

Chapter 3

Types of Networks and Topologies

Outline

➤ Network Types

- LAN, MAN, WAN
- Centralized and decentralized Networks
- Peer to peer versus Server based Networks

➤ Network Topologies

- Physical Topology
- Logical Topology

Classification of Networks

Network can be classified:

- Based on Geographical Location (coverage of the network).
 - LAN- Local Area Network
 - MAN- Metropolitan Area Network
 - WAN- Wide Area Network
- Based on Centralized Network
 - Dump terminal
 - Intelligent terminal
- Based on the Role of computers
 - Peer-to-peer (P2P) network
 - Client/Server network
- Based on Network Topology
 - Logical Topology
 - Physical Topology

Based on Geographical Location

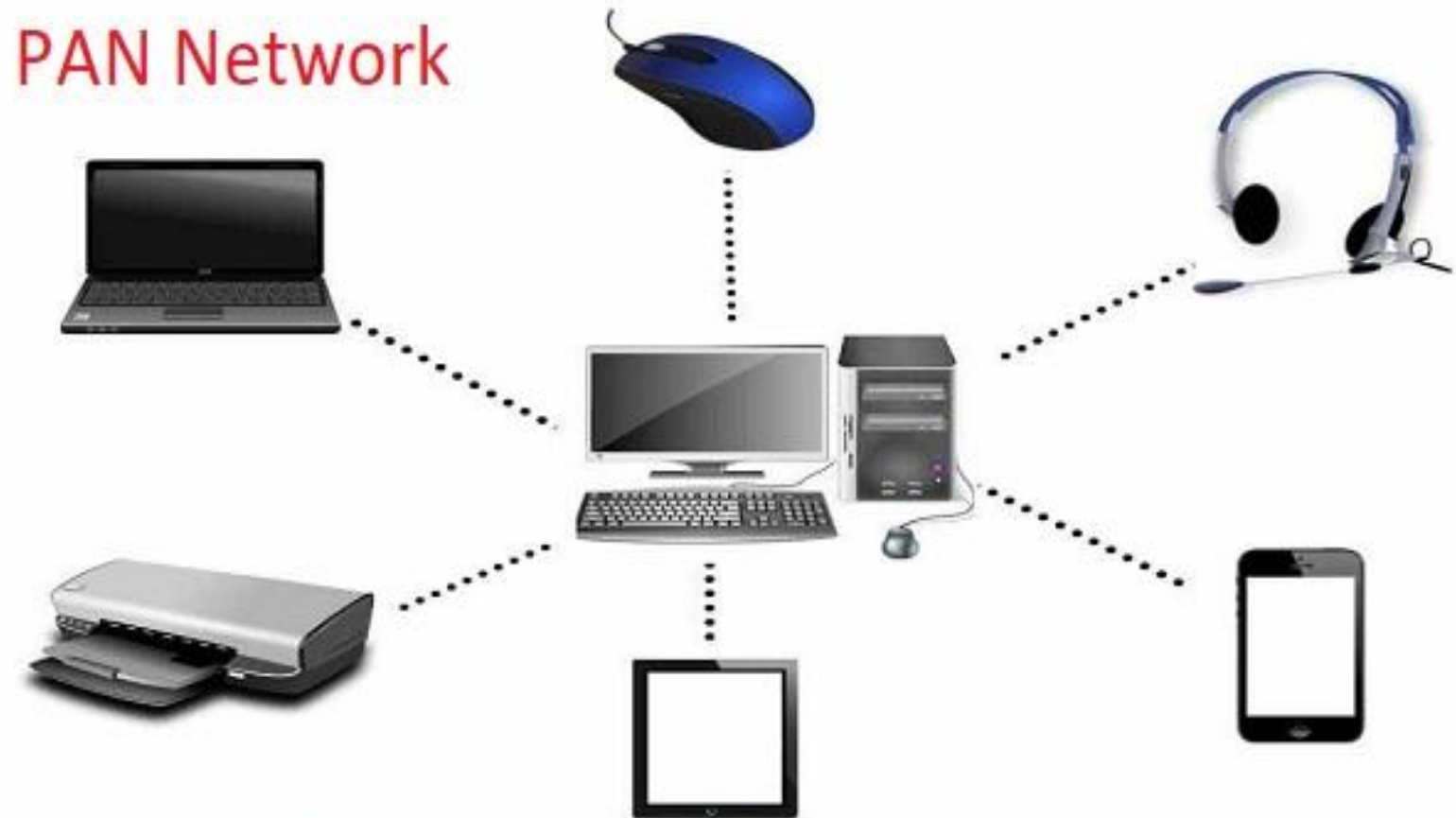
Based on geographical location, Networks can be classified:

- PAN: Personal Area Network
- LAN: Local Area Network.
- MAN: Metropolitan Area Network
- WAN: Wide Area Network.
- CAN: Campus Area Network
- SAN: Storage Area Network
- VPN: Virtual Private Network

PAN – Personal Area Networks

- PAN is a computer network for interconnecting electronic devices within an individual person's workspace.
- A PAN provides data transmission among devices such as computers, smartphones, tablets and personal digital assistants,
- PANs can be wired, such as USB or FireWire, or they can be wireless, such as infrared, ZigBee, Bluetooth and ultrawideband, or UWB.
- The range of a PAN typically is a few meters. (10m)

PAN – Personal Area Networks



LAN - Local Area Networks

- LAN refers to networks that have small geographical coverage usually within a building or a campus.
- LANs are found in most organizations, businesses, government offices, educational institutions.
- A LAN is very useful for sharing resources, such as data storage and printers.

LAN- Local Area Networks

- LANs can be built with relatively inexpensive hardware, such as hubs, network adapters and Ethernet cables.
- The smallest LAN may only use two computers, while larger LANs can accommodate thousands of computers.
- LANs are typically used for single sites where people need to share resources among themselves but not with the rest of the outside world.

LAN - Local Area Networks

- Think of an office building where everybody should be able to access files on a central server or be able to print a document to one or more central printers. Those tasks should be easy for everybody working in the same office, but you would not want somebody just walking outside to be able to send a document to the printer from their cell phone
- In addition to operating in a limited space, LANs are also typically owned, controlled, and managed by a single person or organization.

