7.2** What are the different types of networks?

**7.3** How do the Internet and Internet technology work, and how do they support communication and e-business?

**7.4** What are the principal technologies and standards for wireless networking, communication, and Internet access?

# Alibaba: Redefining Traditional Retailing

- Problem

- omnichannel retail strategy
- supply chain



- Solutions

- Hema app (The Hema Explorer App is **the future of digital mapping**, and as such is more feature rich. Since the improvements of the latest release of Hema Explorer App it's now all we use. The user interface is simple and intuitive. When zooming in and out the maps render quickly and smoothly – making the App a pleasure to use.)

curating through QR codes (Basically, a QR code **works in the same way as a barcode at the supermarket**. It is a machine-scannable image that can instantly be read using a Smartphone camera. Every QR code consists of a number of black squares and dots which represent certain pieces of information.

- The Hema app continuously acquires information from its customers
- Demonstrates IT's role in helping organizations increase efficiency and lower costs
- Illustrates the ability of IT systems to support inventory management and sales

# Networking and Communication Trends

- ***Convergence***

- Telephone networks and computer networks converging into single digital network using Internet standards

- ***Broadband***

- Broadband is the transmission of wide bandwidth data over a high speed internet connection. Broadband provides high speed internet access via multiple types of technologies including fiber optics, wireless, cable, DSL and satellite. ..

- ***Broadband wireless***

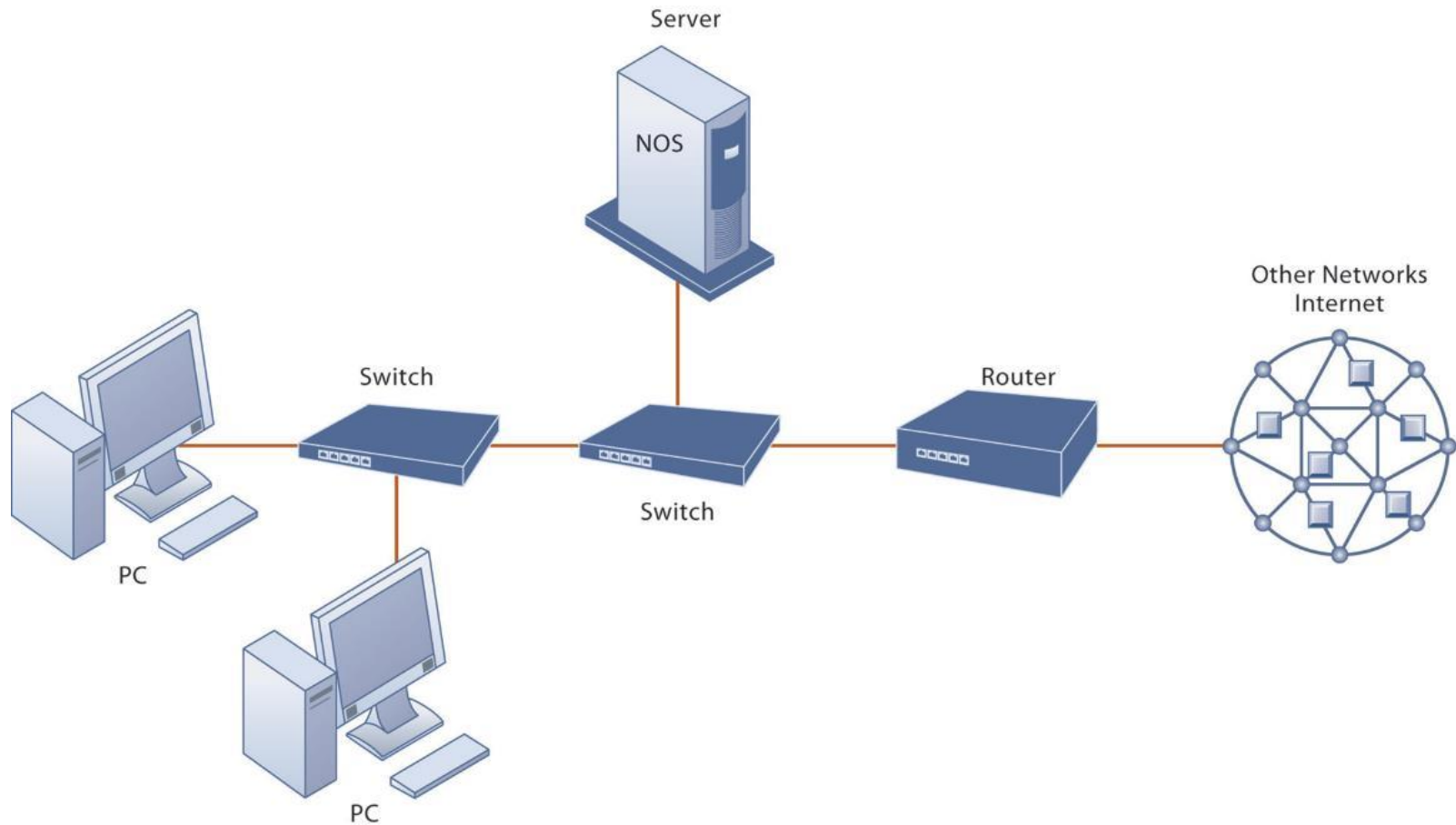
- Voice, data communication are increasingly taking place over broadband wireless platforms

# What is a Computer Network?

- Two or more connected computers
- Major components in simple network
  - Client and server computers
  - Network interfaces (NICs) A network interface is **the point of interconnection between a computer and a private or public network**. A network interface is generally a network interface card (NIC), but does not have to have a physical form. Instead, the network interface can be implemented in software.
  - Connection medium Communication medium refers to **the physical channel through which data is sent and received**. Data is sent in the form of voltage levels which make up the digital signal. ... The speed of data transmission or data rate depends upon the type of medium being used in the network.
  - Network operating system (NOS) A network operating system (NOS) is a **computer operating system (OS)** that is designed primarily to support workstations, personal computers and, in some instances, older terminals that are connected on a local area network (LAN).
  - Hubs, switches, routers Hubs are devices that pass on anything received on one connection to all other connections.
- Switches are semi-intelligent devices that learn which devices are on which connection.
- Software-defined networking (SDN) is an approach to networking that uses software controllers or application programming interfaces (APIs) to communicate with underlying hardware infrastructure and direct traffic on a network.
  - Functions of switches and routers managed by central program

