

Network Structure or Topology

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Abstract: The geometrical arrangement of computer resources, remote devices and communication facilities is known as Network structure or Network topology.

A computer network is comprised of nodes and links, a node is the end point of any branch in a computer, a terminal device, workstation or interconnecting equipment facility.

A link is a communication path between two nodes. The terms "circuit" and "Channel" are frequently used as synonyms for the link.

There are different types of the topologies like bus, ring, tree, mesh etc. However, we will consider five basic network structures- topology.

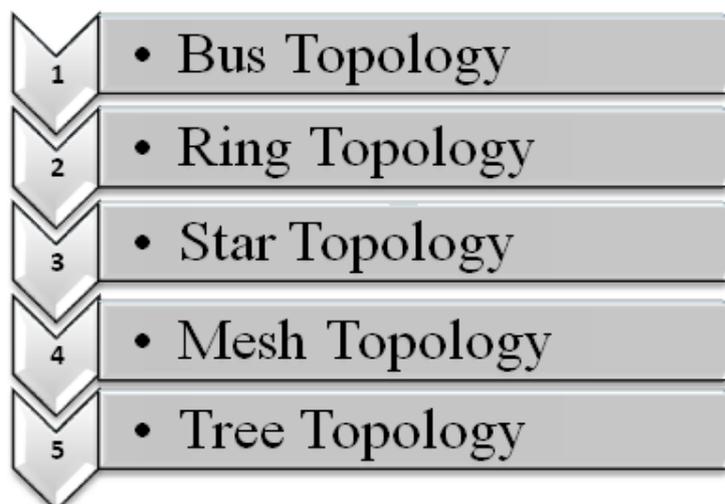
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I. Introduction

Network Topology is the study of the arrangement or mapping of the elements (links, nodes, etc.) of a network interconnection between the nodes.

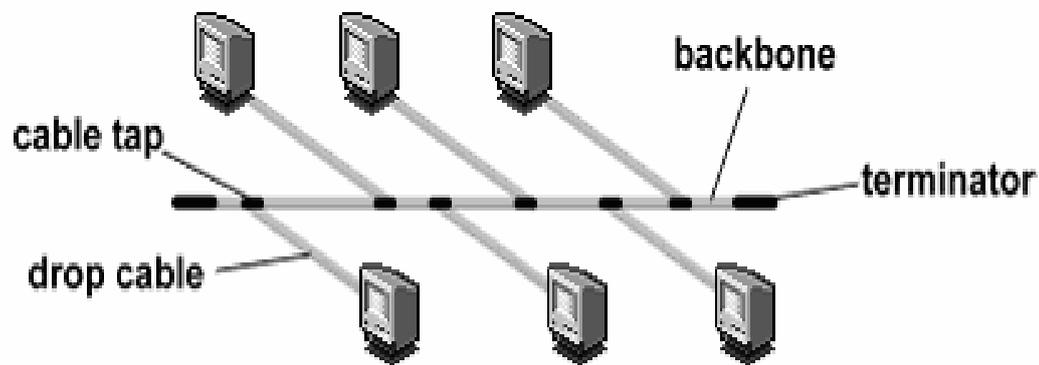
Topologies can be physical or logical. Physical Topology means the physical design of a network including the devices, location and cable installation. Logical Topology refers to the fact that how data actually transfers in a network as opposed to its design.

Some of the most common network topologies are:



II. Bus Topology

This structure is very popular for local area networks. In this structure or topology, a single network cable runs in the building or campus and all nodes are linked along with this communication line with two endpoints called the bus or backbone as show figure.



By this type of topology, if one node goes faulty all nodes may be affected as all nodes share the same cable for the sending and receiving of information. The cabling cost of bus systems is the least of all the different topologies. Each end of the cable is terminated using a special terminator.

[A]. Advantages:

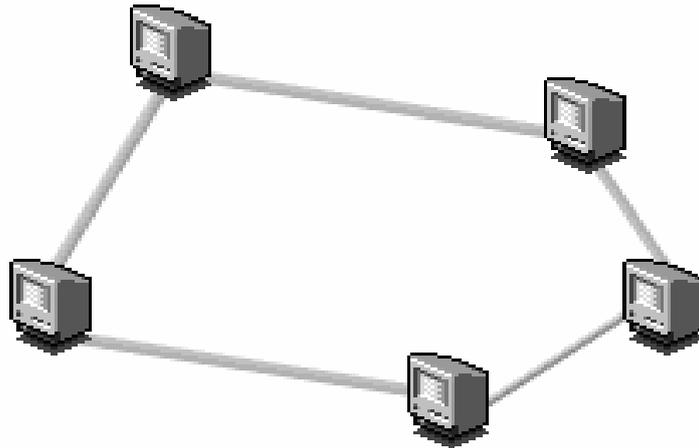
- Reliable in very small networks as well as easy to use and understand.
- Requires least amount of cable to connect the computers (nodes) together and therefore is less expensive than other cabling arrangements.
- It's easy to extend, Two cables can be easily joined with a connector, making a longer cable for more computers to join the network.
- A repeater can also be used to extend a bus configuration.

