



Computer Networks

Unit : Computer Network

- ❖ **Introduction to Data Communication and Computer Network, Network Topologies, classification of computer network, Parallel & Serial Transmission, Transmission Models, Transmission Channel, Data Rate, Bandwidth Signal Encoding Schemes, Data Compression, Transmission Impairments, Layering and Design Issues, OSI Model and TCP/ IP model.**

Unit : Computer Network

- ❖ **Data Link Layer: Need for Data Link Control, Frame Design Consideration, Flow Control & Error Control. MAC sublayer, contention based and polling based MAC protocols.**
- ❖ **Network Layer: Routing, Congestion control, Internetworking principles, Internet Protocols (IPv4, packet format, Hierarchical addressing sub netting, ARP, PPP), Bridges, Routers. Classless IP address.**

Unit : Computer Network

- ❖ **Datalink Layer: Process to process communication. Socket meaning and socket address. Upward and downwards multiplexing. UDP and TPDU.**
- ❖ **Application Layer: HTTP, FTP, Telnet, SMTP, SNMP**



EVOLUTION OF NETWORKS

A group of two or more similar things or people interconnected with each other is called network . Some of the examples of network in our everyday life include:

- **Social network**
- **Mobile network**
- **Network of computers**
- **Airlines, railway, banks, hospitals networks.**





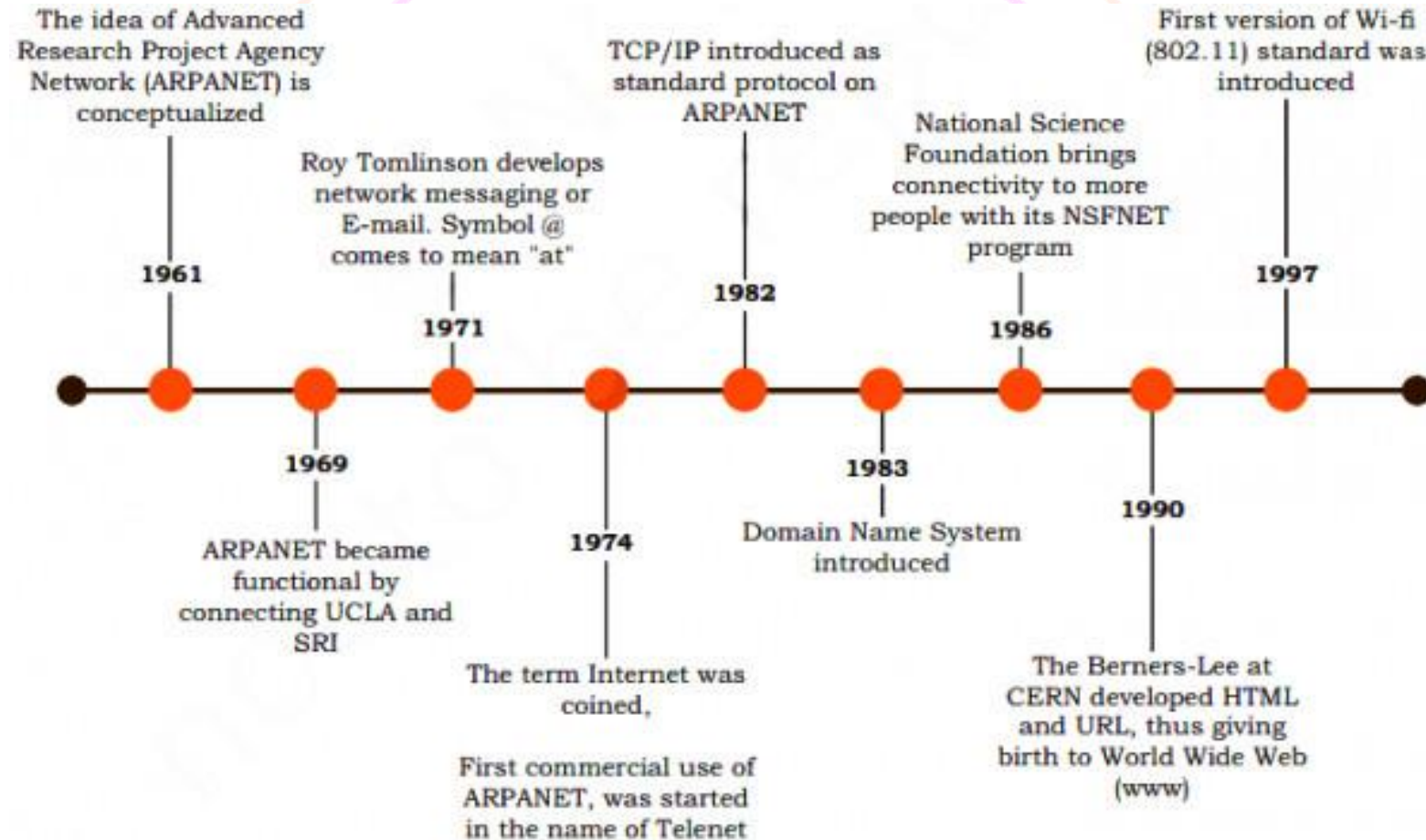
EVOLUTION OF NETWORKS

- A computer network is an interconnection among two or more computers or computing devices.
- Such interconnection allows computers to share data and resources among each other.
- A basic network may connect a few computers placed in a room.
- The network size may vary from small to large depending on the number of computers it connects.
- A computer network can include different types of hosts (also called nodes) like server, desktop, laptop, cellular phones.





EVOLUTION OF NETWORKS





ARPANET (ADVANCED RESEARCH PROJECTS AGENCY NETWORK)

- **ARPANET was the network that became the basis for the Internet.**
- **It was the first network that came into existence in 1969, which was designed and named by the Advanced Research Projects Agency (ARPA) and the US Department of Defence (DoD).**
- **It was where a bunch of PCs was associated at various colleges and US DoD for sharing information and messages and playing long separation diversions and associating with individuals to share their perspectives.**





ARPANET (ADVANCED RESEARCH PROJECTS AGENCY NETWORK)

- The first message was communicated between the University of California, Los Angeles (UCLA) and Stanford Research Institute (SRI).
- Slowly but gradually, more and more organisations joined the ARPANET, and many independent smaller networks were formed.





NSFNET (NATIONAL SCIENCE FEDERATION NETWORK)

- In the mid-'80s another federal agency, NSFNET (National Science Federation Network) created a new network that was more capable than ARPANET and became the first backbone infrastructure for the commercial public Internet.
- Its main aim was to use networks only for academic research and not for any kind of private business activity. Later, many privately owned businesses with their very own private systems joined with ARPANET and NSFNET to make a more capable and wide network, the Internet.





INTERNET

- **The Internet, which is a network of networks, came into existence.**
- **The internet has evolved from ARPANET. The internet is a globally connected network system that utilizes TCP/IP to transmit information.**
- **It allows computers of different types to exchange information and is known as the internet.**





INTERNET

➤ The Internet is the financial communications method on the planet, in which the following services are instantly available:

1. Email
2. Web-enabled audio/video conferencing services
3. Online movies and gaming
4. Data transfer/file-sharing, often through File Transfer Protocol (FTP)
5. Instant messaging
6. Social networking
7. Online shopping
8. Financial services





EVOLUTION OF NETWORKS

1969 ARPANET

First network that came into existence
Network that became the basis for the Internet

1990 INTERNET

The inter-networking of ARPANET, NSFNET and other private networks.

1980 NSFNET

Network which was more capable than ARPANET
Main aim was to use network only for academic research





INTRANET

- **An intranet is a private network contained within an enterprise that is used to securely share company information and computing resources among employees.**
- **An intranet can also be used for working in groups and teleconferences.**





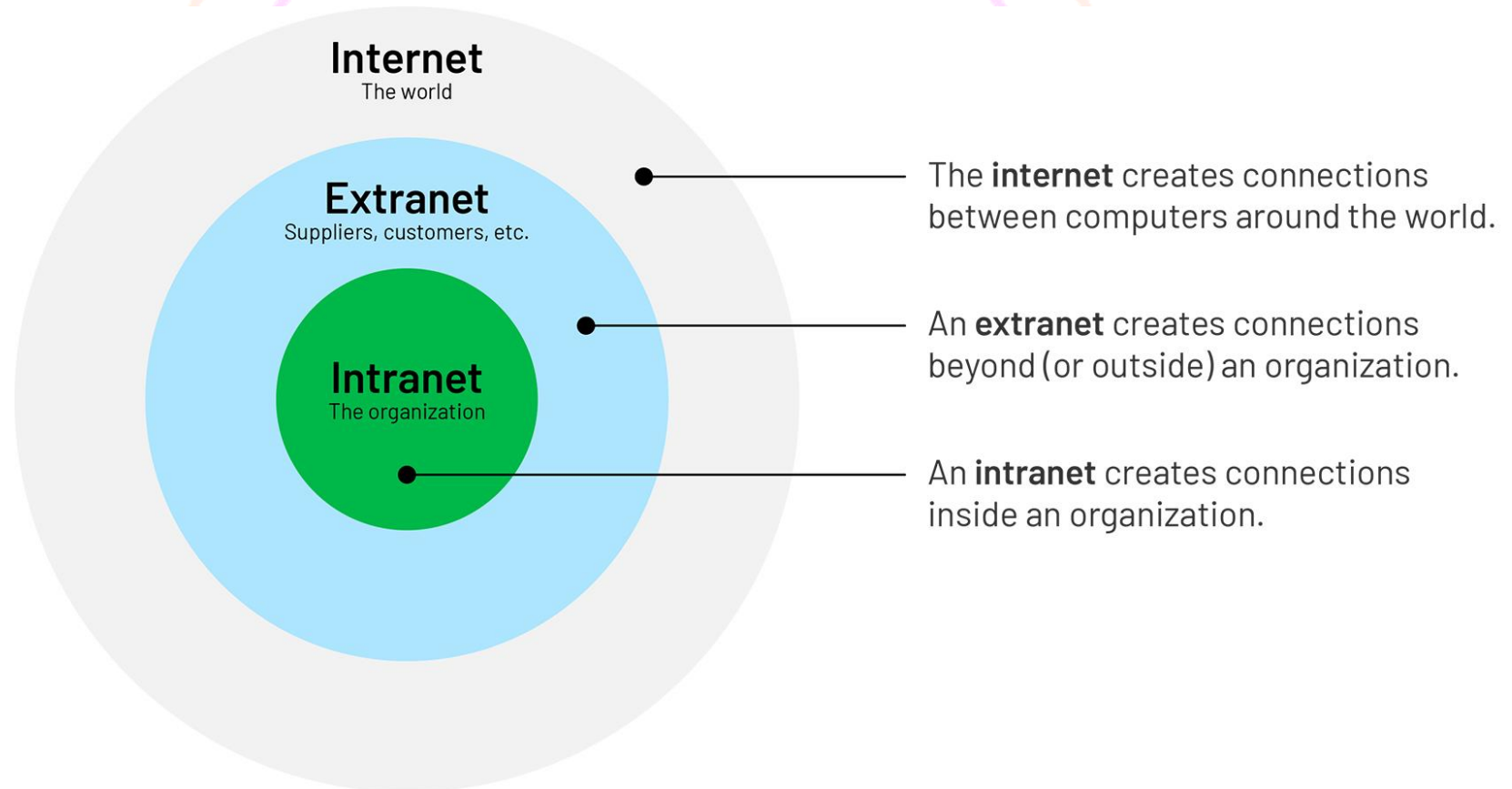
EXTRANET

- An extranet is an intranet that grants access to those outside of an organization to certain information and applications.
- Third parties such as customers, vendors and partners are given access to certain parts of the organization's intranet.