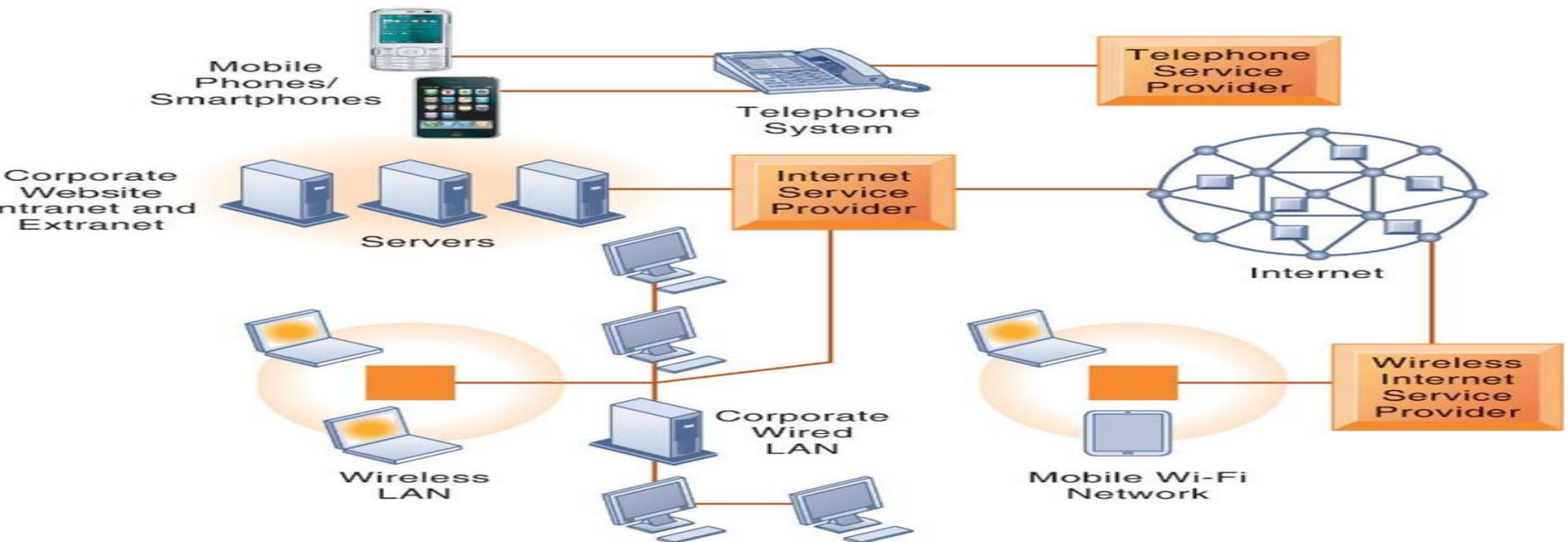


# Figure 7.1 Components of a Simple Computer Network



# Networks in Large Companies

- Large numbers of local area networks (LANs) linked to firm-wide corporate network
- Various powerful servers
  - Website, corporate intranet, extranet
  - Backend systems
- Mobile wireless LANs (Wi-Fi networks)
- Videoconferencing system
- Telephone network, wireless cell phones



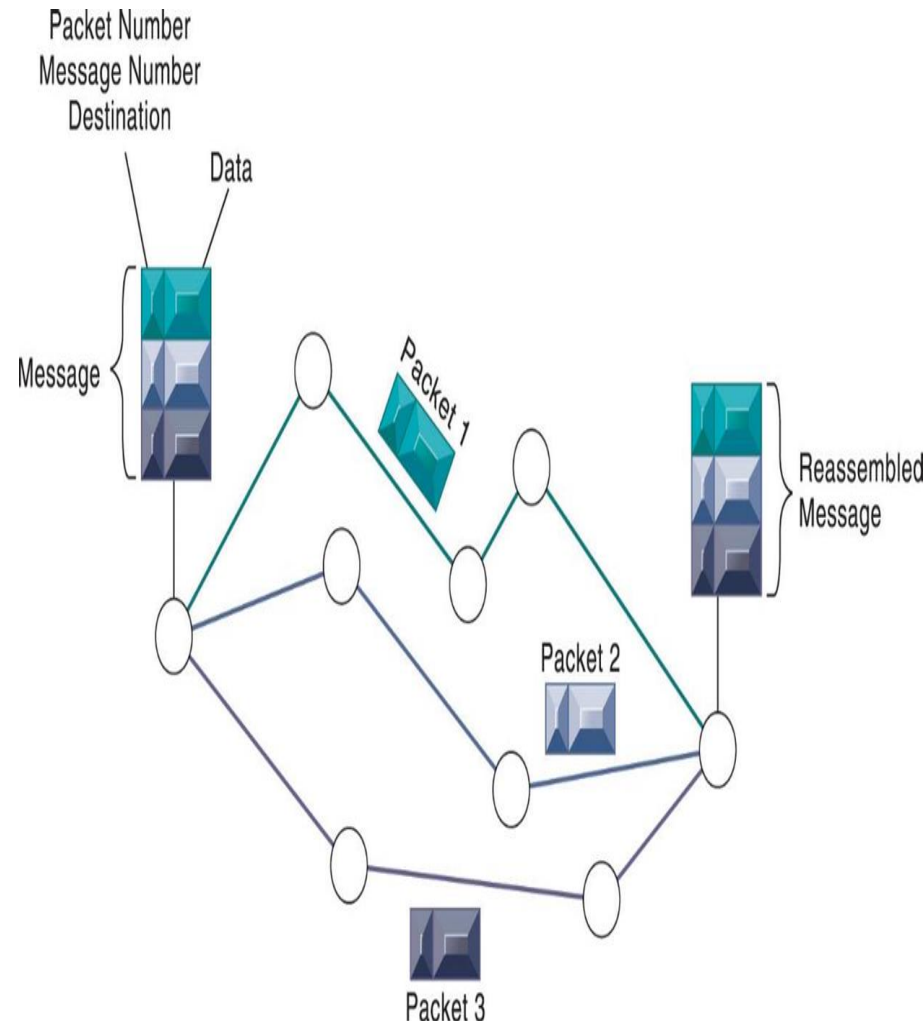
# Key Digital Networking Technologies (1 of 3)

