

# Physical Topologies in Computer Networks

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**Abstract:** - The research is aimed to explain physical topology that means how to connect computers in the network physically. Due to technological improvement different alternatives were invented for physical topology with the help of network hardwares such as switch, cables and connectors. In the paper, bus, star, ring, tree, mesh and cellular topology which are models of physical topology will be emphasized.

**Key-Words:** - Computer Networks, Physical Topology, Data Bus, Ring Topology, Star Topology, Tree Topology, Mesh Topology, Cellular Topology

## 1 Introduction

Physical topology is about the layout of computers in a network. How computers are wired and how computers are connected to each other determines the physical topology [1]. As it is understood from its name physical topology is about the physical appearance of a network. In physical topologies appropriate cable type must be selected according to used protocol and hardware. The cables that are used in network configurations are coaxial, twisted pair, and fiber optic cables. For coaxial cables BNC, BNC-T, BNC barrel ending (node), for shielded and unshielded cables RJ45, for fiber optic cables SC and ST connectors are main components of physical topology [2,8]. Other network devices like hub, switch and repeater are main components of physical topology. Physical topologies are explained below briefly.

## 2 Data Bus Topology

In data bus topology computers are connected to each other through a straight line, it is the simplest connection method. A simple scheme of data bus network topology can be seen in figure 1.

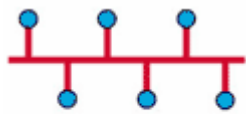


Figure 1. Data Bus Topology.

In this topology there is only a single cable which is called trunk, backbone or segment if we assume the cable which is called backbone as a way, every stop in this way represents a node [3]. Nodes represents both computers and other devices that are connected to the network. 10 BASE-5 thicknet cables RG-8 coaxial cables, 10 BASE-2 thinnet cables and RG-58 cables are used commonly as backbone.

## 3 Star Topology

In this topology there is a device like a hub or switch at the center of the network [4]. The computers that are going to be the part of the network are connected with UTP (Unshielded Twisted Pair) and STP (Shielded Twisted Pair) cables with RJ-45 connectors to a hub or a switch [5].

A hub is a device which distributes the data to every computer with broadcast method on the network. But the broadcast method can make an unnecessary traffic load to the network, for this reason more clever devices called switch are preferred in networks. Switches are devices that send the data to the only targeted computer therefore unnecessary traffic load are not allowed. Star topology can be seen in figure 2.



Figure 2. Star Topology.

The topology that is seen in figure 3 is called as extended star topology and it is a different combination of star topology. This topology is composed of combination of networks that has star topology which is connected with a central device [6]. Dotted display of extended star topology displayed in the figure below.

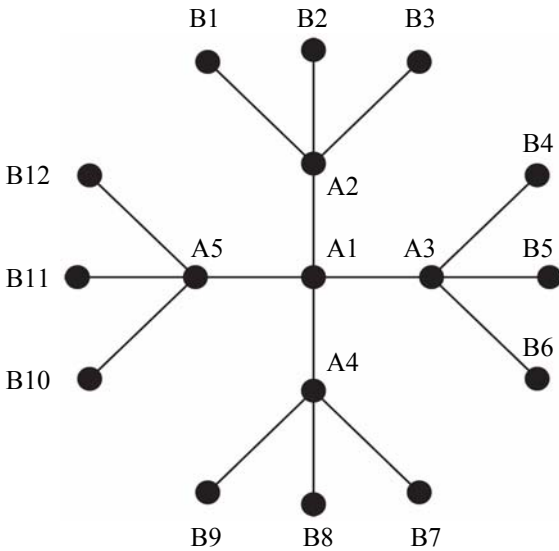


Figure 3. Extended Star Topology.

Switch A1 provides extended star topology to be formed by connection of A2, A3, A4, A5 switches. Telephone networks can be an exemplified to extended star topology.

Nowadays star topology is commonly used, the main reason for this is, it can make data transfer from a central device, it is cheap and it is easy to install.

#### 4 Ring Topology

In ring topology as is in data bus topology there is no need to make termination, as is also understood from its name computers are connected in ring shape. Ring topology is also imaginable as data bus topology which two end of the backbone is connected to each other. Each computer is connected with the previous and the next computer [9]. Ring topology is displayed in figure 4.

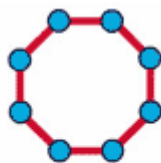


Figure 4. Ring Topology.

Data sent in network is transferred from one computer to another to reach the targeted computer [1].

Every computer strengthens the incoming signal and sends the data to the next computer. Data transfer can only be one sided like clockwise or counter clockwise. The probability of data collision is less than the topologies like data bus. UTP, STP and fiber optic cables are commonly used in ring topologies. Like in data bus topology if there is a problem in one node of the ring data transfer in the whole network will be interrupted.