LAN devices

- The major LAN devices are:
 - Computers
 - Network Interface Card (NIC)
 - Network Cab
 - Hub/Switch
 - RJ-45



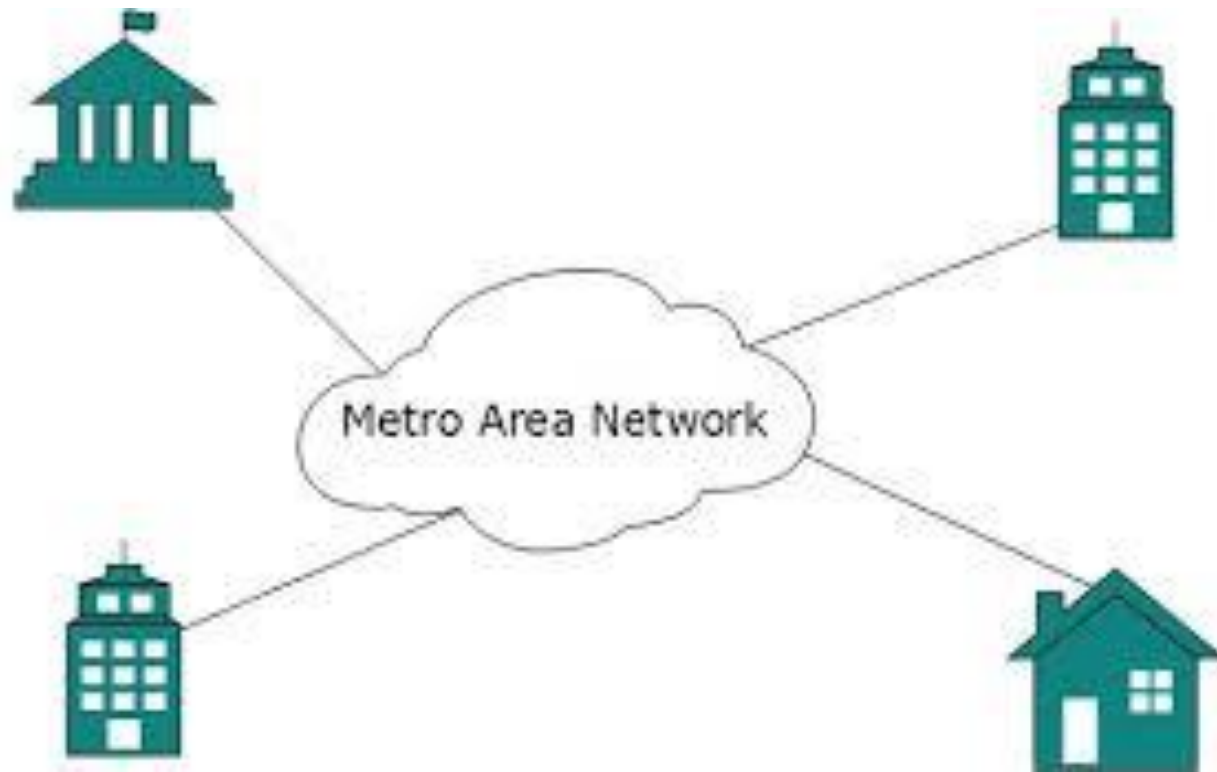
LAN



MAN- Metropolitan Area Network

- It is a network that transmits data and information over citywide distance and at a greater speed than LAN.
- It consists of a computer network across an entire city.
- A MAN is larger than a LAN, which is typically limited to a single building or site. Depending on the configuration, this type of network can cover an area from several miles to tens of miles.
- A MAN is often used to connect several LANs together to form a bigger network.

MAN

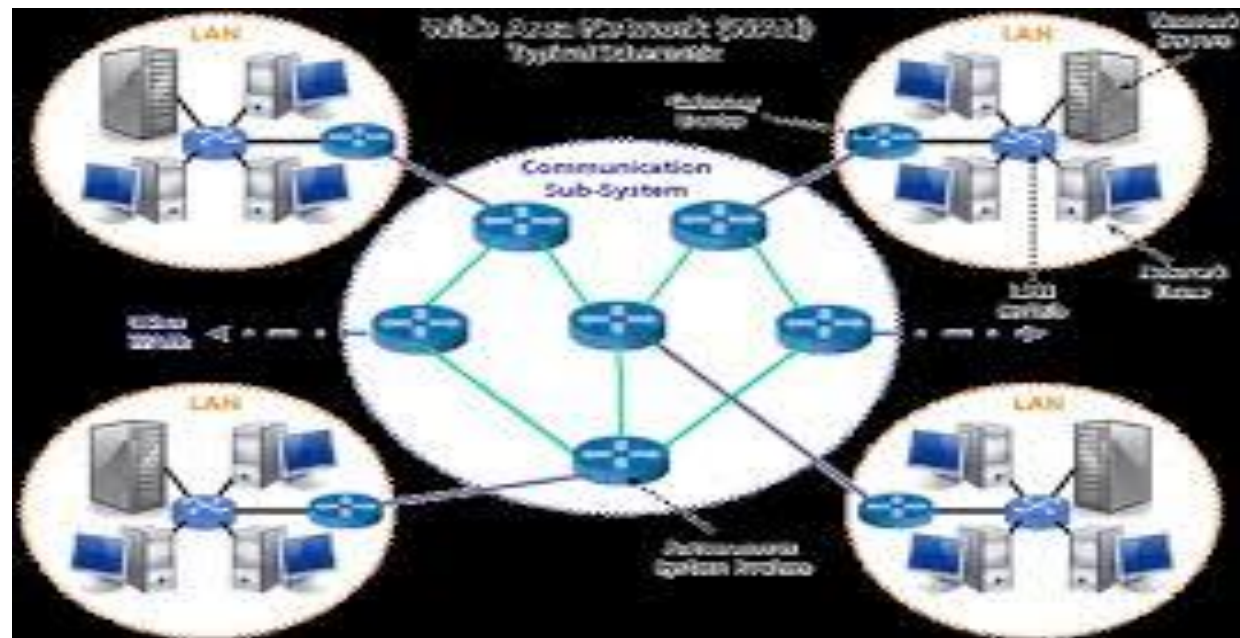


WAN - Wide Area Network

- Wide area networks are networks that cover very large geographical area such as a country or the whole world.
- WAN usually use combination of several types of communication media such as cables, satellites, microwaves, and fiber-optics.
- Because a WAN has no geographical limitations, it can connect computers and other devices in separate cities or on opposite sides of the world.
- A multinational corporation with linked computers in different countries is using a WAN.

WAN - Wide Area Network

- A WAN can contain multiple smaller networks, such as LANs or MANs.
- The Internet is the best-known example of a public WAN.