- 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



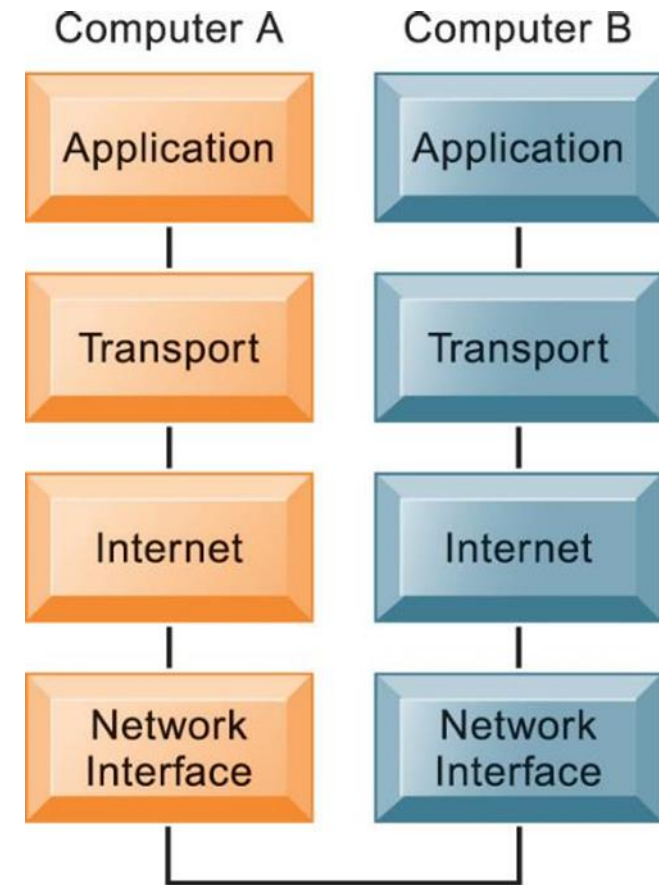
# Key Digital Networking Technologies (2 of 3)

- 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



# Key Digital Networking Technologies (3 of 3)

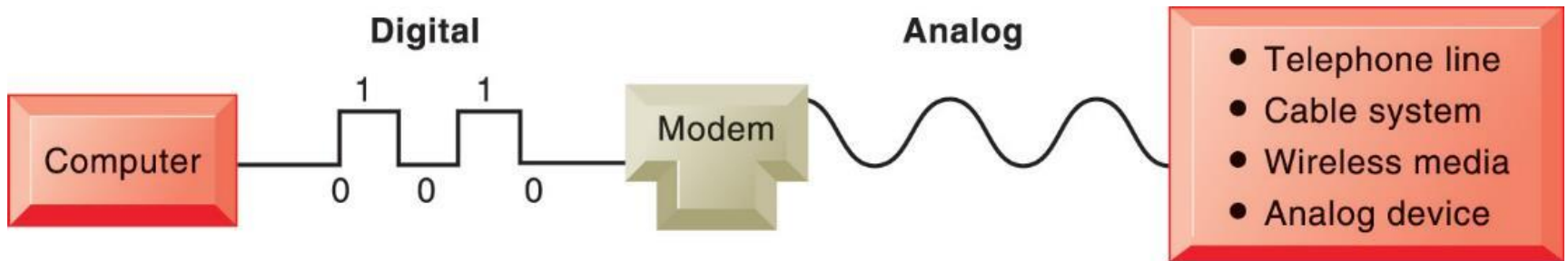
- TCP/IP and connectivity
  - Protocols: rules that govern transmission of information between two points
  - Transmission Control Protocol/Internet Protocol (TCP/IP)
    - Common worldwide standard that is basis for the Internet
  - Department of Defense reference model for TCP/IP
    - Four layers
      - Application layer
      - Transport layer
      - Internet layer
      - Network interface layer



# Types of Networks

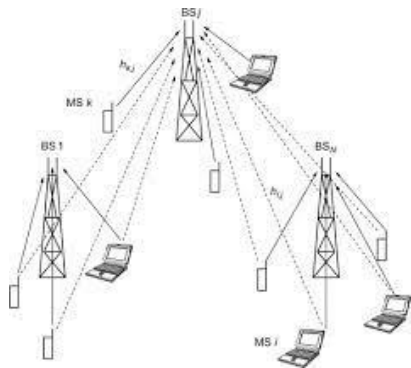
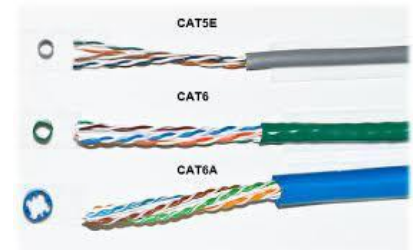
- Signals: Digital versus analog
  - Modem: translates digital signals into analog form (and vice versa)
- Types of networks
  - Local area networks (LANs)
    - Ethernet
    - Client/server vs. peer-to-peer
  - Wide area networks (WANs)
  - Metropolitan area networks (MANs)
  - Campus area networks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

# Figure 7.5 Functions of the Modem



# Transmission Media and Transmission Speed

- 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



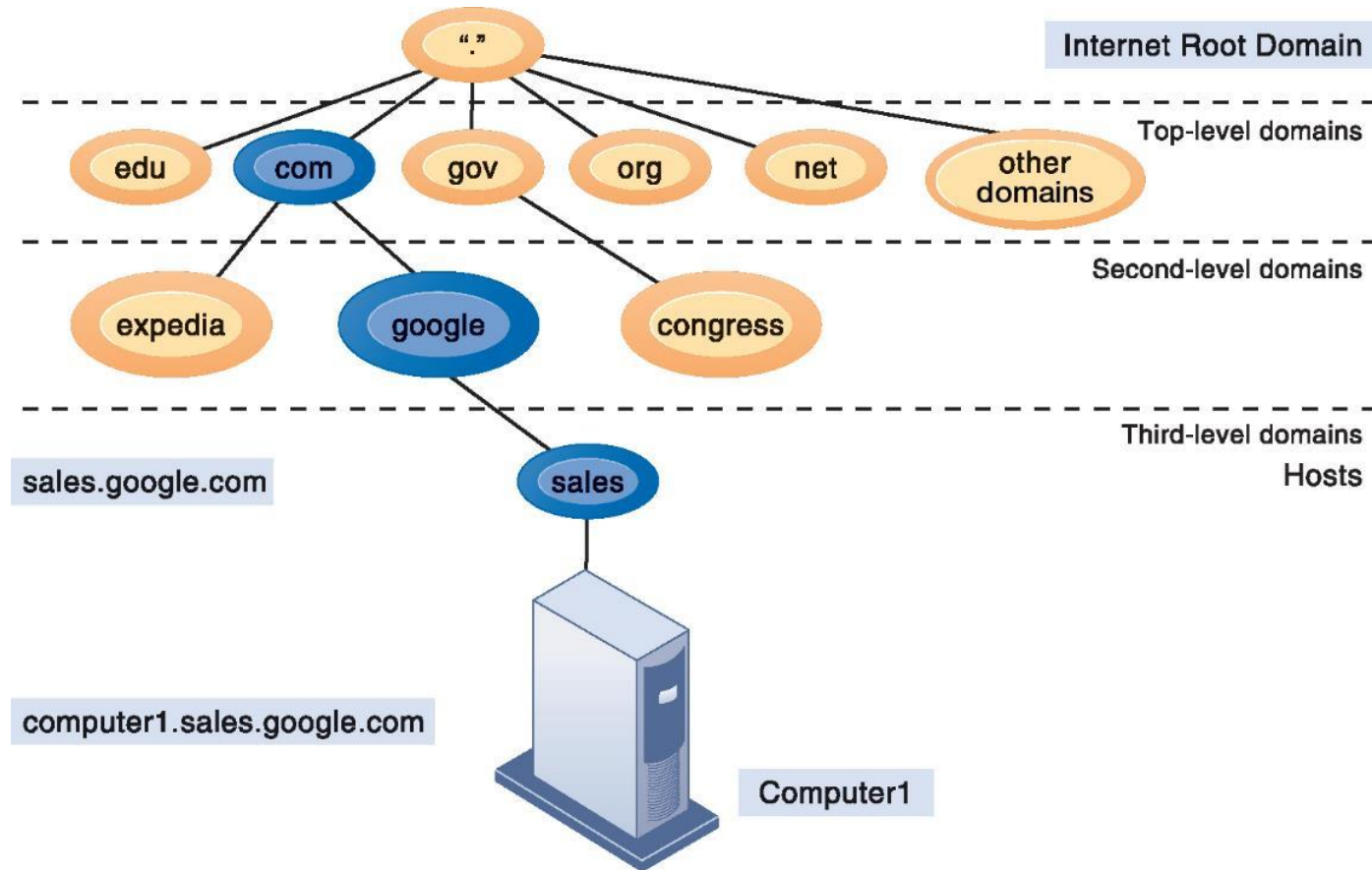
# What is the Internet?

