

Lecture 13

Computer and Information Technology

**Computer Networking
Part I**

What is Networking?

Computer network is a system in which multiple computers are connected to each other to share data, programs and hardware resources. The process of connecting these computers into their network is what we call **computer networking** and in a network these connections can be either wired or wireless or both.



Purpose of Networking

1. File and Data Sharing

Files can be shared instantaneously across the network with hundreds of users if intended. In an office, its employees can contribute to documents, exchange material, revise spreadsheets and make simultaneous additions and updates to a single central customer database without generating conflicting versions.

2. Resource Sharing

Computer networking also allows the sharing of network resources, such as printers, dedicated servers, backup systems, input devices and Internet connections. By sharing resources, unique equipment like scanners, color printers or high-speed copiers can be made available to all network users simultaneously without being relocated, eliminating the need for expensive redundancies.

Purpose of Networking

3. Data Protection and Redundancy

Networking computers together allows users to distribute copies of important files across multiple locations, ensuring essential information isn't lost with the failure of any one computer in the network.

To do that we utilize central backup systems both on- and off-site and this backup process is carefully performed to ensure documents' integrity avoiding redundancy. Data can be gathered automatically from every computer in the network and securely backed up in case of physical computer damage or accidental deletion.

Purpose of Networking

4. Ease of Administration

Information technology (IT) officers and computer network administrators love network systems because they allow the IT professional to maintain uniform versions of software, protocols and security measures across hundreds or thousands of individual computers from one IT management station. Instead of individually upgrading each computer in a company one at a time, a network administrator can initiate an upgrade from a server and automatically duplicate the upgrade throughout the network simultaneously, allowing everyone in the company to maintain uniform software, resources and procedures.

Purpose of Networking

5. Internal Communications

Computer networking also allows organizations to maintain complex internal communications systems. Network email can be instantly delivered to all users. Voice mail, audio and video conferencing and calls can be arranged via network and made available to anyone connected to the network. Various scheduling software and program management tools allow employees to coordinate meetings and work activities that maximize effectiveness, while also notifying managers and co-workers of plans and progress.

Purpose of Networking

6. Distributing Computing Power

Organizations that demand extraordinary computing power can benefit from computer networking by distributing computational tasks across multiple computers throughout the network, breaking complex problems into hundreds or thousands of smaller operations, which are then parceled out to individual computers. Each computer in the network performs its operations on its own portion of the larger problem and returns its results to the controller, which gathers the results and makes conclusions no computer could accomplish on its own.

Types of Network

There are several different types of computer networks and computer networks can be characterized by their size as well as their purpose. Here we will only discuss their size based categorization.

The size of a network can be expressed by the geographic area they occupy and the number of computers that are part of the network. Networks can cover anything from a handful of devices within a single room to millions of devices spread across the entire globe.

Some of the different networks based on size are:

- Local area network, or LAN
- Metropolitan area network, or MAN
- Wide area network, or WAN

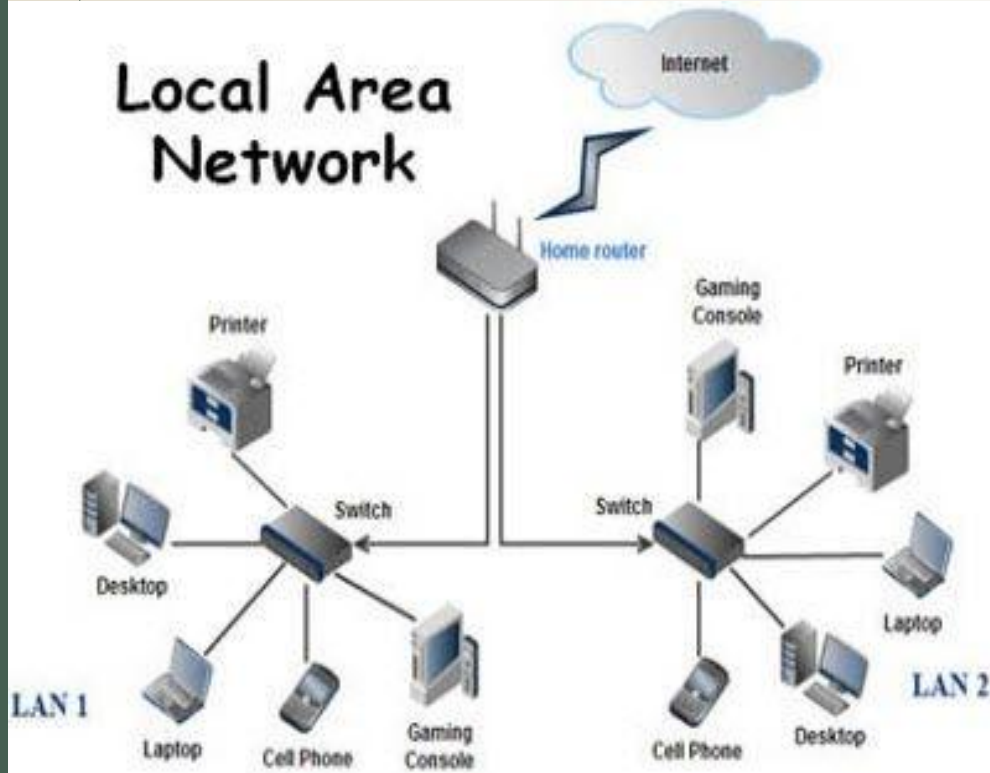
Local Area Network: LAN

LAN consists of a small number of computers at a single site, typically an individual office building. A LAN is very useful for sharing resources, such as data storage and printers. 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. A LAN typically relies mostly on wired connections for increased speed and security, but wireless connections can also be part of a LAN. High speed and relatively low cost are the defining characteristics of LANs.

A LAN is typically owned, controlled and managed by a single person or organization.

Local Area Network: LAN

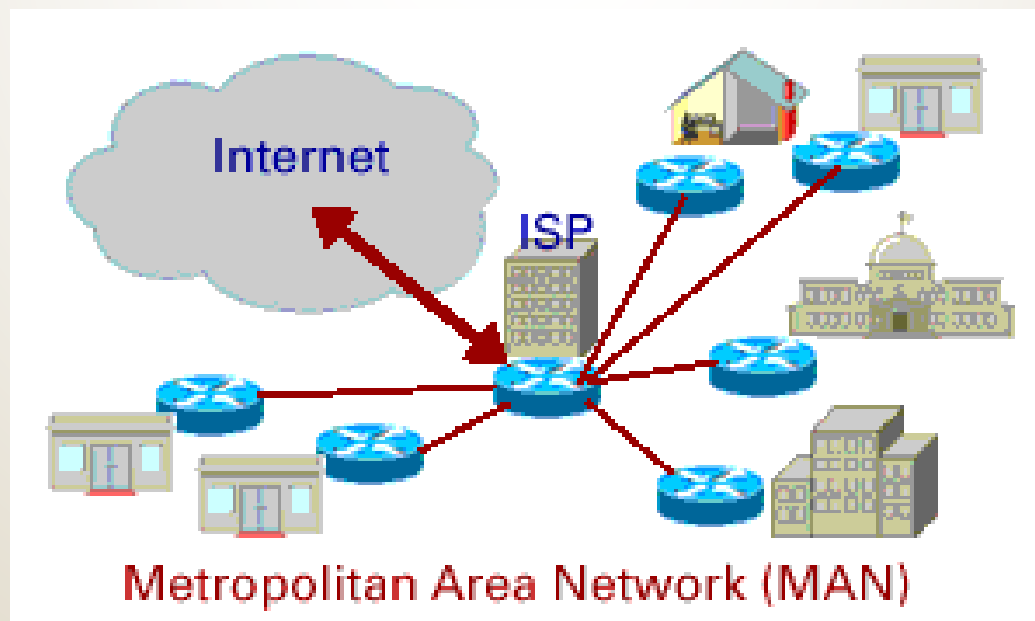


LANs are typically used for single sites where people need to share resources among themselves but not with the rest of the outside world. Think of an office building where everybody should be able to access files on a central server or be able to print a document to one or more central printers.

