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Q. 1. Explain all network topologies in detail.

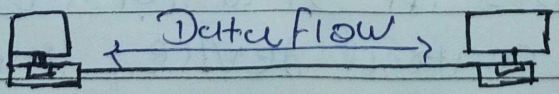
A → A Network Topology is the arrangement with which computer systems or network devices are connected to each other.

- Topologies may define both physical and logical aspect of the network.
- Both logical and physical topologies could be same or different in a same network.

Point-to-Point Topology

Point-to-Point networks contain exactly two hosts such as computer, switches or routers, servers connected back to back using a single piece of of cable.

- often, the receiving end of one host is connected to sending end of the other. and vice-versa.



- If the hosts are connected Point-to-Point logically, then may have multiple intermediate devices.

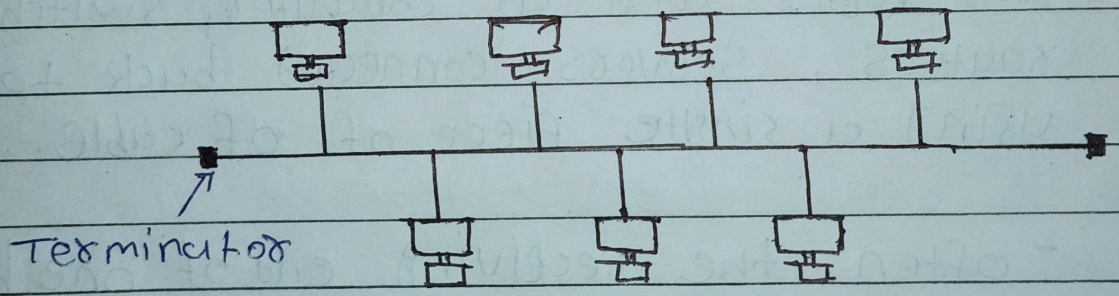
Bus Topology

In Bus Topology, all devices share single communication line or cable.

- Bus topology may have problem while multiple hosts sending data at the same time.

- Bus topology either uses CSMA/CD technology or recognizes one host as Bus master to solve the issue.

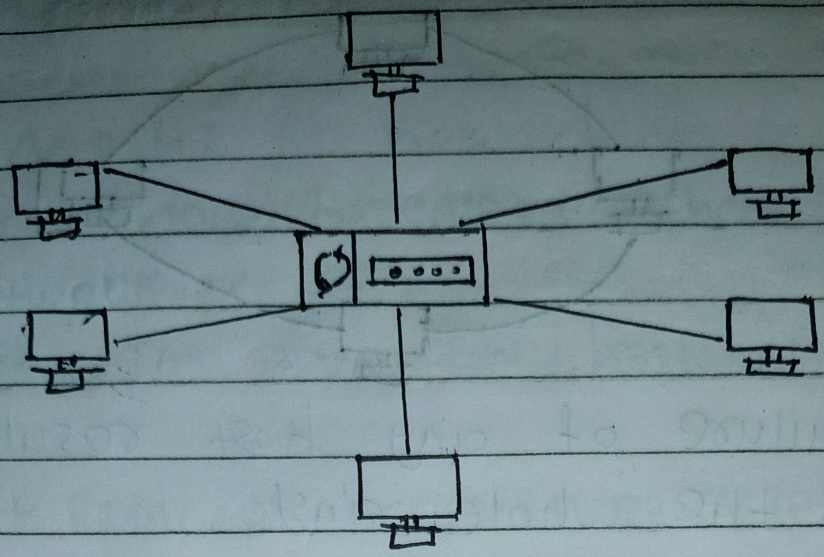
- It is one of the simple forms of networking where a failure of a device does not affect the other devices.



Star Topology

All hosts in Star topology are connected to a central device, known as hub device, using a point-to-point connection.

- Layer-1 device such as hub or repeater
- Layer-2 device such as switch or bridge
- Layer-3 device such as router or gateway



- If hub fails, connectivity of all hosts to all other hosts fails.