- 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

# 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

# Figure 7.6 The Domain Name System









# Internet Architecture and Governance

- There are five Internet standards organizations: the Internet **Engineering Task Force** (IETF), **Internet Society** (ISOC), **Internet Architecture Board** (IAB), **Internet Research Task Force** (IRTF), **World Wide Web Consortium** (W3C).
- 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

The Intersection of Media Development Principles and Internet Governance

INTERNET GOVERNANCE BODY	PRINCIPLE AT STAKE	TECHNICAL DEBATE
	Freedom of Expression	<b>Domain Names (gTLDs)</b> Management of new, generic Top-Level Domains (gTLDs)
	Media Pluralism	<b>Social Media as News Platforms</b> Algorithms and Media Plurality
	Access to Information	<b>Wireless Internet</b> 5G Cellular Networks and Unlicensed Spectrum Standards
	Privacy	<b>Web Browsing Privacy</b> Encryption
	Secure Access and Trust	<b>Wi-Fi Security</b> Local Area Networks (LAN) Protocols in Diverse Settings

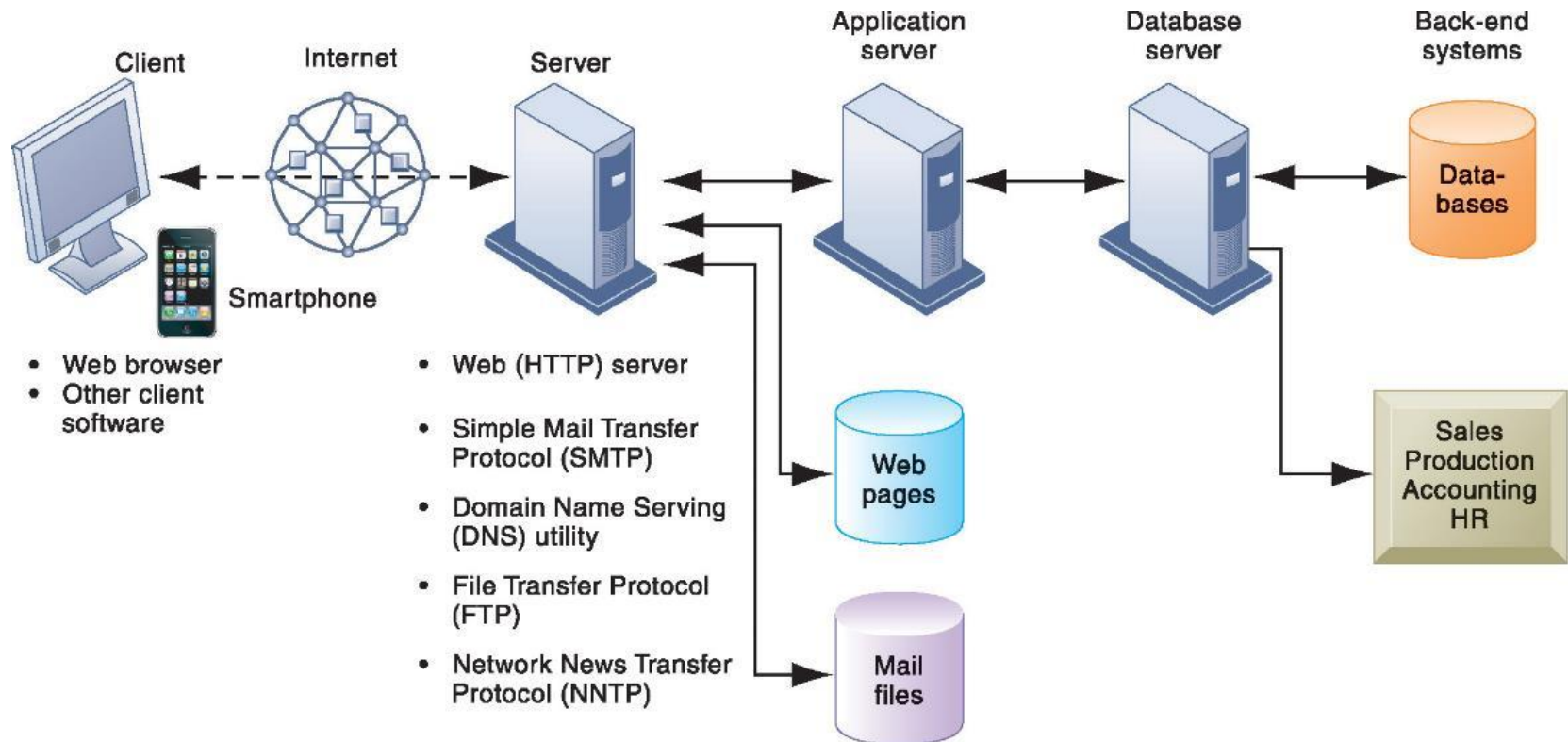
# The Future Internet: IPv6 and Internet 2

- **IPv6** The primary function of IPv6 is to allow for more unique TCP/IP address identifiers to be created,
- **IPv6 addresses consist of 128 bits, instead of 32 bits, and include a scope field that identifies the type of application suitable for the address**
- **Internet2** is a community providing a secure high-speed network, cloud solutions, research support, and services tailored for research and education.
  - is a U.S.-based and international nonprofit networking consortium led by researchers, academia and industry/government leaders.
  - Launched in 1996, Internet2 works to advance the development of networking education and global partnering to facilitate innovative Internet technologies.

