

A Review Paper on Networking Topologies

Jasdeep Singh, Raj Kumar,
RIMT University, Mandi Gobindgarh, Punjab
Email id- jasdeepsingh@rimt.ac.in,raj.kumar@rimt.ac.in

ABSTRACT: *Topology refers to the process of ordering, arranging, or linking things in a certain way. As a result, network topology refers to the process of organising, arranging, or connecting several devices in a network. The many ways in which devices can be connected to one another are referred to as network topology. These network topologies have been divided into sections depending on how devices are connected and how data flows between them. The topologies of star, ring, hybrid, mesh, tree, and bus are some of the topologies that are utilised in various industries for system layout. The merits and disadvantages of these topologies based on connections and data flow have been explored in this study. This article discusses the importance of network topology. This article discusses the growing demand for these topologies in numerous start-ups and global corporations. It highlights how the future of topologies is bright since every organisation needs to set up a network that must be properly organised, resulting in increased use of network topologies.*

KEYWORDS: *Cable, Data, Network, System, Topology.*

1. INTRODUCTION

Networking topology is the process of arranging several elements (such as links and nodes) of a network. It can be referred as a geometric representation of how several systems can be linked and communicate with each other[1].

1.1 Importance of network topology:

The network layout is critical for a variety of causes. Above all, it is important for any network's operation and performance. Picking the correct topology for operational model of any company can increase performance while also it makes it simpler to discover errors, rectify mistakes, and allocate resource more effectively through the network to make sure best network health[2].

A software-created network topology diagram is widely used to demonstrate and alter the architecture and structure of a network. The most significant reason for these diagrams is that they may give visual representations of both physical and logical layouts, helping managers to comprehend the relationships between devices during troubleshooting[3].

An efficient and correctly managed topology can boost energy and efficiency of data that can assist to minimise operating and maintaining of expenses. The manner a network is structured may make or break functioning of network, connection, and protection from downtime. To guarantee that any network is efficient and healthy, effective network administration and monitoring necessitates a thorough understanding of both the logical and physical topology[4].

1.2 Types of Topologies:

Figure 1 shows several types of network topologies used for arrangement of systems. There are several types of topologies that are used for arranging systems. These are discussed below.

