Computer Networks

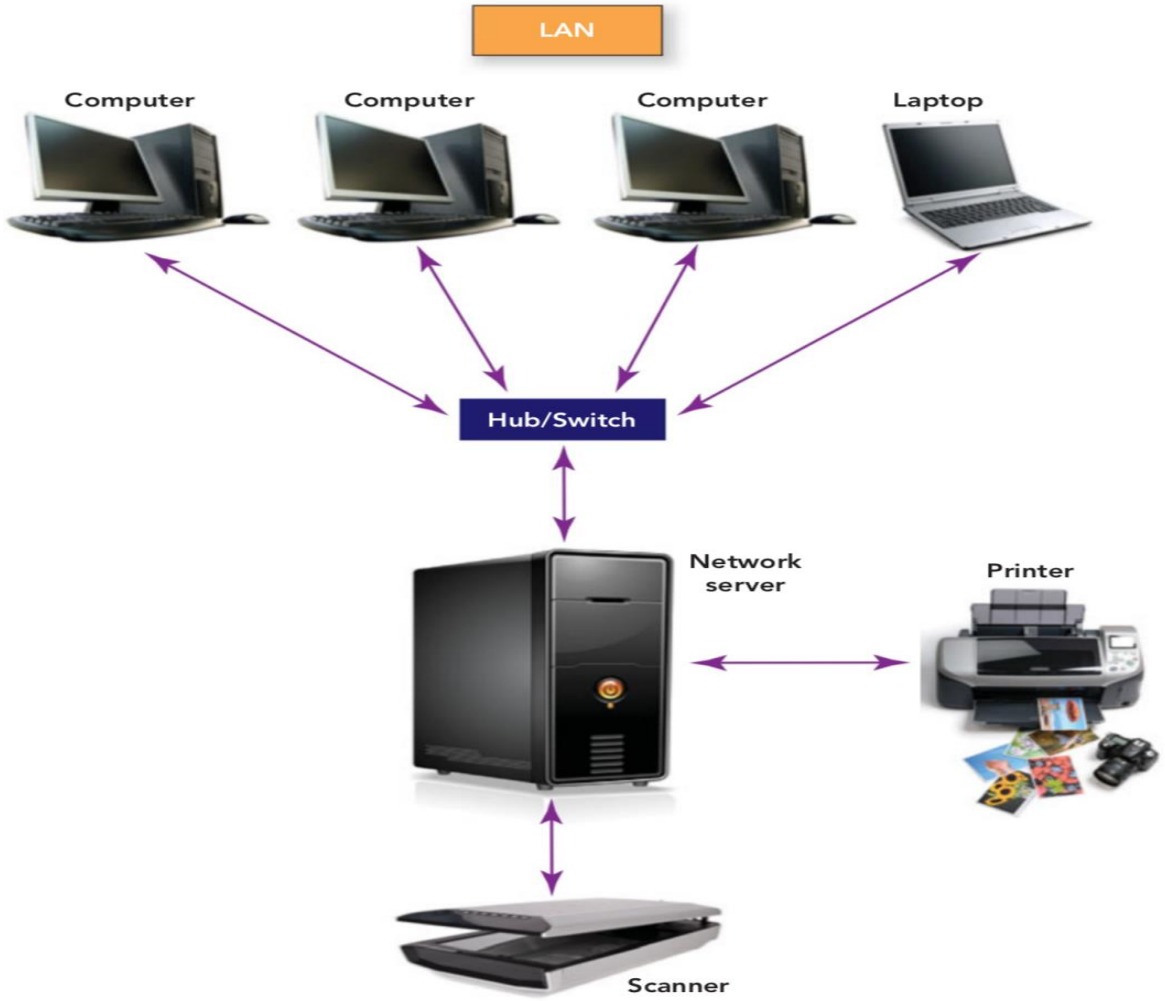
A computer network

a group of two or more computer systems linked together to exchange data and share resources, including expensive peripherals such as high-performance laser printers

Through the use of networked computers, people and businesses are able to communicate and collaborate in ways that were not possible before.

