Azərbaycan TEXNİKİ Universiteti

TYPES OF NETWORK TOPOLOGY

ASMAR SEYIDOVA   GROUP:6424E

Types of Network Topology

Network topology refers to the arrangement of different elements like nodes, links, or devices in a computer network. Common types of network topology include bus, star, ring, mesh, and tree topologies, each with its advantages and disadvantages. In this article, we will discuss different types of network topology in detail.

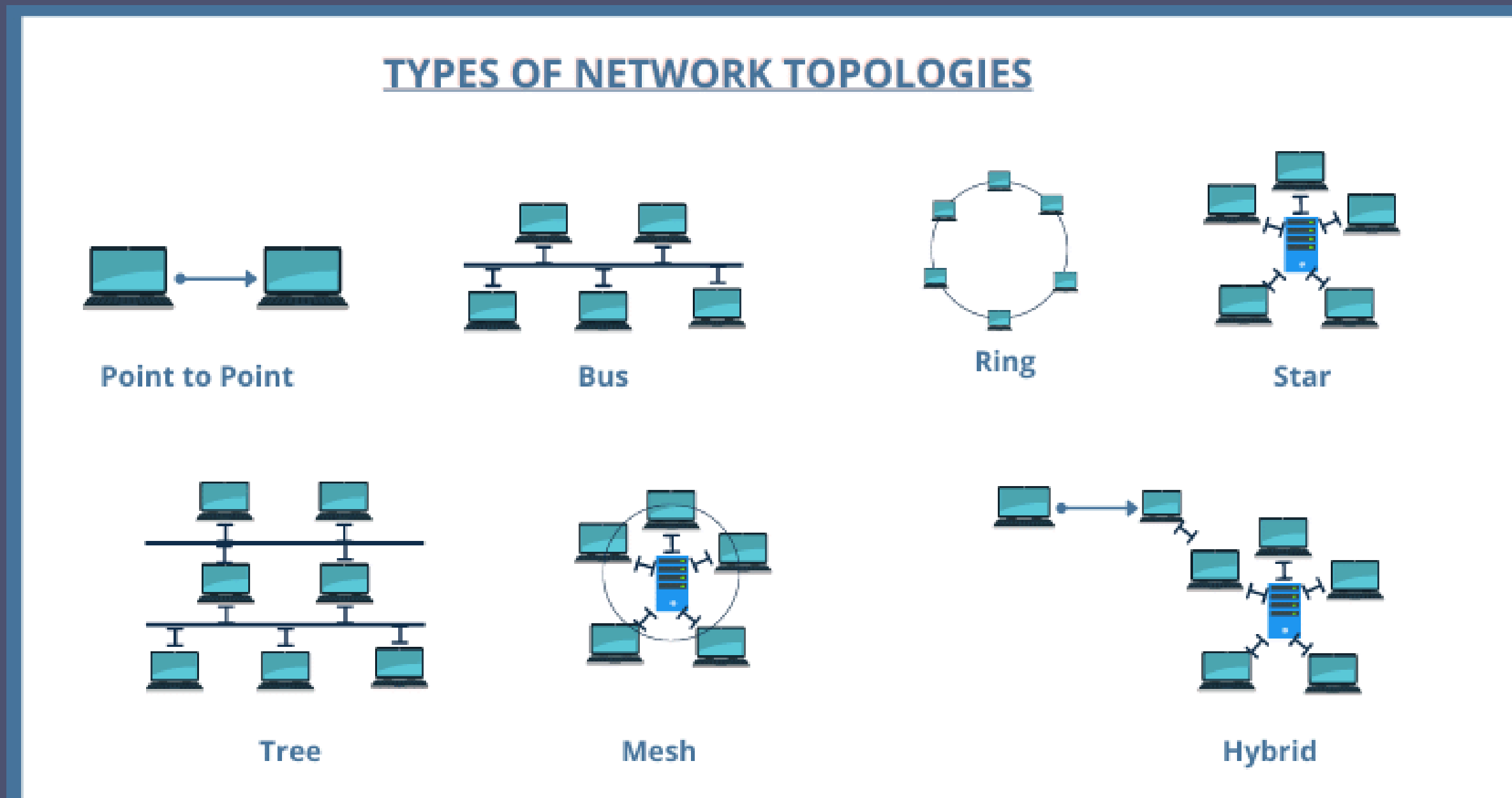# Types of Network Topology

Point to Point Topology

Mesh Topology

Star Topology

Bus Topology

Ring Topology

Tree Topology

Hybrid Topology

TYPES OF NETWORK TOPOLOGIES

Point to Point

Bus

Ring

Star

Tree

Mesh

Hybrid

Point to Point Topology

Point-to-point topology is a type of topology that works on the functionality of the sender and receiver. It is the simplest communication between two nodes, in which one is the sender and the other one is the receiver. Point-to-Point provides high bandwidth.

