# GLS UNIVERSITY

0301404 DATA COMMUNICATION & NETWORKING.

UNIT– III

Network Topologies

- Network topology defines **how various computers or nodes are connected to one another.**
- It determines the various communication paths available between any pair of nodes in the network.
- There are six basic topologies as shown:
- Topologies may define both **physical and logical** aspect of the network.
  - **Physical –** actual layout of the computer cables(wire or media) and other network devices.
  - **Logical –** Defines how the hosts access the media to send data.

Network Topologies

Mesh   Star   Tree   Ring   Bus   Hybrid
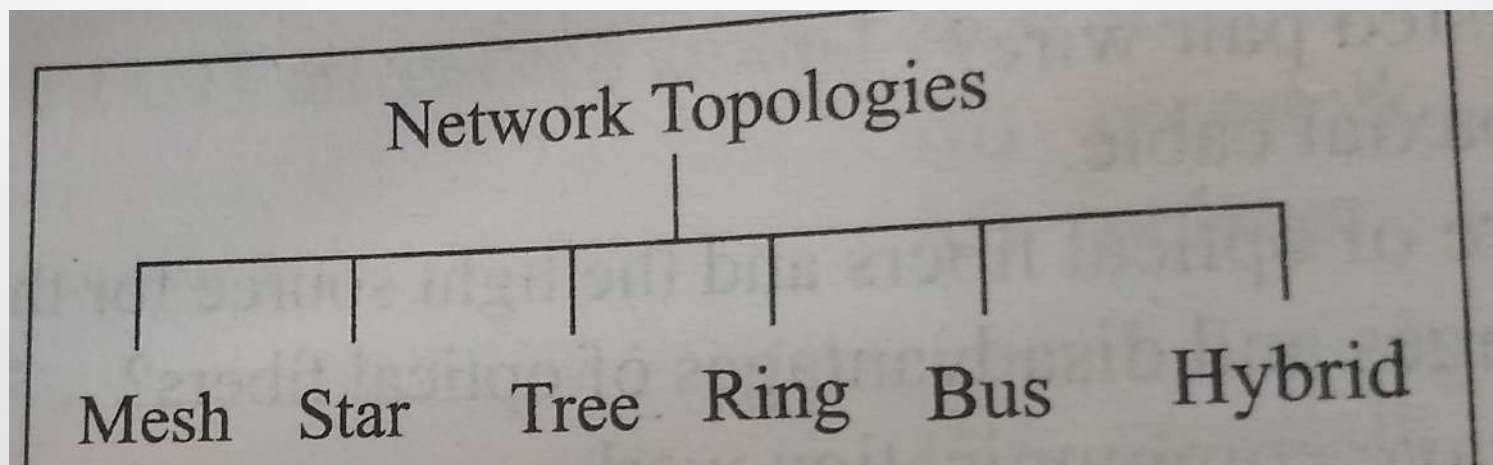
Network Topologies : MESH

- In **Mesh Topology**(also called **complete topology**) each node is connected to every other node by direct links.
- So for **m nodes** there would be **m(m-1)/2** physical links.
- This also means that every node must have **(m-1)** I/O ports.
- Mesh topology does note have traffic congestion problem due to dedicated links.
- Creats a point-to-point connection between every device on the network.
- The purpose of the mesh design is to provide a high level of redundancy. If one network cable fails, the data always has an alternative path to get to its destination.

Mesh Topology
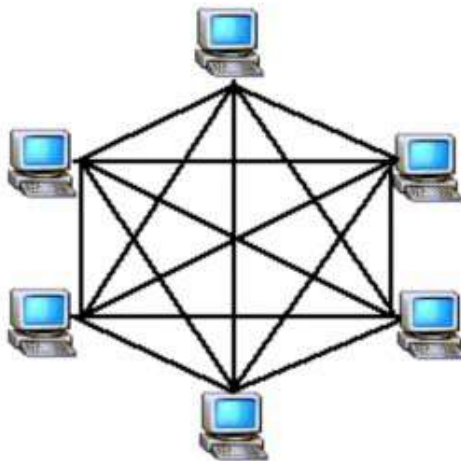
Mesh Topology
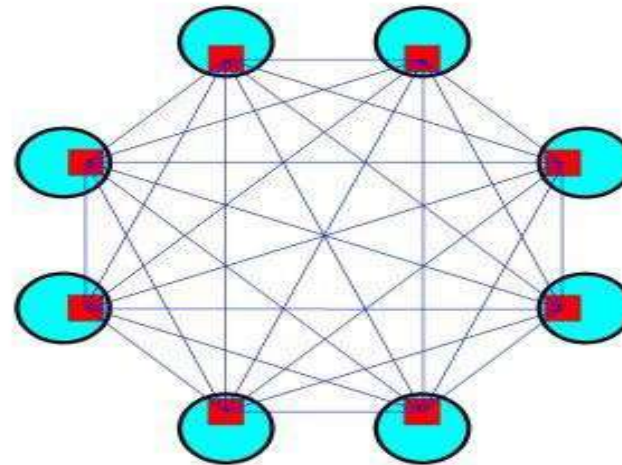
Network Topologies : MESH

- **Full Mesh:** All hosts have a point-to-point connection to every other host in the network. Thus for every new host n(n-1)/2 connections are required. It provides the most reliable network structure among all network topologies.

- **Partially Mesh:** Not all hosts have point-to-point connection to every other host. Hosts connect to each other in some arbitrarily fashion. This topology exists where we need to provide reliability to some hosts out of all.