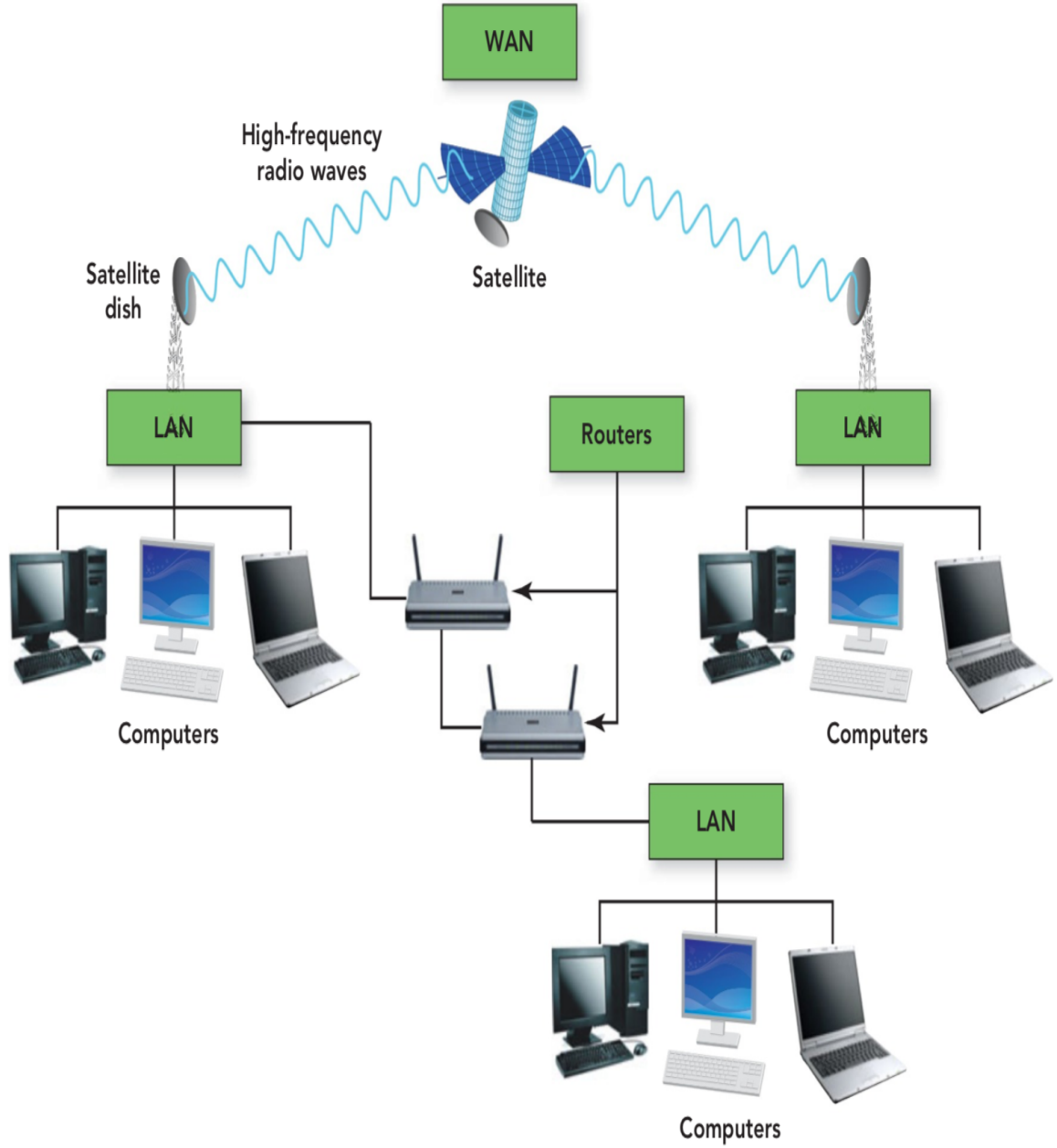
LAN, WAN, MAN, CAN and PAN

- **local area network (LAN)**
  - uses cables, radio waves, or infrared signals
  - links computers or peripherals, such as printers, within a small geographic area, such as a building or a group of buildings.
  - owned and managed by a single person or organization



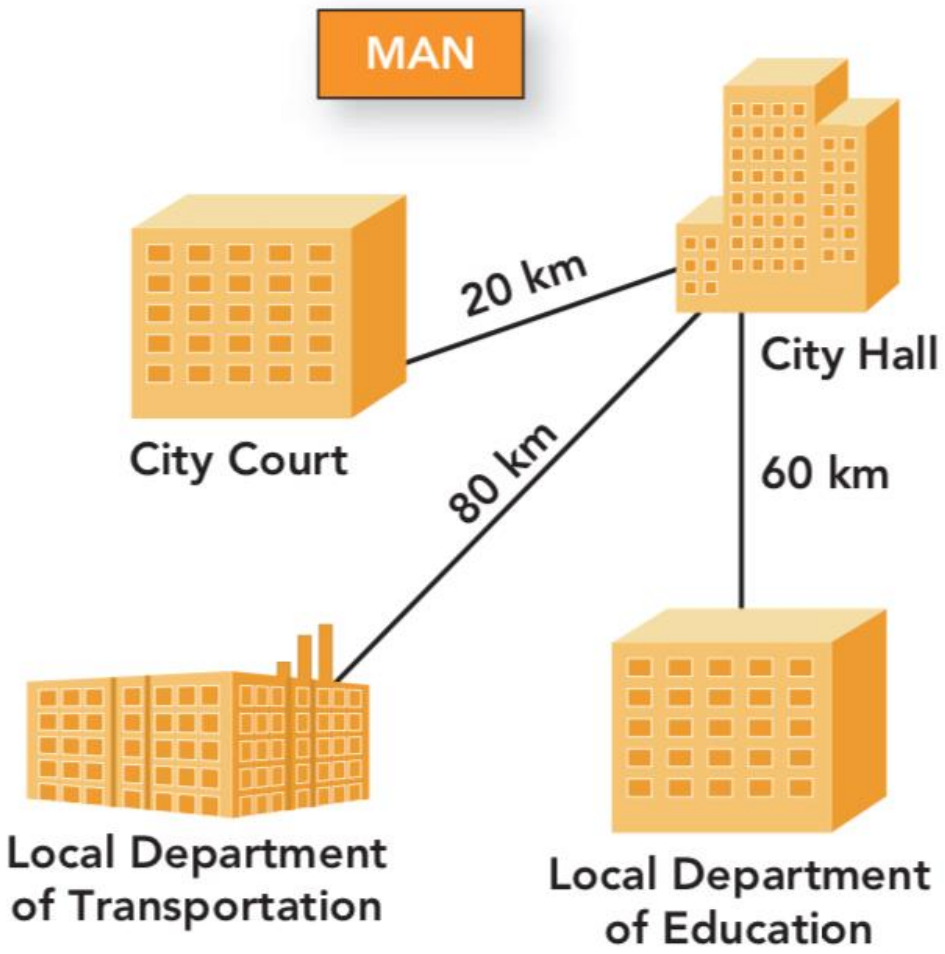
- **Wide area network (WAN)**

- uses long-distance transmission media to link computers separated by a few miles or even thousands of miles
- a geographically dispersed collection of LANs
- Internet is the largest WAN; it connects millions of LANs all over the globe. Unlike a LAN, a WAN is not owned by a single organization. Instead, it has a collective ownership or management, like the Internet