Point to Point Connection

Mesh Topology

In a mesh topology, every device is connected to another device via a particular channel. Every device is connected to another via dedicated channels. These channels are known as links. In Mesh Topology, the protocols used are AHCP (Ad Hoc Configuration Protocols), DHCP (Dynamic Host Configuration Protocol), etc.
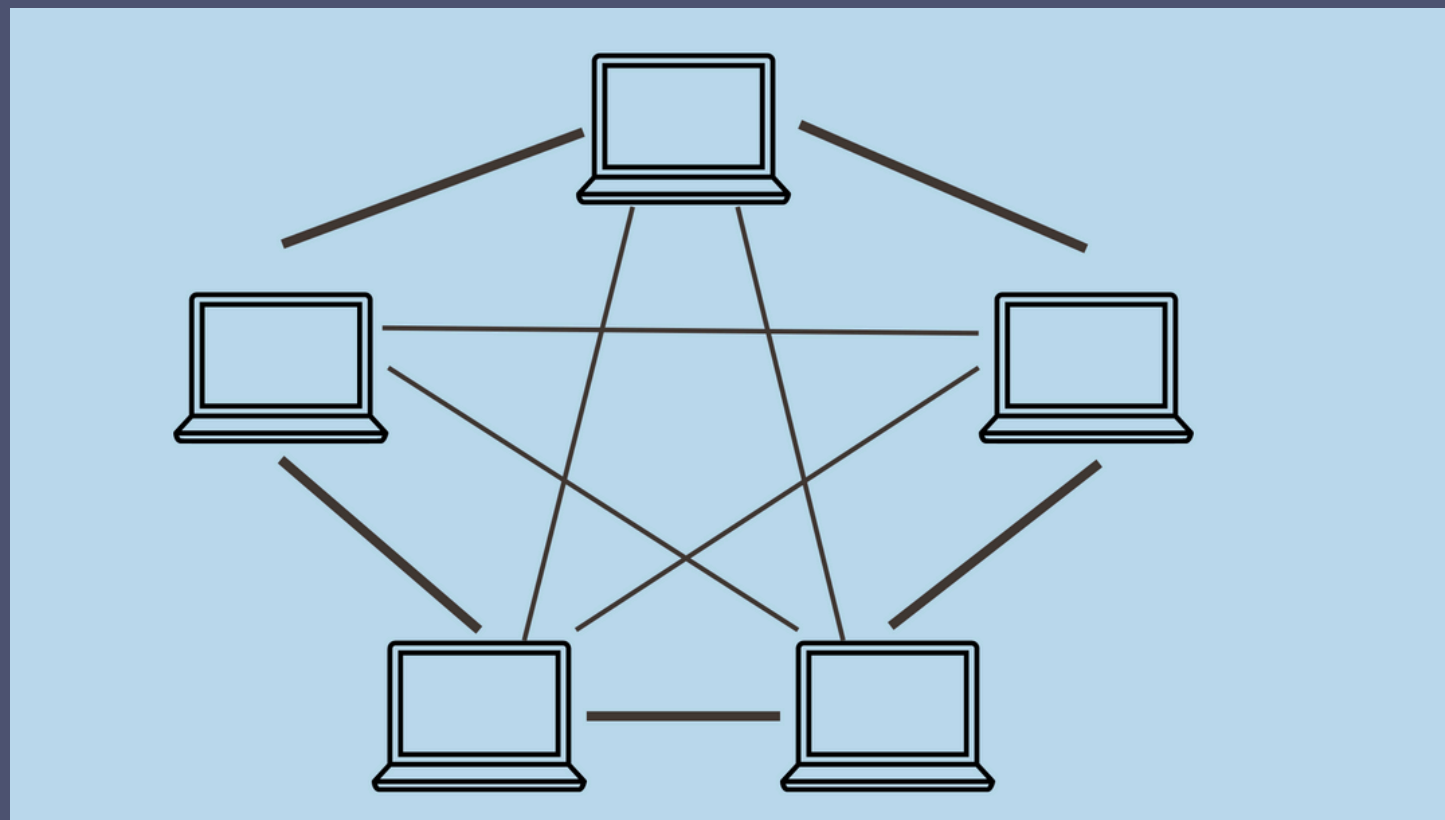
Advantages of Mesh Topology

Communication is very fast between the nodes.
Mesh Topology is robust.
The fault is diagnosed easily. Data is reliable because data is transferred among the devices through dedicated channels or links.
Provides security and privacy.

Disadvantages of Mesh Topology

Installation and configuration are difficult.
The cost of cables is high as bulk wiring is required, hence suitable for less number of devices.
The cost of maintenance is high.

