NETWORK TOPOLOGIES

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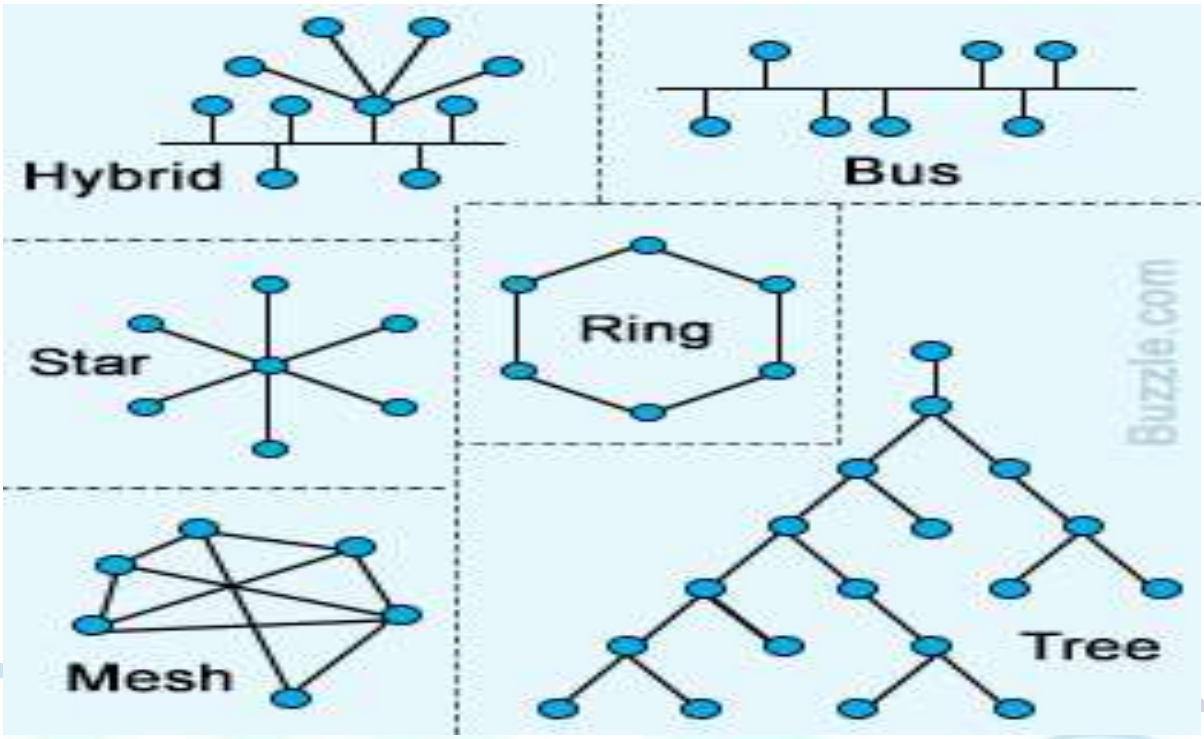
ABSTRACT

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.

1. INTRODUCTION

The mathematical subject of Topology investigates objects whose characteristics are constant through distortion. Objects can be topologically equivalent while appearing physically different. As an example, any two objects formed with a simple rubber band are topologically equivalent so long as the band is not parted. A noteworthy practical analysis technique based on Topology is Kirchoff circuit analysis. Computer Network Topology is an extension of basic Topology. This discipline examines the configuration of computer system elements and their associated interconnections. Physical Network Topology emphasizes the hardware associated with the system including workstations, remote terminals, servers, and the associated wiring between assets. Logical Network Topology (also known as Signal Topology) emphasizes the representation of data flow between nodes, not dissimilar from Graph Theory analysis. 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.