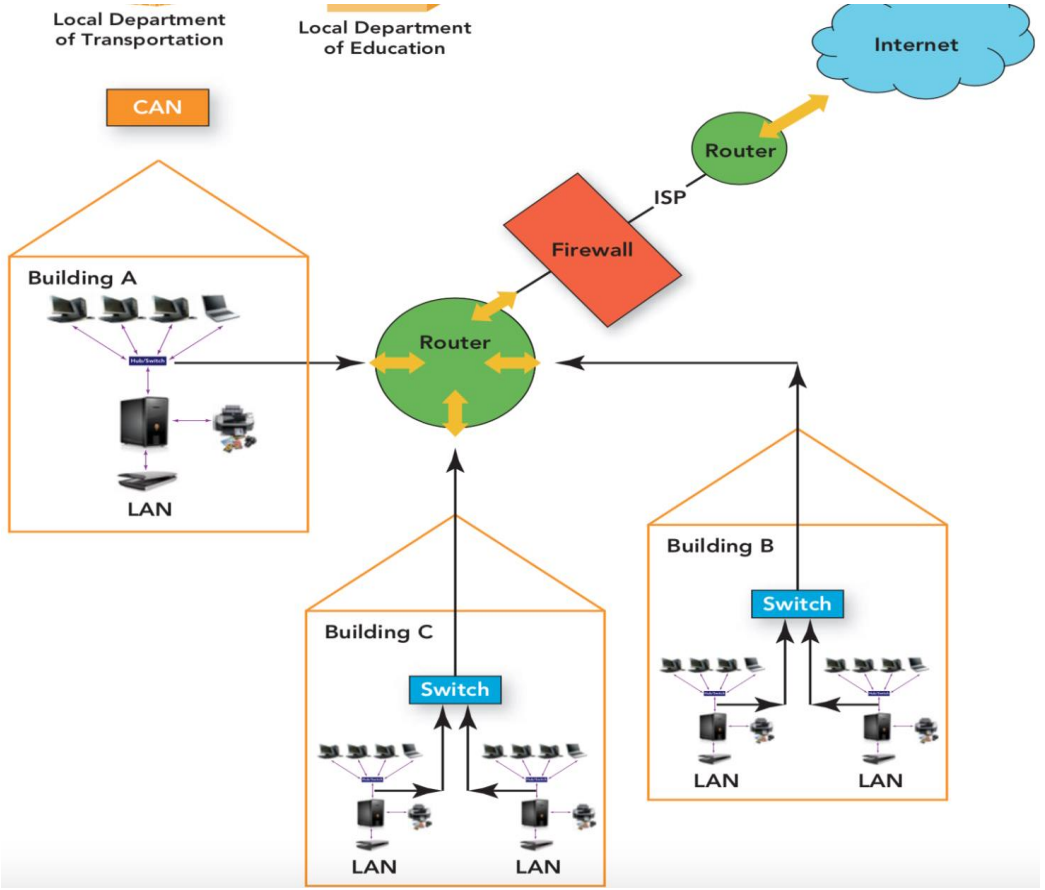
- **metropolitan area network (MAN)**

- a network designed for a city or town.
- larger than a LAN but smaller than a WAN
- owned by a single government or organization
- example : a network used to connect firehouses across a region or county and the network that supports a site which informs travelers of statewide traffic conditions



- **campus area net- work (CAN)**

- includes several LANs that are housed in various locations on a college or business campus
- smaller than a WAN
- CANs use devices such as switches, hubs, and routers to interconnect



- **personal area network (PAN)**

- a network created among an individual's own personal devices, usually within a range of 32 feet
- involve wireless technology

Advantages and Disadvantages of Networking

advantages

- **Reduced hardware costs:** Networks reduce costs because users can share expensive equipment. For example, dozens of users on a network can share a high-capacity printer, storage devices, and a common connection to the Internet.
- **Application sharing:** Networks enable users to share software. Network versions of applications installed on a file server can be used by more than one user at a time
- **Sharing information resources:** Organizations can use networks to create common pools of data that employees can access.
- **Centralized data management:** Data stored on a network can be accessed by multiple users
- **Connecting people:** Networks create powerful new ways for people to work together. For example, workers can use groupware applications to create a shared calendar for scheduling purposes.

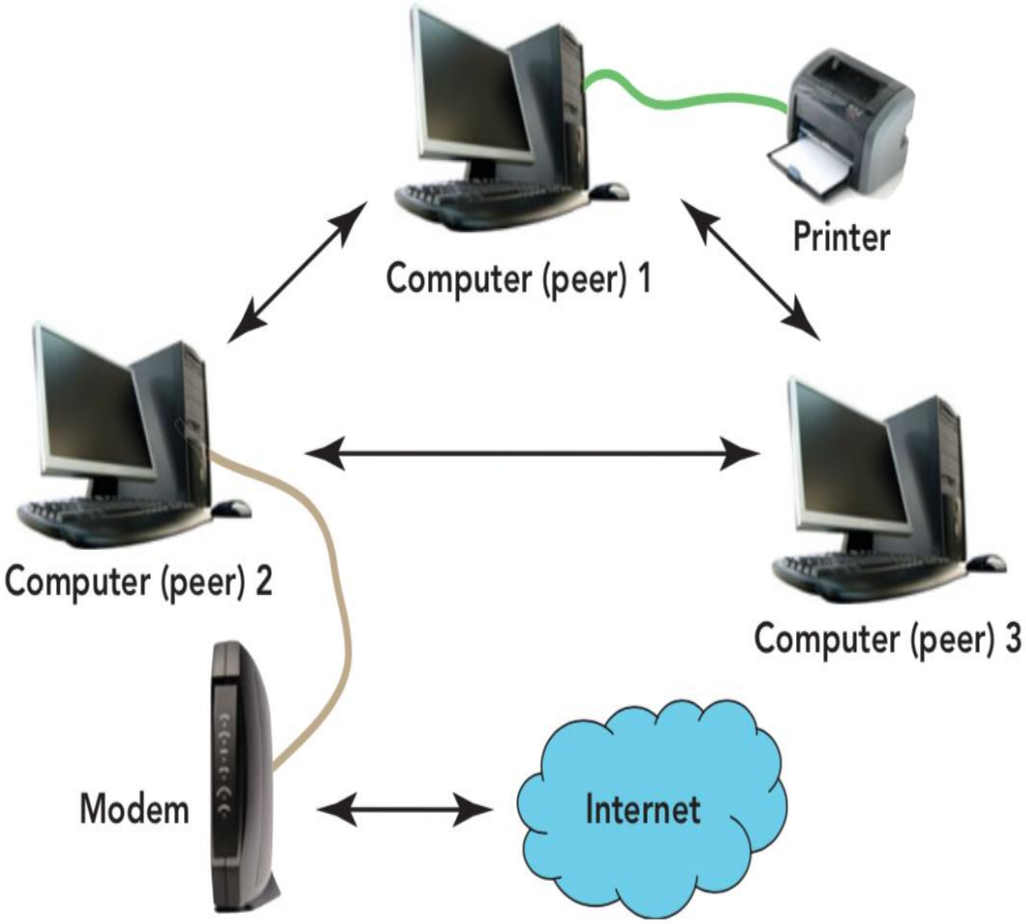
disadvantages

• **Loss of autonomy.** When you become a part of a network, you become a part of a community of users, this means that you have to give up personal freedoms
• **Lack of privacy.** Network member- ship can threaten your privacy. Net- work administrators can access your files and may monitor your network and Internet activities.
• **Security threats.** Because some personal and corporate information is inevitably stored on network
servers, it is possible that others may gain unauthorized access to files,
user names, and passwords.
• **Loss of productivity.** Access to resources is sometimes unavailable because of viruses and hackings

