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Communication and Networks

Chapter 8

Computing Essentials 2023
O'Leary

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Learning Objectives

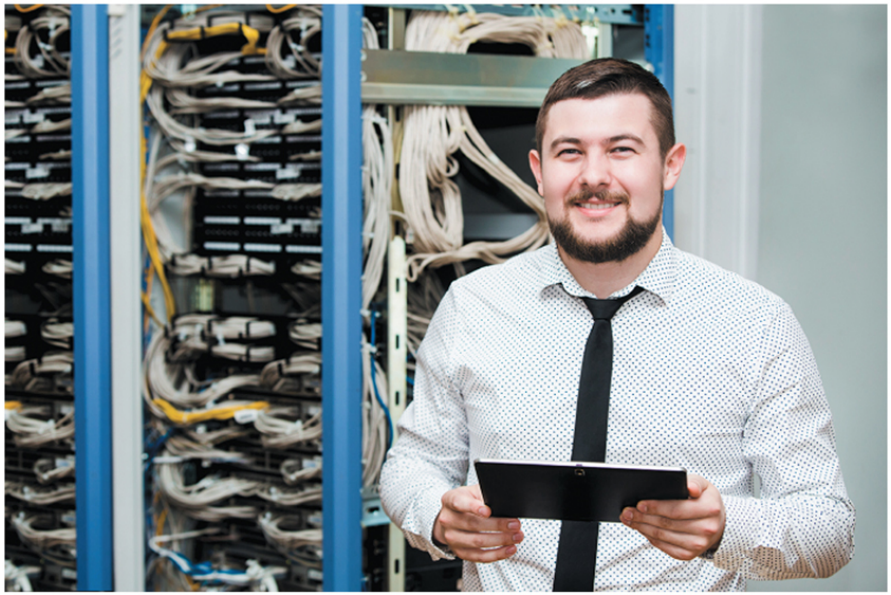
1. Explain connectivity, the wireless revolution, and communication systems.
2. Describe physical and wireless communications channels.
3. Differentiate between connection devices and services, including dial-up, DSL, satellite, and cellular.
4. Describe data transmission factors, including bandwidth and protocols.
5. Define networks and key network terminology, including network interface cards and network operating systems.
6. Describe different types of networks, including local, home, wireless, personal, metropolitan, and wide area networks.
7. Describe network architectures, including topologies and strategies.
8. Explain the organization issues related to Internet technologies and network security.

Introduction

We live in a truly connected society.

Increased connectivity potentially means increased productivity, especially in business.

You will learn more about the concept of connectivity and the impact of the wireless revolution in this chapter.



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Communication

Computer communications is the process of sharing data, programs, and information between two or more computers

Numerous applications depend on communication systems, including

- Texting
- E-mail
- Videoconferencing
- Electronic commerce

Connectivity

Connectivity uses computer networks to link people and resources

Connects your personal computer to other computers and resources on a network and the Internet

The Wireless Revolution

- Single most dramatic change in connectivity since the development of the Internet
- Allows individuals to connect to the Internet and share information from almost anywhere in the world

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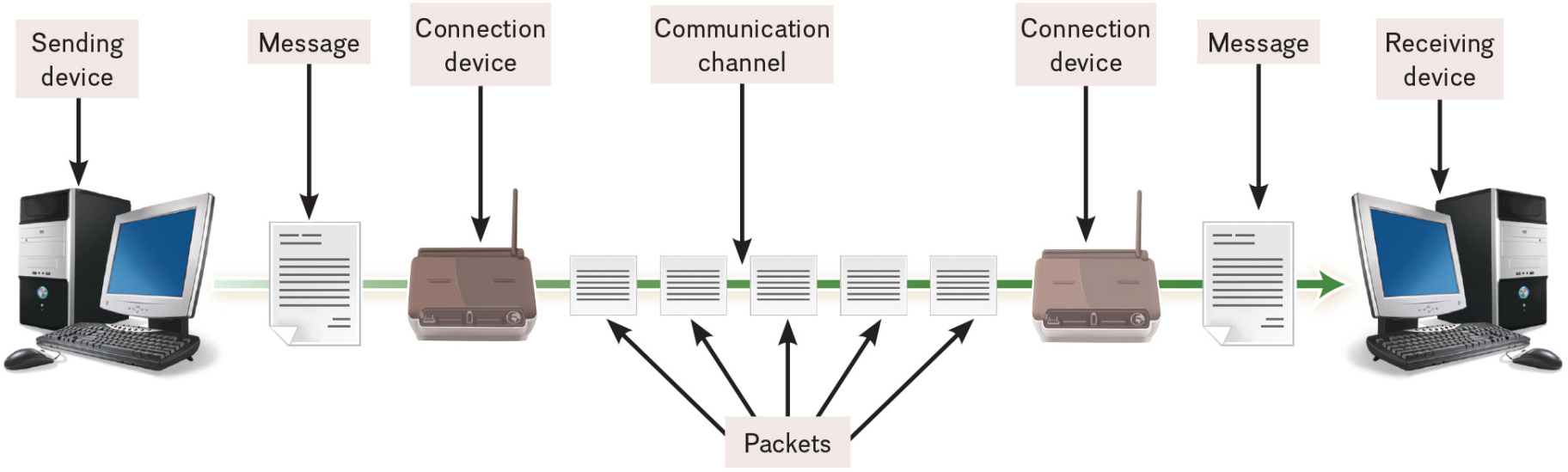
The Revolution is just beginning

