iJRASET
International Journal For Research in Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 4 **Issue:** XI **Month of publication:** November 2016

DOI:

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Volume 4 Issue XI, November 2016
ISSN: 2321-9653
International Journal for Research in Applied Science & Engineering Technology (IJRASET)

Study on Various Network Topologies for set –up best Network

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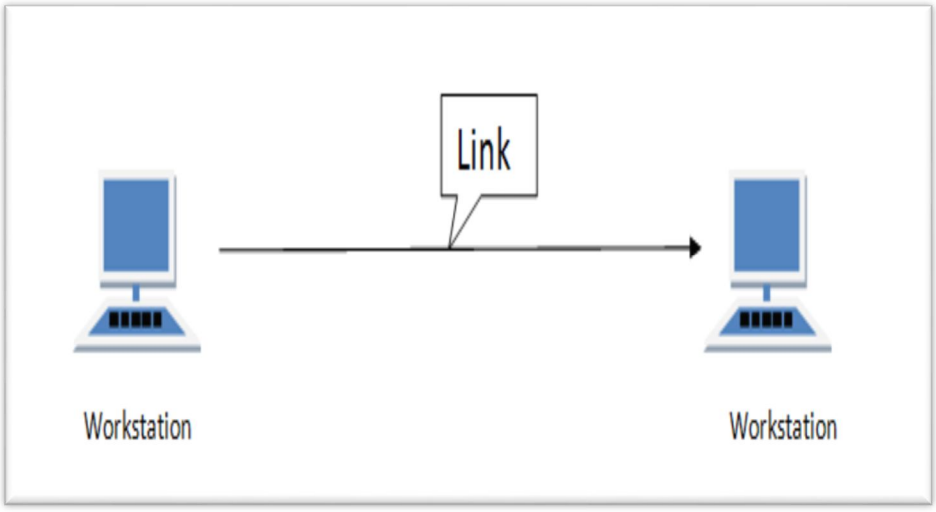
Abstract:- This paper presents an introduction to Computer Network Topology. Definitions of Physical and Logical Topologies are provided. Additionally common Computer Network realizations of Physical Topologies are reviewed. This is followed by a discussion of Graph Theory and its relation to topological analysis. A discussion of analysis examples follows with an emphasis on message routing issues, network sizing, and virus analysis. These examples are discussed to underscore the impotance of topological design when constructing a new computer network, or adding to an existing one.
Keywords: Physical Network Topology, Logical Network Topology, Minimum Spanning Tree, Graph Theory, Bus Network Topology, Ring Network Topology, Star Network Topology, Tree Network Topology, Mesh Network Topology, Hybrid Topology

I. INTRODUCTION

What is a network topology? In communication networks, a topology is a usually schematic description of the arrangement of a network, including its nodes and connecting lines. There are two ways of defining network geometry: the physical topology and the logical (or signal) topology.The layout pattern of the interconnections between computers in a network is called network topology. There are a number of different types of network topologies, including point-to-point, bus, star, ring, mesh, tree and hybrid. Let's review these main types.

Line Configuration in Computer Networks:-Network is a connection made through connection links between two or more devices. Devices can be a computer, printer or any other device that is capable to send and receive data. There are two ways to connect the devices :

A. Point-to-Point connection
B. Multipoint connection



Example: Point-to-Point connection between remote control and Television for changing the channels

MultiPoint Connection

It is also called Multidrop configuration. In this connection two or more devices share a single link.There are two kinds of Multipoint Connections:

1) If the links are used simultaneously between many devices, then it is spatially shared line configuration.
2) If user takes turns while using the link, then it is time shared (temporal) line configuration.