INTERNET, INTRANET & EXTRANET





TYPES OF AREA NETWORKS



TEACHERS ADDA BY TARGET ABHI

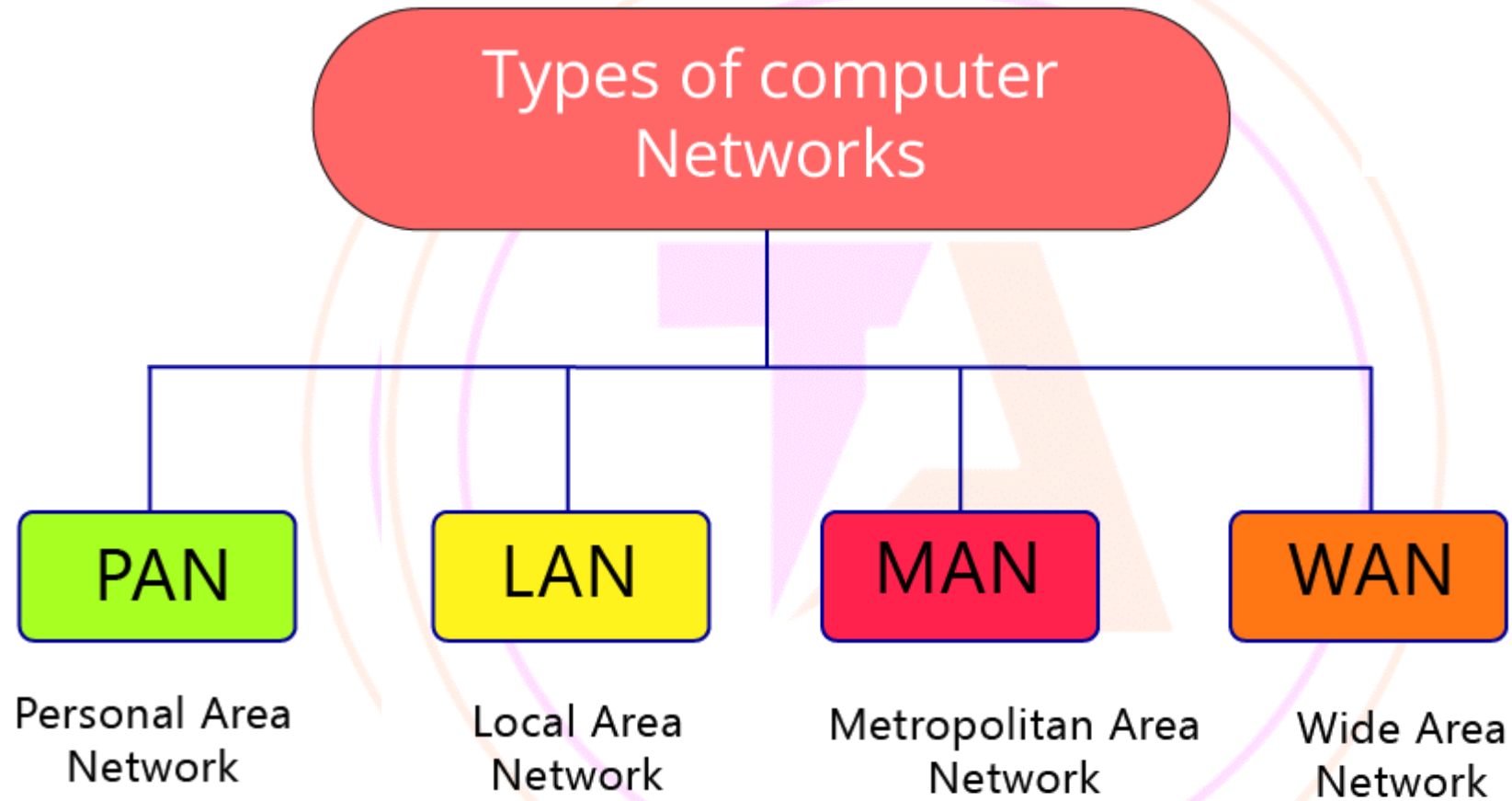
7877719287



TYPES OF AREA NETWORKS

- **The Network allows computers to connect and communicate with different computers via any medium.**
- **LAN, MAN, and WAN are the three major types of networks designed to operate over the area they cover.**



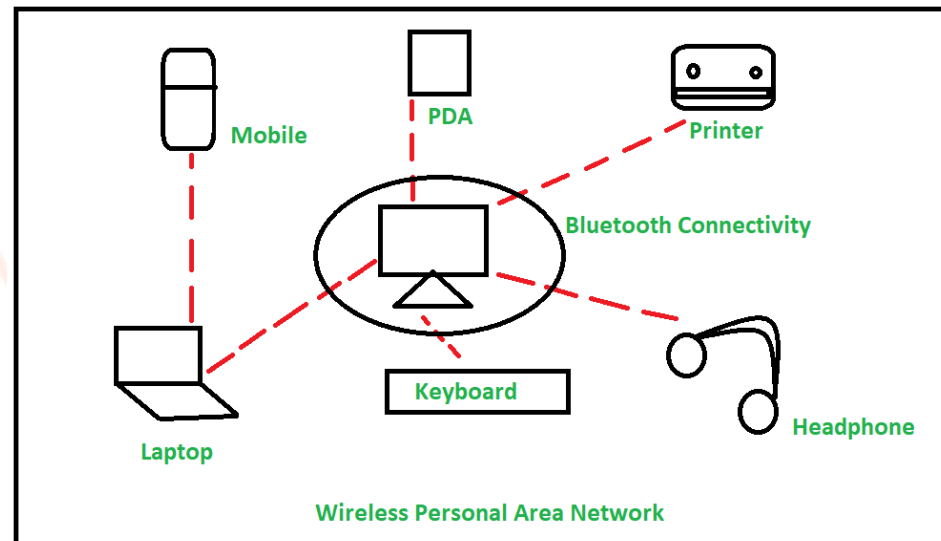




PERSONAL AREA NETWORK (PAN)-



- PAN is a personal area network having an interconnection of personal technology devices to communicate over a short distance. It covers only less than 10 meters or 33 feet of area.





LOCAL AREA NETWORK (LAN) –

- **LAN or Local Area Network connects network devices in such a way that personal computers and workstations can share data, tools, and programs.**
- **LANs cover a smaller geographical area (Size is limited to a few kilometers) and are privately owned. One can use it for an office building, home, hospital, school, etc. LAN is easy to design and maintain. A Communication medium used for LAN has twisted-pair cables and coaxial cables.**





LOCAL AREA NETWORK (LAN) –

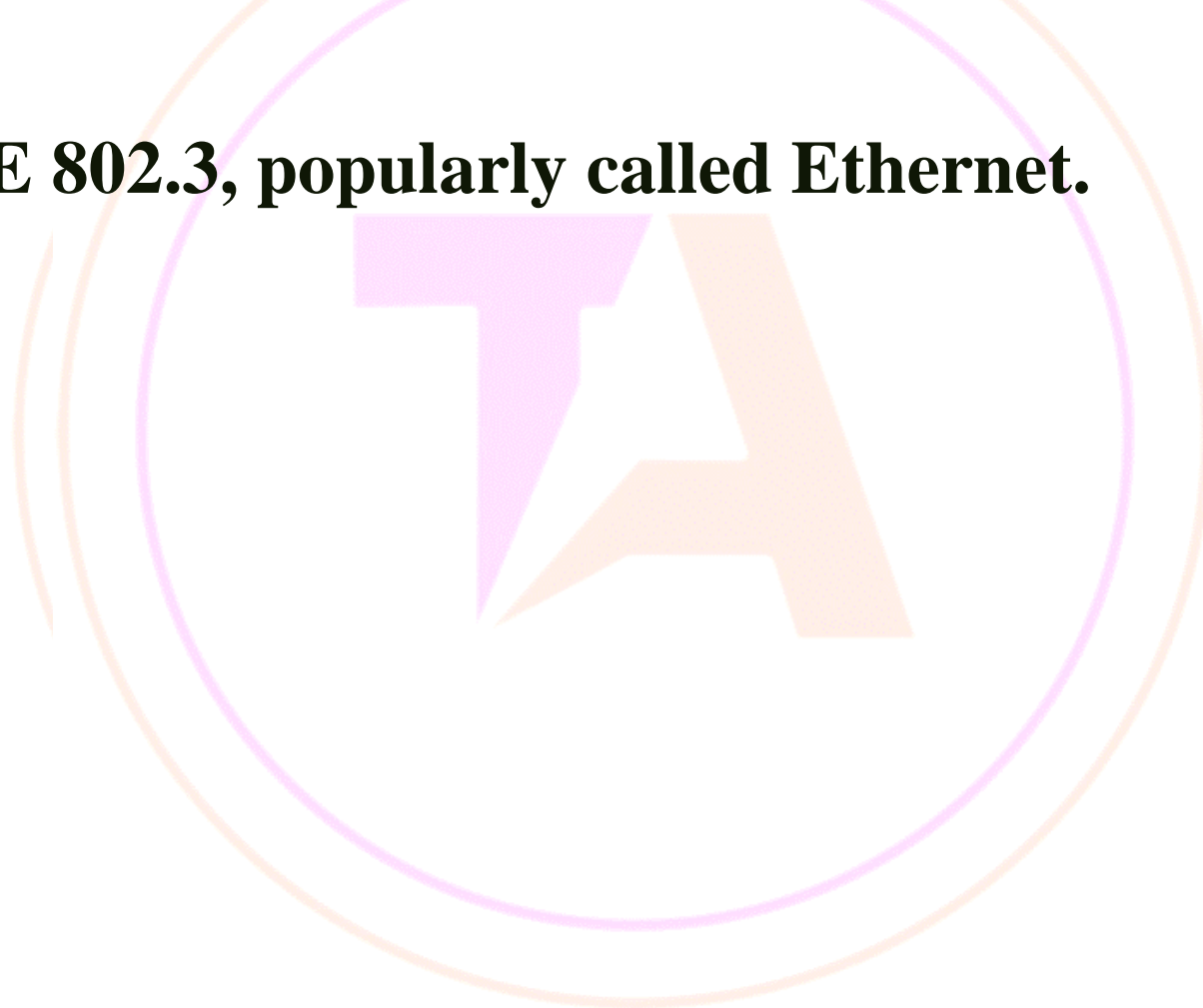
- **Data transfer in LAN is quite high, and usually varies from 10 Mbps (called Ethernet) to 1000 Mbps (called Gigabit Ethernet)**
- **When LANs are used by companies, they are called enterprise networks.**
- **There is a standard for wireless LANs called IEEE 802.11, popularly known as WiFi.**





