

Unit 5

Data Communication and Computer Network

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Introduction to Communication System

- A communication system is a set of processes, technologies, and channels that allow individuals or groups to exchange information.
- The basic components / elements of a communication system include a sender, a message, a channel, a receiver, and feedback.
- Communication systems can be analog or digital and can be used for various purposes such as interpersonal communication, mass communication, or machine-to-machine communication.

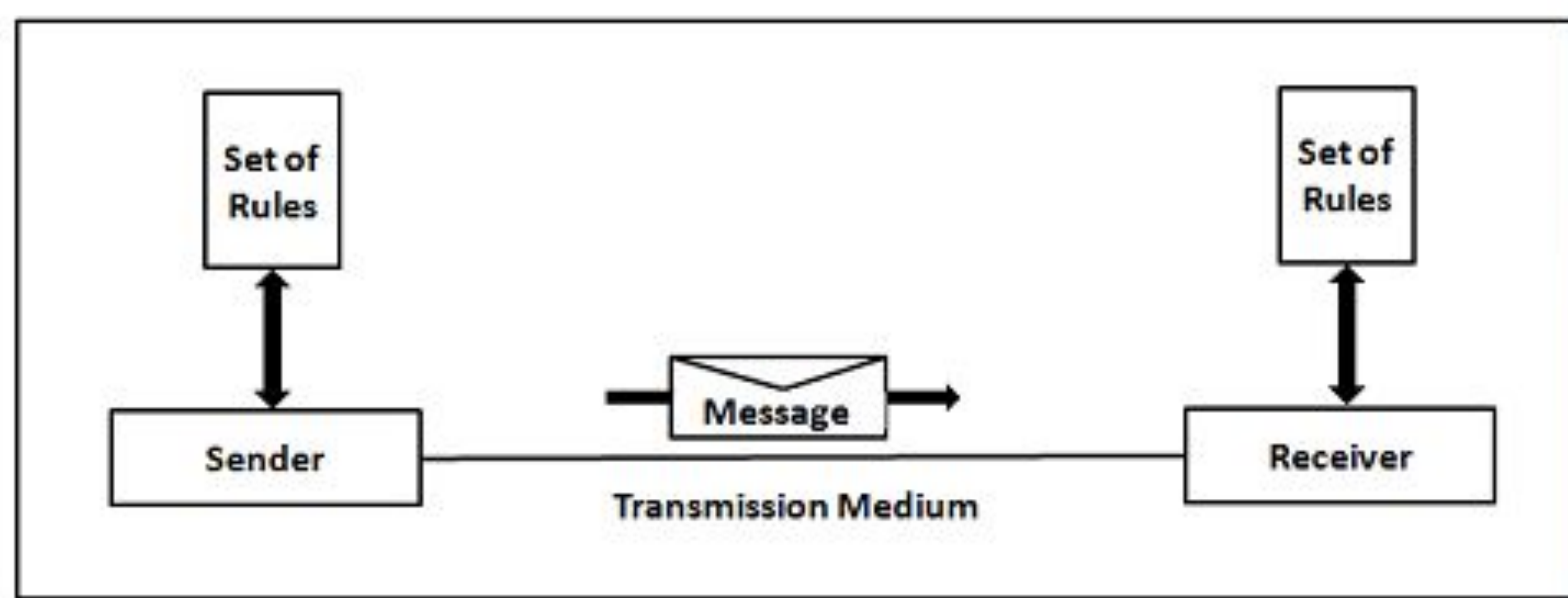
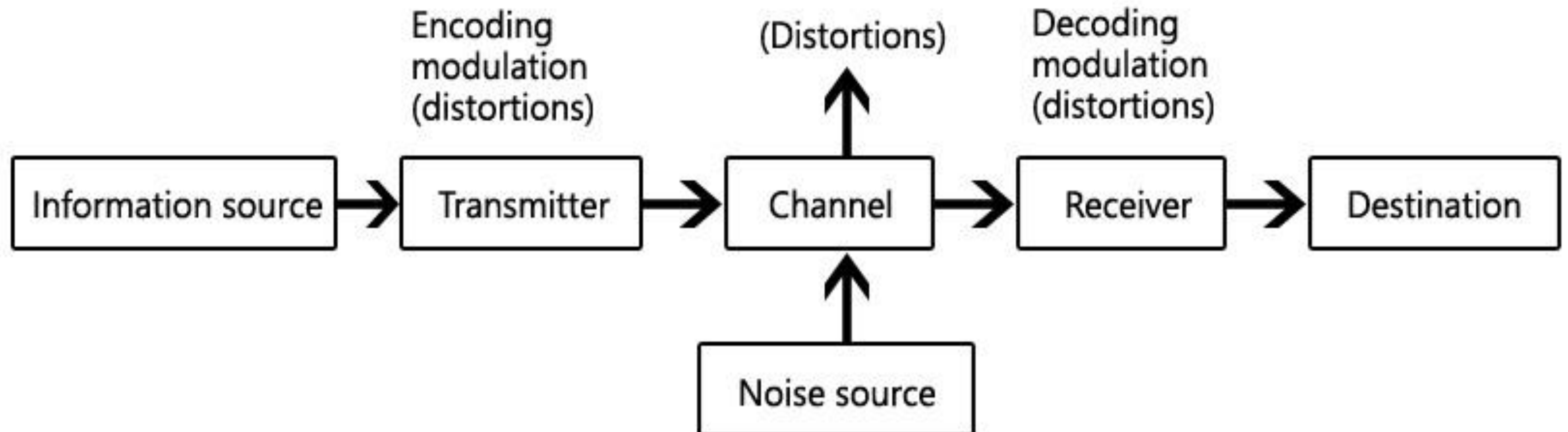


Fig. Components of a Data Communication System

Block diagram of Communication system



Assignment

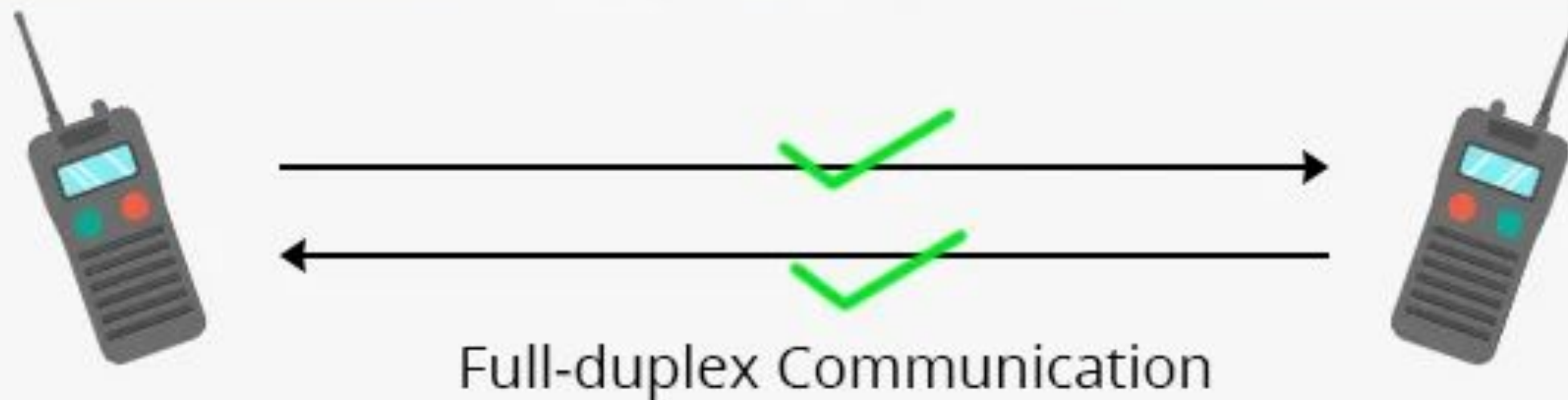
- What are the basic elements of data communication system? Explain with a block diagram.
- Explain the communication system with block diagram.

Mode of Communication

In a network communication system, there are several modes of communication, including:

- **Simplex communication:** This is a one-way communication mode where data is transmitted in only one direction. In simplex mode, sender sends data but receiver cannot acknowledge to the sender. Entire capacity of the channel can be used to send the data/ An example of this is a television broadcast, radio broadcast, keyboard and monitors.
- **Half-duplex communication:** This is a two-way communication mode where data can be transmitted in both directions, but not at the same time. Only one side is active at a time. In this mode, entire communication channel can be used in each direction. It is like a one lane road with two direction traffic. An example of this is a walkie-talkie, fax machines, credit cards verification systems.
- **Full-duplex communication:** This is a two-way communication mode where data can be transmitted in both directions simultaneously. So the communication is bidirectional. In this mode, the capacity of the channel is shared or separate channel is used. It is like a two way street with traffic flowing in both direction at a time. An example of this is a telephone call, mobile communication, satellite communication etc.

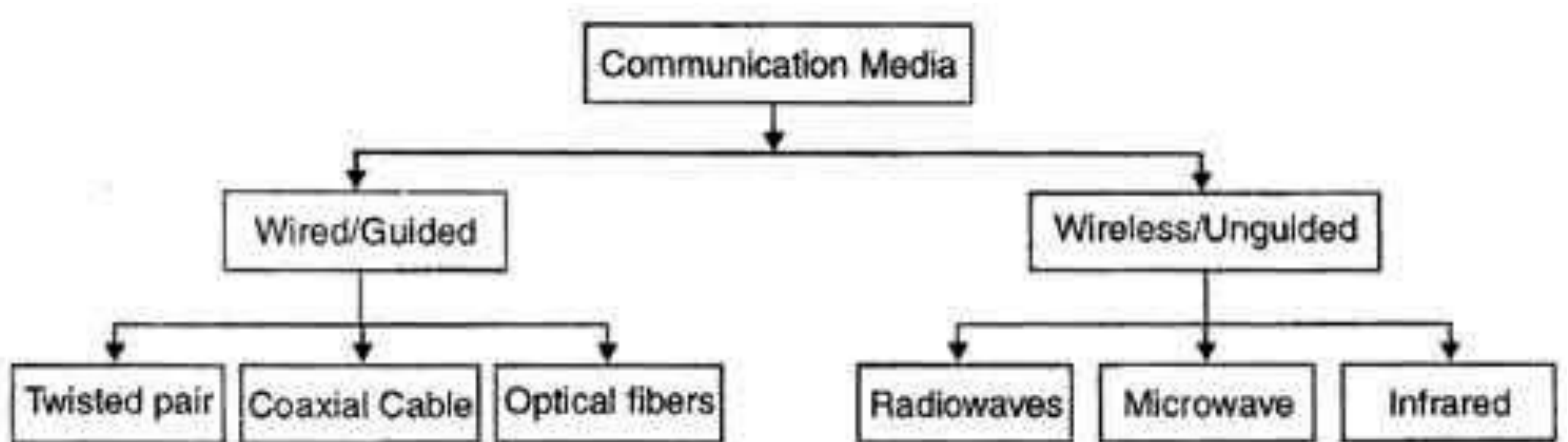
Mode of Communication



Modes/Types of Transmission Media

- Transmission media refers to the physical means by which data is transmitted from one device to another in a communication system.
- Data is transmitted through the electromagnetic signals.
- Transmission media is of two types are:
 - Wired media / Guided media
 - Wireless media / Unguided 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.

Types of Transmission media



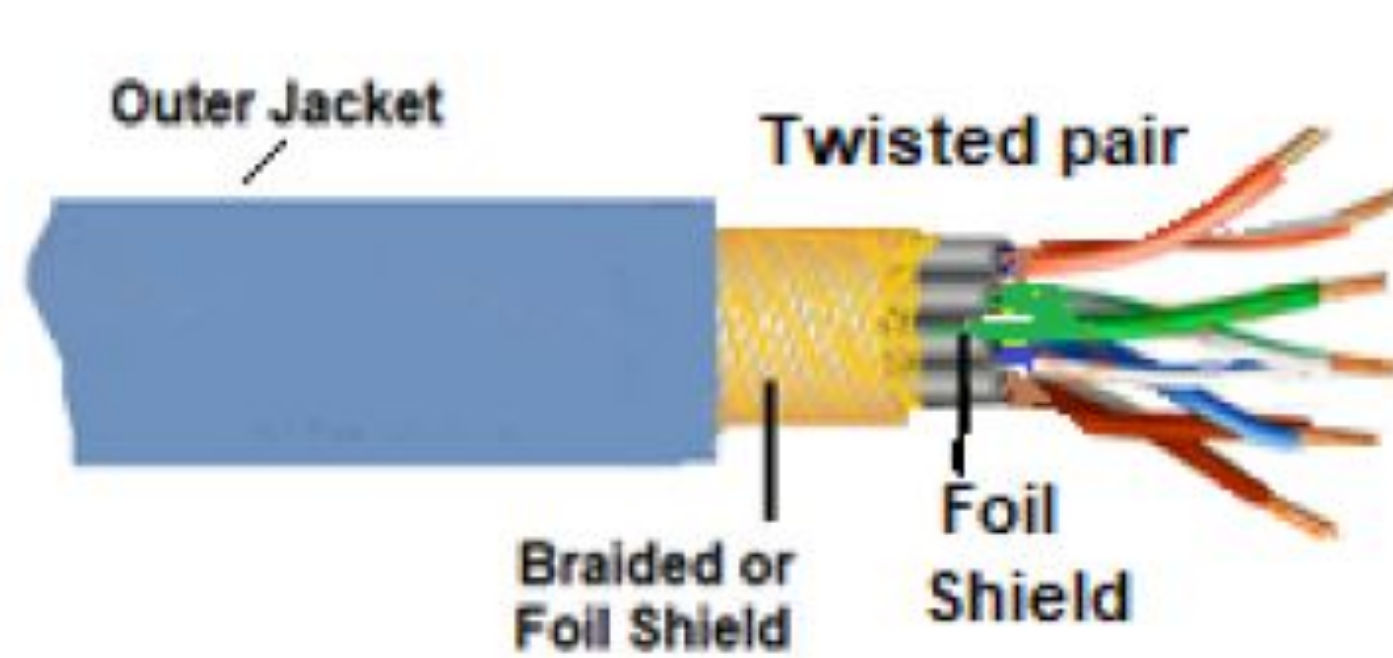
Guided Media

- It is defined as the physical medium through which the signals are transmitted . The data signals are bounded by the cabling system so it is also known as Bounded media.
- It includes:-
 - Twisted pair cable
 - Co-axial cable
 - Optical fiber cable