Star Topology

In Star Topology, all the devices are connected to a single hub through a cable. This hub is the central node and all other nodes are connected to the central node. The hub can be passive in nature i.e., not an intelligent hub such as broadcasting devices, at the same time the hub can be intelligent known as an active hub. Active hubs have repeaters in them. Coaxial cables or RJ-45 cables are used to connect the computers. In Star Topology, many popular Ethernet LAN protocols are used as CD(Collision Detection), CSMA (Carrier Sense Multiple Access), etc.

Start Topology
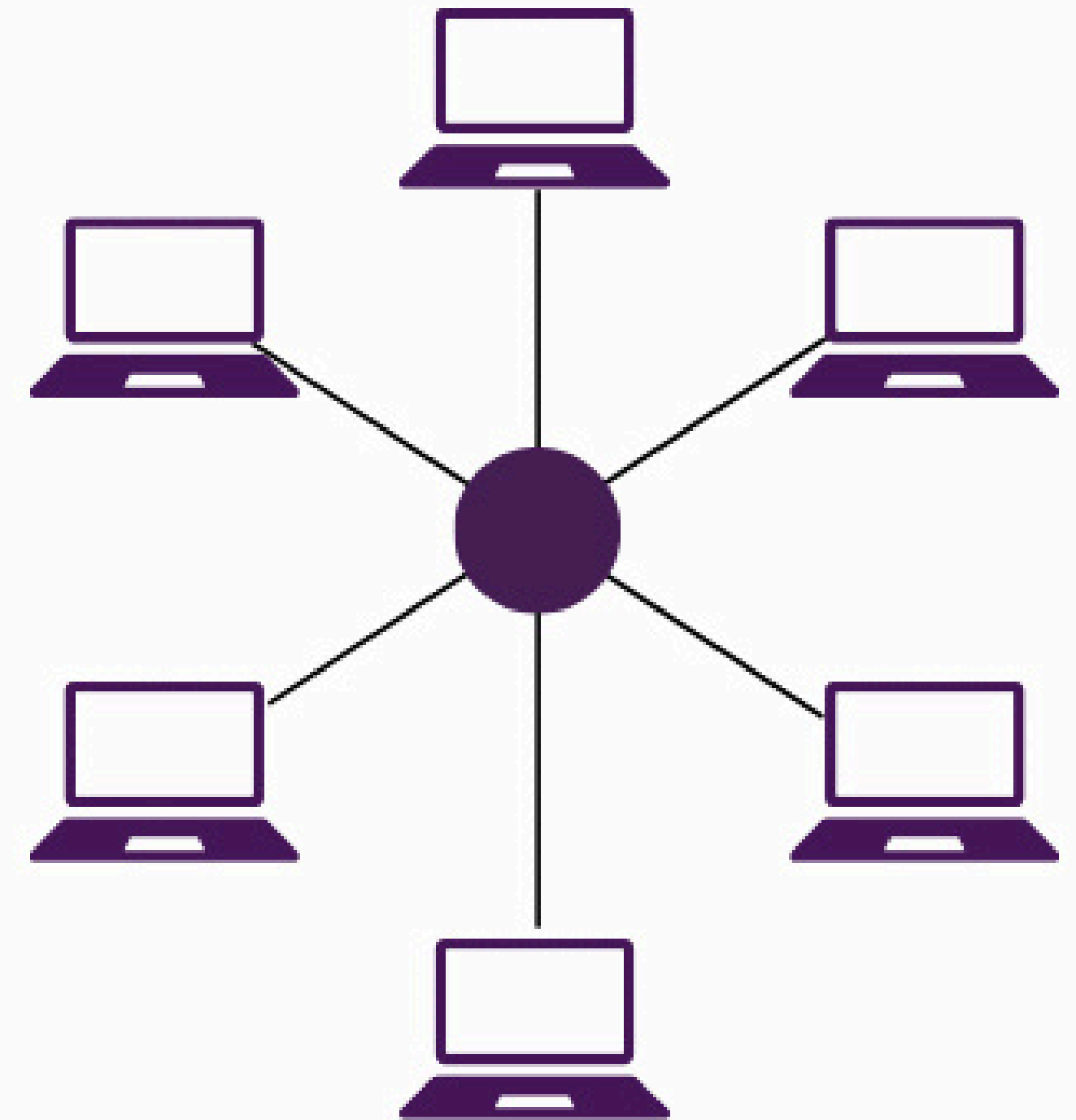
Advantages of Star Topology

If N devices are connected to each other in a star topology, then the number of cables required to connect them is N. So, it is easy to set up.
Each device requires only 1 port i.e. to connect to the hub, therefore the total number of ports required is N.
It is Robust. If one link fails only that link will affect and not other than that.
Easy to fault identification and fault isolation.
Star topology is cost-effective as it uses inexpensive coaxial cable.