peer to peer, client/server and private local area network

peer-to-peer (P2P) network

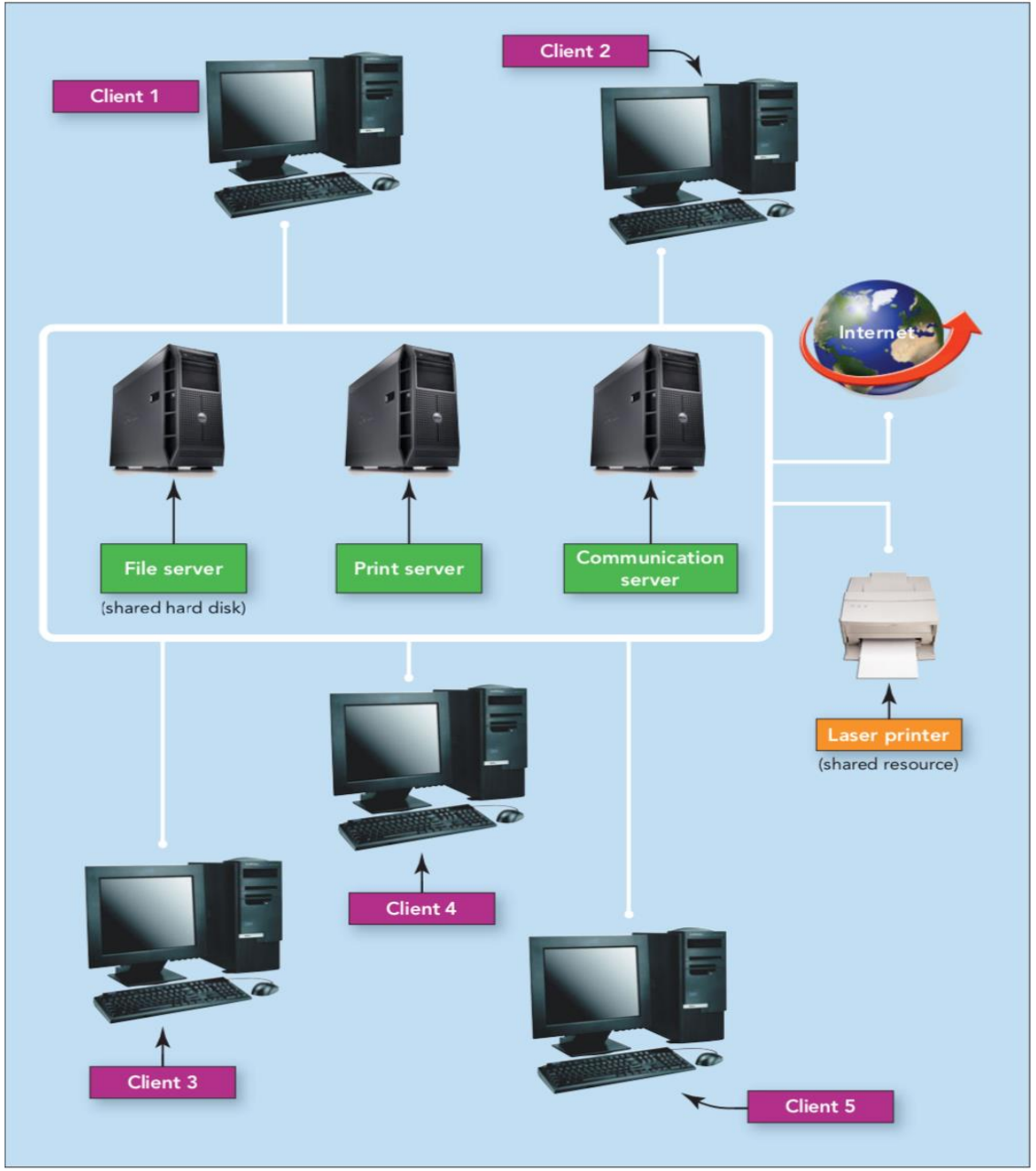
- all of the computers on the network are equals, or peers
- on a P2P network there's no file server, but each computer user decides which files will be accessible to other users on the network
- Users can also choose to share entire directories, entire disks, and even peripherals, such as printers and scanners.
- Easy to set up (non-experts set it up, to share an expensive laser printer for example)
- used for home networks or small businesses.