FIGURE 1-3   Partial- and full-mesh topologies
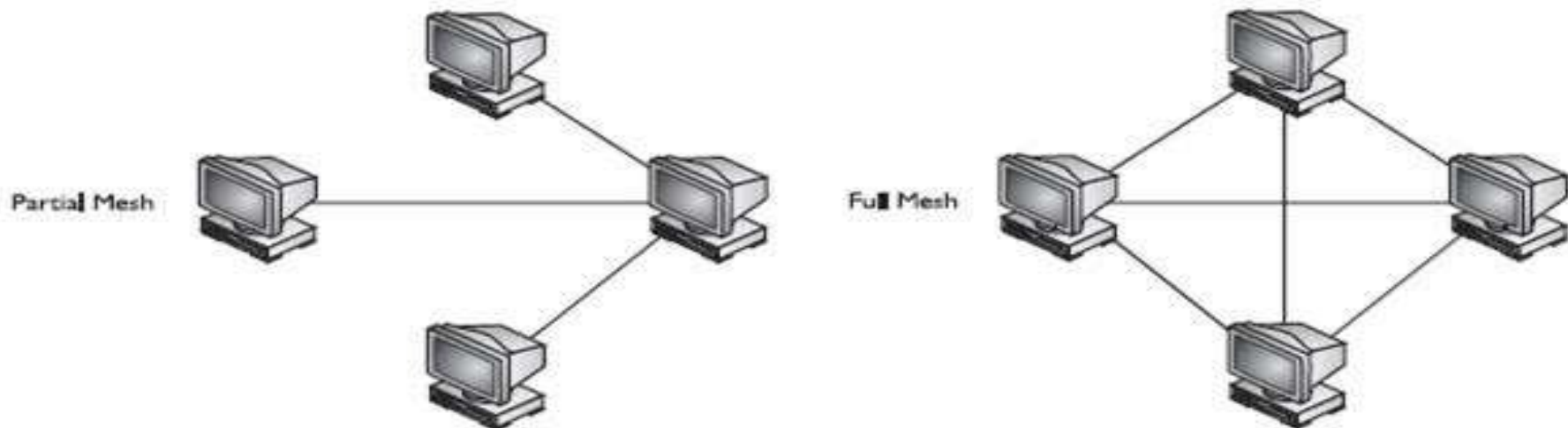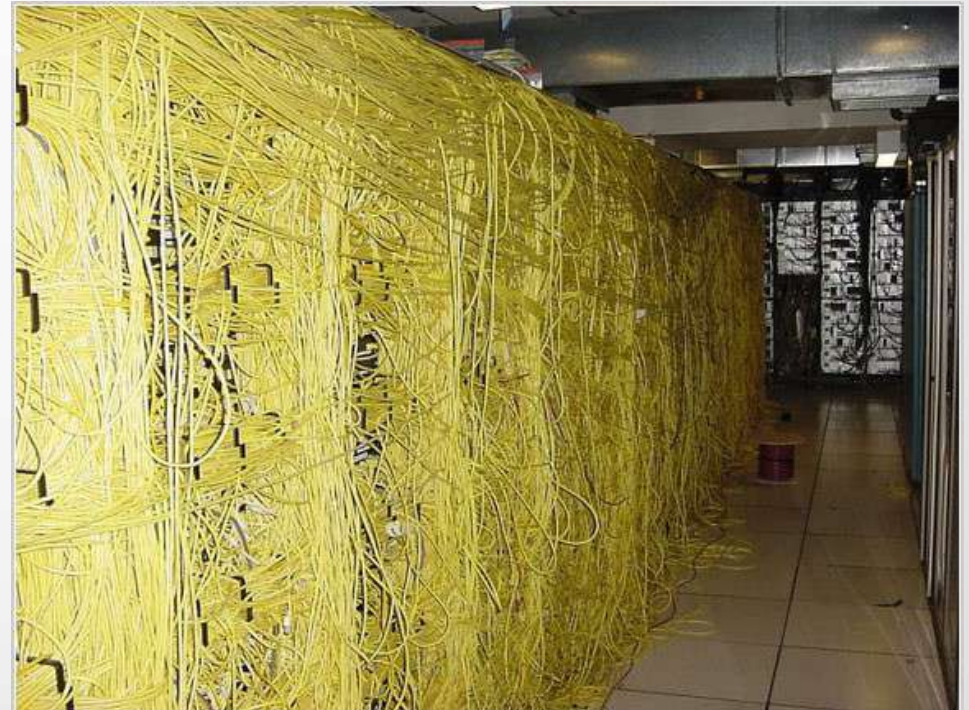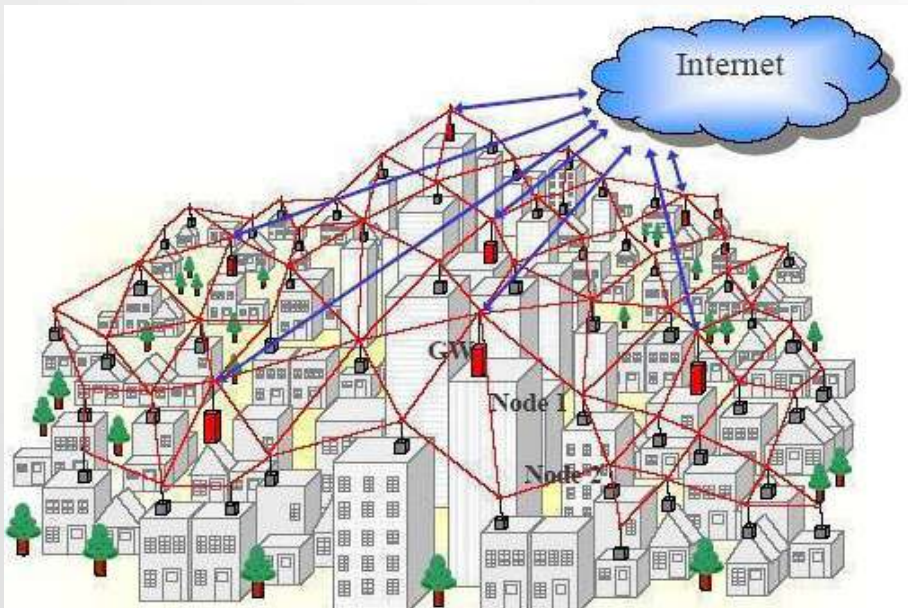
Network Topologies : MESH