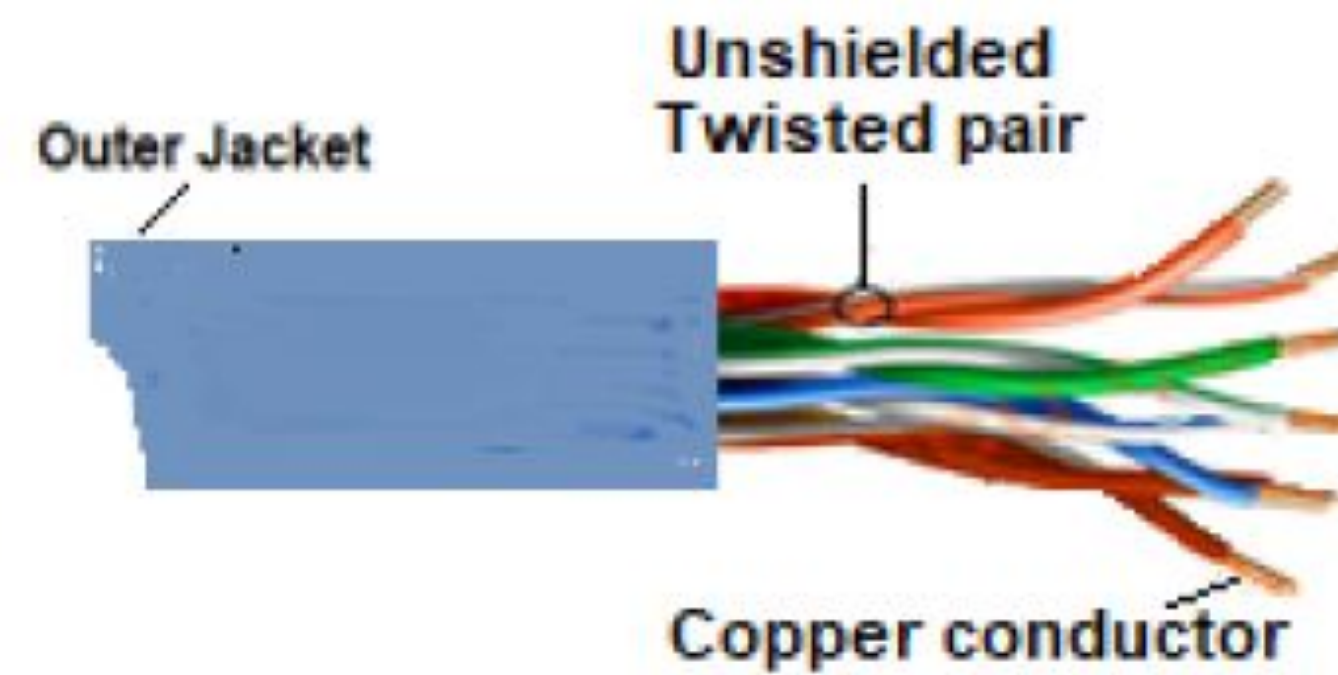
Twisted pair

- It is a type of guided media. Twisted pair cables have two conductors that are generally made up of copper and each conductor has its own color plastic insulation. These two conductors are twisted together, thus giving the name twisted pair cables. The twisting is done in order to avoid the inference of noise. Twisting doesn't eliminate the noise but does significantly reduce it. The degree of reduction in the noise inference is determined by the number of twists per foot. There are two types of twisted pair cable: unshielded twisted pair (UTP) and shielded twisted pair (STP).
- UTP cables consist of pairs of insulated copper wires twisted together without any additional shielding. STP cables have each pair of copper wires shielded with metallic foil or braiding to provide additional protection against electromagnetic interference (EMI) and crosstalk.
- UTP cable is more commonly used for networking applications because it is lightweight, flexible, and less expensive than STP cable.
- Twisted pair cable is commonly used for Ethernet networks and telephone lines. It is a reliable and cost-effective transmission medium that can support both data and voice communication.

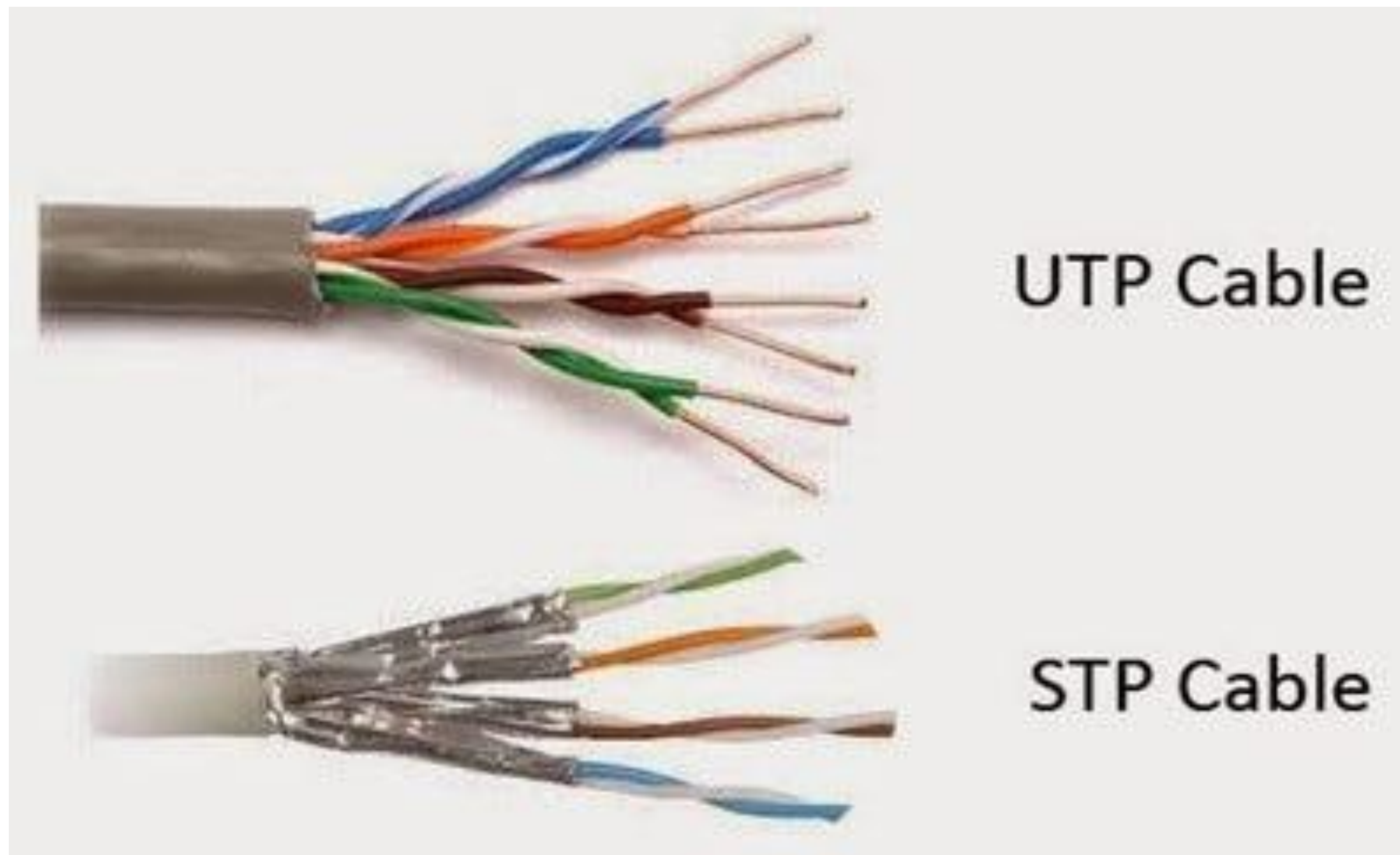
Twisted Pair



Shielded Twisted pair cable



Unshielded Twisted pair cable



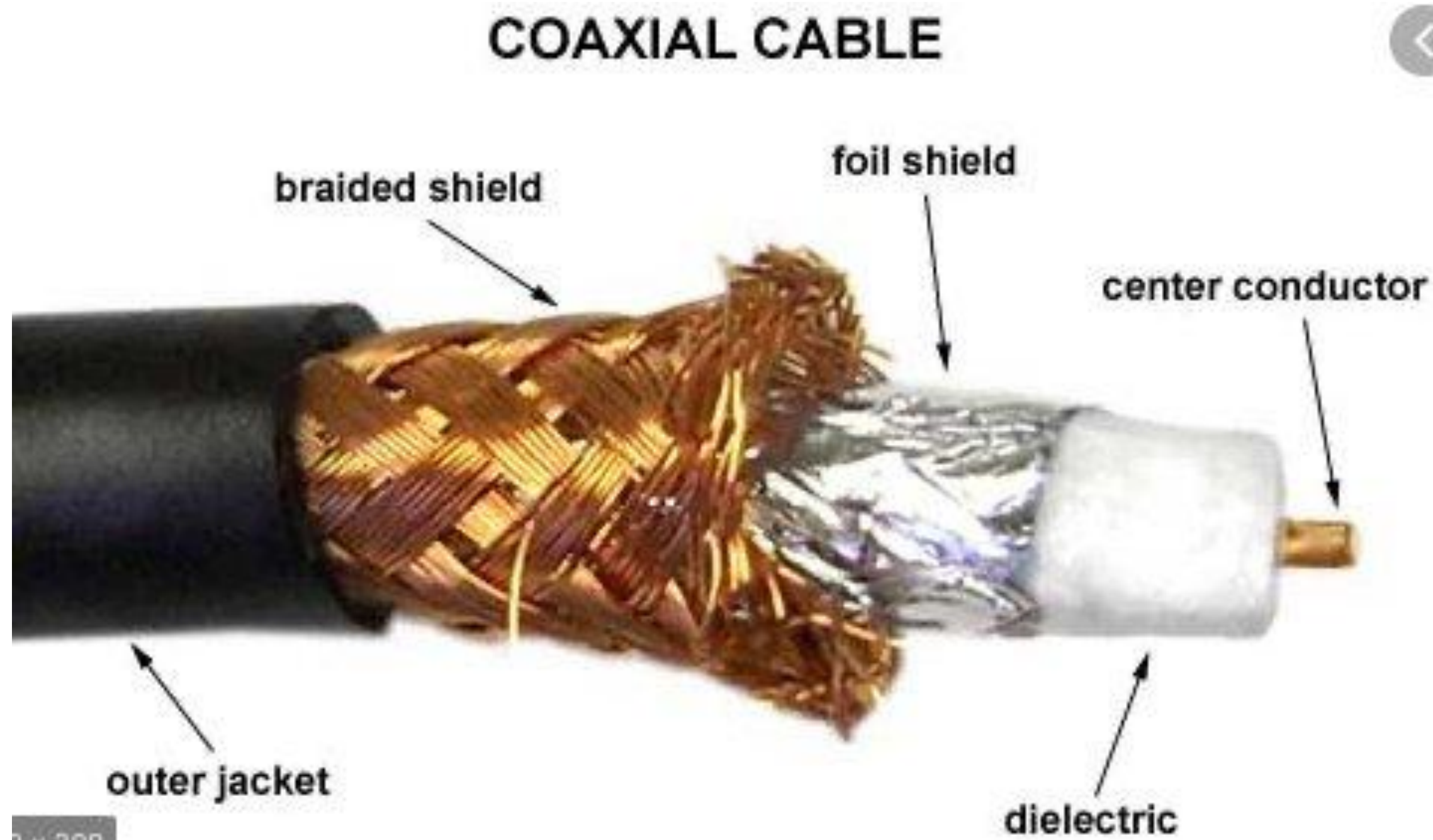
UTP Cable

STP Cable

Coaxial cable

- Coaxial cable, often referred to as coax cable, is a type of guided media used for transmitting electrical signals, including audio, video, and data. It consists of a central cylindrical conductor as the core surrounded by an insulating material, a metallic shield, and an outer protective plastic covering. The design of coaxial cable allows it to transmit signals with minimal loss and interference.
- Coaxial cable is commonly used for cable television (CATV) and broadband internet. It is also used in professional video and audio applications, such as in studios and broadcast facilities.
- One of the advantages of coaxial cable is its ability to transmit high-frequency signals over long distances with minimal signal loss.

