SHRI VILEPARLE KELAVANI MANDAL'S
DWARKADAS J. SANGHVI COLLEGE OF ENGINEERING
(Autonomous College Affiliated to the University of Mumbai)
NAAC ACCREDITED with "A" GRADE (CGPA : 3.18)
Department of Computer Engineering

Class: S.Y. B.Tech. Semester: IV

Course Code: DJ19CEL405 Course Name: Computer Networks Lab

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Date of Performance: Date of Submission:

Experiment No: 1

Aim: To study different networking devices and topologies.

Theory:

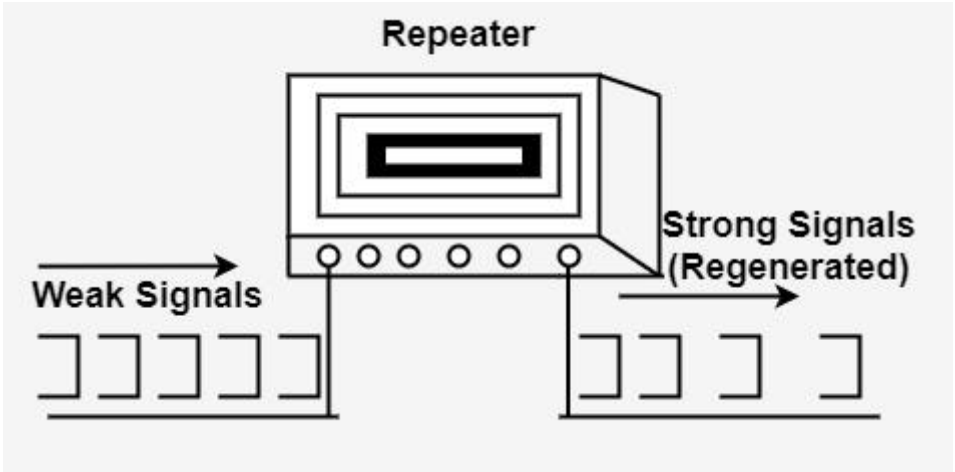
Networking Devices:

1) Repeater:

- Introduction:

  Repeater is a buffer like device where in the weak signals are regenerated into strong signal so it basically is buffer.
  It is operated at physical layer. This device has two ports.
  Repeaters are commonly used in the Ethernet networks, where they can extend the distance over which data can be transmitted between network devices. They are often used in conjuction with other networking devices such as switches and routes to help extend the reach of network

- Diagram:



❖ Advantages:

- The repeater provides the stability of the signals.
- These repeaters are cost-effective and easy to use
- They are transparent to the network meaning they don't modify or alter the signal in any way.
- They increase the network range

❖ Disadvantages:

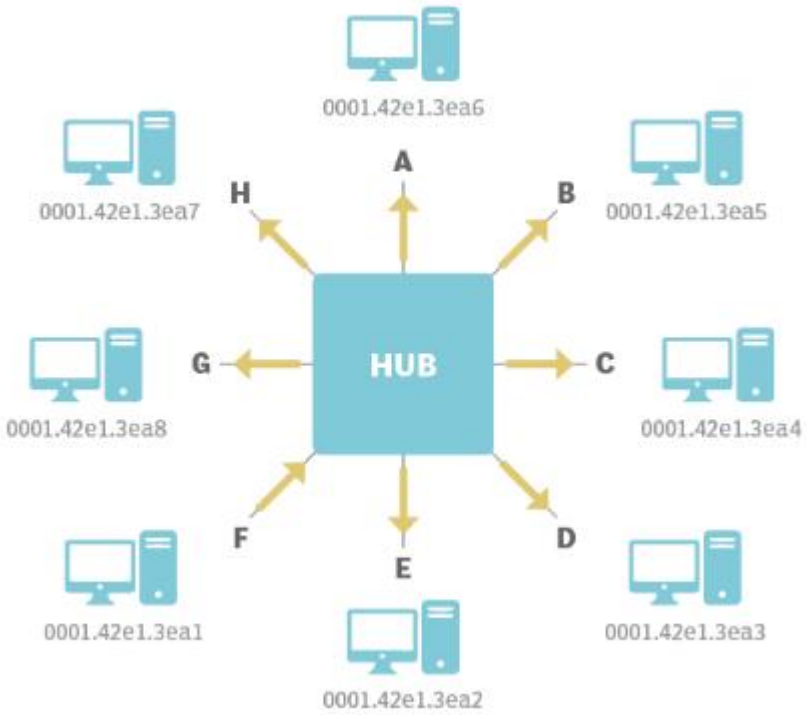
- It has limited capacity i.e. If more of them are deployed, it'll create noises on the wire and increase the possibilities of packet collision
- It can cause signal degradation as each time a signal is regenerated there is loss of original signal which cause degradation, also it can amlify the noise.
- It has limited capability, they can regenerate the signal and extend the range but it cant perform function like filtering and directing traffic

2) Hub :

❖ Introduction:

It is a basic network device that is used to connect multiple device in a network. It is operated at physical layer of Osi model.
A hub works by receiving data packets from one device and broadcasting them to all other devices connected to it.
This means that any device connected to the hub can receive data sent by any other device connected to the hub. It has 4 ports

❖ Diagram:



❖ Advantages:

- They are simple so they are easy to install All you need to do is plug in the devices, and they will start communicating with each other.
- They are cost effective solution for small network as it inexpensive
- Hubs do not require any configuration, which means they are plug-and-play devices. This makes them ideal for home networks or small offices.
- Hubs can be used to create a simple network topology with a star configuration. This makes it easy to manage and troubleshoot the network.