- **Advantages:**
- It has multiple links, so if one route is blocked then other routes can be used for data communication.
- Each connection can have its own data load, so the traffic problem is eliminated.
- It ensures the data privacy or security, because every message travels along a dediacated link.
- Its performance is not affected with heavy load of data transmission.
- The arrangement of the network nodes is such that it is possible to transmit data from one node to many other nodes at the same time.
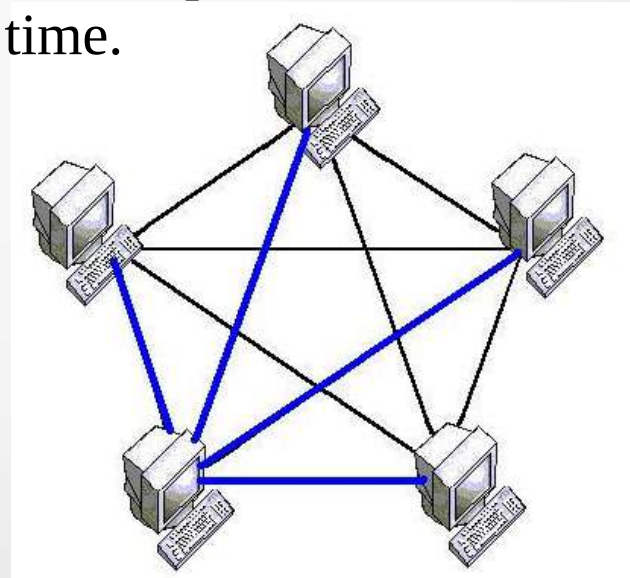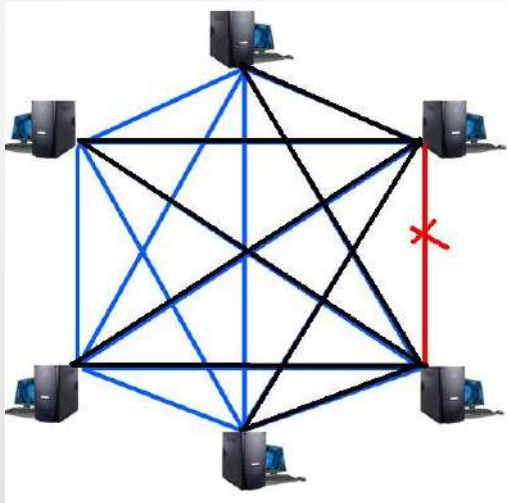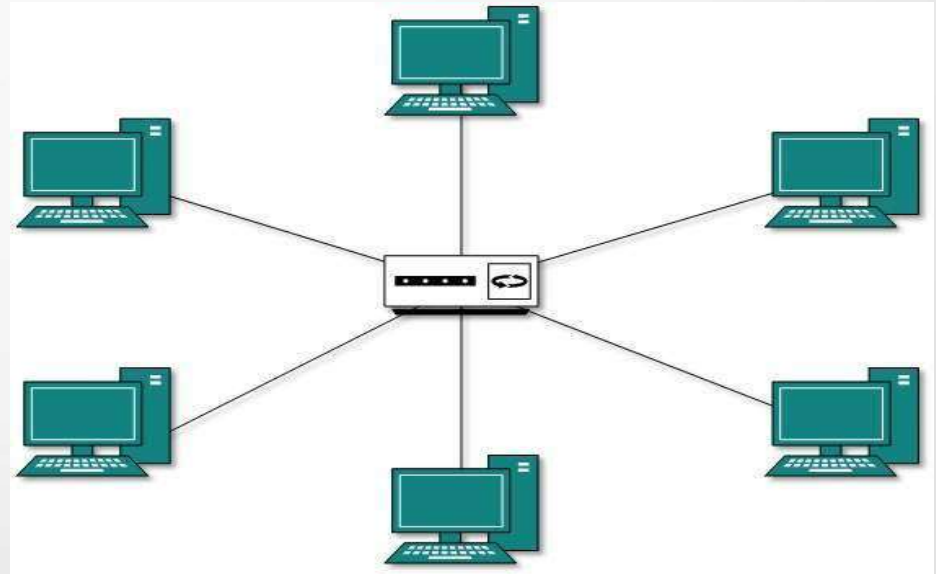
Network Topologies : MESH

- **Disadvantages:**
- It becomes very expensive because a large number of cabling when large number of ports are required.
- Difficult and complicated to install.
- Installation is complex as each node is connected to every node.