Communication Systems

Electronic systems that transmit data from one location to another



Basic Elements of Communication

Sending and receiving devices	Computer or a specialized communication device
Connection devices	Interface between sending and receiving device
Data transmission specifications	Rules and procedures that coordinate the devices
Communication channel	Carries the message

Communication Channels

Physical Connections using wire or cable

Wireless Connections

Wireless Connections

Wireless connections do not use a solid substance to connect; uses the air itself. Most use radio waves to communicate

Standard	Maximum Speed
802.11g	54 mps
802.11n	600 mps
802.11ac	2.6 Gbps
802.11ax	10.5 Gbps

Primary Wireless Technology

Cellular

- Use multiple antennae to communication

Bluetooth (short-range)

- Radio communication standard

Wi-Fi (wireless fidelity)

- Uses high frequency radio

Microwave

- Uses high frequency radio wave signals

WiMax (extends Wi-Fi)

- New standard that uses microwave to extend WiFi

Satellite

- Uses satellites as microwave relay stations

GPS

- Determine geographic location of the devices

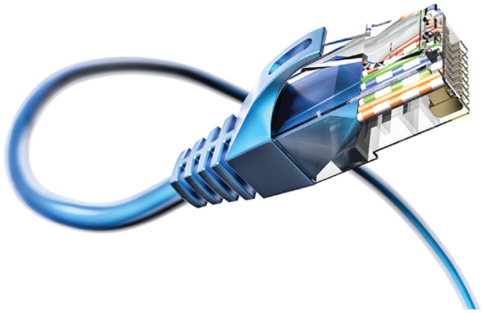
Infrared

- Use infrared light wants to communication over short distances

Physical Connections

Physical connection between sending and receiving device include

- Twisted pair cable: two pairs of copper wire twisted together
  - Telephone lines
  - Ethernet cables
- Coaxial cable: single solid copper core
  - Cable TV
- Fiber-optic cable: tiny glass tubes
  - Faster and more reliable than coax
  - Speeds as high as 1 petabit per second



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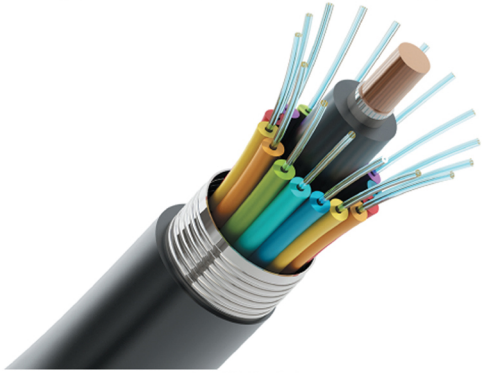

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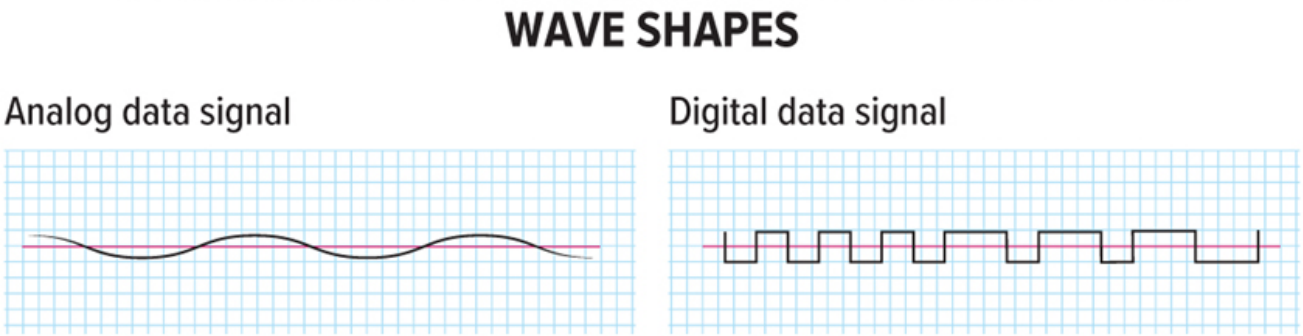
Connection Device Signals