LOCAL AREA NETWORK (LAN) –

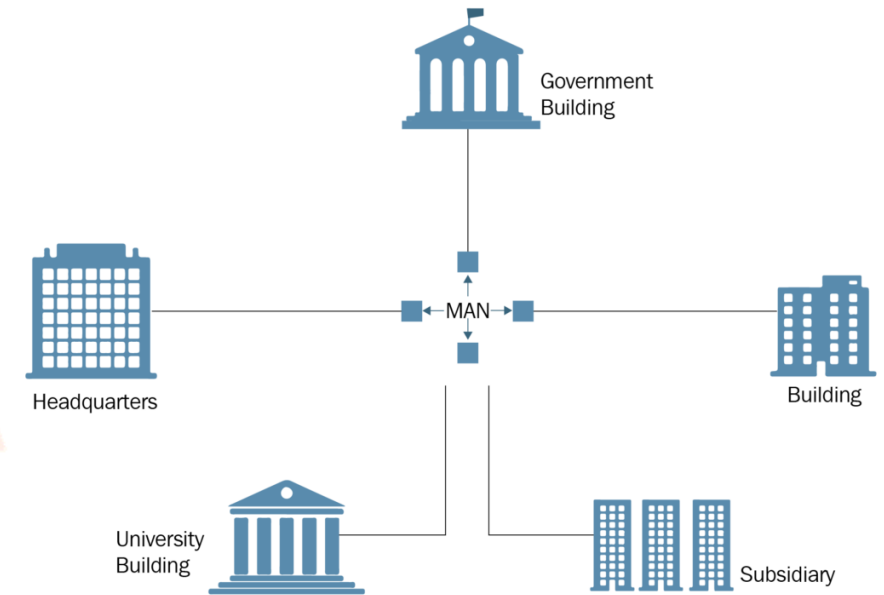
- **IEEE 802.3, popularly called Ethernet.**





METROPOLITAN AREA NETWORK (MAN)

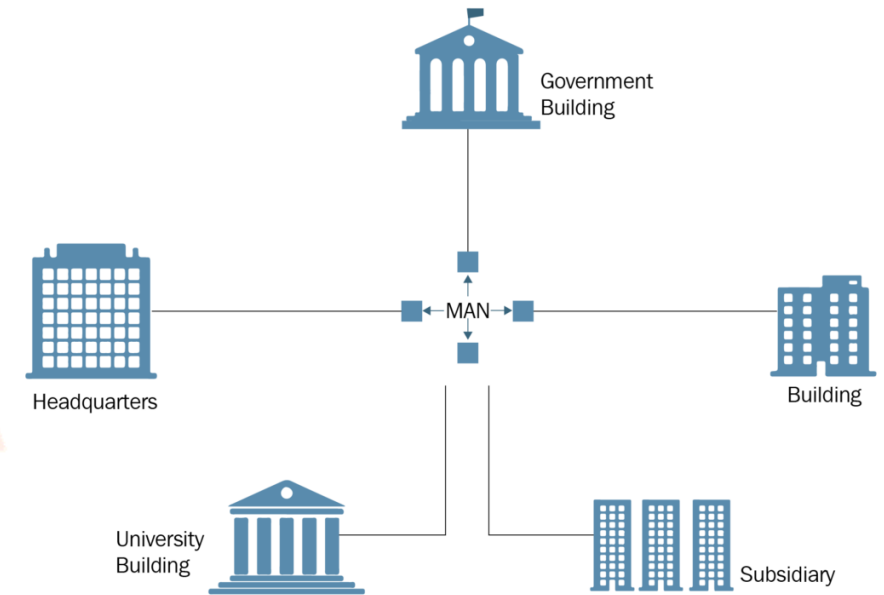
- MAN or Metropolitan area Network covers a larger area than that covered by a LAN and a smaller area as compared to WAN.
- MAN has a range of 5-50km. It connects two or more computers that are apart but reside in the same or different cities.





METROPOLITAN AREA NETWORK (MAN)

- In highspeed wireless Internet access have resulted in another MAN, which has been standardized as IEEE 802.16 and is popularly known as WiMAX.





WIDE AREA NETWORK (WAN)



- WAN or Wide Area Network is a computer network that extends over a large geographical area, although it might be confined within the bounds of a state or country.
- WAN has a range of above 50 km.





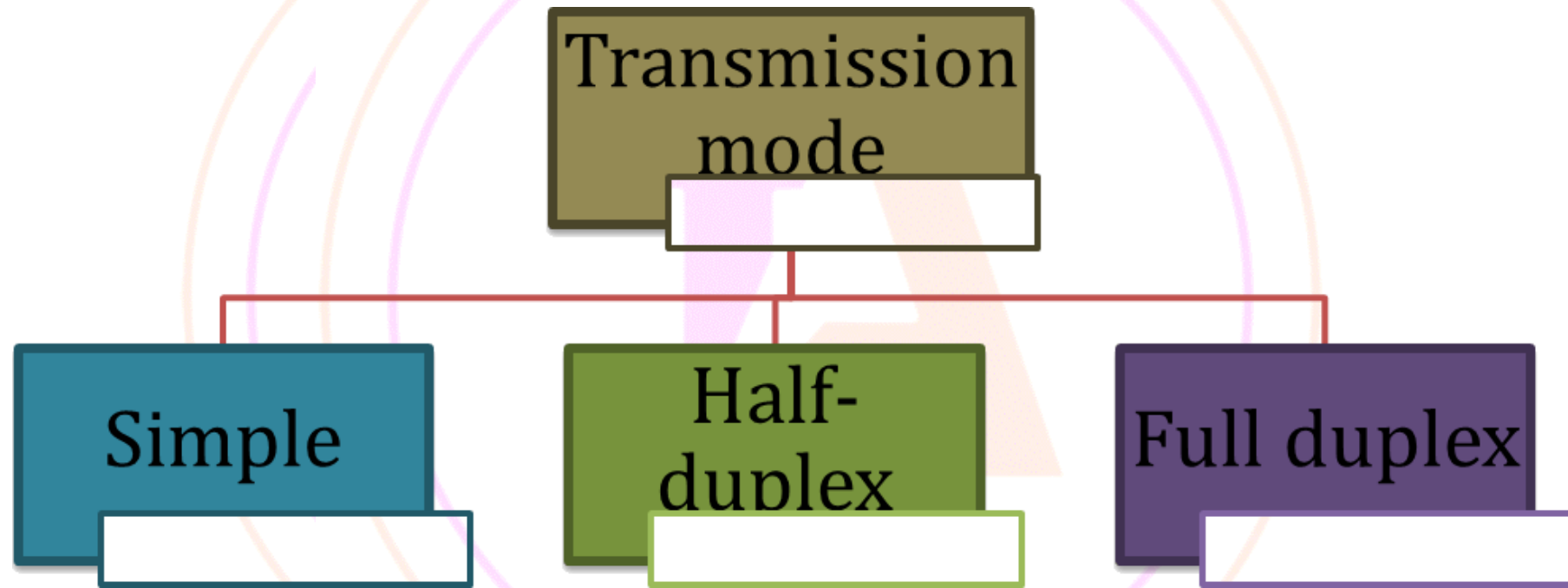
Network → Parameter ↓	PAN	LAN	MAN	WAN
Area Covered	Small Area (Upto 10m radius)	A few meters to a few kilometers (Upto 10Km radius)	A city and its vicinity (Upto 100Km radius)	Entire country, continent, or globe (No upper limit)
Error Rates	Lowest	Lowest	Moderate	Highest
Transmission Speed	High Speed	High Speed	Moderate Speed	Low speed
Networking Cost	Negligible	Inexpensive	moderately expensive equipment	Expensive





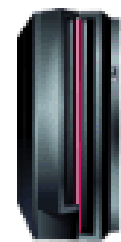
Interprocessor distance	Processors located in same	Example
1 m	Square meter	Personal area network
10 m	Room	Local area network
100 m	Building	
1 km	Campus	
10 km	City	Metropolitan area network
100 km	Country	Wide area network
1000 km	Continent	
10,000 km	Planet	The Internet







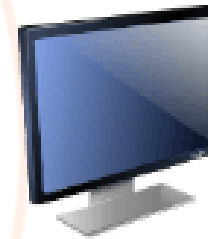
SIMPLEX



Mainframe



Direction of data



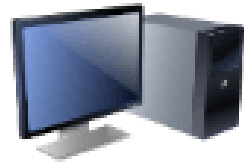
Monitor

SIMPLEX

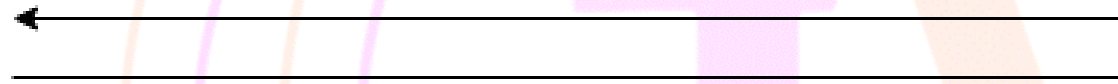




HALF-DUPLEX



workstation



Direction of data at time 1

Direction of data at time 2



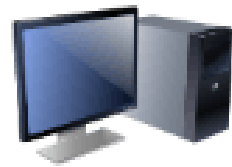
workstation

HALF DUPLEX





FULL-DUPLEX



workstation



Direction of data all the time



workstation

FULL DUPLEX





TRANSMISSION MODE

Simplex mode	Half-duplex mode	Full-duplex mode
The communication is unidirectional.	The communication is bidirectional, but one at a time.	The communication is bidirectional.
A device can only send data but cannot receive it or it can only receive data but cannot send it.	Both the devices can send and receive the data, but one at a time.	Both the devices can send and receive the data simultaneously.
The lowest performance among the mods.	The performance is better than simplex but less than full duplex.	The highest performance among the mods.
Examples are radio, keyboard, and monitor.	Example is Walkie-Talkies.	Example is a telephone or mobile network.





TRANSMISSION TECHNOLOGY

- **Two types of transmission technology that are in widespread use: broadcast links and point-to-point links.**
- **Transmission with exactly one sender and exactly one receiver is sometimes called unicasting.**
- **In a broadcast network, the communication channel is shared by all the machines on the network; packets sent by any machine are received by all the others.**



