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Study of Different Network Topologies

Ritu

Department of Computer Science and Engineering, Galgotias University, Yamuna Expressway Greater Noida, Uttar Pradesh, India

ABSTRACT: A network is that two or more devices are interconnected. Computer resources, remote computers, and networking facilities are geometrically organized as network structure or network topology. The study of setup or mapping of a network's elements (links, nodes) is called network topology. Connectivity distribution of computers is now very important issue that delivers end-to-end output at low cost, thus distribution system efficiency is affected by the technology adopted by network interconnection so computer distribution is done according to communication network organized in a geometrical manner called network topology. A connection is a route of communication between two nodes. Also, the words "circuit" and "path" are used as synonyms for the connection. There are various types of topology which includes bus, ring, tree, mesh etc. This paper presents an empirical analysis of various types of basic topologies of the network based on their advantages, disadvantages and various factors which distinguish them.

KEYWORDS*:* Microenterprises, Network Topologies, Wired Network

I. INTRODUCTION

In the computer network two or more computers are connected together in order to communicate and share resources through a medium and data communication devices. The word topology in communication network relates to how the network connects the computers or workstations together. The primary types of topologies of the network are: Bus Topology, Star Topology, Ring Topology, Mesh Topology and Tree Topology[1]. The mathematical field of Topology examines structures whose features are unchanged due to distortion. While appearing physically different, objects can be topologically equivalent. Any two objects formed with a simple rubber band, for example, are topologically equivalent so long as the band is not split. Kirchhoff circuit analysis is a notable functional research method focused on topology[2]. Computer Network Topology is a simple topology extension. This discipline explores the configuration and related interconnections of computer system components. It could be physical or logical to topologies. Physical topology means a network's physical architecture including equipment, location, and installation of cables. Physical Network Topology highlights the hardware linked to the network, comprising workstations, remote terminals, servers, and related wiring between resources. Logical Network Topology focuses the presentation of flow of data between nodes, not different from the Graph Theory analysis[3]. A network's logical topography can be dynamically reconfigured when there is a variety of network equipment, such as routers. Logical Topology refers to the fact that in contrast to its architecture, the way data actually moves in a network. A comparative example of physical and logical topologies is shown in Fig 1.

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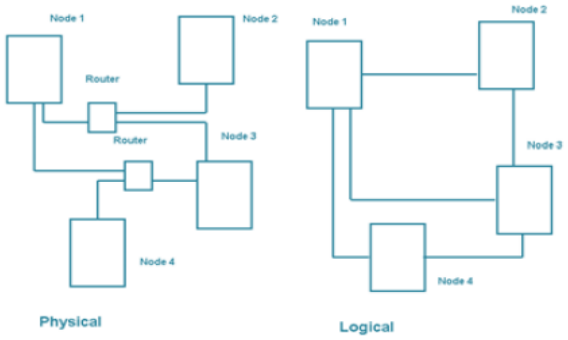

Fig. 1: Logical and Physical Topology

II. NETWORK TOPOLOGIES

Bus Topology:

A single cable is used in Bus Network Topology to link all devices over the net. This cable is often called backbone network. As communication takes place between nodes the computer sends the message to all nodes on the network but only the intended recipient digests the message. Problems arise when two customers want to communicate in the same bus at same time[4]. Fig.2 shows the bus topology

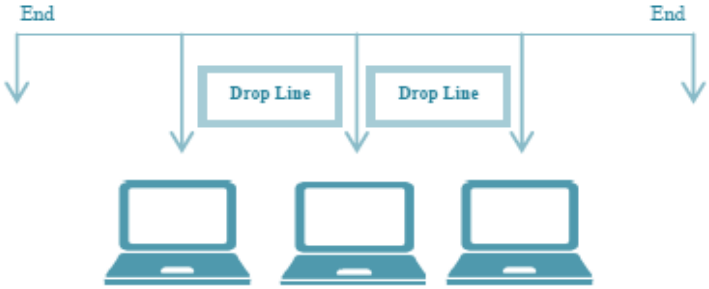

Fig. 2: Bus Topology

Advantages:

- Simple to deploy and extend.
- Less costly because the linking of computers requires less cable.
- Suitable for small or temporary networks, and simple to use.
- Repeater can also be used for extension.

Disadvantages:

- A bus will delay due to heavy network traffic.
- Clearance is necessary.
- Bus cable fault prohibits all transmission.
- Hard to administer.