Network Topologies : STAR

- **Suppose a we have a telephone exchage to which all phones are connected and through which connections are established using switching. Star topology uses same concept.**
- In this type of topology **all the computers are connected to a single hub through a cable.**
- There is a central node, often called a hub. If a node wants to send some data to another node, it sends it to this hub. The hub in turn sends to the appropriate node.
- This hub is the central node and all others nodes are connected to the central node, known as hub device, using a point-to-point connection.
- There is no direct link between these computers and the computers can communicate via central controller only.
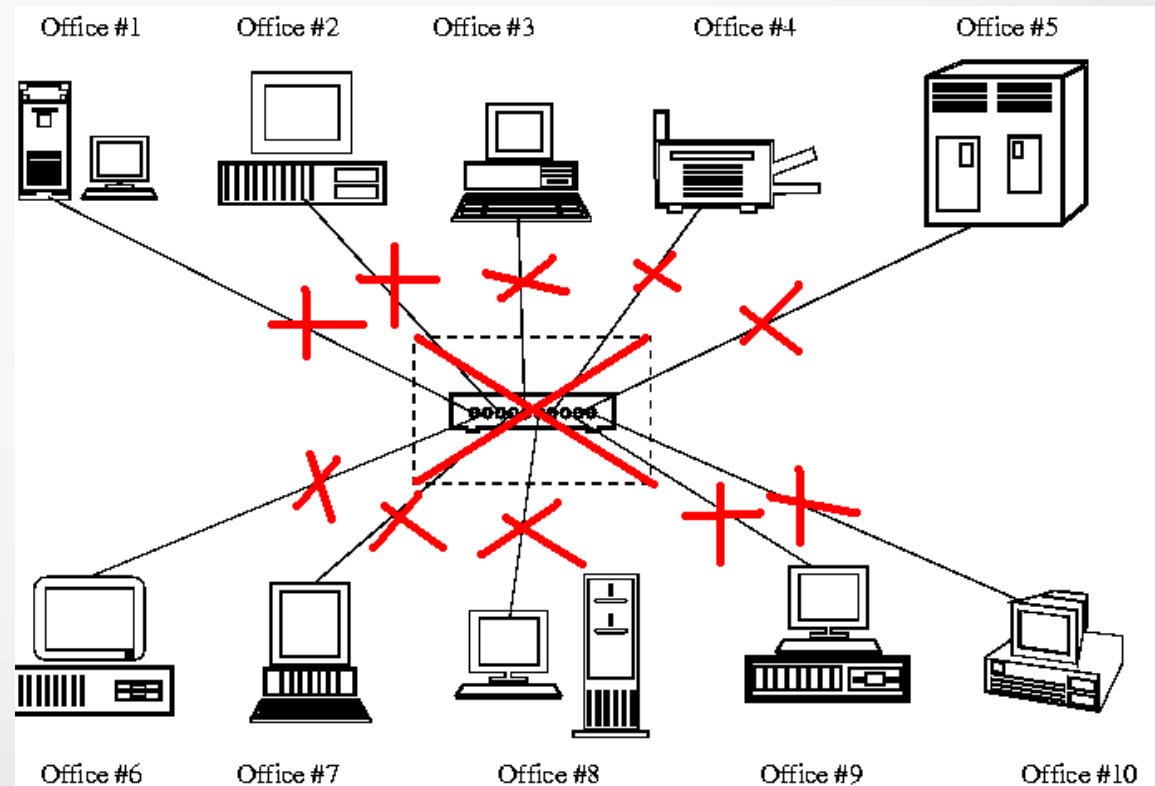
Network Topologies : STAR

- **Advantages:**
- Less Expensive than Mesh topology.
- Hub can be upgraded easily.
- Easy to troubleshoot.
- Easy to setup and modify.
- Less Cabling, Addition and Deletion involves only one connection between the devices and the Hub or Switch.
- Easy for Fault identification and fault isolation. If one link fails, only that link is affected. All other links remain active.
- It is easier to add new node or modify any existing node without disturbing network
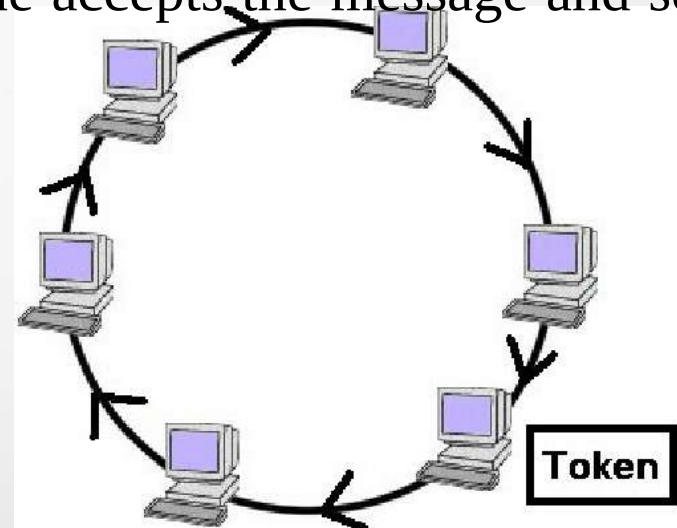
Network Topologies : STAR

- **Disadvantages:**
- Performance is based on the hub that is it depends on its capacity.
- One big disadvantage of a star topology is the dependency of the whole topology on one single point, the hub. If the hub goes down, the whole system is dead.
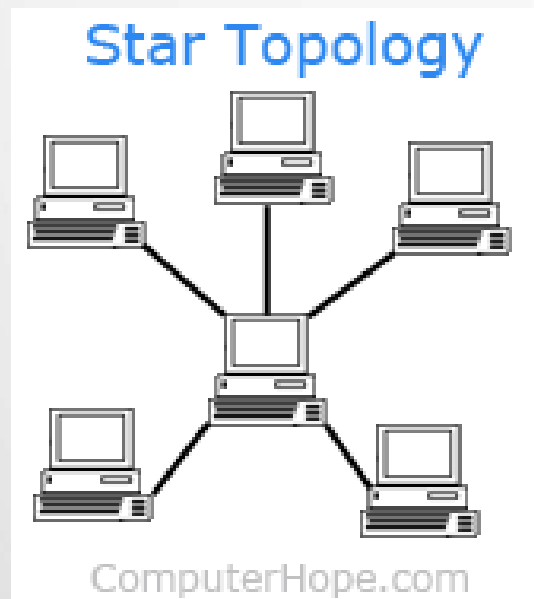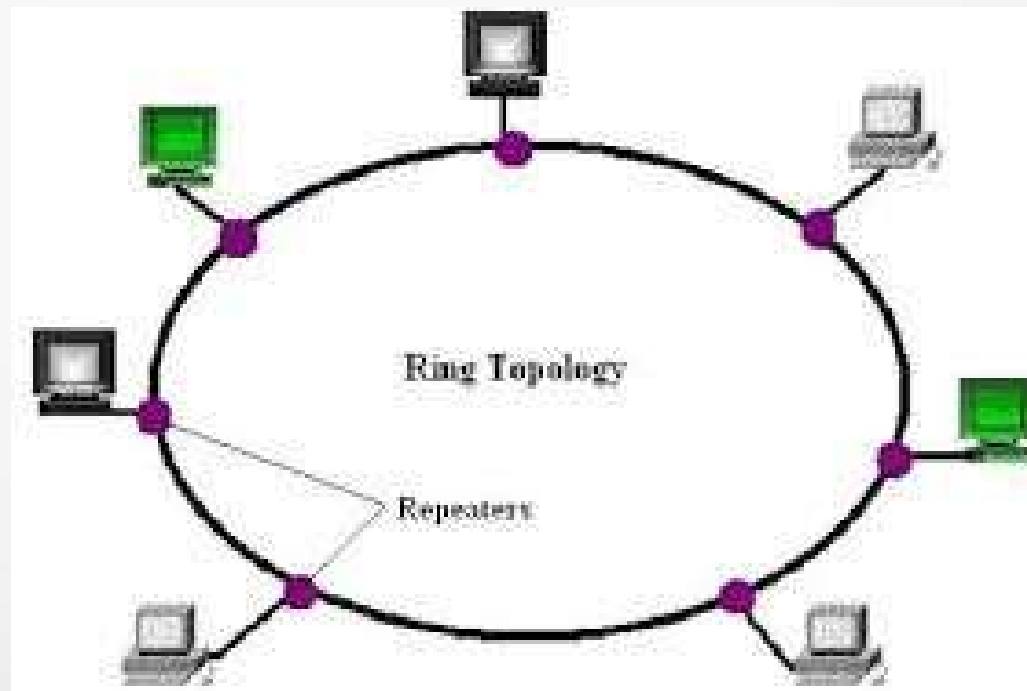
Network Topologies : RING