#### 5 Tree Topology

Tree topology is formed by adding star shaped stations onto the backbone of the data bus topology. With this aspect tree topology accommodates all the features of data bus and star topology. As it is seen from figure 5 it is exactly like a tree, in this figure the branches of this tree represents networks that has different topologies and different networks are connected to each other with tree trunk [10]. By means of tree topology larger LAN networks can be built. Tree topologies are used to connect networks that have different topologies, for example Ethernet and Token-Ring networks. Using bridges allows different physical and logical topologies to connect each other and provides data flow smoothly.

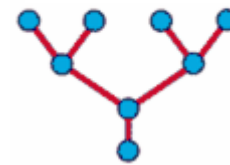


Figure 5. Tree Topology

#### 6 Mesh Topology

In this topology all computers are connected to the other computers with separate cables. As it is seen in figure 6 there is no meaningful shape like star, ring or tree topology.

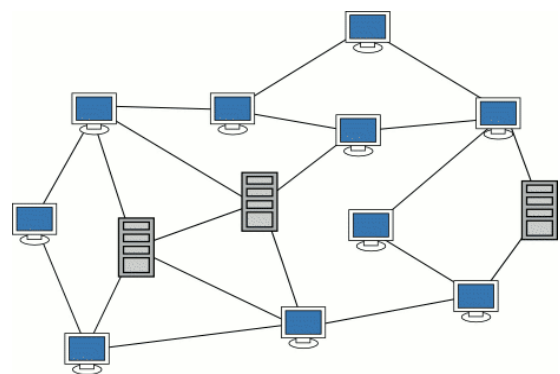


Figure 6. Mesh Topology

Mesh topology is only used in special cases with low number of computers, because with the increase of the number of computers the number of cables will increase incrementally. In mesh topology computers that are part of the network can connect to the other computers by numbers of different ways. A computer which is a part of a mesh network doesn't have the obligation to connect directly to the all other computers in the network, but there can be some situations which it is a necessity, such a topology is called full mesh topology. In order to say that a network has full mesh topology it must have  $N(N-1)/2$  connections, in this formula N refers to the number of the devices such as computers, scanners and printers which are connected to the network [1]. In figure 7 a scheme of full mesh network can be seen.

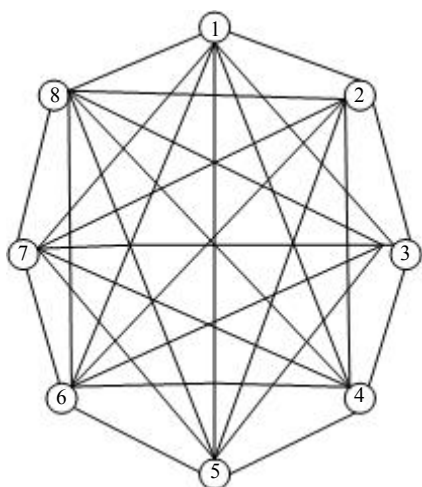


Figure 7. Full Mesh Topology

Among 8 computers there must be  $8*7/2=28$  connections. Full mesh topology is not commonly used because it requires a lot of unnecessary cable connections. With this topology computer networks that has different dimensions and capacities are connected to internet without having a pattern or hierarchic structure [7]. The advantage of this topology is when connection is gone down it doesn't hinder the data transfer because with the mesh topology data can travel across different path to reach the destination. Routers select the shortest way to reach destination computer otherwise we would spend lots of time because of slow data transfer [13].

### 7 Cellular Topology

Wireless networks are commonly used in these days and there is no doubt that wireless communication will be the next generations' communication technology, 3G technologies can be given as an example to this.

As in wired networks, wireless networks also have physical appearance. The physical topology in wireless networks is called cellular topology.

In wireless networks access points are used instead of hubs and switches a sample access point and its properties is shown in figure 8.

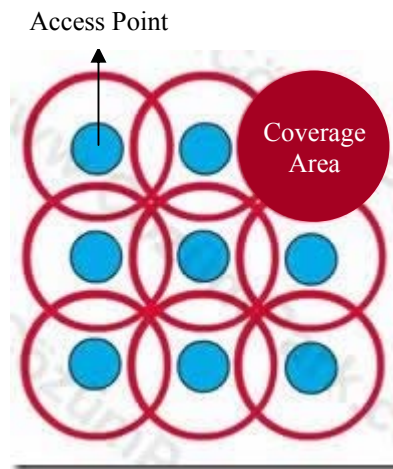


Figure 8. Integration of access points

Access points are the connection points of wired and wireless networks, from this point of view access points also serve as a bridge and they enable such devices like a printer that doesn't have wireless property [11]. In addition to this access points strengthens the incoming signals to transmit them further.

