KAYODE PETER TEMITOPE 208077 COMPUTER SCIENCE (300 LEVEL)

CSC 322: PRINCIPLES OF DATA COMMUNICATION ASSIGNMENT (2021/2022 SESSION)

1. Write a short note on Network Topology
2. State the advantages and disadvantages of each of the Network Topology

Question 1

Network topology is the arrangement of the elements (links, nodes, etc.) of a communication network. Network topology can be used to define or describe the arrangement of various types of telecommunication networks, including command and control radio networks, industrial fieldbuses and computer networks. It is the arrangement of a network that comprises nodes and connecting lines via sender and receiver.

Network topology is the topological structure of a network and may be depicted physically or logically. It is an application of graph theory wherein communicating devices are modeled as nodes and the connections between the devices are modeled as links or lines between the nodes. Physical topology is the placement of the various components of a network (e.g., device location and cable installation), while logical topology illustrates how data flows within a network. Distances between nodes, physical interconnections, transmission rates, or signal types may differ between two different networks, yet their logical topologies may be identical. A network's physical topology is a particular concern of the physical layer of the OSI model.

Network topology refers to the manner in which the links and nodes of a network are arranged to relate to each other. Topologies are categorized as either physical network topology, which is the physical signal transmission medium, or logical network topology, which refers to the manner in which data travels through the network between devices, independent of physical connection of the devices. Logical network topology examples include twisted pair Ethernet, which is categorized as a logical bus topology, and token ring, which is categorized as a logical ring topology.

Examples of network topologies are found in local area networks (LAN), a common computer network installation. Any given node in the LAN has one or more physical links to other devices in the network; graphically mapping these links results in a geometric shape that can be used to describe the physical topology of the network. A wide variety of physical topologies have been used in LANs, including ring, bus, mesh and star. Conversely, mapping the data flow between the components determines the logical topology of the network. In comparison, Controller Area Networks, common in vehicles, are primarily distributed control system networks of one or more controllers interconnected with sensors and actuators over, invariably, a physical bus topology.

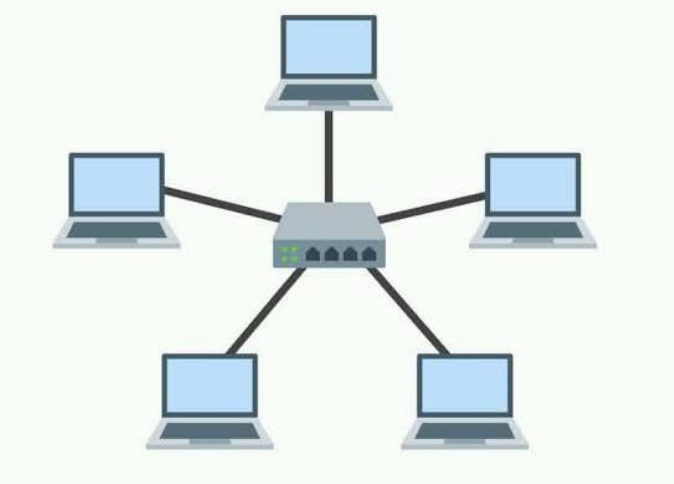
Types of Network Topology

There are many types of Network Topology. However, the major and most common ones are considered below.

1. Star Topology
2. Bus Topology
3. Mesh Topology
4. Ring Topology

1. Star Topology

In star topology, all the devices are connected to a single hub through a cable. This hub is the central node and all other nodes are connected to the central node. The hub can be passive in nature i.e., not an intelligent hub such as broadcasting devices, at the same time the hub can be intelligent known as an active hub. Active hubs have repeaters in them. Coaxial cables or RJ-45 cables are used to connect the computers. In Star Topology, many popular Ethernet LAN protocols are used as CD (Collision Detection), CSMA (Carrier Sense Multiple Access), etc.



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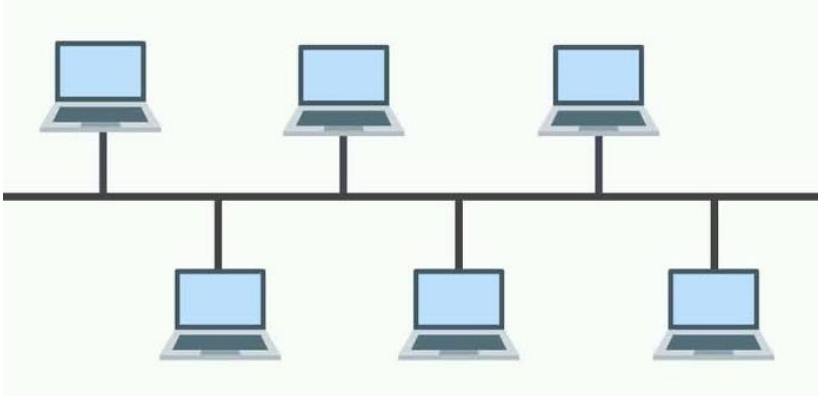
2. Bus Topology

Bus topology is a network type in which every computer and network device is connected to a single cable. It transmits the data from one end to another in a single direction. No bi-directional feature is in bus topology. It is a multi-point connection and a non-robust topology because if the backbone fails the topology crashes. In Bus Topology, various MAC (Media Access Control) protocols are followed by LAN Ethernet connections like TDMA, Pure Aloha, CDMA, Slotted Aloha, etc.