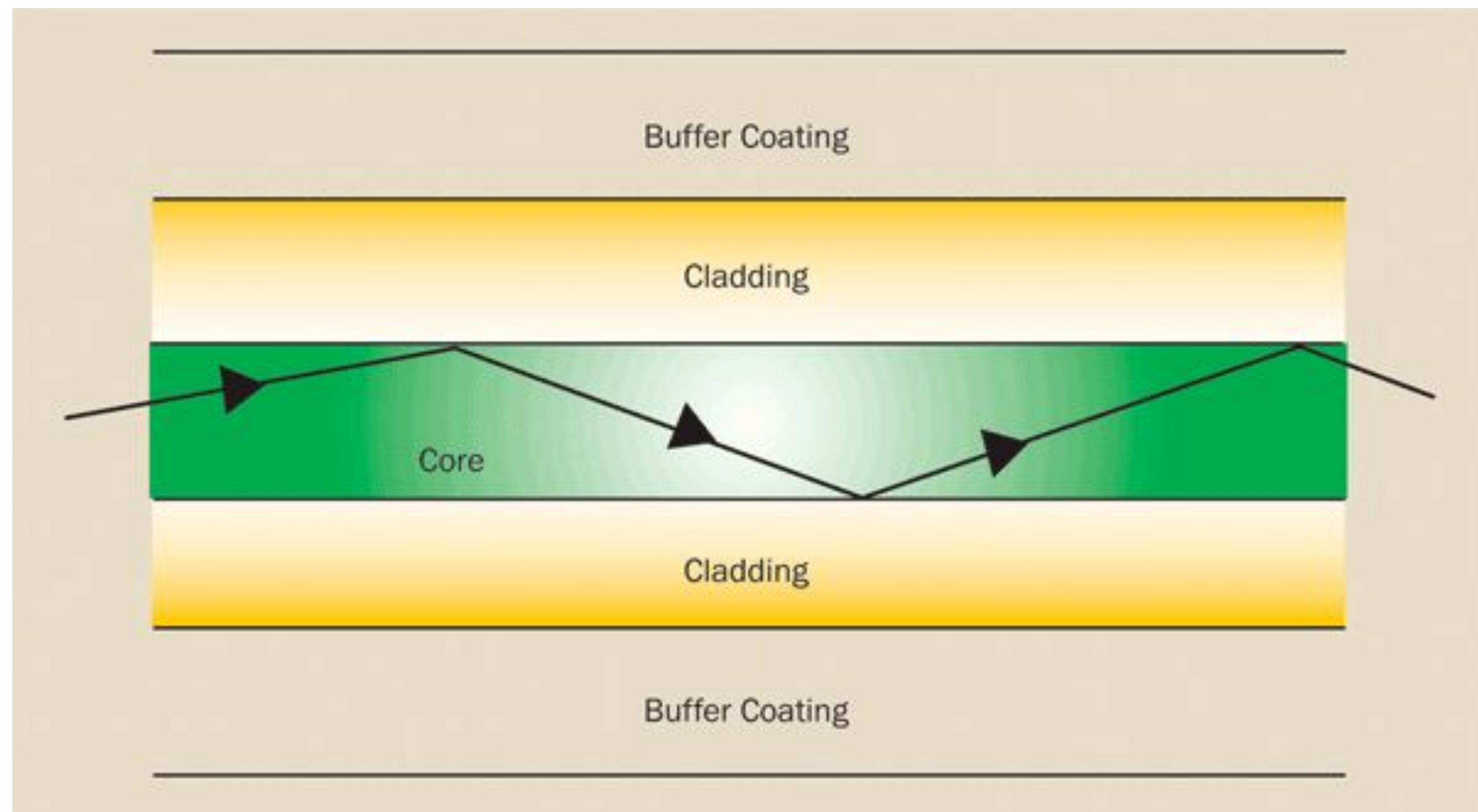
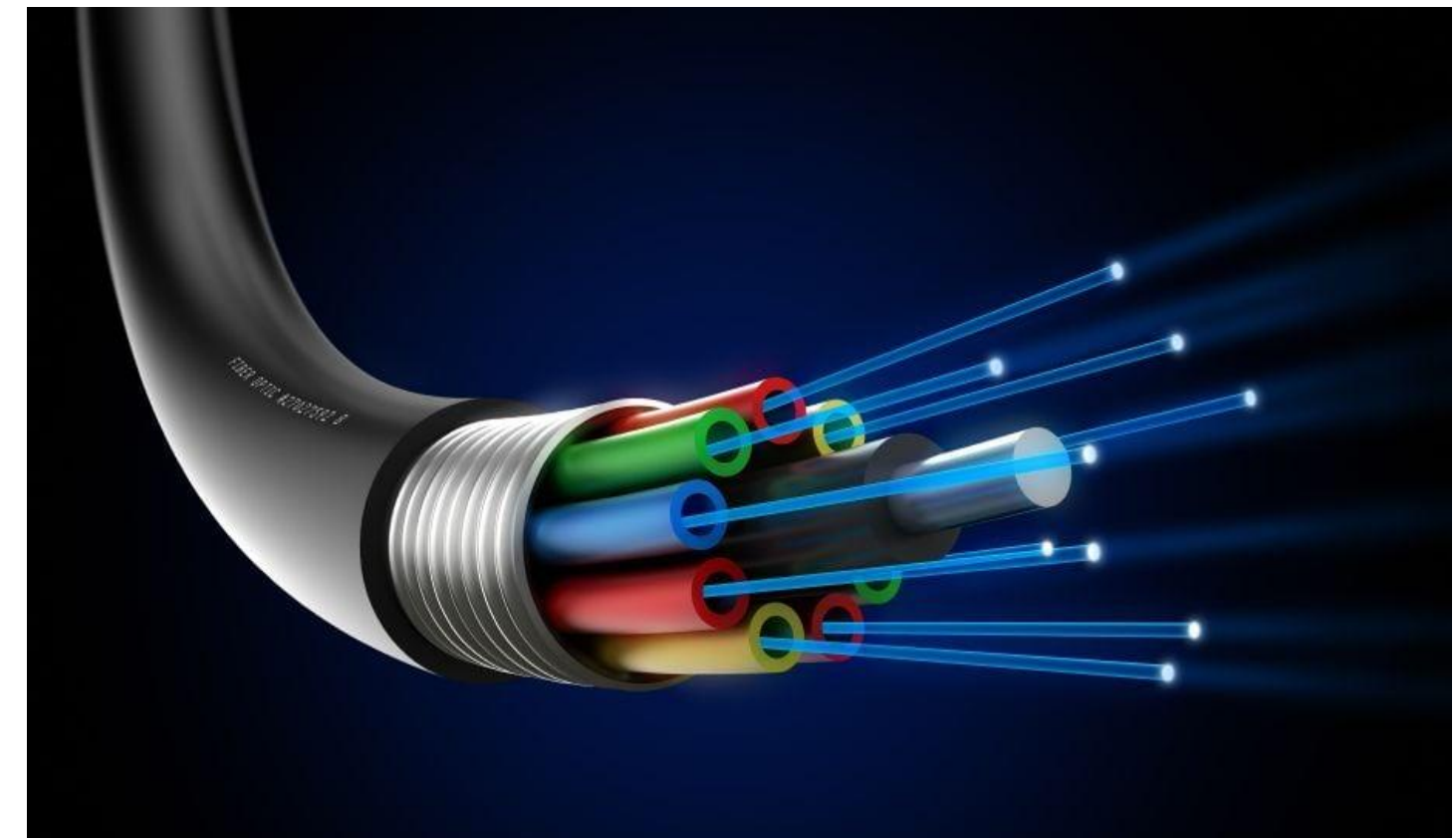
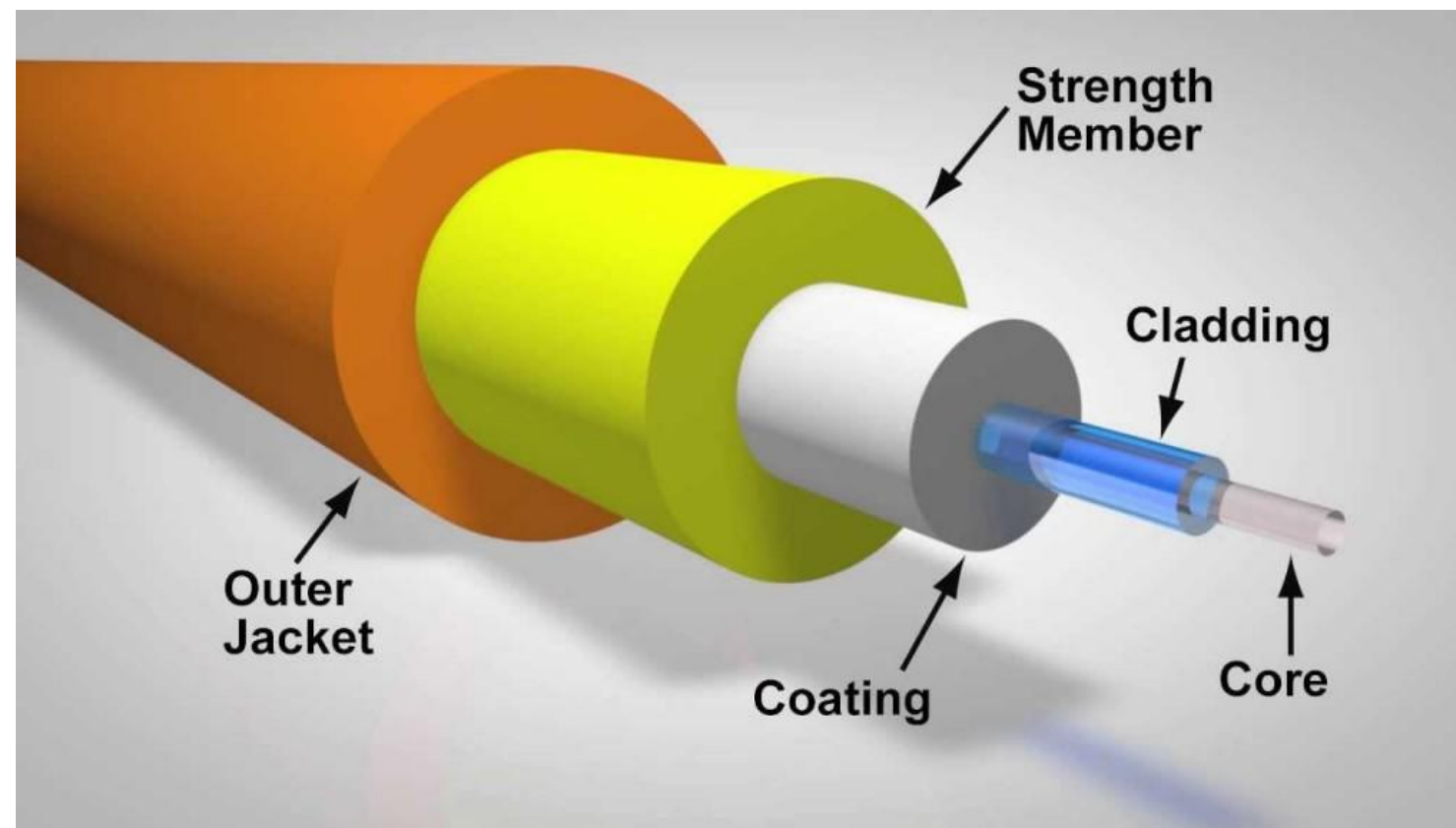
Coaxial cable



Fiber Optic Cable

- Fiber optic cable, also known as optical fiber cable, is a type of cable used in communication systems that transmits data using light.
- It consists of a glass or plastic core that carries the light, surrounded by cladding that helps to keep the light within the core. The core and cladding are covered by a protective outer layer called the buffer.
- Fiber optic cable is known for its high bandwidth, fast data transmission speeds, and resistance to interference.
- It is widely used in high-speed data transmission applications, such as in the internet backbone, long-distance telecommunications, and in local area networks (LANs).

Fiber Optic Cable



Fiber Optic Cable

- They consist of three elements as shown in the figure:
 - a central core,
 - cladding and
 - a protective coating.
- Optical fibers operate on the principle of **total internal reflection**, which keeps the light in the fiber core and guides it down the length of the fiber. Refraction refers to the bending of light as it passes from one substance to another. As the glass used in the fiber core has a higher refractive index than the glass used in the cladding it traps the light in the core by total internal reflection at the cladding interface. The cladding prevents light from exiting the core and being absorbed by the rest of the cable.
- A protective coating of one or two layers of cushioning material is used to reduce cross talk between adjacent fibers. Sometimes additional metallic sheets are added for further environmental and physical protection.

Unguided Media

- Unguided or wireless communication refers to the transmission of information or data without the use of physical connections or wires.
- Instead, wireless communication relies on electromagnetic waves or other forms of energy to transmit data from one device to another.
- This type of communication provides greater mobility and freedom for users as they are not tied to a physical connection.