# Internet Services and Communication Tools

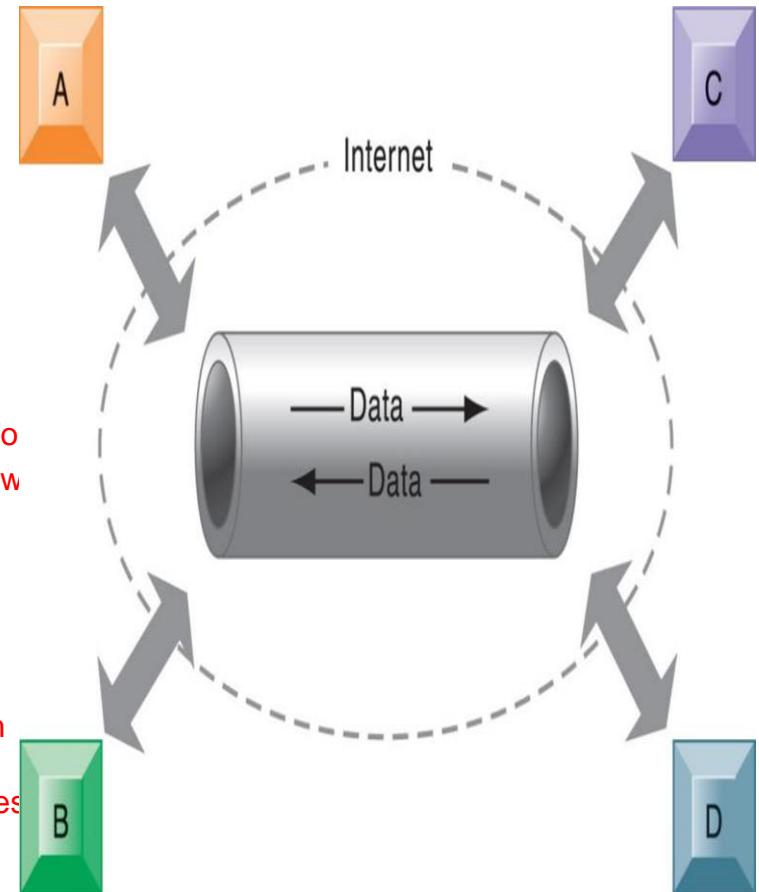
- Internet services
  - Email
  - Chatting and instant messaging
  - Newsgroups is a repository usually within the Usenet system, for messages posted from users in different locations using the Internet. They are discussion groups and are not devoted to publishing news.
  - Telnet is an application protocol used on the Internet or local area network to provide a bidirectional interactive text-oriented communication facility using a virtual terminal connection
  - File Transfer Protocol (F T P) is a standard communication protocol used for the transfer of computer files from a server to a client on a computer network. FTP is built on a client–server model architecture using separate control and data connections between the client and the server.
  - World Wide Web he World Wide Web, commonly known as the Web, is an information system where documents and other web resources are identified by Uniform Resource Locators, which may be interlinked by hyperlinks, and are accessible over the Internet.
- Voice over I P (V o I P) also called IP telephony, is a method and group of technologies for the delivery of voice communications and multimedia sessions over Internet Protocol networks, such as the Internet.
  - Digital voice communication using I P, packet switching

# Figure 7.8 Client/Server Computing on the Internet

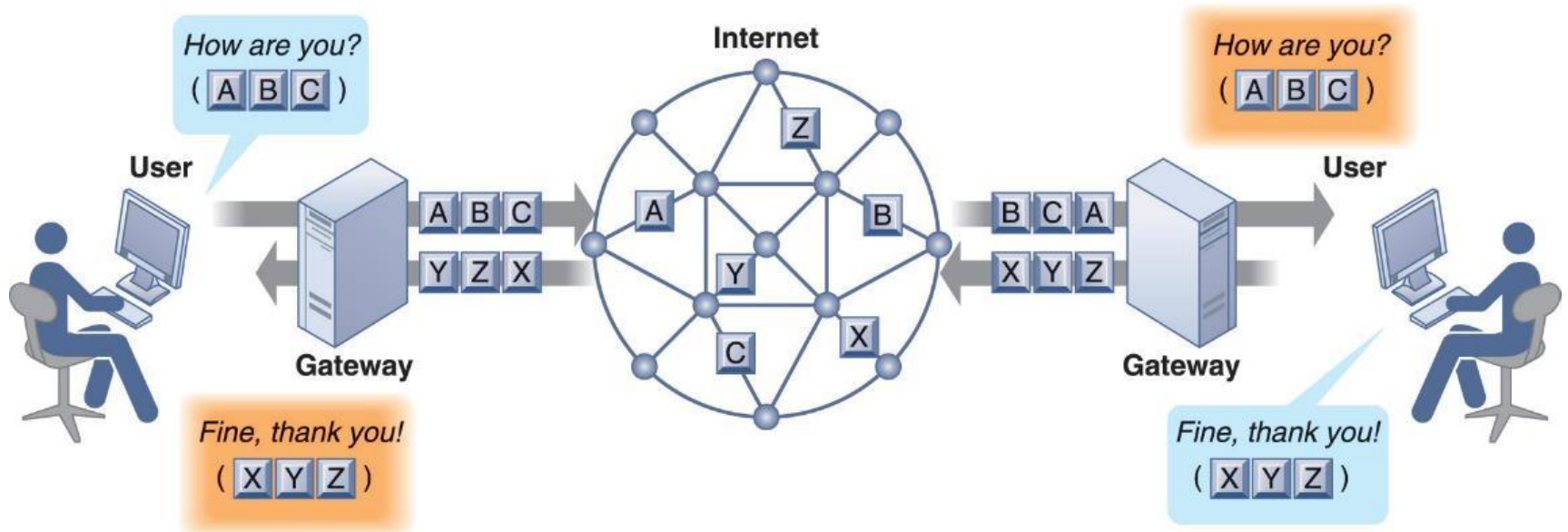


# Internet Services and Communication Tools

- Unified communications
  - Communications systems that integrate voice, data, email, conferencing
- Virtual private network (VPN)
  - Secure, encrypted, private network run over Internet
  - PPTP The Point-to-Point Tunneling Protocol is an obsolete method for implementing virtual private networks. PPTP has many well known security issues. PPTP uses a TCP control channel and a Generic Routing Encapsulation tunnel to encapsulate PPP packets. Many modern VPNs use various forms of UDP for this same functionality
  - Tunneling computer networks, a tunneling protocol is a communications protocol that allows for the movement of data from one network to another. It involves allowing private network communications to be sent across a public network through a process called encapsulation.



