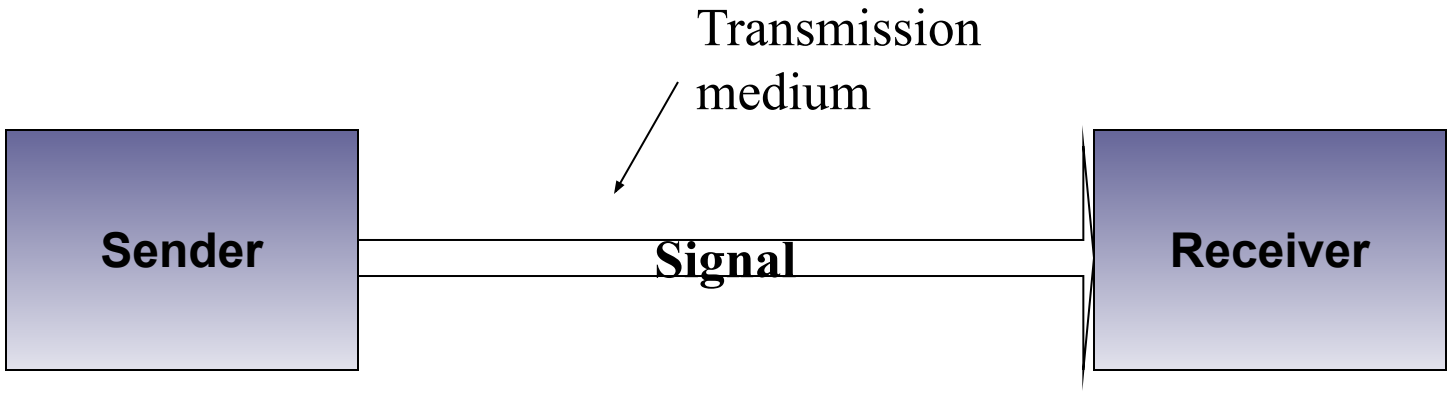
Telecommunications and Networks

Communications

- Communications
  - The message (data and information) is communicated via the signal
  - The transmission medium “carries” the signal