Disadvantages of Star Topology

If the concentrator (hub) on which the whole topology relies fails, the whole system will crash down.
The cost of installation is high.
Performance is based on the single concentrator i.e. hub.
A common example of star topology is a local area network (LAN) in an office where all computers are connected to a central hub. This topology is also used in wireless networks where all devices are connected to a wireless access point.

Bus Topology

Bus Topology is a network type in which every computer and network device is connected to a single cable. It is bi-directional. It is a multi-point connection and a non-robust topology because if the backbone fails the topology crashes. In Bus Topology, various MAC (Media Access Control) protocols are followed by LAN ethernet connections like TDMA, Pure Aloha, CDMA, Slotted Aloha, etc.
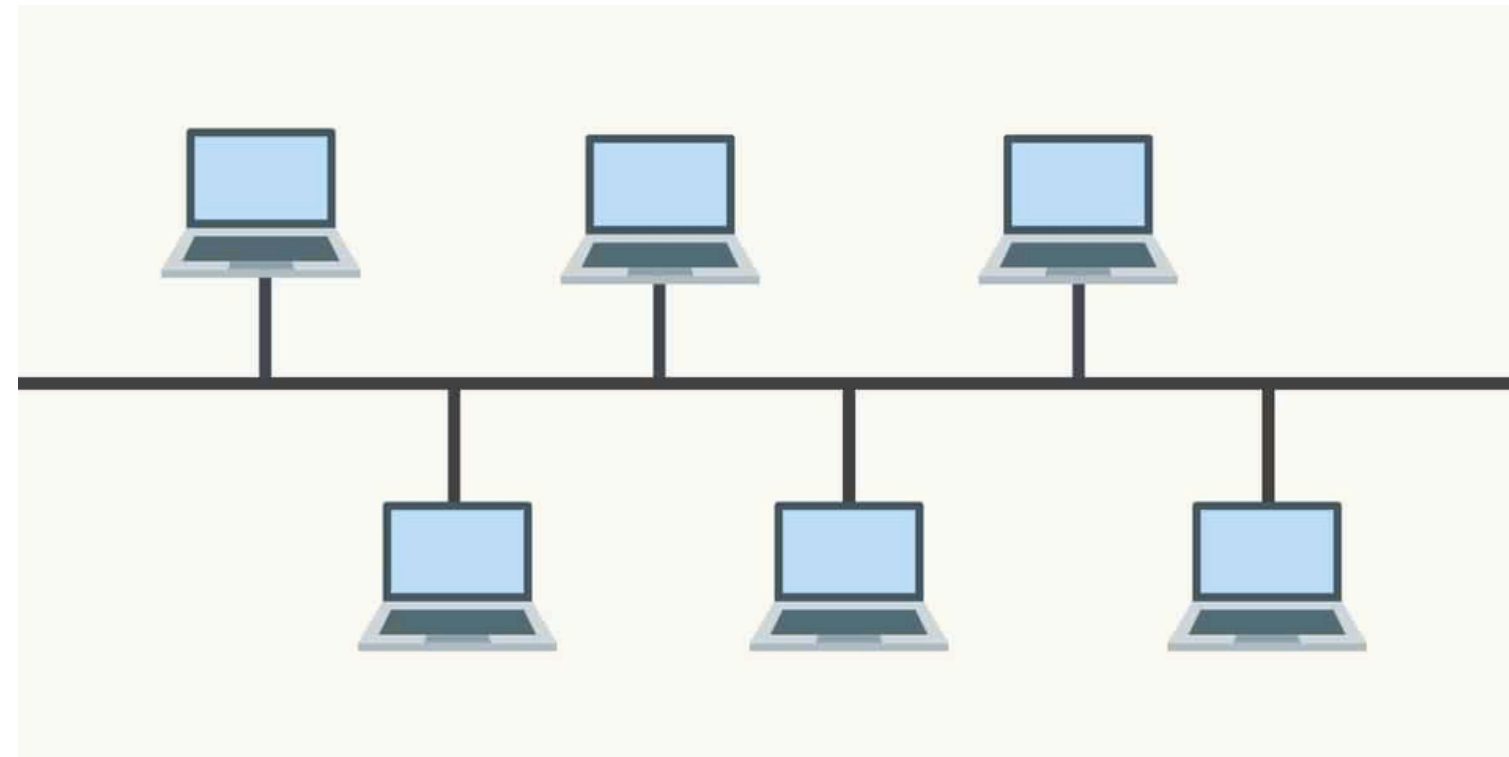
Advantages of Bus Topology

- If N devices are connected to each other in a bus topology, then the number of cables required to connect them is 1, known as backbone cable, and N drop lines are required.
- Coaxial or twisted pair cables are mainly used in bus-based networks that support up to 10 Mbps.
- The cost of the cable is less compared to other topologies, but it is used to build small networks.
- Bus topology is familiar technology as installation and troubleshooting techniques are well known.

