COMPUTER NETWORKS

EXPERIMENT-1

NAME: Ayush Jain

SAP ID: 60004200132

DIV: B/B2

Branch: Computer Engineering

Aim: To study various networking devices and networking topologies

THEORY:-

What is a Networking Device?

- Network devices, or networking hardware, are physical devices that are required for communication and interaction between hardware on a computer network.

Types of Networking Devices:-

- Hub
- Switch
- Router
- Gateway
- Repeater

HUB:

- **Introduction:**

A hub is a common connection point, also known as a network hub, which is used for connection of devices in a network. It works as a central connection for all the devices that are connected through a hub. The hub has numerous ports. If a packet reaches at one port, it is able to see by all the segments of the network due to a packet is copied to the other ports. A network hub has no routing tables or intelligence (unlike a network switch or router), which is used to send information and broadcast all network data across each and every connection.

Although most of the hubs can recognize network troubles or errors like collisions, broadcasting all information to the several ports can be a security risk and cause bottlenecks. The network hubs were popular in the past time as they were cheaper as compared to a switch or router. Nowadays, switches are much cheaper than a hub and provide a better solution for any network. Furthermore, a hub is no IP address, as it is a dumb device.

There are three types of the hub that are given below:

1. **Passive Hub**: The passive hubs are the connection point for wires that helps to make the physical network. It is capable of determining the bugs and faulty hardware. Simply, it accepts the packet over a port and circulates it to all ports.

2. **Active Hub**: As compared to a passive hub, it includes some additional features. It is able to monitor the data sent to the connected devices.

3. **Intelligent Hub**: It is a little smarter than passive and active hubs. These hubs have some kinds of management software that help to analyse the problem in the network and resolve them.

Logical symbol-
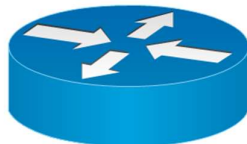
Advantages of hub:

- Easy to install.
- Very little delay.
- It is used for internal connectivity between the systems.
- Hub device does not affect the performance of the network seriously.
- It can extend the total distance of the network.
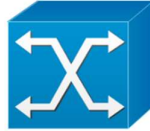
Disadvantages of hub:

- It runs half-duplex.
- Cannot filter information.
- It cannot connect different type of network architecture such as a token ring and Ethernet extra.
- Cannot reduce network traffic.
- It will broadcast to all the port.

SWITCH:-

Introduction:

A switch is a multiport bridge with a buffer and a design that can boost its efficiency (a large number of ports imply less traffic) and performance. A switch is a data link layer device. The switch can perform error checking before forwarding data, which makes it very efficient as it does not forward packets that have errors and forward good packets selectively to the correct port only. In other words, the switch divides the collision domain of hosts, but broadcast domain remains the same.

Logical symbol:

Advantages of switch:

- The number of broadcast domains gets decreases
- They help in reducing the workload on individual host PCs
- Switches can be connected directly to work station.
- They increase the available bandwidth of the network
- Support centralized management

Disadvantages of switch:

- High cost.
- Failure of switch bridge down the network.
- When we use a switch, a network connectivity problem can be difficult to trace through a switch.
- Broadcast traffic may be troublesome
- If a switch is in promiscuous, they are vulnerable to security attacks

ROUTER:-

Introduction:

Routers are general-purpose devices that interconnect two or more heterogeneous networks. They are usually dedicated to special-purpose computers, with separate input and output network interfaces for each connected network. Because routers and gateways are the backbone of large computer networks like the internet, they have special features that give them the flexibility and the ability to cope with varying network addressing schemes and frame sizes through segmentation of big packets into smaller sizes that fit the new network components. Each router interface has its own Address Resolution Protocol (ARP) module, its own LAN address (network card address) and its own Internet Protocol (IP) address. The router, with the help of a routing table, has knowledge of routes a packet could take from its source to its destination. The routing table, like in the bridge and switch, grows dynamically. Upon

receipt of a packet, the router removes the packet headers and trailers and analyses the IP header by determining the source and destination addresses and data type, and noting the arrival time. It also updates the router table with new addresses not already in the table. The IP header and arrival time information is entered in the routing table. Routers normally work at the Network layer of the OSI model.
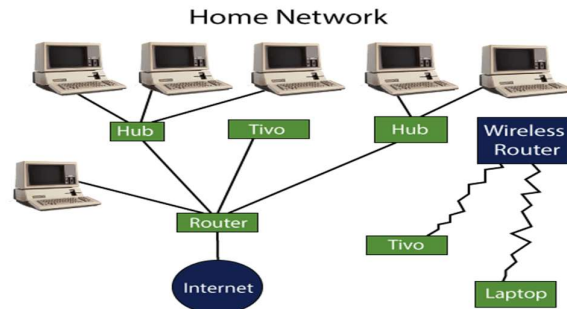
Home Network