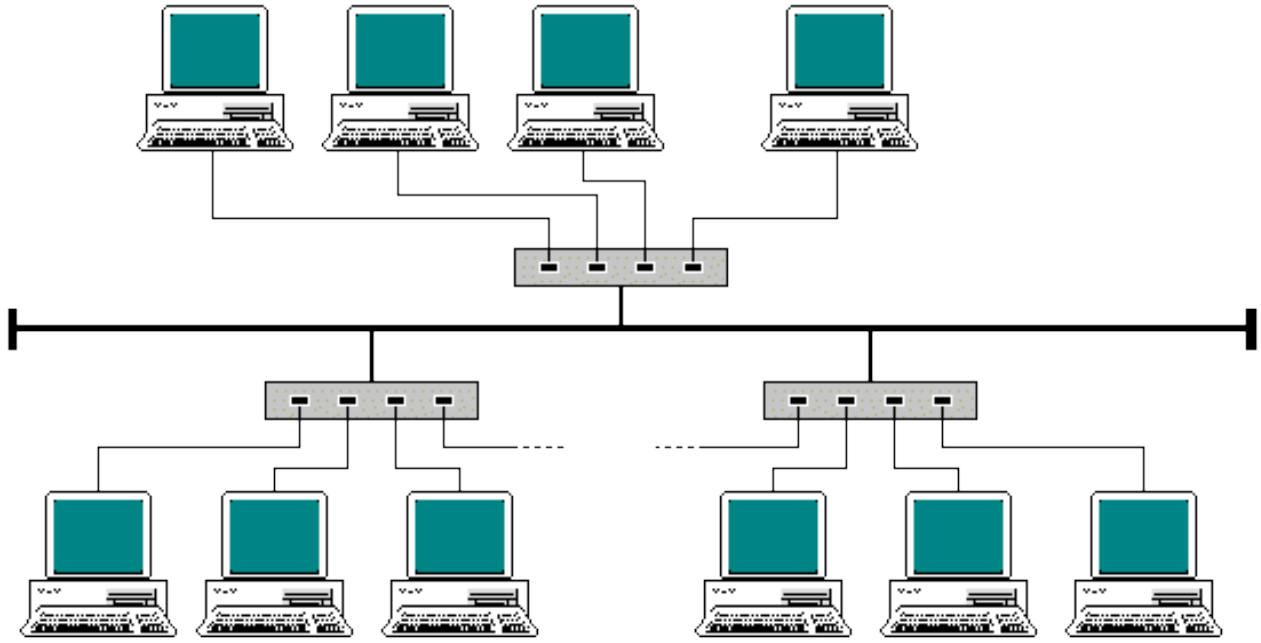
TOPOLOGIES

2. TYPES OF TOPOLOGIES

There are various types of Network topologies being used these days. These are mentioned below.

2.1 BUS TOPOLOGY

Alternatively referred to as a **line topology**, a **bus topology** is a network setup where each computer and network device are connected to a single cable orbackbone. Bus networks are useful in small networks (like those setup in a small offices) and have the advantage of using less cable. Their main disadvantage is that if any segment of the network fails, all transmissions do as well. Below is a visual example of a simple computer setup on a network using the bus topology.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.



BUS TOPOLOGY

ADVANTAGES

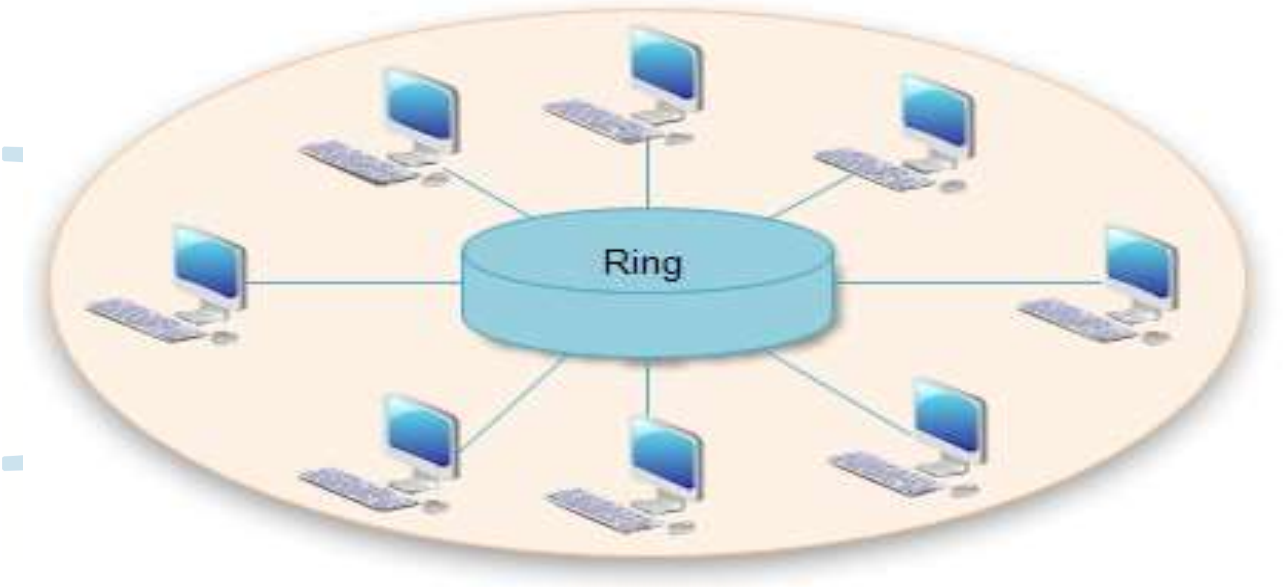
Reliable in very small networks as well as easy to use and understand. –
Requires least amount of cable to connect the computers (nodes) together and therefore is less expensive than other cabling arrangements. –
It's easy to extend, Two cables can be easily joined with a connector, making a longer cable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