Disadvantages of Bus Topology

A bus topology is quite simpler, but still, it requires a lot of cabling.
If the common cable fails, then the whole system will crash down.
If the network traffic is heavy, it increases collisions in the network. To avoid this, various protocols are used in the MAC layer known as Pure Aloha, Slotted Aloha, CSMA/CD, etc.
Adding new devices to the network would slow down networks.
Security is very low.

Ring Topology

In a Ring Topology, it fThe data flows in one direction, i.e. it is unidirectional, but it can be made bidirectional by having 2 connections between each Network Node, it is called Dual Ring Topology. In-Ring Topology, the Token Ring Passing protocol is used by the workstations to transmit the data.orms a ring connecting devices with exactly two neighboring devices. A number of repeaters are used for Ring topology with a 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.

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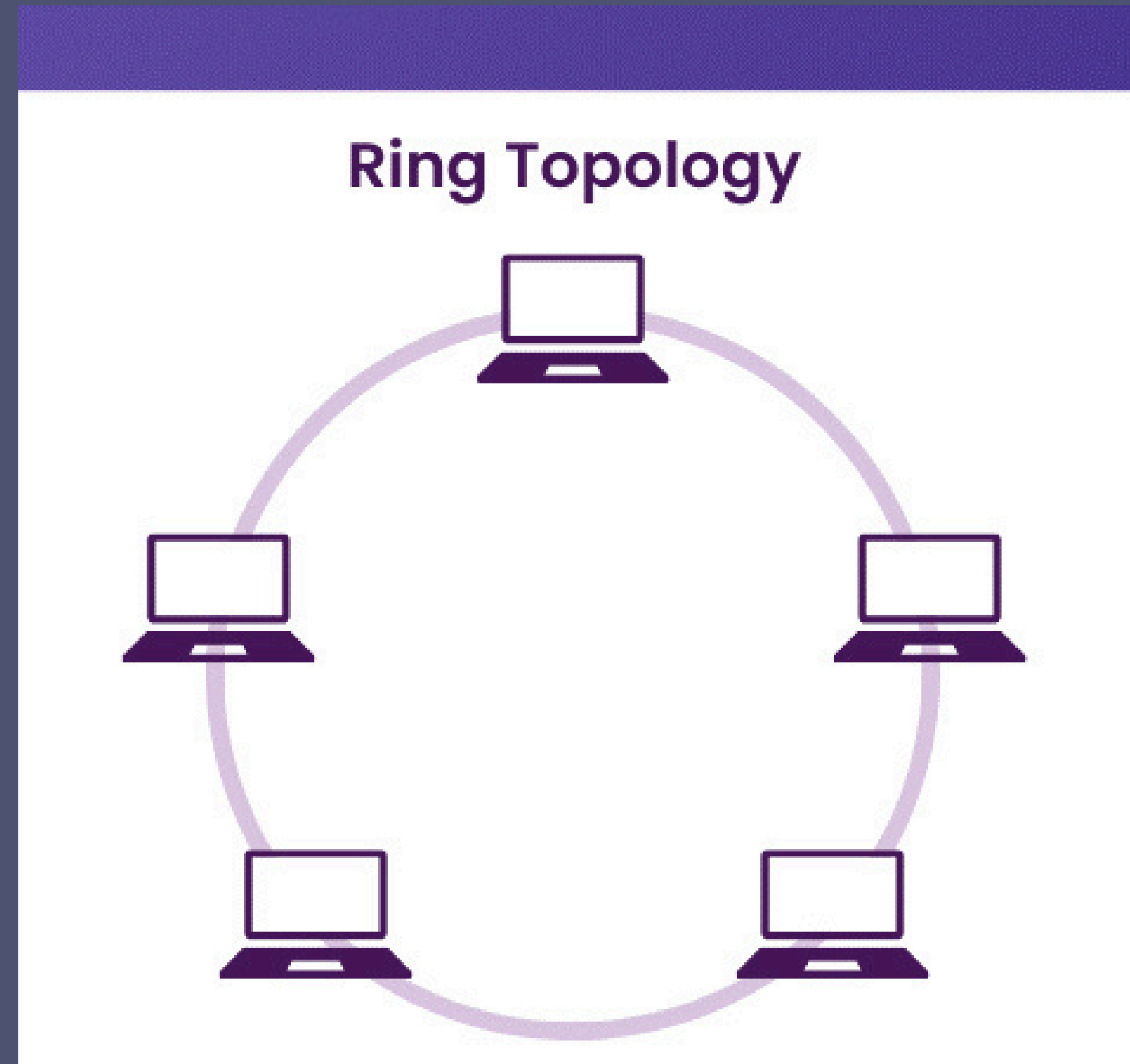
The most common access method of ring topology is token passing.