❖ Disadvantages:

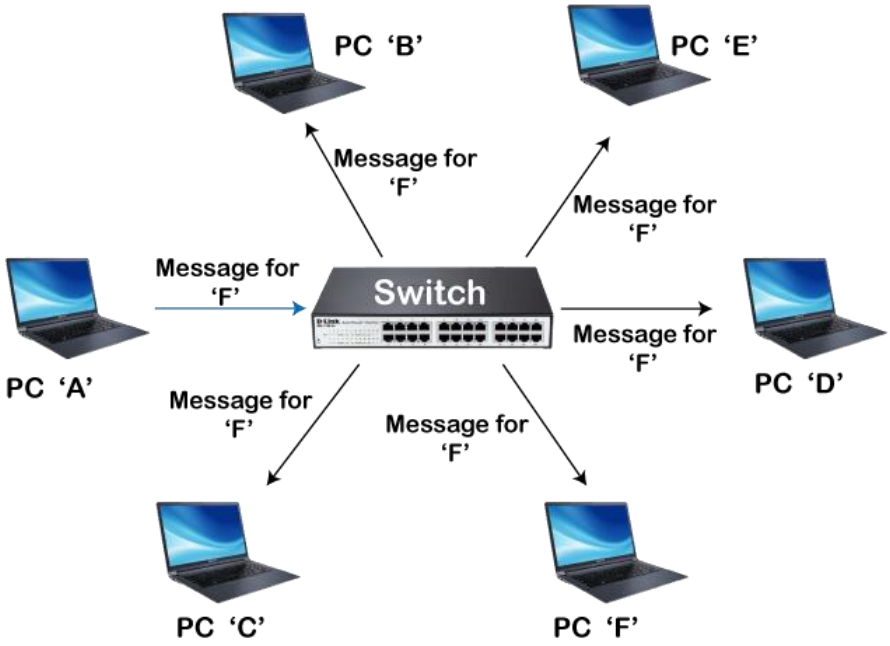
- Hubs do not have any built-in security features, which means that any device connected to the hub can access the network
- They are not highly scalable as more and more devices are connected to its network performance gets degrade.,
- It has no traffic management
- It also has limited bandwidth as all the devices connected to them share the same bandwidth. This can lead to network congestion and slow network speeds

3) Switch :

- introduction:

Switches are networking devices that connect devices together within a local area network (LAN). It is operated at the data link layer. They are commonly used network devices. When a switch receives a data packet, it examines the destination MAC address and forwards the packet only to the port that connects to the device with that MAC address. This process is called "switching."
Switches can have different port densities, ranging from 4 ports to 48 ports or more. They also differenet speeds. By connecting switches together, network administrators can increase network capacity and improve network reliability.

- diagram:



- advantages:
  - it has increased network performance Switches allow for dedicated bandwidth between devices, meaning that data packets are sent only to their intended destination rather than being broadcast to all devices on the network.
  - It reduces the network congestion and improves performance
  - It has improved security as it sends the data packet to its desired destination.
  - Switches can be connected together to create larger networks, allowing businesses to expand their networks as needed

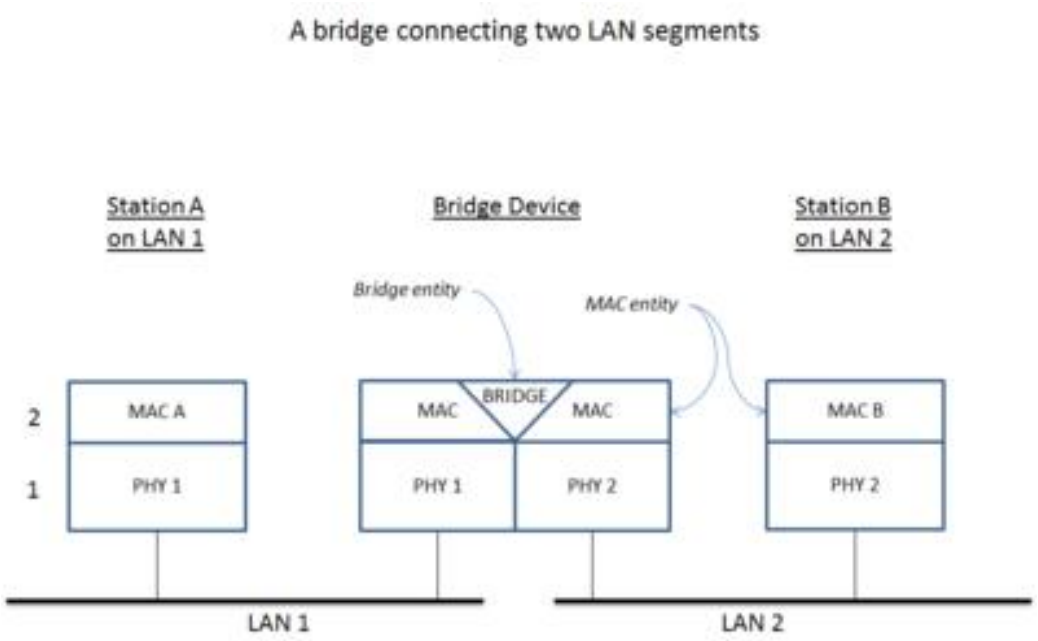
- Disadvantages:
  - They are expensive than other networking devices
  - They are also complex devices difficult to manage\
  - Because switches are critical networking devices, a failure in the switch can bring down the entire network
  - As switch is designed to use within LAN so they have limited distance capabilities

4) Bridge :

❖ introduction:

it is a network device used to connect two or more network segments together effectively creating a single network.
It is operated at the data link layer ,it is designed to forward data packets between different network segments based on their MAC addresses. A bridge can be used to connect different types of network technologies, such as Ethernet and Wi-Fi, and can also be used to connect different networks with different network addresses. In this case, the bridge will forward packets between the networks while maintaining their original network addresses.

❖ diagram:



❖ advantages:

- A bridge network device can divide a network into smaller segments, which reduces the amount of network traffic on each segment, resulting in more efficient use of available bandwidth.
- By dividing a network into smaller segments, a bridge network device can reduce the likelihood of collisions and congestion, leading to improved network performance and reduced latency.
- A bridge network device can be used to create separate network segments, which can be used to implement different security policies and restrict access to sensitive data, thus improving overall network security.
- A bridge network device is a relatively inexpensive solution compared to other network devices, such as routers or switches.

