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Computer Network Topology

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Abstract: In recent day's demands of high productivity, security of computer systems and computer networks is very important and popular issue. Communication network in a distributed computing environment, which is arranged in a geometrical shape, called network topology. There are different types of the topologies like bus, ring, star, tree, mesh, hybrid etc. However, we will consider five basic network structures- topology. In the present paper a detailed study and analysis on network topologies is presented. Definitions of physical and logical topology are also provided.

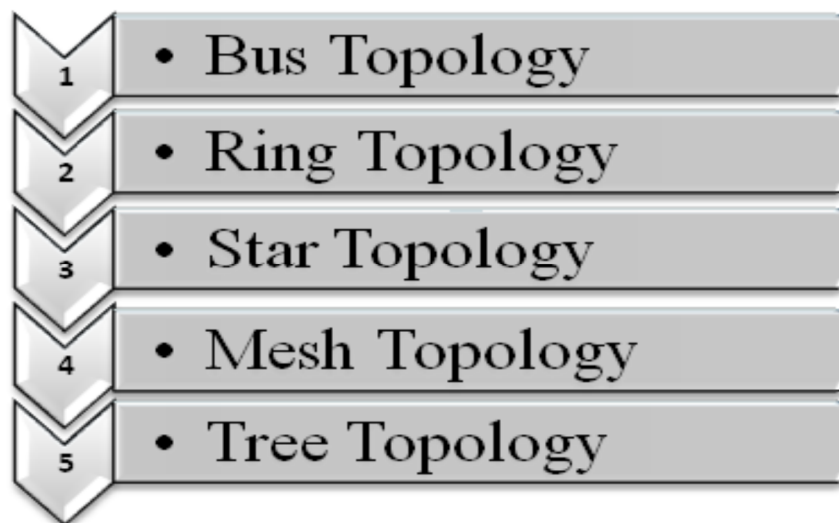
Keywords: - How topology use, physical and logical topology, Advantages, Disadvantages of network topology

I. INTRODUCTION

In communication network, the term topology refers to the way in which the end points, or stations, attached to the network are interconnected. In computer networking, topology refers to the layout of connected devices. Topologies can be physical or logical.

II. PHYSICAL TOPOLOGY

Physical Network Topology emphasizes the hardware associated with the system including workstations, remote terminals, servers, and the associated wiring between assets. Physical topology defines how the systems are physically connected. It means the arrangement of devices on a computer network through the actual cables that transmit data. The shape of the cabling layout used to link devices is called the physical topology of the network. This refers to the layout of cabling, the locations of nodes, and the interconnections between the nodes and the cabling. The physical topology of a network is determined by the capabilities of the network access devices and media, the level of control or fault tolerance desired, and the cost associated with cabling or telecommunications circuits. There are five basic topologies. In below each of these topologies are described_

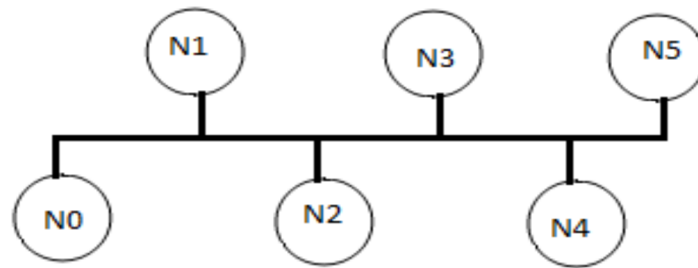


III. BUS TOPOLOGY

The bus topology carries the transmitted message along the cable. As the message arrives at each device (node), the nodes check the destination address contained in the message to see if it matches its own. In this 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. 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

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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

A. Advantages

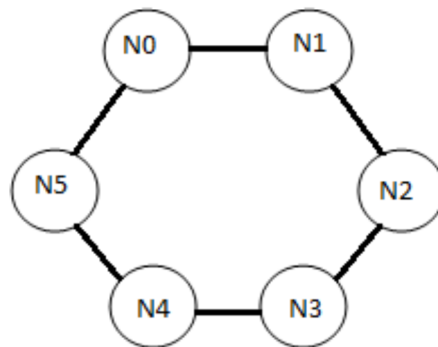
- 1) Reliable in very small networks as well as easy to use and understand.
- 2) Requires least amount of cable to connect the computers (nodes) together and therefore is less expensive than other cabling arrangements.
- 3) It's easy to extend, Two cables can be easily joined with a connector, making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

B. Disadvantages

- 1) 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.
- 2) Each connection between two cables weakens the electrical signal.
- 4) The bus configuration can be difficult to find and can cause the whole networks to stop functioning.

