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The Study on the Importance of Various Network Topologies For Multinetwork Systems

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Abstract: *The process of placing objects in a specific relationship, order, or arrangement is referred to as topology. Thus, network topology is the process of arranging or connecting different devices in a network. The several ways that devices can be connected to one another are referred to as network topologies. These network topologies are divided into a number of categories based on how devices are connected to one another and how data flows between them. Various topologies such as star, ring, hybrid, mesh, tree, and bus are employed in various industries for system architecture. The benefits and drawbacks of various topologies based on connections and data flow have been investigated in this study. The importance of network topology will be covered in this study.*

Keywords: *Network System, Physical Topology, Logical Topology, Bus, Ring, Star, Mesh, Hybrid and Wireless Topology*

I. INTRODUCTION

Networking topology is the process of configuring various network components, such as links and nodes. It can be viewed as a geometric representation of how several systems are connected to one another and communicate[1]. The network layout is significant for a number of reasons. Above all, it is essential to the functionality and efficiency of any network. Selecting the appropriate network topology for an organization's operating model can enhance performance and facilitate the identification and resolution of problems, as well as the more prudent distribution of resources across the network to guarantee optimal network health[2]. A software-generated network topology diagram is widely used to display and modify a network architecture and configuration. The main advantage of employing these diagrams is their ability to give users visual representations of both physical and logical layouts, which helps them during troubleshooting by helping them comprehend how the links between devices function[3]. Reducing operational and maintenance expenses can be achieved by increasing data energy and efficiency through an efficient and well-managed topology. The configuration of a network can determine how successfully it connects, performs, and is safeguarded against outages. To guarantee that any network is dependable and efficient, efficient network administration and monitoring necessitate a thorough understanding of both the logical and physical topology[4]. There are several types of topologies that are employed to arrange systems. The main advantage of employing these diagrams is their ability to give users visual representations of both physical and logical layouts, which helps them during troubleshooting by helping them comprehend how the links between devices function[3]. Reducing operational and maintenance expenses can be achieved by increasing data energy and efficiency through an efficient and well-managed topology. The configuration of a network can determine how successfully it connects, performs, and is safeguarded against outages. To guarantee that any network is dependable and efficient, efficient network administration and monitoring necessitate a thorough understanding of both the logical and physical topology[4]. There are several types of topologies that are employed to arrange systems.

II. THE IMPORTANCE OF NETWORK TOPOLOGY

The performance of a network is largely dependent on its configuration, or topology. The arrangement of a network, including the logical or physical description of how nodes and links are connected to one another, is known as network topology. A network can be configured in a variety of ways, each with their own advantages and disadvantages with some applications better suited to a certain situation than others. When it comes to selecting a network topology, administrators have a number of options to consider. These include the goals, budget, and size and scope of the firm. Effective network topology management involves a number of responsibilities, such as visual mapping, configuration management, and overall performance monitoring. The key is to understand your objectives and requirements to create and manage the network topology in the right way for industries and business. Following an in-depth network topology definition, this article will look at the main types of network topologies, their benefits and drawbacks, and considerations for determining which one is best to be used. The physical or logical arrangement of different nodes, devices, and connections inside your network with respect to one another is known as network topology.

Consider the topology of your network as the city's road map. There are numerous methods to set up and manage a city, such as ensuring that avenues and boulevards allow traffic to flow between the areas of the city that receive the greatest volume of traffic. Similarly, there are numerous methods to set up a network. Each has benefits and drawbacks, and different setups can offer you a higher level of security and connectivity based on your company's needs. Network topology can be approached in two ways: logically and physically. As the name implies, physical network topology describes the actual wires, cables, and other physical links and interconnections that exist between nodes and the network. A bit more strategic and abstract, logical network topology refers to the conceptual knowledge of how and why the network is set up the way it is and how data flows across it. [5]