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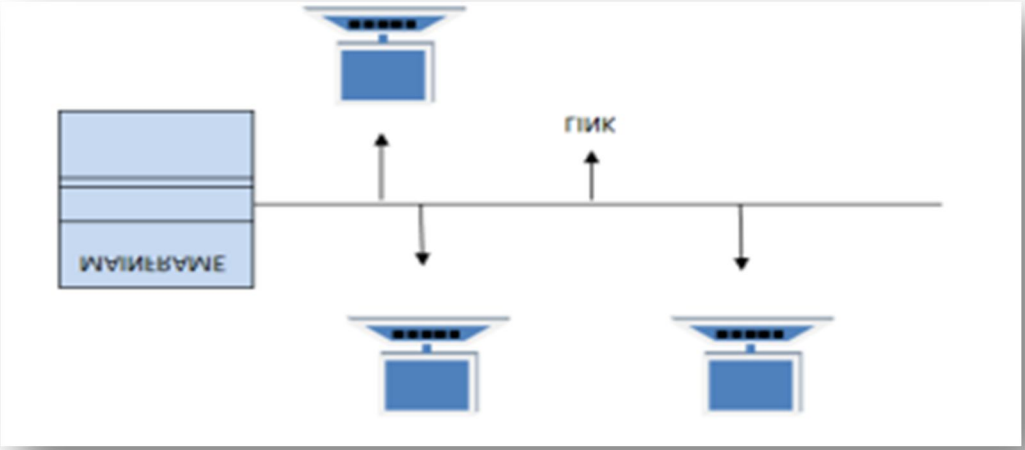
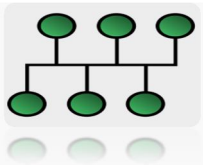


II. TYPES OF NETWORK TOPOLOGY

A. *Bus*

Bus topology uses one main cable to which all nodes are directly connected. The main cable acts as a backbone for the network. One of the computers in the network typically acts as the computer server. Bus topology is a network type in which every computer and network device is connected to single cable. When it has exactly two endpoints, then it is called Linear Bus topology



In local area networks where bus topology is used, each node is connected to a single cable, by the help of interface connectors. This central cable is the backbone of the network and is known as the bus (thus the name). A signal from the source travels in both directions to all machines connected on the bus cable until it finds the intended recipient. If the machine address does not match the intended address for the data, the machine ignores the data. Alternatively, if the data matches the machine address, the data is accepted. Because the bus topology consists of only one wire, it is rather inexpensive to implement when compared to other topologies. However, the low cost of implementing the technology is offset by the high cost of managing the network. Additionally, because only one cable is utilized, it can be the single point of failure.

1) Linear bus
2) Distributed bus

Features of Bus Topology

It transmits data only in one direction.

Every device is connected to a single cable

Advantages of Bus Topology

a) It is cost effective.
b) Cable required is least compared to other network topology.
c) Used in small networks.
d) It is easy to understand.
e) Easy to expand joining two cables together.

Disadvantages of Bus Topology

a) Cables fails then whole network fails.
b) If network traffic is heavy or nodes are more the performance of the network decreases.
c) Cable has a limited length.
d) It is slower than the ring topology.

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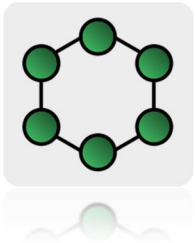
B. RING Topology

It is called ring topology because it forms a ring as each computer is connected to another computer, with the last one connected to the first. Exactly two neighbours for each device.In ring topology, the computers in the network are connected in a circular fashion, and the data travels in one direction. Each computer is directly connected to the next computer, forming a single pathway for signals through the network. This type of network is easy to install and manage.



Features of Ring Topology

1) A number of repeaters are used for Ring topology with large number of nodes, because if someone wants to send some data to the last node in the ring topology with 100 nodes, then the data will have to pass through 99 nodes to reach the 100th node. Hence to prevent data loss repeaters are used in the network.
2) The transmission is unidirectional, but it can be made bidirectional by having 2 connections between each Network Node, it is called Dual Ring Topology.
3) In Dual Ring Topology, two ring networks are formed, and data flow is in opposite direction in them. Also, if one ring fails, the second ring can act as a backup, to keep the network up.
4) Data is transferred in a sequential manner that is bit by bit. Data transmitted, has to pass through each node of the network, till the destination node.

Advantages of Ring Topology

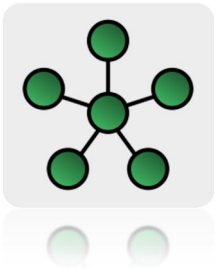
a) Transmitting network is not affected by high traffic or by adding more nodes, as only the nodes having tokens can transmit data.
b) Cheap to install and expand

Disadvantages of Ring Topology

a) Troubleshooting is difficult in ring topology.
b) Adding or deleting the computers disturbs the network activity.
c) Failure of one computer disturbs the whole network.

