

Computer Communication and Networks

(Lecture-03)



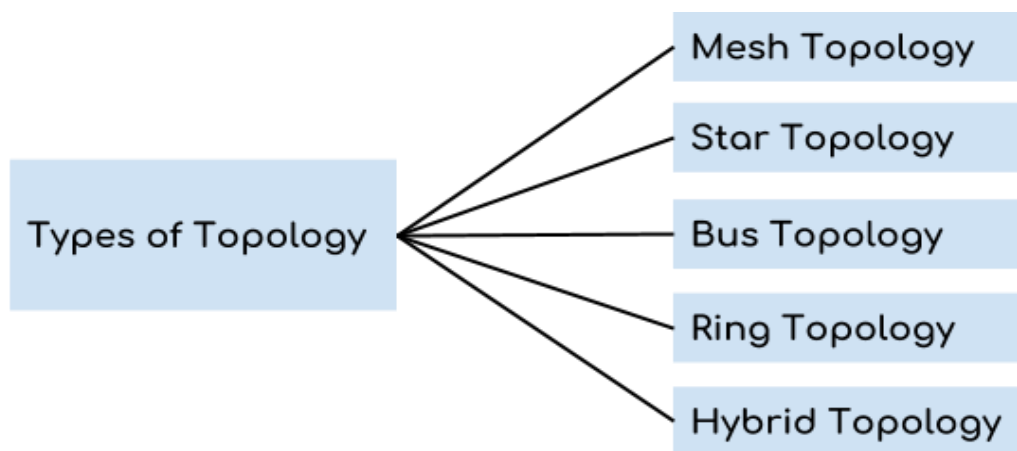
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Computer Network Topology

Geometric representation of how the computers are connected to each other is known as 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 numerous ways a network can be arranged, all with different pros and cons, and some are more useful in certain circumstances than others.

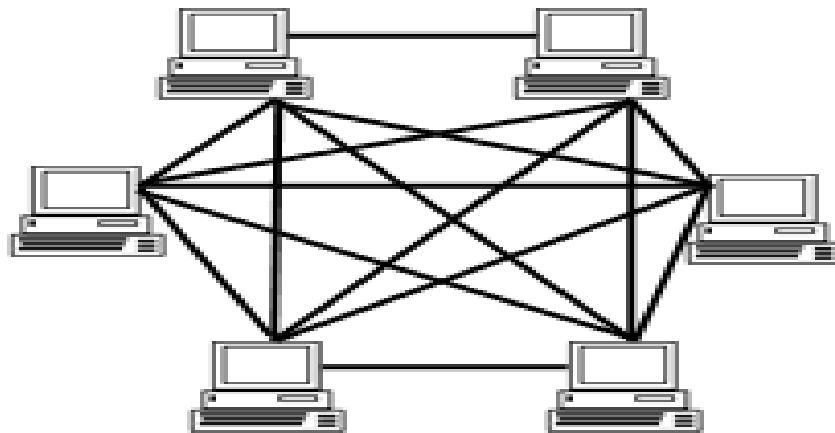
There are five major types of topology – Mesh, Star, Bus, Ring and Hybrid.



Mesh Topology

A mesh topology is a network setup where each computer and network device is interconnected with one another. In such type of topology each device is connected to every other device on the network through a dedicated point-to-point link. When we say dedicated it means that the link only carries data for the two connected devices only. Let's say we have n devices in the network then each device must be connected with $(n-1)$ devices of the network. Number of links in a mesh topology of n devices would be $n(n-1)/2$.

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.



Advantages of Mesh topology

- No data traffic issues as there is a dedicated link between two devices which means the link is only available for those two devices.
- Mesh topology is reliable and robust as failure of one link doesn't affect other links and the communication between other devices on the network.
- Mesh topology is secure because there is a point to point link thus unauthorized access is not possible.
- Fault detection is easy.

Disadvantages of Mesh topology

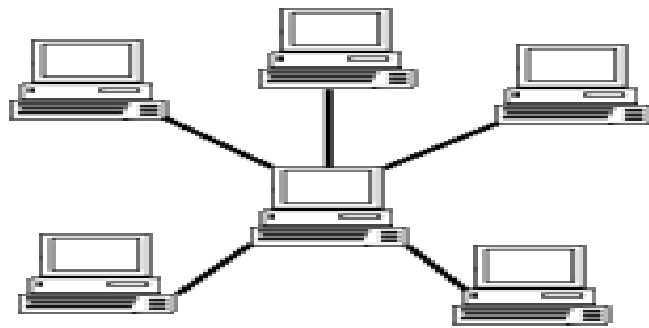
- Amount of wires required to connect each system is tedious and headache.
- Since each device needs to be connected with other devices, number of I/O ports required must be huge.
- Scalability issues because a device cannot be connected with large number of devices with a dedicated point to point link.