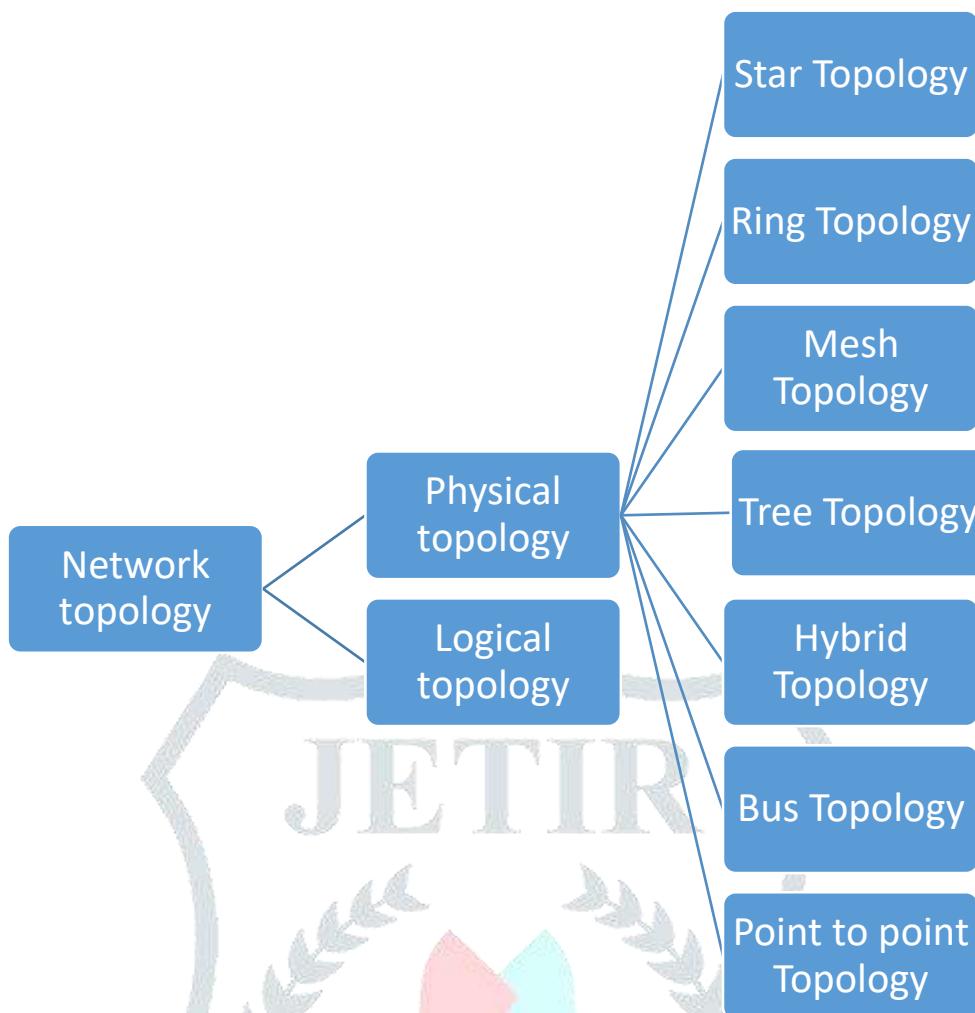


Figure 1: Representation of several types of Network Topologies used for arrangement of systems.

1.2.1 *Physical topology:*

It deals with the physical connections between several nodes, cables, wires, etc. It is the set-up of numerous elements including links, nodes, etc. of a network, involving device placement and installation of code. In simpler words, it can be said as the physical set-up of the nodes, workstations and cables of network[5].

1.2.2 *Bus topology:*

Each system and device present in network are connected to a single cable in a network of bus topology. It sends data in a single way from one end to the other. Line terminators are present on both ends of the shared channel. Whenever any node wants to transmit a signal through the network, it makes that happen by sending a message through network. Irrespective of whom the message has been sent to, it will be received by all accessible stations present in network. In this, there are no bi-directional characteristics. It is a multi-point connection with a non-robust topology as the topology crashes if the backbone breaks[6]. It is also referred as line topology and sometimes as backbone topology. Data flows in the same direction as the cable.

If multiple hosts try to send data at same time, it might face some issues. That is why to overcome the issue it utilises Carrier Sense Multiple Access / Collision Avoidance technology (CSMA/CD) or identifies one host as Bus Master. It is a basic kind of networking in which the failure of one device has no impact on the other devices. However, if the common communication channel fails, all other devices will cease working. It is commonly used in standard networks such as 802.3 (Ethernet) and 802.4 standard networks[7]. Figure 2 represents how devices can be linked to each other over a network in bus topology and how data flows from one end to another.

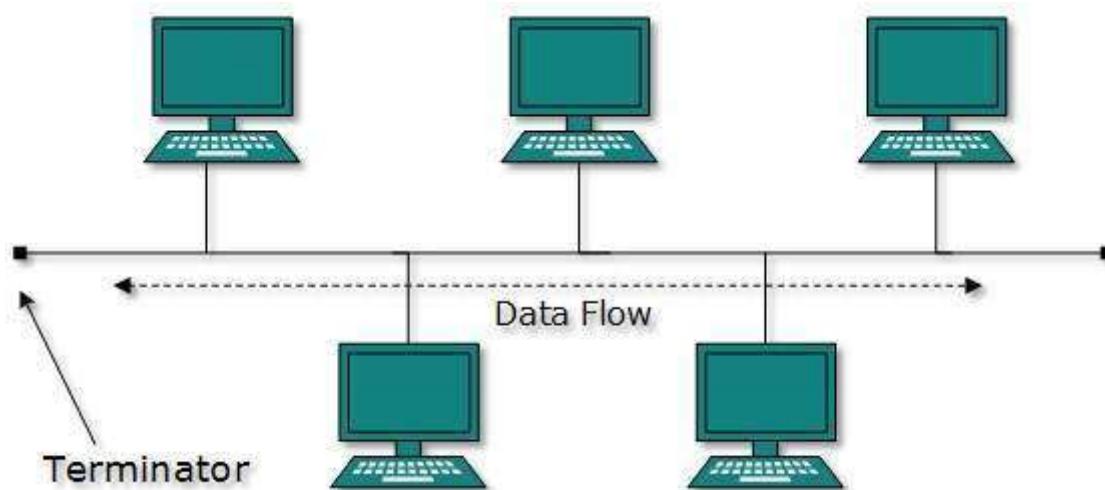


Figure 2: Represents of how devices are connected in bus topology and how data flows from one end to another.

- *CSMA (Carrier Sense Multiple Access):*

It is a type of media access control, which is used for regulating flow of data to ensure integrity of data, or that packets do not get lost. Generally, two different approaches are used for dealing with the problems that are caused when any two nodes deliver messages at the same time.