Network Classification

Based on span of control computer networks can be classified into two major grouped as either :

- **Centralized**
 - Dumb Terminals
 - Intelligent Terminals
- **Distributed Network**
 - Client/Server
 - Peer-to-Peer

Centralized Network

- Centralized network has one main CPU that processes all information requests and handles communication.
- The main CPU in a centralized network is usually a mainframe or minicomputer capable of handling the processing workload of many people simultaneously.
- People interface with the host computer by using terminals and other input and output devices.

Centralized Network

- A terminal is a hardware device consisting of a keyboard, mouse and monitor.
- There are two types of terminals:
- **Dumb terminals**- Terminals that have no storage or processing capabilities. Dumb terminals do not have any processing capabilities, they must be connected to a host computer that can perform any processing functions necessary.
- **Intelligent terminals**, on the other hand, do have limited storage and processing capabilities.

Distributed Networks

- Distributed network is a collection of workstations connected to each other, along with various shared storage and input and output devices (for example, scanners and printers).
- In a distributed network each workstation can handle some, if not all, of its own processing.
- Workstations in a distributed network also maintain local information and software.

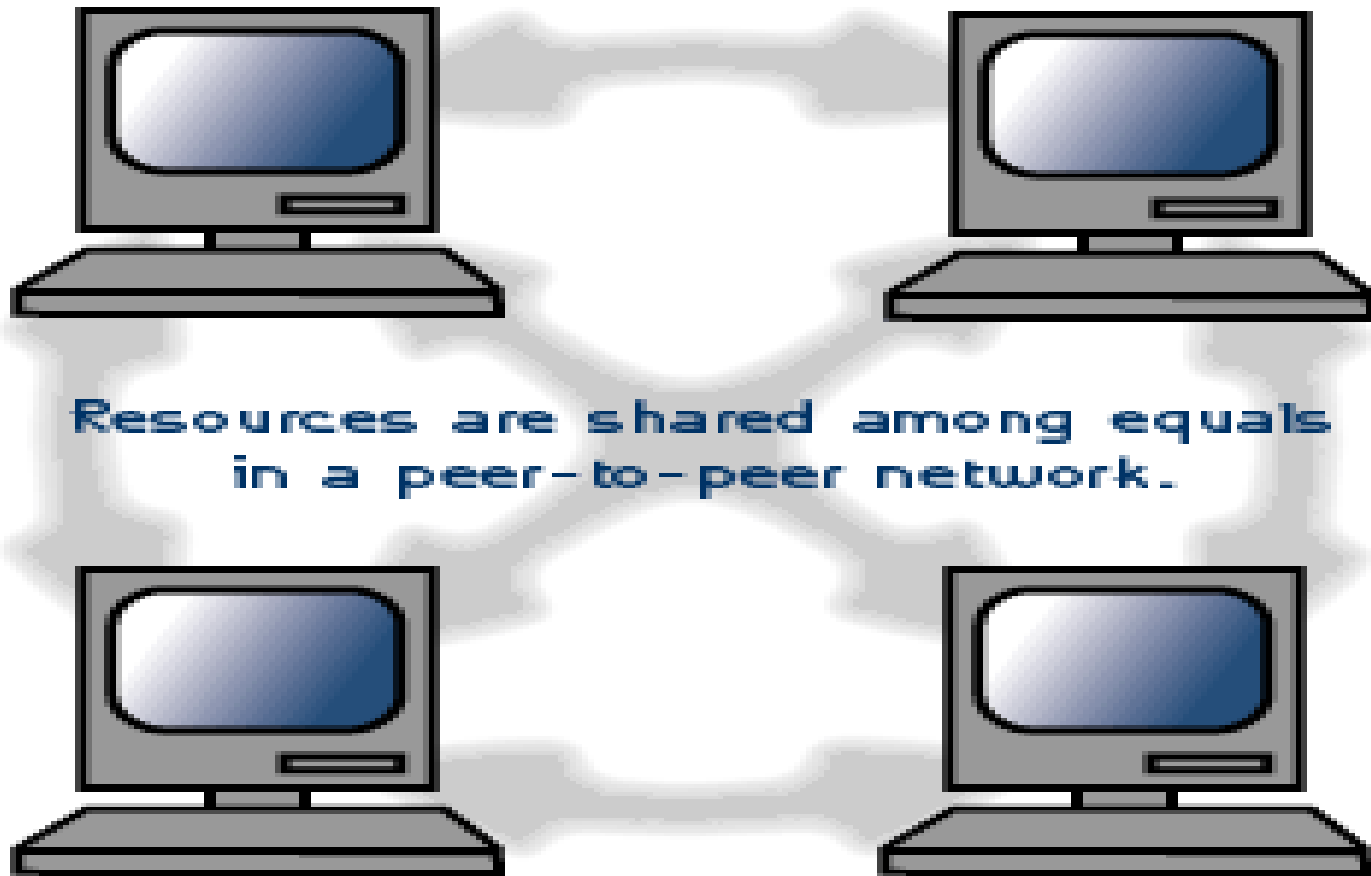
Distributed Network

- Distributed Network can be either:
 - **Client/Server network**
 - **Peer-to-Peer network**
- The type of network you choose to implement depends on:
 - Size of the organization
 - Level of security required
 - Level of administrative support available
 - Amount of network traffic
 - Network budget

Peer to Peer Network

- In a peer-to-peer network, workstations are connected to each other and do not rely on a server for global software and data, data processing tasks, or communication within the network.
- Basically, a peer-to-peer network consists of many workstations connected together that can share resources and communicate with each other.
- Each workstation can serve as a client at one time and serves as server at another time and all the computers are at the same level.

Peer to Peer Network



ADVANTAGES & DISADVANTAGES OF PEER TO PEER NETWORK

Advantages:

- **Use less expensive computer hardware**
- **Easy to administer**
- **No NOS required**
- **More built in redundancy**
- **Easy setup & low cost**

