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A Research Paper on Basic of Computer Network

Dhyan Patel
ICT, Ganpat University, India

Abstract: ***Computer networks facilitate the interconnection of systems for the purpose of exchanging digital information. Essentially, they comprise a collection of devices linked together through various connections. Distributed processing is employed in computer networks, wherein tasks are divided among multiple computers. However, one of the most pressing challenges faced by networks is the threat of resource attacks.This research paper delves into the fundamental concepts of computer networks, which are essentially a collection of devices interconnected via links. These devices, or nodes, encompass a variety of entities ranging from personal computers and phones to servers and networking hardware. Computer networks enable various applications to access resources such as the World Wide Web, shared application and storage servers, printers, fax machines, as well as email and instant messaging applications. They play a pivotal role in facilitating information sharing across diverse tasks.Computer networks can be classified into two types: open systems and closed systems. Open systems are easily connected to networks and are primed for communication. Conversely, closed systems require proper authentication and are not as readily connected to other networks..***

Keywords: Computer networks, Protocols, Types of networks, Topology, Nodes, Data transfer.

I. INTRODUCTION

A computer network, also known as a data network, is a telecommunications infrastructure enabling computers to exchange data through data connections. These connections, established via cable or wireless media, facilitate the transmission of information between networked computing devices. Examples of such devices include personal computers, phones, servers, and networking hardware. The Internet serves as one of the most prominent examples of a computer network. Network nodes within these systems originate, route, and terminate data, supporting a wide array of applications such as web browsing, shared use of servers and printers, as well as email and instant messaging. The design and implementation of computer networks involve considerations such as transmission signals, communications protocols for organizing network traffic, and factors like size, topology, and organizational intent.

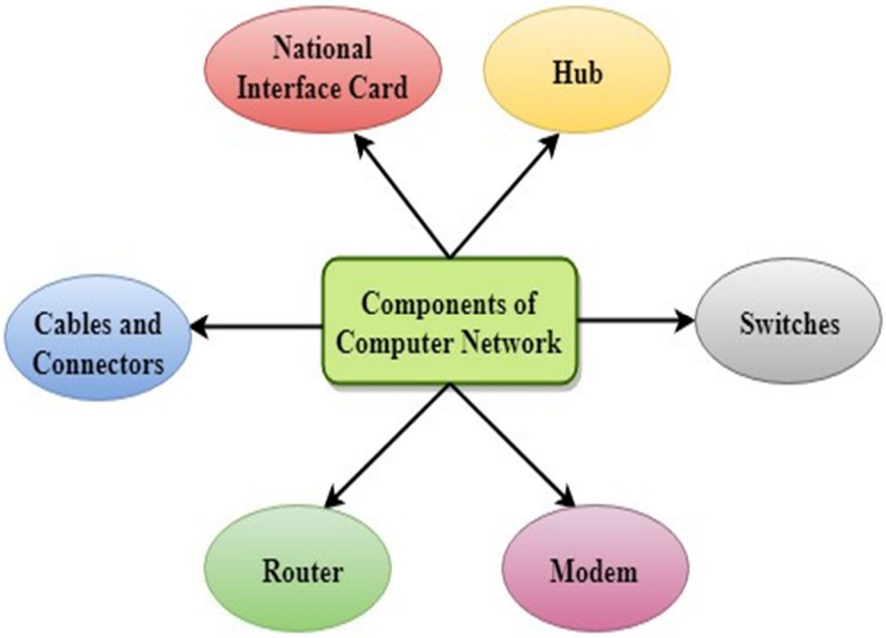


Fig. 1: Components of Computer Network

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II. COMPONENTS OF A COMPUTER NETWORK

A. National Interface card (NIC)

1) The Network Interface Card (NIC) facilitates communication between a computer and other devices. It stores hardware addresses, which data-link layer protocols use to identify systems on the network and ensure accurate data transfer to the intended destination. There are two types of NIC: Wireless NICs, which modern laptops commonly use, establish connections via antennas utilizing radio wave technology; and Wired NICs, which transfer data through cables.