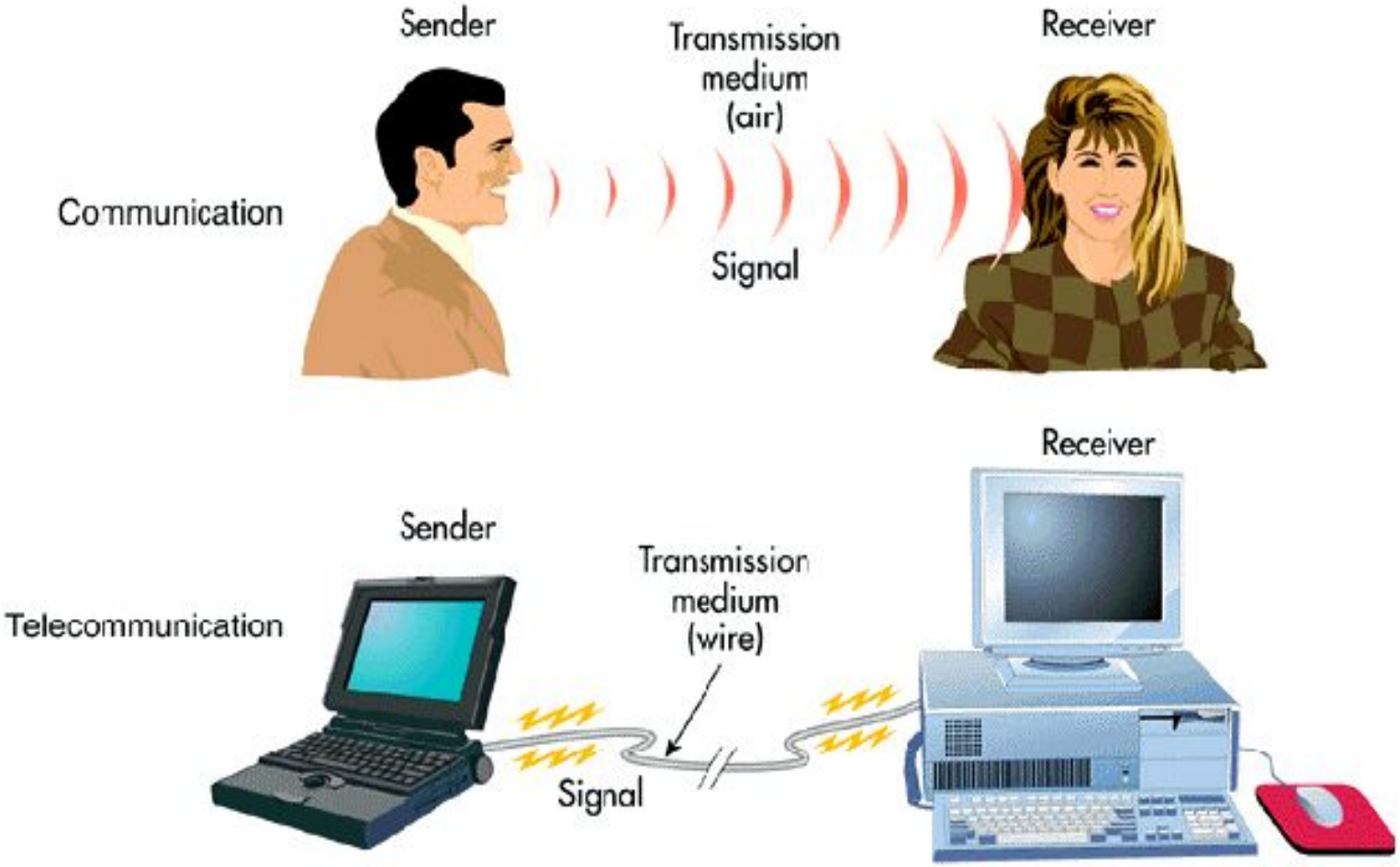
-The transmission of data from one computer to another, or from one device to another. A communications device, therefore, is any machine that assists data transmission. For example, modems, cables, and ports are all communications devices. Communications software refers to programs that make it possible to transmit data.

Telecommunications

- Telecommunications
  - The electronic transmission of signals for communications, including such means as:
    - Telephone
    - Radio
    - Television
- Telecommunication medium
  - Anything that carries an electronic signal and interfaces between a sending device and a receiving device

Communications and Telecommunications

- In human speech, the sender transmits a signal through the transmission medium of the air
- In telecommunications, the sender transmits a signal through the transmission medium of a cable


Sender
Transmission medium (air)
Receiver
Communication
Signal
Receiver
Sender
Transmission medium (wire)
Telecommunication
Signal

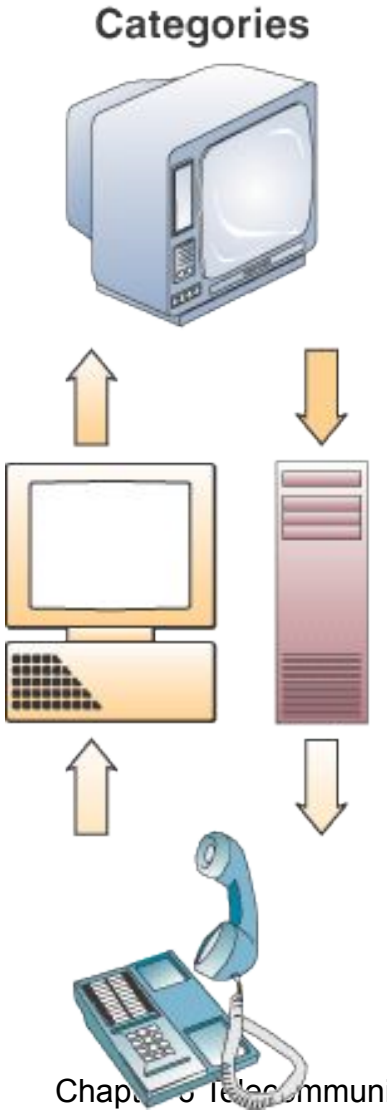
Data Communications

- Data communications
  - A specialized subset of telecommunications that refers to the electronic collection, processing, and distribution of data -- typically between computer system hardware devices