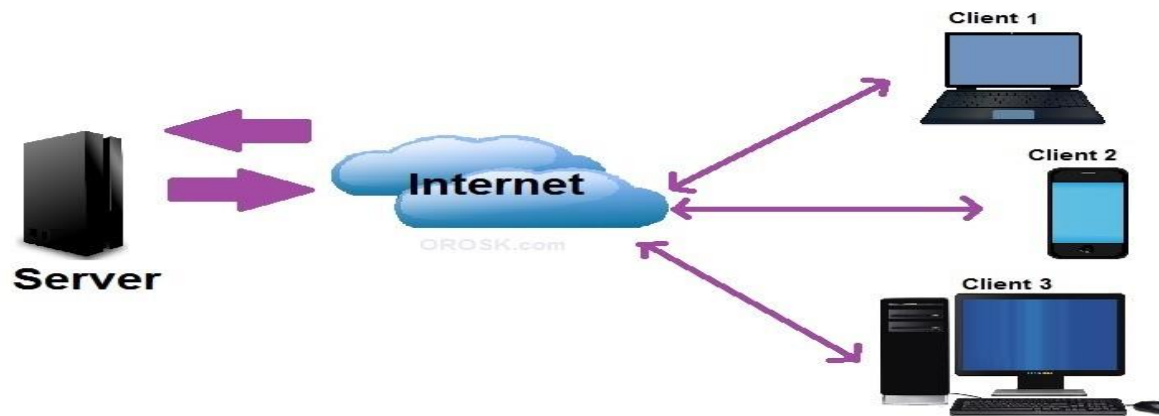
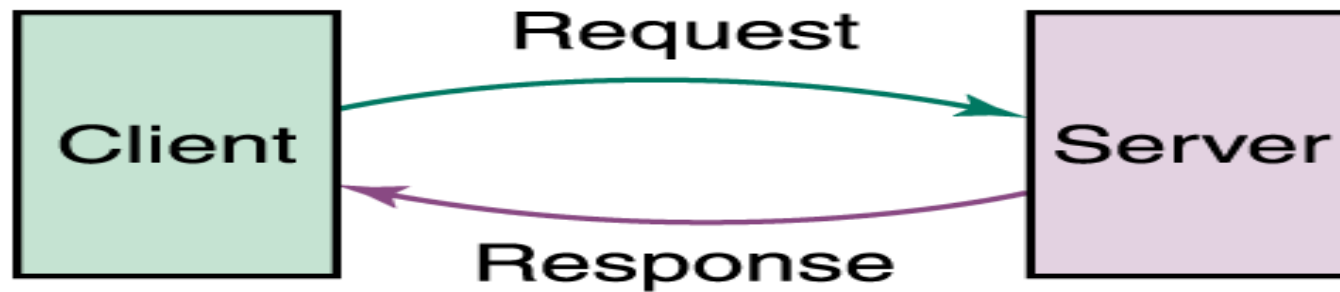
Disadvantages:

- **Not very secure**
- **No central point of storage or file archiving**
- **Additional load on computer because of resource sharing**
- **Hard to maintain version control**

Client/Server Network

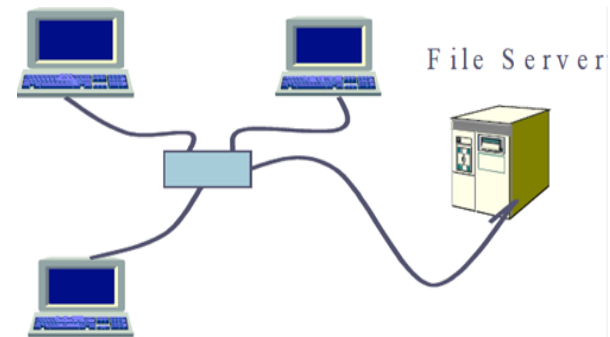
- A Client/Server network is a distributed network in which many workstations (called Clients) are connected to a central host computer (called the Server).
- The clients are the workstations in a Client/Server network that maintain local software and information and do as much of the processing as possible.

Client/Server Network



Specialized Servers

- Servers must perform varied and complex tasks. Servers for large networks have become specialized to accommodate the expanding needs of users. types of servers included on many large networks.
 - **File Servers**
 - **Print Servers**
 - **Database Servers**
 - **Application Servers**
 - **Mail Servers**
 - **Web Servers**
 - **Proxy Server**



Types of Network Topologies

- Logical Topology
- Physical Topology

Logical Network Topologies

- Logical topologies are protocols
- **Logical topology** is bound to network protocols and describe how data is moved across the network.
- Logical Topology is the method used to pass the information between the computers.
- Connections to the Internet may use multiple protocols.
- TCP/IP is a suite of protocols that work together to transmit data.