- In Ring Topology, all the nodes are connected to each-other in such a way that they make a closed loop. Each computer is connected to two other computer on either side, and it communicates with these two adjacent neighbors.
- **Data travels around the network, in one direction.** Sending and receiving of data takes place by the help of TOKEN(PACKETS).
- **Exactly two neighbours for each device.**
- Message travel around the ring from node to node in a very organized manner. Each workstation checks the message for a matching destination address.
- If the address doesn't match the node simply regenerates the message and sends it on its way. If the address matches, the node accepts the message and sends a reply to the originating sender.
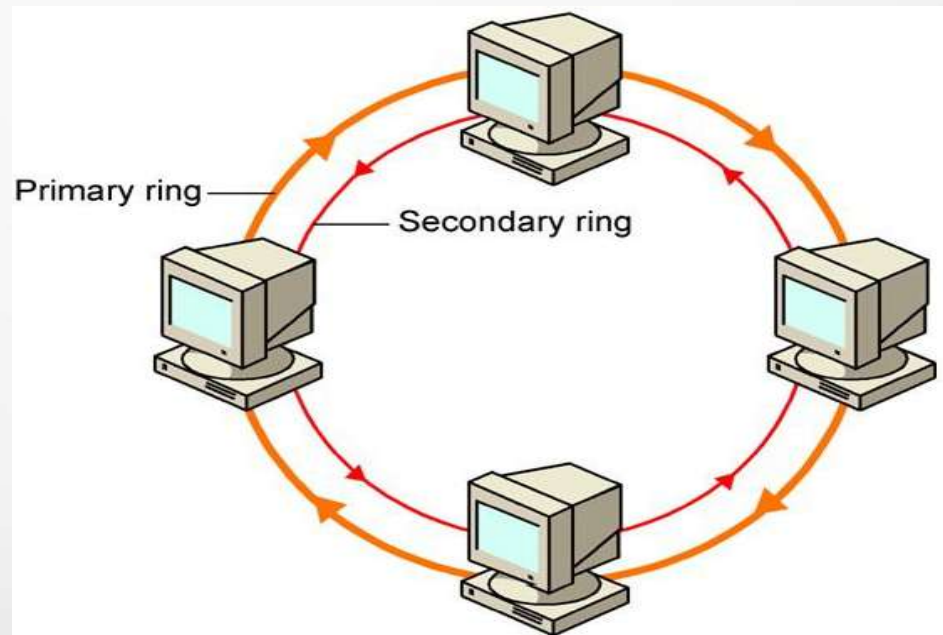
Network Topologies : RING

- A number of repeaters are used for Ring topology with large number of nodes, because if someone wants to send some data to the last node in the ring topology with 100 nodes, then the data will have to pass through 99 nodes to reach the 100th node. Hence to prevent data loss repeaters are used in the network.

Ring Topology

Repeaters

Network Topologies : RING

- The transmission is **unidirectional**, but it can be made **bidirectional** by having 2 connections between each Network Node, it is called **Dual Ring Topology.**
- In Dual Ring Topology, two ring networks are formed, and data flow is in opposite direction in them. Also, if one ring fails, the second ring can act as a backup, to keep the network up.
- Data is transferred in a sequential manner that is bit by bit.
- Data transmitted, has to pass through each node of the network, till the destination node.
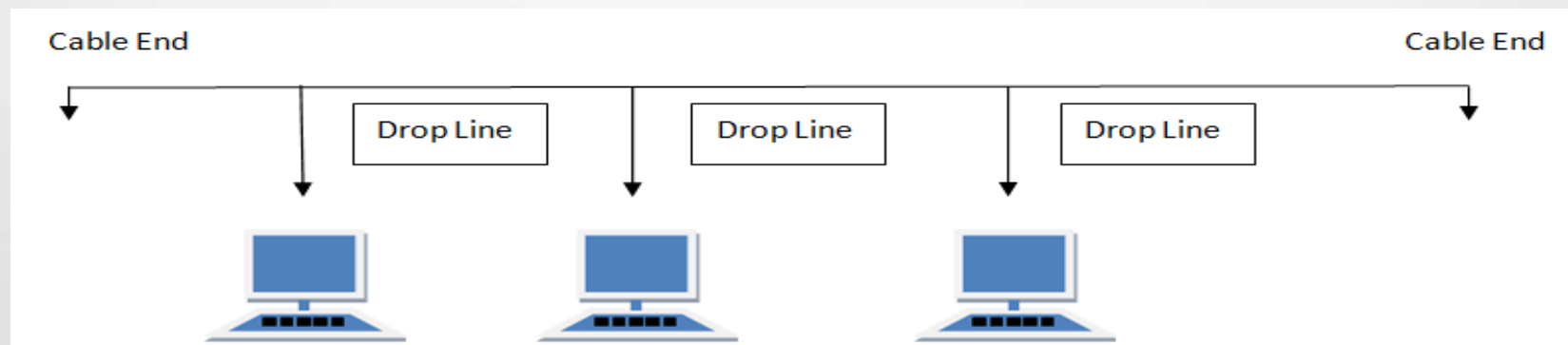
Network Topologies : RING