Token passing: It is a network access method in which a token is passed from one node to another node.

Token: It is a frame that circulates around the network.

Operations of Ring Topology

One station is known as a monitor station which takes all the responsibility for performing the operations.

To transmit the data, the station has to hold the token. After the transmission is done, the token is to be released for other stations to use.

When no station is transmitting the data, then the token will circulate in the ring.

There are two types of token release techniques: Early token release releases the token just after transmitting the data and Delayed token release releases the token after the acknowledgment is received from the receiver.

Advantages of Ring Topology

The data transmission is high-speed.
The possibility of collision is minimum in this type of topology.
Cheap to install and expand.
It is less costly than a star topology.

Disadvantages of Ring Topology

The failure of a single node in the network can cause the entire network to fail.
Troubleshooting is difficult in this topology.
The addition of stations in between or the removal of stations can disturb the whole topology.
Less secure.

Tree Topology

Tree topology is the variation of the Star topology. This topology has a hierarchical flow of data. In Tree Topology, protocols like DHCP and SAC (Standard Automatic Configuration) are used.

In tree topology, the various secondary hubs are connected to the central hub which contains the repeater. This data flow from top to bottom i.e. from the central hub to the secondary and then to the devices or from bottom to top i.e. devices to the secondary hub and then to the central hub. It is a multi-point connection and a non-robust topology because if the backbone fails the topology crashes.
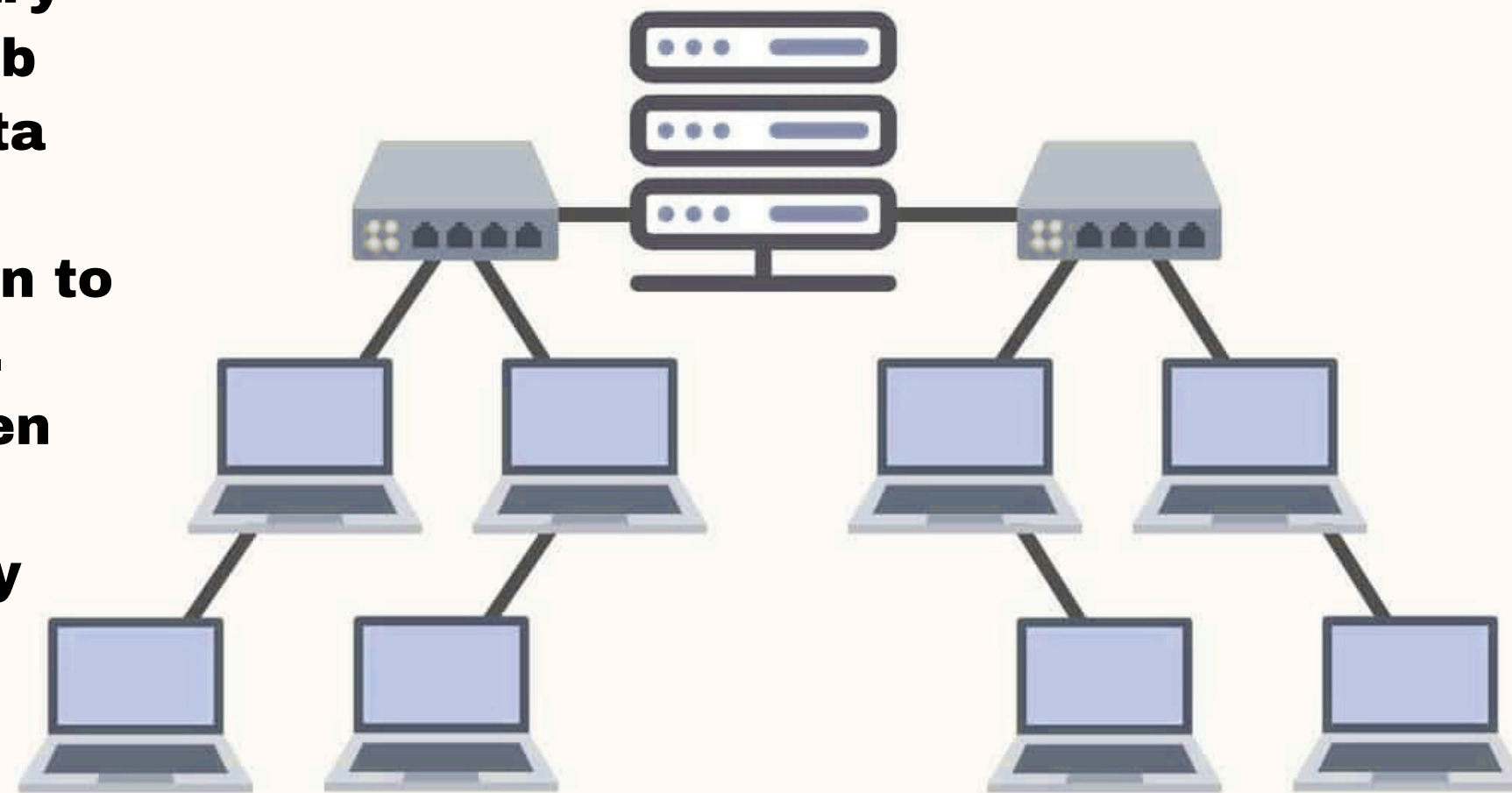
Advantages of Tree Topology