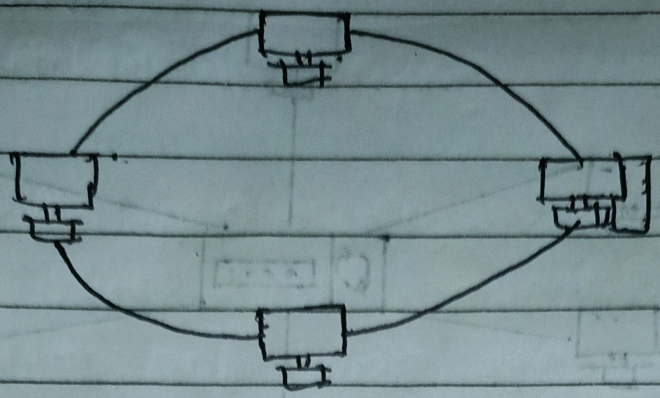
- Star topology is not expensive as to connect one more host, only one cable is required and configuration is simple.

~~Rig~~ Ring Topology.

In ring topology, each host machine to exactly two other machines, creating a circular network structure.

- When one host tries to communicate or send message to a host which is not adjacent to it, the data travels through all intermediate hosts.

- To connect one more host in the existing structure, the administrator may need only one more extra cable.



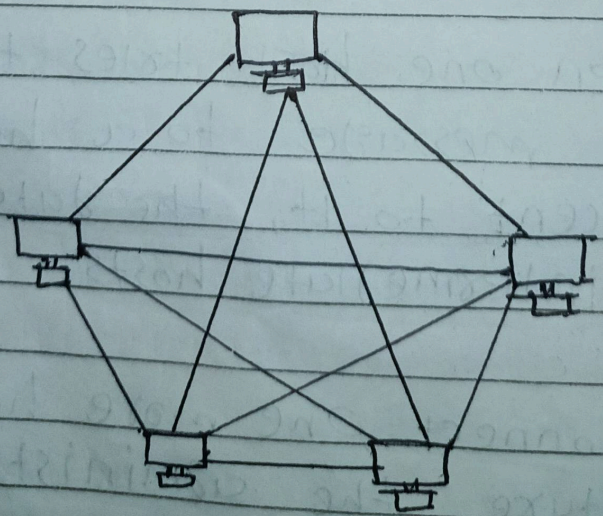
→ failure of any host results in failure of the whole ring.

- There are methods which employ one more backup ring.

Mesh Topology

In this type of Topology, a host is connected to one or multiple hosts.

- This topology has hosts in points-to-points connection with every other host or may also have hosts which are in point-to-point connection to few hosts only.



- Mesh topology comes into two types:

  - **Full Mesh:** All hosts have a Point-to-Point connection to every other host in the network.
    - Thus for every new host n(n-1)/2 connections are required.
    - It provides the most reliable network structure among all network topologies.

  - **Partialy Mesh:** Not all hosts have point-to-Point ~~Com~~ connection to every other host.
    - Hosts connect to each other in some arbitrarily fashion.
    - This topology exists where we need to provide reliability to some hosts out of all.

Tree (Hierarchical) Topology

This Topology also known as Hierarchical Topology.

- this is the most common form of network topology in use presently.

