



Network Fundamentals



Physical Topology

- The term physical topology refers to the way in which network is laid out physically.
- Two or more devices connect to a link; two or more links forms a topology.
- The topology of a network is the geometric representation of the relationship all the links and linking devices to one another.

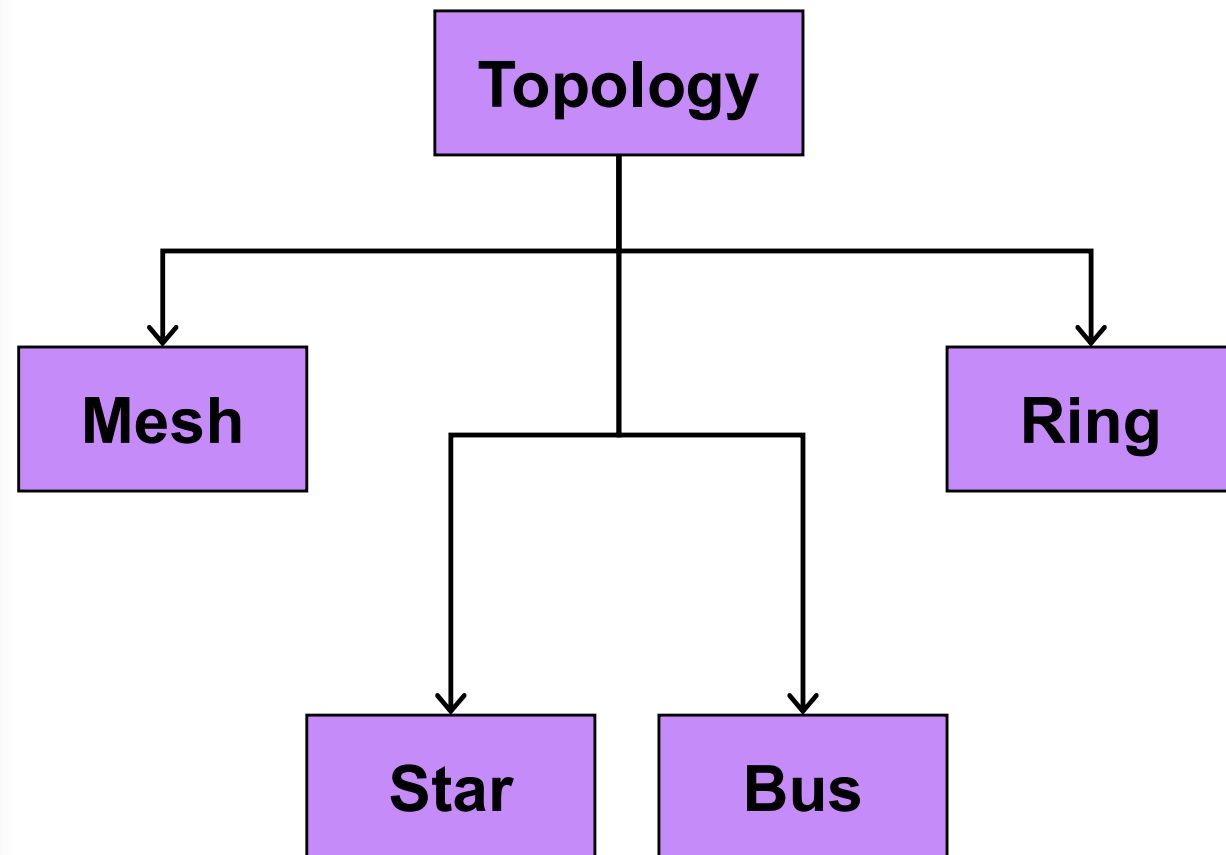


Physical Topology

There are four basic topologies possible:

- Mesh
- Star
- Bus
- Ring

Physical Topology

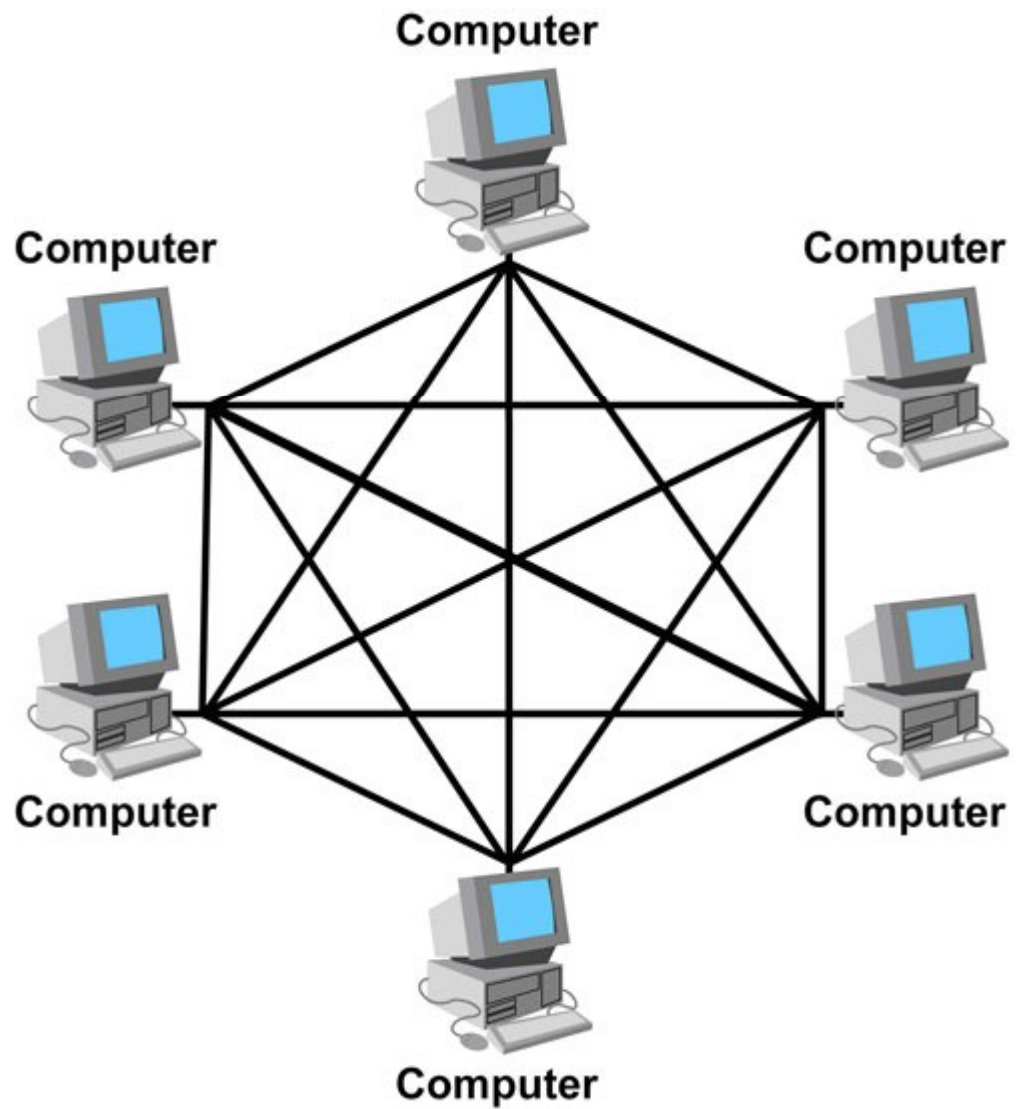




Mesh

- In a mesh topology, every device has a dedicated point-to-point link to every other device.
- The term dedicated means that the link carries traffic only between two devices it connects.

Mesh





Mesh

- A fully connected mesh network therefore has

$$n * (n - 1) / 2$$

physical channels to link n devices.

- To accommodate that many links, every device on the network must have $n - 1$ input/output ports.



Mesh

- A mesh offers several advantages over other network topologies.
- First, the use of dedicated links guarantees that each connection can carry its own data load, thus eliminating the traffic problems that can occur when links must be shared by multiple devices.



Mesh

- Second, a mesh topology is robust.
- If one link becomes unusable, it does not incapacitate the entire system.
- Another advantage is privacy or security.
- Physical boundaries prevent other users from gaining access to messages.



Mesh

- Finally, point-to-point links make fault identification and fault isolation easy.
- The main disadvantages of a mesh are related to the amount of cabling and the number of I/O ports required.
- First, because every device must be connect to every other device, installation and reconnection are difficult.