Example of Unguided media

- Radio Waves: Radio waves are electromagnetic waves ranging in frequencies between 3KHz and 1 GHz. Radio waves are easy to generate, can travel long distance and can penetrate obstacles so they are widely used for communications both indoors and outdoors. They are omnidirectional because they can travel in all the directions. Because of this sending and receiving antennas do not have to be aligned. The disadvantage of the omnidirectional property is that. The radio waves transmitted by one receiving antennas are susceptible to interference by another antenna that may send signals using the same frequency or band.

Radio waves are used when we want to send same information to multiple receiver. FM radio. Televisions and cordless phones use radio waves for transmission.

Example of Unguided media

- Infrared: Infrared is a type of light that is outside of the visible spectrum and can be used for wireless communication between devices. Infrared is commonly used for short distance communication between two mobile devices, TV remote operations, data transfer between a computer and a mobile phone within a closed area.
- Microwaves: Microwaves are a type of radio wave that have longer wavelengths than traditional radio waves. Microwaves frequencies cannot pass obstacles like hills. It is necessary that the microwaves transmission be in a line-of-sight. Line-of-sight communication means that there must be an unblocked direct line between the workstation and transceiver.

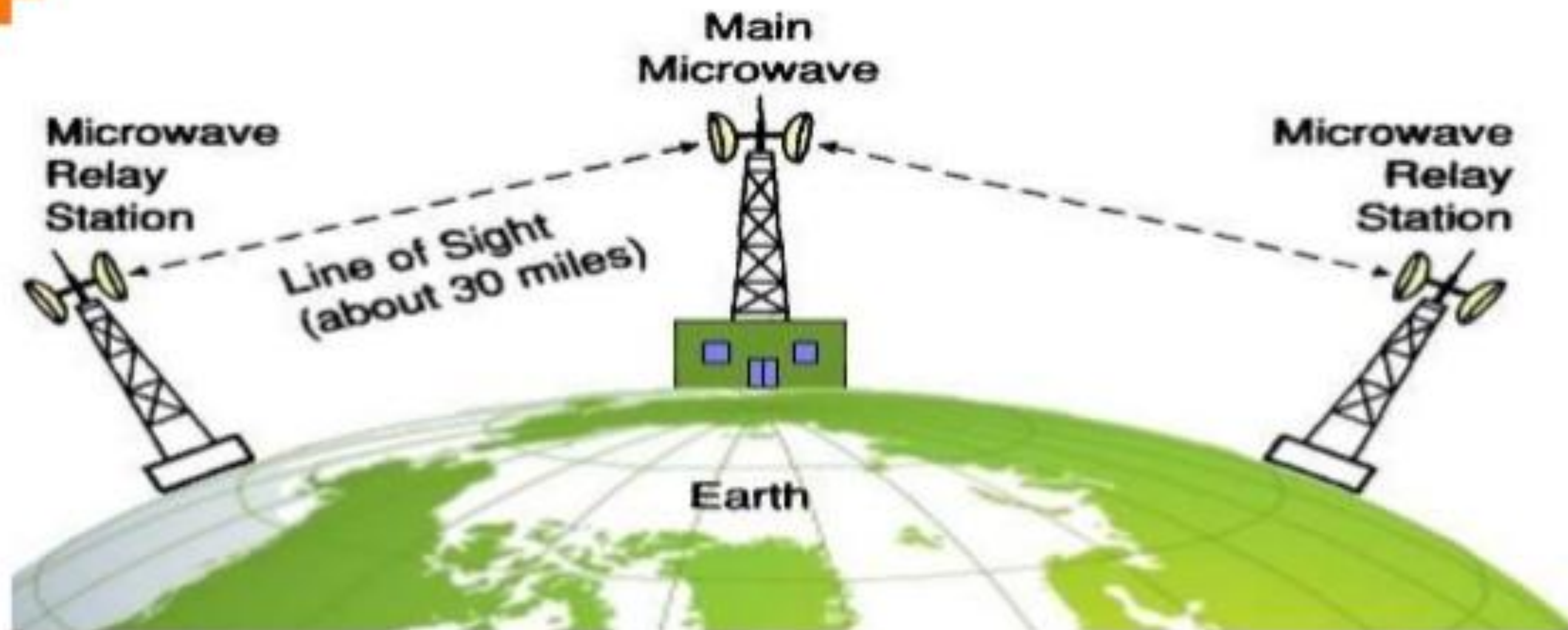
Microwave system

Microwaves signals propagate in one directions at a time, hence two frequencies are need for two way communication. Microwaves signals become weaker after travelling a certain distance and requires power amplification. That's why repeaters are used at regular interval of 25-30 km in between transmitting and receiving stations.

Microwave station



MICROWAVES TRANSMISSION



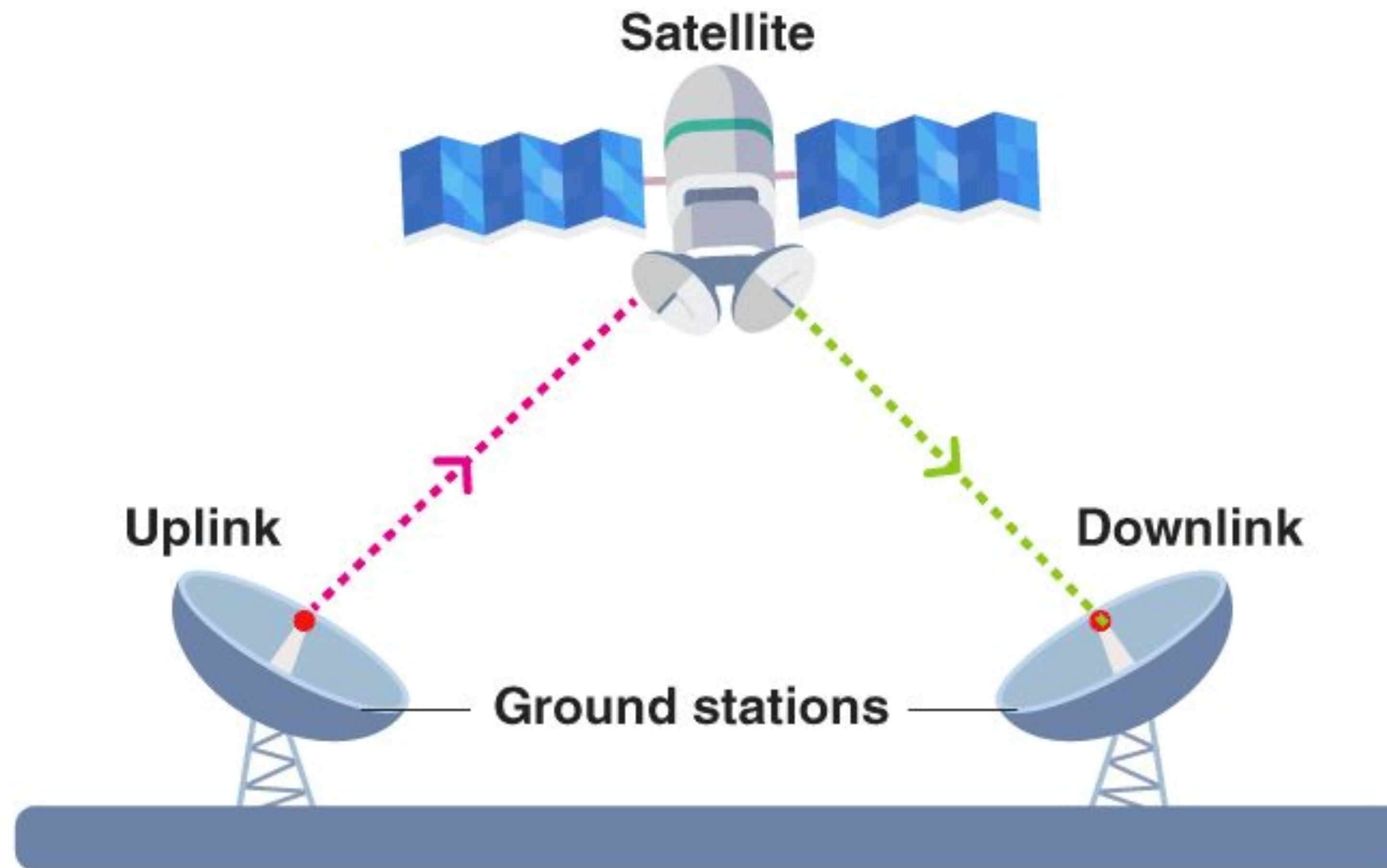
Microwave Relay Stations

- ✓ Height of 40-50ft
- ✓ Spaced at least 20-30miles apart

Satellite

- A satellite is an artificial object that is designed to orbit the Earth or another celestial body in a fixed and well defined path. Artificial satellites are designed and launched into the space for a variety of purposes such as weather monitoring, navigation, TV and mobile communication, planetary research etc.
- Communication satellites are used to transmit signals from one location on the Earth to another, and are an important component of the global communication network. Navigation satellites are used to provide precise positional information to enable navigation systems, such as GPS.
- In satellite communication, the terms "uplink" and "downlink" refer to the transmission of signals between the Earth and a satellite. The uplink refers to the transmission of signals from the Earth to the satellite, while the downlink refers to the transmission of signals from the satellite to the Earth.

Satellite



Question 1:

- What is satellite communication? Explain the importance of satellite communication.
- What is communication media? Explain the types of guided and unguided media.

Computer Network

- Computer networking is the group of computer system interconnected with each other by means of transmission medium and are capable of transmitting and receiving the data, information and instructions from one computer to another computer.
- The interconnection may be wired or wireless.
- In the computer network, computer providing the services and resources to other computer on the network are called the servers. And the individual computer which access shared network resources are known as clients or nodes.

Importance of Networking

- Today individuals, businesses and organizations heavily rely on computer network to get message and information
- There are numerous importance of networking:-
 1. Sharing of resources: Computer network helps in sharing of resources among multiple users that leads to cost reduction and faster access to required information.
 - a) Information sharing:- Data is shared in each computer so that users can get information easily.
 - b) Hardware and software sharing: Before the advent of computer network users required their own printers and other peripherals, now the network revolution have drastically reduced the cost.

Importance of Networking

2. Centralized administration and support

All the computer in the computer network are manages and controlled by a central computer called server. This simplifies operation and supports tasks just from a single location.

3. Remote Management:

Networking allows administrators to remotely manage and monitor devices and systems, making it easier to troubleshoot and resolve issues without having to be physically present.

4. Backup and recovery:-

Networking enables centralized data storage and backup solutions, reducing the risk of data loss and providing disaster recovery capabilities. This is particularly important for businesses and organizations that rely on critical data for their operations.

5. Global Connectivity:

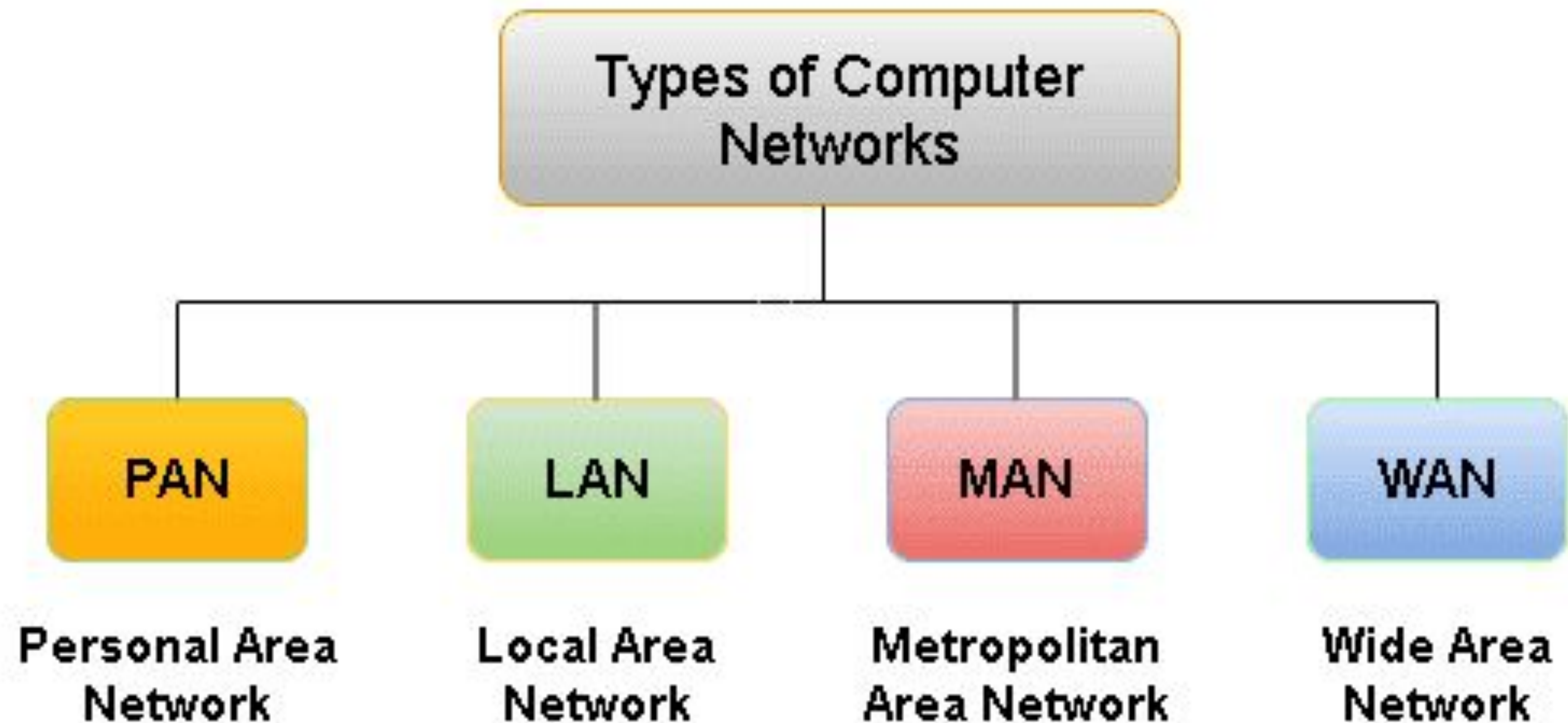
Computer networks connect people and businesses worldwide, facilitating global communication, trade, and collaboration. This interconnectedness has transformed the way businesses operate and has opened up new opportunities for international cooperation and innovation.