Computer Network

- Computer network…
  - The communications media, devices, and software needed to connect two or more computer systems and/or devices
  - Used to share hardware, programs, and databases across the organization

Telecommunications-Based Services



Full Service Spectrum

Categories	
Entertainment	■ Broadcast TV ■ High-definition TV ■ Enhanced pay-per-view ■ Video-on-demand ■ Interactive TV ■ Interactive video games ■ Video catalog shopping
Information Transactions	■ Distance learning ■ Multimedia services ■ Image networking ■ Transaction services ■ Internet access ■ Telecommuting ■ Videoconferencing
Communications	■ Video telephony ■ Wireless access ■ Cellular/PCS systems ■ POTS—Plain old telephone service

Internet Networking Technologies

- Internet networking technologies are being used as technology platform
  - Web browser suites
  - HTML Web page editors
  - Network management software
  - Firewalls
- Being applied in Internet, intranet, and extranet applications
- Reinforces previous move toward client/server networks based on open-systems architecture

Open Systems

- Open systems use common standards for hardware, software, applications, and networks
  - Internet networking technologies are a common standard for open systems
- Connectivity
  - Open systems provide greater connectivity and network interoperability
  - Middleware may be needed to help diverse systems work together

Digital Network Technologies

- Telecommunications are being revolutionized by switch from analog to digital
  - Analog: voice-oriented transmission
  - Digital: discrete pulse transmission
- Benefits
  - Higher transmission speeds
  - Moves larger amounts of information
  - Greater economy and much lower error rates
  - Transmits multiple types of communications (data, voice, video) on the same circuits

Telecommunications Network Components

- Terminals
  - Any input/output device that uses networks to transmit or receive data
- Telecommunications processors
  - Devices that support data transmission, reception
- Telecommunications channels
  - Media over which data are transmitted, received
- Computers
  - All sizes and types

Telecommunications Network Components

- Telecommunications control software
  - Controls telecommunications activities
  - Manages the functions of telecommunications networks
- Includes network management programs of all kinds
  - Telecommunications monitors (mainframes)
  - Network operating systems (network servers)
  - Web browsers (microcomputers)