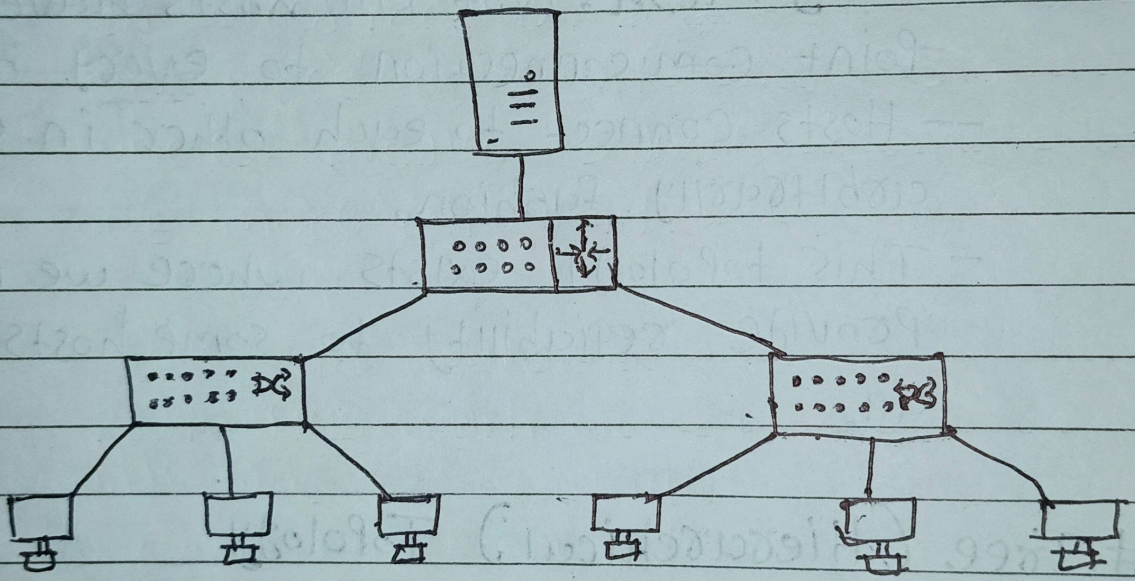
- This topology divides the network in to multiple levels / layers of network.

- mainly in LANs, a network is bifurcated into three types of network devices.

- The lowermost is access-layer where computers are attached.

- The middle layer is known as dir distribution layer, which works as mediator between upper layer and lower layer.

- The highest layer is known as core layer. and is central point of the network, i.e, root of the tree from which all nodes fork.



Hybrid Topology

A network structure whose design contains more than one topology is said to be hybrid Topology.

Irregular Topology

A network structure which is not having any fixed design means the devices connected in the network will not follow any topology they are connected in the network randomly.

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Q 2. Explain transmission media in detail.

A→ Transmission media is a communication channel that carries the information from the sender. to the receiver.

- Data is trasmitted through the electromagnetic signals.

- The main functionality of the transmission media is to carry the information in the form of bits through LAN, MAN, WAN.

- It is a physical path between transmitter and receiver in data communication.

- In a copper-based network, the bits in the form of electrical signals.

- In a fiber based network, the bits in the form of light pulses.

- In OSI (open System Interconnection) phase, transmission media supports the Layer 1.

- Therefore, it is considered to be as a Layer 1 Component.

- The electrical signals can be sent through

the copper wire, fiber optics, atmosphere, water, and vacuum.

- The characteristics and quality of data transmission are determined by the characteristics of medium and signal.

- Transmission media is of two types are wired media and wireless media.

- In wired media, medium characteristics are more important whereas, in wireless media, signal characteristics are more important.

- Different transmission media have different properties such as bandwidth, delay, cost and ease of installation and maintenance.

- The transmission media is available in the lowest layer of the OSI reference model, i.e., Physical layer.

Some factors need to be cosidered for designing the transmission media:

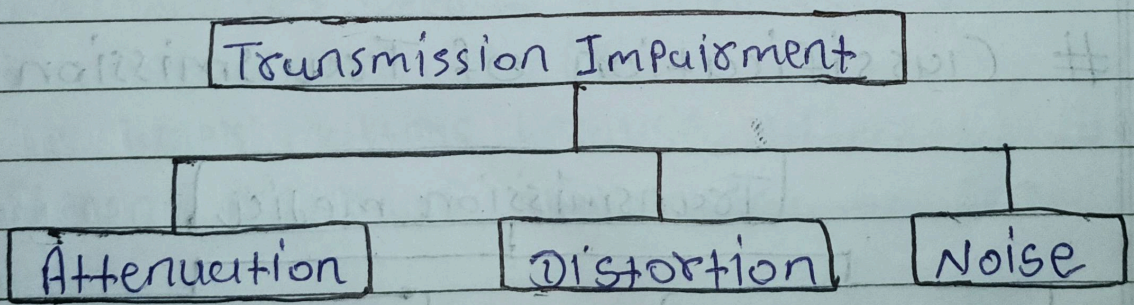
- Bandwidth: All the factors are Remaining constemet, the greater

the bandwidth of a Medium, the higher the data transmission Rate of a signal.