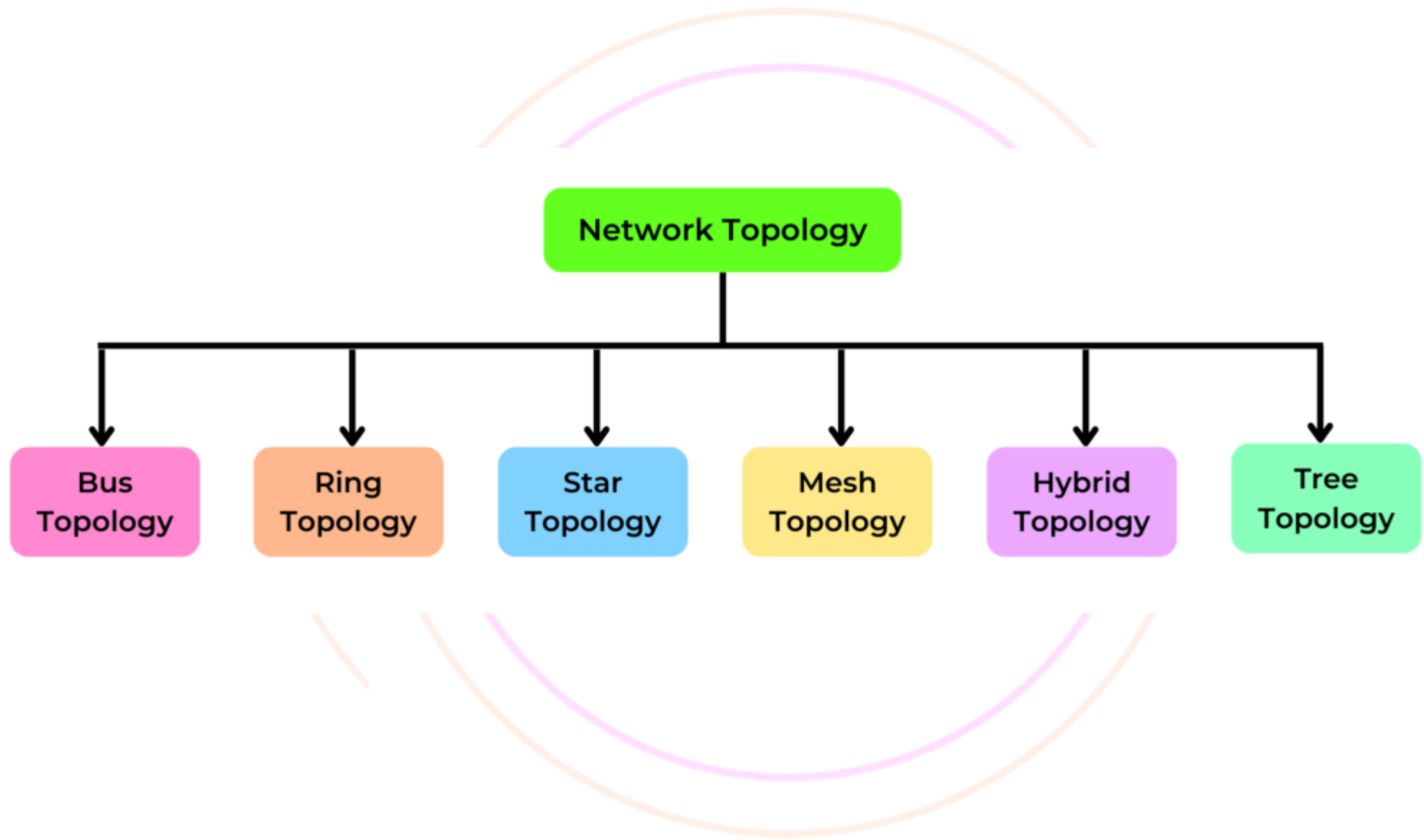


TRANSMISSION TECHNOLOGY



- Some broadcast systems also support transmission to a subset of the machines, which known as multicasting.

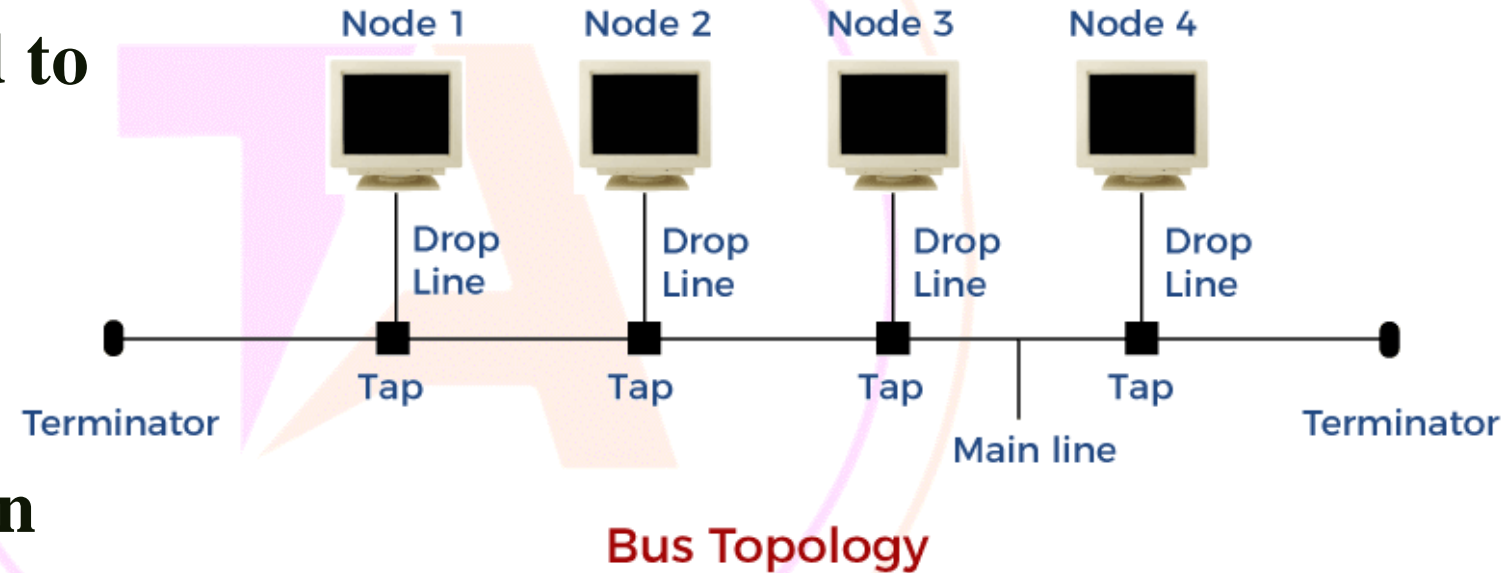






BUS TOPOLOGY

- In which every computer and network device is connected to a single cable.
- It is bi-directional.
- It is a multi-point connection
- Ethernet LAN





BUS TOPOLOGY

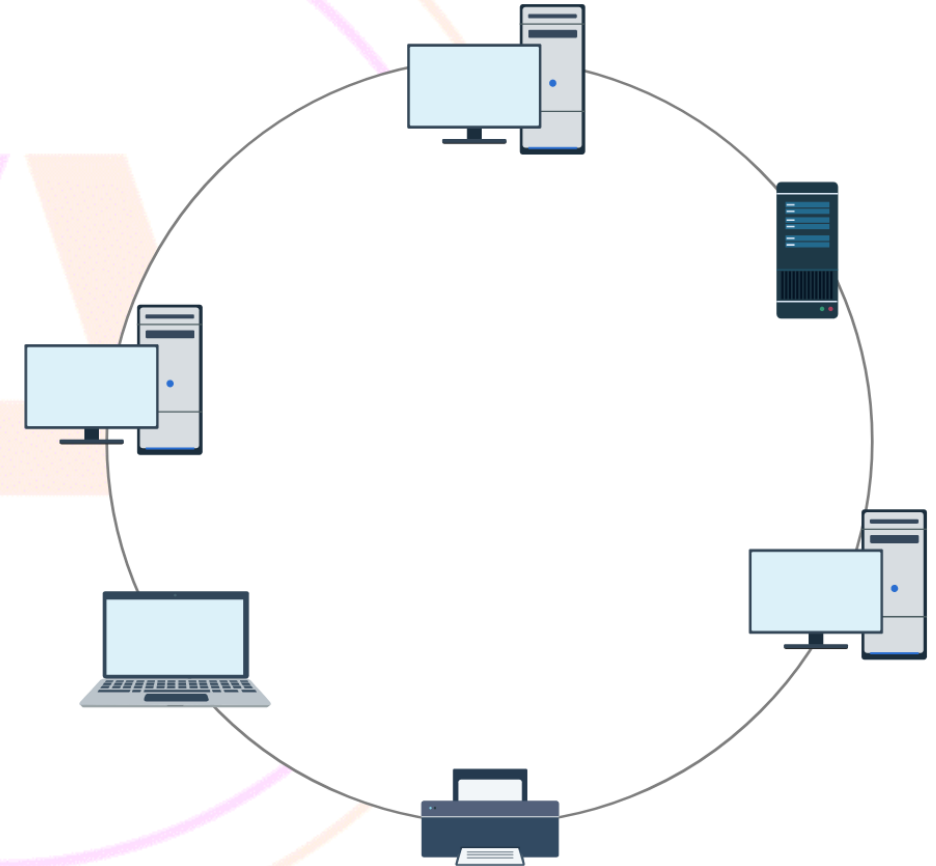
- **In Bus Topology, various MAC (Media Access Control) protocols are followed by LAN ethernet connections like TDMA, Pure Aloha, CDMA, Slotted Aloha, etc.**





RING TOPOLOGY

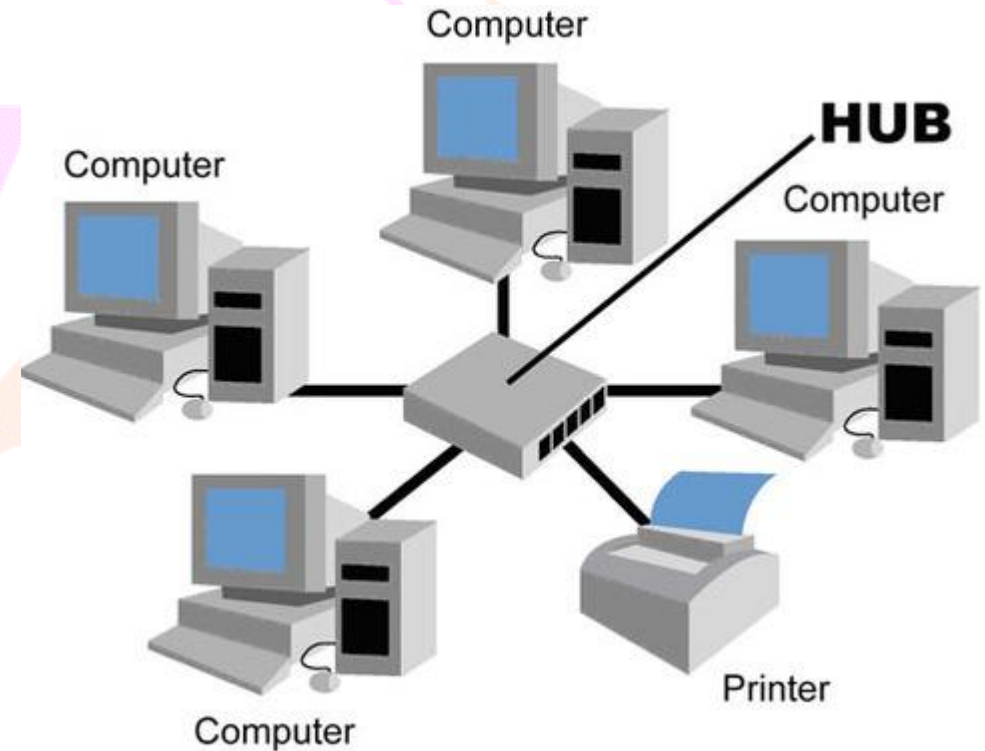
- It forms a ring connecting devices with exactly two neighboring devices.
- The data flows in one direction, i.e. it is unidirectional, but it can be made bidirectional by having 2 connections between each Network Node, it is called Dual Ring Topology.