Logical symbol-
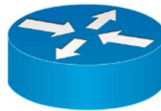
Advantages of router:

- It provides sophisticated routing, flow control, and traffic isolation
- Reduce network traffic by creating collision domains
- Reduce network traffic by creating broadcast domains
- It can choose the best path across the internetwork using dynamic routing algorithms
- Allow achieving loop so that redundant paths are available

Disadvantages of router:

- A router is more expensive than bridge or repeaters
- Router only work with rotatable network protocol, not all protocol are routable
- The router is slower than bridge or repeaters because they must analyze data transmission from the physical to the network layer
- Are relatively complex device
- Can require a considerable amount of initial configuration

GATEWAY:-

Introduction:

Gateways normally work at the Transport and Session layers of the OSI model. At the Transport layer and above, there are numerous protocols and standards from different vendors; gateways are used to deal with them. Gateways provide translation between networking technologies such as Open System Interconnection (OSI) and Transmission Control Protocol/Internet Protocol (TCP/IP). Because of this, gateways connect two or more autonomous networks, each with its own routing algorithms, protocols, topology, domain name service, and network administration procedures and policies.

Gateways perform all of the functions of routers and more. In fact, a router with added translation functionality is a gateway. The function that does the translation between different network technologies is called a protocol converter.
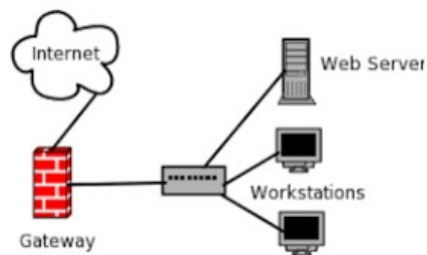
Logical symbol:

Advantages of gateway:

- It can connect the devices of two different networks having dissimilar structures.
- It is an intelligent device with filtering capabilities.
- It has control over both collisions as well as a broadcast domain.
- It uses a full-duplex mode of communication.
- It has the fastest data transmission speed amongst all network connecting devices.
- It can perform data translation and protocol conversion of the data packet as per the destination network's need.
- It can encapsulate and decapsulate the data packets

Disadvantages of gateway:

- It is complex to design and implement.
- The implementation cost is very high.
- It requires a special system administration configuration.

Bridge:-

Introduction:

A bridge operates at the data link layer. A bridge is a repeater, with add on the functionality of filtering content by reading the MAC addresses of source and destination. It is also used for interconnecting two LANs working on the same protocol. It has a single input and single output port, thus making it a two port device.
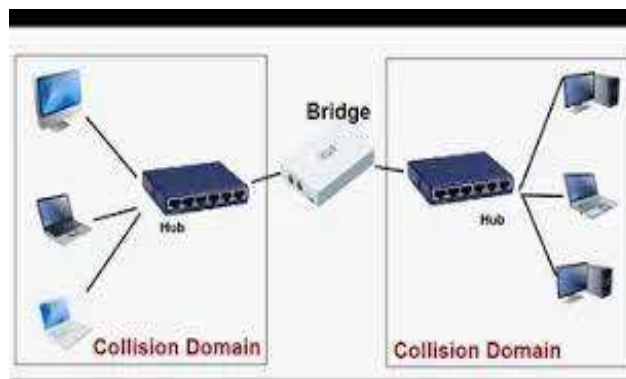
Logical symbol:

Advantages of bridge:

- It reduces network traffic with minor segmentation
- It reduces collisions
- Bridge connects similar network types with different cabling
- Bridge increases the number of attached workstation and network segments
- It extends the physical network
- Bridges also can reduce network traffic on a segment by subdividing network communications
- It connects different architecture
- Bridges network can extend a network by acting as a repeater

Disadvantages of bridge:

- It does not filter broadcasts
- It is slower compare to repeaters due to the filtering process
- It is more expensive compared to repeaters
- Complex network topology, it can pose a problem for transparent bridge
- A bridge is more expensive than repeaters or hubs'
- Does not limit the scope of broadcast
- Does not scale to extremely large network
- Buffering and processing introduces delays

Repeater:-

Introduction:

Repeaters are network devices operating at physical layer of the OSI model that amplify or regenerate an incoming signal before retransmitting it. They are incorporated in networks to expand its coverage area. They are also known as signal boosters. When an electrical signal is transmitted via a channel, it gets attenuated depending upon the nature of the channel or the technology. This poses a limitation upon the length of the LAN or coverage area of cellular networks. This problem is alleviated by installing repeaters at certain intervals. Repeaters amplifies the

attenuated signal and then retransmits it. Digital repeaters can even reconstruct signals distorted by transmission loss. So, repeaters are popularly incorporated to connect between two LANs thus forming a large single LAN.