- *Carrier Sense Multiple Access with Collision Detection (CSMA CD):*

It is a technique of access that is used for detecting data collision. The transmitter will cease delivering data if a collision is detected. As a result, it focuses on recovery after a data collision.

- *Carrier-sense multiple access with collision avoidance (CSMA/CA):*

It is a technique for avoiding collisions by determining whether transmission medium is busy or not. If the one who send data is busy, he will wait until the media is accessible. This way efficiently reduces the probabilities of a collision. Recovery after the collision is not supported.

1.2.3 Ring topology:

Each host machine in this kind of topology links to precisely two other machines, forming a circular network structure. Whenever any host wants to interact with or send any message to a host that is not directly next to it, the data is routed via all intermediary hosts. The system, which gets the message of preceding system, passes it to the next system[8]. The administrator may just require one additional cable to join one more host in the current arrangement. It is similar to bus topology; the only difference is that its ends are connected. In this also data flow, take place in one direction only in a loop, which continues to move endlessly in the loop. However, by giving two connections between each network Node, it may be turned bidirectional, which is referred as Dual ring topology. As both the ends are linked, there is no termination point. In it, data moves in clockwise direction. When a ring topology with a high no. of nodes is utilised, many repeaters are needed for the reason that if someone wishes to transmit data to the final node in a ring topology with 90 nodes, the data must transit through 89 nodes before reaching the 90th node[9]. As a result, repeaters are employed in the network for prevention of loss of data. Figure 3 represents of how devices are connected in Ring topology and how data flows in loop.

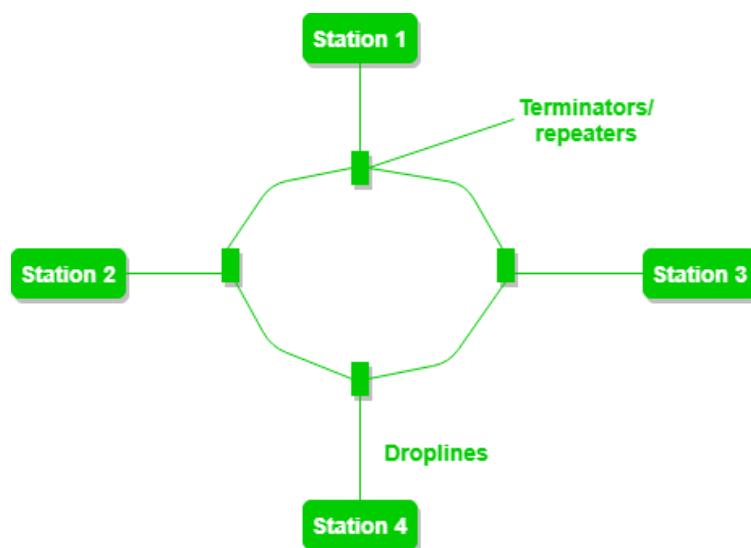


Figure 3: Represents of how devices are connected in Ring topology and how data flows in loop.

1.2.4 Star topology:

It is most commonly used topology. All of the systems in this topology are linked to a solo hub using a cable. This hub acts as the centre node, with all other nodes linked with it. This hub might be passive in nature that means not intelligent, such as broadcasting devices, or it can be intelligent, i.e., active hubs. Repeaters are present in hubs, which are active. The main computer is referred to as a server, and the devices connected to it as clients. The devices are connected through coaxial cable or RJ-45 connections[10].

In a physical star architecture, hubs or switches are primarily utilised as connecting devices. In this there is no direct interaction of devices, any system have to interact with the hub first. In this to reach its destination, information transmitted from any node in network must travel through the main system, which acts as a repeater and helps in avoiding loss of data. Figure 4 represents how devices are connected in Star topology and how data flows between devices.