[B]. Disadvantages:

- Heavy network traffic can slow a bus considerably because any computer can transmit at any time. But networks do not Coordinate when information is sent. Computer interrupting each other can use a lot of bandwidth.
- Each connection between two cables weakens the electrical signal.
- The bus configuration can be difficult to find and can cause the whole networks to stop functioning.

III. Ring Topology

This is yet another structure for local area networks. In this topology, the network cable passes from one node to another until all nodes are connected in the form of a loop or ring. There is a direct point-to-point link between two neighboring nodes (the Next and the Previous). These links are unidirectional which ensures that transmission by a node traverses the whole ring and comes back to the node, which made the transmission as shown in figure.



Information travels around the ring from one node to the next. Each packet of data sent to the ring is prefixed by the address of the station to which it is being sent. When a packet of data arrives, the node checks to see if the packet address is the same as its own, if it is, it grabs the data in the packet. If the packet does not belong to it, it sends the packet to the next node in the ring.

Faulty nodes can be isolated from the ring. When the workstation is powered on, it connects itself to the ring. When power is off, it disconnects itself from the ring and allows the information to bypass the node.

The most common implementation of this topology is token ring. A break in the ring causes the entire network to fail. Individual nodes can be isolated from the ring.

[A]. Advantages:

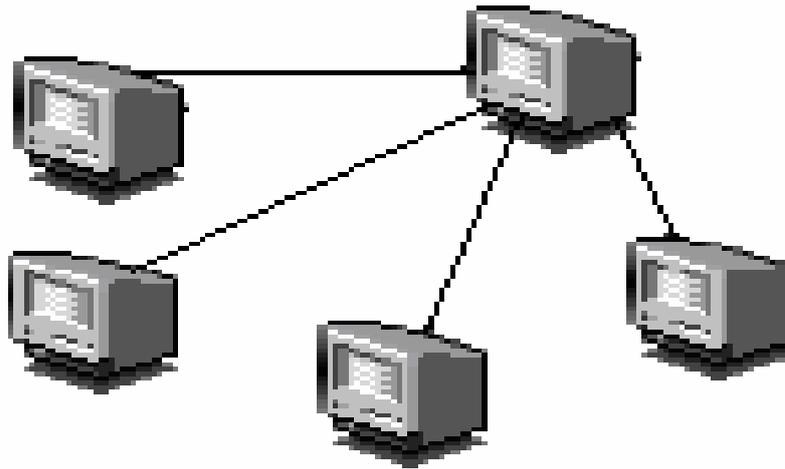
- Ring networks offer high performance for a small number of workstations or for larger networks where each station has a similar workload.
- Ring networks can span longer distances than other types of networks.
- Ring networks are easily extendable.
- Unlike Bus topology, there is no signal loss in Ring topology because the tokens are data packets that are re-generated at each node.

[B]. Disadvantages:

- Relatively expensive and difficult to install
- Failure of one computer on the network can affect the whole network.
- It is difficult to find fault in a ring network.
- Adding or removing computers can disrupt the network.
- It is much slower than an Ethernet network under normal load.

IV. Star Topology

Star topology uses a central hub through which, all components are connected. In a Star topology, the central hub is the host computer, and at the end of each connection is a terminal as shown in Figure.



Nodes communicate across the network by passing data through the hub. A star network uses a significant amount of cable as each terminal is wired back to the central hub, even if two terminals are side by side but several hundred meters away from the host. The central hub makes all routing decisions, and all other workstations can be simple.

An advantage of the star topology is that failure, in one of the terminals does not affect any other terminal; however, failure of the central hub affects all terminals. This type of topology is frequently used to connect terminals to a large time-sharing host computer.