It allows more devices to be attached to a single central hub thus it decreases the distance that is traveled by the signal to come to the devices.
It allows the network to get isolated and also prioritize from different computers.
We can add new devices to the existing network.
Error detection and error correction are very easy in a tree topology.
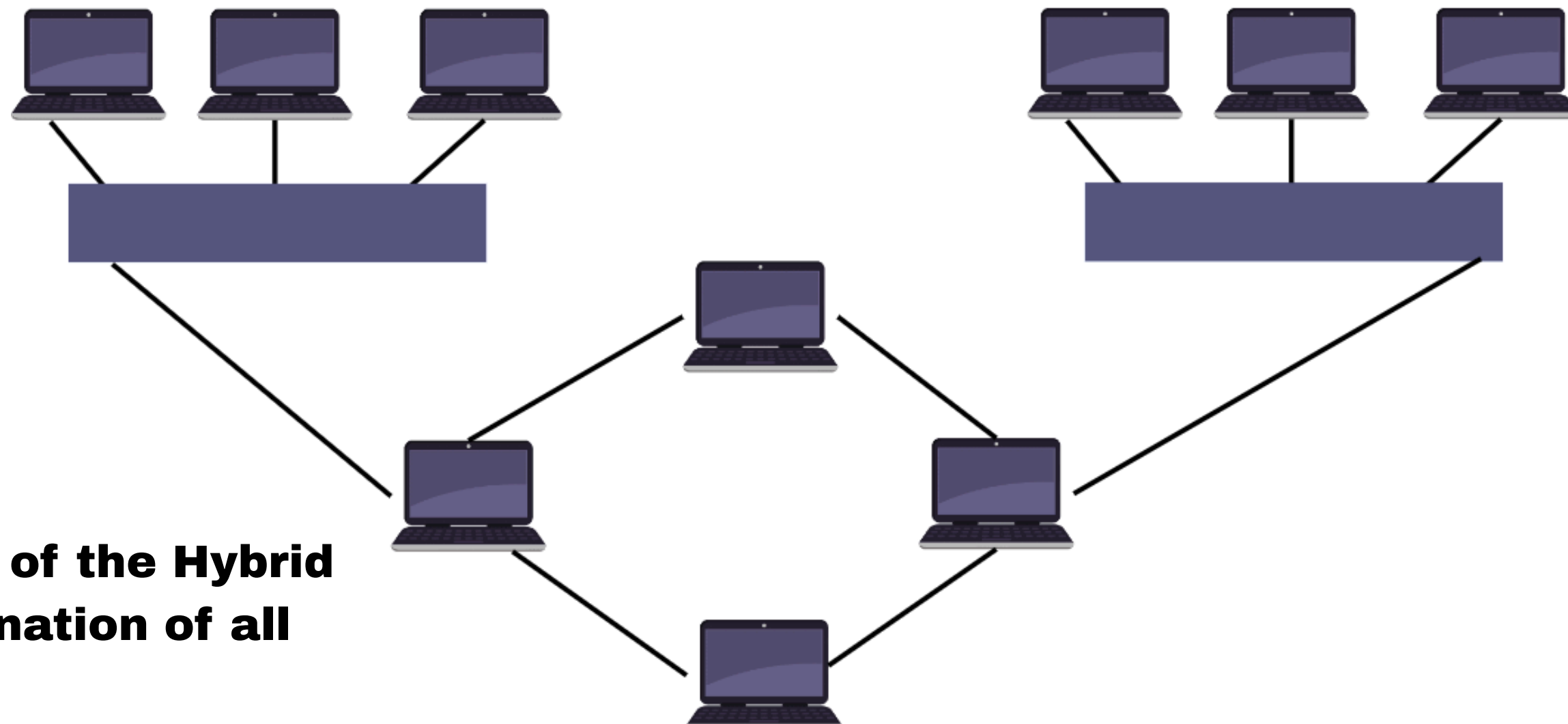
Disadvantages of Tree Topology

If the central hub gets fails the entire system fails.
The cost is high because of the cabling.
If new devices are added, it becomes difficult to reconfigure.

A common example of a tree topology is the hierarchy in a large organization. At the top of the tree is the CEO, who is connected to the different departments or divisions (child nodes) of the company. Each department has its own hierarchy, with managers overseeing different teams (grandchild nodes). The team members (leaf nodes) are at the bottom of the hierarchy, connected to their respective managers and departments.