Importance of Networking

6. Faster and cheaper communication:-

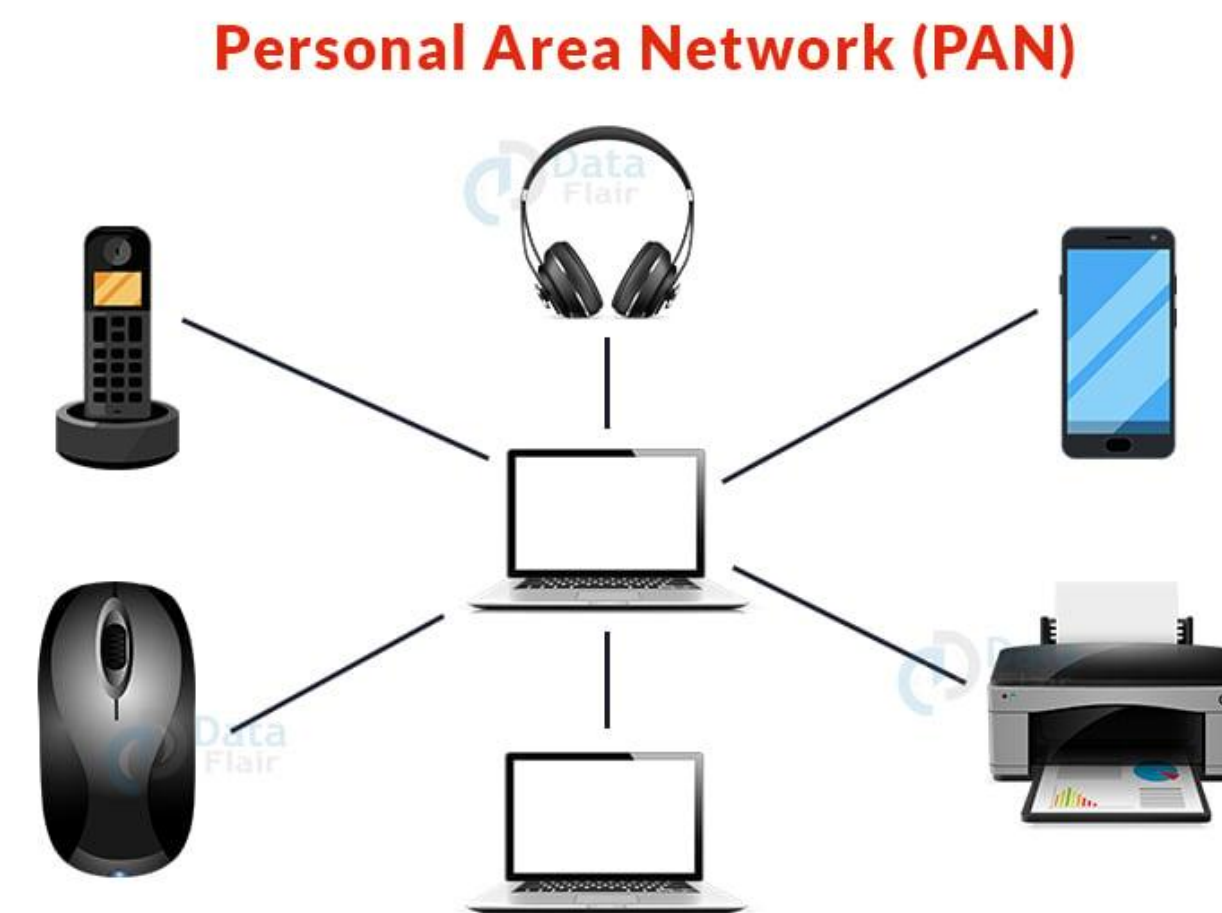
By sharing resources and infrastructure, organizations can reduce costs associated with hardware, software, and maintenance. Additionally, networking allows for remote work opportunities, saving on overhead expenses related to office space and commuting.

Types of Computer Network



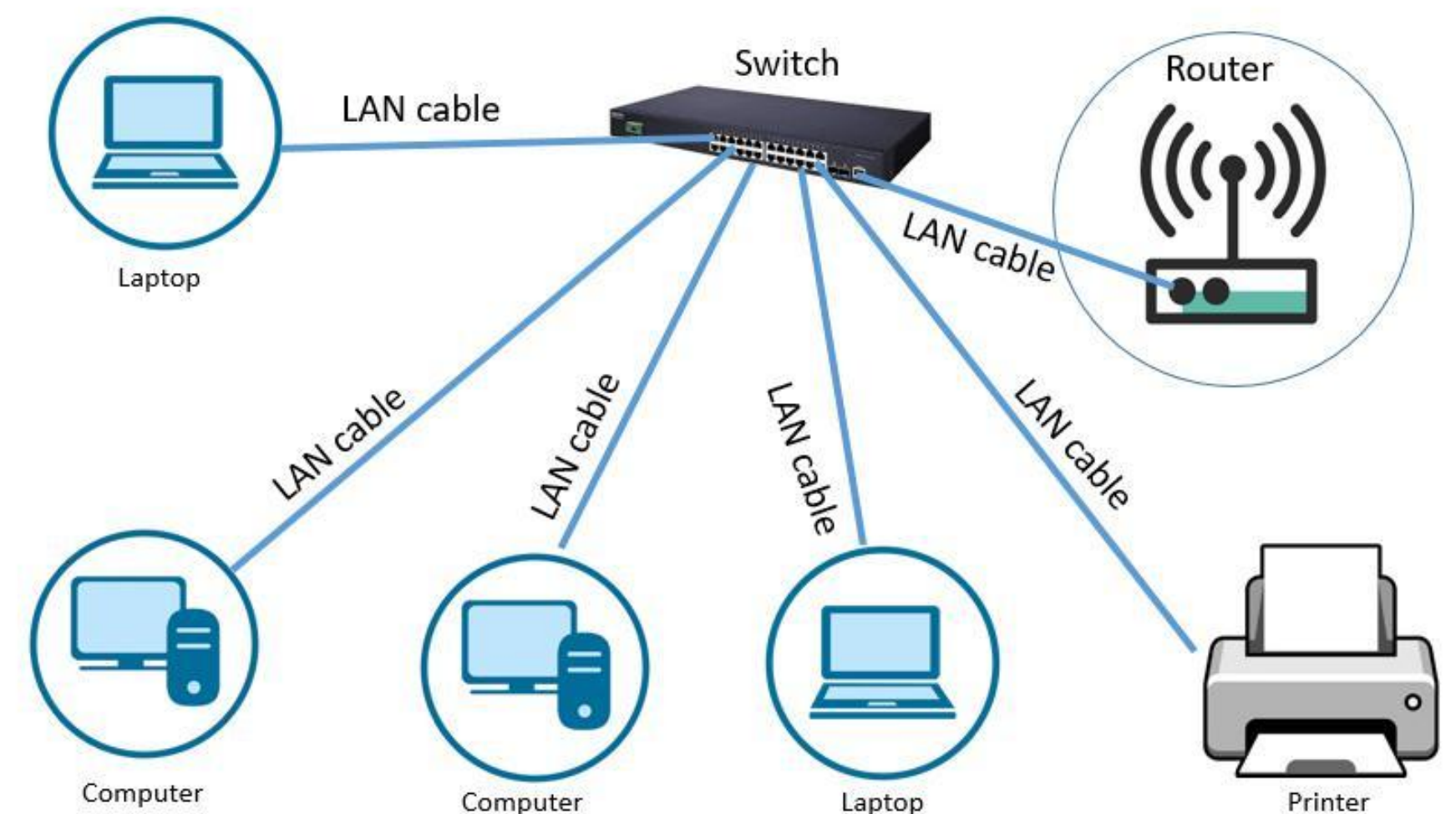
Personal Area Network (PAN)

- A Personal Area Network (PAN) is a type of computer network that is used to connect devices that are close to an individual, such as a smartphone, tablet, or laptop. PANs are typically created using wireless communication technologies, such as Bluetooth.
- The main purpose of a PAN is to allow devices to exchange data and share resources, such as printers or files, with each other without the need for a wired connection. PANs are also used to connect wearable devices, such as smartwatches or fitness trackers, to other devices, such as smartphones.



Local Area Network (LAN)

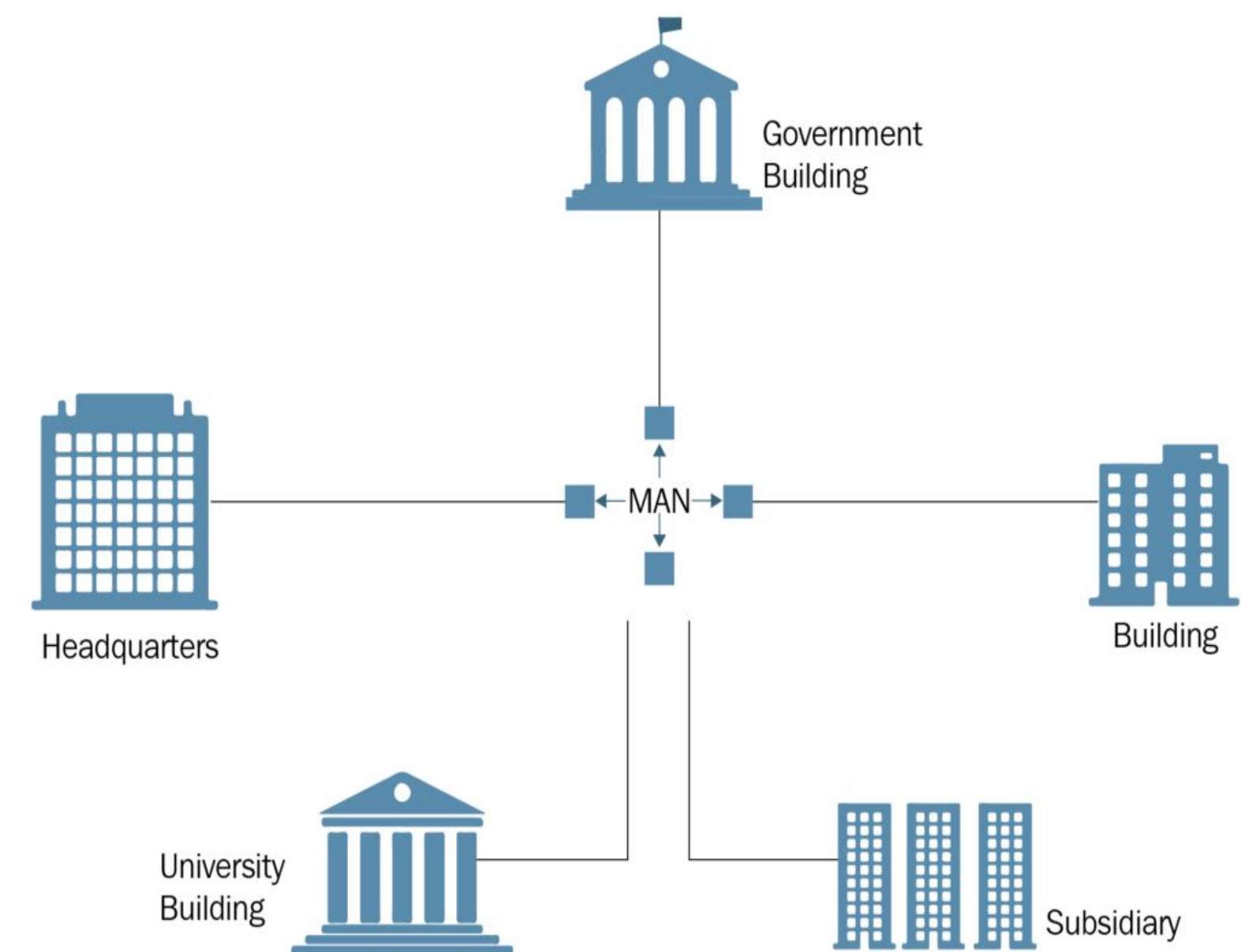
- A Local Area Network (LAN) is a type of computer network that covers a small geographic area, such as a home, office, or a building.
- A LAN network is typically used to connect computers and other devices, such as printers, in a small area to allow them to share resources and exchange data.
- In a LAN network, computers are connected to each other using cables, such as Ethernet cables, or through wireless communication.
- The main advantage of a LAN network is that it provides high-speed communication and allows for the sharing of resources, such as printers and files, among all connected devices.