Ring Topology:

Ring Topology has each node connected to two other nodes in the network in accordance with the connection of the first and last nodes. Messages from one node to another then pass via the set of intermediate nodes from the originator to destination. The intermediate nodes for messages intended for other nodes serve as active repeaters. Many types of Ring Network Topology have messages moving in a specific direction about ring (either clockwise or clockwise) while other variants of this type of configuration (called bi-directional rings) have messages flowing in either direction using two cables across each linked node[5]. In some situations, in a Ring Topology Network, blocking devices are needed to avoid packet storming, the state in which packets not consumed by a network node fall into an infinite loop about the ring. Typically, ring network topology is used in networks where the volume of traffic between nodes is minimal[6]. Fig.3 shows the ring topology.

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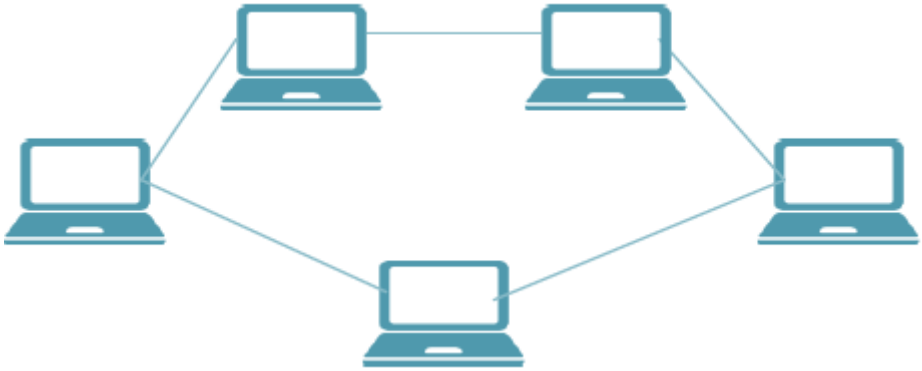

Fig. 3: Ring Topology

Advantages:

- Ring offer better efficiency for a low number of workstations or for larger systems where there is equal workload for each station.
- Ring topology can extend greater distances than other network types.
- Easily extendable.
- In Ring topology, unlike Bus topology, there is no signal loss, because the tokens are data packets that are re-generated on each node.

Disadvantages:

- Relatively costly and hard to install.
- Network failure will affect the entire network.
- Fault is hard to find on a ring network.
- Adding or deleting computers may interrupt the network.
- It is much slower under normal load than an Ethernet network.

Tree Topology:

Tree Topology is designed either by subordinating a set of Star Network Topologies to a central node, or by connecting a set of Star Network Topologies directly through a bus, thus spreading the central node functionality among several Star Network Topology top-level nodes. In the second arrangement, the top level nodes from each Star Network are the elements that are connected via a bus[7]. No subordinate nodes to Star Network Topology are connected to the bus in simple Tree Topology. Signals in a Tree Topology can either be transmitted to all interconnected Star Networks from the central node, or be targeted to select Star Networks. Fig.4 shows the tree topology.

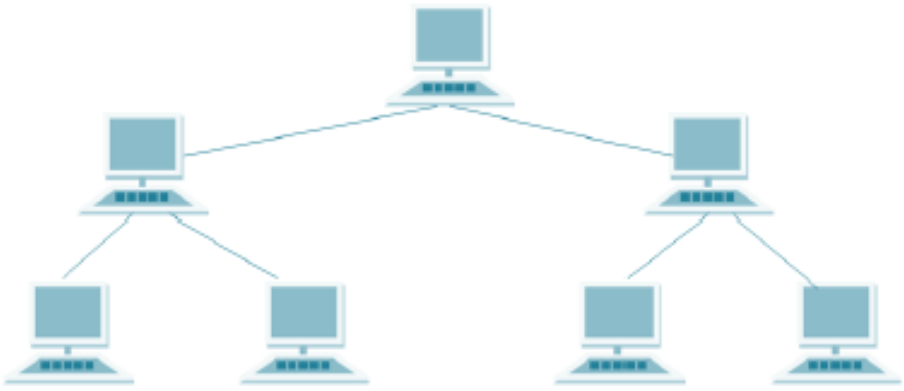

Fig. 4: Tree Topology

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Advantages:

- Network installation and setup is simple.
- Adding the secondary hub enables more devices to be connected to the main hub.
- Less expensive than mesh topology.

Disadvantages:

- Error in the central hub blocks the whole network.
- In contrast to the bus topology, more cabling is needed as each node is linked to the central hub.