If a local area network, or LAN, is entirely wireless, it is referred to as a wireless local area network, or WLAN.

Metropolitan Area Network: MAN

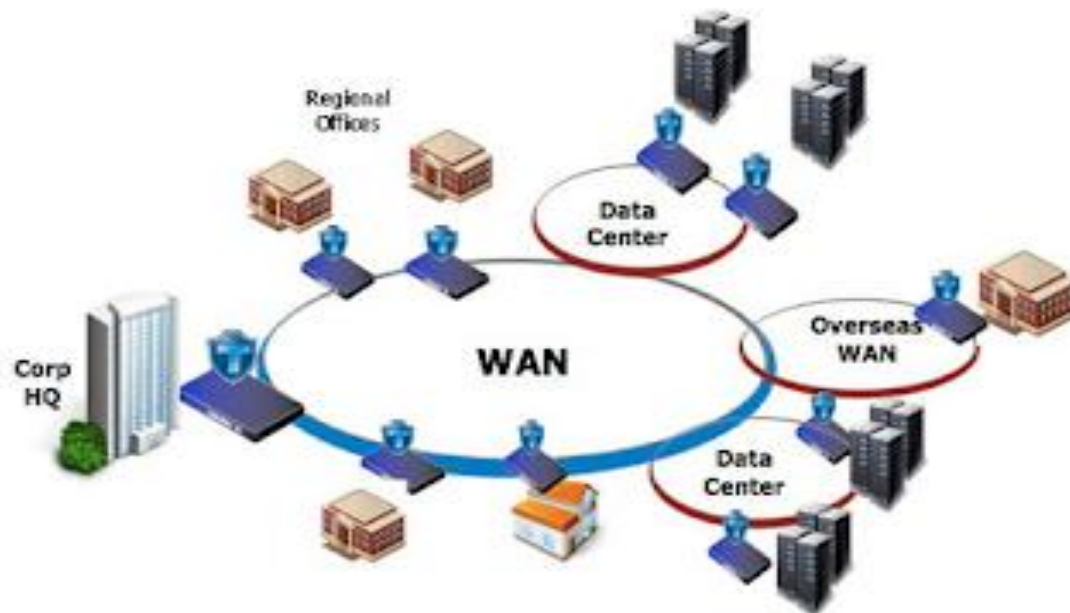
A MAN consists of a computer network across an entire city, university campus or small region. A MAN is larger than a LAN, which is typically limited to a single building or site. Depending on the configuration, this type of network can cover an area from several miles to tens of miles. A MAN is often used to connect several LANs together to form a bigger network.



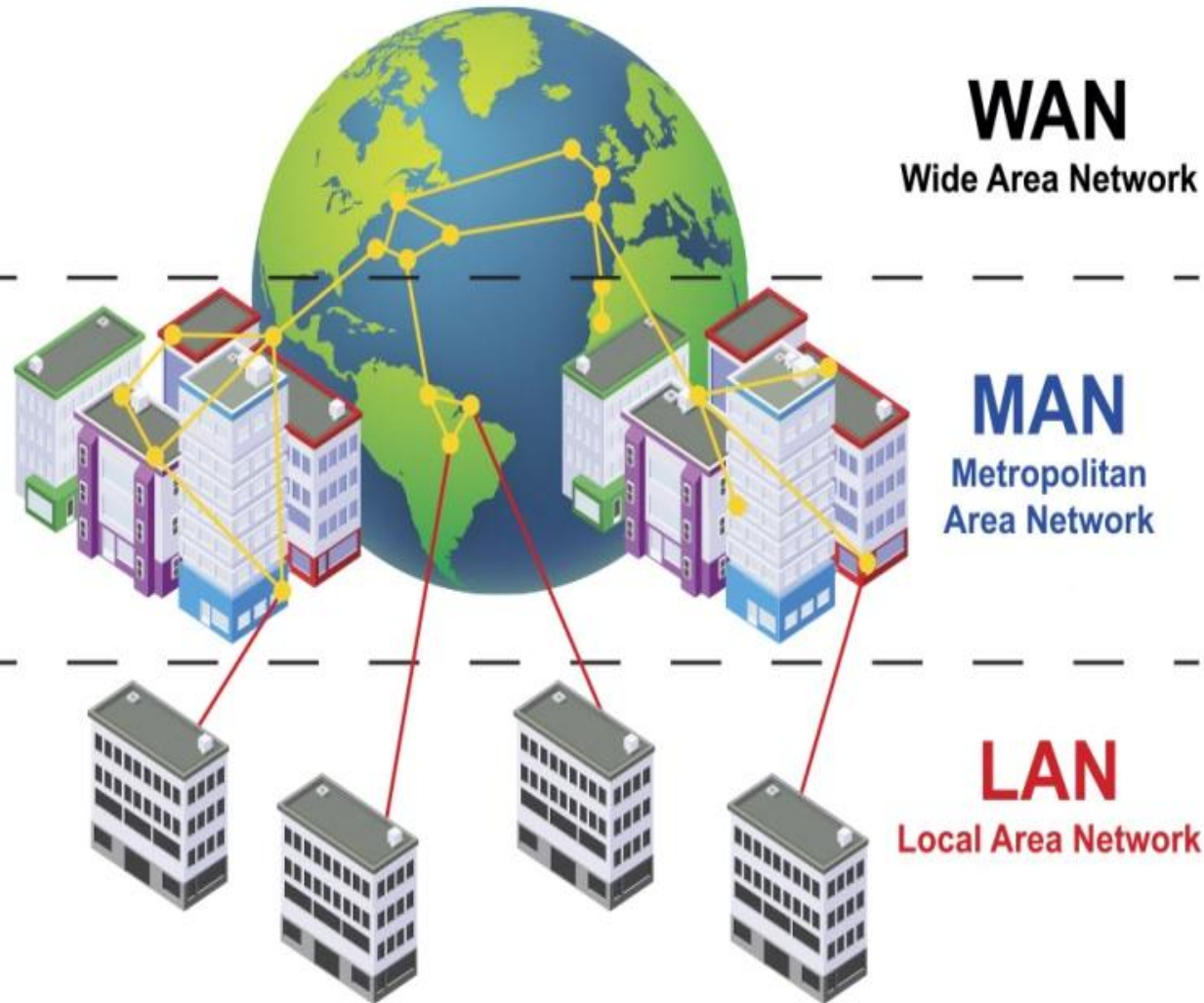
Wide Area Network: WAN

A wide area network, or WAN, occupies a very large area, such as an entire country or the entire world. A WAN can contain multiple smaller networks, such as LANs or MANs. The Internet is the best-known example of a public WAN.

WANs are not owned by any one organization but rather exist under collective or distributed ownership and management.



LAN vs. MAN vs. WAN



- Covers entire country, continent or the whole world.
- No single owner.
- Varied data transfer speed

- Size covers a city at best.
- MAN can be made up of a consortium of users or implemented by a single service provider.
- Better speed than WAN

- ❖ Size is smaller than 1km
- ❖ Owned by single owner or organization.
- ❖ Inside LAN, users enjoy best data transmission speed.

Network Topology

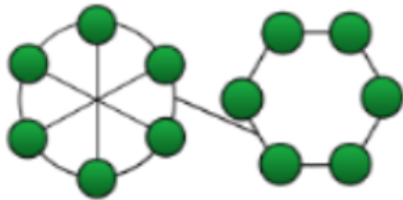
In a computer network, geometric representation of how they are connected to each other is known as network topology. Network topology is the way a network is arranged, including the physical or logical description of how links and nodes are set up to relate to each other.