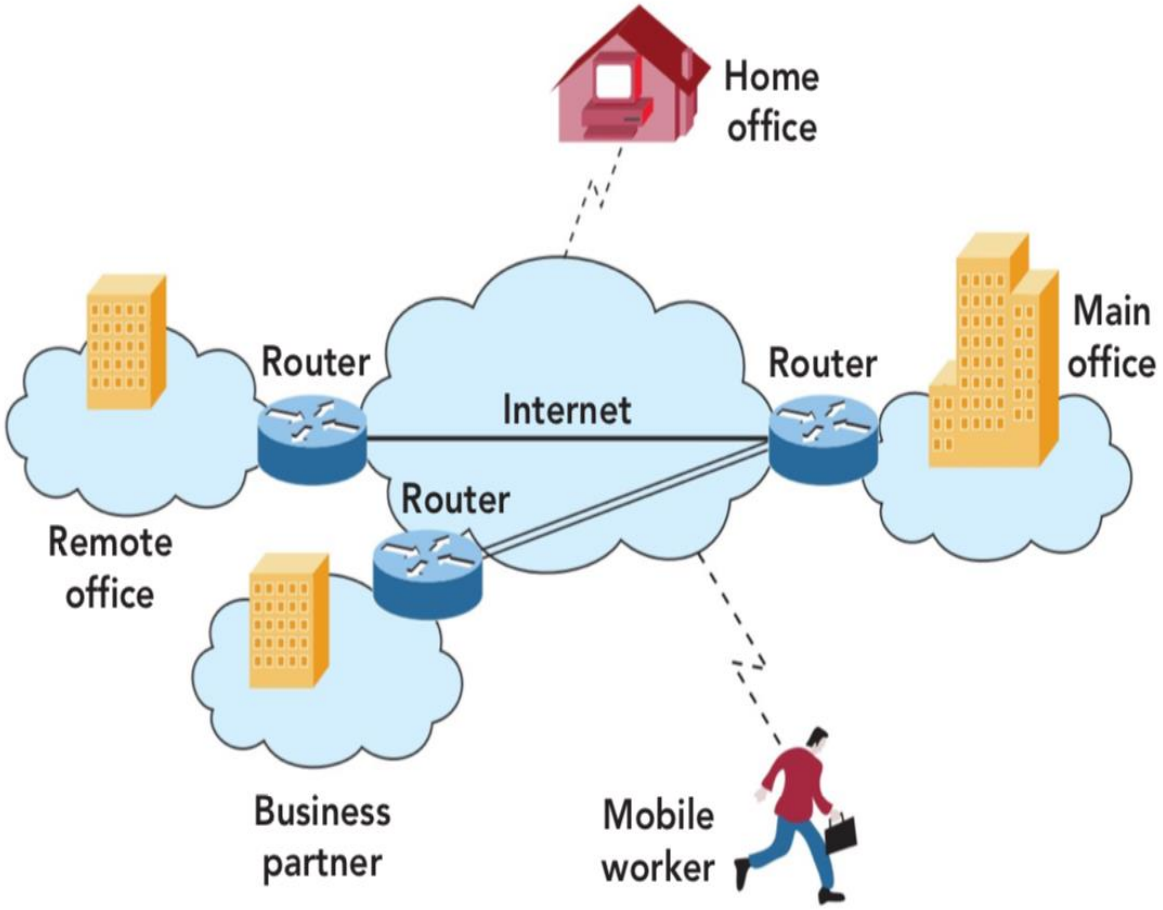
Peer-to- peer networks have no servers. Users share resources equally.

Client/Server Networks

- includes one or more servers as well as clients
- common servers : those that provide e-mail, file storage, and database storage, and facilitate communication with other networks, including the Internet
- **client :** any type of computer that is connected to a network and contains the software that enables it to send requests to a server



A client/server network includes one or more servers as well as other nodes on the network.



In a virtual private network, local and private businesses make use of the Internet to transmit data between locations and remote mobile employees.

Virtual Private Network (VPN)

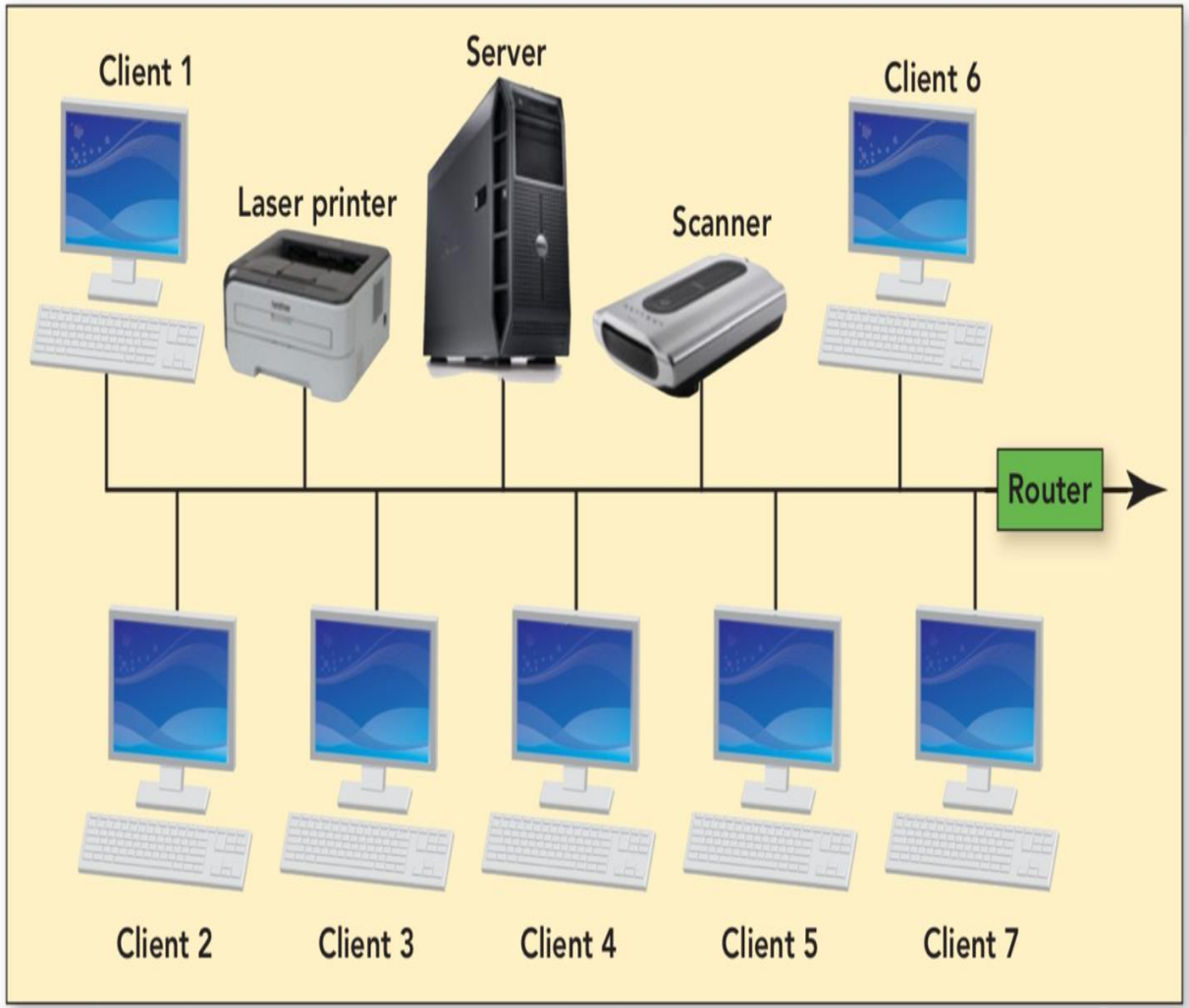
- operates as a private network over a public network, usually the Internet, making data accessible to authorized users in remote locations through the use of secure, encrypted connections and special software