❖ Disadvantages:

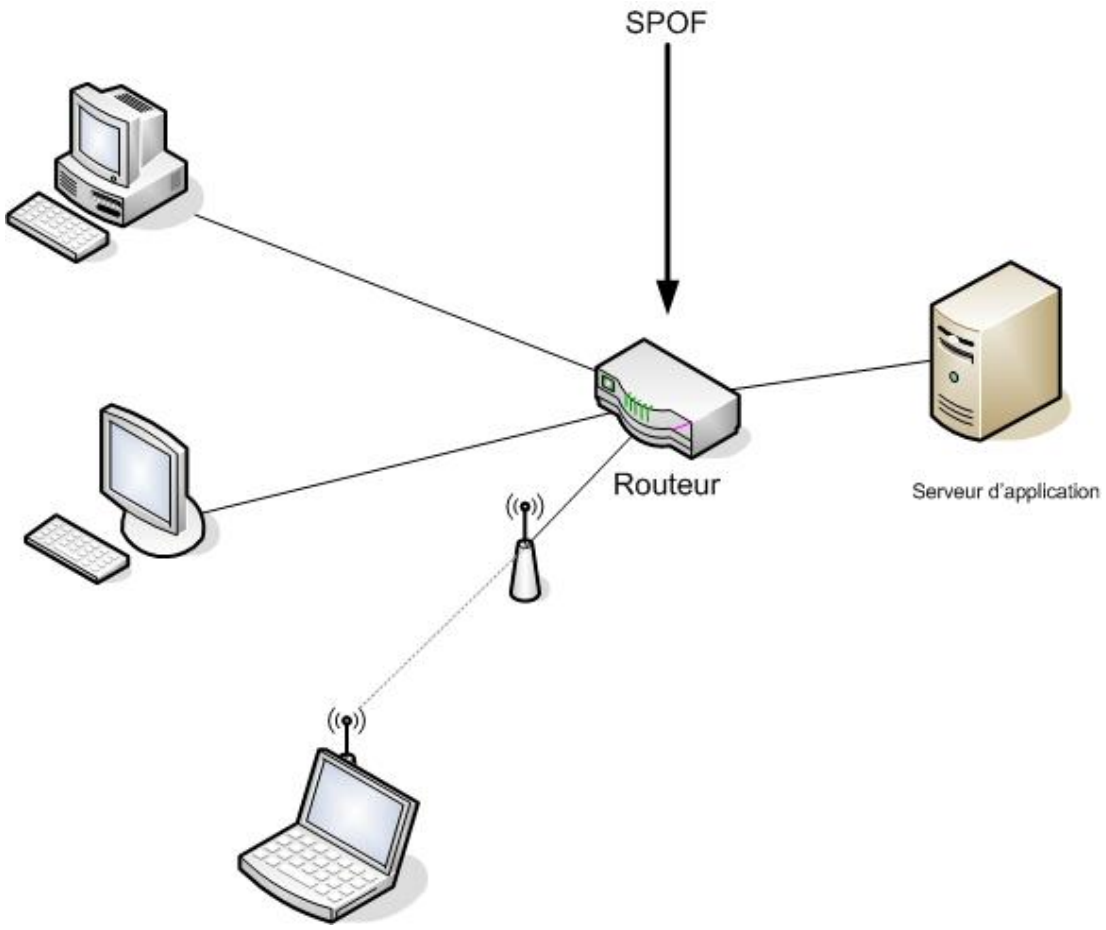
- It has limited scalability A bridge network device can become a bottleneck in a large network, leading to reduced network performance.
- Unlike routers or switches, bridge network devices have limited functionality, which may not meet the requirements of certain network environments.
- Bridge network devices are not very flexible, and changes to the network topology can be difficult to implement.
- Some older network devices may not support bridging, which can limit the interoperability of a bridge network device with other network devices.

5) Router :

❖ introduction:

A router network device is a networking device that connects multiple networks and directs traffic between them. It is operated at the network layer of OSI model. It is designed to route data packets based on their destination IP addresses. Routers use routing tables to determine the best path for forwarding data packets to their intended destinations. Routers are commonly used in both LAN and WAN .They can connect networks of different types, such as Ethernet LANs, token ring networks, and ATM networks. In addition to forwarding data packets, routers can also provide advanced networking features such as Quality of Service (QoS) to ensure critical traffic gets the necessary bandwidth, access control lists (ACLs) to restrict access to specific resources, and security features such as firewalls and Virtual Private Networks (VPNs) to protect the network against unauthorized access and attacks.

❖ diagram:



❖ advantages:

- It can route data packets based on their destination IP addresses, which allows them to connect multiple networks and ensure that packets are delivered to their intended destinations efficiently.
- It provide a higher level of security compared to other networking devices like hubs or switches. They can use access control lists (ACLs), firewalls, and VPNs to protect the network from unauthorized access and attacks.
- It can prioritize traffic based on its type or origin, ensuring that critical traffic gets the necessary bandwidth.
- It can handle large networks with many connected devices, making them ideal for enterprise-level networks.
- It can interconnect different types of networks, such as LANs, WANs, and wireless networks, allowing them to communicate with each other.

❖ Disadvantages:

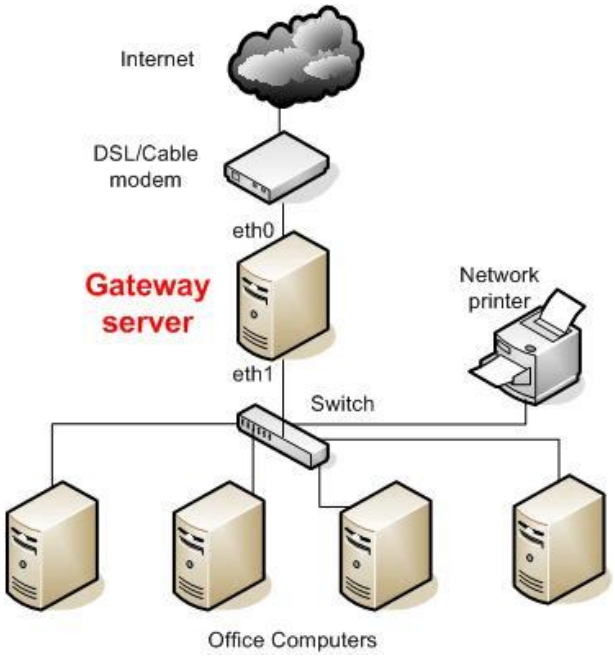
- It is a complex device and it requires knowledge and expertise in networking protocols and configurations.
- They are expensive compared to other network device.
- It require ongoing maintenance and updates to keep up with changing network conditions and security threats.
- It can introduce additional latency in the network due to the time it takes to route packets.
- If a router fails, the entire network can be affected, making it a single point of failure in the network.