Local Area Network

Metropolitan Area Network (MAN)

- A Metropolitan Area Network (MAN) is a type of computer network that covers a city or a metropolitan area. It is larger than a Local Area Network (LAN) but smaller than a Wide Area Network (WAN).
- MANs are typically used to connect multiple LANs within a metropolitan area to provide high-speed communication and resource sharing among a large number of users.



Wide Area Network (WAN)

- A Wide Area Network (WAN) is a type of computer network that covers a large geographic area, such as a country or the entire world.
- WANs are used to connect multiple local area networks (LANs) and metropolitan area networks (MANs) to provide communication and resource sharing among a large number of users and devices.
- WANs are typically implemented using long-distance communication technologies, such as leased lines, satellite communication, or public communication networks, such as the internet.
- They are designed to support large numbers of users and devices and can cover distances that span thousands of miles.



Differentiate between types of networks:

| 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 |

Assignment

- Differentiate between PAN, LAN, MAN and WAN.

Network Topology

- Computer network topology is the way various components of a network (like nodes, links, peripherals, etc) are arranged.
- Network topologies define the layout, virtual shape or structure of network, not only physically but also logically.
- The way in which different systems and nodes are connected and communicate with each other is determined by topology of the network.

Network Topology

- Topology can be physical or logical:-
 - Physical Topology is the physical layout of nodes, workstations and cables in the network.
 - Logical topology is the way information flows between different components.

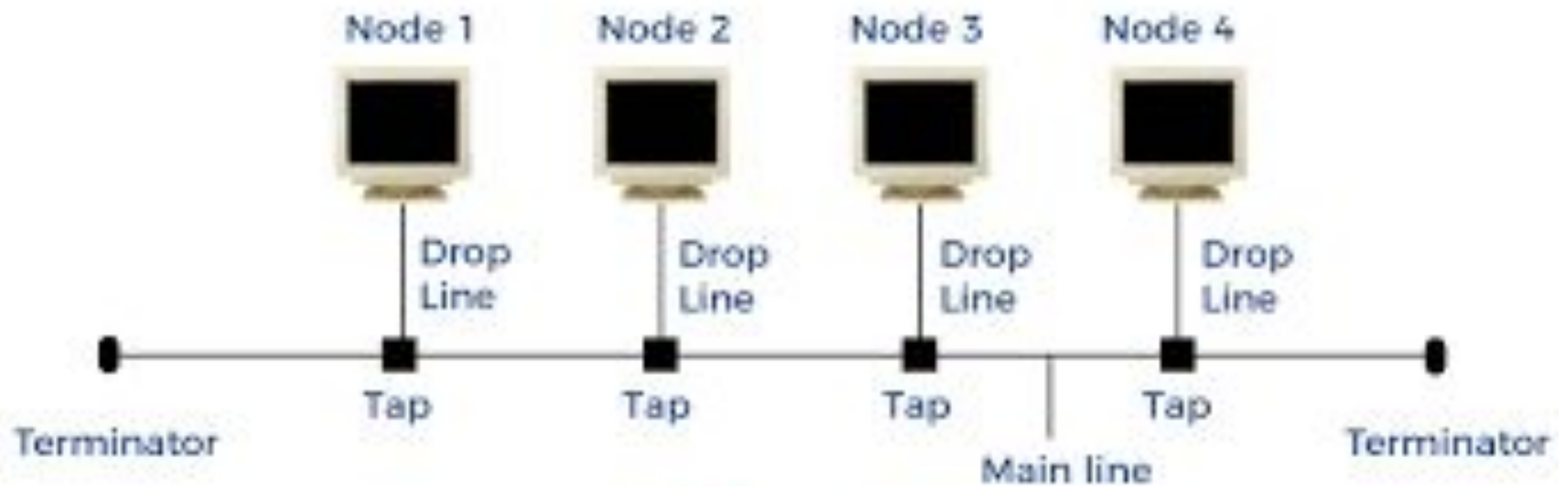
Types of Physical Network Topologies

- Bus Topology
- Star Topology
- Ring Topology
- Mesh Topology
- Tree Topology
- Hybrid Topology

Bus Topology

- In the bus topology, the computers are connected through a common communication media. A special type of central wire is used as communication media. This wire is called the backbone that connects all the devices. Computers or nodes are connected to the bus cable by drop line or taps. The ends of the bus are closed with the terminator. The terminators are used to absorb signals. Message can be transmitted in both direction in bus.
- In bus topology, when one computer sends the signal, all the computers are able to receive the information. Still the message is acceptable by only that computer whose address is specified in the message's address field, the rest of the nodes rejects the message.

Bus Topology



Bus Topology

Advantages of Bus Topology

- Easy to install and configure.
- Inexpensive since only one wire is used.
- Easily extended.
- Suited for temporary network.
- Node failure does not affect other nodes.

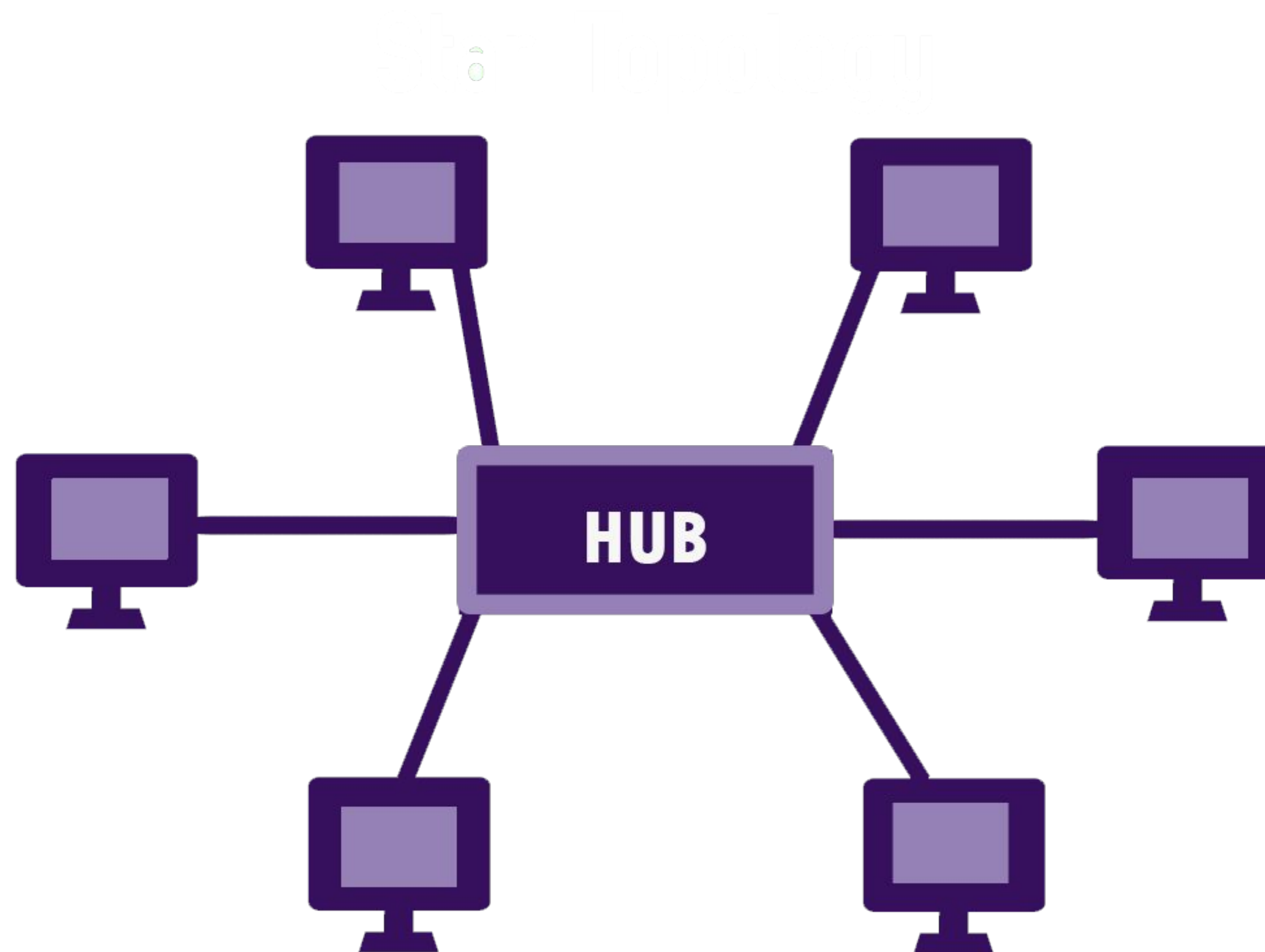
Disadvantages of Bus Topology

- Failure in the backbone cable results the failure of the whole network.
- Adding new device may require the replacement of the backbone.
- Limited cable length.
- Risk of data collision.

Star Topology

- The star topology uses a separate cable for each work station. The cable connects the work station to a central device typically a HUB.
- The configuration provides a more reliable network that is easily expanded. With star there is no central point of failure in the cable. If there is a problem with the cable only the station connected to that cable is affected. To add more work stations simply connect another HUB.
- The devices are not directly connected to each other, so this topology does not allow direct transfer of data between devices.

Star Topology



Advantages of Star Topology

- Easily expended and modified
- If one link fails, only that particular link is affected. The failure in one cable does not bring down the whole network.
- Multiple cable types supported by hub

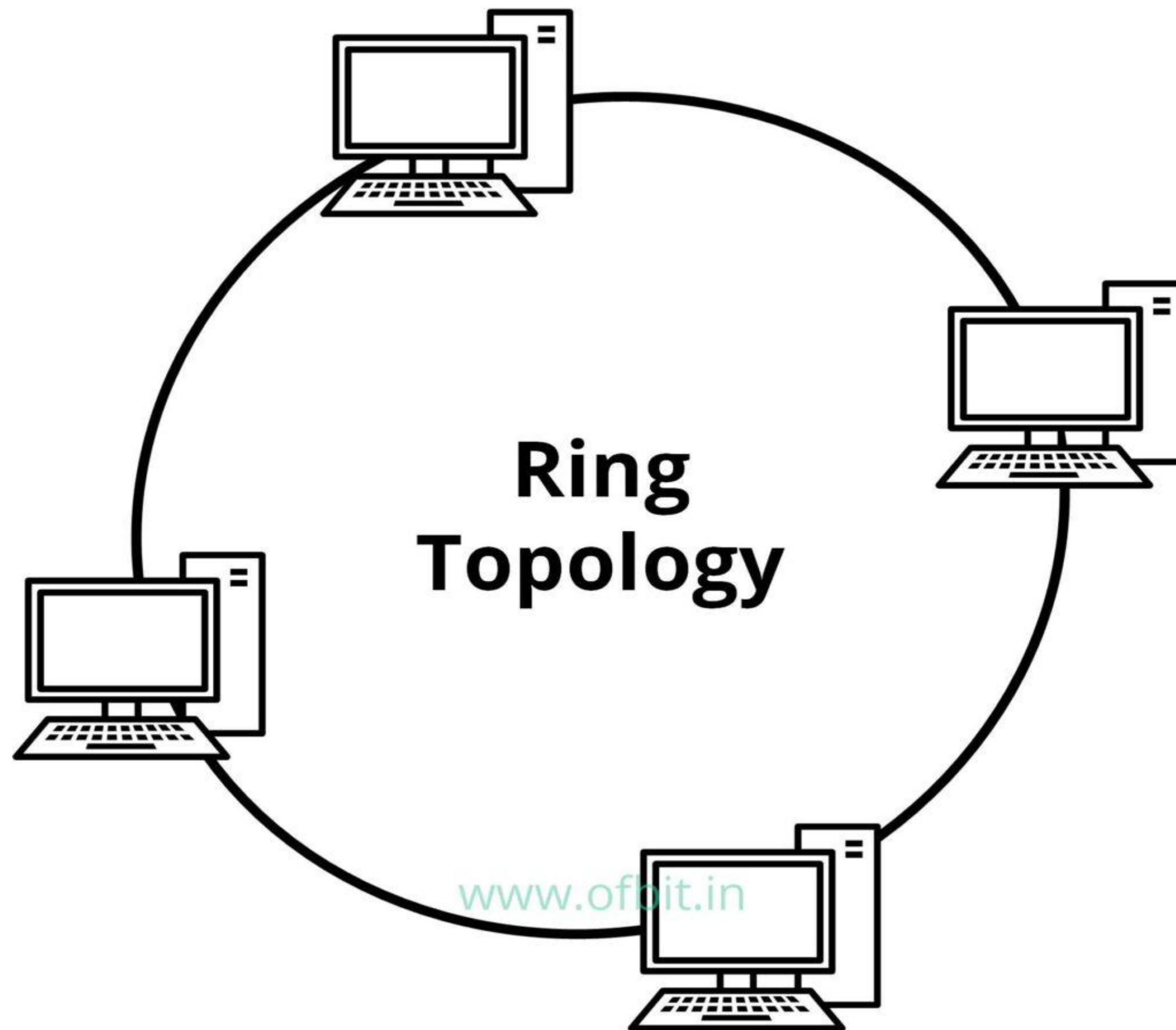
Disadvantages of Star Topology

- If hub fails then entire network will fail.
- HUB has high data collision rate.
- Requirement of more cables and hub makes it more expensive than bus and ring topology.