The 3 LAN topologies

- a topology provides a solution to the problem of **contention** (when 2 computers try to access the LAN at the same time

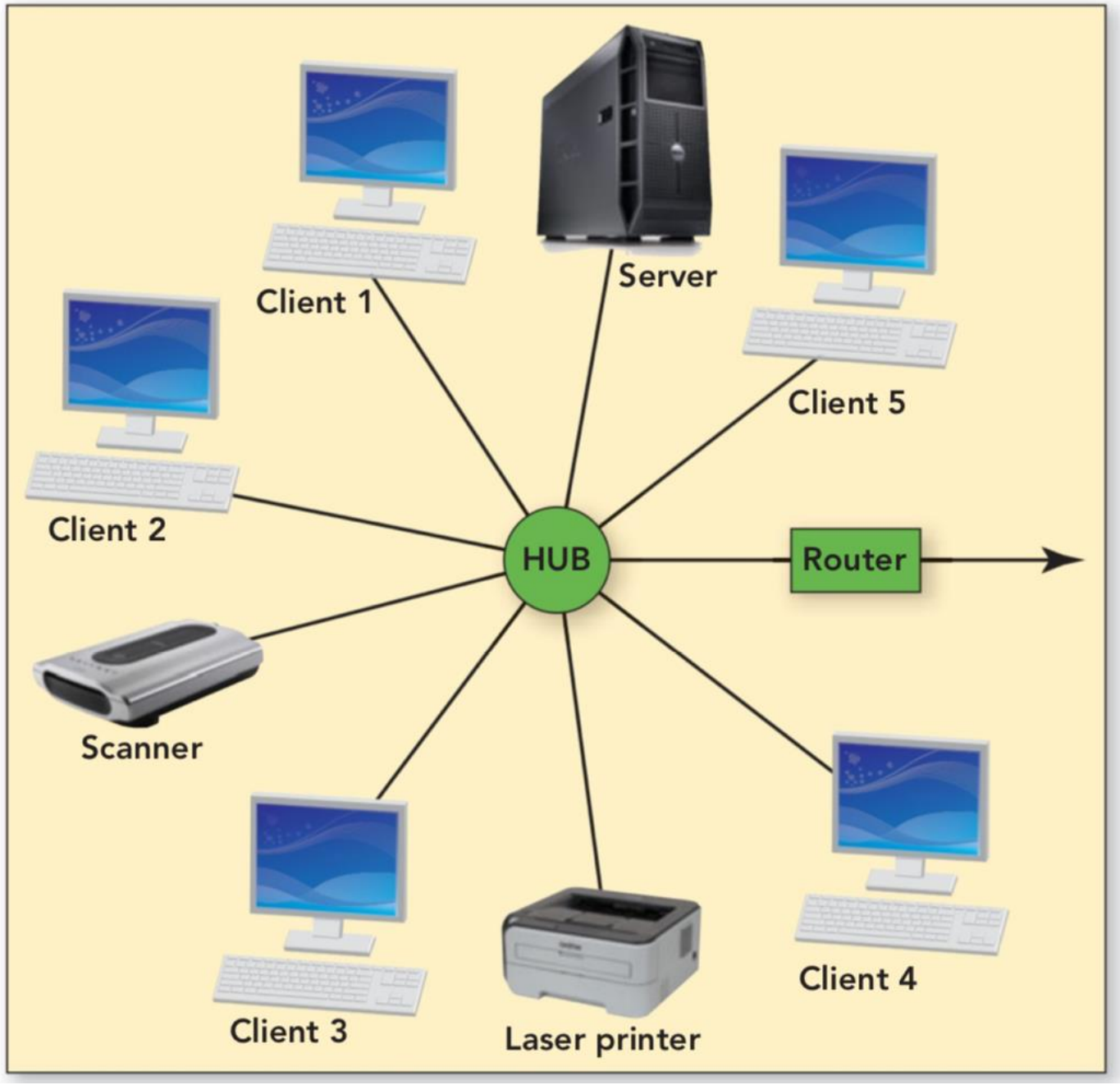
1- bus topology

- Every node (a computer/peripheral device) is attached to a common cable / pathway (the bus)
- At the end of the bus, special connectors (terminators) signify the end of the circuit
- Only one node can transmit at a time, if more than one node tries to send data at the same time, each node waits a small amount of time, and then retransmits the data
- Practical in a small environment such as a home or an office