Mesh

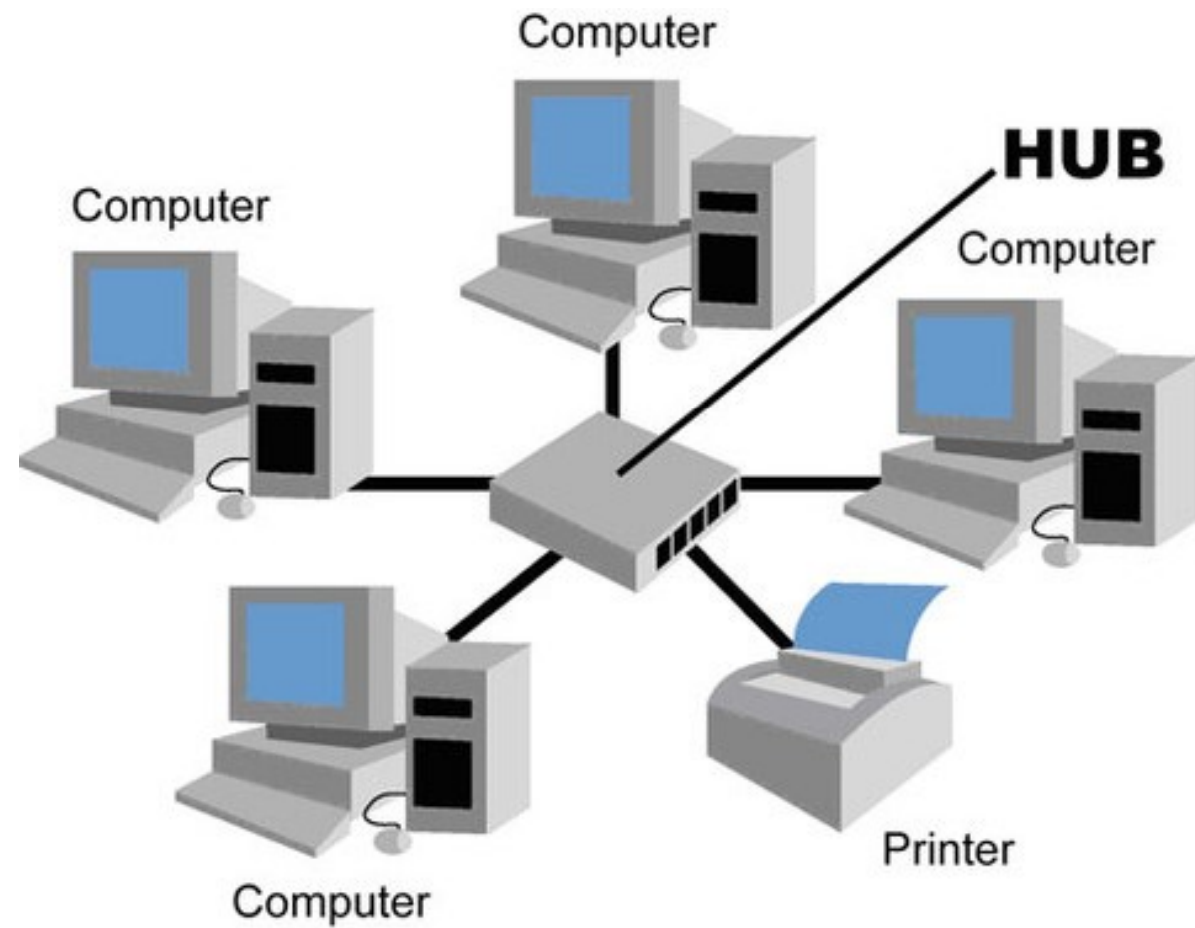
- Second, the sheer bulk of the wiring can be greater than the available space can accommodate.
- Finally, the hardware required to connect each link can be prohibitively expensive.
- For these reasons a mesh topology is usually implemented in limited fashion.



Star

- Here each device has a dedicate point-to-point link only to central controller, usually called a hub.
- The devices are not directly linked to one another.
- Unlike a mesh topology, a star topology does not allow direct traffic between devices.

Star





Star

- The controller acts as an exchange: if one device want to send data to another, it sends the data to the controller, which then relays the data to the other connected device.
- A star topology is less expensive than a mesh topology.



Star

- In a star, each device needs only one link and one I/O port to connect it to any number of others.
- This factor also makes it easy to install and reconfigure.
- Far less cabling needs to be housed, and additions, moves and deletions involve only one connection.



Star

- If one link fails, only that link is affected.
- All other links remain active.
- This factor also lends itself to easy fault identification and fault isolation.
- As long as the hub is working, it can be used to monitor link problems and bypass defective links.