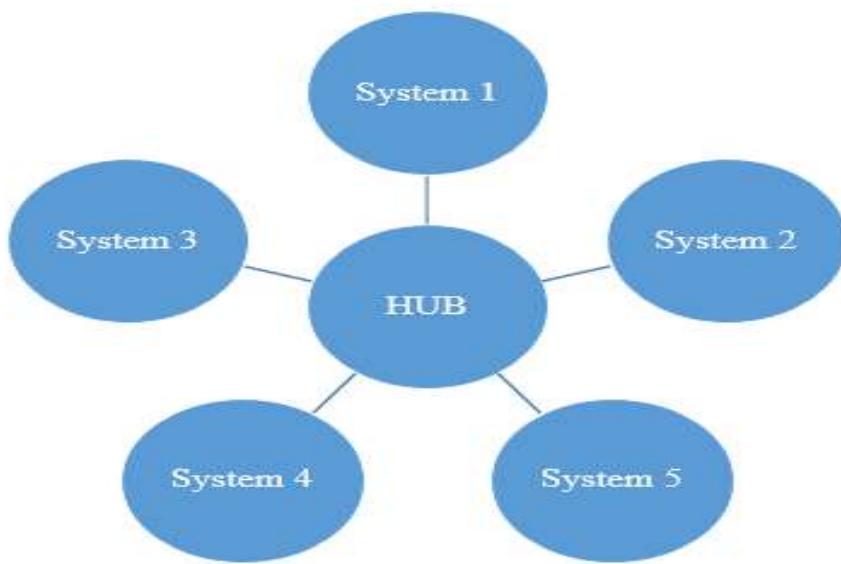


Figure 4: Representation of how devices are connected in Star topology and how data flows in loop.

1.2.5 Mesh Topology:

In this, a host is linked with multiple other systems. In it, point-to-point connection is available between any two systems. Some devices may be present in which only few have point-to-point connection between them. There are two kinds of mesh networks: first, one is complete mesh and other one is partial mesh. Mesh topology, which are partially interconnected, have fewer nodes with only two or three connections, whereas mesh topology, which are fully interconnected, contains all connected nodes as shown in Figure 5.

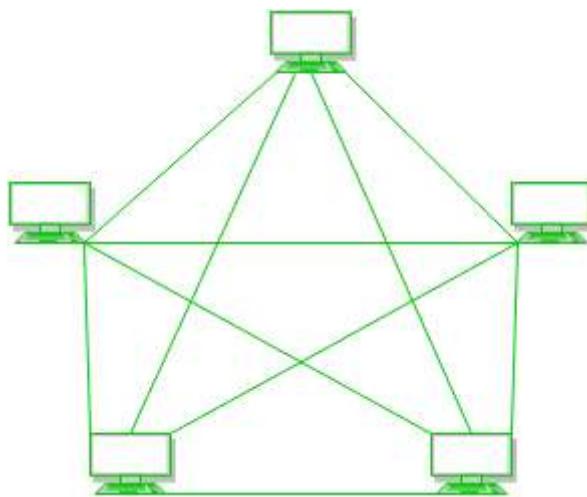


Figure 5: Represents of how devices are connected in Mesh topology and how data flows in devices.

1.2.6 Tree topology:

The network is divided into several levels/layers using this topology. A network is divided into 3 categories of network devices, mostly in LANs. The lowest layer is the access layer, which is where systems are linked. The distribution layer is the intermediate layer that acts as a link between the top and lower layer. The topmost layer, referred as core layer, is the network's nerve centre. A point-to-point link exists between all nearby hosts. In a similar way as the bus, topology, in case if the root fails the whole network faces the problem. It is not, however, the only site of failure. Every connection acts as a single point of failure, separating the network in segments, which are inaccessible if it fails. Figure 6 represents of how devices are connected in tree topology and how data flows in devices.

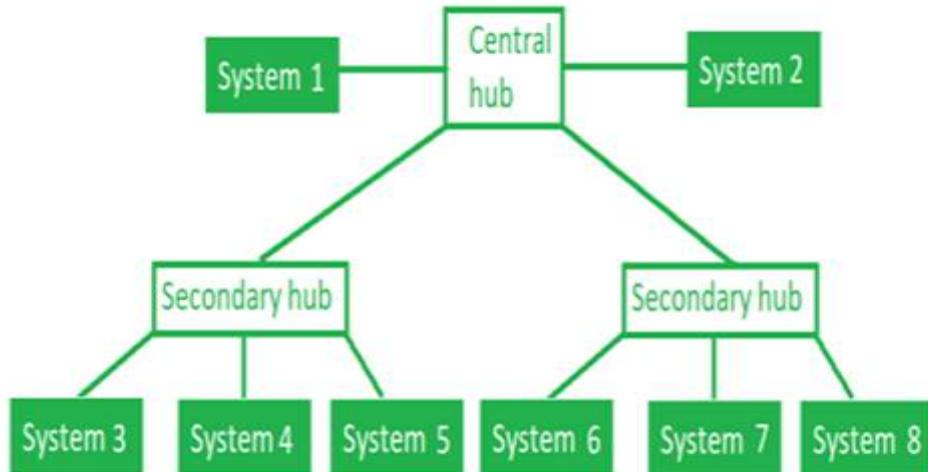


Figure 6: Representation of how devices are connected in tree topology and how data flows in devices.

