

Networking



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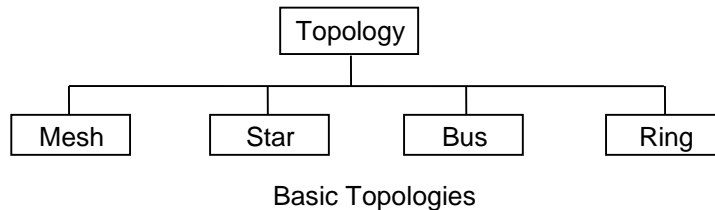
Module 1 Introduction to Topology

NETWORK TOPOLOGY

The term physical topology refers to the way in which a network is laid out physically.

- Two or more devices connect to a link; two or more links form a topology.
- The topology of a network is the geometric representation of the relationship of all the links and linking devices (usually called nodes) to one another.

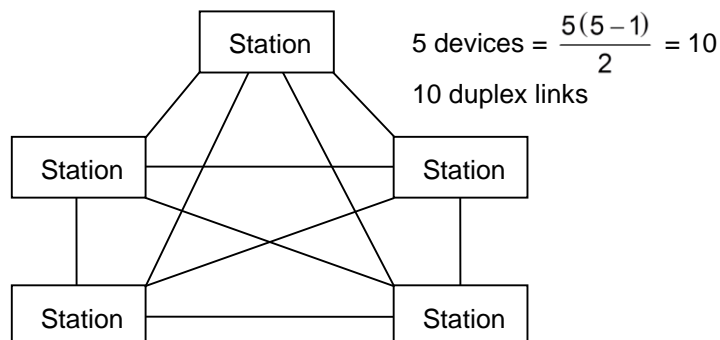
There are four basic topologies.



Other than above (i) Tree Topology (ii) Hybrid Topology

i) Mesh Topology

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- To find the number of physical links in a fully connected mesh network with n nodes, we first consider that each node must be connected to every other node i.e. Node 1 must be connected to $(n - 1)$ nodes, node 2 must be connected to $(n - 1)$ nodes and

finally node n must be connected to $(n - 1)$ nodes.

Hence, we need $n(n - 1)$ physical links.

- However, if each physical link allows communication in both directions (duplex mode), we can divide the number of links by 2.

In other words, we need $\frac{n(n-1)}{2}$ duplex mode links.

- This topology has point-to-point connection.

Advantages

- 1) **No Traffic** – The use of dedicated links guarantees that each connection can carry its data load, thus eliminating traffic problems than can occur when links must be shared by multiple devices.
- 2) **Robust** : If one link becomes unusable, it does not incapacitate the entire system.
- 3) **Privacy or Security** : Every message travels along a dedicated link, hence only the intended recipient sees it.
- 4) Point-to-point links make fault identification and fault isolation easy.

Disadvantages

- 1) Because every device must be connected to every other device. Installation and reconnection are difficult.
- 2) The share bulk of the wiring can be greater than the available space (in walls, ceilings or floors) can accommodate.
- 3) The hardware required to connect each links (I/O ports and cable) can be prohibitively expensive.

Example : Connection of telephone regional offices in which each regional office needs to be connected to every other regional office.

ii) Star Topology

- In this topology, each device has a dedicated point-to-point link only to a central controller usually called a hub.
- Unlike, a mesh topology a star topology does not allow direct traffic between devices, Controller acts as on Exchange.
- This topology has point-to-point connection.

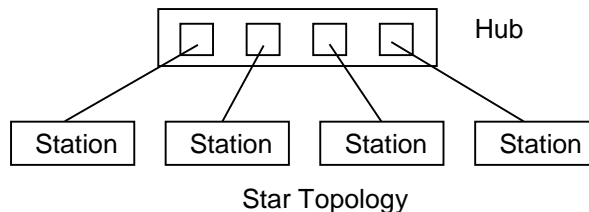
Advantages :

- 1) Less expensive than mesh topology.
- 2) Easy to install and reconfigure.
- 3) Less cabling required as compared to mesh.
- 4) Robustness : if one link is damaged then the complete system is not affected. This also leads to easy fault identification and isolation.

Disadvantages :

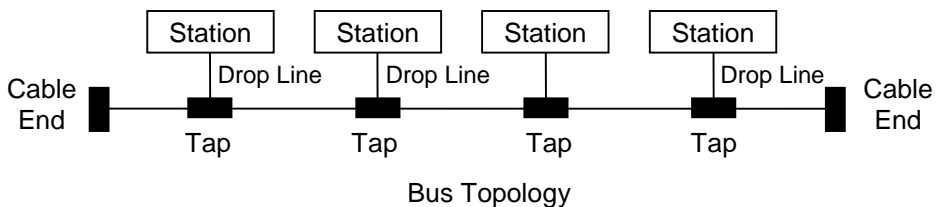
- 1) One of the biggest disadvantage of a star topology is the dependency of the whole topology on one single point, the hub, if the hub goes down, the whole system is dead.
- 2) More cabling required as compared to bus or ring topology.