The cables, wires, and other physical connections that connect different nodes are the subject of physical topology. It entails positioning devices, installing code, and configuring different network elements, like links and nodes. It is more easily defined as the physical arrangement of the network's cables, workstations, and nodes[6]. The arrangement of a network's different components is referred to as its physical topology. It shows how the connections and hardware that make up a network are actually configured. Minor factors like device kind and data flow are disregarded in favour of the network's primary priorities. The configuration of the network's nodes and network cables will vary depending on how easy it is to construct and set up. Logical topology reflects the configuration and communication of devices. Physical topology and node configurations have no bearing on data transmission via it. It is focused on the smallest details of the network, like the kind and quality of switches and routers, which affect the rate and speed at which data packets are transmitted. The logical topology of the network ensures optimal and controllable flow control. Either a linear pattern called a logical bus or a circular logical ring can represent the data flow.

The network's architecture is crucial for a number of reasons. Most importantly, it is crucial to the operation of the network. In addition to improving performance, selecting the appropriate topology for one company's operational model helps facilitate the efficient allocation of resources throughout the network to maintain optimal network health and facilitate the identification and troubleshooting of errors. Reducing operating and maintenance expenses can be achieved by increasing energy and data efficiency through a well-managed and optimised network architecture. To maintain the effectiveness and health of your network, effective management and monitoring require a solid understanding of the logical and physical topology of a network.

III. VARIOUS TYPES OF NETWORK TOPOLOGY

A. Bus Topology

Every system and device in a network with a bus architecture is connected to a single wire. It transfers data in a single direction from one end to the other. The shared channel has line terminators at both ends. Sending a message to the network is a prerequisite for each node that wishes to send a signal through it. Any reachable station in the network will get the message, regardless of the intended recipient. This does not have any bi-directional features. It is a multipoint connection with a non-robust topology since the topology collapses if the backbone is hacked[7]. It is also known as backbone topology and line topology. The direction of data travel on the cable is constant. If multiple hosts try to send data at the same time, things could go wrong. As a result, it either assigns one host to be the bus master or uses CSMA/CD (Carrier Sense Multiple Access / Collision Avoidance) technology to resolve the issue. This type of networking is basic in that the malfunction of one device does not affect the operation of the others. However, in the event that the shared communication channel malfunctions, all other devices will cease to operate. It is widely used in well-established networks, such as 802.4 and 802.3 (Ethernet) networks[8]. The bus topology displayed in Figure 2 demonstrates how devices can be networked to one another and how data is transferred between ends.

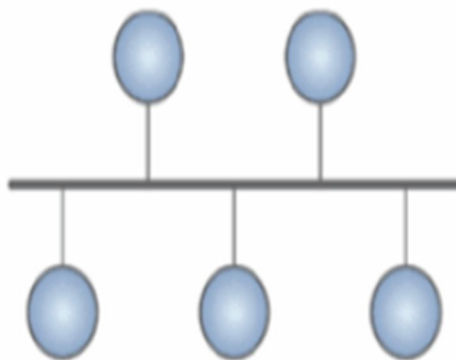


Figure 1: Bus Topology [12]

B. Ring Topology

Each host computer in this kind of design is linked to precisely two other hosts, creating a circular network topology. If a host wants to talk to or send a message to another host that is not right next to it, the data is routed through all of the intermediary hosts. The message is sent to the system after it by the one that gets it from the one before it[9]. It may only take the administrator to connect one additional wire to add a host to the current configuration. Its connected endpoints are the sole thing that sets it apart from bus topology. In this instance, too, data flow is unidirectional and takes place in an endless cycle. In contrast, dual ring topology is a bidirectional topology that may be accomplished by giving every network node two connections. Since the two ends are connected, there isn't a termination point. It is traversed by data in a clockwise manner. Since data in a ring topology with 90 nodes must pass through 89 nodes before reaching the 90th node, a significant number of repeaters are needed when a ring topology with many nodes is used[10]. As a result, the network uses repeaters to guard against data loss. Figure 3 illustrates the looping data flow and the Ring topology configuration of the devices.