Types of signals

- Analog (telephone)
- Digital (computer)

Transfer rates

- Mbps – million bits per second
- Gbps – billion bits per second
- Tbps – trillion bits per second



Connection Devices

Modem – *modulator-demodulator*

- Modulation is the process of converting from digital to analog
- Demodulation is the process of converting from analog to digital

Transfer rate

- Speed in which modems transfer data
- Usually measured in megabits per second (Mbps)

Types of Modems

Digital subscriber line (DSL)

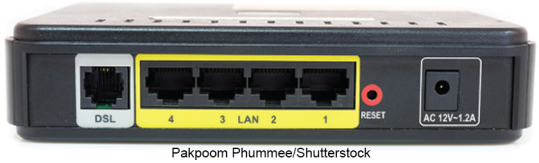
- High speed telephone lines

Cable

- Uses coaxial cable

Wireless

- Also known as WWAN



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Wireless

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Connection Services

Leased lines

- T1 combined to form T3 and DS3
- Have been replaced by OC lines
  - Faster optical carrier lines
- Higher capacity
  - Not affordable for individuals

Cellular service providers

- First Generation 1G, only voice
- Second Generation 2G, used radio signals and introduced texting
- Third Generation 3G, improved data speed, introduced Internet on phones
- Fourth Generation 4G, increased speed, streaming video and music
- Fifth Generation 5G, speeds approaching those of a home Internet connection

Connection Services - Individual

Digital subscriber line (DSL)

- Uses phone lines
- ADSL is most widely used type of DSL

Cable

- Uses existing TV cable
- Faster than DSL

Fiber Optic Service (FiOS)