Example : Star topology is used in local are networks (LANs).



iii) Bus Topology

- This topology has multipoint connection. One long cable acts as a backbone to link all the devices in a network.



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

Advantages :

- 1) Ease of installation.
- 2) Backbone cable can be laid along the most efficient path.
- 3) Bus topology uses less cabling than mesh or star topology.

Disadvantages :

- 1) Difficult reconnection and fault isolation i.e. difficult to add new devices.
- 2) Signal reflection at the taps can cause degradation in quality.
- 3) A fault or break in the bus cable stops all transmission.

Example : Bus topology was one of the first topologies used in the design of early local area networks.

Ethernet LANs can use a bus topology, but they are less popular.

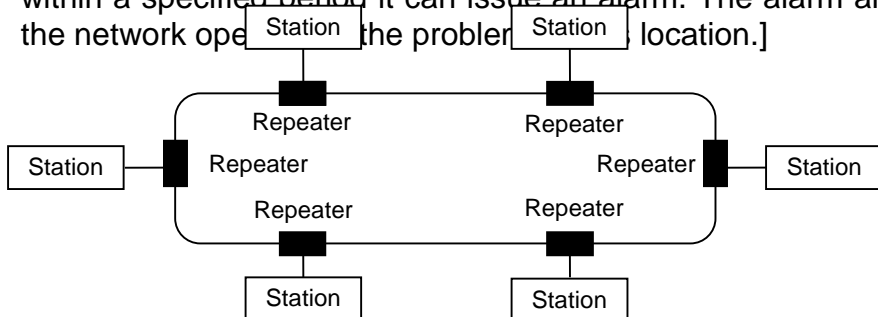
iv) Ring Topology

In a ring topology, each device has a dedicated point-to-point connection with only 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.

Advantages :

- 1) Relatively easy to install and reconfigure.
- 2) Fault isolation is simplified. [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 location.]



Ring Topology

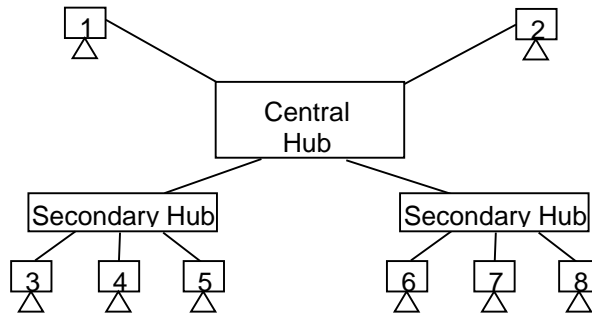
Disadvantages :

- 1) Unidirectional traffic can be disadvantage.
- 2) A break in the ring can disable the entire network.

Ring topology was prevalent when IBM introduced its local area network token ring.

v) TREE (Variation of Star)

In tree majority devices are connected to a secondary hub that in turn is connected to the central hub.



Advantages :

- 1) Less expensive than mesh topology.
- 2) Easy to install and configure.
- 3) Less cabling required as compared to mesh.
- 4) Robust
- 5) More devices can be attached to a single hub
- 6) Allows network to isolate and prioritize communication from difficult computers.

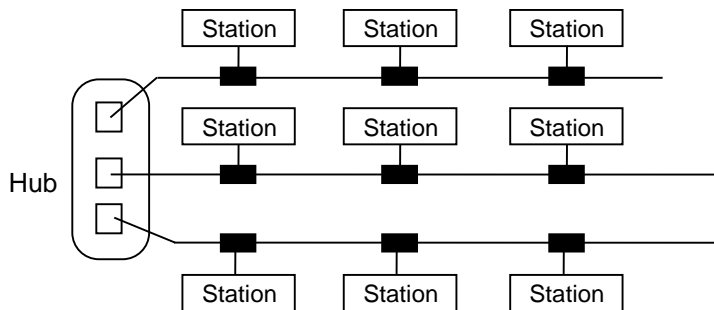
Disadvantages :

- 1) More cabling compared to bus or ring topology.
- 2) Central controller is required.

vi) Hybrid Topology

A network can be hybrid. For example, we can have a main star topology with each branch connecting several stations in a bus topology as shown in the figure

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Video:

Network Topology by Prof. Amit K. Nerurkar

The slide features a portrait of Prof. Amit K. Nerurkar on the left. To the right, the title 'Computer Networks' is displayed in a large, bold font, followed by 'Network Topologies' in a slightly smaller, bold font. Below the title, the following information is listed:

- Name:** Amit K. Nerurkar
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The VIT logo is visible in the top right corner of the slide.