Logical Symbol:

Repeater

Advantages of Repeaters:

- Repeaters are simple to install and can easily extend the length or the coverage area of networks.
- They are cost effective.
- Repeaters don't require any processing overhead. The only time they need to be investigated is in case of degradation of performance. They can connect signals using different types of cables.

Disadvantages of Repeaters:

- Repeaters cannot connect dissimilar networks.
- They cannot differentiate between actual signal and noise.
- They cannot reduce network traffic or congestion.
- Most networks have limitations upon the number of repeaters that can be deployed.

Topologies

A Network Topology is the arrangement with which computer systems or network devices are connected to each other. Topologies may define both physical and logical aspects of the network. Both logical and physical topologies could be the same or different in the same network.

The various network topologies are:

Mesh Topology

In a mesh topology, every device is connected to another device via a particular channel.
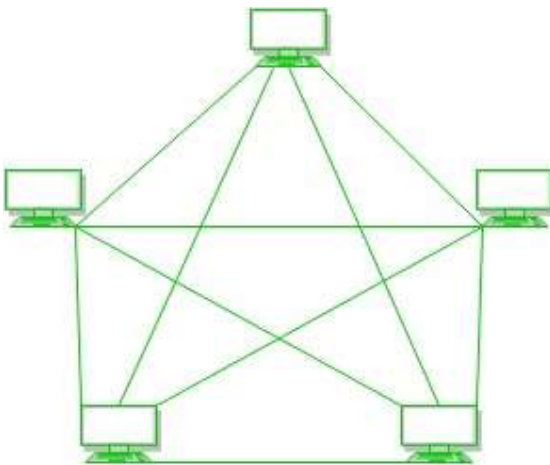
Figure 1: Every device is connected with another via dedicated channels.

These channels are known as links.

- Suppose, 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. In Figure 1, there are 5 devices connected to each other, hence the total number of ports required by each device is 4. Total number of ports required=N*(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.

Logical Symbol:
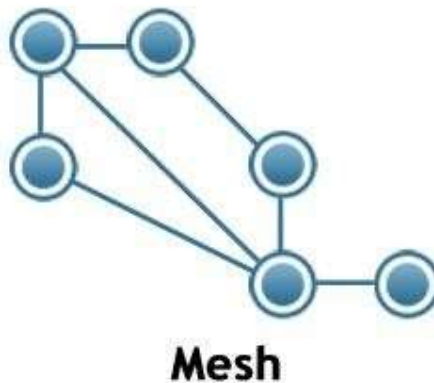
Mesh

Advantages of mesh topology:

- It is robust.
- The fault is diagnosed easily. Data is reliable because data is transferred among the devices through dedicated channels or links.

Disadvantages of mesh topology:

- Installation and configuration are difficult.
- The cost of cables is high as bulk wiring is required, hence suitable for less number of devices.
- The cost of maintenance is high.

Applications:

- This network topology is used wherever the network reliability communication is extremely significant.
- This kind of topology is used by military organizations to evade breakdowns within communication
- These network topologies are used to assist while monitoring traffic flow, street light control, and sewage treatment.

- These network topologies are used in crisis services like fire, police services and also to ensure that communication is consistent
- These networks are used by utility companies to allow smart meters to transmit readings automatically.

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.
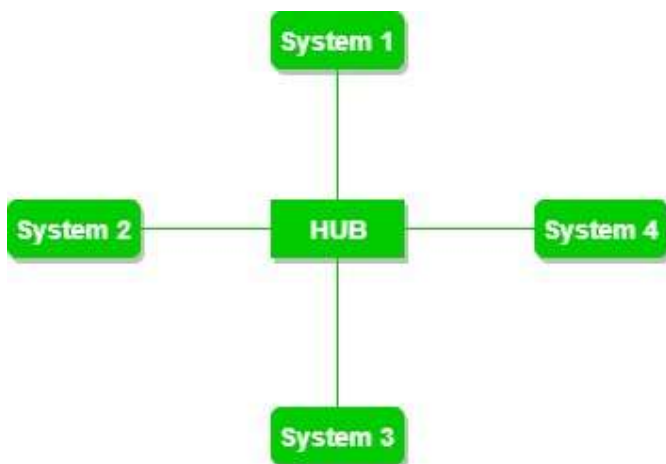

Figure 2: A star topology having four systems connected to a single point of connection i.e. hub.