- New technology
  - Google and Verizon

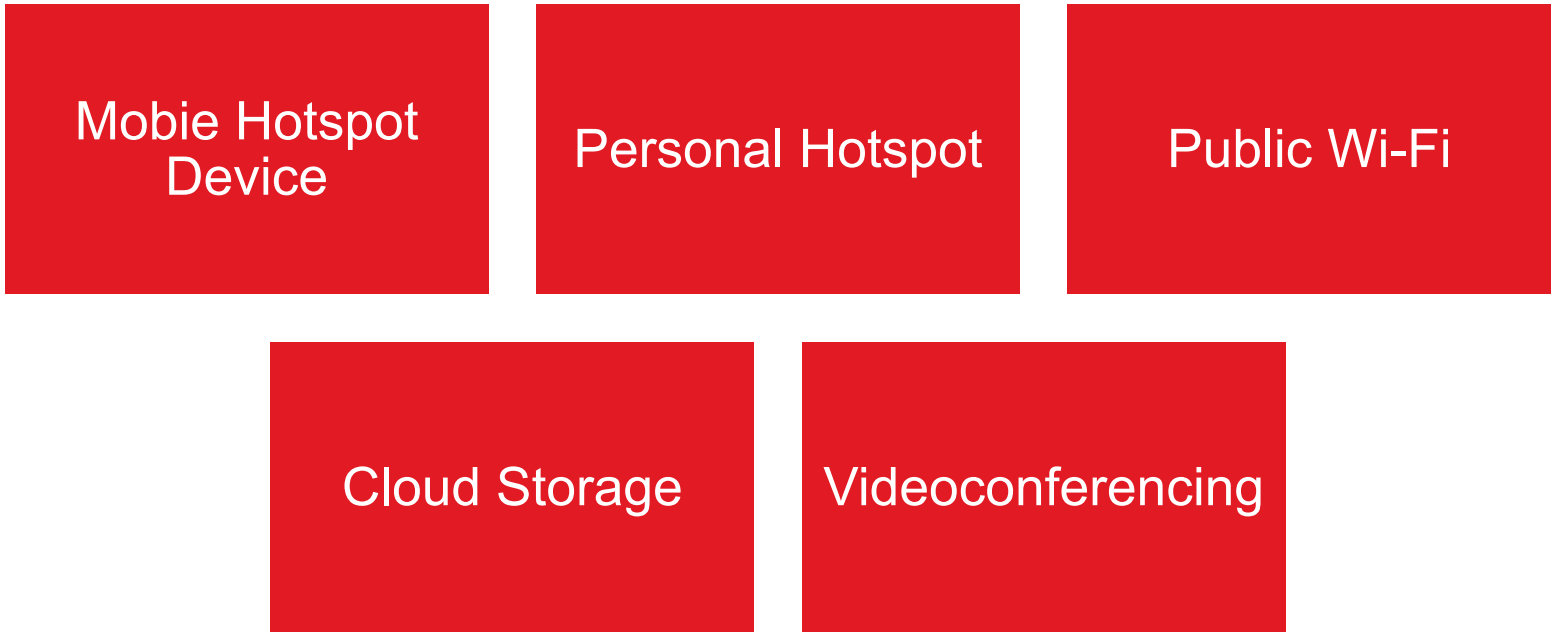
Satellite connection services

- Use almost anywhere

Making IT Work for You ~ The Mobile Office

Can telecommute from anywhere

Become a one-man workforce



Factors that Affect Data Transmission

Bandwidth is how much information can move across the communication channel in a given amount of time

- Measurement of the width or capacity of the communication channel

Categories of bandwidth

- Voiceband (or low bandwidth) – standard telephone
- Medium band – leased lines for high-speed
  - Mid-range computer and mainframes
- Broadband for DSL, cable, satellite connections to the Internet