Star

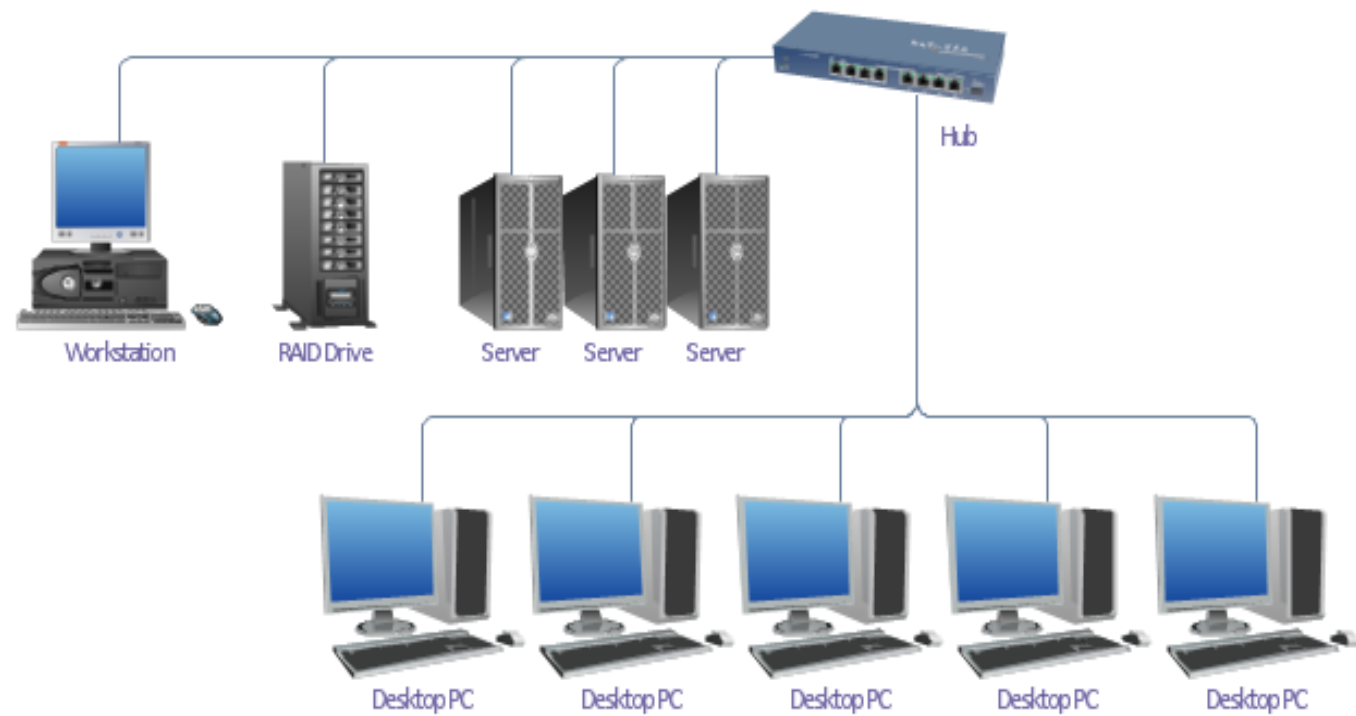
- Although a star requires far less cable than a mesh, each node must be linked to a central hub.
- For this reason, often more cabling is required in a star than in some other topologies.



Bus

- The preceding examples all describe point-to-point connections.
- A bus topology, on other hand, is multipoint.
- One long cable acts as a backbone to link all the devices in a network.

Bus





Bus

- Nodes are connected to the bus cable by drop lines and taps.
- A drop line is a connection running between the device and the main cable.
- A tap is a connector that either splices into the main cable or punctures the sheathing of a cable to create a contact with the metallic core.



Bus

- As a signal travels along the backbone, some of its energy is transformed into heat.
- Therefore, it becomes weaker and weaker as it has to travel farther and farther.
- For this reason there is a limit on the number of taps a bus can support and on the distance between those taps.



Bus

- Advantage of a bus topology include ease of installation,.
- Backbone cable can be laid along the most efficient path, then connected to the nodes by drop lines of various lengths.
- In this way, a bus uses less cabling than mesh or star topologies.



Bus

- Disadvantages include difficult reconnection and fault isolation.
- A bus is usually designed to be optimally efficient at installation.
- It can therefore be difficult to add new devices.



Bus

- Signal reflection at the taps can cause degradation in quality.
- This degradation can be controlled by limiting the number and spacing of devices connected to a given length of cable.
- Adding new devices may therefore require modification or replacement of the backbone.