By using lots of access points the length of the transfer distance of wireless network can be enhanced. Access points provides with a data transfer of 11 Mbps for up to 40metres and 1 Mbps for up to 100 meters, with the help of more enhanced wireless bridges wireless networks can be provided for LAN type wired networks which has kilometers of distance in between and that may provide larger networks of MAN and WAN [12].

Figure 8 displays a cellular topology which composed from integration of access points. Every access point has a circular coverage area. In such a wireless network a computer that is in the coverage area of any access point can be connected wirelessly to the network as displayed in figure 9(Mobile phone, palm, pda, etc.).

Data transfer in wireless networks occurs within the scope of cellular topology mentioned above. Wireless network topologies don't have many alternatives like wired network topologies. In wireless networks star and mesh topologies are used that are mentioned in wired topologies.

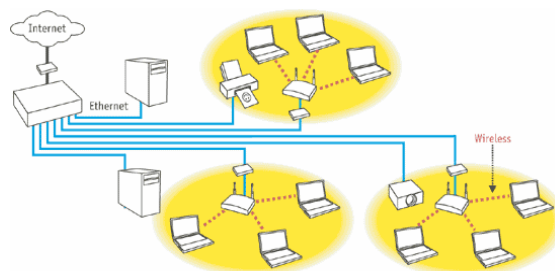


Figure 9. Wireless Star Topology

**Wireless Star Topology:** In figure 9 an example for wireless topology is shown. Mobile computers in a local network first of all connect to the wireless access point then to the switch and lastly connects to the internet by a router. In the figure 9 mobile computers are connected to 3 access points are displayed. The red lines show that mobile computers in coverage area of an access point like physical star topology. Meanwhile, the access point which serves a bridge, makes the wireless and wired connections work in harmony.

**Wireless Mesh Topology:** At home and offices to make a wireless connection establishing a star topology connection will be sufficient. However within the borders of country, when it is required to establish a wireless WAN (Mobile Phones) the question of what kind of topology is needed explains the reason for using mesh topology in wireless networks. In such a big area one access point wont be sufficient as a result of this more access points will be needed for establishing the connections. When it is required to enlarge the wireless network in the same form new access points are located as they can communicate with each other.

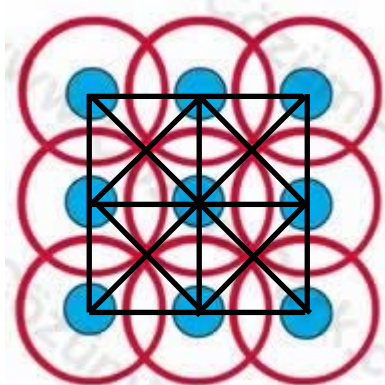


Figure 10. Wireless Mesh Topology

The topology used for mobile phones are also cellular mesh topology. Base points might be regarded as access points. In figure 10 black lines shows access points can reach other access points from different ways.

In wireless network environments like Bluetooth when the devices are in the coverage areas of other devices they can transfer data from one point to other point without using any other hardware . In mobile phones this method is used for sharing files.

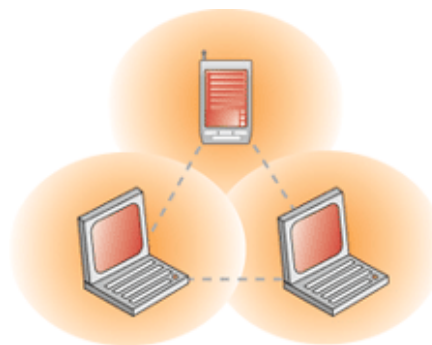


Figure 11. Ad hoc connection

In figure 11 the systems that are not using access points can transfer data between each other with Ad Hoc method [2]. These kinds of connections are used for sharing music and pictures.

#### Wireless mesh topologies

If we imagine wiring every single computer, wireless mesh topology provides great convenience to us. The greatest advantage of wireless mesh topology is it doesn't need any other carrier except atmosphere and space, the weakest part of it is the signal in the air can easily be listened and the security threads related to this.

## 8 Conclusion

With the rapid development of technology faster processors, more clever devices and better equipments are used for transferring data. For example instead of using coaxial cables twisted pair cables are developed, having said that central devices like hub and switch are generated. By this means physical topologies that use Ethernet cards came forward, with mentioned topologies LAN type networks developed rather than the other network types.

Star topology is developed to work in harmony with data bus topology thus with the data bus that forms the body and star topology that forms the branches tree topology aroused.

With fiber optic cables data is carried securely to hundreds kilometers away where coaxial and twisted pair cables can't reach. Bridge like devices helps us to transfer data between different topologies. Nowadays star topology is the most commonly used topology, the Internet network that is formed with connection of computers in world wide uses mesh topology.

Having said that we must consider about the topologies, network devices we have, necessities and the physical environment that we are in before setting up a network

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