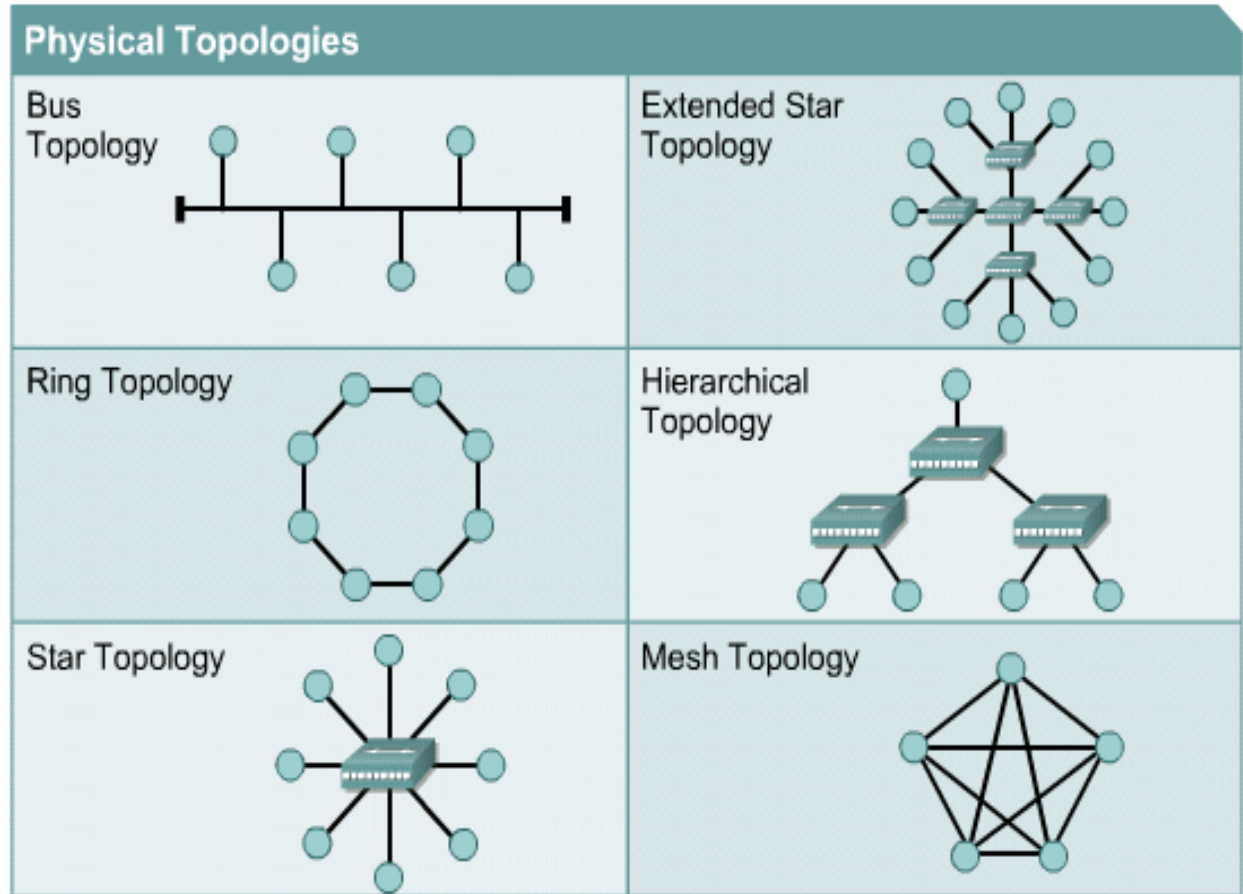
Physical Network Topologies

- **Physical topology** is the mapping of the nodes of a network and the physical connections between them — i.e., the layout of wiring, cables, the locations of nodes, and the interconnections between the nodes and the cabling or wiring system.
- The physical topology of a network refers to the configuration of cables, computers, and other peripheral devices.

Physical Topologies

Main types of physical topologies used in networks are:

- Bus
- Ring
- Star
- Mesh
- Tree
- Hybrid



Bus Topology

- Bus networks use a common backbone to connect all devices.
- In the bus network topology, every workstation or computer/server is connected to a main cable called the bus.
- A device wanting to communicate with another device on the network sends a broadcast message onto the wire that all other devices see, but only the intended recipient actually accepts and processes the message.

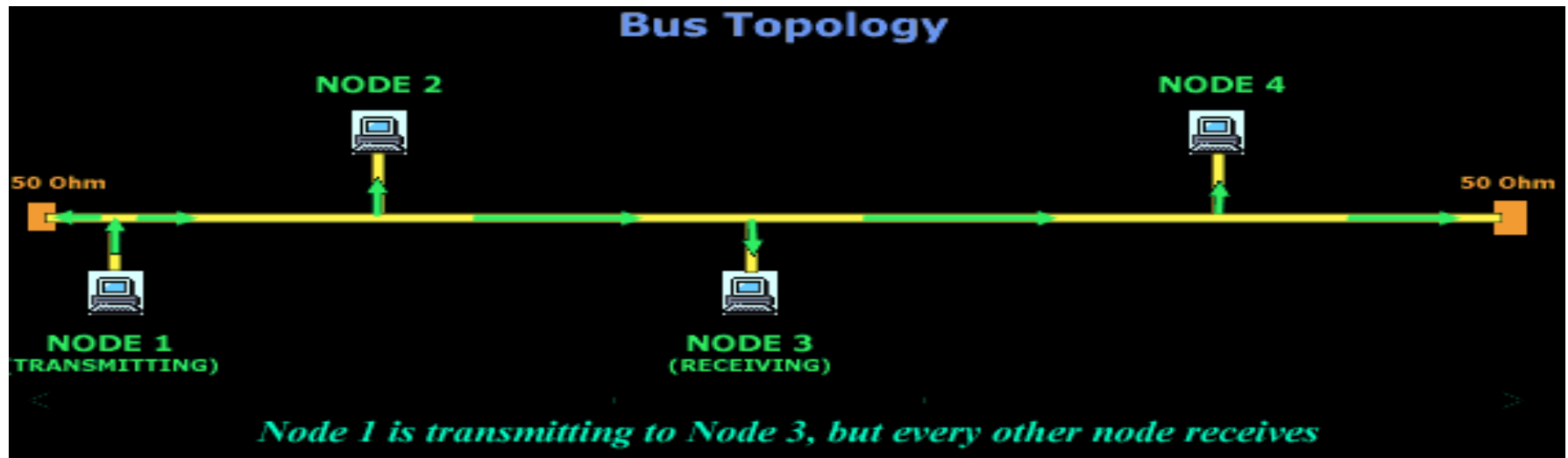
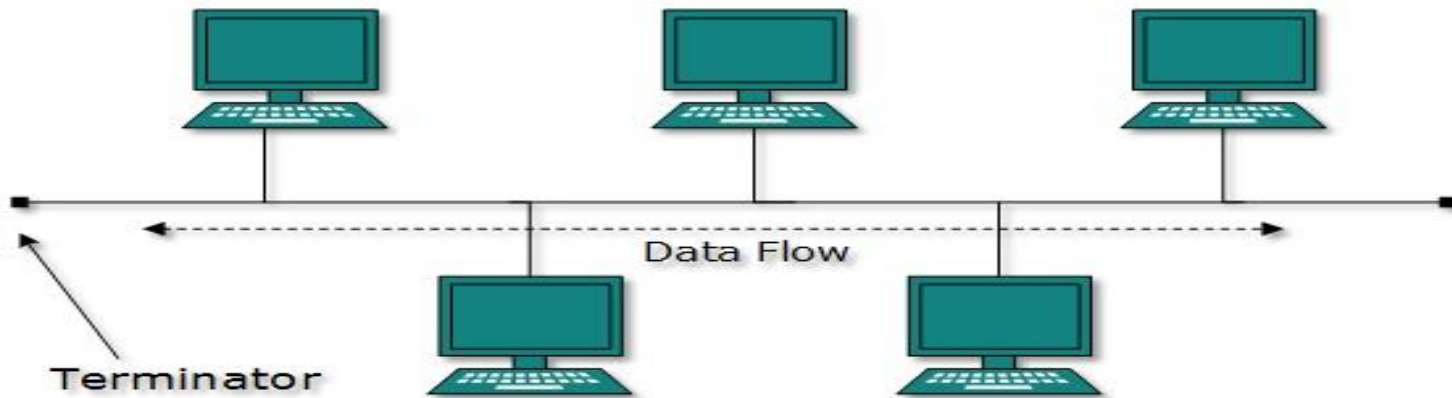
Bus Topology

- Bus networks work best with a limited number of devices.
- If more than a few dozen computers are added to a network bus, performance problems will result.
- In addition, if the backbone cable fails, the entire network effectively becomes unusable.
- A signal from the source travels in both directions to all machines connected on the bus cable until it finds the intended recipient.

Bus Topology

- If the machine address does not match the intended address for the data, the machine ignores the data. Alternatively, if the data matches the machine address, the data is accepted.
- Since the bus topology consists of only one wire, it is rather inexpensive to implement when compared to other topologies.
- However, the low cost of implementing the technology is offset by the high cost of managing the network.
- Additionally, since only one cable is utilized, it can be the single point of failure.