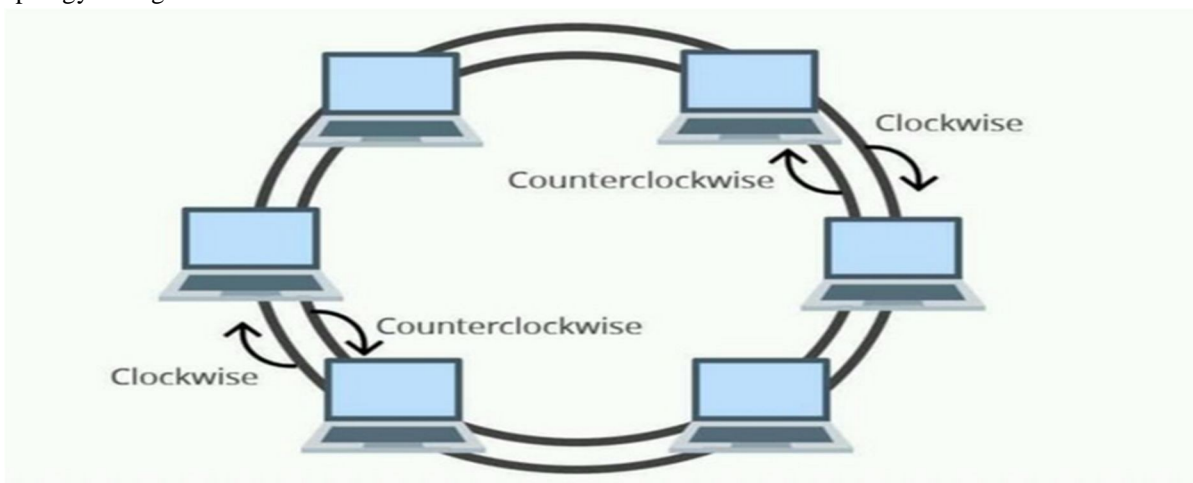


Figure 2 : Double Ring Topology [13]

C. Star Topology

It is the topology that is most frequently used. Each system in this configuration is connected to a different hub by a wire. This hub acts as the centre node and is connected to the other nodes. This hub could be passive that is, not intelligent, like broadcasting devices or intelligent that is, active hubs. Repeaters are found in operational hubs. The main computer is referred to as a server, and the devices connected to it as clients. The devices are connected by coaxial cable or RJ-45 connectors[11]. In a physical star design, hubs or switches are typically employed as connecting elements. In this case, there is not a direct device connection; instead, all systems must speak with the hub first. To reach its destination, information transferred from each network node must pass through the main system, which acts as a repeater and guards against data loss. The data flow and Star topology of connected devices are depicted in Figure 4.

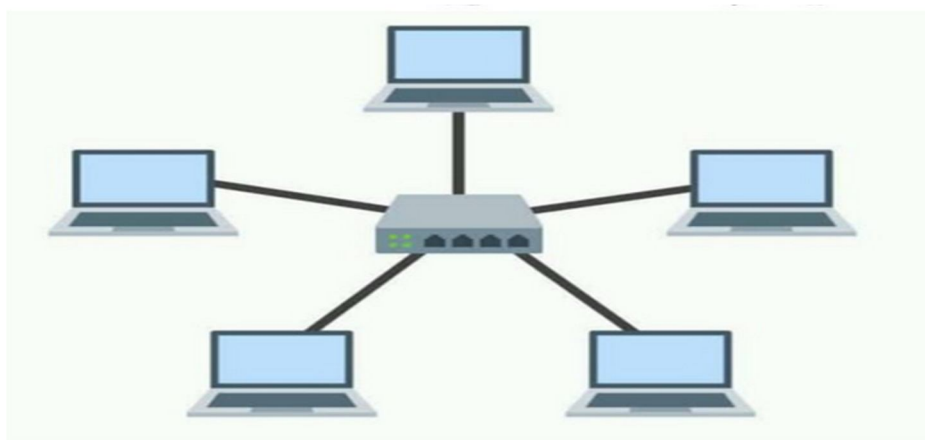


Figure 3: Star Topology [13]