VIDEO:
Networking Topologies and Types

NETWORK TOPOLOGY & its TYPES



PROTOCOL HIERARCHIES

Protocols

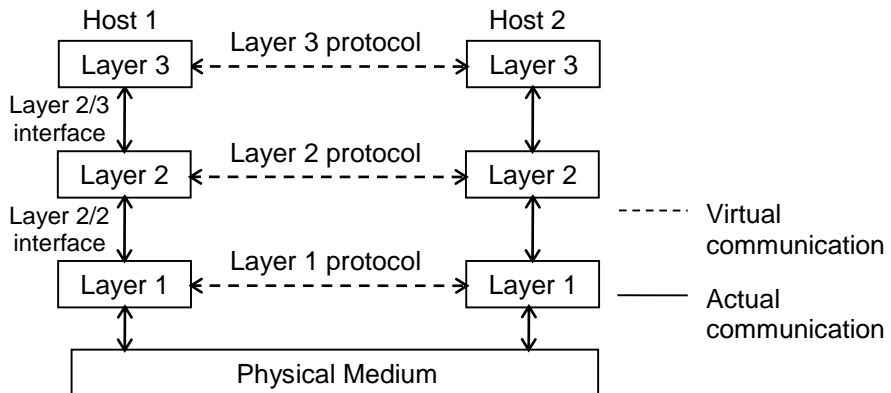
- A protocol is a set of rules that govern data communication.
- A protocol defines what is communicated, when it is communicated and how it is communicated.

Protocol Stack

It is defined as a list of protocols used for a certain system, one protocol per layer.

Protocol Hierarchies [Layered Architecture]

- Most networks are organized as a series of layers or levels.
- To reduce the design complexity networks are organized as a series of layers or levels one above the other as shown in figure.



Layers, Protocols and interfaces

- The number of layers, the name of each layer, the content of each layer and the function of each layer differ from network to network.
- The purpose of each layer is to offer certain services to the highest layers.
- Layer n on one machine (source) carries on a conversation with layer n on another machine (destination).
- The rules and conventions used in this conversation are collectively known as layer n protocol.

Peer

A three layer network is shown above. The entities comprising the corresponding layers on different machines are called as peers.

- The communication actually takes place between the peers using the protocol.
- The dotted lines in the figure show the virtual communication and physical communication is shown by solid lines.

Reasons for having layered protocols and its benefits

- The process of establishing a link between two devices to communicate and share information is complex.
- In network architecture the communication functions are grouped into related and manageable all sets called LAYERS.
- A network architecture refers to a set of protocols that tell how every layer is to function.

Advantages :

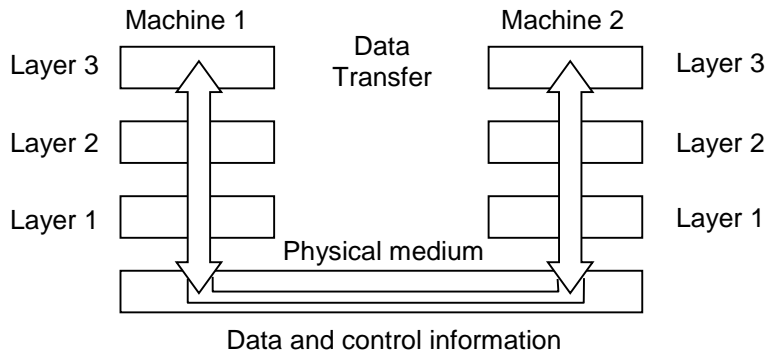
- i) It simplifies the design process as the functions of each layers and their interactions are well defined.
- ii) The layered architecture provides flexibility to modify and develop network services.
- iii) The number of layers, names of the layers and the tasks assigned to them may change from network to network. But for all networks, always the lower layer offers certain services to its upper layer.
- iv) The concept of layered architecture redefines the way of conceiving networks. This leads to a considerable cost saving and managerial benefits.
- v) Addition of new services and management of network infrastructure becomes easy.
- vi) Due to segmentation, it is possible to break complex problems into smaller and more manageable pieces.
- vii) Logical segmentations helps development taking place by different teams.

Disadvantages :

- i) The problem associated with the layered protocols is that he loose touch with the reality.
- ii) Layering is a kind of hiding information.
- iii) Layered architecture can sometimes result in poor performance.

How does the Data transfer take place?

- Data does not get transferred directly from layer n of one machine to layer n of the other machine. Data transfer takes place as explained below.
- The data and control information is passed on to the lower layers until the lowest layer (layer 1) is reached. Below layer 1 lies the physical medium such as co-axial cable, through which the actual communication takes place.



Interface defines the operations and services offered by lower layer to the upper layer.

- There is interface between each pair of adjacent layers.

References

1. TCP/IP Protocol Suite by Fourozan
2. Computer Networks by Tanenbaum

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Computer Network

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