Ring Topology

- In Ring topology, computers are connected in a circular manner forming a closed loop. In this setup, each device is connected to exactly two other devices (each of its nearest neighbours) creating a continuous pathway for data transmission. It is unidirectional. This means that the messages flow around the ring in only one direction passing through each computer till it reaches the destination.
- Some ring network do ring token passing. A short message called token (memory area) is passed around a ring until a computer wishes to send information to other computers. Only the device that possesses the token has the right to transmit data.
- When you want to send data in such a system, you wait for the token to arrive at your device. Once you have the token, you can attach your data and send it to the next device, which then becomes the new token holder.
- When a computer wants to send data to other computer, that computer modifies token, adds an electronic address and data and send it around the ring. Each computer in sequence receives the token and passes to the next computer until either the electronic address matches the address of a computer or the token returns to its origin .The receiving computer returns a message to the sender indicating that message has been received.

Ring Topology



Advantages

- It provides an orderly network in which every device has access to the token and can transmit.
- It performs well under a heavy load.
- There is no problem of data collision because of unidirectional data transmission.
- Adding and removing the devices requires moving only two connections.

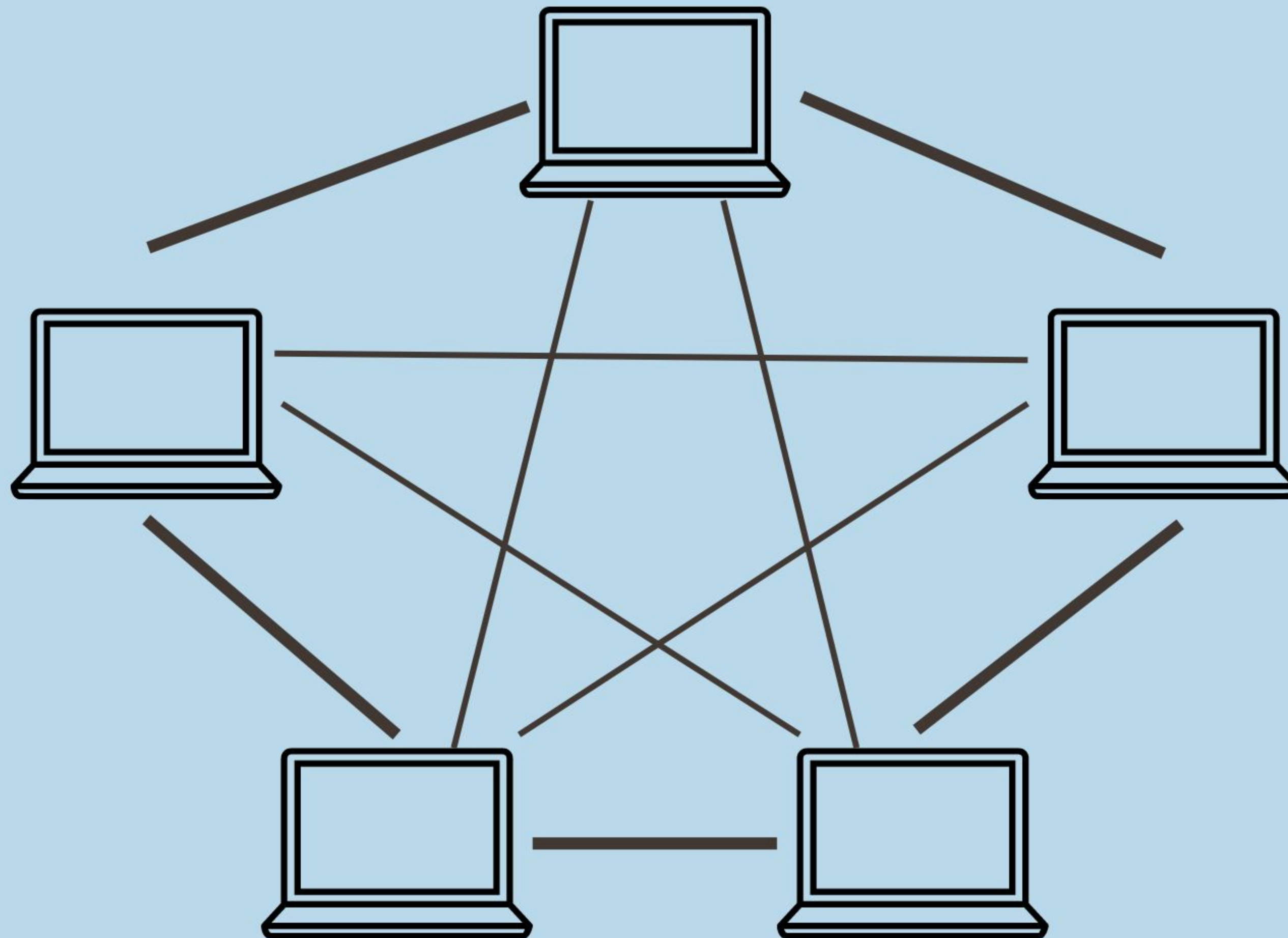
Disadvantages

- Failure of one computer can effect the whole network .
- Communication delay in case of large networks.
- If at any point the cable breaks, the entire network stops functioning.

Mesh Topology

- A mesh network or mesh topology uses separate cable to connect each device to every other device on the network, providing a straight communication path.
- For sending messages, check the cable connected into two devices. A message is send directly from sender to receiver because each one has individual and separate connection.
- A fully connected mesh has $n(n-1)/2$ physical channels to link n devices. And every device in the network must have $(n-1)$ input/output ports.

Mesh Topology



Advantages

- No traffic problem due to dedicated link.
- One link failure does not affect the entire system.
- Privacy and security.

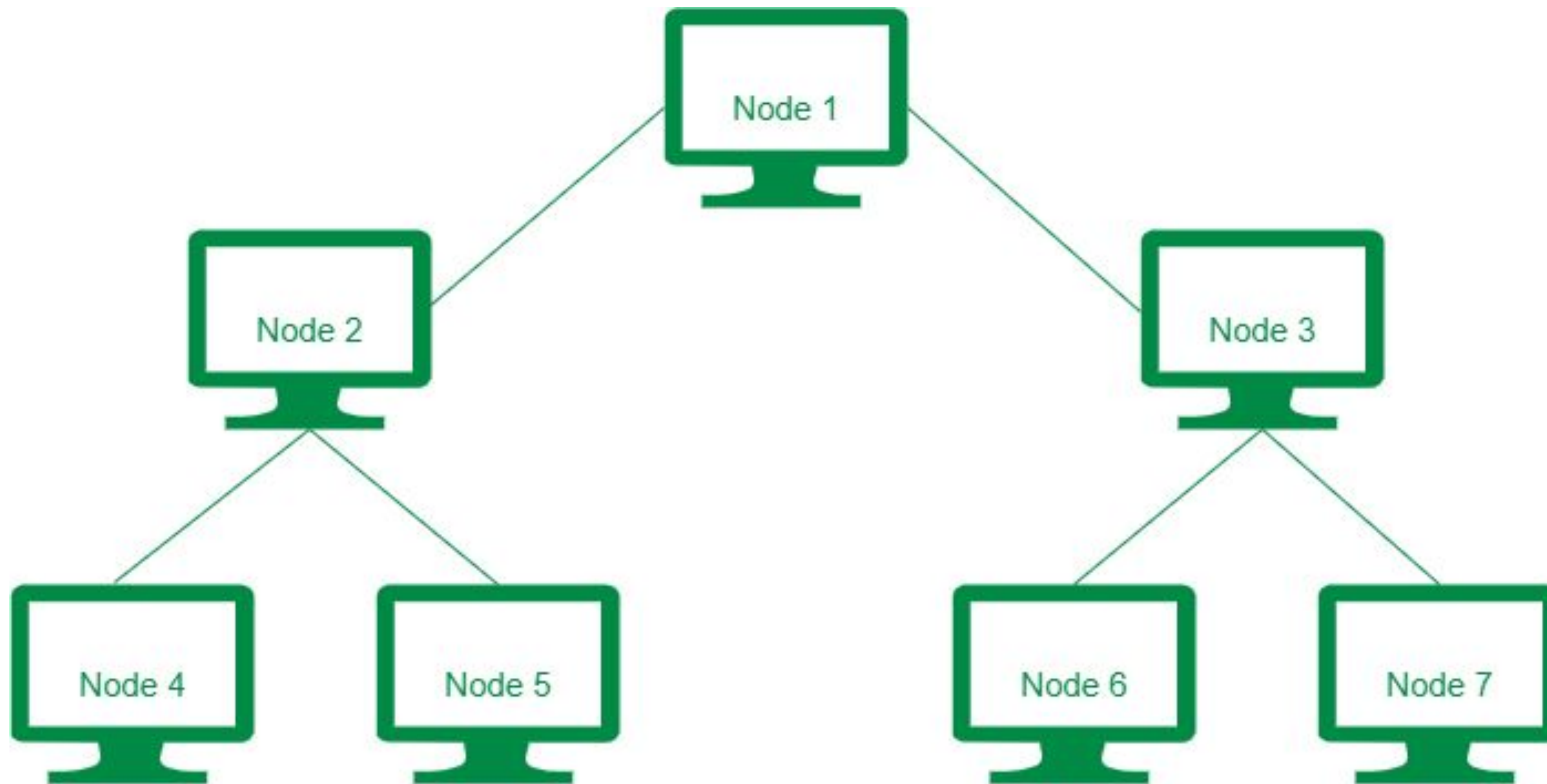
Disadvantages

- Difficult to install and maintain.
- Expensive.
- Difficult to add and remove nodes.

Tree Topology

- The type of network topology in which a central 'root' node (the top level of the hierarchy) is connected to one or more other nodes that are one level lower in the hierarchy (i.e., the second level) with a point-to-point link between each of the second level nodes and the top level central 'root' node, while each of the second level nodes that are connected to the top level central 'root' node will also have one or more other nodes that are one level lower in the hierarchy (i.e., the third level) connected to it, also with a point-to-point link, the top level central 'root' node being the only node that has no other node above it in the hierarchy (The hierarchy of the tree is symmetrical.)
- Each node in the network having a specific fixed number, of nodes connected to it at the next lower level in the hierarchy, the number, being referred to as the 'branching factor' of the hierarchical tree.

Tree Topology



Tree Topology.

Advantages

- **It is scalable.** Secondary nodes allow more devices to be connected to a central node.
- Point to point connection of devices.
- Having different levels of the network makes it more manageable hence easier fault identification and isolation.

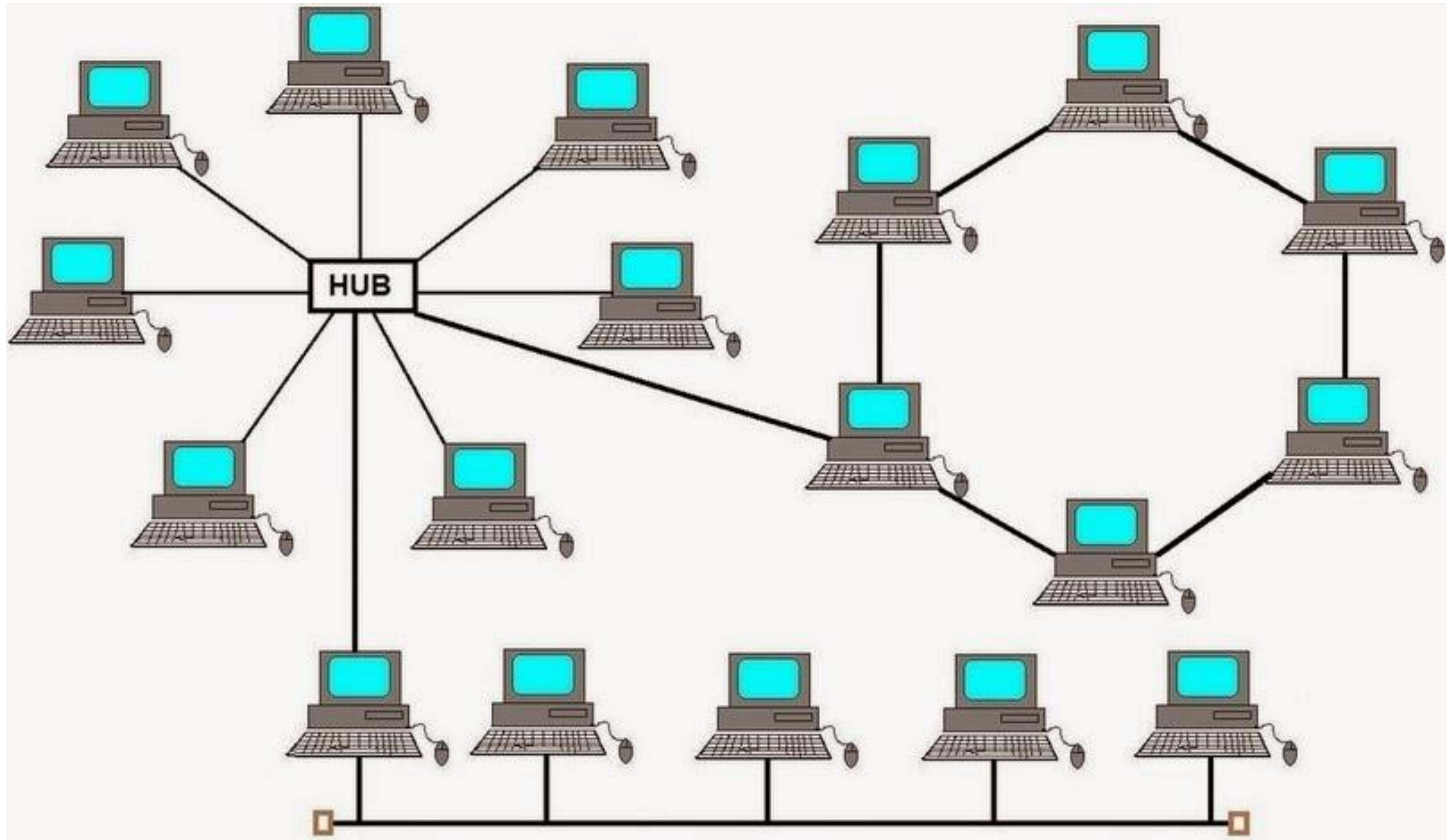
Disadvantages

- Maintenance of the network may be an issue when the network spans a great area.