Star Topology

Star topology is one of the most common network setups. In this configuration, every node connects to a central network device, like a hub, switch, or computer. The central network device acts as a server and the peripheral devices act as clients. In a star topology setup, either a coaxial or RJ-45 network cable is used, depending on the type of network card installed in each computer.

Unlike Mesh topology, star topology doesn't allow direct communication between devices, a device must have to communicate through hub. If one device wants to send data to other device, it has to first send the data to hub and then the hub transmit that data to the designated device. The image shows how this network setup gets its name, as it is shaped like a star.

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Advantages of Star topology

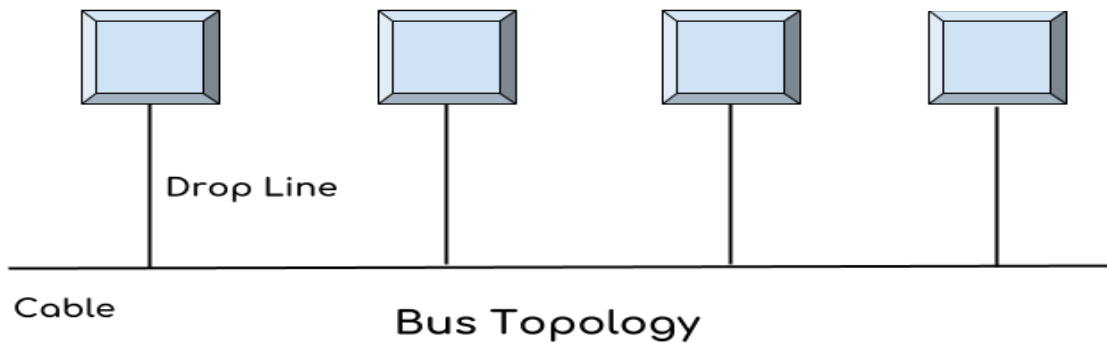
- Less expensive because each device only need one I/O port and needs to be connected with hub with one link.
- Easier to install
- Less amount of cables required because each device needs to be connected with the hub only.
- Robust, if one link fails, other links will work just fine.
- Easy fault detection because the link can be easily identified.

Disadvantages of Star topology

- If hub goes down everything goes down, none of the devices can work without hub.
- Hub requires more resources and regular maintenance because it is the central system of star topology.

Bus Topology

Alternatively referred to as line topology, bus topology is a network setup where each computer and network device is connected to a single cable or backbone. Depending on the type of computer network card, a coaxial cable or an RJ-45 network cable is used to connect them together. In bus topology there is a main cable and all the devices are connected to this main cable through drop lines. There is a device called tap that connects the drop line to the main cable. Since all the data is transmitted over the main cable, there is a limit of drop lines and the distance a main cable can have.



Advantages of bus topology

- Easy installation, each cable needs to be connected with backbone cable.
- Less cables required than Mesh and star topology

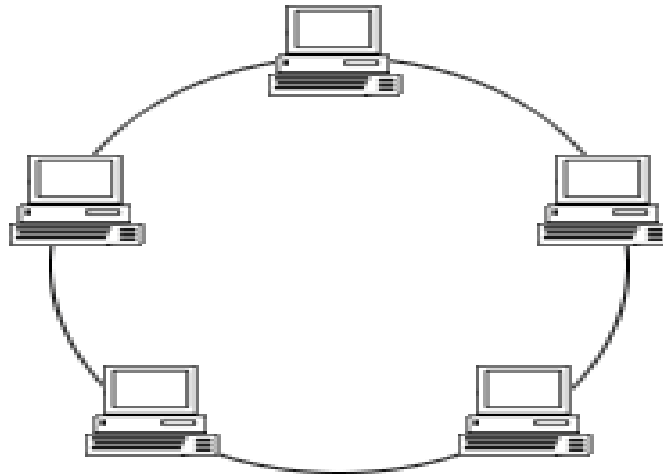
Disadvantages of bus topology

- Difficultly in fault detection.
- Not scalable as there is a limit of how many nodes you can connect with backbone cable.