D. Mesh Topology

This is establishing connections between a host and multiple other systems. Any two systems can establish point-to-point connections with one another. There could be a number of gadgets out there, just a few of which are point-to-point connected. There are two types of mesh networks: complete mesh and partial mesh. Mesh topologies that are partially interconnected have fewer nodes with only two or three connections, but fully linked mesh topologies, as seen in Figure 4, have all connected nodes.

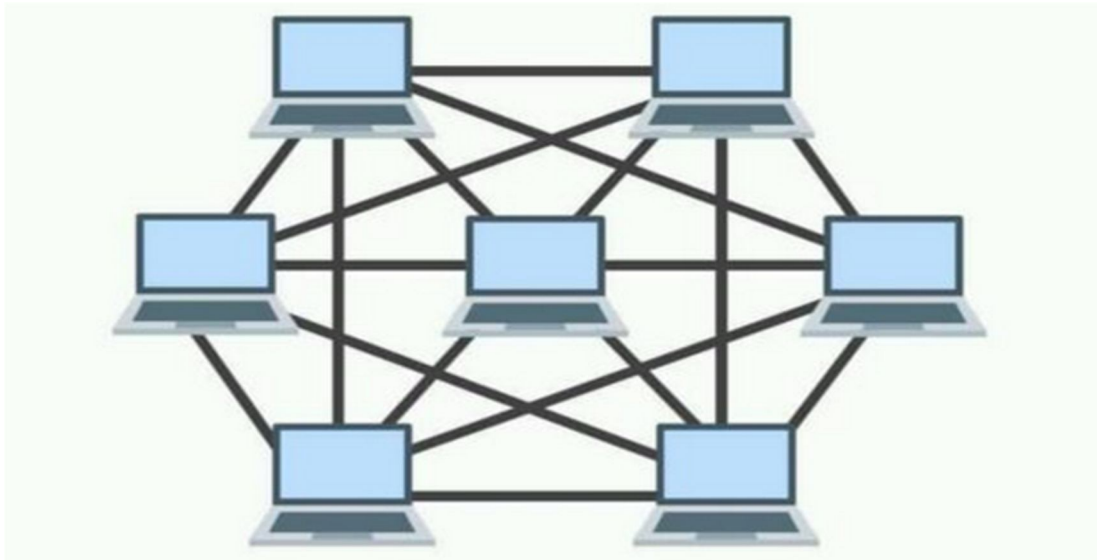


Figure 4: Mesh Topology [13]

E. Tree Topology

The network is divided into numerous tiers and layers using this design. A network is made up of three types of network devices, most of which are found in LANs. Systems are connected at the lowest layer, known as the access layer. The distribution layer is the layer that sits between the top and bottom layers. The uppermost layer, sometimes referred to as the core layer, houses the network's central nervous system. A point-to-point link connects all of the adjacent hosts. Topology faces a problem if the root node fails since it impacts the entire network, much like a bus does. It is not, however, the only point of failure. The network is divided into areas that cannot be accessed in the event of a link failure, with each link acting as a single point of failure.