STAR TOPOLOGY

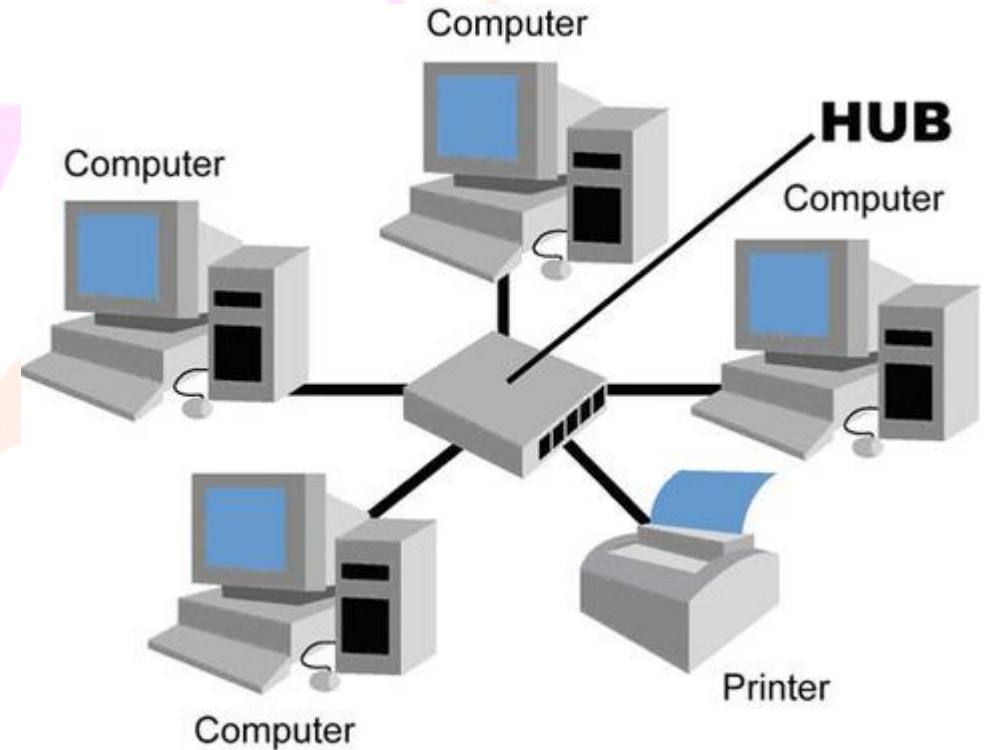
- All the devices are connected to a single hub through a cable.
- This hub is the central node and all other nodes are connected to the central node





STAR TOPOLOGY

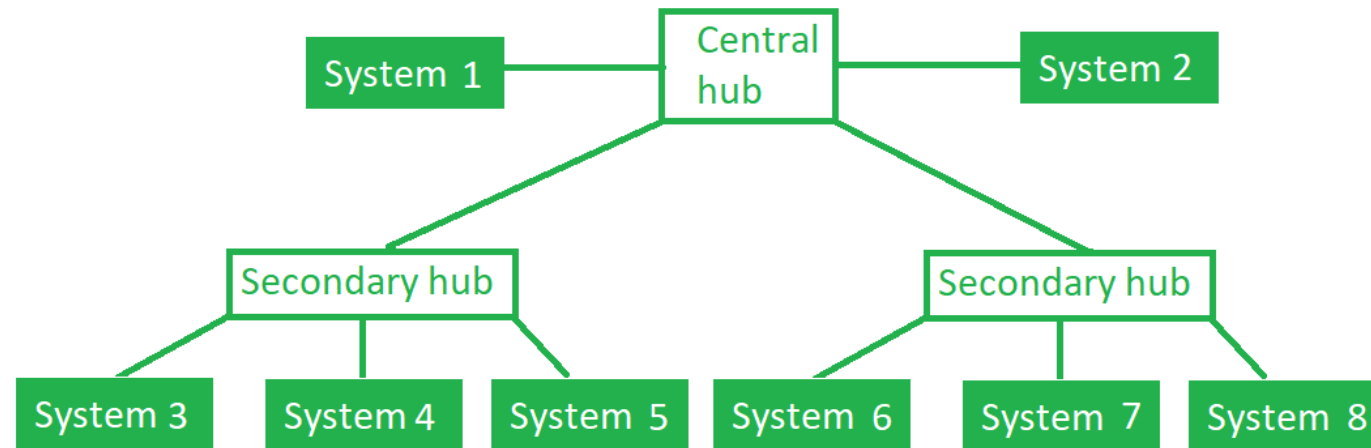
- Coaxial cables or RJ-45 cables are used to connect the computers. In Star Topology, many popular Ethernet LAN protocols are used as CD(Collision Detection), CSMA (Carrier Sense Multiple Access), etc.





TREE TOPOLOGY

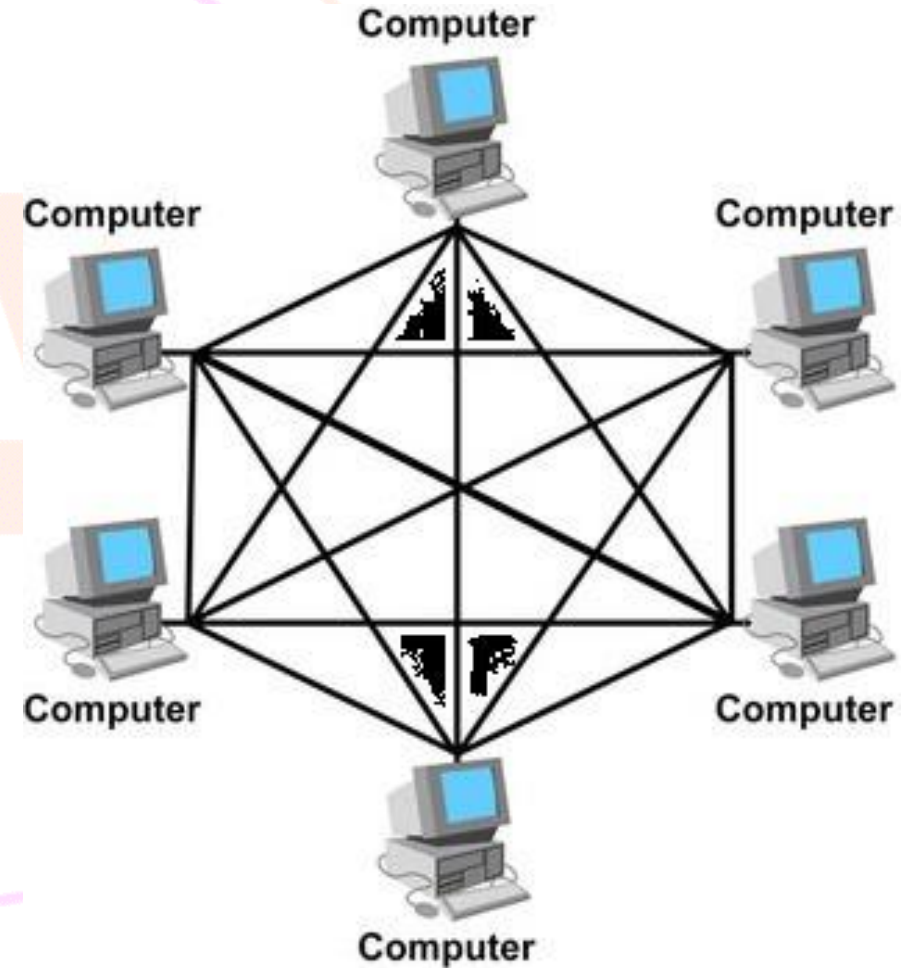
- This topology is the variation of the Star topology.
- This topology has a hierarchical flow of data.





MESH TOPOLOGY

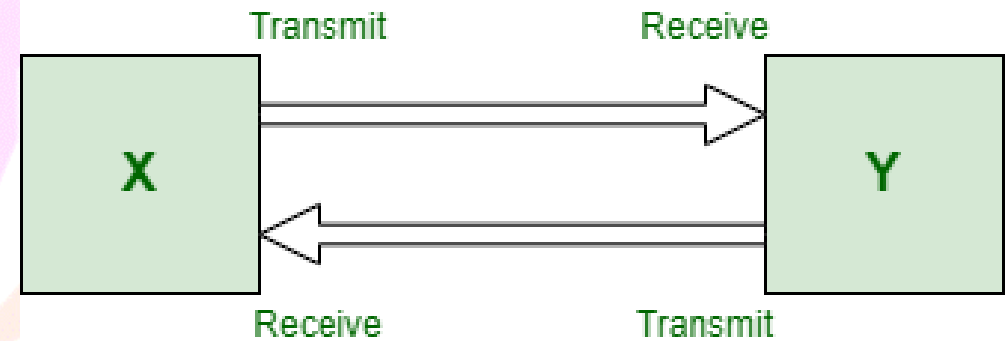
- In a mesh topology, every device is connected to another device via a particular channel.
- the protocols used are AHCPC (Ad Hoc Configuration Protocols), DHCP (Dynamic Host Configuration Protocol), etc.





POINT TO POINT TOPOLOGY

- Point-to-Point Topology is a type of topology that works on the functionality of the sender and receiver.
- It is the simplest communication between two nodes, in which one is the sender and the other one is the receiver. Point-to-Point provides high bandwidth.

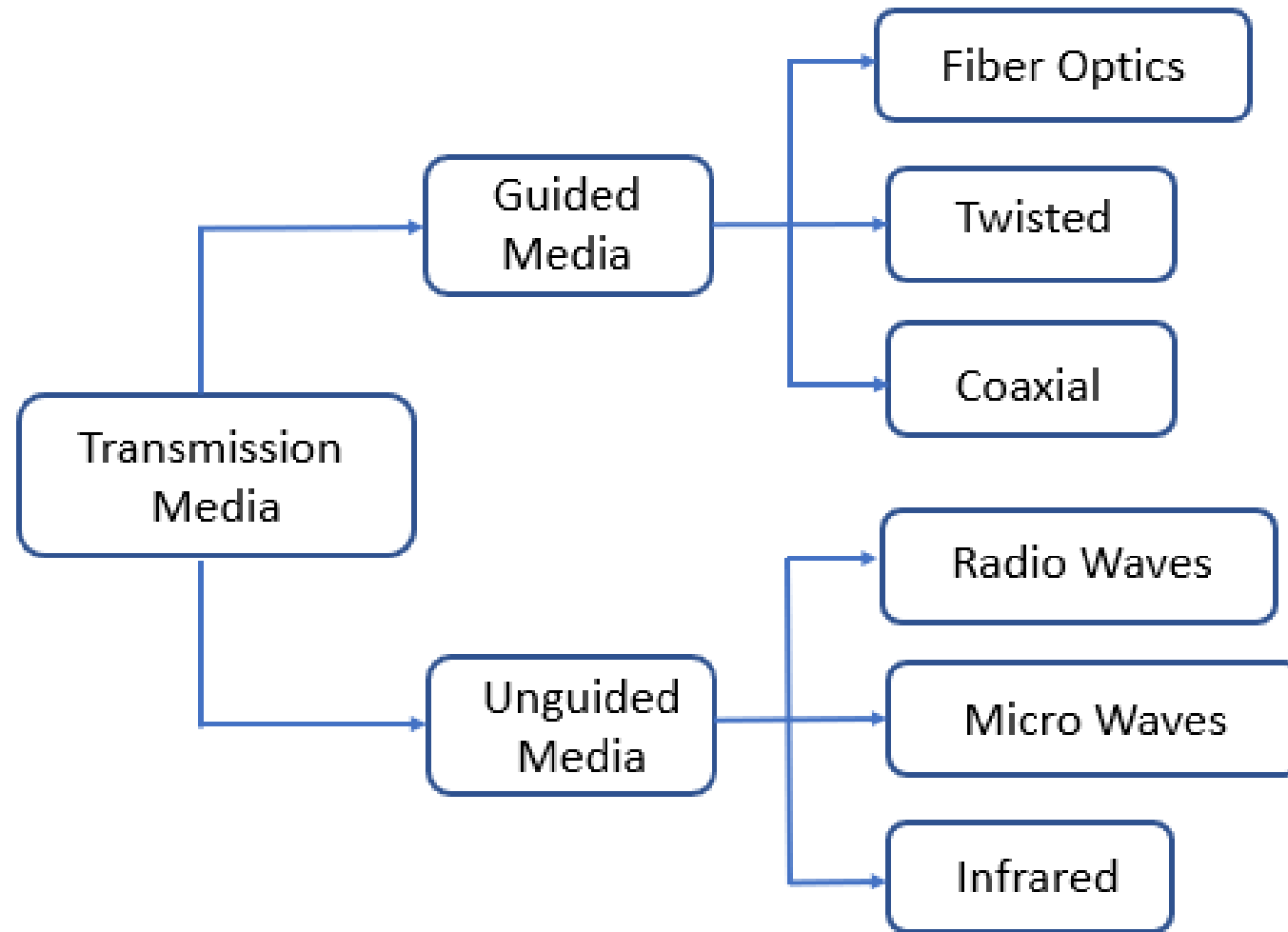




TRANSMISSION MEDIA

- A transmission medium is a physical path between the transmitter and the receiver i.e. it is the channel through which data is sent from one place to another.