C. STAR Topology

In this type of topology all the computers are connected to a single hub through a cable. This hub is the central node and all others nodes are connected to the central node.In local area networks with a star topology, each network host is connected to a central hub with a point-to-point connection. So it can be said that every computer is indirectly connected to every other node with the help of the hub. In Star topology, every node (computer workstation or any other peripheral) is connected to a central node called hub, router or switch. The switch is the server and the peripherals are the clients. The network does not necessarily have to resemble a star to be classified as a star network, but all of the nodes on the network must be connected to one central device. All traffic that traverses the network passes through the central hub. The hub acts as a signal repeater. The star topology is considered the easiest topology to design and implement. An advantage of the star topology is the simplicity of adding additional nodes. The primary disadvantage of the star topology is that the hub represents a single point of failure.



Features of Star Topology

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1) Every node has its own dedicated connection to the hub.
2) Hub acts as a repeater for data flow.
3) Can be used with twisted pair, Optical Fibre or coaxial cable.

Advantages of Star Topology

a) Fast performance with few nodes and low network traffic.
b) Hub can be upgraded easily.
c) Easy to troubleshoot.
d) Easy to setup and modify.
e) Only that node is affected which has failed, rest of the nodes can work smoothly.

Disadvantages of Star Topology

a) Cost of installation is high.
b) Expensive to use.
c) If the hub fails then the whole network is stopped because all the nodes depend on the hub.
d) Performance is based on the hub that is it depends on its capacity

D. MESH Topology

It is a point-to-point connection to other nodes or devices. All the network nodes are connected to each other. Mesh has $n(n-2)/2$ physical channels to link n devices.The value of fully meshed networks is proportional to the exponent of the number of subscribers, assuming that communicating groups of any two endpoints, up to and including all the endpoints, is approximated
There are two techniques to transmit data over the Mesh topology, they are :

1) *Routing:* In routing, the nodes have a routing logic, as per the network requirements. Like routing logic to direct the data to reach the destination using the shortest distance. Or, routing logic which has information about the broken links, and it avoids those node etc. We can even have routing logic, to re-configure the failed nodes.
2) *Flooding:* In flooding, the same data is transmitted to all the network nodes, hence no routing logic is required. The network is robust, and the its very unlikely to lose the data. But it leads to unwanted load over the network.

Types of Mesh Topology

a) *Partial Mesh Topology:* In this topology some of the systems are connected in the same fashion as mesh topology but some devices are only connected to two or three devices.
b) *Full Mesh Topology*: Each and every nodes or devices are connected to each other.

Features of Mesh Topology

Fully connected.
Robust.
Not flexible.

Advantages of Mesh Topology

Each connection can carry its own data load.
It is robust.
Fault is diagnosed easily.
Provides security and privacy.

Disadvantages of Mesh Topology

Installation and configuration is difficult.
Cabling cost is more.
Bulk wiring is required.

E. TREE Topology

It has a root node and all other nodes are connected to it forming a hierarchy. It is also called hierarchical topology. It should at least have three levels to the hierarchy.

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Features of Tree Topology

- Ideal if workstations are located in groups.
- Used in Wide Area Network.

Advantages of Tree Topology

- Extension of bus and star topologies.
- Expansion of nodes is possible and easy.
- Easily managed and maintained.
- Error detection is easily done.

Disadvantages of Tree Topology

- Heavily cabled.
- Costly.
- If more nodes are added maintenance is difficult.
- Central hub fails, network fails.

F. HYBRID Topology

It is two different types of topologies which is a mixture of two or more topologies. For example, a tree network (or *star-bus network*) is a hybrid topology in which star networks are interconnected via bus networks.[6][7] However, a tree network connected to another tree network is still topologically a tree network, not a distinct network type. A hybrid topology is always produced when two different basic network topologies are connected.

Features of Hybrid Topology

- It is a combination of two or topologies
- Inherits the advantages and disadvantages of the topologies included

Advantages of Hybrid Topology

- Reliable as Error detecting and trouble shooting is easy.
- Effective.
- Scalable as size can be increased easily.
- Flexible.

Disadvantages of Hybrid Topology

- Complex in design.
- Costly.