- **Advantages:**
- Transmitting network is not affected by high traffic or by adding more nodes, as only the nodes having tokens can transmit data.
- Cheap to install and expand
- There are no collisions.
- Data packets travel at greater speeds.
- It is easier to locate the problems with device and cable i.e. fault isolation is simplified.

- **Disadvantages:**
- A break in cable ring brings down entire network (in case of single ring).
- Adding or removing the node disturbs the network activity.
- It is considerably difficult to install and reconfigure ring Topology

Network Topologies : BUS

- Bus topology is a network type in which every computer and network device is **connected to single cable.** When it has exactly two endpoints, then it is called **Linear Bus topology.**
- **It uses multipoint philosophy.**
- A long cable called **bus** acts as a backbone for all the nodes.
- In networking a bus is the **central cable** -- the main wire -- that connects all devices on a local-area network (LAN). It is also called the **backbone**
- It consists of one continuous **length of cable** (**trunk**) that is shared by all the nodes in the network and a **terminating resistor (terminator**) at each end that absorbs the signal when it reaches the end of line.
- Data communication message travels along the bus in both directions until it is picked up by a workstation or server NIC.

Network Topologies : BUS

- A signal from the source is broadcasted and it travels to all workstations connected to bus cable. Although the message is broadcasted but only the intended recipient, whose MAC address or IP address matches, accepts it.
- If the MAC /IP address of machine doesn't match with the intended address, machine discards the signal.
- A terminator is added at ends of the central cable, to prevent bouncing of signals. A barrel connector can be used to extend it.
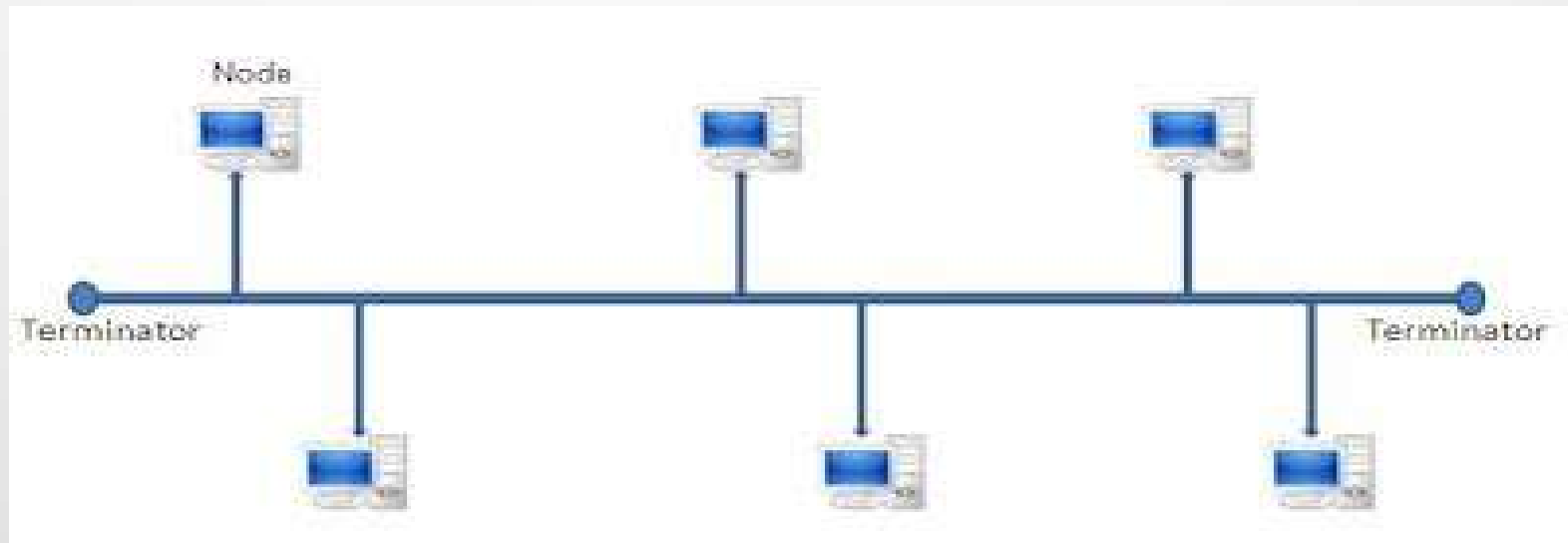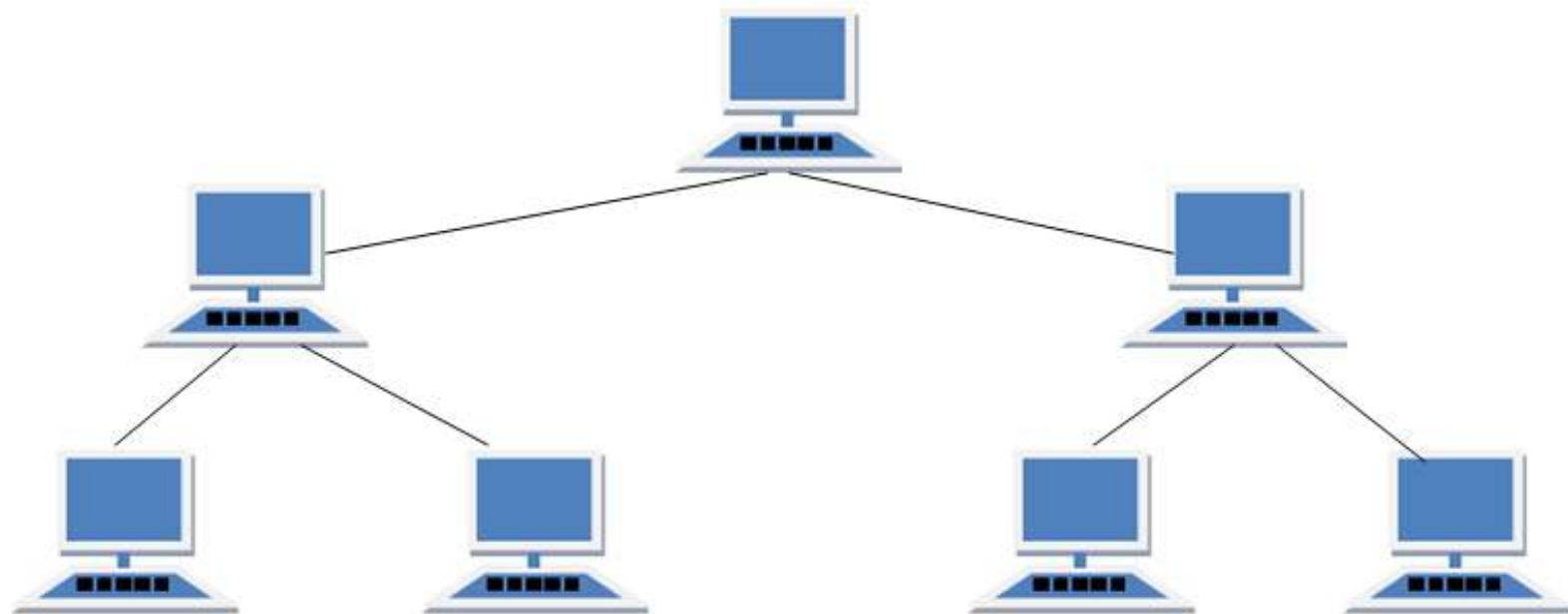
Network Topologies : BUS