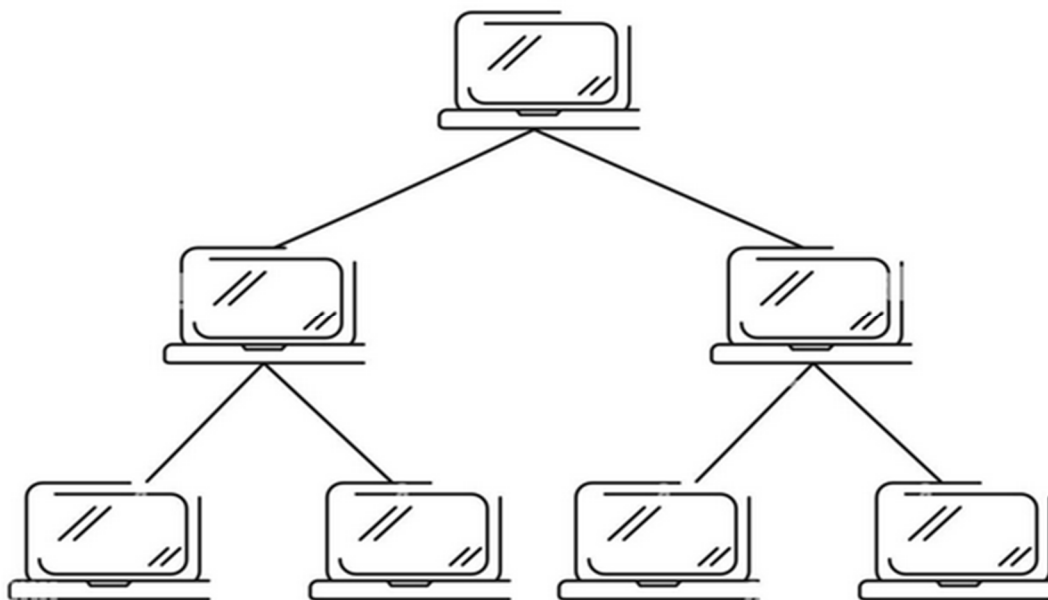


Figure 5 : Tree Topology [14]

F. Hybrid Topology

It can be explained as a synthesis of several topologies. These are often used in big, international companies with distinct organisational structures for every department. They greatly increase the network system's flexibility. Numerous topologies can be chosen and implemented according on the needs and requirements of the user.

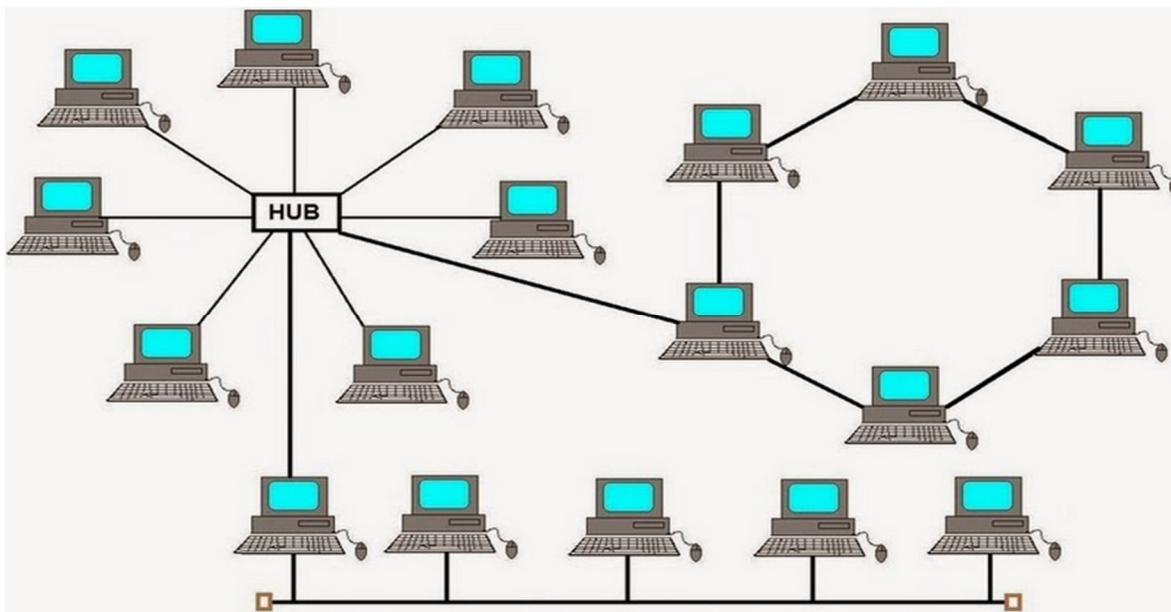


Figure 6 : Hybrid network Topology [15]