Logical Symbol:

Star

Advantages of star topology:

- 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.
- Each device requires only 1 port i.e. to connect to the hub, therefore the total number of ports required is N.

Disadvantages of star topology:

- If the concentrator (hub) on which the whole topology relies fails, the whole system will crash down.
- The cost of installation is high.
- Performance is based on the single concentrator i.e. hub.

Applications

- Star network topology is used in different locations because of readily available as well as cheap equipment.
- In most of the colleges, this technology is used in computer labs for connecting different nodes w
- In bank sectors, this topology is used to connect different banking users.
- Home networks can be connected by using this topology.

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.
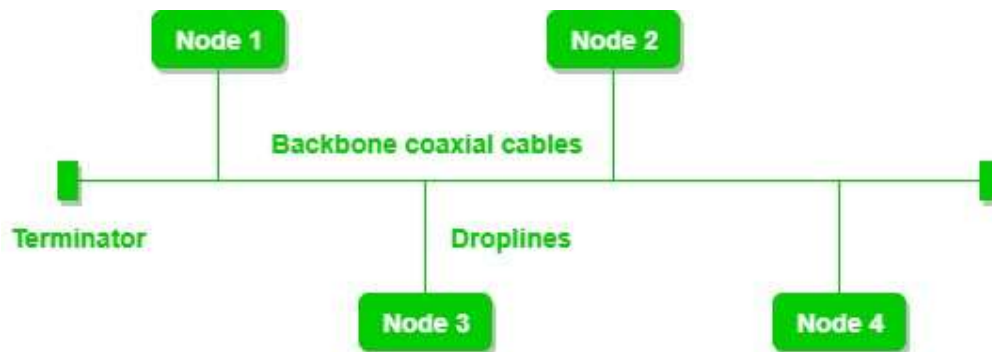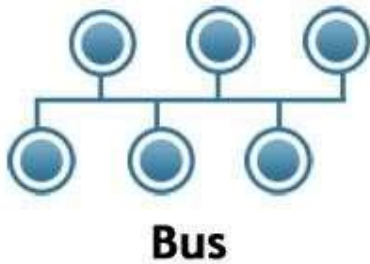

Figure 3: A bus topology with shared backbone cable. The nodes are connected to the channel via drop lines.

Logical Symbol

Bus

Advantages of bus topology:

- If N devices are connected to each other in a bus topology, then the number of cables required to connect them is 1, which is known as backbone cable, and N drop lines are required.
- The cost of the cable is less as compared to other topologies, but it is used to build small networks.

Disadvantages of bus topology:

- If the common cable fails, then the whole system will crash down.
- 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. Security is very low.

Applications

- This network topology is used wherever the network reliability communication is extremely significant
- This kind of topology is used by military organizations to evade breakdowns within communication
- These network topologies are used to assist while monitoring traffic flow, street light control, and sewage treatment.
- These network topologies are used in crisis services like fire, police services and also to ensure that communication is consistent
- These networks are used by utility companies to allow smart meters to transmit readings automatically.

Ring Topology:

In this topology, it forms a ring connecting devices with exactly two neighbouring 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 transmission is unidirectional, but it can be made bidirectional by having 2 connections between each Network Node, it is called Dual Ring Topology.
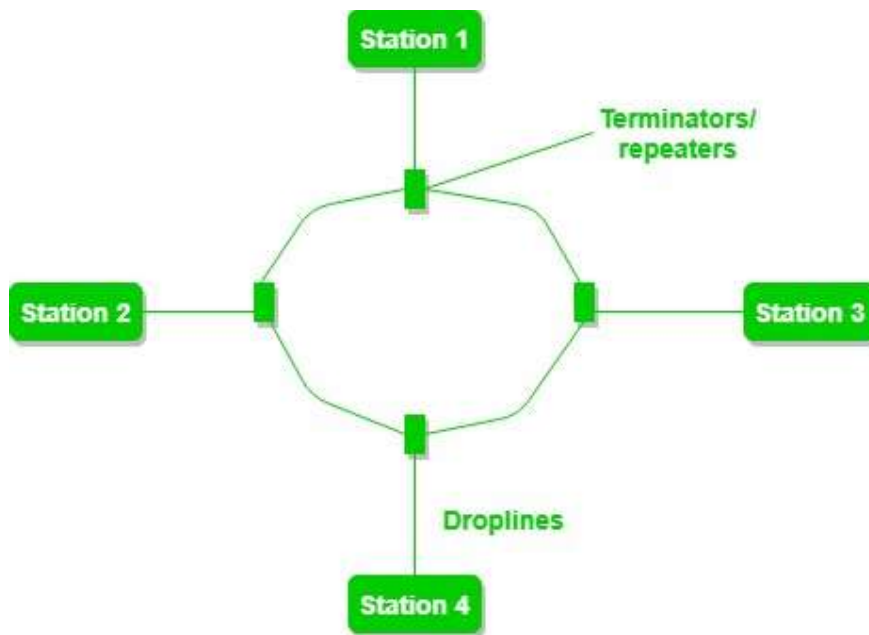