2) A Hub, also known as a central device, divides network connections among multiple devices. When a computer requests information, it sends the request to the Hub, which then distributes it to all interconnected devices.

3) A Router links Local Area Networks (LANs) to the internet, enabling connections between different networks or connecting multiple computers to the internet.

4) A Modem facilitates internet connection via existing telephone lines. It's a separate component typically inserted into a PC slot on the motherboard, as the motherboard doesn't come integrated with a modem.

5) Switches organize devices on a network to efficiently transfer data. Unlike Hubs, switches don't broadcast messages across the network; instead, they send messages directly from the source to the intended recipient, improving network performance.

6) Cables serve as transmission media for communication signals. There are three types: Coaxial cables, resembling TV installation cables, offer high-speed data transmission despite being more expensive than twisted pair cables; Twisted pair cables, capable of transmitting data at over 1Gbps, are cost-effective and commonly used for high-speed connections; and Fibre optic cables, which transmit data using light beams, provide the highest data transmission speeds and are typically used in government installations despite being the most expensive option.

III. APPLICATION OF COMPUTER NETWORK

1) *Resource Sharing:* Facilitates the sharing of files, data, and various information types among authorized users in a networked environment, enabling access to resources stored on other computers within the network.

2) *Interpersonal Communications:* Enables easy and efficient communication through various means such as email, instant messaging, chat rooms, telephone, video calls, and video conferencing, fostering interpersonal connections across distances.

3) *Server-Client Model:* In computer networking, the server-client model involves a central server responsible for storing and managing information, accessible remotely by client machines seeking to retrieve data or services.

4) *E-commerce:* Computer networks play a vital role in modern businesses, facilitating online transactions and operations. Platforms like Amazon.com exemplify e-commerce, conducting business activities over the internet.

5) *Communication Medium:* Computer networks serve as communication mediums, connecting multiple users within an organization. For instance, a company's email system enables employees to engage in daily communication, enhancing collaboration and information exchange.

A. Advantages Of Computer Network

1) Easy to install and expand.

2) Requires minimal cables, reducing costs.

3) Suited for small organizations like schools.

4) Utilizes repeaters for extended coverage..

B. Disadvantages Of Computer Network

1) Heavy network traffic slow down the network bus.

2) Proper termination is required.

3) Sometime complex to implement.

4) Fault in the cable stops all transmission.

IV. TOPOLOGY IN COMPUTER NETWORK

Topology defines how devices are interconnected within a network. It can be categorized into two types: physical and logical. Physical topology focuses on the geometric arrangement of network nodes, representing the actual layout of devices within the network.

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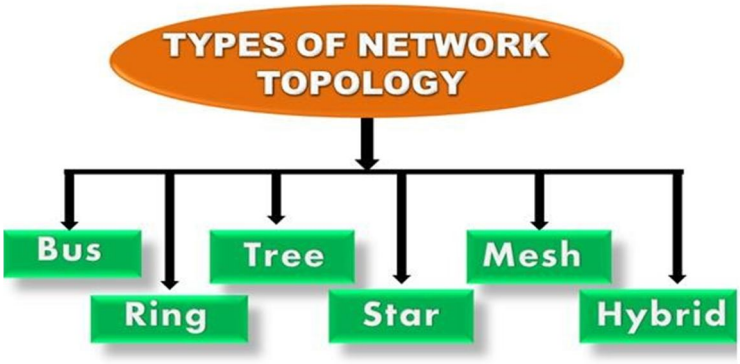


Fig. 2: Types of Network Topology

A. Bus Topology

Bus topology is also called as backbone cable. In bus topology all the nodes are connected through a single cable.