IV. RING TOPOLOGY

In a ring topology, every device has exactly two neighbors for communication purposes. All messages travel through a ring in the same direction (either “clockwise” or “counter clock wise”). 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_



Ring Topology

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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

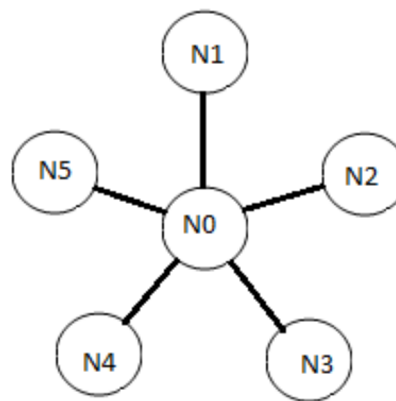
- 1) Ring networks offer high performance for a small number of workstations or for larger networks where each station has a similar workload.
- 2) Ring networks can span longer distances than other types of networks.
- 3) Ring networks are easily extendable.
- 4) Unlike Bus topology, there is no signal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

B. Disadvantages

- 1) Relatively expensive and difficult to install
- 2) Failure of one computer on the network can affect the whole network.
- 3) It is difficult to find fault in a ring network.
- 4) Adding or removing computers can disrupt the network.

V. 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 node. Nodes communicate across the network by passing data through the hub. A star network uses a significant amount of cable as each node is wired back to the central hub, even if two nodes 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 nodes does not affect any other node; 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. Many home networks use the star topology.



Star Topology

A. Advantages

- 1) It is more reliable (if one connection fails, it does not affect others)
- 2) 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.

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- 3) 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.
- 4) Use of multiple cable types in a same network with a hub.
- 5) It has good performance

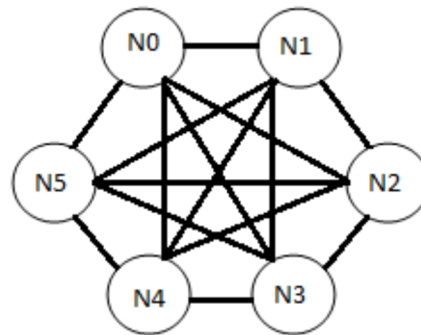
B. Disadvantages

- 1) 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.
- 2) Central node dependency, if central hub fails, the whole network fails to operate.
- 3) Many star networks require a device at the central point to rebroadcast or switch the network traffic.

VI. MESH TOPOLOGY

Mesh topologies involve the concept of routes. 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 Topology

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 $n(n-1)/2$ physical channels to link n devices. To accommodate these, every device on the network must have $(n-1)$ input/output ports.

A. Advantages

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

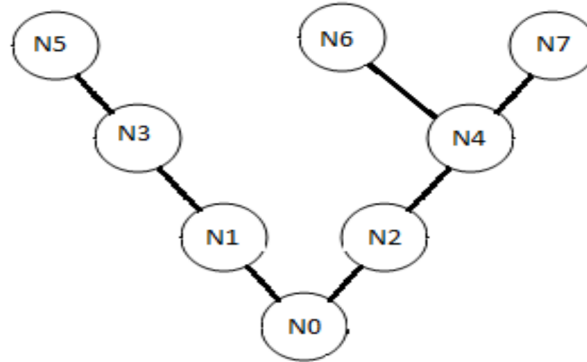
B. Disadvantages

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

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VII. TREE TOPOLOGY

The most common 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

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. Tree topology is a combination of two or more bus and the star topology. In this topology group of star-configured networks are connected to a linear bus backbone.

A. Advantages

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

B. Disadvantages

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

VIII. LOGICAL TOPOLOGY

Logical Network Topology emphasizes the representation of data flow between nodes. It means logical topology is associated with the arrangement of devices on a computer network and how they communicate with one another. The main role of logical topology is to communicate across the physical topologies among different systems. Logical topologies are often closely associated with Media Access Control methods and protocols. Logical topologies are able to be dynamically reconfigured by special types of equipment such as routers and switches. There are two categories of logical topologies: Shared media topology and token-based topology.

A. Shared Media Topology

In shared media topology the systems have unrestricted access to the physical media that is all the systems in a network have the ability to access the physical layout whenever they need it. Collision is the main disadvantage of this topology as more than one system send information out on the wire at the same time, the packets collide and as a result this collision kills the packets. Ethernet is an example of a shared media topology. As a remedy some huge networks are broken down into smaller networks. Some Ethernet uses Carrier Sense Multiple Access protocol to reduce the number of collisions.

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B. Token Based Topology

In token based topology a token is used which travels around the network to access the physical media. If any node wants to send a packet to another one it should wait for the token which is traverse within the network either clockwise or anti-clockwise direction.

IX. 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. Description of some inherent advantages and disadvantages computer network topologies to any system under study also has been described in this paper. 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 it's some demerits so its alternate option is Ring Topology. This paper has provided some knowledge of analysis approaches for dealing with network topology related problems. The techniques covered in this discussion can be adapted to related computer network applications. 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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