DISADVANTAGES

Entire network shuts down if there is a break in the main cable
Terminators are required at both ends of the backbone cable
Difficult to identify the problem if the entire network shuts down
Not meant to be used as a stand-alone solution in a large building
It is slow when more devices are added into the network
If a main cable is damaged then network will fail or be split into two networks

2.2 RING TOPOLOGY

A **ring network** is a network topology in which each node connects to exactly two other nodes, forming a single continuous pathway for signals through each node - a ring. Data travel from node to node, with each node along the way handling every packet.Because a ring topology provides only one pathway between any two nodes, ring networks may be disrupted by the failure of a single link. A node failure or cable break might isolate every node attached to the ring. In response, some ring networks add a "counter-rotating ring" (C-Ring) to form a redundant topology: in the event of a break, data are wrapped back onto the complementary ring before reaching the end of the cable, maintaining a path to every node along the resulting C-Ring. Such "dual ring" networks include Spatial Reuse Protocol, Fiber Distributed Data Interface (FDDI), and Resilient Packet Ring. 802.5 networks - also known as IBM token ringnetworks - avoid the weakness of a ring topology altogether: they actually use a *star* topology at the *physical* layer and a media access unit (MAU) to *imitate* a ring at the *datalink* layer.



RING TOPOLOGY

ADVANTAGES

Very orderly network where every device has access to the token and the opportunity to transmit

Performs better than a bus topology under heavy network load

Does not require a central node to manage the connectivity between the computers

Due to the point to point line configuration of devices with a device on either side (each device is connected to its immediate neighbor), it is quite easy to install and reconfigure since adding or removing a device requires moving just two connections.

Point to point line configuration makes it easy to identify and isolate faults.

DISADVANTAGES

One malfunctioning workstation can create problems for the entire network. This can be solved by using a dual ring or a switch that closes off the break.

Moving, adding and changing the devices can affect the network

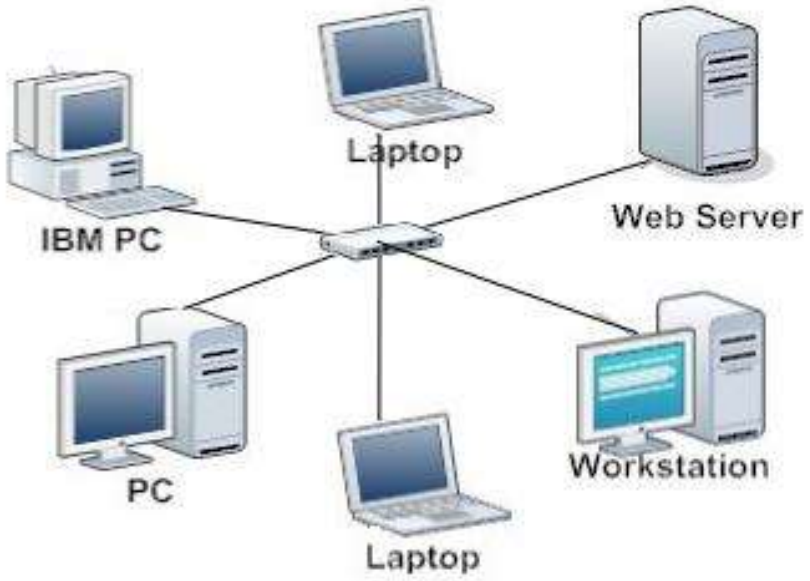
Communication delay is directly proportional to number of nodes in the network

Bandwidth is shared on all links between devices

More difficult to configure than a Star: node adjunction = Ring shutdown and reconfiguration