Ring Topology

In ring topology each device is connected with the two devices on either side of it. There are two dedicated point to point links a device has with the devices on the either side of it. This structure forms a ring thus it is known as ring topology. If a device wants to send data to another device then it sends the data in one direction, each device in ring topology has a repeater, if the received data is intended for other device then repeater forwards this data until the intended device receives it.

In a ring network, packets of data travel from one device to the next until they reach their destination. Most ring topologies allow packets to travel only in one direction, called a unidirectional ring network. Others permit data to move in either direction, called bidirectional.



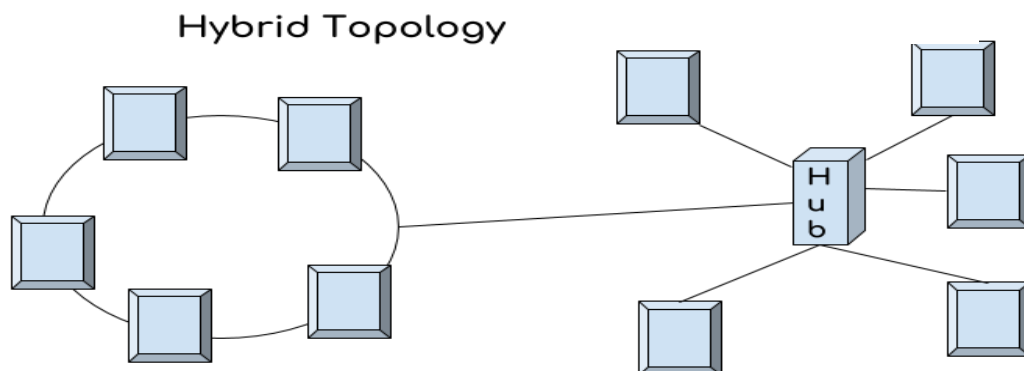
Advantages of Ring Topology

- Easy to install.
- Managing is easier as to add or remove a device from the topology only two links are required to be changed.

Disadvantages of Ring Topology

- A link failure can fail the entire network as the signal will not travel forward due to failure.
- Data traffic issues, since all the data is circulating in a ring.

Hybrid topology



A hybrid topology is a type of network topology that uses two or more different network topologies. These topologies can include a mix of bus topology, mesh topology, ring topology, star topology, and tree topology.

The choice to use a hybrid topology over a standard topology depends on the needs of a business, school, or the users. The number of computers, their location, and desired network performance are all factors in the decision.

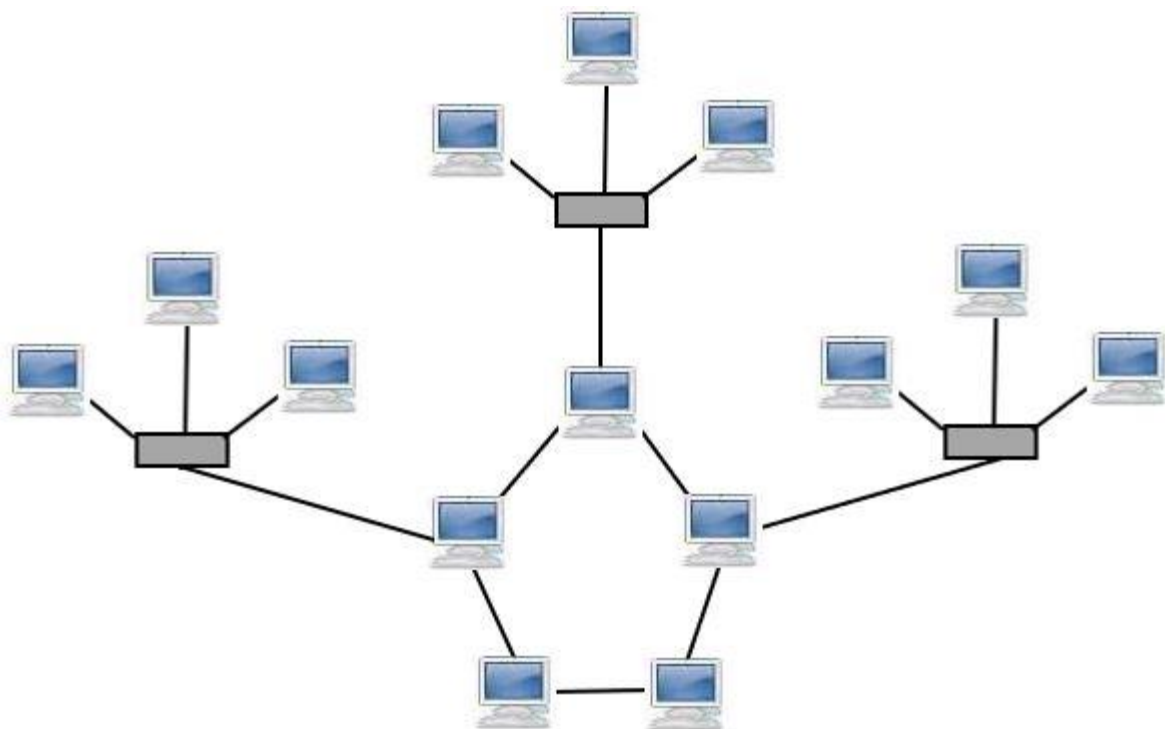
A combination of two or more topology is known as hybrid topology. For example a combination of star and mesh topology is known as hybrid topology.