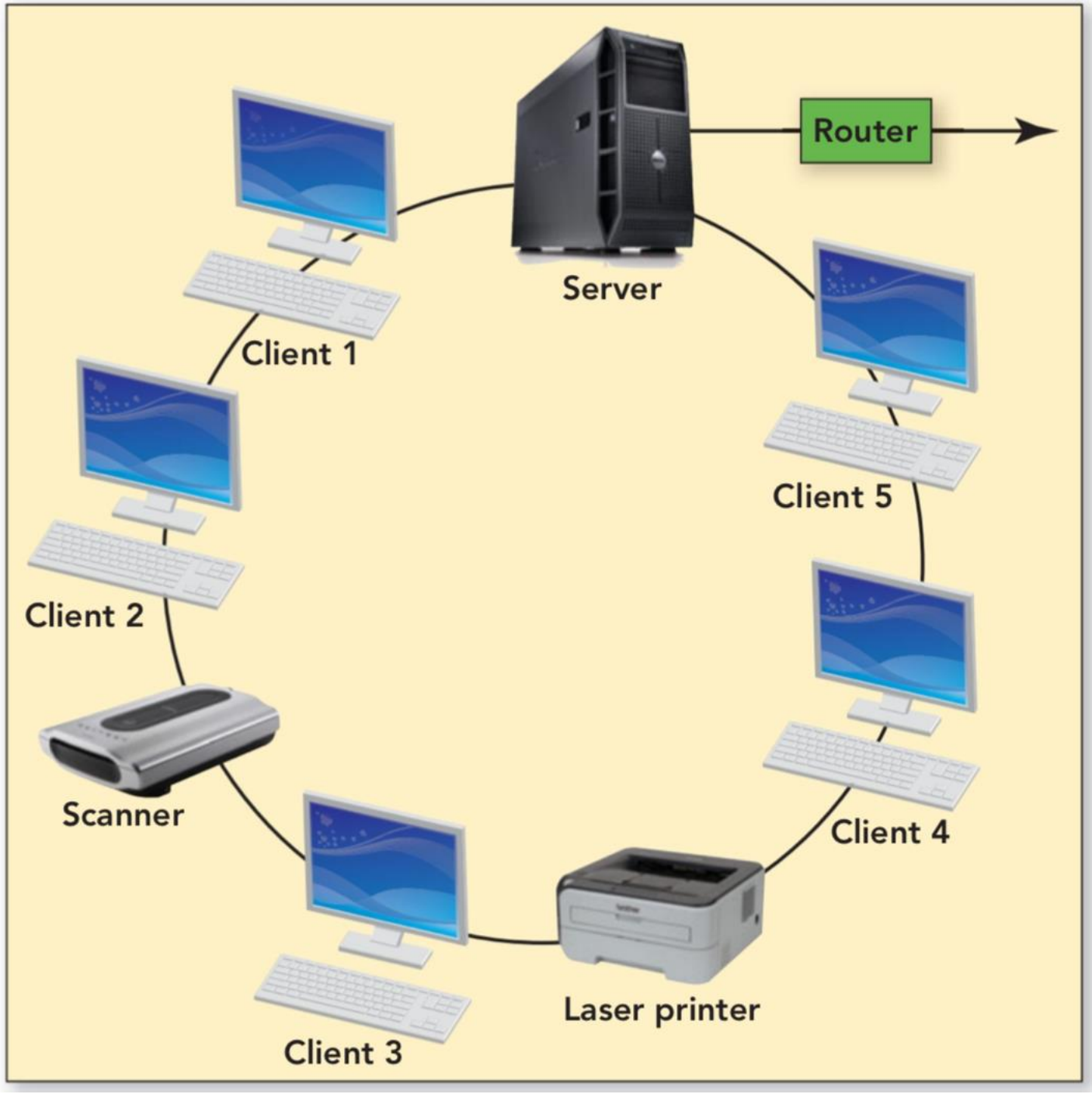
2- star topology

- Solves the expansion problems of the bus topology with a central writing device (hub, switch, computer)
- Adding users is simple: you run a cable to the hub or switch and plug the new node into a vacant connector
- Use contention management to deal with collisions
- Ideal for office buildings, computer labs, and WANs



3- ring topology

- All of the nodes are attached in a circular wiring arrangement
- Prevents collisions in a unique way: a special unit of data (a token) travels around the ring
- A node can transmit only when it possesses the token
- Ideal for use within a division of a company



The special components of LAN

1- Networking interface card (NIC) – a circuit board/card that's installed in a computer to connect it to a network

2- server – a computer designed to process requests and deliver data to other client computers over the internet

3- station – a computer that's connected with a server computer over the LAN, and communicates with other devices connected with it

4- hub – a connection point for devices in a network, used to connect segments of a LAN

5- switch – able to receive a packet and transmit it to only the destination computer

6- router – make the connection to the internet for LANs

7- access point – acts as a communication hub for users of a wireless device to connect to a wired LAN

8- power supply – a wireless network uses the current to generate radio waves and a cabled network send data interpreted as an electronic pulse

9- connector – a device that connects many LAN connections with the computer's hardware

10- shared peripheral device – any device (printer/hard disk driver/modem) that's connected to and controlled by a computer

The special components of WAN

- Point of presence (POP) – a wired or wireless WAN network connection point that enables users to access the WAN. WANs have a POP in as many towns and cities as needed to provide availabilitt to the users

- Backbones – high capacity transmission lines that carry WAN traffic. The LANs and WANs that makeup the internet are connected to the backbone.

The difference between LAN and WAN

	LAN	WAN
Covers	Local areas only (e.g., homes, offices, schools)	Large geographic areas (e.g., cities, states, nations)
Definition	LAN (Local Area Network) is a computer network covering a small geographic area, like a home, office, school, or group of buildings.	WAN (Wide Area Network) is a computer network that covers a broad area (e.g., any network whose communications links cross metropolitan, regional, or national boundaries over a long distance).
Speed	High speed (1000 mbps)	Less speed (150 mbps)
Data transfer rates	LANs have a high data transfer rate.	WANs have a lower data transfer rate compared to LANs.
Example	The network in an office building can be a LAN	The Internet is a good example of a WAN
Technology	Tend to use certain connectivity technologies, primarily Ethernet and Token Ring	WANs tend to use technologies like MPLS, ATM, Frame Relay and X.25 for connectivity over longer distances
Connection	One LAN can be connected to other LANs over any distance via telephone lines and radio waves.	Computers connected to a wide-area network are often connected through public networks, such as the telephone system. They can also be connected through leased lines or satellites.
Components	Layer 2 devices like switches and bridges. Layer 1 devices like hubs and repeaters.	Layers 3 devices Routers, Multi-layer Switches and Technology specific devices like ATM or Frame-relay Switches etc.