2.3 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. This consists of a central node, to which all other nodes are connected; this central node provides a common connection point for all nodes through a hub. In star topology, every node (computer workstation or any other peripheral) is connected to a central node called a hub or switch. The switch is the server and the peripherals are the clients.Thus, the hub and leaf nodes, and the transmission lines between them, form a graph with the topology of a star. If the central node is passive, the originating node must be able to tolerate the reception of an echo of its own transmission, delayed by the two-way transmission time (i.e. to and from the central node) plus any delay generated in the central node. An active star network has an active central node that usually has the means to prevent echo-related problems.The star topology reduces the damage caused by line failure by connecting all of the systems to a central node. When applied to a bus-based network, this central hub rebroadcasts all transmissions received from any peripheral node to all peripheral nodes on the network, sometimes including the originating node. All peripheral nodes may thus communicate with all others by transmitting to, and receiving from, the central node only. The failure of a transmission line linking any peripheral node to the central node will result in the isolation of that peripheral node from all others, but the rest of the systems will be unaffected.It is also designed with each node (file servers, workstations, and peripherals) connected directly to a central network hub, switch, orconcentrator.Data on a star network passes through the hub, switch, or concentrator before continuing to its destination. The hub, switch, or concentrator manages and controls all functions of the network. It also acts as a repeater for the data flow. This configuration is common with twisted pair cable. However, it can also be used with coaxial cable or optical fiber cable.



STAR TOPOLOGY

ADVANTAGES

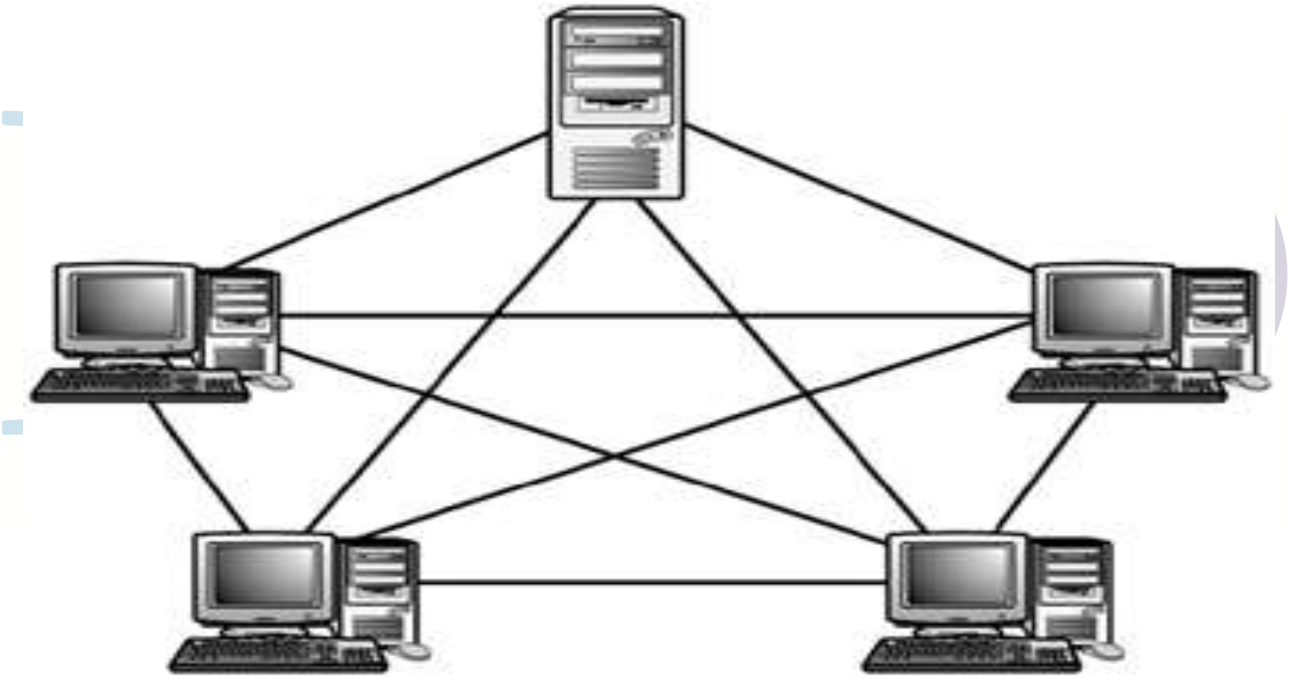
It is more reliable (if one connection fails, it does not affect others)
The center of a star network is a good place to diagnose network faults and if one computer fails whole network is not disturbed. Hub detects the fault and isolates the faulty computer.
It is easy to replace, install or remove hosts 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.

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.

2.4 MESH TOPOLOGY

Mesh Network Topologies capitalize on path redundancy. This Topology is preferred when traffic volume between nodes is large. A proportion of nodes in this type of network have multiple paths to another destination node. With the exception of the Bi-directional Ring (and this was only when a failure was detected) each of the topologies discussed so far had only one path from message source to message destination. Thus the probability of single point network failure is greatly minimized with Mesh Network Topology. A major advantage of the Mesh Network Topology is that source nodes determine the best route from sender to destination based upon such factors connectivity, speed, and pending node tasks. A disadvantage of Mesh Network Topologies is the large cost incurred in setting up the network. A further disadvantage of this type of network is the requirement for each node to have routing algorithm for path computation. A full mesh is described as each node being directly connected to every other node in the network. This type of topology is usually restricted to networks with a small number of nodes. A partial mesh is described as having some nodes in the network being indirectly connected to others in the network. The internet employs Mesh Network Topology.