6) Gateway:

❖ introduction:

A gateway network device is a networking device that provides a bridge between different networks that use different communication protocols. In other words, a gateway device enables communication between two networks that would otherwise be unable to communicate due to using different protocols or communication technologies. It is operated at application layer of OSI model. It is designed to translate data between different network protocols, such as from TCP/IP to ATM or from Ethernet to Token Ring. It can also provide translation services between different application-layer protocols, such as translating between HTTP and FTP. Gateway devices can also provide advanced networking features such as traffic shaping, access control, and security features such as firewalls and VPNs to protect the network against unauthorized access and attacks. It can be standalone devices or integrated into other network devices such as routers or switches. They can be managed through a graphical user interface (GUI) or through command-line interfaces (CLI) using various configuration protocols, such as Simple Network Management Protocol (SNMP) or Command Line Interface (CLI)

❖ diagram:



❖ advantages:

- Gateways can interconnect different types of networks that use different communication protocols, enabling communication between them.
- Gateways can translate data between different network protocols, allowing devices on one network to communicate with devices on another network that use a different protocol.
- Gateways can provide advanced security features, such as firewalls and Virtual Private Networks (VPNs), to protect the network against unauthorized access and attacks.
- Gateways can prioritize traffic based on its type or origin, ensuring that critical traffic gets the necessary bandwidth.
- Gateways can handle large networks with many connected devices, making them ideal for enterprise-level networks.

❖ Disadvantages:

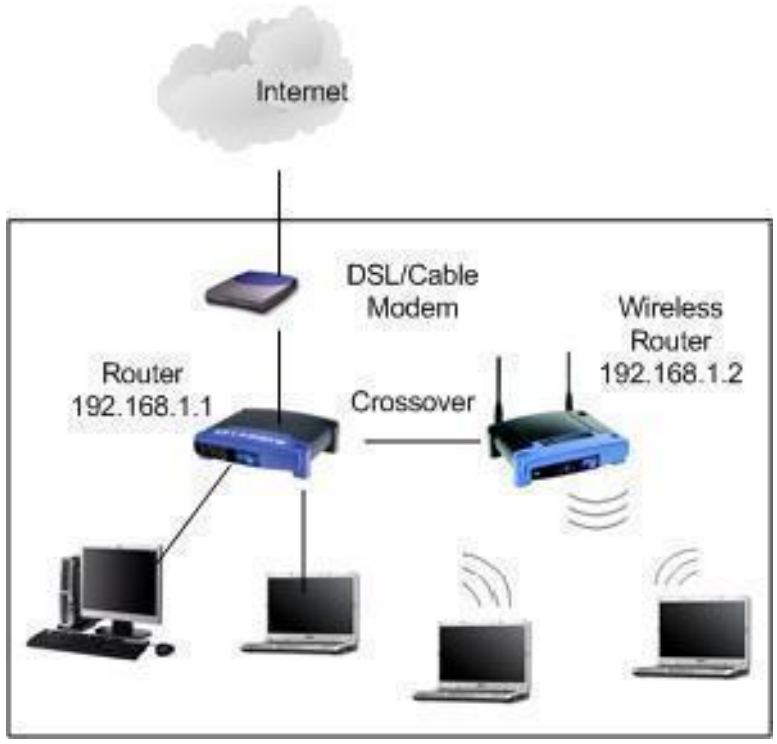
- Configuring a gateway can be complex, and it requires knowledge and expertise in networking protocols and configurations.
- Gateways can be more expensive than other networking devices, such as switches or hubs.
- Gateways can introduce additional latency in the network due to the time it takes to translate data between different protocols.
- If a gateway fails, the entire network can be affected, making it a single point of failure in the network.
- Gateways may not be compatible with all network protocols, limiting their ability to interconnect different types of networks.

7) Access point :

❖ Introduction :

An Access Point (AP) is a wireless network device that allows wireless devices to connect to a wired network using Wi-Fi or other wireless communication protocols. An AP acts as a central hub for wireless devices, providing connectivity to the network and allowing users to access network resources, such as printers, servers, and the Internet. It is operated at Data Link layer and Physical layer. An AP is typically connected to a wired network, such as an Ethernet network, and is responsible for transmitting and receiving wireless signals between wireless devices and the wired network. An AP can support multiple wireless devices simultaneously, allowing users to access the network from different locations and devices.APs are often used in conjunction with other networking devices, such as routers, switches, and firewalls, to provide a complete networking solution. They can also be managed through a graphical user interface (GUI) or through command-line interfaces (CLI) using various configuration protocols, such as Simple Network Management Protocol (SNMP) or Command Line Interface (CLI).

❖ Diagram :



❖ Advantages :

- APs provide wireless connectivity to a wired network, allowing wireless devices to access network resources such as printers, servers, and the Internet.
- APs allow users to access the network from different locations and devices, enabling mobility and flexibility.
- APs can be added to the network to increase wireless coverage and support more wireless devices.
- APs can be easily deployed and configured, allowing for quick and easy setup of wireless networks.
- APs are relatively inexpensive compared to other networking devices, such as routers and switches.

❖ Disadvantages:

- Wireless signals can be interfered with by other devices operating on the same frequency, such as other APs or electronic devices.
- Wireless networks can be less secure than wired networks, making them more vulnerable to attacks and unauthorized access.
- The range of an AP is limited by various factors, such as the strength of the wireless signal and physical barriers such as walls and buildings.
- APs can have bandwidth limitations, which can cause slow connections or network congestion when many devices are connected.
- If an AP fails, the entire wireless network can be affected, making it a single point of failure in the network.