Types of hybrid topology

The two most commonly used types of hybrid topologies are the following.

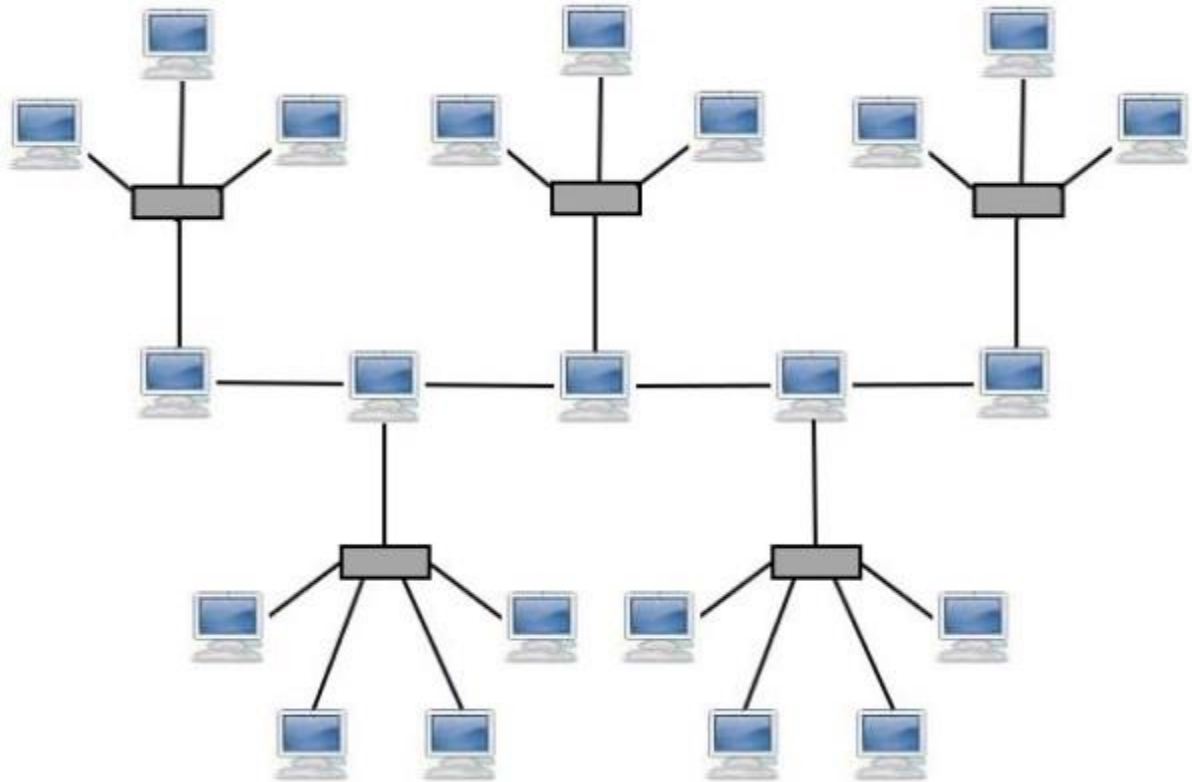
Star-Ring hybrid topology

A star-ring hybrid topology is a combination of the star topology and ring topology. Two or more star topologies are connected together through a ring topology.



Star-Bus hybrid topology

A star-bus hybrid topology is a combination of the star topology and bus topology. Two or more star topologies are connected together through a bus topology.



Advantages of Hybrid topology

- We can choose the topology based on the requirement for example, scalability is our concern then we can use star topology instead of bus technology.
- Scalable as we can further connect other computer networks with the existing networks with different topologies.

Disadvantages of Hybrid topology

- Fault detection is difficult.
- Installation is difficult.
- Design is complex so maintenance is high thus expensive.

End of Lecture-1