MESH TOPOLOGY

ADVANTAGES

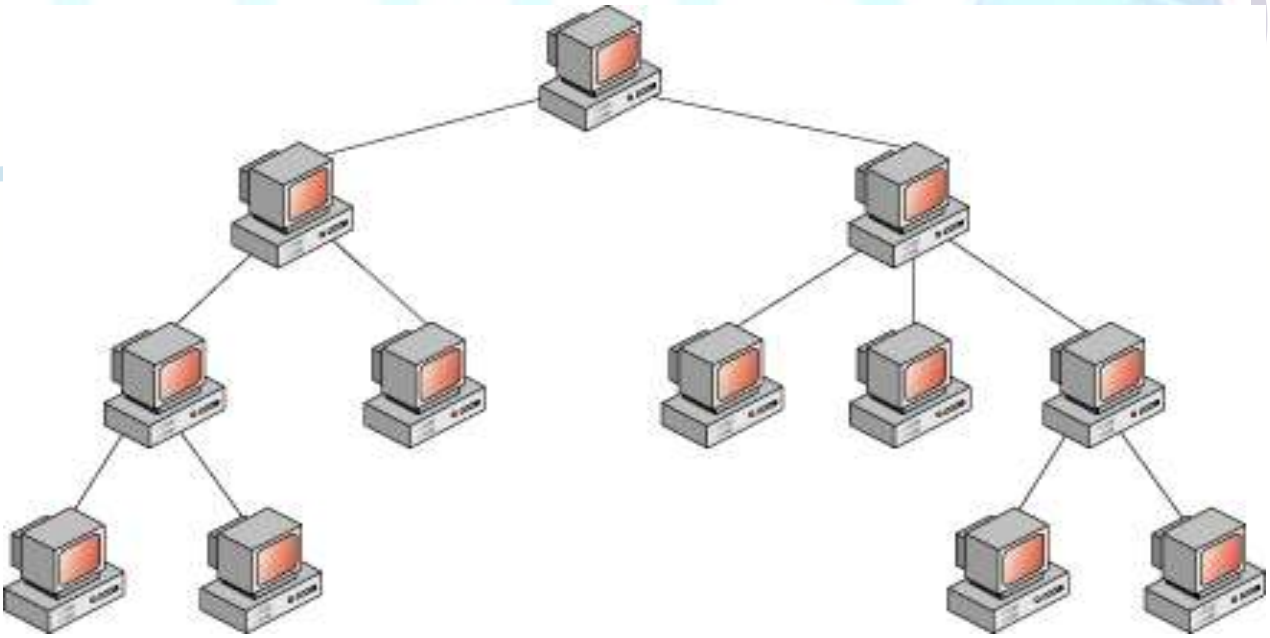
Yield the greatest amount of redundancy in the event that one of the nodes fails where network traffic can be redirected to another node.
Point-to-point link makes fault isolation easy.
Privacy between computers is maintained as messages travel along dedicated path. − Network problems are easier to diagnose.

DISADVANTAGES

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

2.5 TREE TOPOLOGY

Tree Network Topology is constructed from either making a set of Star Network Topologies subordinate to a central node, or by linking a set of Star Network Topologies together directly via a bus, thereby distributing the functionality of the central node among several Star Network Topology top level nodes. The top level nodes from each Star Network are the elements linked via a bus in the second arrangement. In simple Tree Network Topology no Star Network Topology subordinate nodes are connected to the bus. Messages in a Tree Network Topology can be either broadcast from the central node to all interconnected Star Networks, or targeted to select Star Networks. One major advantage of the Tree Network Topology is the ease at which the network can be expanded. Expansion can be as simple as linking in an additional Star Network Topology onto the bus. Also, like the Star Network Topology there is localization of cabling failures with this configuration. However, if a Star Network top level node in the fails, or cabling to it fails an entire section of the network is lost to communication as opposed to just one subordinate node as in pure Star Network Topology.



TREE TOPOLOGY

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

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

3. CONCLUSION

Computer Network Topology brings inherent advantages and disadvantages to any system under study. Description of some of these advantages and disadvantages for several standard physical topologies has been provided in this paper. This will help us to know that which structure or topology is best for which organization or business.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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