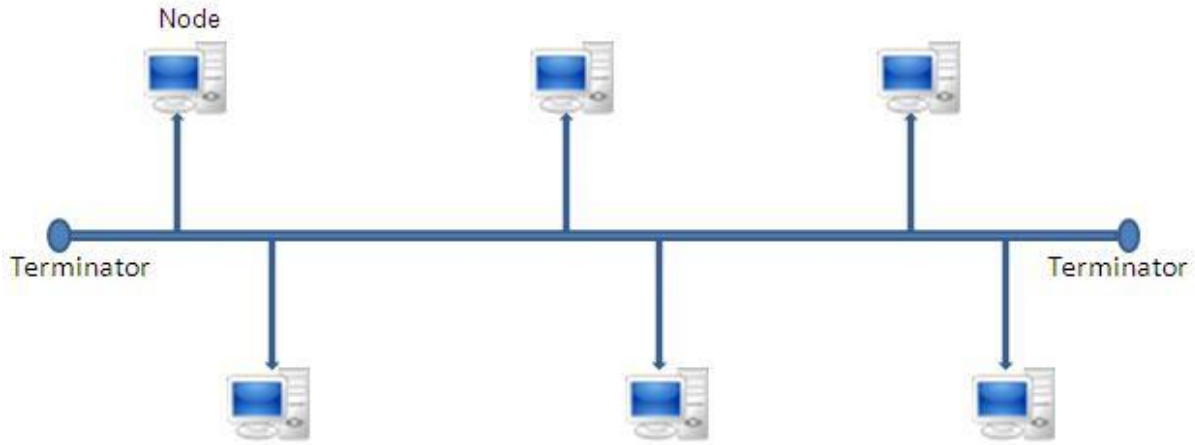
Networking Topologies:

1) Bus:

❖ Introduction:

Bus topology is a type of computer network topology in which all devices are connected to a single cable or backbone. The cable serves as the communication pathway for all the devices in the network, and each device is connected to the cable through a connector called a tap or drop. In a bus topology, all data transmitted by any device is received by all other devices on the network. When a device wants to send data, it broadcasts the message onto the bus, and all other devices on the network receive it. However, only the intended recipient device will process the message and respond accordingly.

❖ Diagram:



❖ Advantages:

- Bus topology is relatively simple to install and set up compared to other topologies since it requires less cabling.
- Bus topology is cost-effective since it requires less cabling and hardware.

- It is easy to add new devices to the network since they can simply be connected to the existing cable.
- Since all devices are connected to a single cable, it is easier to locate and diagnose network issues.
- Easy to expand by joining the two cables together.

❖ Disadvantages:

- If the main cable breaks, the entire network will fail.
- The distance that data can travel on the network is limited by the cable length, and the number of devices that can be connected to the network is also limited.
- The performance of the network can suffer if there are many devices trying to transmit data at the same time, leading to collisions and delays.
- All devices on the network can access all data transmitted on the network, which can be a security concern for sensitive data.
- Here packet loss is high
- If more devices are added it slow downs the network.

❖ Applications:

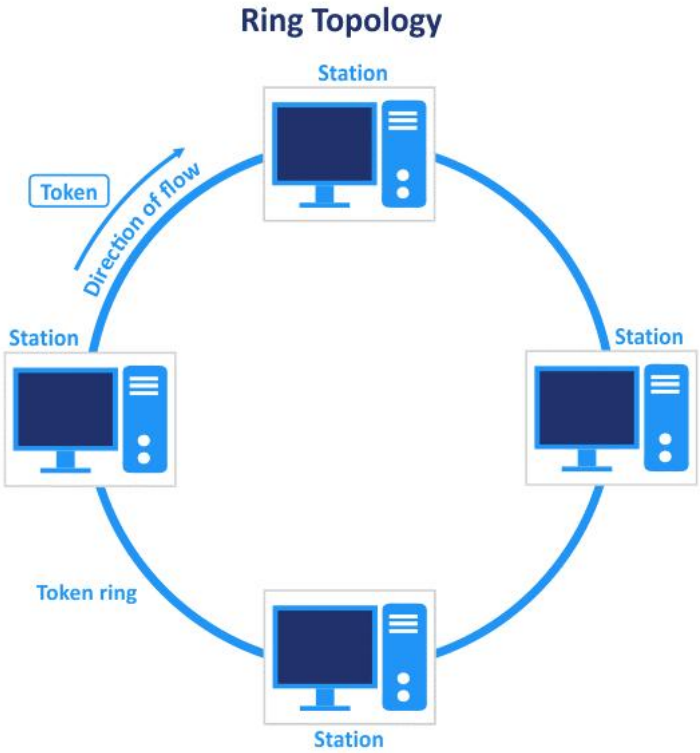
- Bus topology is often used in LANs where the number of devices is relatively small, and the network is limited to a single building or location.
- Bus topology is also used in audio and video transmission systems to transmit signals from the source to multiple receivers over a single cable.
- Bus topology is also used in home networks, where a few computers are connected to a single cable for file sharing, printer sharing, and internet connectivity.
- Bus topology is used in industrial control systems to connect sensors, programmable logic controllers (PLCs), and other devices to the main control unit.

2) Ring :

- Introduction:

Ring topology is a type of computer network topology in which all devices are connected in a circular or ring-like fashion. In a ring topology, each device is connected to the two adjacent devices in the ring, forming a continuous loop or circuit.In a ring topology, data is transmitted in a unidirectional manner, and each device on the network acts as a repeater, regenerating and forwarding the signal to the next device until it reaches its destination. When a device wants to transmit data, it passes the message along the ring until it reaches the destination device.

- Diagram:



- Advantages:
  - Ring topology provides a more efficient use of network bandwidth since data flows in only one direction, and collisions are less likely to occur.
  - Ring topology can support a large number of devices, making it suitable for medium to large-sized networks.
  - Devices can be easily added or removed from the network without disrupting the network operation.
  - In a ring topology, data transmission is unidirectional, which makes it easier to manage network traffic and avoid data collisions.