(I) TWISTED PAIR CABLE –

- It consists of 2 separately insulated conductor wires wound about each other.
- Generally, several such pairs are bundled together in a protective sheath.
- The frequency range for twisted pair cable is from 0 to 3.5KHz.



Shielded Twisted Pair Cable



Unshielded Twisted Pair Cable





UNSHIELDED TWISTED PAIR:

- An unshielded twisted pair is widely used in telecommunication. Following are the categories of the unshielded twisted pair cable:
1. **Category 1:** Category 1 is used for telephone lines that have low-speed data.
 2. **Category 2:** It can support upto 4Mbps.
 3. **Category 3:** It can support upto 16Mbps.
 4. **Category 4:** It can support upto 20Mbps. Therefore, it can be used for long-distance communication.
 5. **Category 5:** It can support upto 200Mbps.





(I) TWISTED PAIR CABLE –

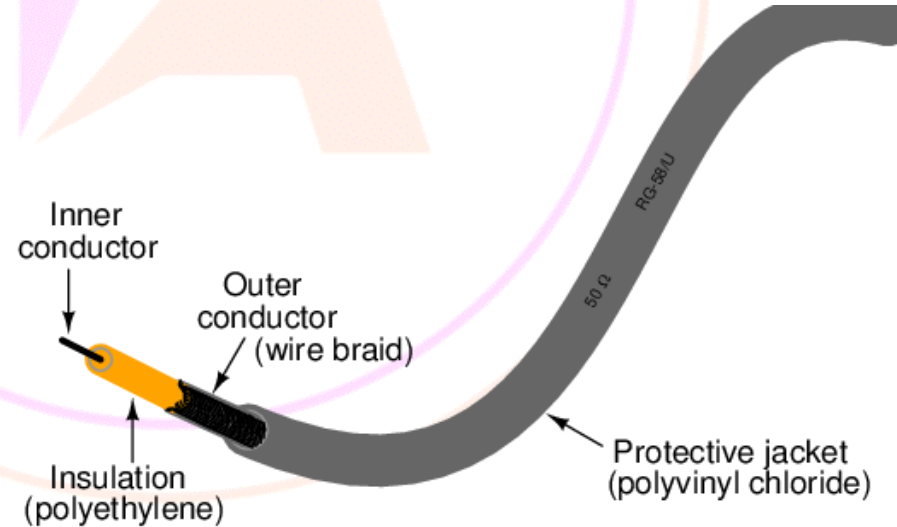
- **The most common application of the twisted pair is the telephone system.**
- **Nearly all telephones are connected to the telephone company (telco) office by a twisted pair. Both telephone calls and ADSL Internet access run over these lines.**





(II) COAXIAL CABLE –

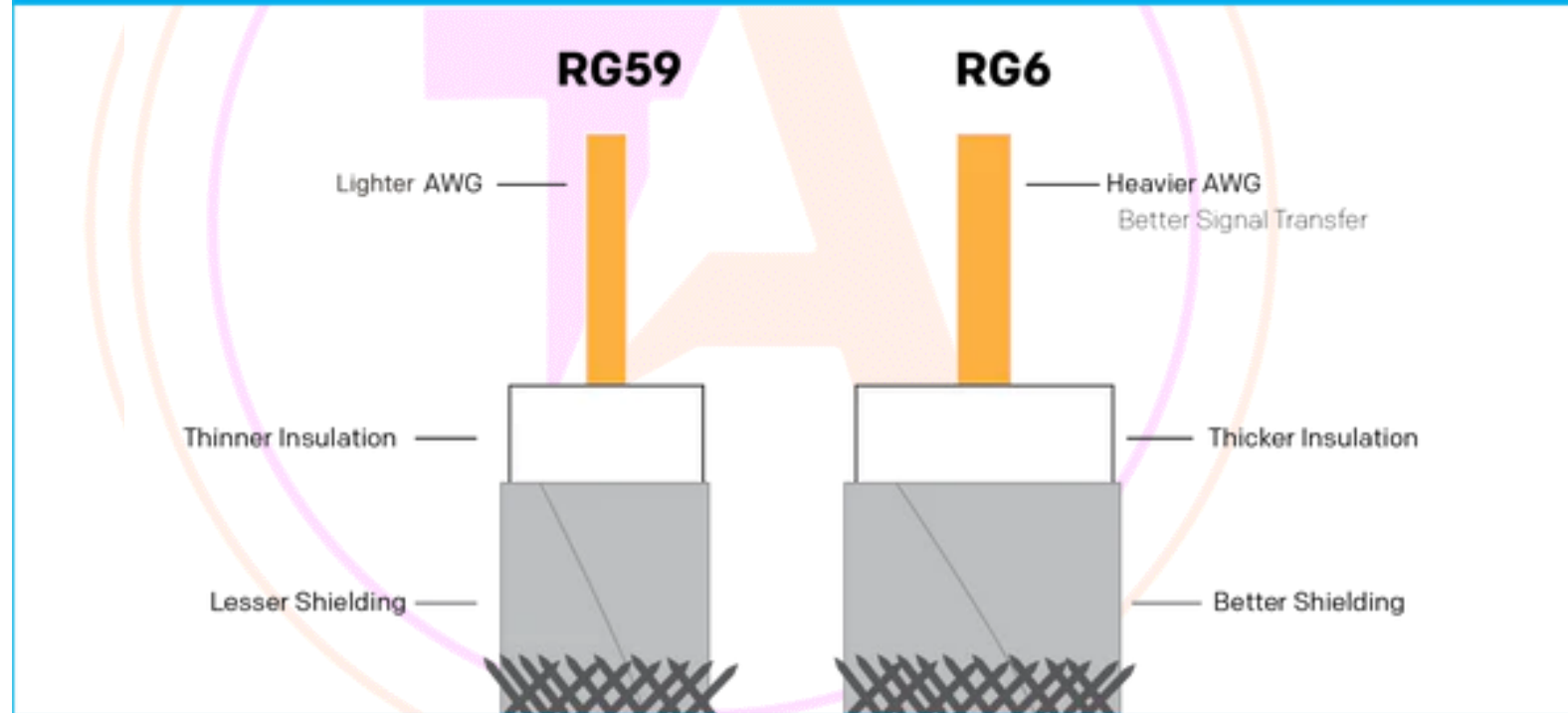
- It has an outer plastic covering containing an insulation layer made of PVC or Teflon and 2 parallel conductors each having a separate insulated protection cover.
- Cable TVs and analog television networks widely use Coaxial cables.





(II) COAXIAL CABLE –

Physical Differences





(II) COAXIAL CABLE –

- **Coaxial cable is of two types:**
- **Baseband transmission:** It is defined as the process of transmitting a single signal at high speed.
- **Broadband transmission:** It is defined as the process of transmitting multiple signals simultaneously.





(II) COAXIAL CABLE –

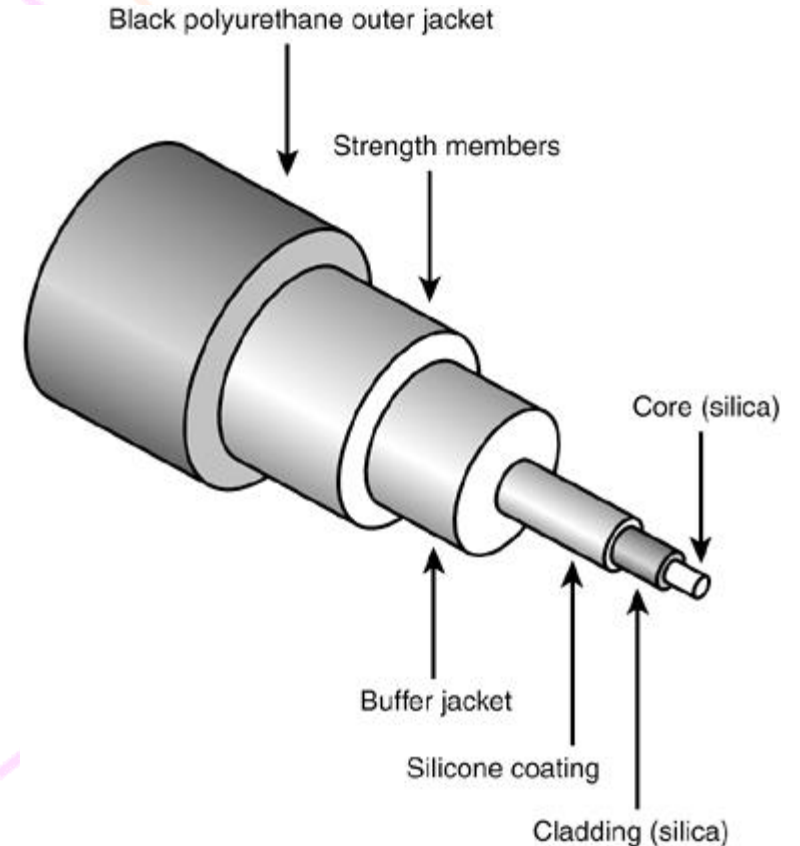
- **Two kinds of coaxial cable are widely used. One kind, 50-ohm cable, is commonly used when it is intended for digital transmission from the start.**
- **The other kind, 75-ohm cable, is commonly used for analog transmission and cable television.**





(III) OPTICAL FIBER CABLE –

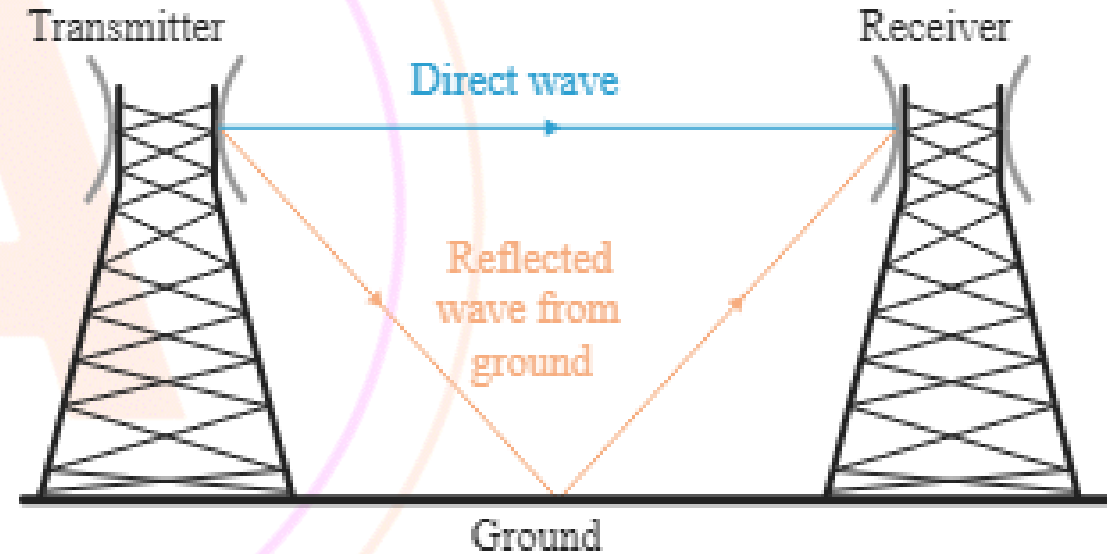
- It uses the concept of refraction of light through a core made up of glass or plastic.
- The core is surrounded by a less dense glass or plastic covering called the cladding. It is used for the transmission of large volumes of data.