Bus

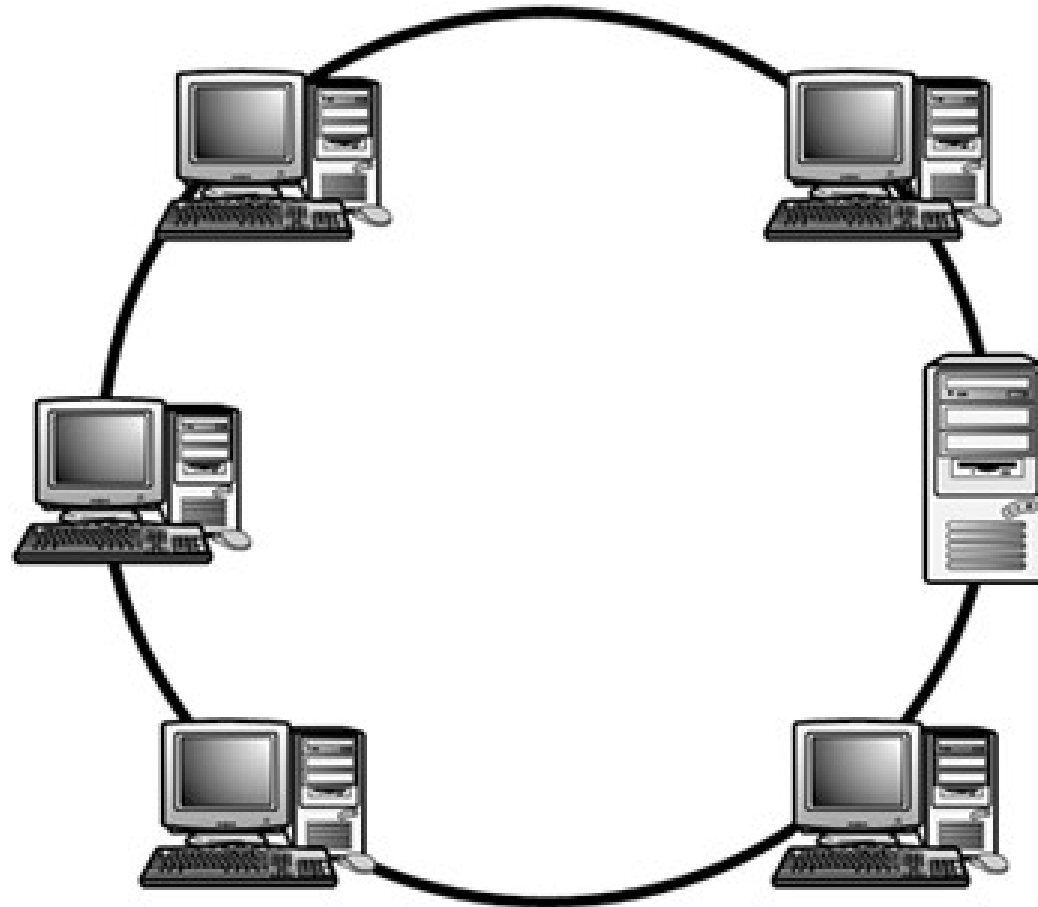
- In addition, a fault or break in the bus cable stops all transmission, even between devices on the same side of the problem.
- The damaged area reflects signals back in the direction of origin, creating noise in both directions.



Ring

- In a ring topology, each device has a dedicated point-to-point connection only with the two devices on either side of it.
- A signal is passed along the ring in one direction, from device to device, until it reaches its destination.
- Each device in the ring incorporates a repeater.

Ring





Ring

- When a device receives a signal intended for another device, its repeater regenerates the bits and passes them along.
- A ring relatively easy to install and reconfigure.
- Each device is linked only to its immediate neighbors (either physically or logically).



Ring

- To add or delete a device requires changing only two connections.
- The only constraints are media and traffic consideration (maximum ring length and number of devices).
- Here fault isolation is simplified.



Ring

- Generally in a ring, a signal is circulating at all times.
- If one device does not receive a signal within a specified period, it can issue an alarm.
- The alarm alerts the network operator to the problem and its location.



Ring

- However, unidirectional traffic can be a disadvantage.
- In a simple ring, a break in the ring (such as a disabled station) can disable the entire network.
- This weakness can be solved by using a dual ring or a switch capable of closing off the break.