Circuit switching and packet switching

• Circuit switching

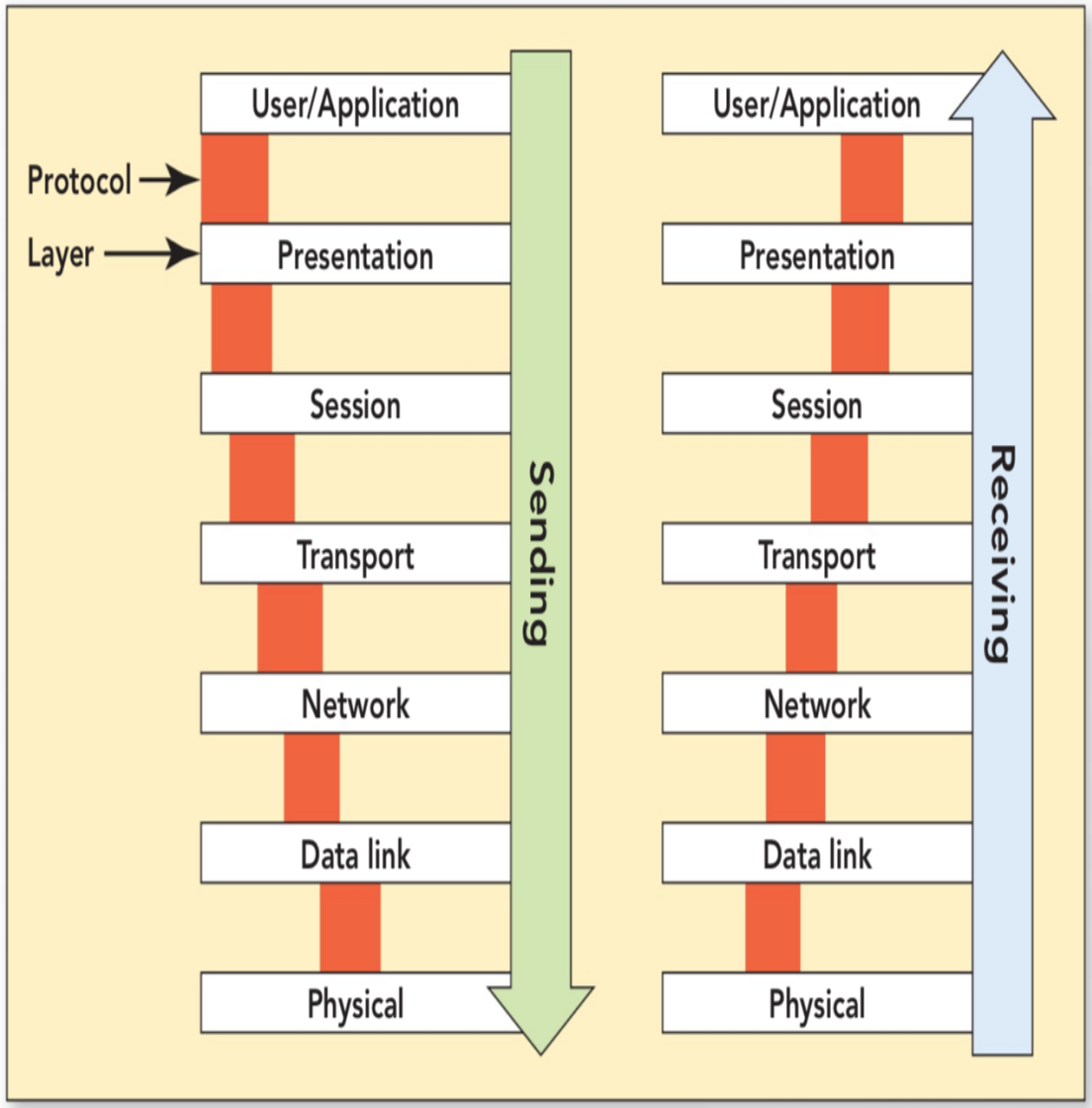
- there's a direct connection between the communication devices
- Data is sent over a physical end to end circuit between the sending and receiving computers
- Used in the public switched telephone system
- Strengths : High speed electronic switching maintain the connection, so it works best when avoiding delivery delay is essential
- Weaknesses : more expensive

• Packet switching

- The sending computer's outgoing message is divided into 2 papackets
- Each packet is numbered & addressed to the destination computer
- The packets travel to a router which examines each packet it detects
- After reading the packet's address, the router consults a table of pathways that the packets can take to get to its destination
- Strengths : more efficient, less expensive, more reliable (can function even if portions of the network arent working)
- Weaknesses: in a huge packet switching network (internet) a packet may be examined by many routers → latency (delay), so it's not ideal for real time delivery

Network protocols

- standards or rules that enable network-connected devices to communicate with each other.
- may be implemented by hardware, software, or a combination of the two.
- fixed, formalized exchanges that specify how two dissimilar network components can establish a communication.
- for example: To establish communications, modems must conform to standards called **modulation protocols**, which ensure that your modem can communicate with another modem
- A network may use dozens of protocols.
- Protocol suite: specifies how the network functions
- Because they're com- plex systems, networks use a network architecture that is divided into separate **network layers**. Each network layer has a function that can be treated separately from other layers



a networking framework for implementing protocols in seven layers.

The difference between wired and wireless LAN

Key	LAN	WLAN
Stands for	LAN stands for Local Area Network.	WLAN stands for Wireless Local Area Network.
Connection Type	LAN connections includes wired as well as wireless connection technologies.	WLAN connections are completely wireless technology based.
Coverage	LAN covers a large area like building.	WLAN slso covers a large regions like building, office etc.
Cost	LAN connections are less expensive, more secure that wireless connections of WLAN.	WLAN connections are more expensive and considered less secure than wired connections.
Complexity	Installation of LAN is relatively cheaper but complex to install. It requires Routers, switches to connect wires.	Installation of WLAN is costly but simple. Routers, switches are not needed to connect wires.
Performance	LAN provides good performance and impact of weather is limited.	WLAN provides high performance but may get impacted in bad weather.
Mobility	LAN has limited mobility. LAN needs ethernet to connect devices.	WLAN is highly mobile in nature. No ethernet is required to connect devices to WLAN.
Interruption	LAN connections can not be interrupted easily.	WLAN connections can be interrupted easily.
Examples	Desktop, laptops connected to LAN in an office.	Desktop, laptops connected on Wifi or hotspot based networks.

Wired and wireless protocols