Star Topology:

Star Topology involves use of a top level central node that all other nodes are connected to. This top level node can be a computer, a simple switch, or just a common point of connection. Messages received by the top-level node can either be sent to all subordinate nodes, or if the top-level system is of appropriate fidelity, sent only to the subordinate node you like. With this configuration internode messaging delays are popular[8]. The computers or users are not interconnected and this allows direct inter-device communication. The active star network has an active central node, which generally has the means to escape echo-related issues. Fig.5 Shows the star topology.

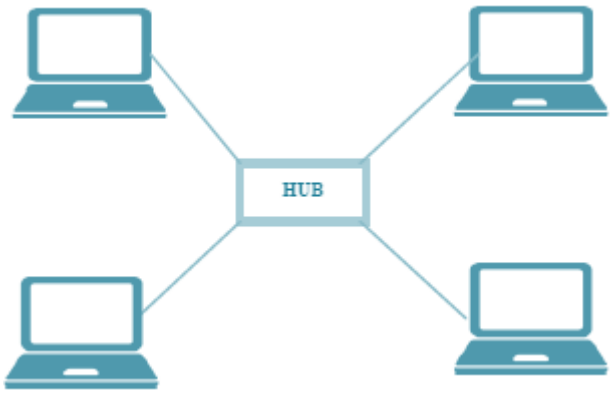

Fig. 5: Star Topology

Advantages:

- It's more secure (if one link fails, it doesn't affect others).
- The star network center is a good place to diagnose network faults and if one device fails the entire network is not disrupted. Hub finds fault and isolate the faulty device.
- Replacing, upgrading or removing hosts or other devices is simple, the problem can be easily detected-it's easier to change or add a new device without affecting the rest of the network simply by running a new line from the computer to the central location and plugging it into the hub.
- Numerous cable types are used in the same hub network.

Disadvantages:

- It is costly to build as it needs more cable, because all network cables have to be pulled to one central point, consuming more wire length than most other topologies.
- Dependence of the central node, if the central hub fails, the entire network will not be operating.
- Many of the star networks require a device to retransmit or switch network traffic at the central point.

Mesh Topology:

Multiple redundant interconnections between network nodes connect devices. Every node has a connection to every other node in the network within a well-connected topology. There are high cable specifications but redundant paths are built in. Because they have alternative paths to other machines, failure in one computer does not break down the network. Mesh topologies have been used in vital host device links (usually telephone interchanges). Alternate paths enable each device to manage the load onto other network computer systems using more than one of the available link paths[9]. Consequently, a fully connected mesh network has no (n-1)/2 physical channels for linking n devices. Every computer on the network must have (n-1) input / output ports to accommodate these[10]. Fig.6 shows the mesh topology.

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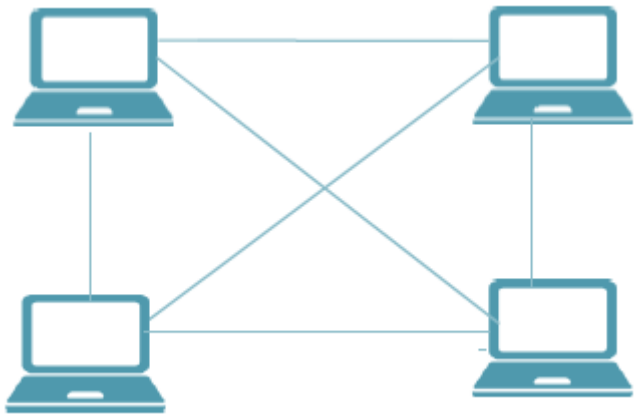

Fig.6: Mesh Topology

Advantages:

- Point-to-point connection enables fast isolation of faults.
- Security is established between computers as messages move through dedicated pathways.
- The issues with the network are easier to address.

Disadvantages:

- The requisite amount of cabling is high.
- Large number of I / O ports are required.

The table 1 portrays the analysis of various topologies.

Table 1: Analysis of Different Topologies

Parameters	BUS	STAR	RING	MESH	TREE
Installation	easy	easy	difficult	difficult	easy
Cost	inexpensive	expensive	moderate	expensive	less
Flexible	yes	yes	no	no	yes
Reliability	moderate	high	high	high	moderate
Extension	easy	easy	easy	poor	easy
Robust	no	yes	no	yes	no

III. CONCLUSION

In this paper author have carried out analytical study of various basic topologies and provide with knowledge of each topology and its features. Every topology has some benefits and drawbacks as discussed, so the solution is that user can integrate two or even more distinct topologies in order to create a resulting topology with a combination topology characteristic known as hybrid topology. It is reliable, scalable, robust and effective topology. The only downside is its architecture complexity and expensive infrastructure, because it is mixed with two or more different topologies.

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