# Figure 7.9 How Voice Over IP Works



# The Web

- Hypertext
  - Hypertext Markup Language (HTML) is the standard markup language for documents designed to be displayed in a web browser. It can be assisted by technologies such as Cascading Style
  - Hypertext Transfer Protocol (HTTP): is an application layer protocol in the Internet protocol suite model for distributed, collaborative, hypermedia information systems.
  - Uniform resource locator (URL): are **the Web site addresses you enter into the address bar of your browser**. They contain the domain name of a site (such as facebook.com) and any directories and files that you're trying to open.
- Web servers is computer software and underlying hardware that accepts requests via HTTP, the network protocol created to distribute web pages, or its secure variant HTTPS
  - Software for locating and managing web pages

# Searching for Information on the Web

- **Search engines** is a software system that is designed to carry out web searches. They search the World Wide Web in a systematic way for particular information specified in a textual web search query
  - Google's PageRank System
- **Mobile search** refers to querying on an online search engine with the use of a mobile device, such as a smartphone or a tablet. In comparison to a searching from a laptop or desktop computer, users on handheld devices are more likely to conduct local searches, seeking information distinct to the area where they are searching from. Mobile search queries are typically done with simpler data results in mind, such as sports scores, rather than complex subject pages.
- **Semantic search** denotes search with meaning, as distinguished from lexical search where the search engine looks for literal matches of the query words or variants of them, without understanding the overall meaning of the query
- **Search engines** is a software system that is designed to carry out web searches. They search the World Wide Web in a
- **Social search** is a behavior of retrieving and searching on a social searching engine that mainly searches user-generated content such as news, videos and images related search queries on social media like Facebook, LinkedIn, Twitter, Instagram and Flickr.



# Searching for Information on the Web

- **Visual search and the visual web**
  - **Tagging** In information systems, a tag is a keyword or term assigned to a piece of information. This kind of metadata helps describe an item and allows it to be found again by browsing or searching.
  - **Pinterest** is an image sharing and social media service designed to enable saving and discovery of information on the internet using images, and on a smaller scale, animated GIFs and videos, in the form of pin boards
- **Intelligent agent shopping bots** are price comparison sites on the World Wide Web that automatically search the inventory of several different online merchants to find the lowest prices for consumers. ... They then are routed to the Web site selling the item, where they can complete their purchase.
- **Search engine marketings** a digital marketing strategy used to increase the visibility of a website in search engine results pages (SERPs).
- **Search engine optimization (SEO)** is the process of improving the quality and quantity of website traffic to a website or a web page from search engines.
- **Search engine algorithms** S a unique formula that a search engine uses to retrieve specific information stored within a data structure and determine the significance of a web page and its content.

# Searching for Information on the Web

- **Intelligent agent shopping bots** are price comparison sites on the World Wide Web that automatically search the inventory of several different online merchants to find the lowest prices for consumers. ... They then are routed to the Web site selling the item, where they can complete their purchase.
- **Search engine marketing** is a form of Internet marketing that involves the promotion of websites by increasing their visibility in search engine results pages primarily through paid advertising.
- **Search engine optimization (SEO)** is the process of improving the quality and quantity of website traffic to a website or a web page from search engines. SEO targets unpaid traffic rather than direct traffic or paid traffic.
  - **Link farms** is any group of websites that all hyperlink to other sites in the group for the purpose of increasing SEO rankings. In graph theoretic terms, a link farm is a clique. Although some link farms can be created by hand, most are created through automated programs and services.
- **Search engine algorithms** is a complex algorithm used by search engines such as Google, Yahoo, and Bing to determine a web page's significance. According to Netcraft, an Internet research company, there are over 150,000,000 active websites on the Internet.

# Top Web Search Engines Worldwide

- **Top 10 Search Engines in the World in 2022**

- 1 The Best Search Engine in The World: Google.
- 2 Search Engine #2. Bing.
- 3 Search Engine #3. Baidu.
- 4 Search Engine #4. Yahoo!
- 5 Search Engine #5. Yandex.
- 6 Search Engine #6. Ask.
- 7 Search Engine #7. DuckDuckGo.
- 8 Search Engine #8. Naver.
- 9. Search Engine #9. AOL
- 10 Search Engine #10. Seznam

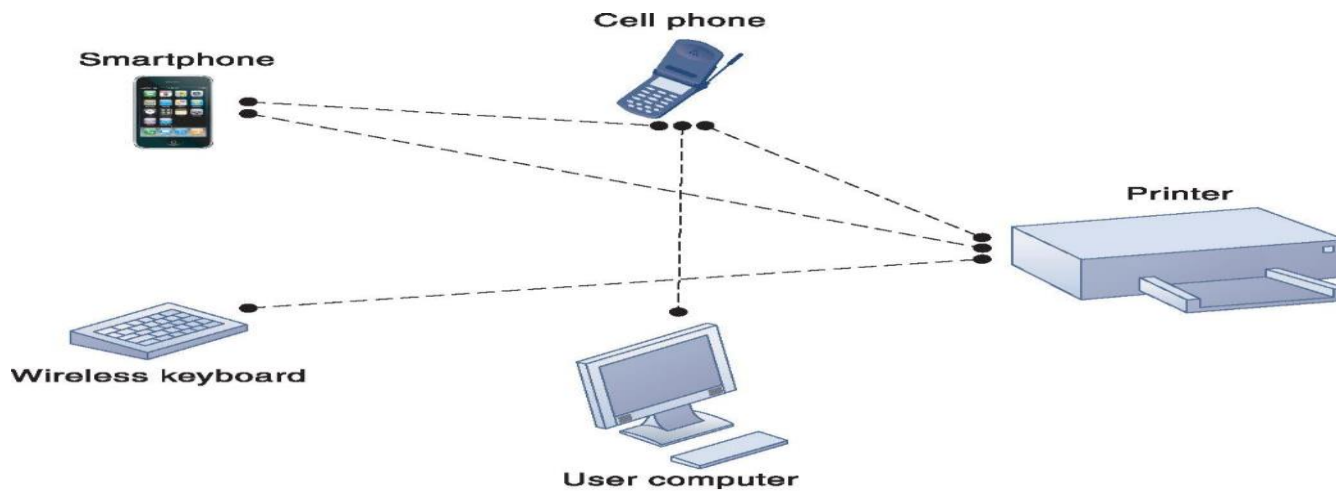
<https://www.oberlo.com/blog/top-search-engines-world>