- Baseband for individual connections for computers in close range

Protocols

Communication rules for exchanging data between computers

- HTTPS – Hypertext Transfer Protocol Secure
  - Widely used to protect the transfer of sensitive data
- TCP/IP (Transmission control protocol/Internet protocol)
  - Each computer is identified with unique IP (Internet Protocol) address
  - DNS – Domain name service resolves IP addresses to names
  - Packetization – information broken down into small parts (packets) and then reassembled

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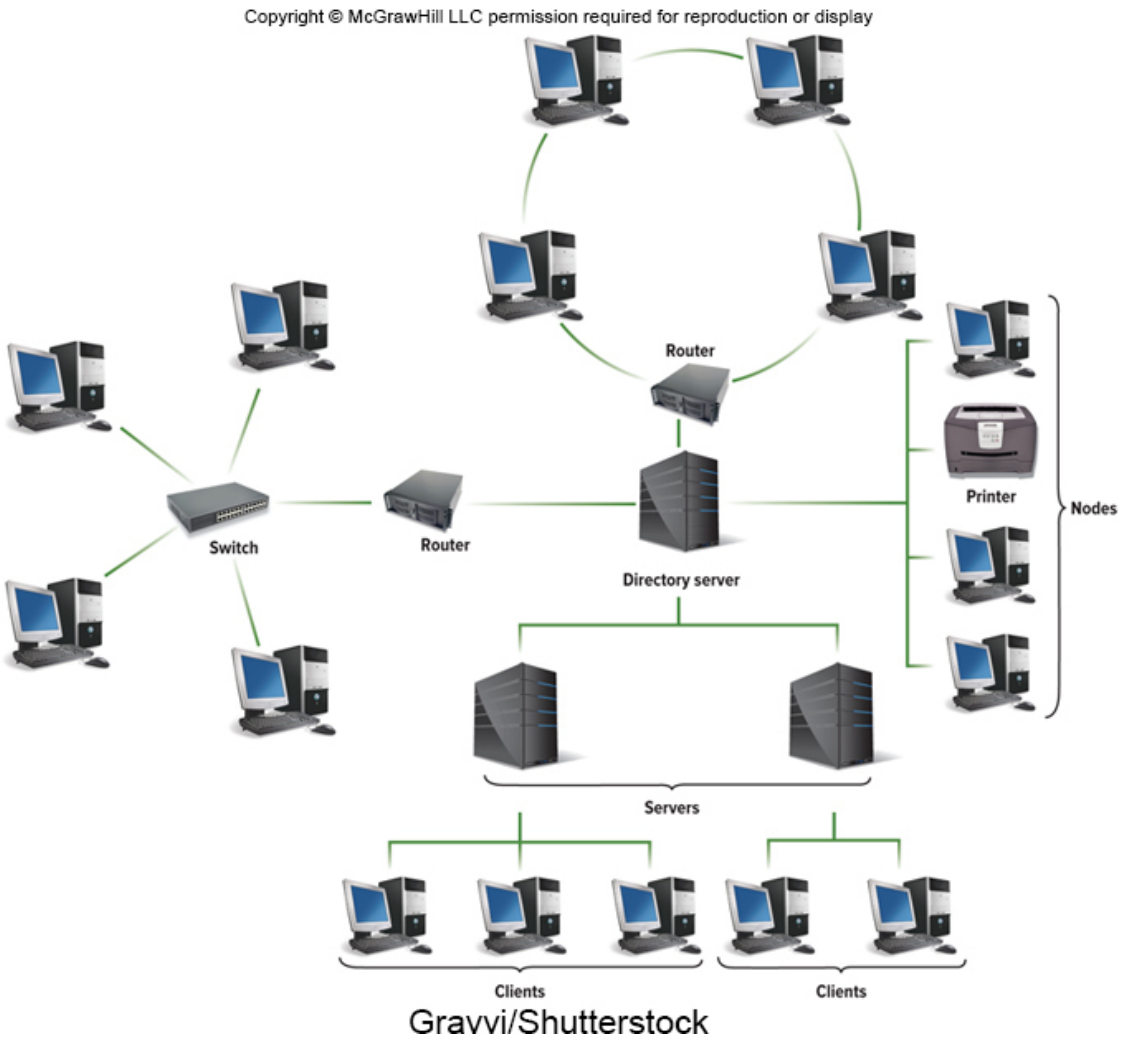
Networks