- Transmission impairment : When the received signal is not identical to the transmitted one due to the transmission impairment.
  - The quality of the signals will be get destroyed due to transmission impairment.

- Interference :
  Interference is defined as the process of disrupting a signal when it travels over a communication medium on the addition of some unwanted signal.

Causes of Transmission Impairment:



- Attenuation :
  Attenuation means means the loss of energy, i.e., the strength of the signal decreases with increasing the distance which causes the loss of energy.

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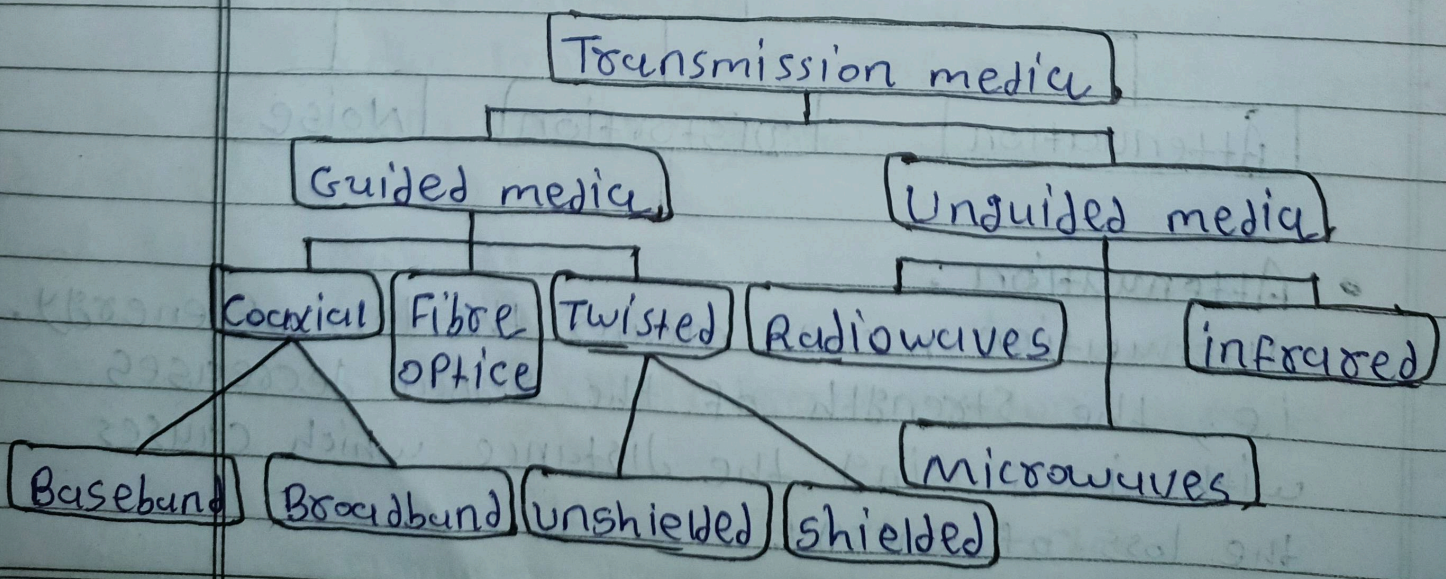
• Distortion:
Distortion occurs when there is a change in the shape of the signal.

- This type of distortion is examied from different signals having different frequencies.

- Each frequency component time which leads to the delay distortion. if they ~~leads~~ reach at a different time which leads to the delay distortion.

• Noise: When data is travelled over a transmission medium, some ~~data~~ unwanted signal is added to it which creates the noise.

Classification of Transmission media:



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Q 3. Explain all networking devices in detail.

A →

Application layer	Application gateway
Transport layer	Transport gateway
Network layer	Router
Datalink layer	Bridge, switch
Physical layer.	Repeater, hub

(a)

Packet (supplied by network layer)

Frame header	Packet header	TCP header	User data	CRC

Frame (built by data link layer)

(b)

- These devices operate in different ~~pieces of~~ layers, as illustrated in Fig (a).
- The layer matters because different devices use different pieces of information to decide how to switch.