(I) RADIO WAVES –

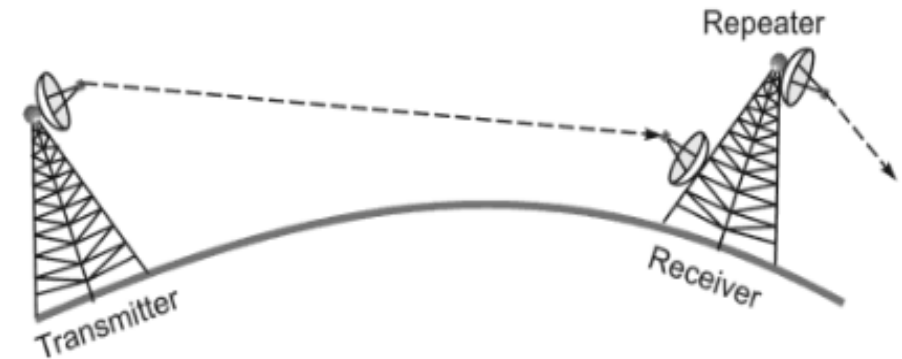
- These are easy to generate and can penetrate through buildings.
- The sending and receiving antennas need not be aligned.
- Frequency Range: 3KHz – 1GHz.
- AM and FM radios and cordless phones use Radio waves for transmission





(II) MICROWAVES –

- It is a line of sight transmission i.e. the sending and receiving antennas need to be properly aligned with each other.
- The distance covered by the signal is directly proportional to the height of the antenna.
- Frequency Range: 1GHz – 300GHz. These are majorly used for mobile phone communication and television distribution.





(III) INFRARED –

- Infrared waves are used for very short distance communication.
- They cannot penetrate through obstacles. This prevents interference between systems.
- Frequency Range: 300GHz – 400THz. It is used in TV remotes, wireless mouse, keyboard, printer, etc.



Television



Infrared Radiations

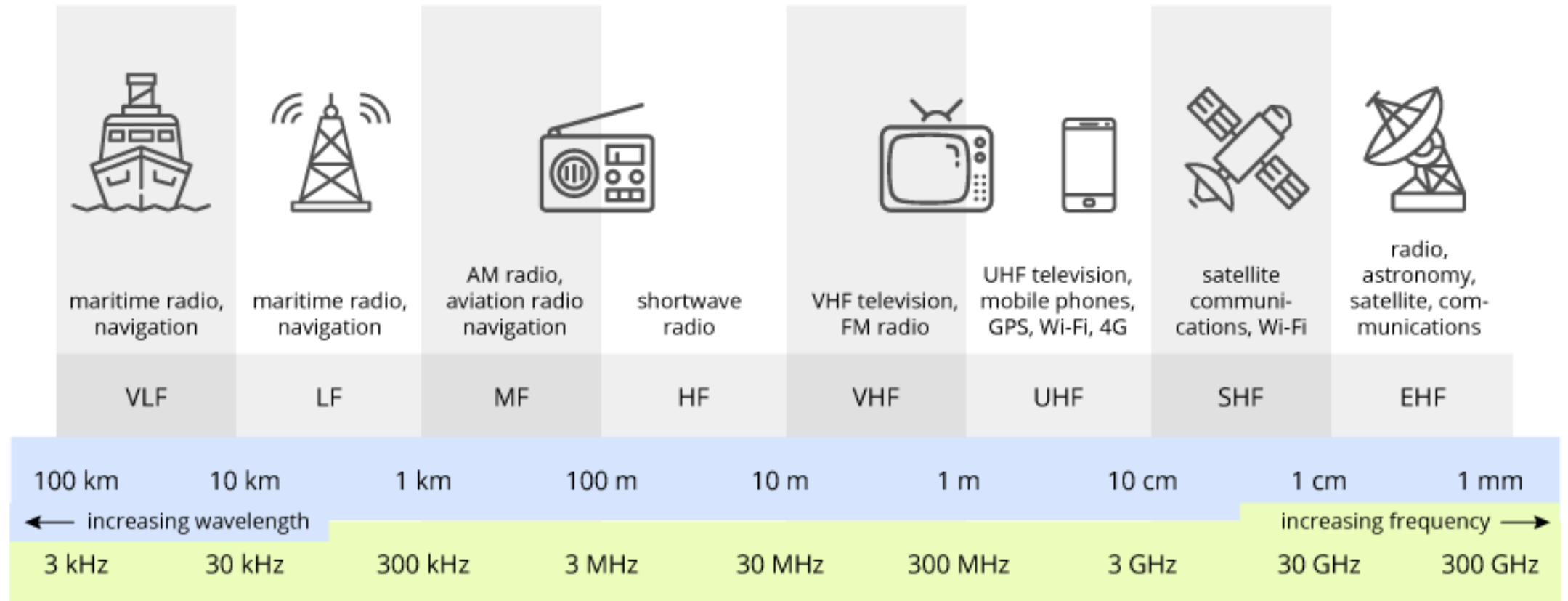


Remote



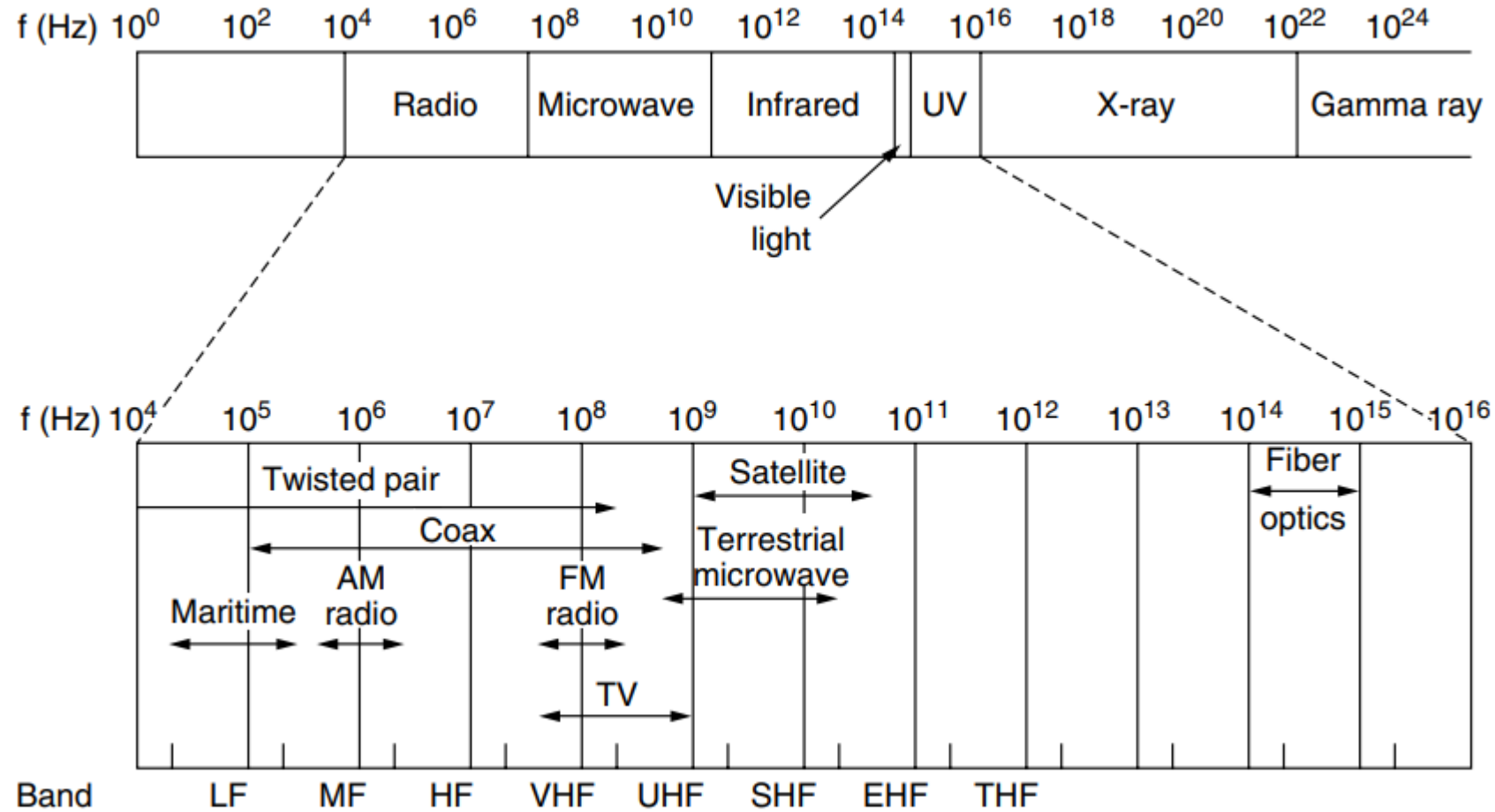


RADIO FREQUENCY BANDS





RADIO FREQUENCY BANDS





NETWORK DEVICES



TEACHERS ADDA BY **TARGET ABHI**

7877719287



NETWORK DEVICES

- Network devices, also known as networking hardware, are physical devices that allow hardware on a computer network to communicate and interact with one another.
- For example Repeater, Hub, Bridge, Switch, Routers, Gateway and NIC, etc

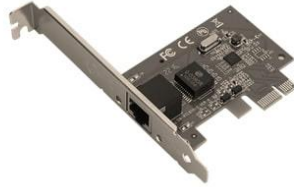




NETWORK DEVICES



Modem



NIC



Repeater



Hub



Switch



Router



Bridge



Gateway

Types of Network Devices

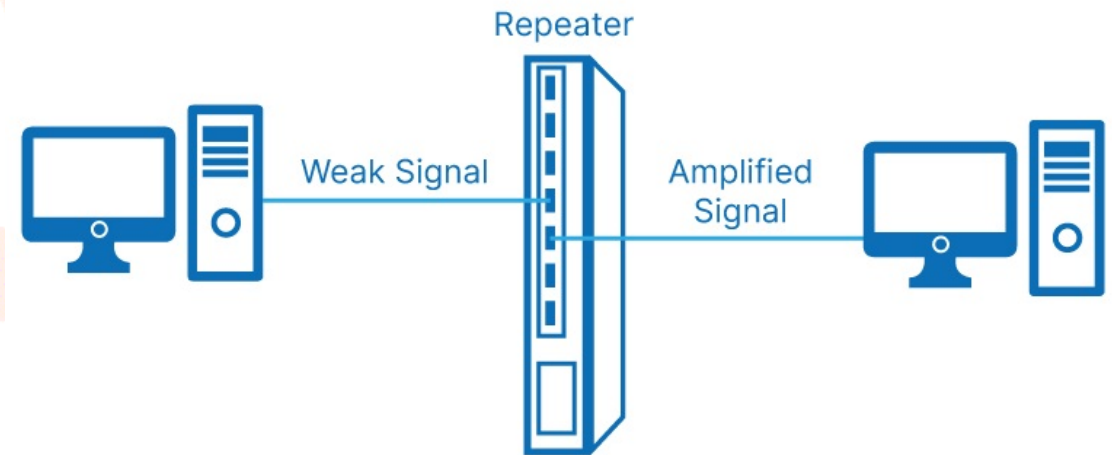




REPEATER



- A repeater operates at the physical layer.
- Its job is to regenerate the signal over the same network before the signal becomes too weak or corrupted to extend the length to which the signal can be transmitted over the same network.