A communication system that connects two or more computers so they can exchange information and share resources



Network Terminology

Nodes

- Any device connected to a network

Client

- A node that requests and uses resources from other nodes

Server

- A node that shares resources with other nodes

Directory Server

- Specialized server that managers resources

Host

- Computer system that can be accessed over a network

Router

- Node that forwards or routes data packets

Switch

- Central node that coordinates the flow of data

Network Interface Cards (NIC)

- Expansion card that connects a computer to a network

Network Operating System

- Control activities of all computers on the network

Network Administrator

- Computer specialists responsible for network operations

Network Types

Type	Description
LAN	Local area network; located within close proximity
Home	Local area network for home use; typically wireless
WLAN	Wireless local area network; all communication passes through an access point
PAN	Personal area network; connects digital devices , such as PDAs
MAN	Metropolitan area network; typically spans cities with coverage up to 100 miles
WAN	Wide area network for countrywide or worldwide coverage

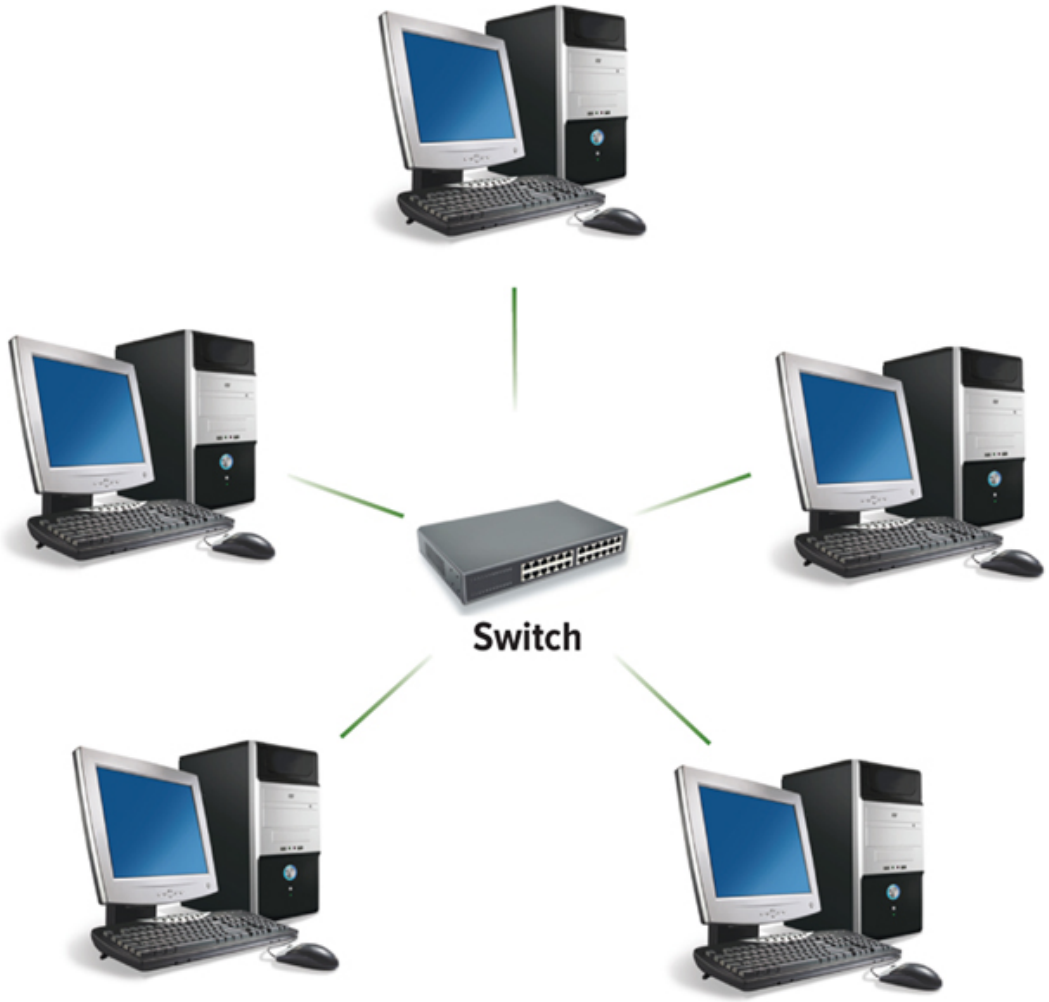
Network Architecture

How the network is arranged and how its resources are shared

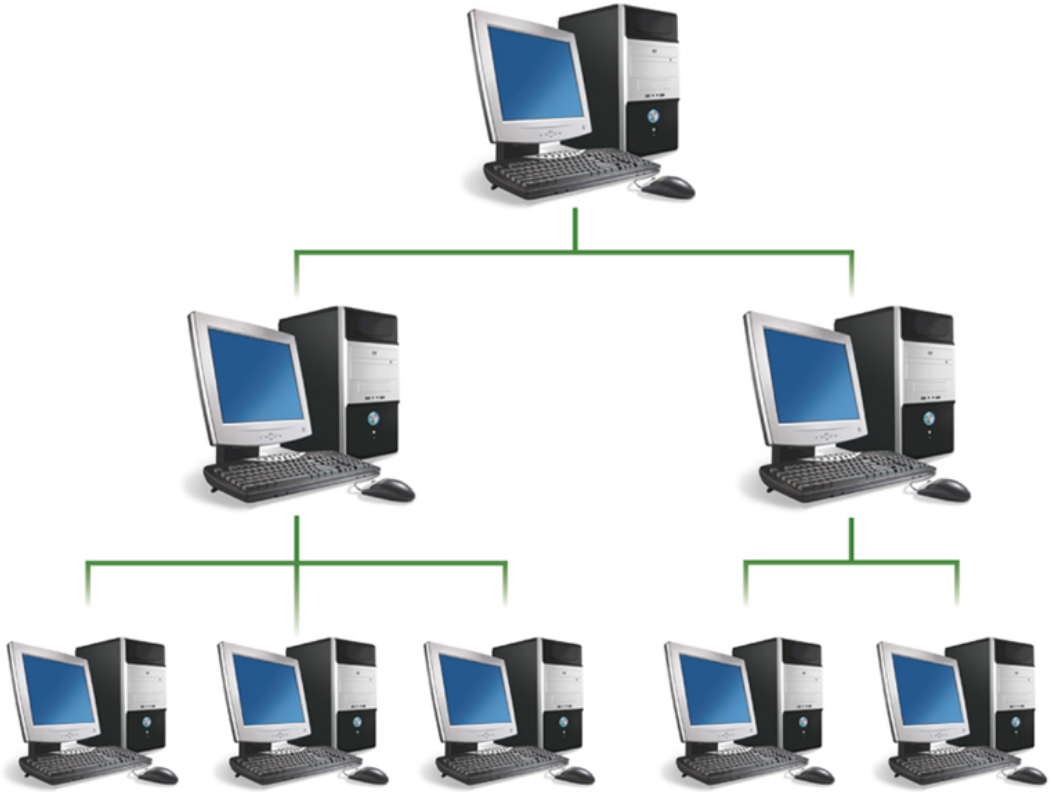
- Network Topology
  - Physical arrangement of the network
- Network Strategy
  - How the information and resources are shared