Network Component Alternatives

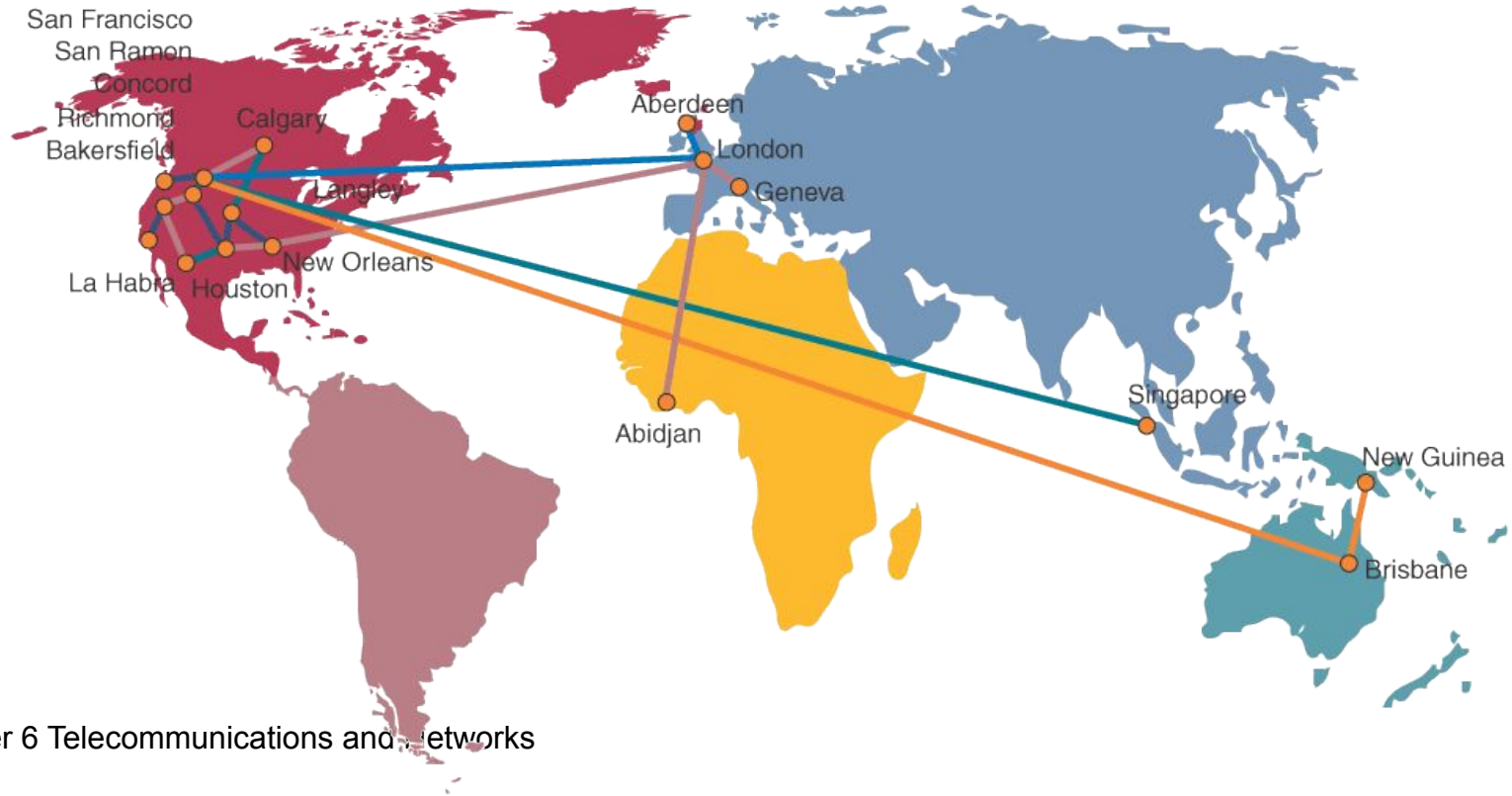
Network Alternative	Examples of Alternatives
Networks	Internet, intranet, extranet, wide area, local area, client/server, network computing, peer-to-peer
Media	Twisted-pair wire, coaxial cable, fiber optics, microwave radio, communications satellites, cellular and PCS systems, wireless mobile and LAN systems
Processors	Modems, multiplexers, switches, routers, hubs, gateways, front-end processors, private branch exchanges
Software	Network operating systems, telecommunications monitors, Web browsers, middleware
Channels	Analog/digital, switched/nonswitched, circuit/message/packet/cell switching, bandwidth alternatives
Topology/architecture	Star, ring, and bus topologies, OSI and TCP/IP architectures and protocols

Types of Communications Networks

- Primary types of communications networks
  - Wide Area
  - Local Area
  - Virtual Private
  - Client/Server
  - Peer-to-peer