There are mainly 4 types of networks according to their topology:

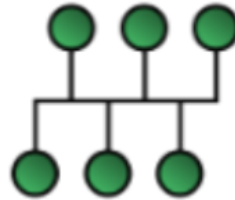
1. Star topology
2. Ring topology
3. Mesh topology
4. Bus topology

However, there are two other topologies; one is called tree (also known as Star Bus) and the other one is called hybrid which is in fact a combination of two or more different topologies.

Network Topology



HYBRID Topology



BUS Topology



RING Topology



TREE Topology



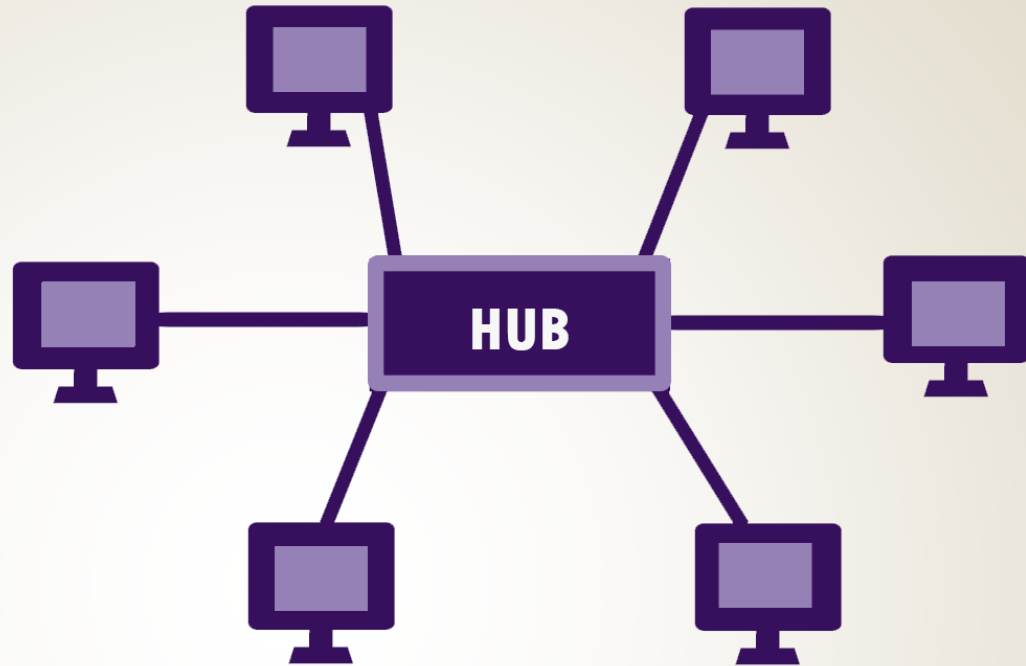
MESH Topology



STAR Topology



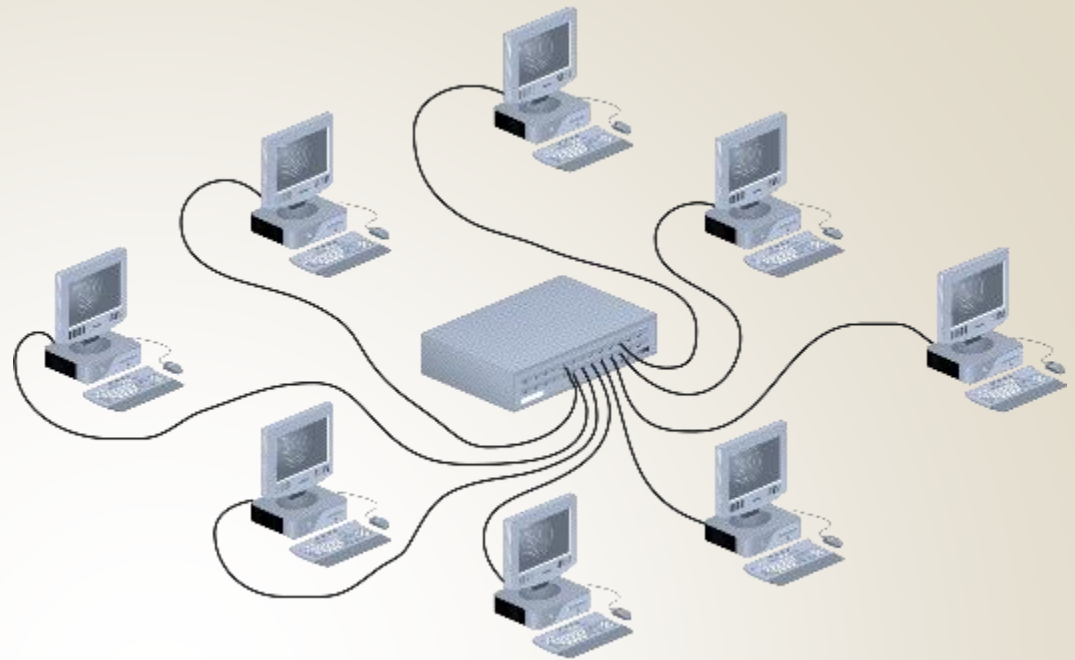
STAR Topology



Star topology is the most common network topology. In this network every node is directly connected to one central hub or switch or a router. This central node manages data transmission—as information sent from any node on the network has to pass through the central one to reach its destination.



STAR Topology

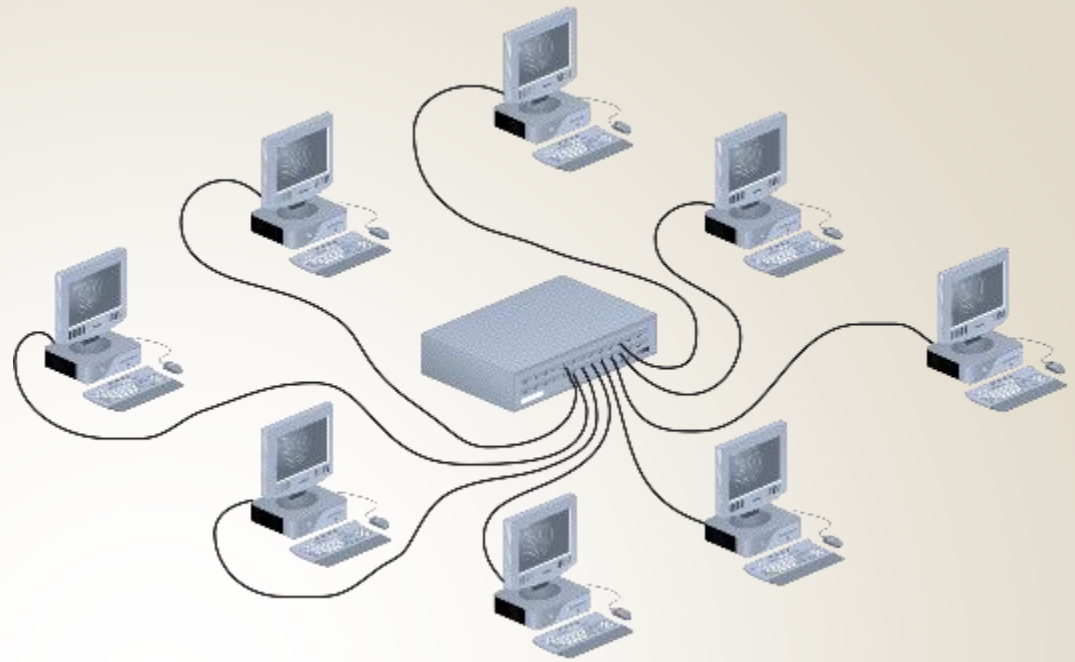


Advantages of Star Topology

- ✓ Can manage the entire network from a single location.
- ✓ Because each of the nodes is independently connected to the central hub, should one go down, the rest of the network will continue functioning unaffected, making the star topology a stable and secure network layout.
- ✓ Devices can be added, removed, and modified without taking the entire network offline.
- ✓ Star topology uses relatively less cabling to connect the network.