Figure 4: A ring topology comprises 4 stations connected with each forming a ring.

The following operations take place in ring topology are:

1. One station is known as a **monitor** station which takes all the responsibility to perform the operations.
2. 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.
3. When no station is transmitting the data, then the token will circulate in the ring.
4. There are two types of token release techniques: **Early token release** releases the token just after transmitting the data and **Delay token release** releases the token after the acknowledgment is received from the receiver.

Logical Symbol

Ring

Advantages of ring topology:

- The possibility of collision is minimum in this type of topology.
- Cheap to install and expand.

Disadvantages of ring topology:

- Troubleshooting is difficult in this topology.
- The addition of stations in between or removal of stations can disturb the whole topology.
- Less secure.

Applications:

- Ring network topology is used in a LAN (Local area network) & a WAN (Wide area network).
- This kind of topology is used in Synchronous optical network (SONET) fiber in the field of telecommunication.
- It is also applicable in educational institutions due to its low cost of operation.

Tree Topology:

This topology is the variation of Star topology. This topology has a hierarchical flow of data.
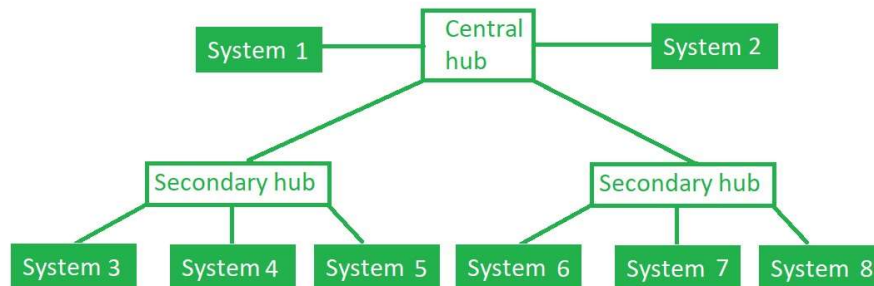

Figure 5: In this, the various secondary hubs are connected to the central hub which contains the repeater. In this data flow from top to bottom i.e. from the central hub to secondary and then to the devices or from bottom to top i.e. devices to the secondary hub and then to the central hub. It is a multi-point connection and a non-robust topology because if the backbone fails the topology crashes.

Logical Symbol:
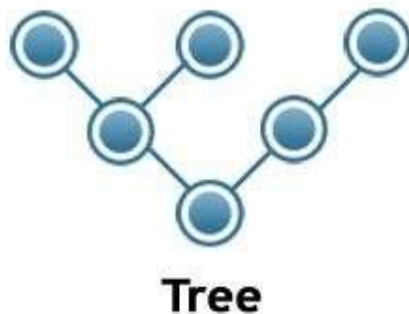
Advantages of tree topology:

- It allows more devices to be attached to a single central hub thus it decreases the distance that is travelled by the signal to come to the devices.
- It allows the network to get isolate and also prioritize from different computers.

Disadvantages of tree topology:

- If the central hub gets fails the entire system fails.
- The cost is high because of cabling.

Applications:

- Tree topology is mainly used for recognizing the system over the network to share data across the network & permits the operators to include several servers on the network.
- This is the best network topology as the signals are transmitted through the root nodes which are received through all the computers simultaneously.
- These topologies are used widely in database systems such as PostgreSQL, MySQL, Redis & file systems like HFS+, Ext4 & NTFS.

Conclusion:

The network of topologies differs from place to place. But how ever, all of them Have their advantages and disadvantages. If the server problem occurs or server gets down, then topology faces its failure