Bus Topology



Advantages of a Bus Topology

Advantage

- Easy to connect a computer or peripheral to a linear bus.
- Requires less cable length than a star topology.

Disadvantage

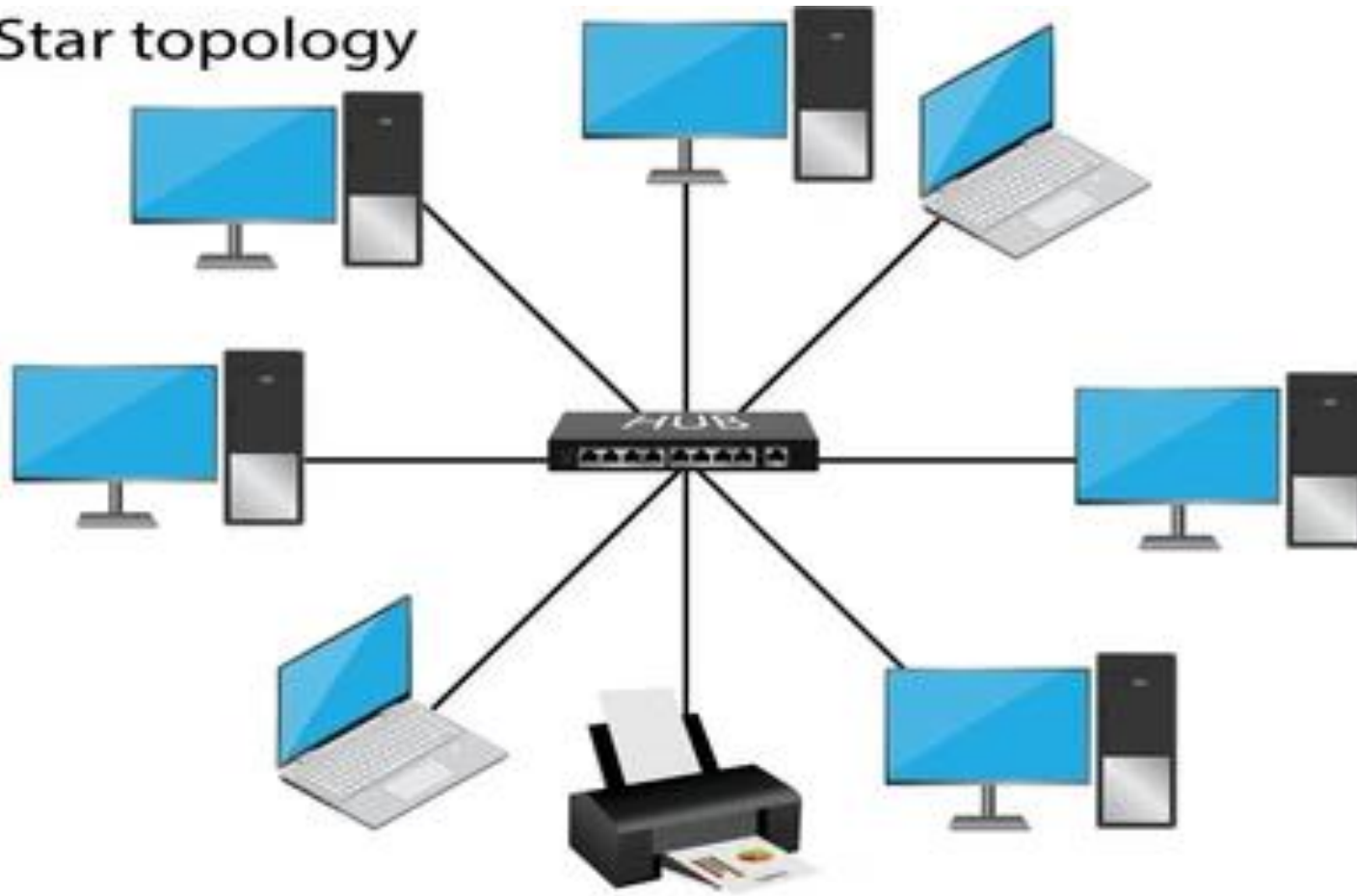
- Entire network shuts down if there is a break in the main cable.
- Terminators are required at both ends of the backbone cable.
- Difficult to identify the problem if the entire network shuts down.

Star Topology

- A star topology is designed with each node file server, workstations, and peripherals connected directly (point to point) to a central device. This device can be network hub or switch.
- Point to point means there exists a point to point/direct connection between hosts and the central device.
- Data on a star network passes through the hub, switch, before continuing to its destination.
- The hub/switch manages and controls all functions of the network. It also acts as a repeater for the data flow.

Star Topology

Star topology



Advantages of a Star Topology

- Easy to install and wire.
- No disruptions to the network when connecting or removing devices.
- Easy to detect faults and to remove parts.

Disadvantages of a Star Topology

- Requires more cable length than a linear topology.
- If the hub, switch, or concentrator fails, nodes attached are disabled.
- More expensive than linear bus topologies because of the cost of the hubs, etc.

Ring Topology

- A network topology that is set up in a circular fashion in which data travels around the ring in one direction and each device on the ring acts as a repeater to keep the signal strong as it travels.
- In a ring network, every device has exactly two neighbors for communication purposes.
- All messages travel through a ring in the same direction (either "clockwise" or "counterclockwise").