STAR Topology



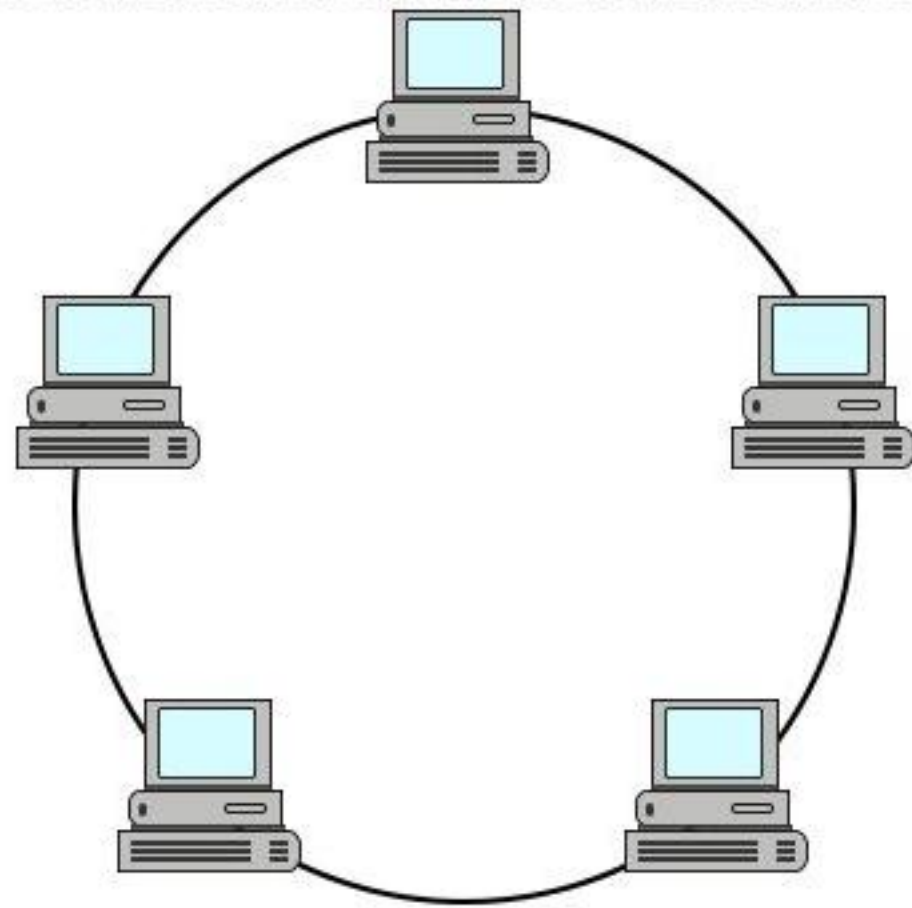
Disadvantages of Star Topology

- ❖ If the central hub goes down, the rest of the network can't function.
- ❖ The overall bandwidth and performance of the network are limited by the central node's configurations and technical specifications, making star topologies expensive to set up and operate.



RING Topology

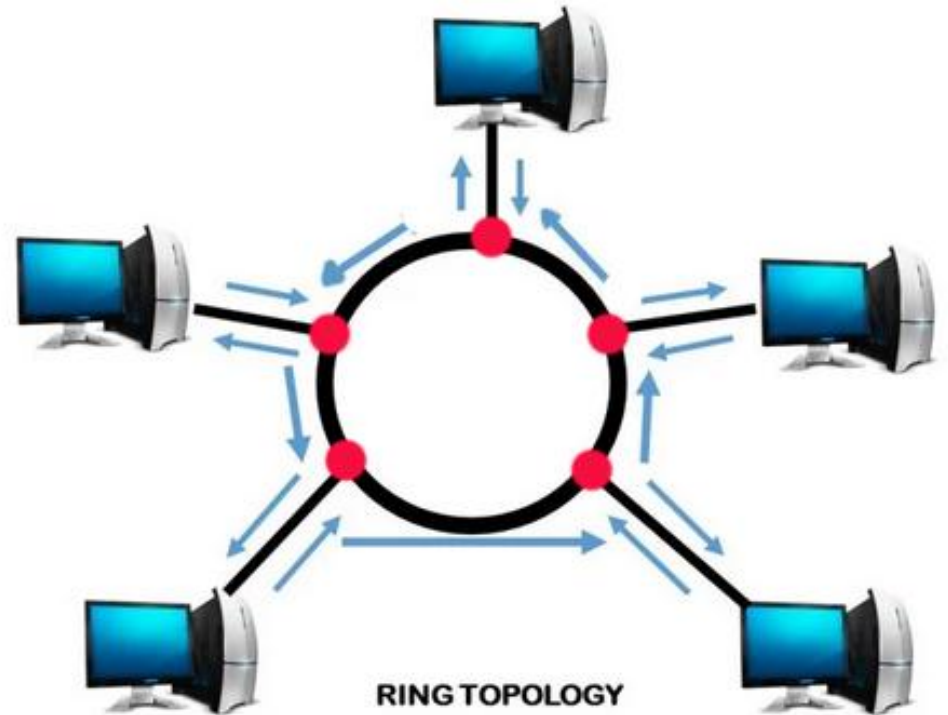
Ring topology is where nodes are arranged in a circle (or ring). The data can travel through the ring network in either one direction or both directions, with each device having exactly two neighbors.



Rings can be of various configurations. Here we will discuss the pros and cons of one way ring only



RING Topology

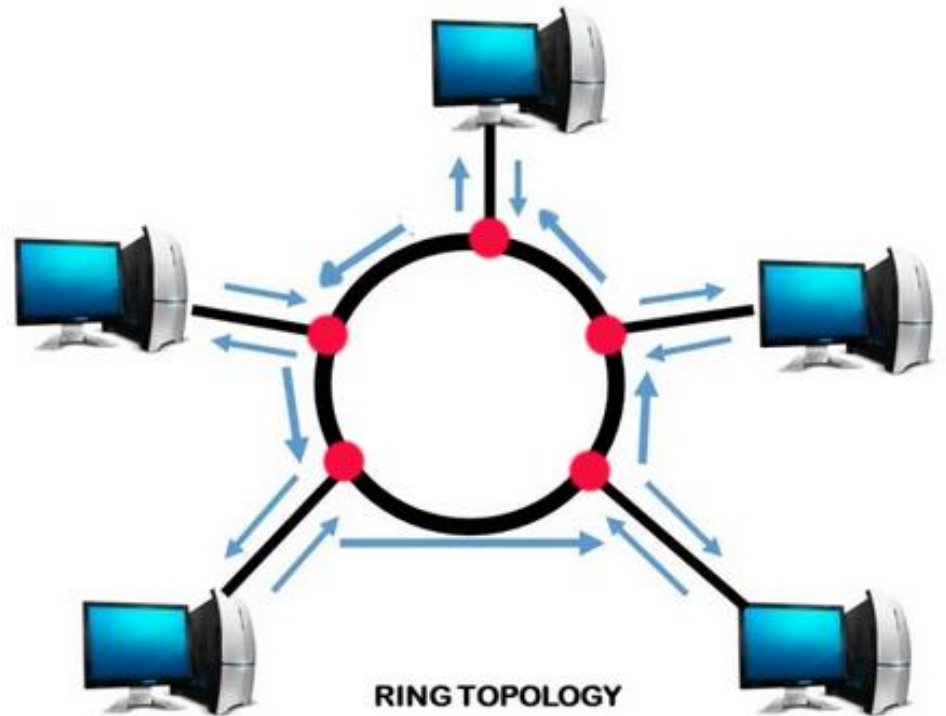


Advantages of Ring Topology

- ✓ Only one station on the network is permitted to send data at a time, which greatly reduces the risk of packet collisions, making ring topologies efficient at transmitting data without errors.
- ✓ Ring topologies are cost-effective and inexpensive to install,
- ✓ As each node is connected to two other nodes only, it is relatively easy to identify issues or misconfigurations on the network.