# Cellular Systems

- Competing standards
  - CDMA: United States only
  - GSM: Rest of world, AT&T, T-Mobile (**Global System for Mobile Communications (GSM)** is a standard developed by the European Telecommunications Standards Institute (ETSI) to describe the protocols for second-generation (2G) digital cellular networks used by mobile devices such as mobile phones and tablets. It was first deployed in Finland in December 1991
- Third-generation (3G) networks
  - 144 Kbps
  - Suitable for email access, web browsing
- Fourth-generation (4G) networks
  - Up to 100 Mbps
  - Suitable for Internet video
  - LTE and WiMax
- Fifth-generation (5G) networks
  - It provides speeds faster than any previous generation
  - up to 3000 Mbps (3 Gbps) in the real world, depending on the conditions and the tech being used — competing even with those delivered via fiber-optic cables

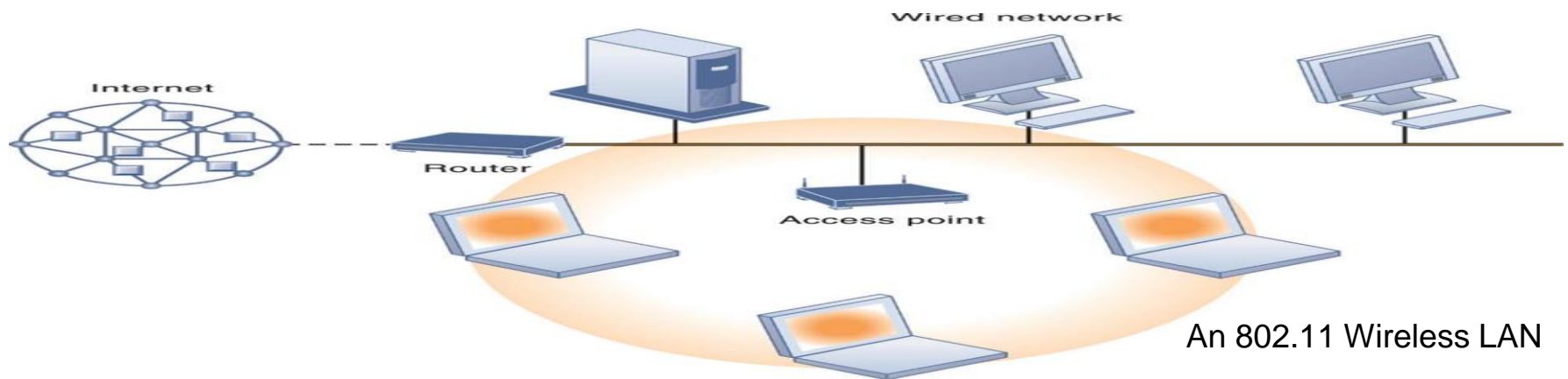
# Wireless Computer Networks and Internet Access

- **Bluetooth (802.15) 802.15. 1**, more commonly known as Bluetooth, is a low-data-rate, low-power wireless networking standard aimed at replacing cables between lightweight devices
  - Links up to 8 devices in 10-m area using low-power, radio-based communication
  - Useful for personal networking (PANs) A Bluetooth PAN (Personal Area Network) host connection lets you share an Internet connection on the rugged handheld computer with other devices. ...
  - 1- Verify that the Internet (such as cell data) connection on the rugged handheld is working on the device itself.



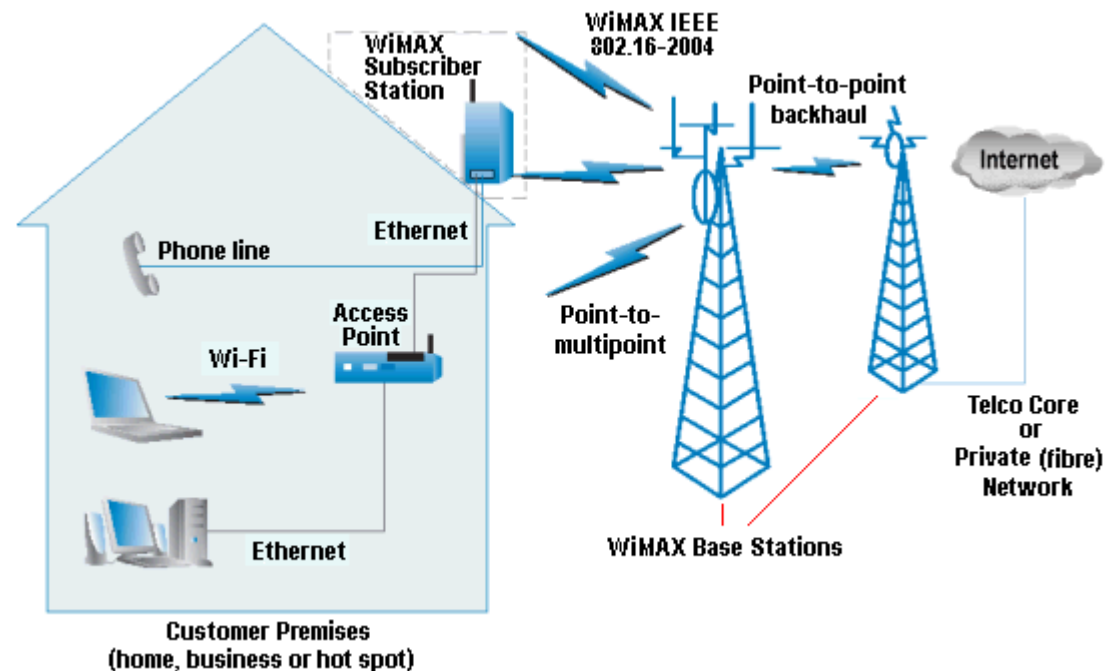
# Wireless Computer Networks and Internet Access

- **Wi-Fi (802.11)** refers to the set of standards that define communication for wireless LANs (wireless local area networks, or WLANs. is a group of colocated computers or other devices that form a network based on radio transmissions rather than wired connections).
  - 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
  - Hotspots: one or more access points in public place to provide maximum wireless coverage for a specific area
  - Weak security features