- **Advantages:**
- It is easy to set-up and extend bus network.
- Cable length required for this topology is the least compared to other networks.
- Bus topology costs very less.
- Cable required is least compared to other network topology.
- Used in small networks.
- It is easy to understand.

- **Disadvantages:**
- It is not suitable for networks with heavy traffic.
- Cables fails then whole network fails.
- Cable has a limited length.
- If network traffic is heavy or nodes are more the performance of the network decreases.
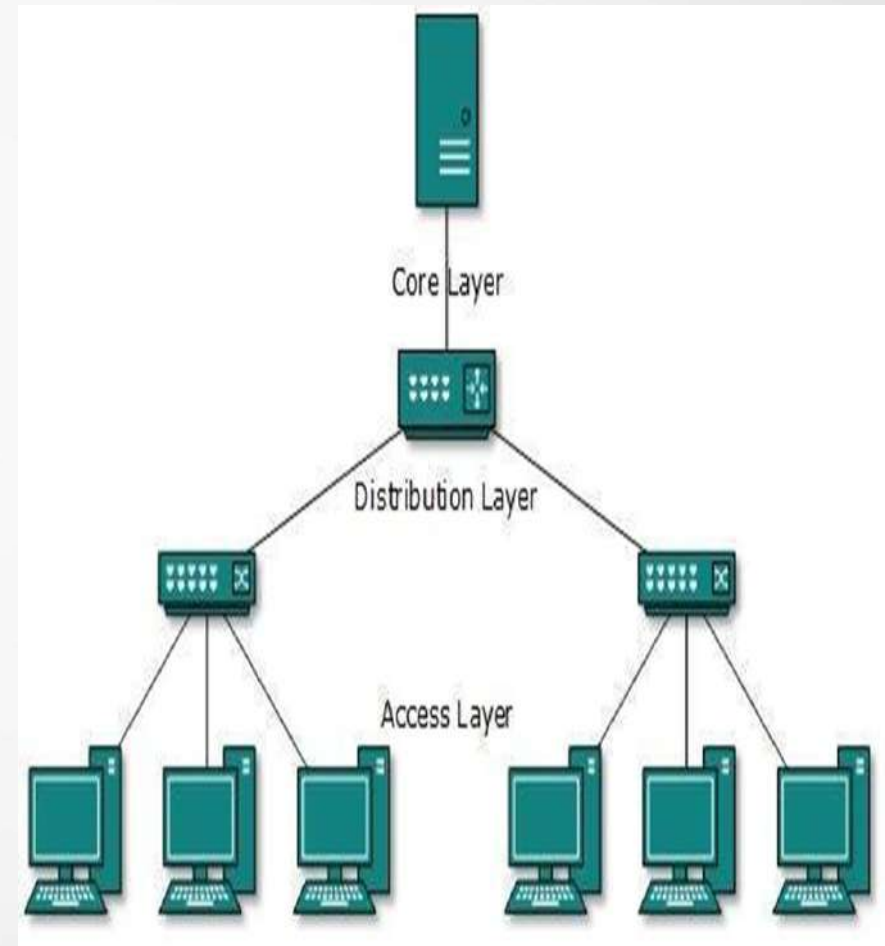
Network Topologies : TREE

- Tree topology is derived from **star topology**.
- Tree has a hierarchy of various hubs like **branches in tree**.
- In **Tree Topology**, every node is connected to some hub. However, only a few nodes are connected directly to the central hub.
- It has a root node and all other nodes are connected to it forming a hierarchy.
- It is also called **hierarchical topology.**

Network Topologies : TREE

- This topology divides the network in to multiple levels/layers of network. Mainly in LANs, a network is bifurcated into three types of network devices.
- The lowermost is **access-layer** where computers are attached.
- The middle layer is known as **distribution layer**, which works as mediator between upper layer and lower layer.
- The highest layer is known as **core layer**, and is central point of the network i.e. root of the tree from which all nodes fork.