- Disadvantages:
  - The failure of any device or link in the ring can cause the entire network to fail.
  - As the signal passes from device to device around the ring, data transmission delays can occur
  - It can be difficult to diagnose network issues since the failure of any device or link in the ring can cause the entire network to fail.
  - Ring topology can be more expensive to install than other topologies, such as bus topology.

- Applications:
  - Ring topology is commonly used in LANs where a large number of devices need to be connected within a single building or location.
  - Ring topology can be used in MANs to connect multiple LANs over a larger geographic area.
  - Ring topology is used in telecommunications networks to provide high-speed data transmission, such as fiber optic networks.
  - Ring topology is used in public address systems to transmit audio signals to multiple speakers, such as in airports, train stations, and shopping malls.

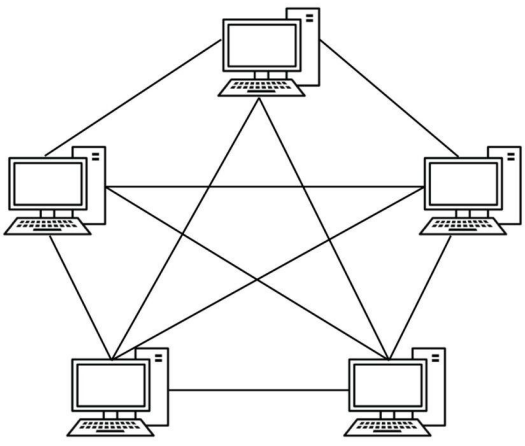
3) Mesh :

❖ Introduction:

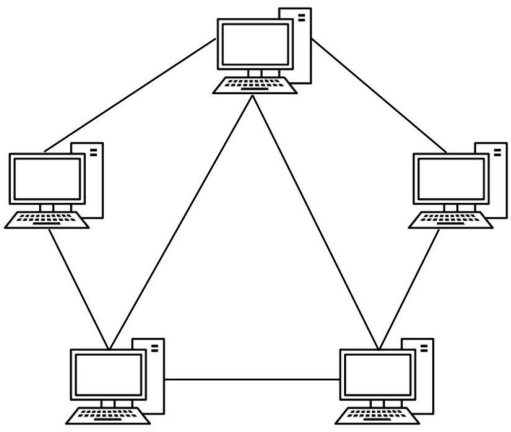
A mesh topology is a network setup where each computer and network device is interconnected with one another. This topology setup allows for most transmissions to be distributed even if one of the connections goes down. It is a topology commonly used for wireless networks. Below is a visual example of a simple computer setup on a network using a mesh topology.In a full mesh topology, every device is directly connected to every other device on the network. This means that the number of connections required can be quite high, and as the number of devices increases, the number of connections required grows exponentially. In a partial mesh topology, some devices are connected to all other devices, while others are only connected to some. This reduces the number of connections required, while still providing redundancy and multiple paths for data transmission.

❖ Diagram:

Full Mesh Topology



Partial Mesh Topology



- Advantages:

  - Mesh topology provides high reliability since data can be transmitted along multiple paths. If one path fails, data can still be transmitted along alternative paths.
  - Mesh topology can support a large number of devices and can be easily expanded as the network grows.
  - Mesh topology can provide high data transmission rates since there are multiple paths for data to travel.
  - Mesh topology provides a high level of security since data can only be transmitted between devices that are directly connected.

- Disadvantages:
  - Mesh topology can be more expensive to install and maintain compared to other topologies since it requires a large number of connections and devices.
  - The design and implementation of a mesh network can be complex since it requires a large number of connections, and the routing of data can be complicated.
  - As the number of devices on the network increases, managing the network can become difficult since there are a large number of connections to manage.
  - In a fully meshed network, the redundancy of connections can lead to inefficiencies in data transmission, as some paths may be longer or slower than others.

- Applications:

  - Mesh topology is commonly used in WANs, where multiple sites need to be interconnected, such as in multinational corporations, government agencies, and research institutions.

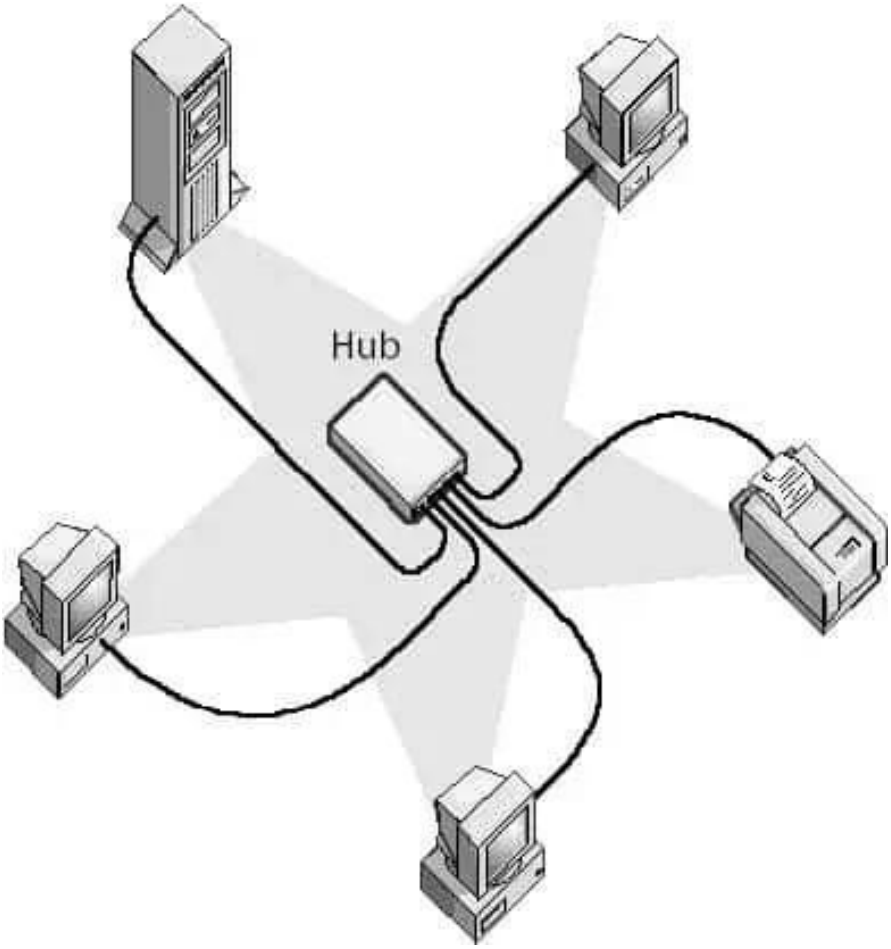
- Mesh topology is used in military and defense networks to provide high reliability and redundancy, particularly in situations where network downtime can have serious consequences.
- Mesh topology is used in IoT networks, particularly in industrial IoT, where a large number of sensors and devices need to be connected over a wide area.
- Mesh topology can be used in large data centers to provide high reliability and redundancy, ensuring that critical applications and services are always available.