Fig. 3: Bus Topology

In a bus topology, each node is connected directly to a backbone cable or through a drop cable. Messages sent by a node are transmitted over the network, reaching all nodes regardless of their address. This topology is commonly used in networks following the 802.3 (Ethernet) and 802.4 standards. The configuration of a bus topology is simpler compared to other topologies, with the backbone acting as a single lane through which messages are broadcast to all nodes.

B. Ring Topology



Fig. 4: Ring Topology

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1) Similar to bus topology, but nodes are interconnected in a point-to-point manner.
2) Data flow is unidirectional, moving in one direction around the ring.
3) Each node connects to another node without a termination point.
4) Known as ring topology due to its circular structure.
5) Data flows clockwise within the ring topology.

C. Star Topology

1) *All* nodes are connected to a central hub in this topology.
2) Nodes are not directly connected to each other.
3) Messages are first received by the hub, which then distributes them to all connected nodes.



Fig. 5: Star Topology

D. Mesh Topology



Fig. 6: Mesh Topology

1) Multiple paths exist from one computer to another in this topology.
2) Mesh topology does not include switches, hubs, or any central computer serving as a central point of communication.
3) Primarily used in wireless networks.
4) The Internet serves as an example of mesh topology.

E. Tree Topology

This topology is the combination of star and bus topology. In this topology all the nodes are connected with each other in hierarchical fashion.

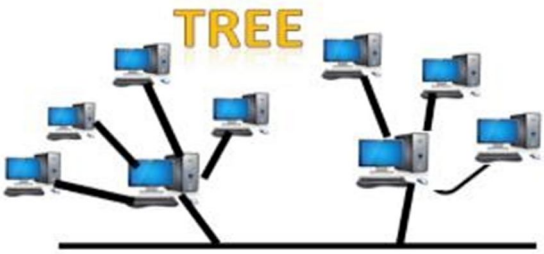


Fig. 7: Tree Topology

There is only one path exists between two nodes for the data transmission.

F. Hybrid Topology

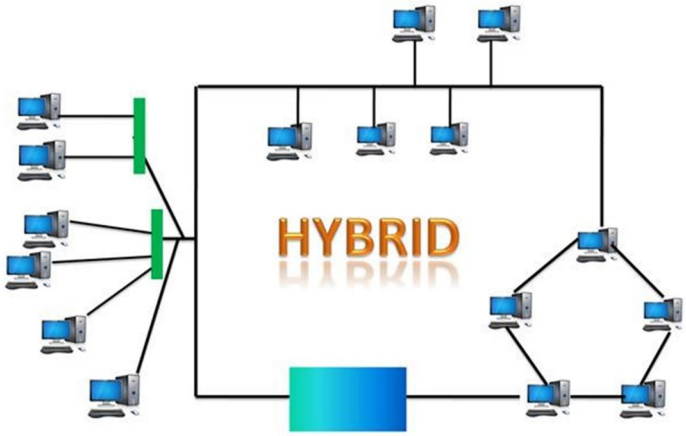


Fig. 8: Hybrid Topology

1) Combination of different topology is called as Hybrid Topology.
2) This topology is a connection between different links and nodes to transfer the data.