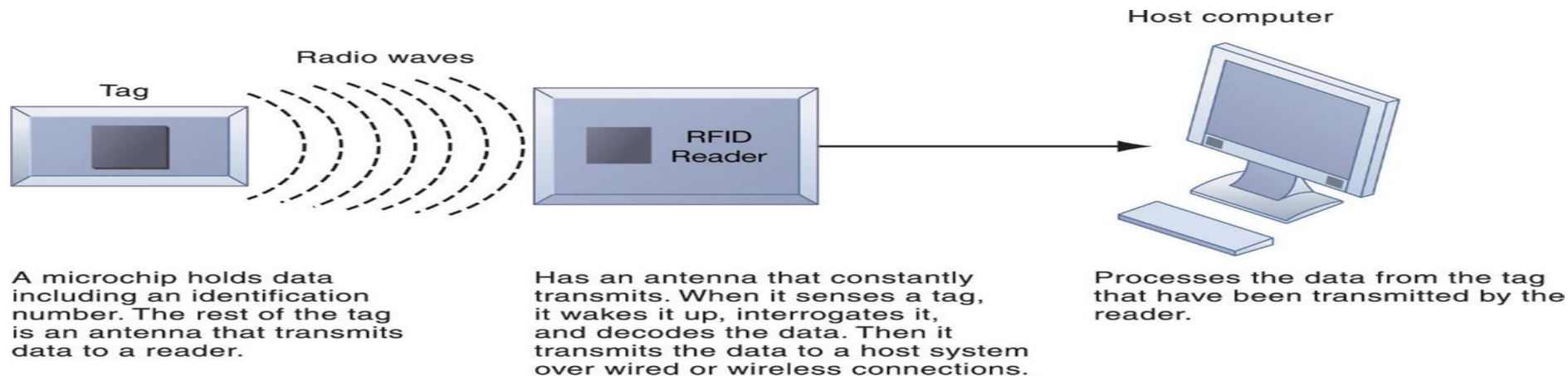
# Wireless Computer Networks and Internet Access

- **Worldwide Interoperability for Microwave Access (WiMax)** (802.16), is a telecommunications technology aimed at providing wireless data over long distances in a variety of ways, from point-to-point links to full mobile cellular type access.
  - Wireless access range of 31 miles
  - Require WiMax antennas



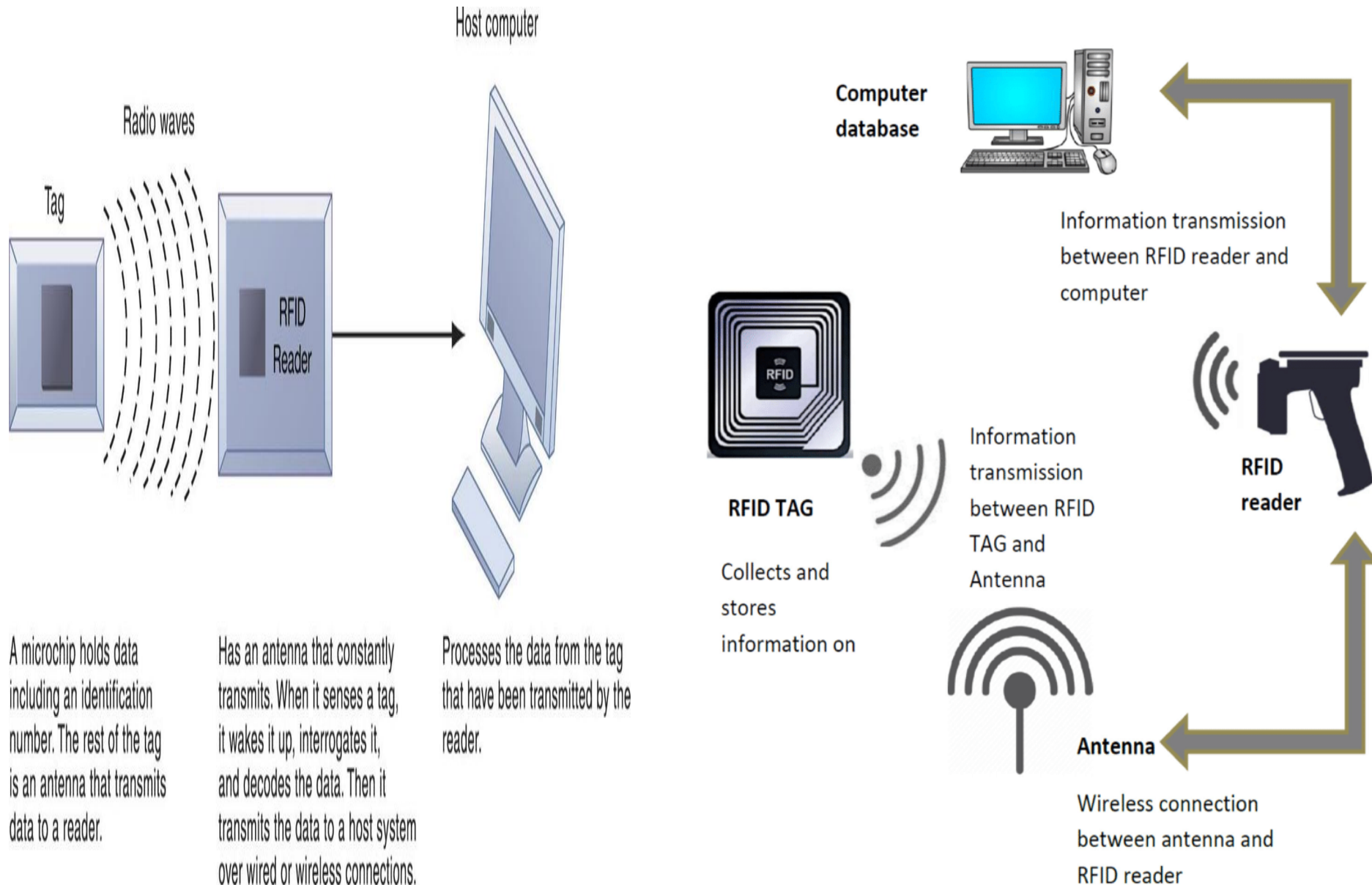
# Radio Frequency Identification (RFID)

- Radio-frequency identification uses electromagnetic fields to automatically identify and track tags attached to objects
- Use tiny tags with microchips containing data about an item and location
- Radio Frequency Identification (RFID) is a technology that uses radio waves to passively identify a tagged object. It is used in several commercial and industrial applications, from tracking items along a supply chain to keeping track of items checked out of a library.
- Tag antennas to transmit radio signals over short distances to special RFID readers
- Common uses:





# Radio Frequency Identification (RFID)



# Wireless Sensor Networks (WSNs)

- WSNs is an infrastructure-less wireless network that is deployed in a large number of wireless sensors in an ad-hoc manner that is used to monitor the system, physical or environmental conditions
- Networks of hundreds or thousands of interconnected wireless devices
- 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