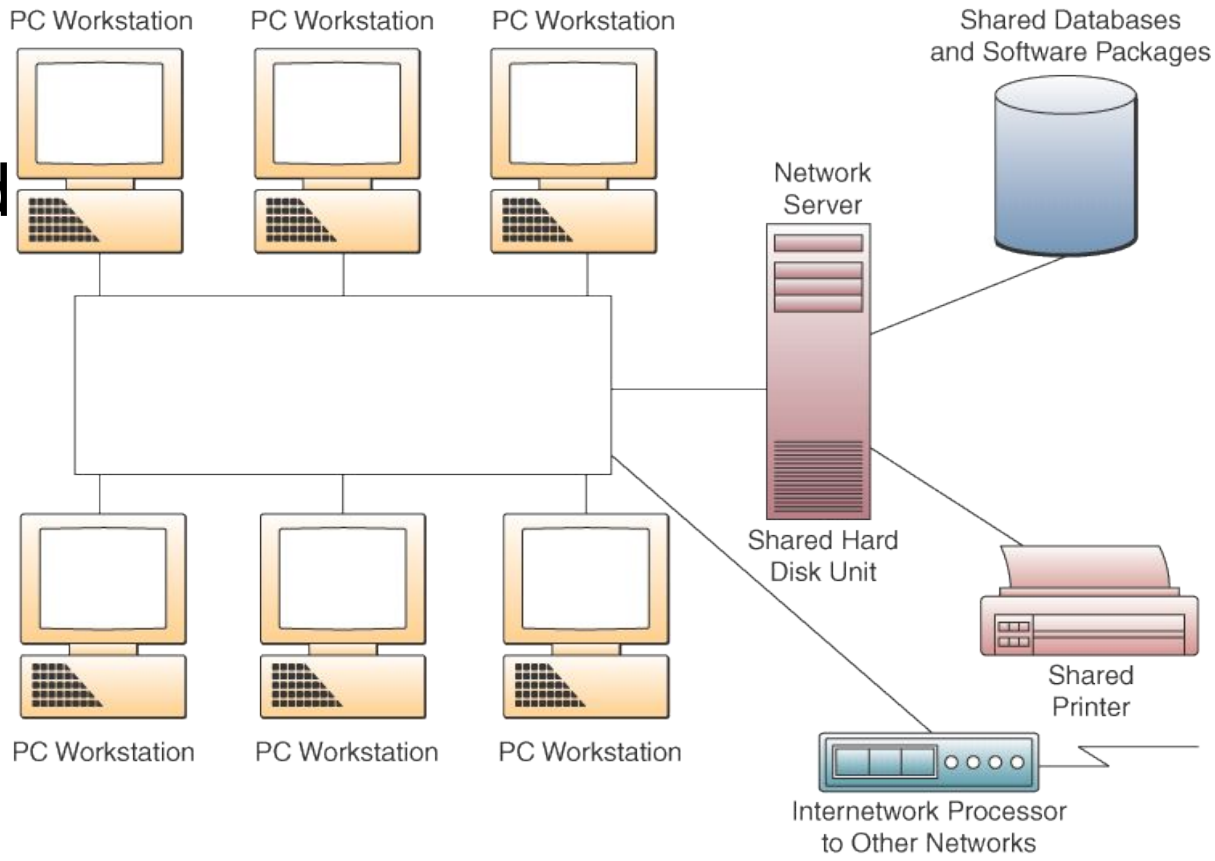
Wide Area Network (WAN)

- Telecommunication network that covers a large geographic area



Local Area Network (LAN)

- Connects computers within a limited physical area, such as an office, classroom, or building