Core Layer

Distribution Layer

Access Layer

Network Topologies : TREE

- **Advantages:**
- Transmitting network is not affected by high traffic or by adding more nodes, as only the nodes having tokens can transmit data.
- Cheap to install and expand
- There are no collisions.
- Data packets travel at greater speeds.
- It is easier to locate the problems with device and cable i.e. fault isolation is simplified.

- **Disadvantages:**
- Overall length of each segment is limited by the type of cabling used.
- If the backbone line breaks, the entire segment goes down.
- More difficult to configure and wire than other topologies.
- Heavily cabled.
- Costly.
- If more nodes are added maintenance is difficult.
- Central hub fails, network fails.

Network Topologies : HYBRID

- **Hybrid topology – which uses two or more of the topologies.**
- It is two different types of topologies which is a mixture of two or more topologies. For example if in an office in one department ring topology is used and in another star topology is used, connecting these topologies will result in Hybrid Topology (ring topology and star topology).
- It is a combination of two or topologies.
- These topologies include a mix of bus topology, mesh topology, ring topology, star topology, and tree topology.

Network Topologies : HYBRID
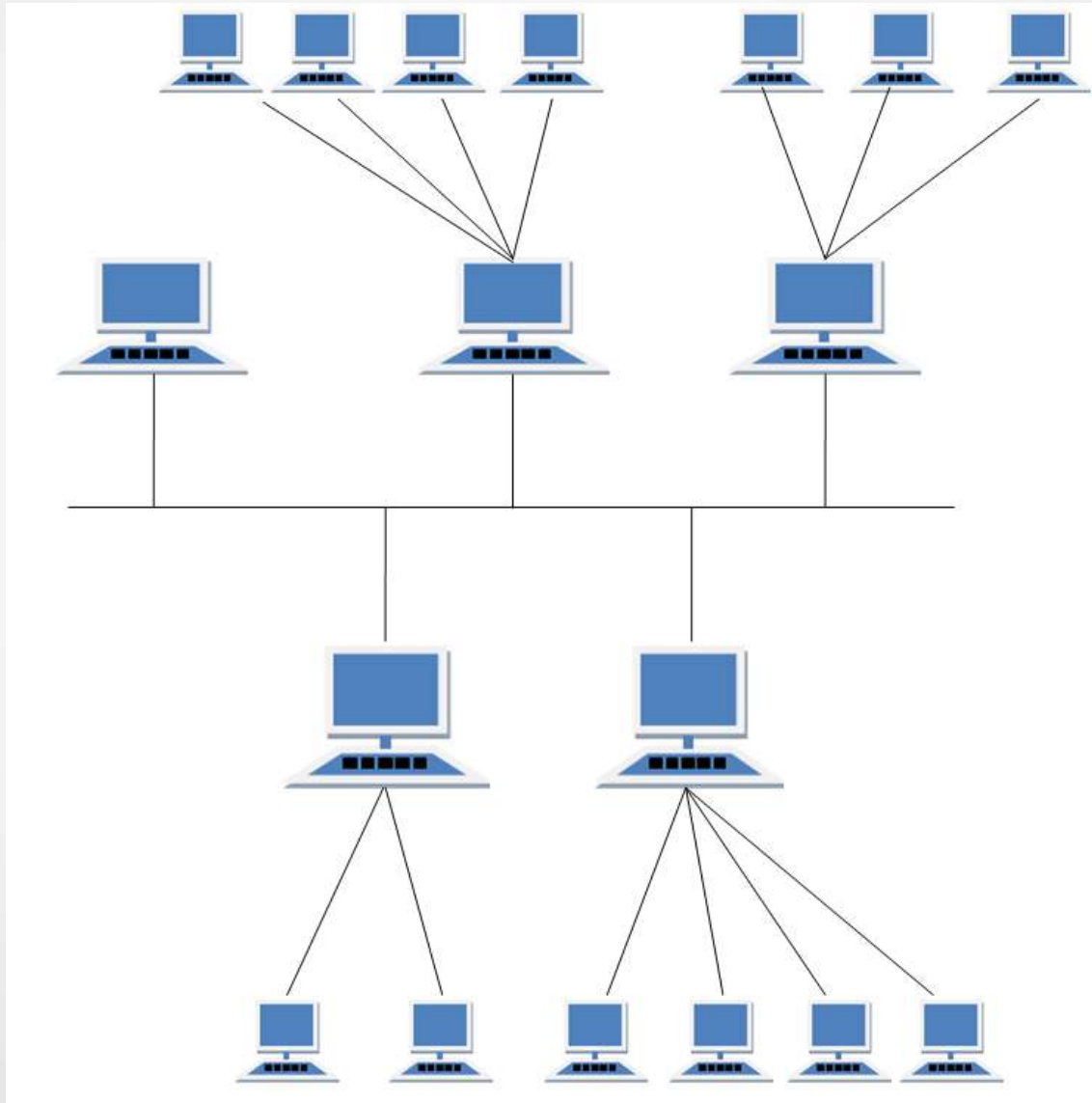
Network Topologies : HYBRID

- **Advantages:**
- Reliable as Error detecting and trouble shooting is easy.
- Effective
- Scalable as size can be increased easily.
- Flexible

- **Disadvantages:**
- Complex in design.
- Costly.