1.2.7 Hybrid topology:

It can be said as combination of several topologies. These are commonly used in big Multinational companies where there are personalized topologies for each department. These provide a great flexibility to the network system. Different topologies can be chosen and implemented according to the needs and requirement of the user. Figure 7 represents of how devices are linked in hybrid topology using an arrangement of star and ring topology.

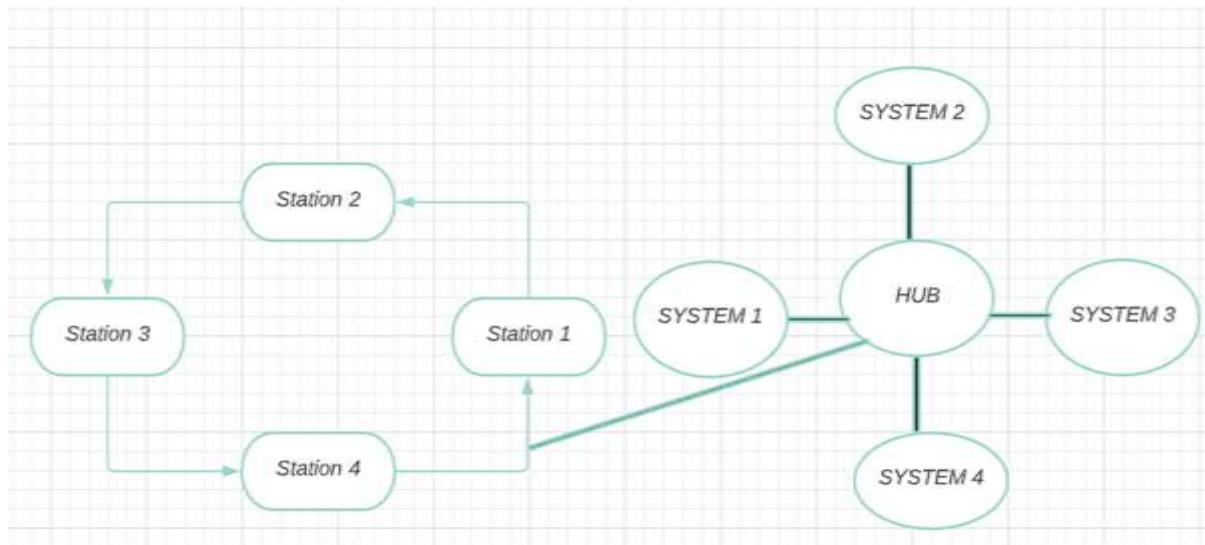


Figure 7: Representation of how devices are linked in hybrid topology using an arrangement of star and ring topology.

2. DISCUSSION

Computer science is a really important and wide branch of engineering. There are many subjects, which are included in the course, which are important for students to have knowledge of such as Analysis of Algorithms, Data structure, Database management, Networking, and many more. These are the subjects, which are important while preparing for several competitive exam, interviews and many technical exams. These subjects comprises of many algorithms, laws and concepts, which are basis for development of various software programs.

Networking is one such subject which comprises concepts such as several network terminologies network topologies including Star, Bus, mesh, tree and ring topology, several types of computer networks, several protocols including Transmission Control Protocol (TCP), Internet Protocol (IP), Hyper Text Transfer Protocol (HTTP), and many more which ensures secure and smooth transfer of data, and many more concepts. These concepts are important and deep and focused study of these topics is required by students to understand networking. Few of these concepts have been discussed in this paper. Various topologies have been discussed in this paper.

3. CONCLUSION

Networking topology is an important concept in networking which deals with several topologies, which defines several ways on how several devices can be connected to each other for exchange of data. There are types of topologies based on different factors. These topologies have been discussed in this paper. Importance of these topologies have been discussed in this paper. It is explained how several arrangements of devices are done in these topologies. Ring topology with its diagrammatic representation along with advantages and disadvantages have been discussed in this paper. Similarly, several other topologies such as mesh, star, bus, and tree and hybrid topology have been discussed in this paper. From every single small to big company, all of these have their several types of networks in which different devices are connected. These connections are done by keeping in mind benefits of several topologies and then accordingly connections are done. As everyday new start, companies are set up so there is a high need of using these topologies, thereby increasing future scope and use of these topologies.

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