4) Star :

❖ Introduction:

Star topology is a type of computer network topology in which all devices on the network are connected to a central hub or switch. The central hub acts as a connection point for all devices, and data is transmitted from one device to another through the hub. In a typical star topology, all devices are connected to the hub through a cable, and each device communicates with the hub directly. The hub acts as a traffic controller, managing the flow of data between devices.

❖ Diagram:



- Advantages:
  - Star topology is easy to install and maintain since each device is only connected to the central hub, making it easy to add or remove devices as needed.
  - Star topology provides high reliability since the failure of one device does not affect the rest of the network.
  - If there is a problem with a device, it can be easily isolated and identified, making troubleshooting easier.
  - Since each device communicates with the hub directly, network performance can be optimized, and data transmission rates can be improved.

- Disadvantages:
  - Star topology is vulnerable to a single point of failure since the entire network relies on the central hub. If the hub fails, the entire network becomes inoperable.
  - Star topology can be limited in terms of scalability since the number of devices that can be connected to the hub is limited.
  - Star topology can be more expensive to install and maintain compared to other topologies since it requires a central hub and cabling for each device.
  - If there is a large amount of data being transmitted, network performance can be affected since all data passes through the central hub.

- Applications:
  - Star topology is commonly used in LANs, particularly in offices and homes, where a small number of devices need to be connected.
  - Star topology is used in telecommunications networks to provide high reliability and scalability, particularly in situations where network downtime can have serious consequences.

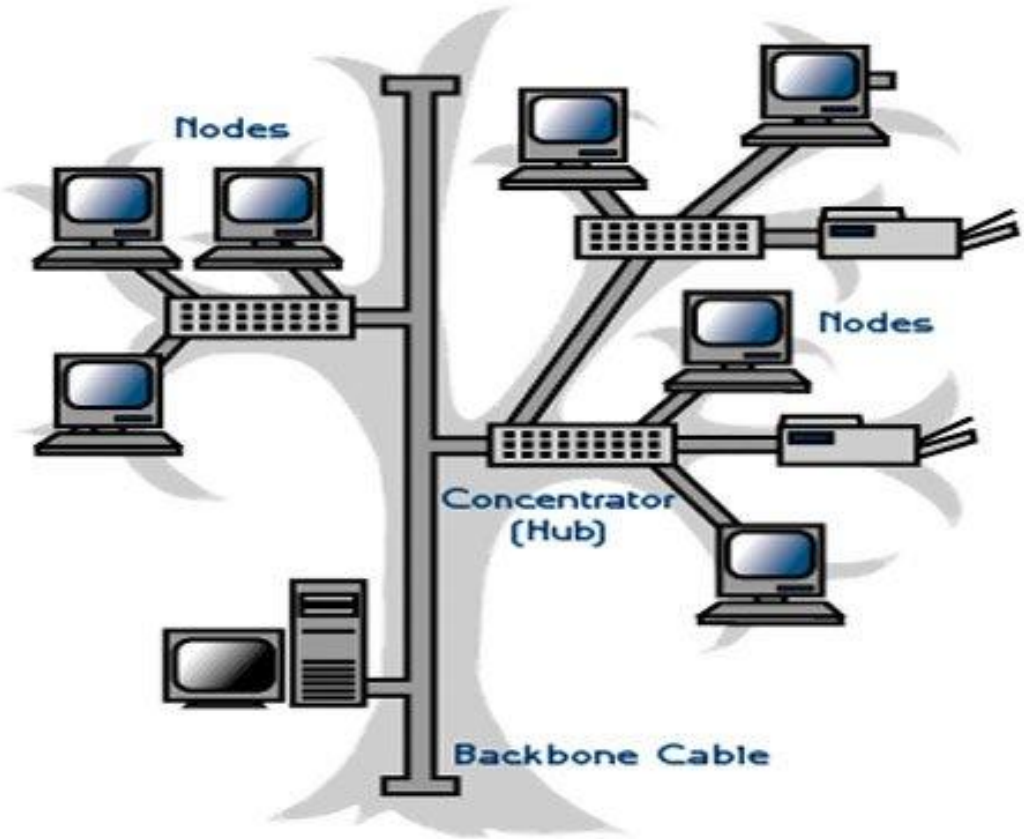
- Star topology is used in data centers to provide high reliability and redundancy, ensuring that critical applications and services are always available.
- Star topology is used in educational institutions to provide reliable and scalable network connectivity, particularly in situations where a large number of devices need to be connected.

5) Tree :

- Introduction:

Tree topology is a type of computer network topology that combines characteristics of both star and bus topology. It is a hierarchical topology in which devices are arranged in a tree-like structure with multiple levels of nodes, and each level of nodes is connected to a central hub or switch. In a typical tree topology, the root node is the central hub, and other nodes are connected to it in a hierarchical manner. Each level of nodes may have its own hub or switch, and devices are connected to these intermediate hubs or switches. Data is transmitted from one device to another through the intermediate hubs or switches, and ultimately to the central hub.