RING Topology

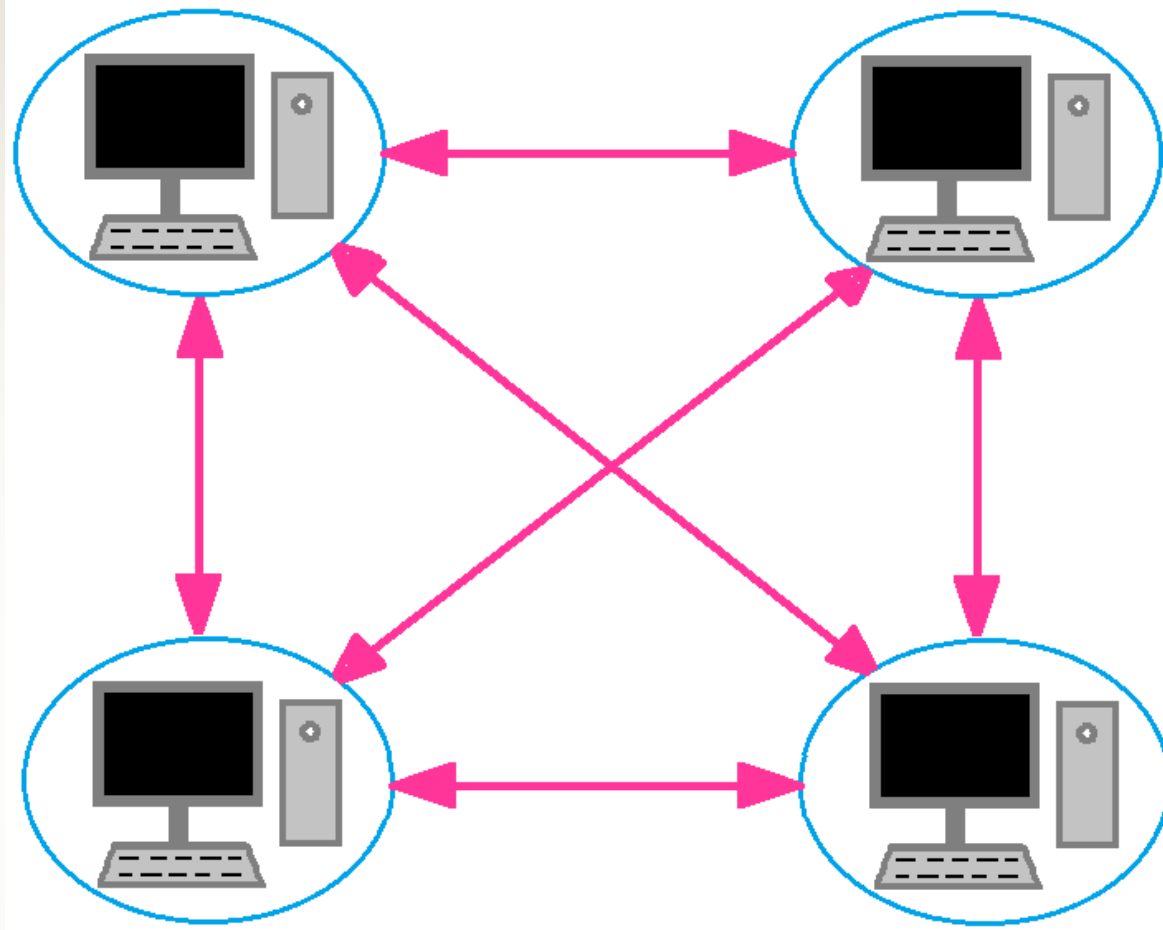


Disadvantages of Ring Topology

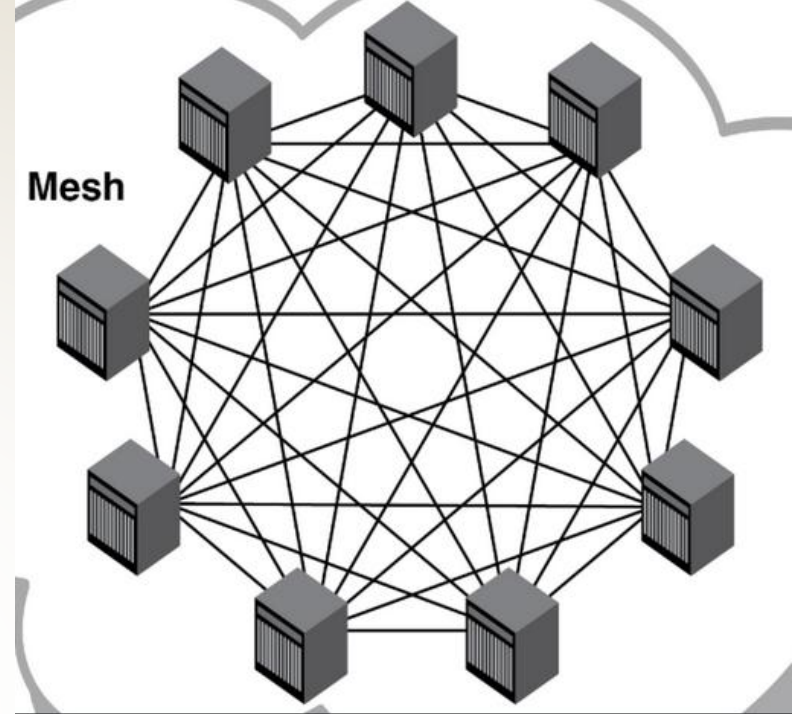
- ❖ If one node goes down, it can take the entire network with it.
- ❖ The addition of more devices can contribute to overall communication delays
- ❖ The entire network must be taken offline to reconfigure, add, or remove nodes.



MESH Topology

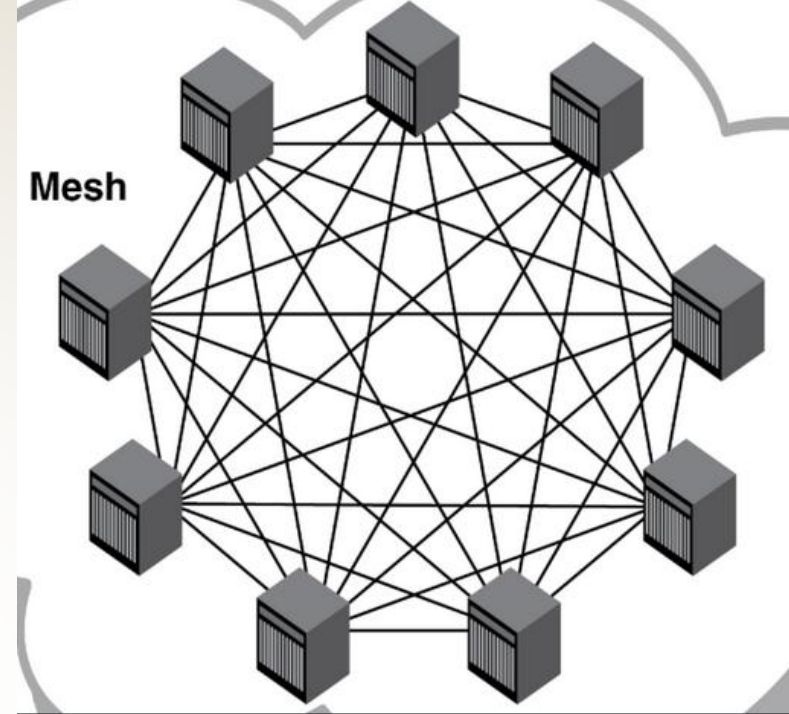


A mesh topology is an intricate and elaborate structure of point-to-point connections where the nodes are interconnected. Mesh networks can be full or partial mesh. Partial mesh topologies are mostly interconnected, with a few nodes with only two or three connections, while full-mesh topologies are fully interconnected.