Ring Network

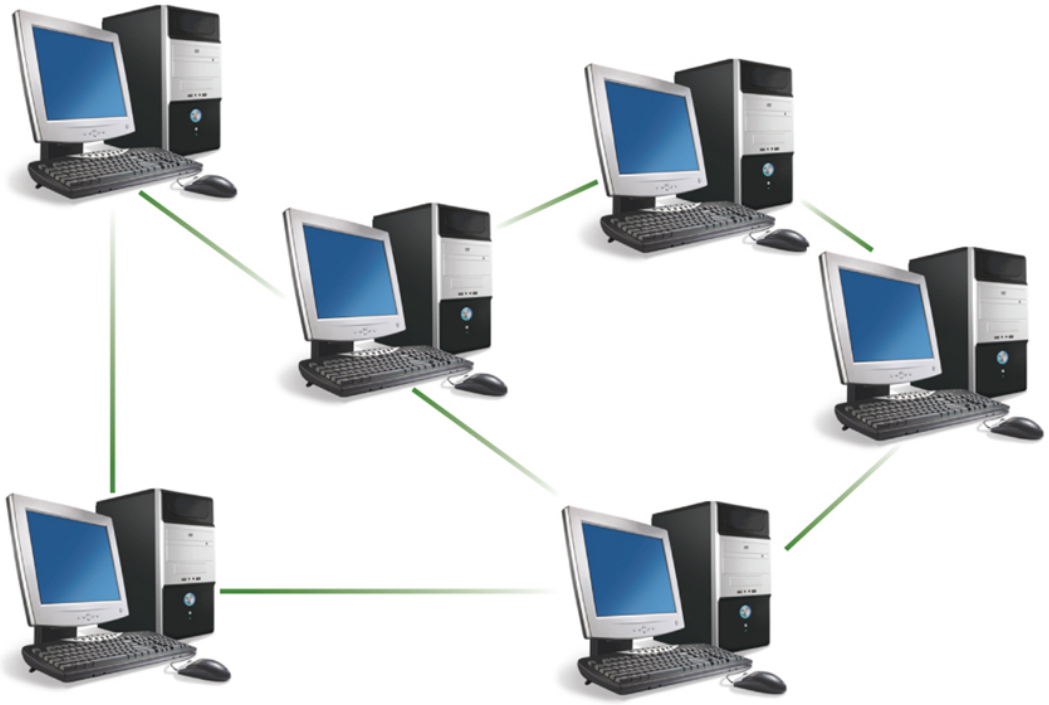
Star Network



Tree Network



Mesh Network



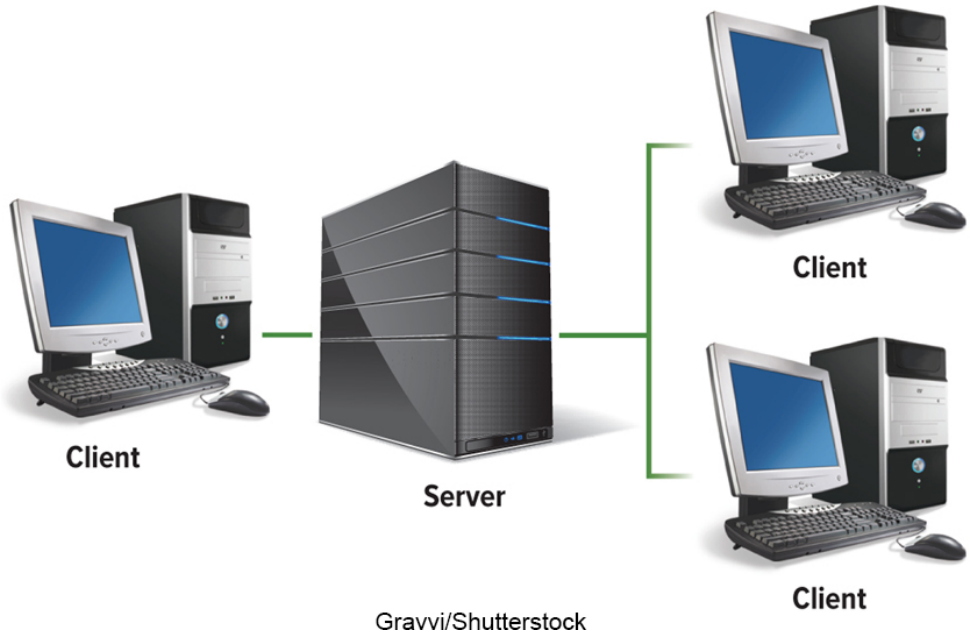
Network Strategies

Client/Server Network

- Central computers coordinate and supply services to other nodes on the network
- Server provides access

Peer-to-Peer (P2P) Network

- All nodes have equal authority
- Can act as both client and server



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Organizational Networks

Internet technologies support effective communication within and between organizations