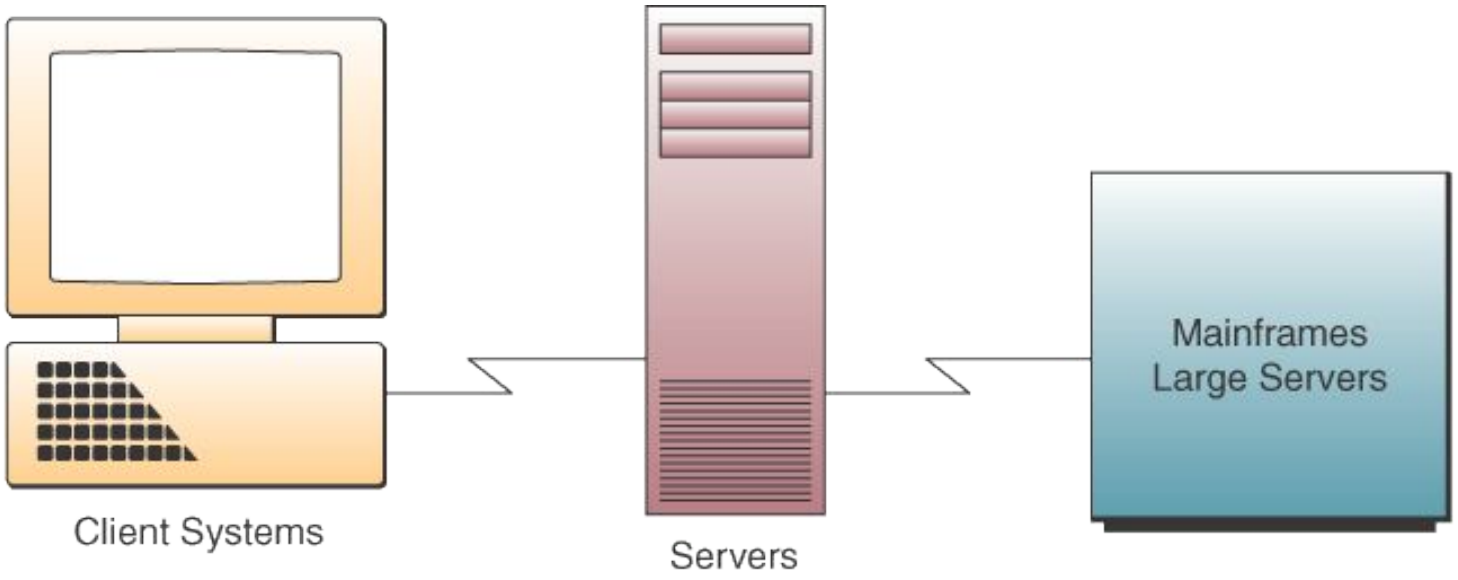
Virtual Private Networks (VPN)

- Used to establish secure intranets and extranets
  - The Internet is the main backbone network
  - Relies on network firewalls, encryption, and other security features to build a “pipe” through the Internet
  - Creates a private network without the high cost of a separate proprietary connection

Client/Server Networks

- Clients
  - End user personal computers or networked computers
- Servers
  - Used to manage the networks
- Processing
  - Shared between the clients and servers
  - Sometimes called a two-tier architecture
- Larger computer systems are being replaced with multiple client/server networks

Client/Server Network



- Functions: Provide user interface, perform some/most processing on an application.
- Functions: Shared computation, application control, distributed databases.
- Functions: Central database control, security, directory management, heavy-duty processing.

Peer-to-Peer Networks

- Central Server Architecture
  - P2P file-sharing software connects all PCs to a central server
  - When a PC requests a file, the server searches all active peers on the network
  - The server sends the requesting PC a list of links to all active peers who have the file
  - Clicking a link connects the two PCs and automatically transfers the file to the requesting PC

Telecommunications Media

- Twisted-Pair Wire
  - Ordinary telephone wire
  - Copper wire is twisted into pairs
- Coaxial Cable
  - Sturdy copper or aluminum wire wrapped with spacers to insulate and protect it
- Fiber-Optic Cable
  - One or more hair-thin filaments of glass fiber wrapped in a protective jacket

Telecommunications Processors

- Modems
  - The most common type of communications processor
  - Converts a digital signal to an analog frequency that can be transmitted over phone lines, then back into a digital signal