Hybrid Topology

Hybrid Topology is the combination of all the various types of topologies we have studied above. Hybrid Topology is used when the nodes are free to take any form. It means these can be individuals such as Ring or Star topology or can be a combination of various types of topologies seen above. Each individual topology uses the protocol that has been discussed earlier.

The above figure shows the structure of the Hybrid topology. As seen it contains a combination of all different types of networks.

Advantages of Hybrid Topology

This topology is very flexible .
The size of the network can
be easily expanded by adding
new devices.

Disadvantages of Hybrid Topology

It is challenging to design the architecture
of the Hybrid Network.
Hubs used in this topology are very
expensive.
The infrastructure cost is very high as a
hybrid network requires a lot of cabling
and network devices .

A common example of a hybrid topology is a university campus network. The network may have a backbone of a star topology, with each building connected to the backbone through a switch or router. Within each building, there may be a bus or ring topology connecting the different rooms and offices. The wireless access points also create a mesh topology for wireless devices. This hybrid topology allows for efficient communication between different buildings while providing flexibility and redundancy within each building.

Factors to Consider When Choosing a Topology

Cost: Some topologies (e.g., mesh) are expensive, while others (e.g., bus) are budget-friendly.

Scalability: Star and tree topologies are easy to scale.

Fault Tolerance: Mesh and hybrid topologies are more fault-tolerant.

Security: Centralized topologies (like star) provide easier monitoring.

Real-World Examples (Case Studies)

Google: Uses mesh and hybrid topologies to ensure redundancy and reliability in their data centers.

Facebook: Uses a combination of tree and star topologies for scalability and management.

Corporate Networks: Often implement star or tree topologies for efficiency.

Why is Network Topology Important?

Network Topology is important because it defines how devices are connected and how they communicate in the network. Here are some points that defines why network topology is important.

Network Performance: Upon choosing the appropriate topology as per requirement, it helps in running the network easily and hence increases network performance.

Network Reliability: Some topologies like Star, Mesh are reliable as if one connection fails, they provide an alternative for that connection, hence it works as a backup.

Network Expansion : Chosing correct topology helps in easier expansion of Network as it helps in adding more devices to the network without disrupting the actual network.

Network Security: Network Topology helps in understanding how devices are connected and hence provides a better security to the network.
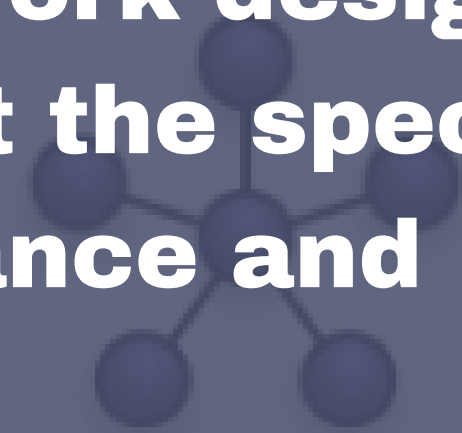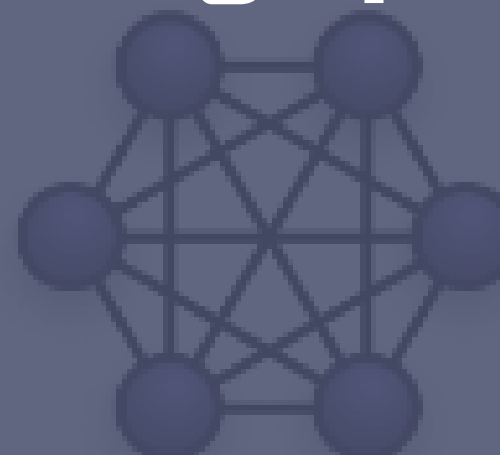
Conclusion
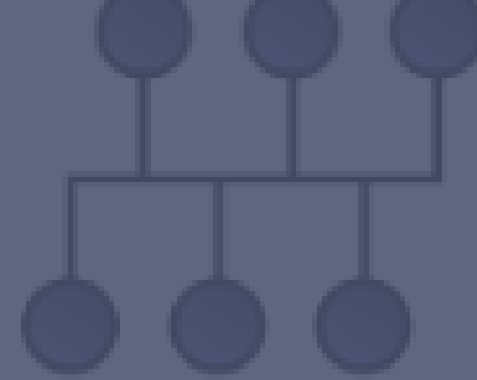
In conclusion, network topologies play a crucial role in determining the efficiency and reliability of a computer network. Each topology, whether it's bus, star, ring, mesh, or tree, offers unique benefits and potential drawbacks. By understanding these different arrangements, network designers can choose the most appropriate topology to meet the specific needs of their systems, ensuring optimal performance and connectivity.