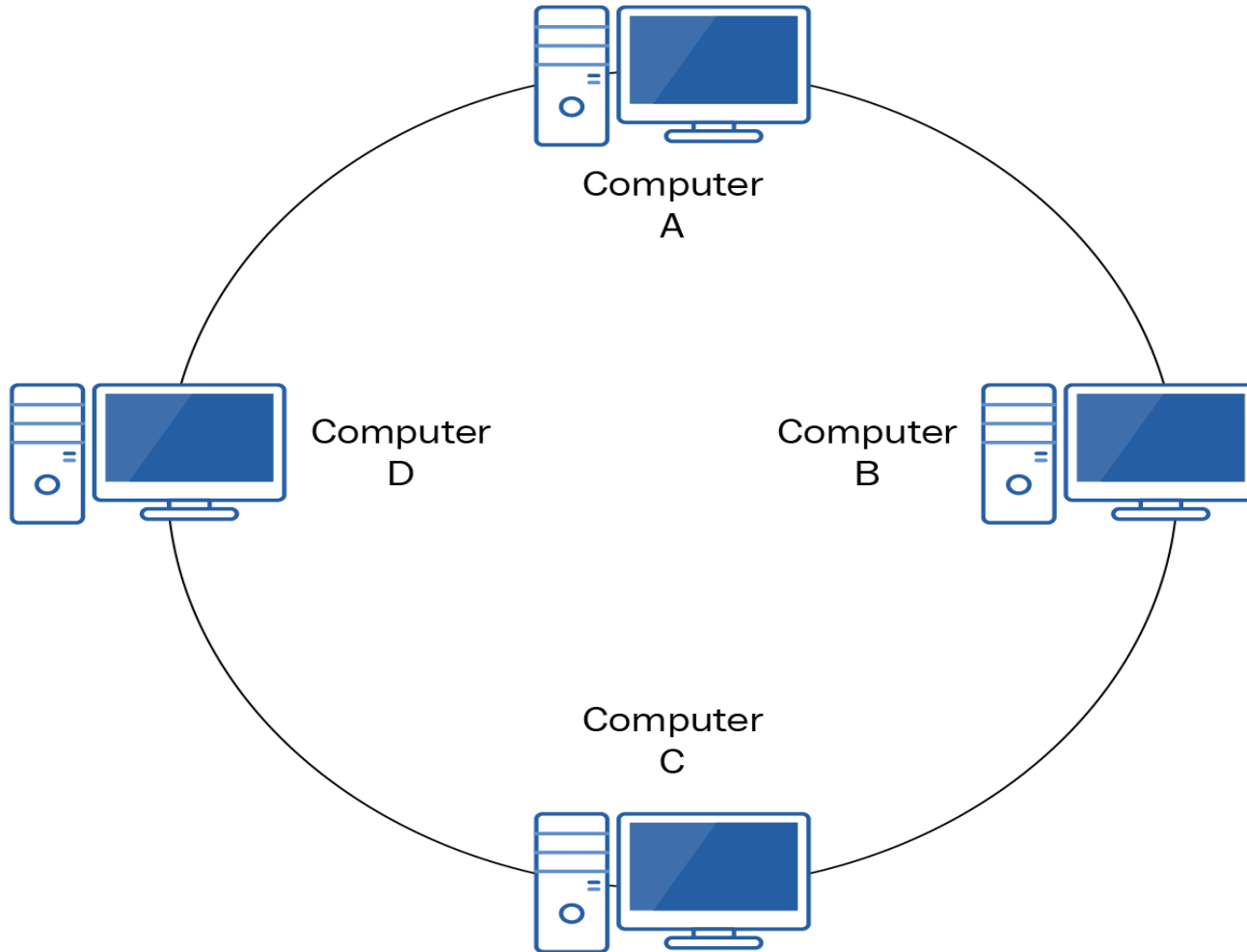
Ring Topology

- A failure in any cable or device breaks the loop and can take down the entire network.
- Ring topologies are found in some office buildings or school campuses
- The workstations are connected in a closed loop configuration.
- Adjacent pairs of workstations are directly connected.
- Other pairs of workstations are indirectly connected, the data passing through one or more intermediate nodes

Ring Topology

- Each device incorporates a receiver for the incoming signal and a transmitter to send the data on to the next device in the ring.
- The network is dependent on the ability of the signal to travel around the ring. When a device sends data, it must travel through each device on the ring until it reaches its destination.
- Every node is a critical link.
- In a ring topology, there is no server computer present; all nodes work as a server and repeat the signal.

Ring Topology

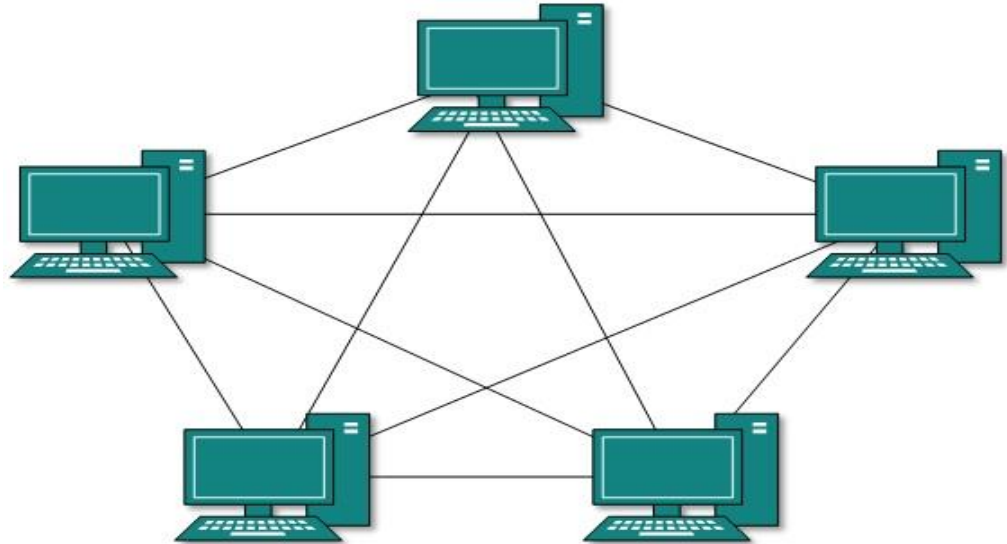
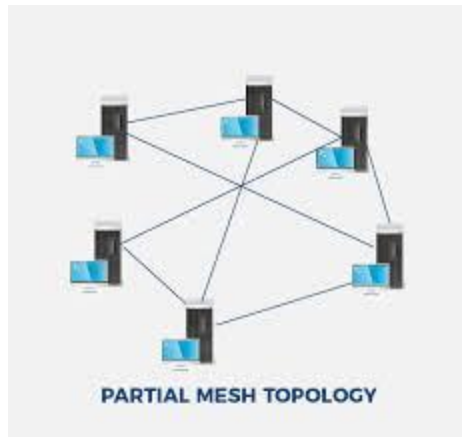


Mesh Topology

- The mesh network topology employs either of two schemes, called full mesh and partial mesh.
- In the full mesh topology, each workstation is connected (point to point connection) directly to each of the others.
- In the partial mesh topology, some workstations are connected to all the others, and some are connected only to those other nodes with which they exchange the most data.