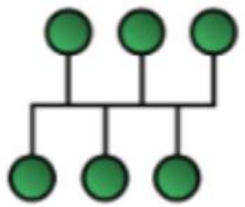
Advantages of Mesh Topology

- ✓ Mesh topologies are reliable and stable, and the complex degree of interconnectivity between nodes makes the network resistant to failure. For instance, no single device going down can bring the network offline.
- ✓ Communication is very fast between any two nodes as messages do not have to go through any other 3rd party nodes or routers.

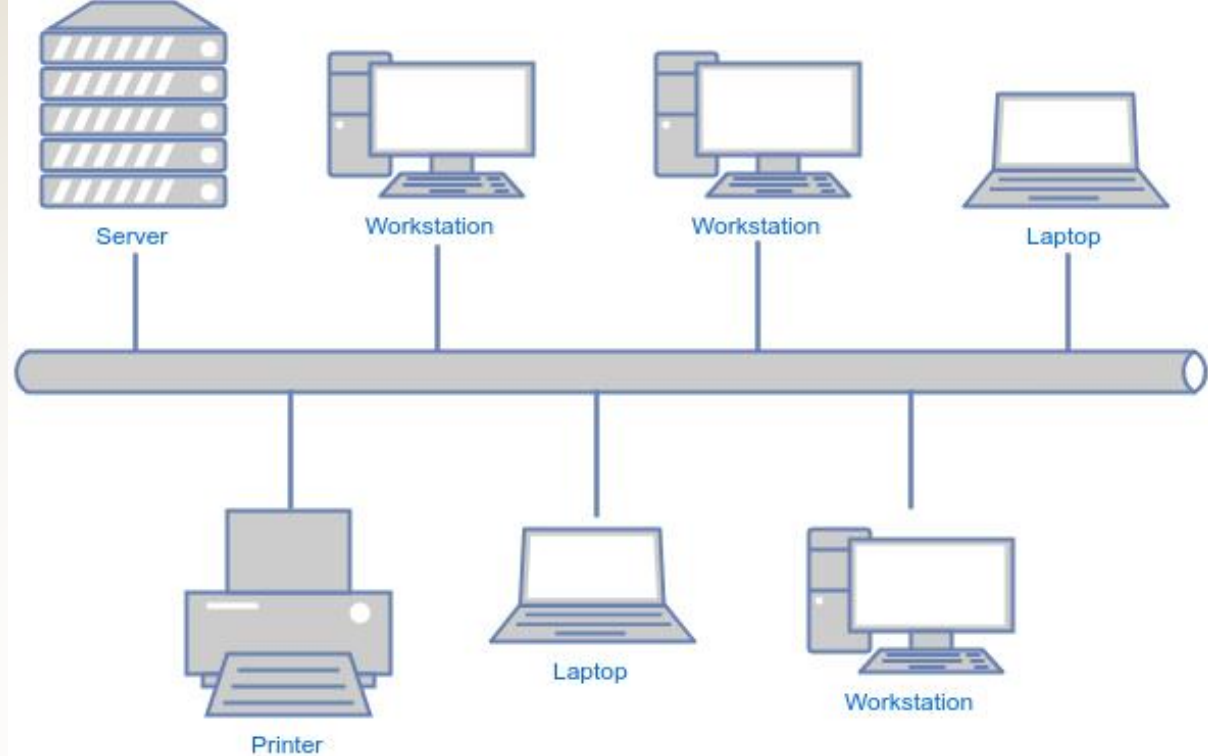


Disadvantages of Mesh Topology

- ❖ Mesh topologies are incredibly labor and time intensive. Each interconnection between nodes requires a cable and configuration once deployed.
- ❖ The cost of cabling adds up fast with each new node. In a fully mesh network with 'n' no. of nodes, it will require $\frac{n(n-1)}{2}$ no. of connecting cables.



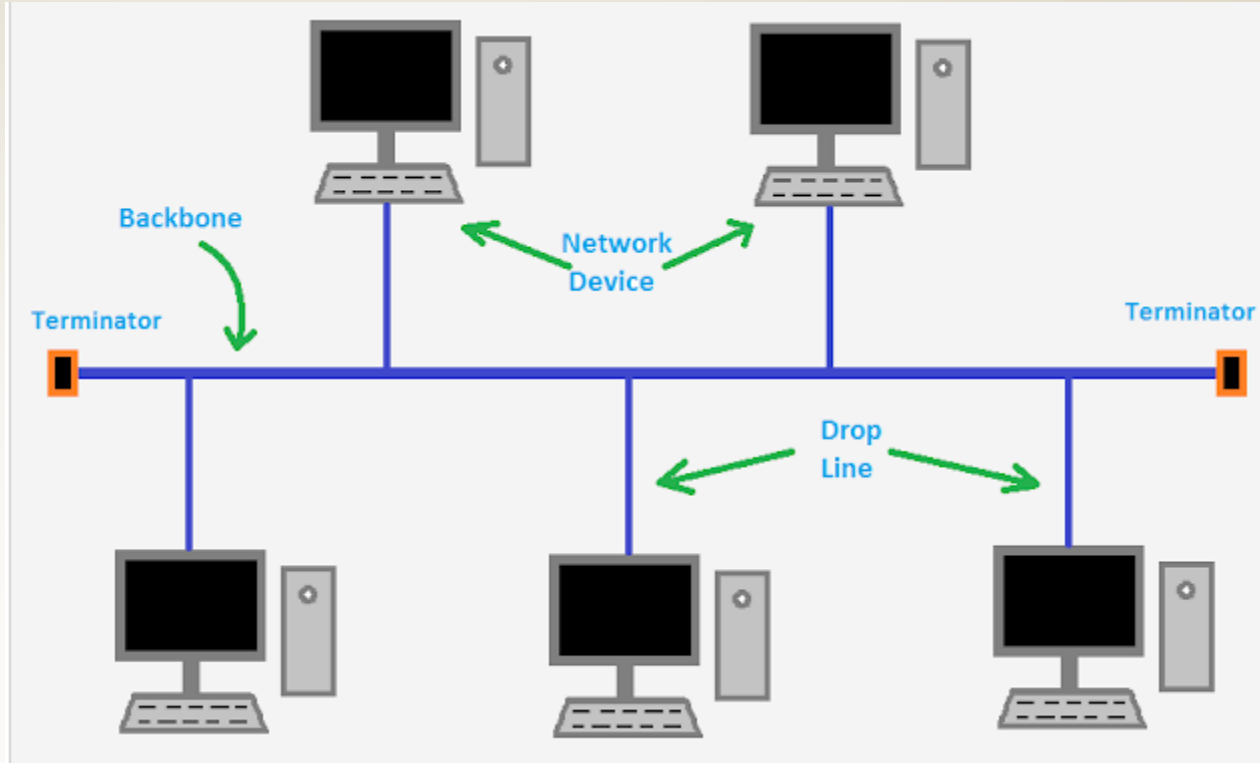
BUS Topology



A bus topology orients all the devices on a network along a single cable running in a single direction from one end of the network to the other—which is why it’s sometimes called a “line topology” or “backbone topology” because this cable is the backbone bus of this type of network.