- Diagram:



- Advantages:
  - Tree topology is highly scalable, making it suitable for large and complex networks. It allows for the addition of new devices and nodes without disrupting the entire network.
  - Tree topology provides a high level of redundancy, as data can be transmitted through multiple paths. This ensures that the network remains operational even if one node fails.
  - Tree topology has a centralized management structure, making it easier to manage and monitor the network.
  - Tree topology provides an efficient data transfer mechanism as data is transmitted through intermediate hubs or switches, which reduces network congestion and improves network performance.

- Disadvantages:
  - Tree topology can be complex to design, install, and maintain, particularly in large networks. It requires careful planning and management to ensure the network operates efficiently.
  - Tree topology can be more expensive to install and maintain compared to other topologies, particularly in large networks.
  - Tree topology has a single point of failure at the root node or central hub. If the central hub fails, the entire network can become inoperable.
  - Tree topology can be limited in terms of flexibility, particularly if the network needs to be reconfigured frequently.

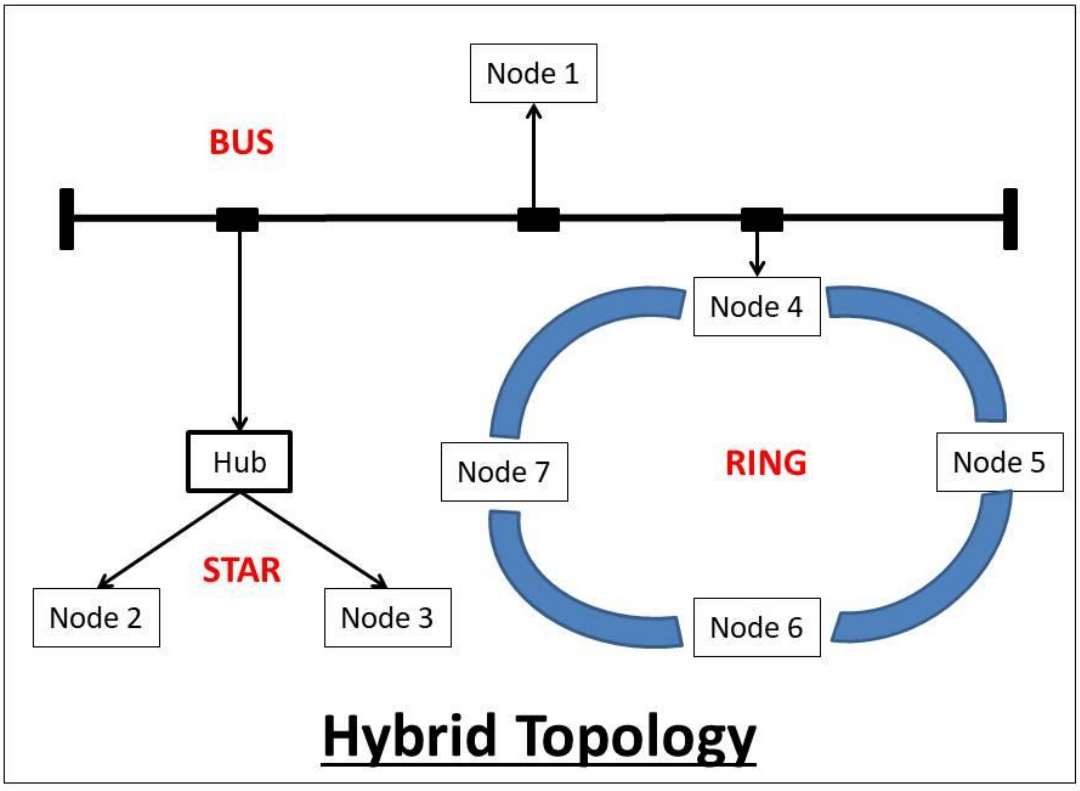
- Applications:
  - Tree topology is commonly used in large corporations to connect multiple departments or locations. This provides a centralized management structure, improved network performance, and high levels of redundancy.
  - Tree topology is used in educational institutions to connect multiple buildings, departments, and campuses. This allows for efficient data transfer, centralized management, and improved network performance.

6) Hybrid :

❖ Introduction:

Hybrid topology is a type of computer network topology that combines two or more different types of topologies, such as bus, star, ring, or mesh, to form a single network. It is a flexible and scalable topology that can meet the specific requirements of a network by combining the advantages of different topologies and minimizing their disadvantages. In a hybrid topology, different topologies are connected through a central hub or switch, creating a network that can support a large number of nodes and provide a high level of redundancy. For example, a hybrid topology may combine a star topology for a small group of computers, a bus topology for a larger group of computers, and a mesh topology for critical systems.

❖ Diagram:



- Advantages:
  - Hybrid topology provides the flexibility to use different types of topologies to meet the specific needs of a network.
  - Hybrid topology is scalable and can accommodate a large number of nodes or devices.
  - Hybrid topology provides redundancy by using multiple types of topologies, ensuring that the network remains operational even if one component fails.
  - Hybrid topology can improve the performance of a network by using the best features of different types of topologies.

- Disadvantages:
  - Hybrid topology can be complex to design and implement, and it may require additional hardware and software.
  - The use of multiple types of topologies in a hybrid topology may increase the cost of the network.
  - Hybrid topology may require more maintenance than other topologies because of its complexity.
  - Hybrid topology may be more susceptible to security threats due to its multiple components.

- Applications:
  - Hybrid topology is commonly used in large enterprise networks that require high levels of performance, reliability, and scalability. It allows organizations to combine different types of topologies to meet their specific needs.
  - Hybrid topology is also used in data centers, where it can combine different types of topologies to support the high volume of data traffic and critical applications.
  - Hybrid topology is used in educational institutions to support large networks that must accommodate multiple departments and campuses. The hybrid topology can combine different types of topologies to provide the necessary levels of performance, reliability, and scalability.

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Conclusion:

studying different networking devices and topologies is essential for understanding how computer networks function and communicate. The various types of devices, such as routers, switches, hubs, and repeaters, each play a critical role in ensuring data flows seamlessly throughout the network. Meanwhile, understanding the different network topologies, such as bus, ring, mesh, star, and tree, provides insight into how network components are connected and how data is transmitted.