- In Fig (b) we see the IP packet shaded in gray.
- Then the packet goes to the data link layer, which adds its own header and checksum (CRC) and gives the resulting frame to the physical layer for transmission, for example, over a LAN.

HUB:

Hub is a network device which is used to connect multiple devices together to form a network.

- It operates on layer-1 of OSI stack i.e Physical layer.

- It simply broadcasts the packet out ~~to~~ to all the ports except the port of entry.

- Hubs are of various types and are available in various port cofigurations viz. 4, 5, 8, 12 and so on.

- There are three basic types of hubs.
  - Passive Hub
  - Active Hub
  - Intelligent Hub.

Repeater:

- A network device used to regenerate or replicate a signal.

- Repeaters are used in transmission systems to regenerate analog or digital signals distorted by transmission loss.

- Analog repeaters frequently can only amplify the signal while digital

repeaters can reconstruct a signal to near its original quality.

- A repeater forwards every frame; it has no filtering capability.

- A repeater is a regenerator, not an amplifier.

#Switches:

- A switch is a device in a computer network that connects other devices together.

- An Ethernet switch operates at the data link (layer 2) of the OSI model to create a seperate collision domain for each switch port.

- Each device connected to a switch port can transfer data to any of the other ports at any time and the transmissions will not interfere.

- Multiple data cables are plugged into a switch to enable communication between different networked devices.

- Switches are transmitted data ~~thro~~ by this two methods
  - Store-end-forword
  - cut-through

- Types of switches
  - Crossbar Switch
  - Multistage Switch
  - Folded switch

Bridges

A Bridge is another device used to connect LAN cable segments together. Bridge operates at the data link layer of OSI model.

- A Bridge Provides Packet filtering at data link layer, meaning that it only passes the packets that are destinated for the other side of the network.

- A Bridge examines each packet as it enters through one of the ports.
- It first looks at the MAC address.

- The Bridge look up the Port number and forwards the Packet to the Port where it thinks the recipient is connected.
- If the recipient's MAC address is not in the list, the Bridge blocks the data from passing.

- Types of Bridges
  1 Transparent Bridge
  2 Remote Bridges
  3 Multiport bridging
  4 Spanning Tree Bridge

Routers

A routers is a networking device that forwards data pakets between computer networks.

- Router is connected to the network in the LAN or WAN equipment.

- It will automatically select and set the route according to the channel to the best path, in order to send the signal.

- In other word, Router is the hub of the Internet, "a traffic police."

- working consept of Routers
  - A router checks the source and destination IP addresses of each packet, looks up the destination of the packet in the router's IP routing table, and routes the packet to another router or a switch.
  - The process keeps happening until the destination IP address is reached and responds back.

- when there is more than one way to go to the destination IP address, routers can smartly choose the most economical one.

- If there's no destination existing for the packet, it will be dropped.

- Types of routers:
  1 Broadband Routers.
  2 wireless Routers.

Gateway

- A gateway is a network node that forms a passage between two networks operating with different transmission protocols.
- The most comman type of gateways, the networks should pass ~~tro~~ through the getway operates at layer 3, i.e Network layer. of the OSI model.

- It acts as the entry-exit point for a network since all traffic that flows across the network should pass through the gateway.

- only the internal traffic between the nodes of a LAN does not pass through the gateway.

- Types of Gateways
  - Network Gateway
  - Cloud storage Gateway
  - Internet-To-Orbit Gateway (I2O)
  - IoT Gateway
  - VoIP Trunk Gateway

Modems

- A modem is a modulator / Demodulator, it connects a terminal / computer (DTE) to the voice channel (dial-up line).

- The modem (DCE - Data Communication Equipment) is connected between the terminal / computer and the phone line.

→ A modem is a hardware device that allows a computer to send and receive information over telephone lines.

- When sending a signal, the device converts ("modulates") digital data to an analog audio signal, and transmits it over a telephone line.

- Similary, when an analog signal is received, the modem converts it back ("demodulates") to a digital signal.
- there serial port is RS232 and out going Phone line is RJ11 cable connector.

- Physical types of modems
  - External modems
  - Internal modems.

Q 4. Explain internet control protocols in detail.