BUS Topology

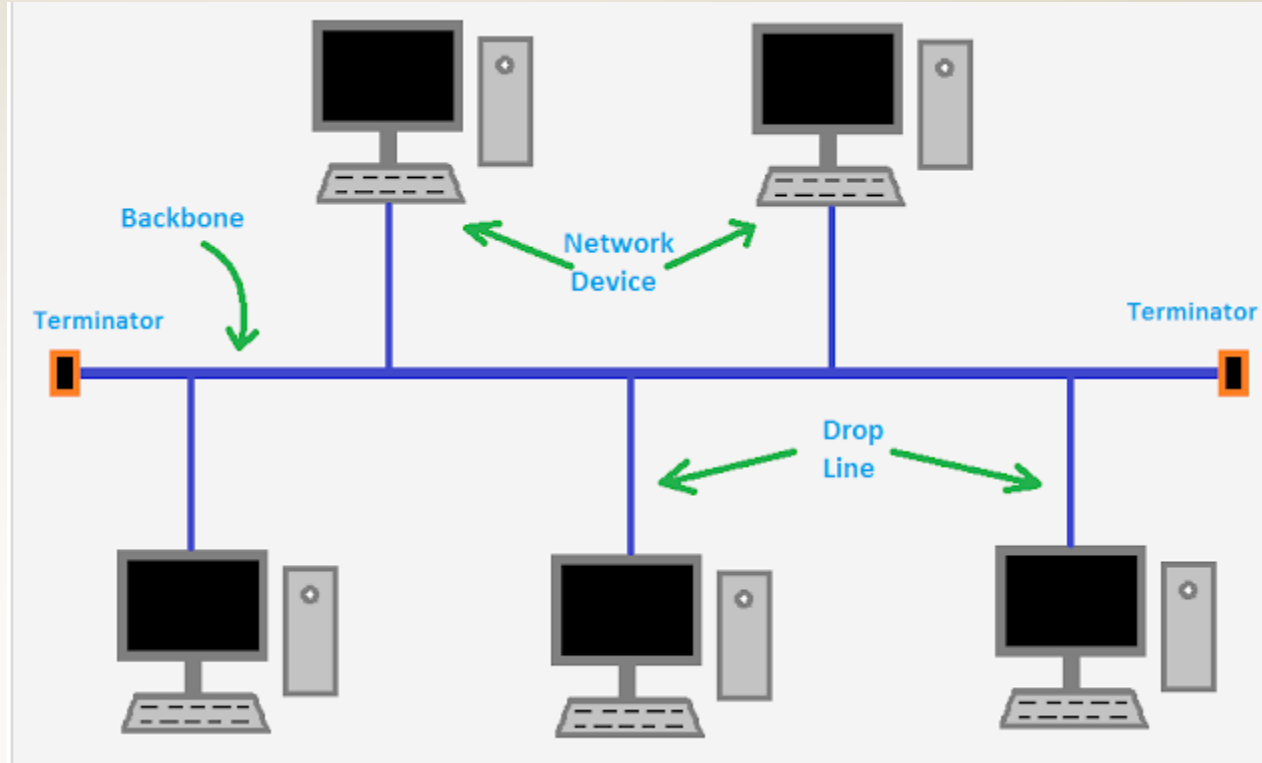


Advantages of Bus Topology

- ✓ This topology requires fewer physical lines and hence ensures cost effectiveness.
- ✓ They are good choice for smaller networks because the layout is simple, allowing all devices to be connected via a single coaxial or RJ45 cable. If needed, more nodes can be easily added to the network by joining additional cables.
- ✓ In case of a node failure, the rest of the network does not suffer.

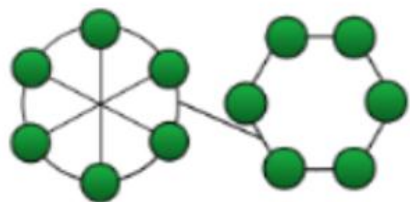


BUS Topology



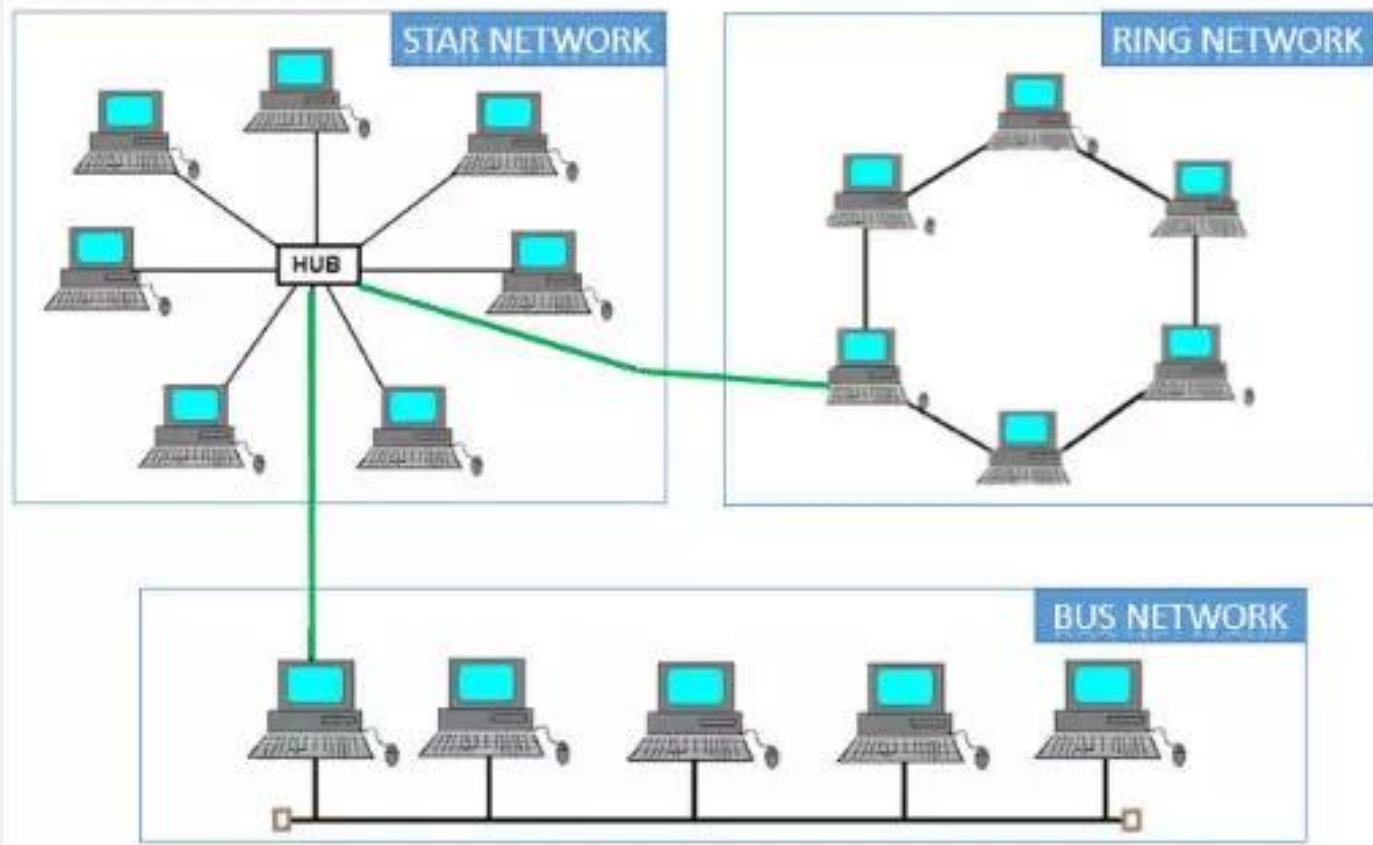
Disadvantages of Bus Topology

- ❖ If the backbone fails, the entire network goes offline.
- ❖ Bus topologies are best suited for small networks as every additional node reduces transmission speed because of limited bandwidth.
- ❖ Data is “half-duplex,” which means it can’t be sent in two opposite directions at the same time, so this layout is not the ideal choice for networks with huge amounts of traffic.