G. Wireless Topology

According to the description, data is transmitted by non-guided medium, such as air, in a wireless topology. In essence, it sent data into space. Wireless topologies can be configured in a cellular, mesh, or star configuration. The wireless architecture in the star configuration is known as Basic Service Set (BSS). In this configuration, a base station called an access point (AP) or wireless access point (WAP) connects wireless devices to the wired LAN.

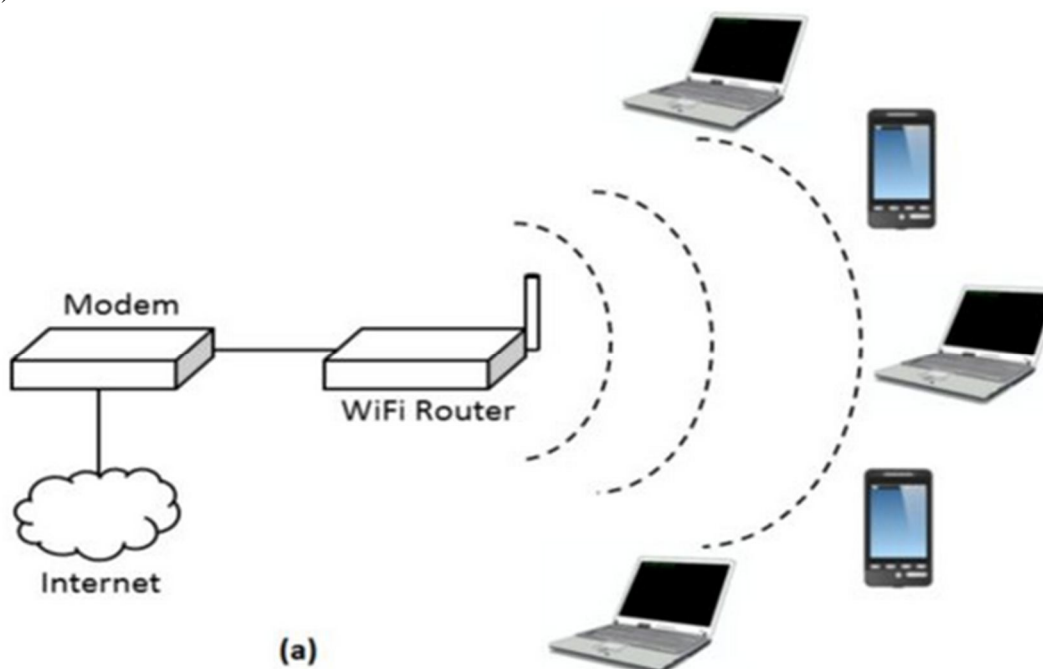


Figure: Wireless Topology [13]

IV. CONCLUSION

Network Topology is an extensive and significant area of engineering in computer science. The course covers a number of topics that are crucial for students to understand, including networking, database administration, data structures, and algorithm analysis. These are the courses that are crucial to study for when getting ready for technical exams, interviews, and competitive exams. These topics include laws, concepts, and algorithms that serve as the foundation for the creation of different software applications. One topic that falls under this category is networking, which covers concepts such as network terminologies, network topologies (such as the star, bus, mesh, tree, and ring topologies), different types of computer networks, protocols (such as the Transmission Control Protocol [TCP] and Hyper Text Transfer Protocol [HTTP]), to ensure the secure and effective transfer of data.

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