Hybrid Topology

- Hybrid networks use a combination of any two or more topologies in such a way that the resulting network does not exhibit one of the standard topologies (e.g., bus, star, ring, etc.).
- For example, a tree network connected to a tree network is still a tree network topology. A hybrid topology is always produced when two different basic network topologies are connected. Two common examples for Hybrid network are: *star ring network* and *star bus network*.

Hybrid Topology



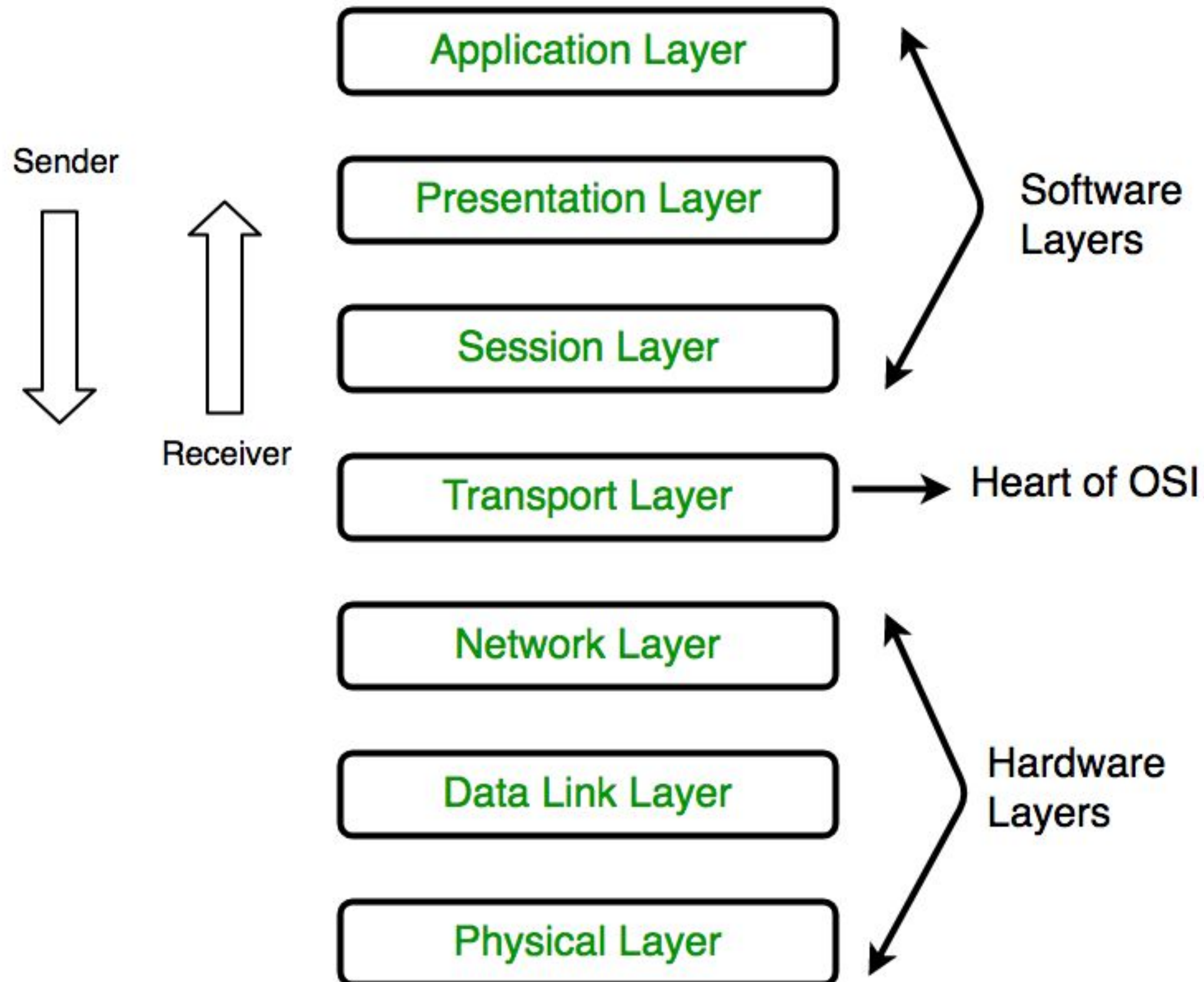
Assignment

- What is Network Topology? What are the types of network topology? Explain with proper figure. And if you have to arrange the network, Which topology would you choose and why?

OSI (Open Systems Interconnection)

- The OSI (Open Systems Interconnection) reference model is a conceptual model that provides a framework for understanding how communication between different computer systems and network devices occurs.
- It was developed by the International Organization for Standardization (ISO) in 1984 and is composed of seven layers, each with a specific function in the communication process.

OSI (Open Systems Interconnection)



Here are the seven layers of the OSI reference model:

- Application layer: This layer provides services to network applications and aids the applications to work properly in the network/internet. The network applications running on our PC are dependent on different protocols to function. There are many protocols that enables various function at the application layers. These protocols form the basis for various network services like file transfer, web surfing, email, virtual terminals etc. FTP, HTTP/S, SMTP and telnet are some protocols used by different applications. Application layer provides services to the network applications with the help protocols to perform user activities.
- Presentation layer: This layer receives data from the application layer. This data is in the form of characters and numbers. Presentation layers converts the characters and numbers to the machine understandable binary formats. This function is called translation. This layer is also responsible for data compression, data encryption/decryption.
- Session layer: This layer establishes, manages, and terminates sessions between devices. It also manages the exchange of data between the devices during the session. It uses APIs such as NETBIOS that allows computers in the network to communicate with each others. Just before session is established with a server, server performs a function called authentication(process of verifying who your are). Similarly authorization is also performed in this layer

Our web Browser performs all the function of the session, presentation and application layer.

Here are the seven layers of the OSI reference model:

- Transport layer: This layer ensures that data is delivered reliably and accurately between end systems. It manages flow control, error recovery, and retransmission of lost packets. At this layer, data is divided into segments.
- Network layer: This layer is responsible for routing data between different networks. It determines the most efficient path for data to take and manages congestion control. At this layer, data is divided into packets.
- Data link layer: This layer ensures that data is delivered error-free and in the correct sequence. It also manages access to the physical medium and handles error detection and correction. At this layer, data is divided into data frames.

Here are the seven layers of the OSI reference model:

- Physical layer: This layer is responsible for transmitting and receiving data over the physical medium, such as cables or wireless signals. It defines the electrical and physical specifications for devices. At this layer, data is transmitted as a stream of bits.
- By dividing the communication process into seven layers, the OSI reference model provides a standardized way for different network devices and computer systems to communicate with each other. It allows for different types of hardware and software to work together, and provides a common language for network engineers and developers to use when designing and troubleshooting network communication.

Communication Protocols

- Communication protocols are a set of rules and standards that govern the exchange of data and information between devices, systems, or networks. They are used to ensure that devices or systems can communicate with each other efficiently, accurately, and securely. In general, communication protocols define the format, timing, sequencing, and error-checking of messages exchanged between communicating entities.

Some common types of communication protocols

include:

- Transmission Control Protocol/Internet Protocol (TCP/IP): This is a widely used protocol for communication over the internet and is the basis of the internet's infrastructure. It provides reliable, connection-oriented communication between devices on different networks.
- Hypertext Transfer Protocol (HTTP): This is a protocol used for communication between web servers and web clients. It defines how data is exchanged between web servers and clients and is used to transfer web pages and other web content.
- Simple Mail Transfer Protocol (SMTP): This is a protocol used for sending and receiving email messages over the internet. It defines the format and transmission of email messages between email servers.

Some common types of communication protocols include:

- File Transfer Protocol (FTP): This is a protocol used for transferring files between computers on a network. It allows users to upload and download files from a remote server.
- User Datagram Protocol (UDP): This is a simple, connectionless protocol that does not provide the reliability of TCP/IP. It is used for streaming media, gaming, and other applications that require real-time data transfer.
- Wireless Application Protocol (WAP): This is a protocol used for accessing the internet on mobile devices. It defines how data is transferred between mobile devices and the internet.

Centralized vs Distributed network

- In computer networking, a centralized network and a decentralized network are two different ways of organizing and managing network resources, such as data, applications, and computing power.
- A centralized network, also known as a client-server network, has a centralized server that is responsible for managing and controlling network resources. In this type of network, clients or end-users access the network resources through a central server. The server controls access to the network resources and manages the sharing of data and applications. Examples of centralized networks include email servers, file servers, and web servers.

Centralized vs Distributed network

- On the other hand, a decentralized network, also known as a peer-to-peer (P2P) network, distributes the control and management of network resources across all the connected devices or nodes. In a decentralized network, each node is responsible for storing and sharing its own resources with other nodes on the network. This type of network allows for more distributed decision making, better scalability, and greater resilience against system failures. Examples of decentralized networks include BitTorrent, blockchain networks, and some file sharing networks.
- Both centralized and decentralized networks have their advantages and disadvantages. Centralized networks can provide more efficient management and control of network resources, and can be easier to manage and secure. However, they may also be more vulnerable to attacks and system failures, and can be limited in terms of scalability and flexibility.

Networking Hardware

Networking hardware is the physical equipment used in computer networking to facilitate communication and data exchange between devices or computers. Some examples of networking hardware are:

- Network Interface Cards (NICs): These are hardware components that enable computers to connect to a network. They are responsible for transmitting and receiving data between the computer and the network.
- Switches: A switch is a device that connects multiple devices or computers in a network, allowing them to communicate with each other. It can route data between different devices in the network and can be used to segment a network to improve performance and security.
- Routers: A router is a device that connects multiple networks together, allowing devices in one network to communicate with devices in another network. It can route data between different networks, and can also provide network security by filtering and blocking unwanted traffic.

Networking Hardware

- **Firewalls:** A firewall is a network security device that monitors and controls incoming and outgoing network traffic based on a set of rules. It can be used to block unauthorized access and prevent malicious attacks.
- **Modems:** A modem is a device that connects a computer or network to the internet or other networks. It converts digital signals from a computer to analog signals that can be transmitted over telephone or cable lines.
- **Wireless Access Points:** A wireless access point (WAP) is a device that allows devices to connect to a wireless network. It can be used to provide wireless connectivity to computers, smartphones, and other devices.
- **Repeaters and Range Extenders:** These devices can be used to boost the signal of a wireless network, extending the range of the network and improving connectivity in areas with weak signals.

Wireless Networking

- Wireless networking is a method of connecting devices or computers without using physical cables or wires. It is a type of computer networking that uses radio waves or infrared signals to transmit data between devices. Some common wireless networking technologies include Wi-Fi, Bluetooth etc.
- Wireless networking is popular in many different settings, including homes, offices, public spaces, and transportation systems.

Advantages:

Some advantages of wireless networking include:

- **Mobility:** Wireless networking allows devices to connect and communicate with each other without being physically connected. This makes it easy to move devices around and connect to the network from different locations.
- **Convenience:** Wireless networking eliminates the need for messy cables and wires, making it easier to set up and use.
- **Scalability:** Wireless networks can be easily expanded and upgraded by adding new devices or access points, allowing them to grow as the network needs expand.
- **Cost-effective:** Wireless networking can be more cost-effective than wired networking, especially in situations where a wired network is difficult or expensive to install.

Disadvantages:

However, wireless networking also has some disadvantages, such as:

- **Security:** Wireless networks can be more vulnerable to security threats, such as hacking or eavesdropping, than wired networks. Proper security measures such as encryption and secure authentication are necessary to keep wireless networks secure.
- **Interference:** Wireless networks can be affected by interference from other wireless devices or physical obstacles such as walls or buildings. This can lead to reduced performance or signal loss.
- **Performance:** Wireless networks may have lower performance or speed compared to wired networks, especially in situations where many devices are connected to the network or the network is located in an area with a lot of interference.

Overall, wireless networking can be a convenient and flexible way to connect devices and computers in a variety of settings, but it's important to be aware of the potential security and performance issues associated with wireless networks.

Question

- What is communication protocols? Explain any 5 communication protocols?
- What kind of hardware we used in networking?