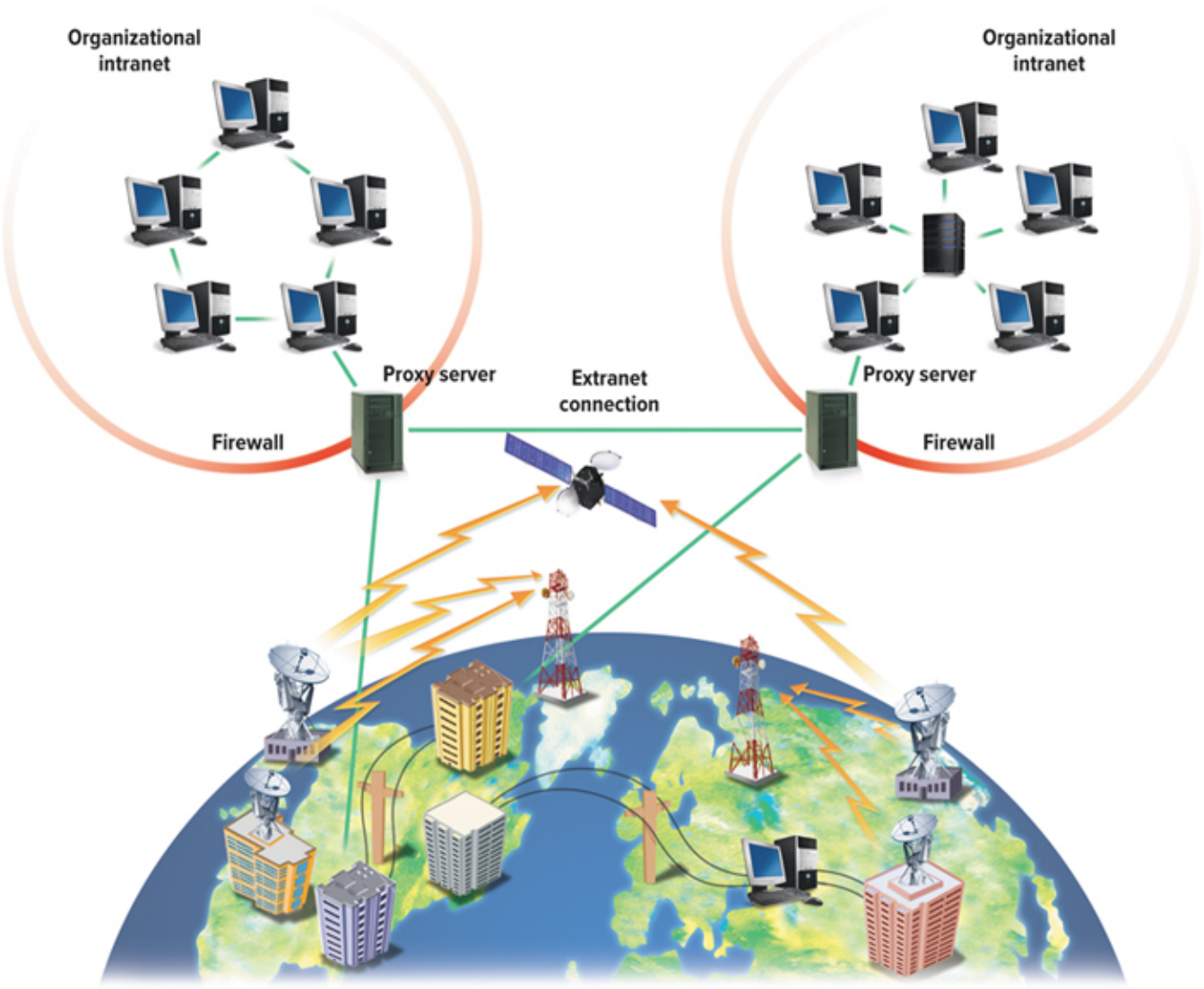
- Intranet
  - Private network within an organization
  - Works like the Internet
- Extranet
  - Private network that connects more than one organization
  - Works like the Internet, but provides suppliers and other trusted partners with limited access to the organization's networks

Network Security

Commonly used technologies to ensure network security

- Firewall
  - Hardware and software that controls access to network
  - Proxy server provides pass-through access
  - Protects against external threats
- Intrusion detection system (IDS)
  - Works with firewall to protect organization's network
  - Analyzes all incoming and outgoing network traffic
- Virtual private network (VPN)
  - Creates a secure private network connection between your computer and the organization

Network Security Graphic



Careers in IT

Network Administrator

- Manages a company's LAN and WAN networks
- Maintains networking hardware and software, diagnosing and repairing problems that arise
- Candidates usually have a bachelor's or associate's degree in computer science, computer technology or information systems
- Practical networking experience
- Annual salary is typically between $43,000 and $84,000

A Look to the Future

Telepresence

- Seeks to create the illusion that you are actually at a remote location
- Early implementations mainly focus on an extension of video-conferencing

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Open Ended Questions

1. Define communications including connectivity, the wireless revolution, and communication systems.
2. Discuss communication channels, including physical connections and wireless connections.
3. Discuss connection devices including modems (DSL, cable, and wireless modems) and connection services (DSL, ADSL, cable, satellite, and cellular connection services).
4. Discuss data transmission including bandwidths (voiceband, medium band, broadband, and baseband) as well as protocols (IP addresses, domain name servers, and packetization).
5. Discuss networks by identifying and defining specialized terms that describe computer networks.
6. Discuss network types including local area, home, wireless, personal, metropolitan, and wide area networks.
7. Define network architecture including topologies (bus, ring, star, tree, and mesh) and strategies (client/server and peer-to-peer).
8. Discuss organization networks including Internet technologies (intranets and extranets) and network security (firewalls, proxy servers, intrusion detection systems, and virtual private networks).

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