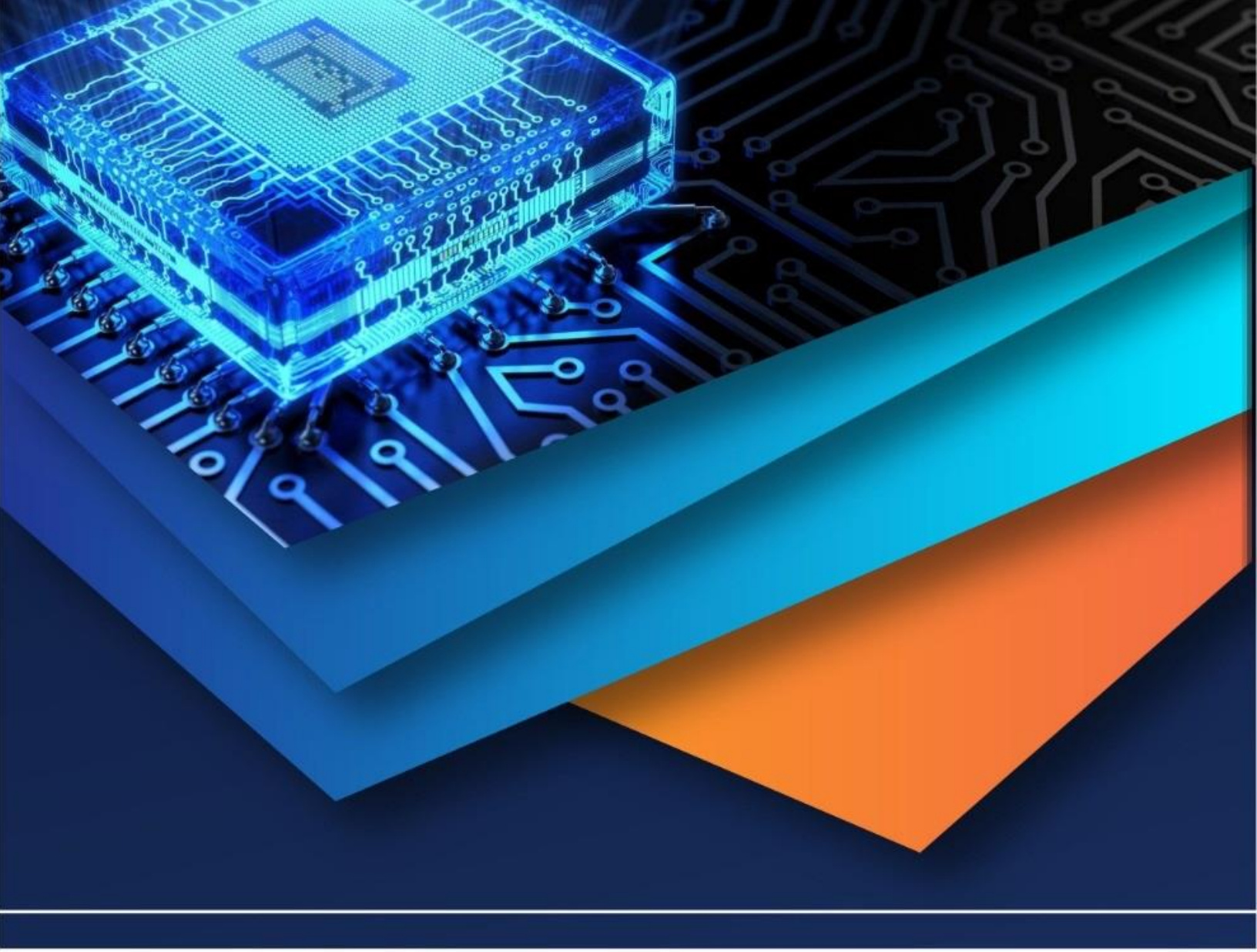
V. CONCLUSION

This paper conducts an analytical examination of various fundamental network topologies, offering concise insights into their respective attributes. Assessing these topologies for factors like reliability, scalability, flexibility, and effectiveness reveals their diverse strengths and limitations. While topologies play a crucial role in enabling communication and resource sharing, they also pose challenges such as intricate design complexities and high infrastructure costs, especially when combining multiple topologies. Computer networks have profoundly transformed human lifestyles, serving as integral platforms for work, leisure, and communication. As networks continue to evolve, driven by the emergence of new protocols, standards, and applications, their significance in facilitating seamless communication and resource sharing among connected entities remains paramount. Without networks, the efficient sharing of resources among organizations would be severely hindered. Despite ongoing advancements, our understanding of complex network properties remains nascent, suggesting vast potential for electronic communication to become an even more potent networking tool, particularly when accessible to large communities sharing common interests.

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