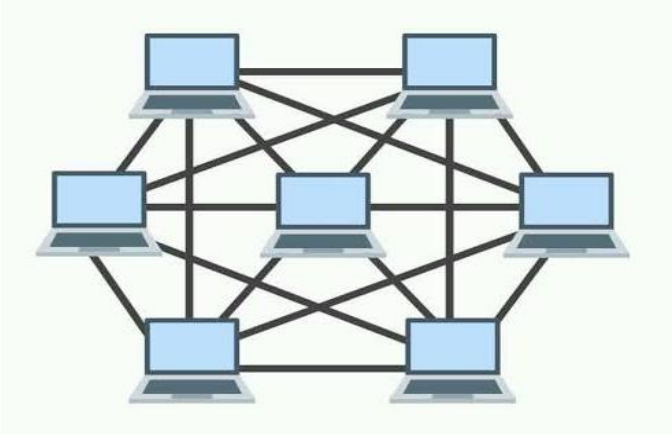


3. Mesh Topology

In a mesh topology, every device is connected to another device via a particular channel. In Mesh Topology, the protocols used are AHCP (Ad Hoc Configuration Protocols), DHCP (Dynamic Host Configuration Protocol), etc.

Suppose, the N number of devices are connected with each other in a mesh topology, the total number of ports that are required by each device is N-1.

Suppose, N number of devices are connected with each other in a mesh topology, then the total number of dedicated links required to connect them is NC2 i.e. N(N-1)/2. In Figure 1, there are 5 devices connected to each other, hence the total number of links required is 5*4/2 = 10.



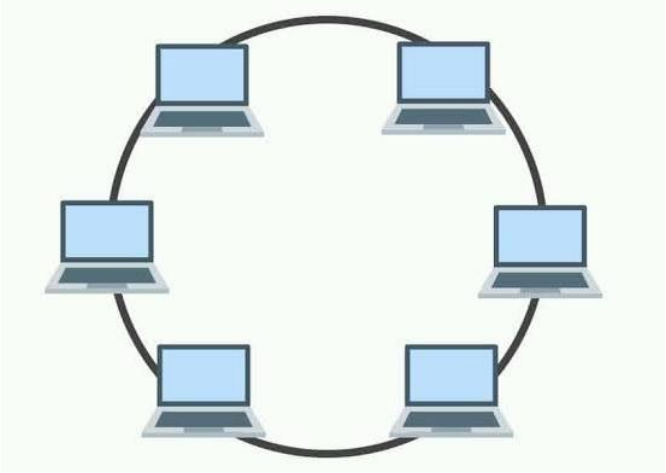
4. Ring Topology

In this topology, it forms a ring connecting devices with exactly two neighboring devices.
A number of repeaters are used for Ring topology with a 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.
The data flows in one direction, i.e., it is unidirectional, but it can be made bidirectional by having 2 connections between each Network Node, it is called Dual Ring Topology. In-Ring Topology, the Token Ring Passing protocol is used by the workstations to transmit the data. The most common access method of ring topology is token passing.
Token passing is a network access method in which a token is passed from one node to another node and Token is a frame that circulates around the network.

The following operations take place in ring topology:

a. One station is known as a monitor station which takes all the responsibility for performing the operations.
b. To transmit the data, the station has to hold the token. After the transmission is done, the token is to be released for other stations to use.
c. When no station is transmitting the data, then the token will circulate in the ring.

There are two types of token release techniques: Early token release releases the token just after transmitting the data and Delayed token release releases the token after the acknowledgment is received from the receiver.



Question 2

	Advantages	Disadvantages
Star Network Topology	1. If N devices are connected to each other in a star topology, then the number of cables required to connect them is N. So, it is easy to set up. 2. Each device requires only 1 port i.e. to connect to the hub, therefore the total number of ports required is N. 3. It is Robust. If one link fails only that link will affect and not other than that. 4. Easy to fault identification and fault isolation. 5. Star topology is cost-effective as it uses inexpensive coaxial cable.	1. If the concentrator (hub) on which the whole topology relies fails, the whole system will crash down. 2. The cost of installation is high. 3. Performance is based on the single concentrator i.e. hub.
Bus Network Topology	1. If N devices are connected to each other in a bus topology, then the number of cables required to connect them is 1, known as backbone cable, and N drop lines are required. 2. Coaxial or twisted pair cables are mainly used in bus-based networks that support up to 10 Mbps. 3. The cost of the cable is less compared to other topologies, but it is used to build small networks. 4. Bus topology is familiar technology as installation and troubleshooting techniques are well known.	1. A bus topology is quite simpler, but still, it requires a lot of cabling. 2. If the common cable fails, then the whole system will crash down. 3. If the network traffic is heavy, it increases collisions in the network. To avoid this, various protocols are used in the MAC layer known as Pure Aloha, Slotted Aloha, CSMA/CD, etc. 4. Adding new devices to the network would slow down networks. 5. Security is very low.
Mesh Network Topology	1. Communication is very fast between the nodes. 2. It is robust. 3. The fault is diagnosed easily. Data is reliable because data is transferred among the devices through dedicated channels or links. 4. Provides security and privacy	1. Installation and configuration are difficult. 2. The cost of cables is high as bulk wiring is required, hence suitable for less number of devices. 3. The cost of maintenance is high.
Ring Network Topology	1. The data transmission is high-speed. 2. The possibility of collision is minimum in this type of topology. 3. Cheap to install and expand. 4. It is less costly than a star topology	1. The failure of a single node in the network can cause the entire network to fail. 2. Troubleshooting is difficult in this topology. 3. The addition of stations in between or the removal of stations can disturb the whole topology. 4. Less secure.

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