[A]. Advantages:

- It is more reliable (if one connection fails, it does not affect others)
- The center of a star network is a good place to diagnose network faults and if one computer fails whole network is not disturbed. Hub detects the fault and isolates the faulty computer.
- It is easy to replace, install or remove hosts or other devices, the problem can be easily detected-It is easier to modify or add a new computer without disturbing the rest of the network by simply running a new line from the computer to the central location and plugging it to the hub.
- Use of multiple cable types in a same network with a hub.
- It has good performance

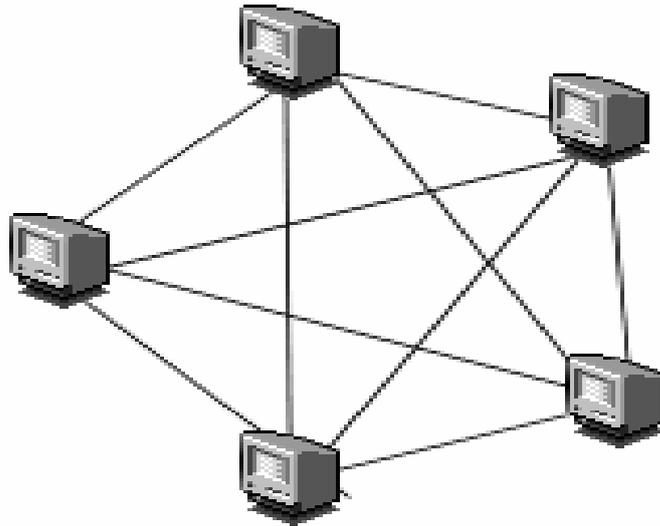
[B]. Disadvantages

- It is expensive to install as it requires more cable, it costs more to cable a star network because all network cables must be pulled to one central point, requiring more cable length than other networking topologies.
- Central node dependency, if central hub fails, the whole network fails to operate.
- Many star networks require a device at the central point to rebroadcast or switch the network traffic.

V. Mesh Topology

Devices are connected with many redundant interconnections between network nodes. In a well-connected topology, every node has a connection to every other node in the network. The cable requirements are high, but there are redundant paths built in.

Failure in one of the computers does not cause the network to break down, as they have alternative paths to other computers.



Mesh topologies are used in critical connection of host computers (typically telephone exchanges). Alternate paths allow each computer to balance the load to other computer systems in the network by using more than one of the connection paths available.

A fully connected mesh network therefore has no $(n-1)/2$ physical channels to link n devices. To accommodate these, every device on the network must have $(n-1)$ input/output ports.

[A]. Advantages

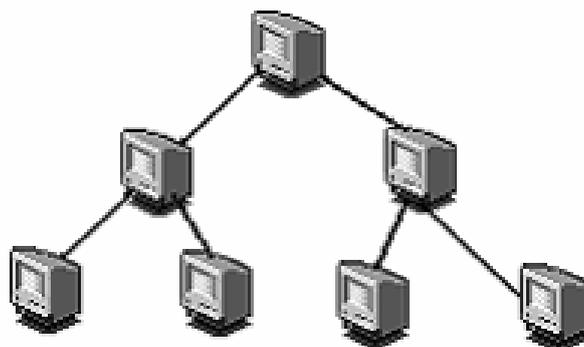
- Yield the greatest amount of redundancy in the event that one of the nodes fails where network traffic can be redirected to another node.
- Point-to-point link makes fault isolation easy.
- Privacy between computers is maintained as messages travel along dedicated path.
- Network problems are easier to diagnose.

[B]. Disadvantages

- The amount of cabling required is high.
- A large number of I/O (input/output) ports are required.

VI. Tree Topology

The most common structure or topology known as Tree topology, Tree topology is a LAN topology in which only one route exists between any two nodes on the network. The pattern of connection resembles a tree in which all branches spring from one root.



Tree topology is a hybrid topology, it is similar to the star topology but the nodes are connected to the secondary hub, which in turn is connected to the central hub. In this topology group of star-configured networks are connected to a linear bus backbone.

[A]. Advantages

- Installation and configuration of network are easy.
- The addition of the secondary hub allows more devices to be attached to the central hub.
- Less expensive when compared to mesh topology.
- Faults in the network can be detected traces.

[B]. Disadvantages

- Failure in the central hub brings the entire network to a halt.
- More cabling is required when compared to the bus topology because each node is connected to the central hub.

VII. Conclusion

In this paper we have to study the different types of the topologies like Bus Topology, Ring Topology, Star Topology, Mesh Topology and Tree Topology.

In this paper we have considered above five topology uses and its merits and demerits that will study will help to know that which structure or topology is best for which organization or business. We have to study the topology and finally we have to find the fact that all topologies are alternate options for business like that Bus Topology is use full for small network but its some demerits so its alternate option is Ring Topology. So finally, we can say that all topologies have some extra and different feature are available from other topology and that features are making it special from other topology.

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