III. 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. OR performance analysis studies do not solely focus on physical topology, but logical topology as well. Graph Theory provides a useful tool in prosecuting these analysis. This paper has provided several examples of analysis approaches for dealing with topologically related problems. Those areas covered included routing analysis, network sizing, and network corruption. The techniques covered in this discussion can be adapted to related computer network applications. Understanding of Computer Network Topology is fundamental to any network analysis effort, and may prevent wasted effort in the pursuit of less productive analysis approaches.

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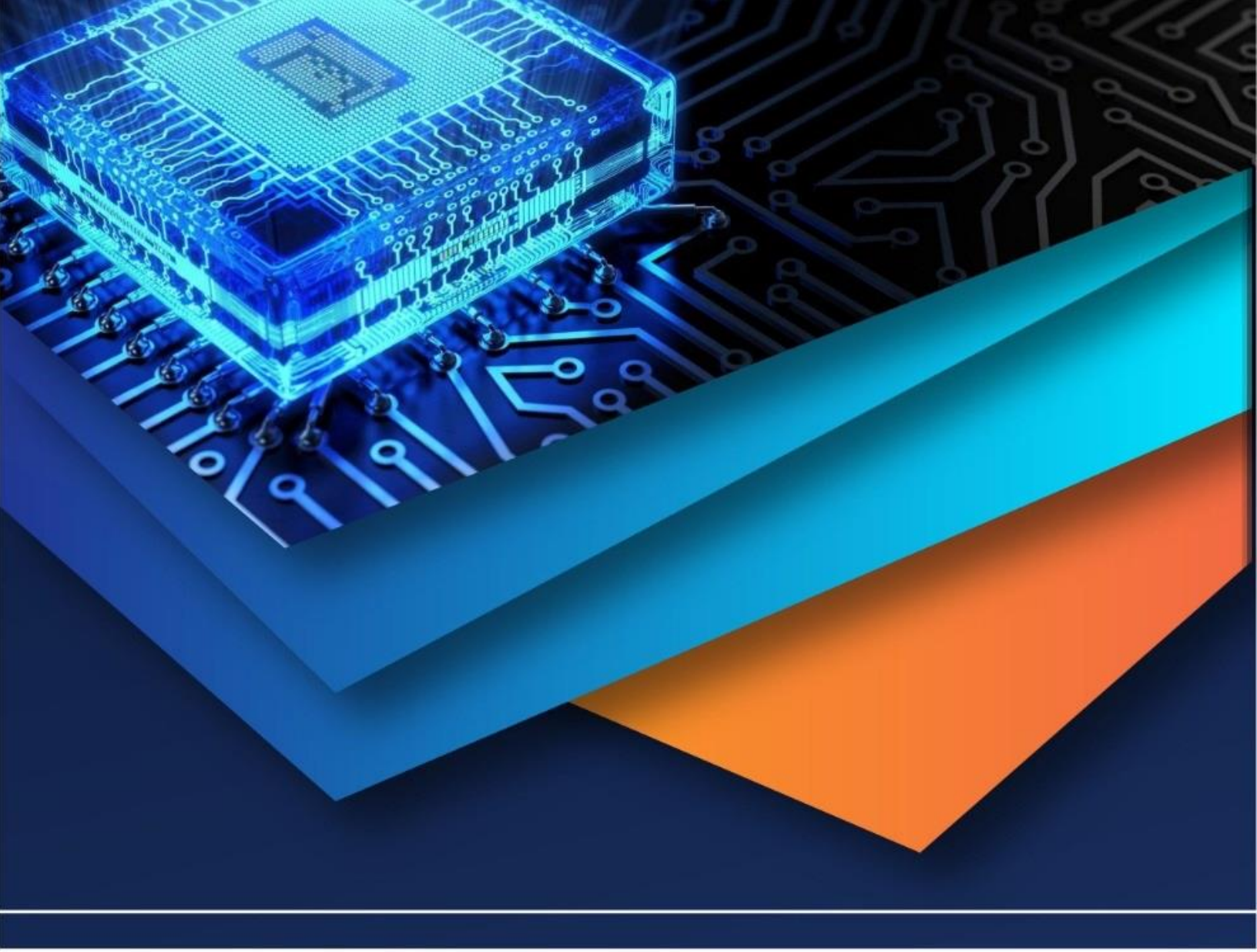

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