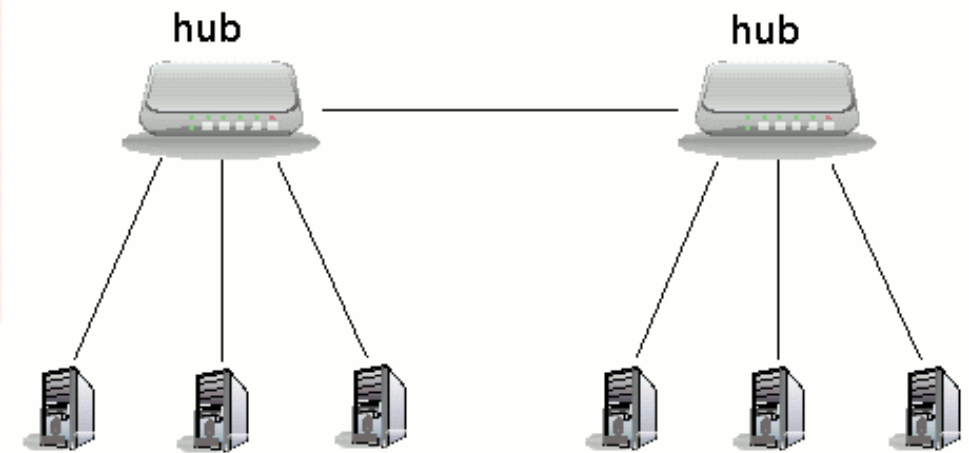




HUB



- A network hub is a node that broadcasts data to every computer or Ethernet-based device connected to it.
- They are generally used to connect computers in a LAN.

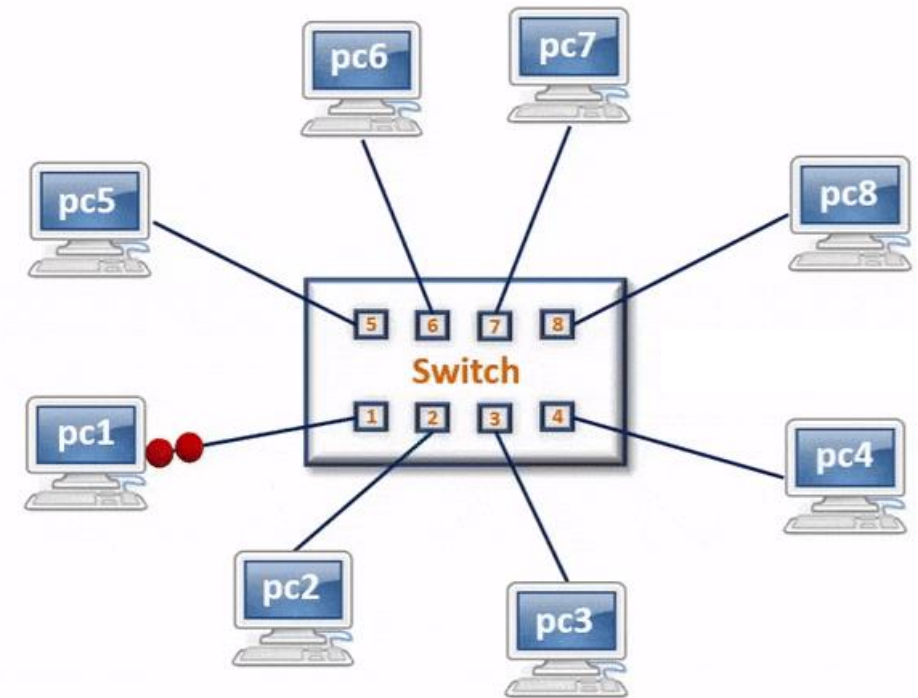




SWITCHES



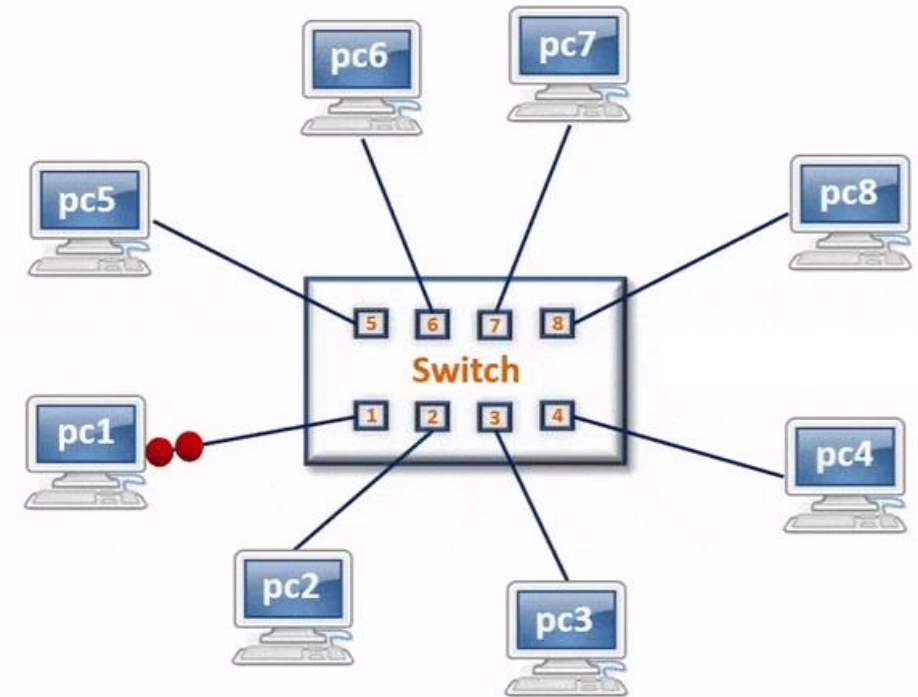
- A switch is a data link layer networking device which connects devices in a network and uses packet switching to send and receive data over the network.
- Like a hub, a switch also has many ports, to which computers are plugged in.





SWITCHES

- However, when a data frame arrives at any port of a network switch, it examines the destination address and sends the frame to the corresponding device(s).
- Thus, it supports both unicast and multicast communications





BRIDGE

- 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 the source and destination.
- It is also used for interconnecting two LANs working on the same protocol.





ROUTERS

- A router is a device like a switch that routes data packets based on their IP addresses.
- The router is mainly a Network Layer device.





ROUTERS

- A Router is a networking device that forwards data packets between computer networks.
- One or more packet-switched networks or subnetworks can be connected using a router.
- By sending data packets to their intended IP addresses, it manages traffic between different networks and permits several devices to share an Internet connection.





ROUTERS

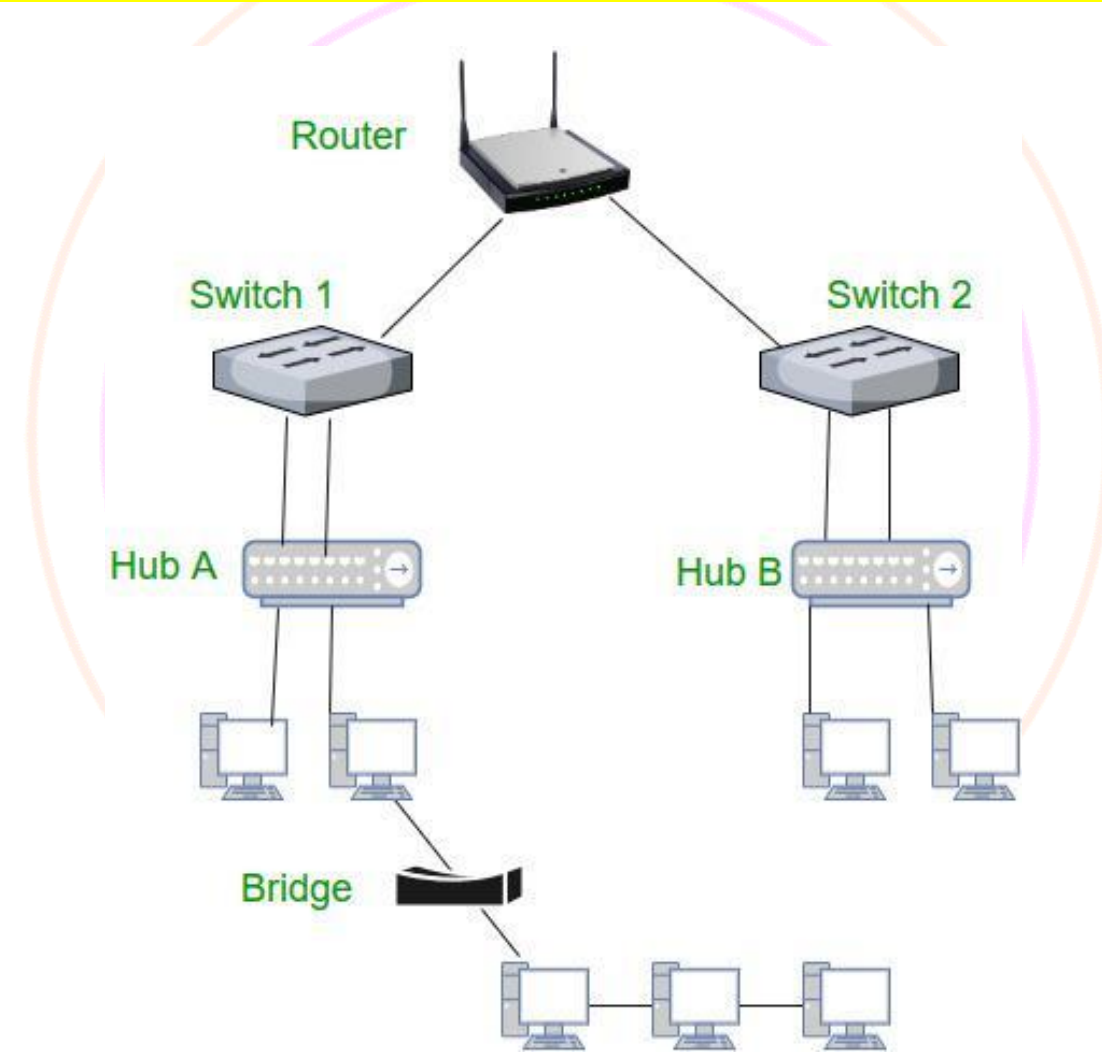
- A router determines a packet's future path by examining the destination IP address of the header and comparing it to the routing database.
- The list of routing tables outlines how to send the data to a specific network location. They use a set of rules to determine the most effective way to transmit the data to the specified IP address.



Router	Switch
Router is used to connect multiple networks	Switch is used to connect multiple devices in a network
Router maintain Routing table	Switch maintain MAC address table for decision making
It supports Network Address Translation(NAT)	It does not support NAT
Routers works at Network Layer	Switch works at Data Link Layer
Routers are more expensive then Switches	Switches are less expensive then Routers.



ROUTERS





GATEWAY

- A gateway, as the name suggests, is a passage to connect two networks that may work upon different networking models.
- Gateways are also called protocol converters and can operate at any network layer.