HYBRID Topology

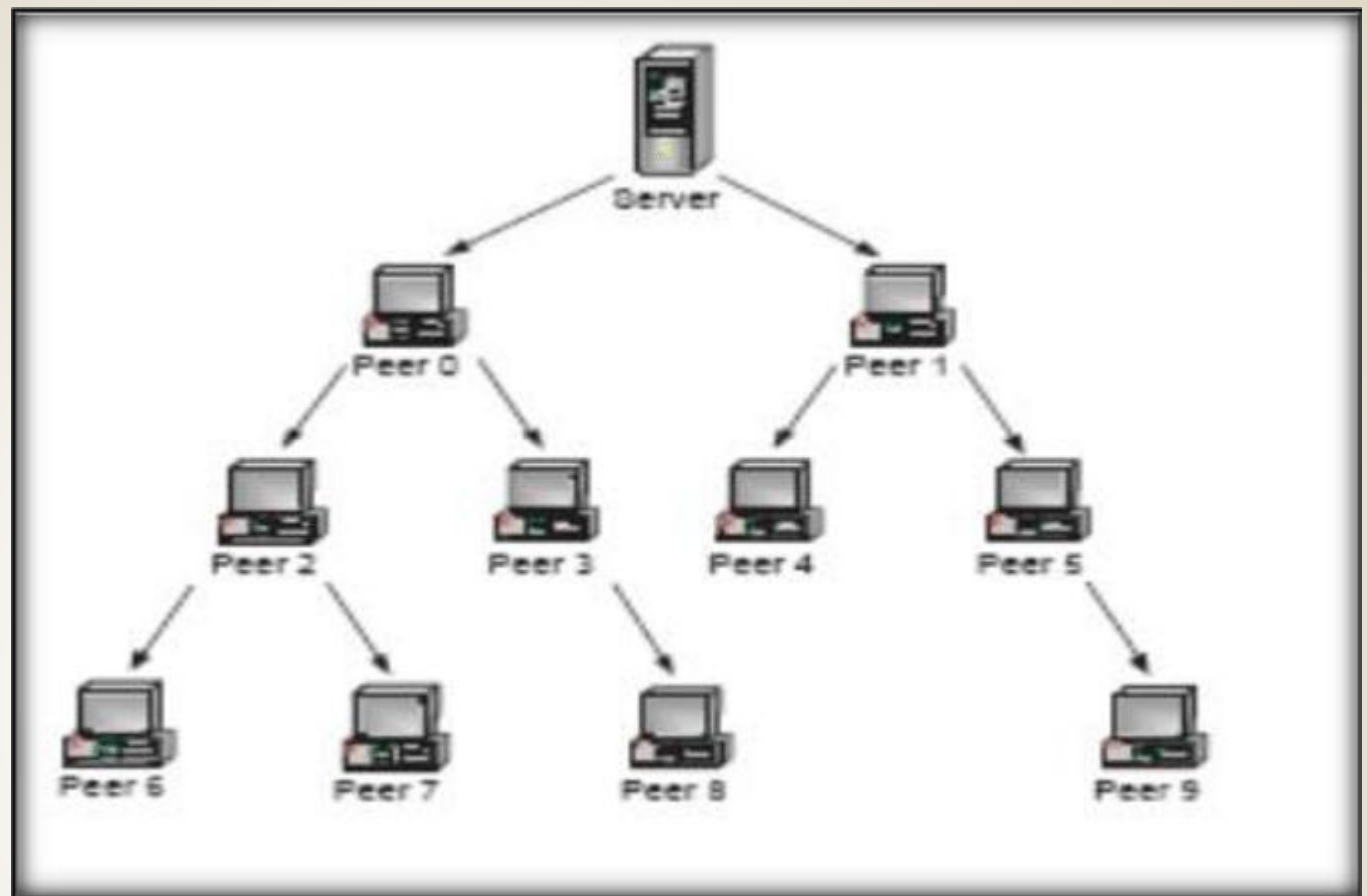
HYBRID TOPOLOGY



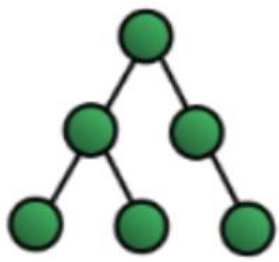
Hybrid topologies combine two or more different topology. Hybrid structures are most commonly found in larger companies where individual departments have personalized network topologies adapted to suit their needs and network usage.



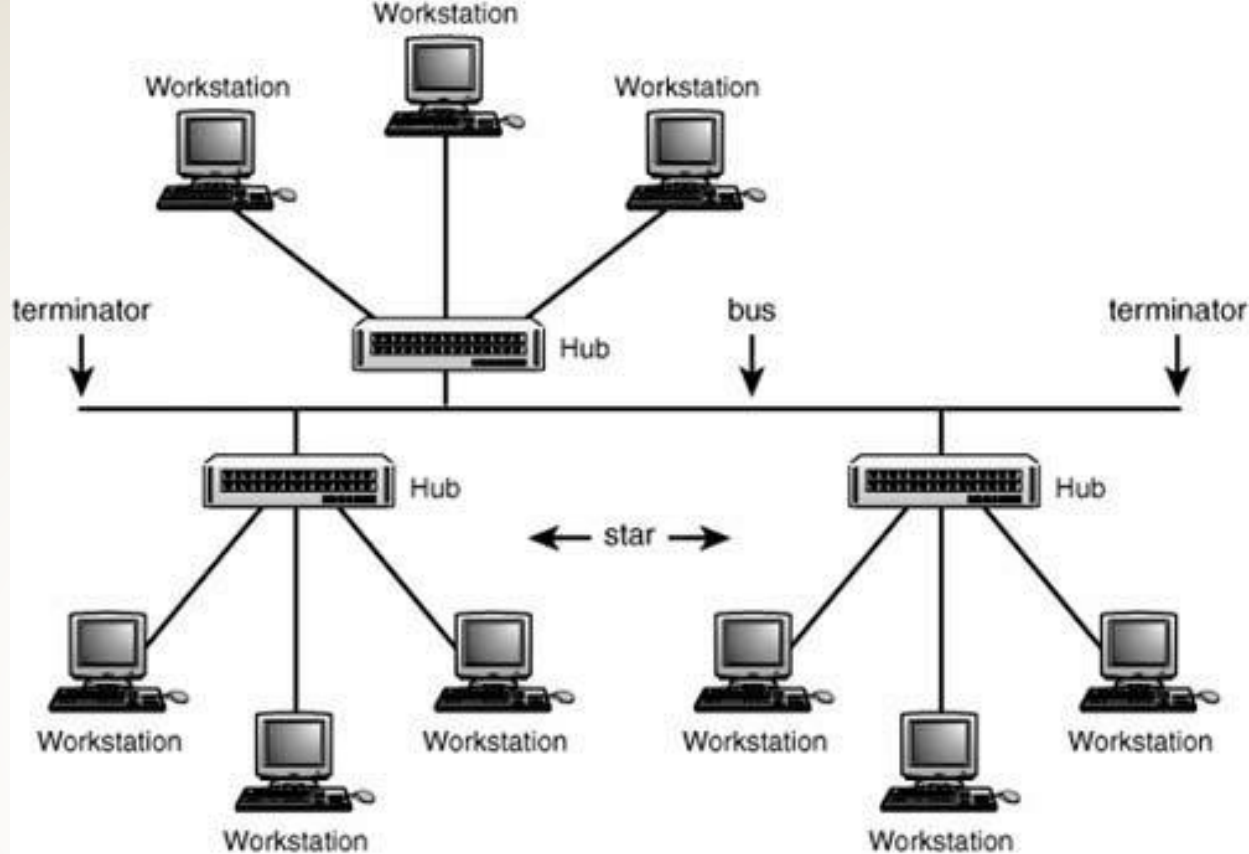
TREE Topology



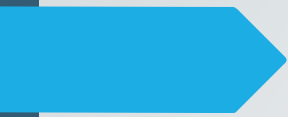
Tree topology gets its name from how the central node functions as a sort of trunk for the network, with nodes extending outward in a branch-like fashion. Tree topology has a parent-child hierarchy to how the nodes are connected. This structure is both extremely flexible and scalable, it's often used for wide area networks to support many spread-out devices.



TREE Topology



Tree, which is also known as star-bus topology allows for the easy addition of nodes and network expansion. Though it looks complex, troubleshooting is a straightforward process, as each of the branches can be individually assessed for performance issues. However the entire network depends on the health of the root node. Failure of root will disconnects its branches from one another keeping them able to communicate within their own branch.



Stay Home, Stay Safe
Always put on a mask
when you are in public!