Mesh Topology

- Unlike each of the previous topologies, messages sent on a mesh network can take any of several possible paths from source to destination.
- It is extremely impractical for large networks



Advantage and disadvantage of a Mesh Topology

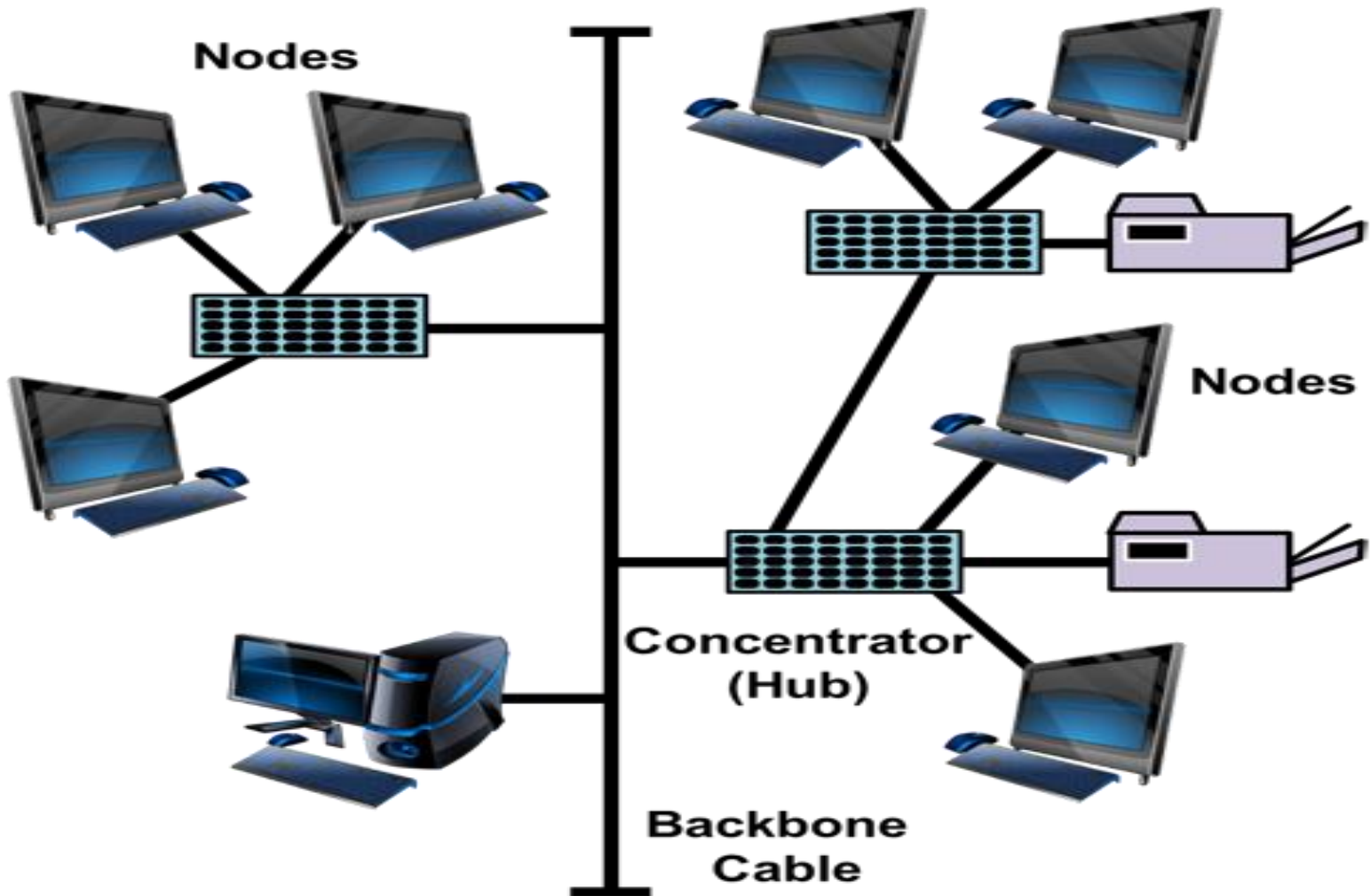
Advantage

- Improves Fault Tolerance

Disadvantage

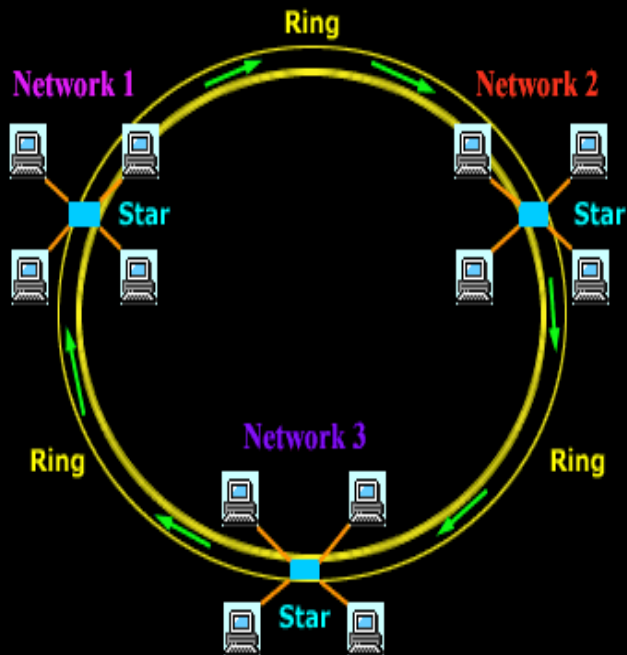
- The most Expensive
- Difficult to install
- Difficult to manage
- Difficult to troubleshoot

Tree Topology



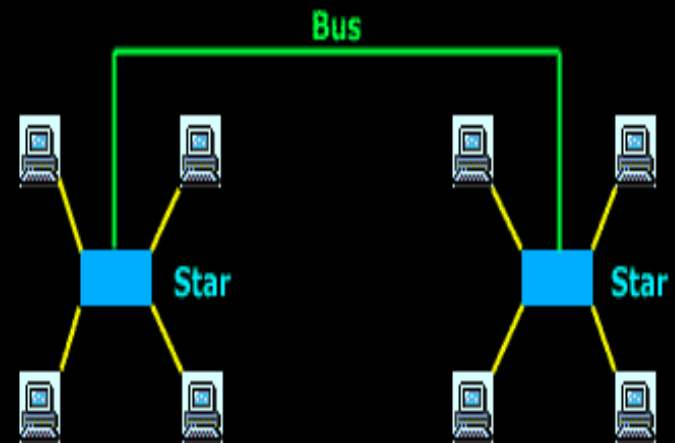
Hybrid Topology Types

Hybrid - Star Ring Topology



Network 1, 2 and 3 are based on a Star Topology, but connect between each other using a Ring Topology

Hybrid - Star Bus Topology



Network 1 and 2 are based on a Star Topology, but connect between each other using a Bus Topology