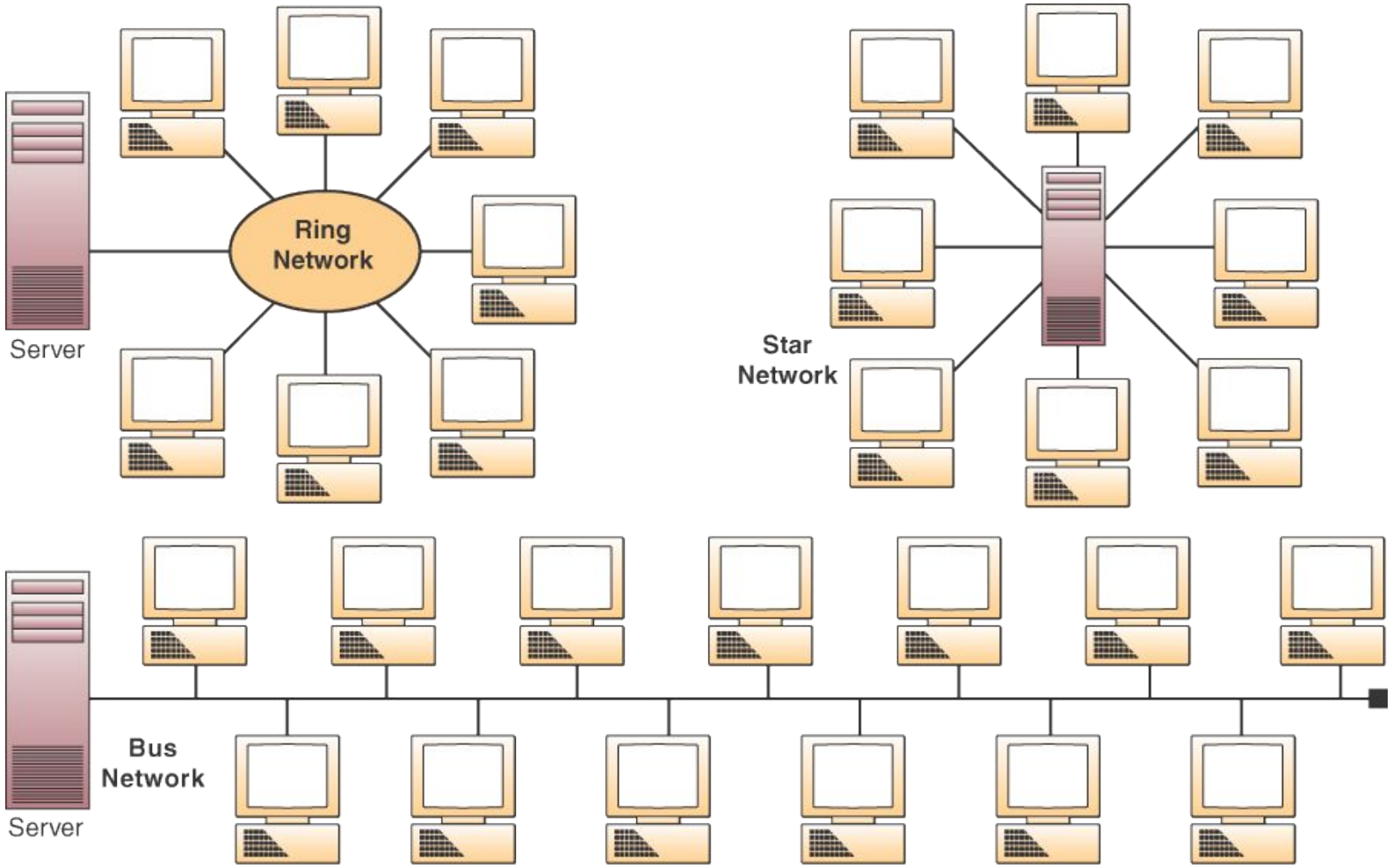
Inter-Network Processors

- **Switch**… makes connections between telecommunications circuits in a network
- **Router**… intelligent communications processor that interconnects networks based on different protocols
- **Hub**… a port-switching communications processor
- **Gateway**… connects networks with different communications architectures

Network Topologies

- Topology - The structure of a network
- Star Network - Ties end user computers to a central computer
- Ring Network - Ties local computer processors together in a ring on a relatively equal basis
- Bus Network - Local processors share the same communications channel
- Mesh Network - Uses direct communications lines to connect some or all of the computers in the ring to each other
- Switch - A message-switching computer that handles data communication between autonomous local computers

Network Topologies



OSI and TCP/IP Models

- Open Systems Interconnection (OSI) Model
  - A seven-layer model that serves as a standard model for network architectures
  - Model for how messages should be transmitted between two points in a network
  - Each layer adds functions
- Transmission Control Protocol/Internet Protocol (TCP/IP)
  - A five-layer telecommunications protocol used by the Internet