PRACTICAL : 1

AIM : Network Topologies

Theory:

What are the topologies in CN?

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.

Types of topology:

There are mainly six types of network topologies and those are as following:

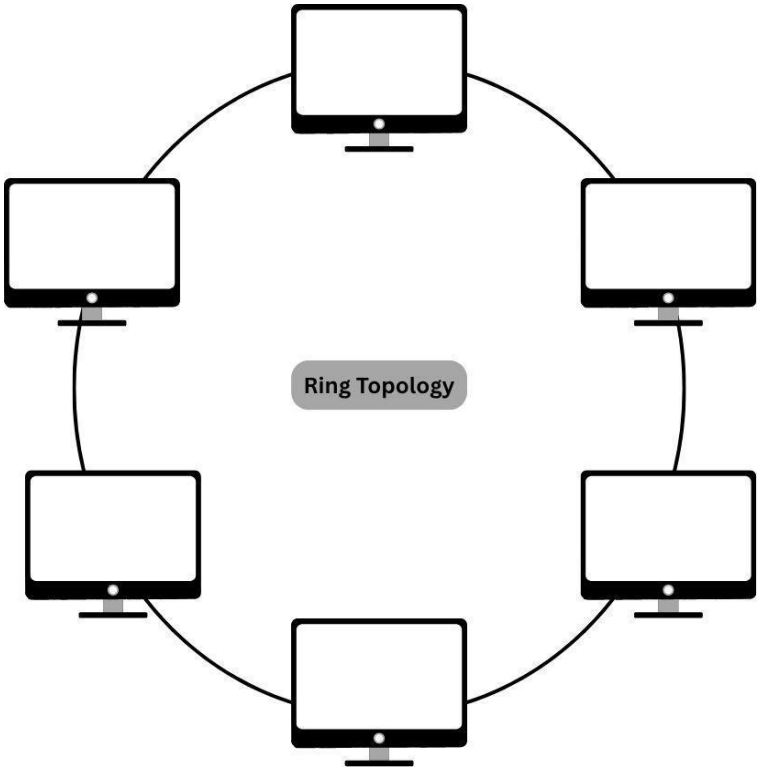
1. Bus
2. Ring
3. Star
4. Mesh
5. Tree
6. Hybrid

Ring Topology:

In computer networking, a ring topology is a network configuration in which each node is connected to two other nodes in the network, building a single continuous pathway for signals through the network. Ring topologies are often used in local area networks (LANs).

In a ring topology, each node has two neighbours, with the signals travelling in opposite directions around the ring. If one node fails, the network can reroute signals around the failed node using the other nodes as alternate paths. This redundancy can improve reliability and fault tolerance, but it also adds complexity to the network.

Ring topologies can be designed using either twisted pair cable or fibre optic cable. The choice of cable type will depend on the distance between nodes, the data transfer speed required, and other factors.



Advantages:

- One major advantage is that it is very difficult for an outsider to tap into or interfere with a network using this type of configuration.
- Additionally, if one node on the network goes down, the rest of the nodes can continue to communicate with each other without issue. This can be a big advantage in mission-critical situations where uptime is key.
- Finally, ring topologies tend to be very easy to expand and add new nodes to as needed.

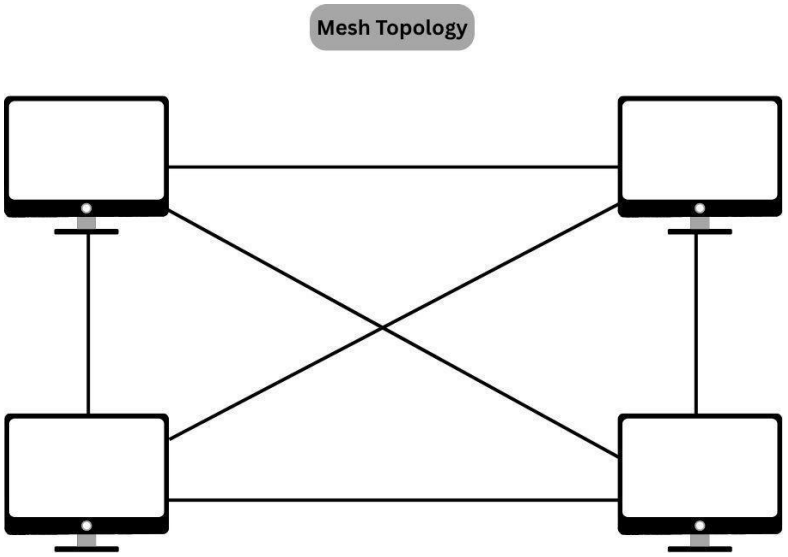
Disadvantages:

- First, if one node fails, the entire network fails.
- Second, adding or removing a node from the network can be difficult.
- Third, ring topologies are not well suited for large networks.
- Finally, they are susceptible to broadcast storms.

Mesh Topology:

A mesh topology is a type of computer network in which each node (computer or other device) is connected to every other node in the network. This type of network is often used in large organisations or companies because it can handle a large amount of data traffic and can be easily expanded.

In a mesh topology, every node is connected to every other node in the network. This provides redundant paths between nodes and allows for every node to act as a router. A mesh topology is therefore very fault tolerant – if one link fails, there are alternate routes that can be taken.



Advantages:

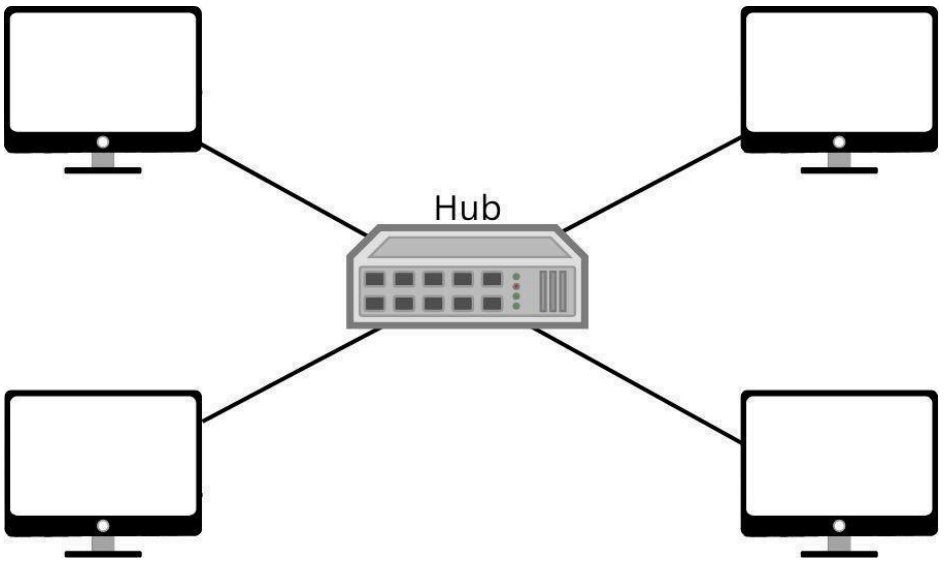
- It is very fault tolerant. If one node in the network goes down, the rest of the nodes can still communicate with each other.
- All nodes in a mesh network have a dedicated connection to every other node in the network. This means that there is no single point of failure and the network can continue to operate even if one node fails.

Disadvantages:

- It can be expensive to implement because each node needs its own dedicated connection to every other node in the network. This can make mesh topology impractical for large networks.
- Mesh topology can be complex to configure and manage.

Star Topology:

A Star topology is a type of network topology in which all the devices or nodes are physically connected to a central node such as a router, switch, or hub. The central node (hub) acts as a server, and the connecting nodes act as clients.



Advantages:

- Fast performance with few nodes and low network traffic.
- Hub can be upgraded easily.
- Easy to troubleshoot.
- Easy to set up and modify.

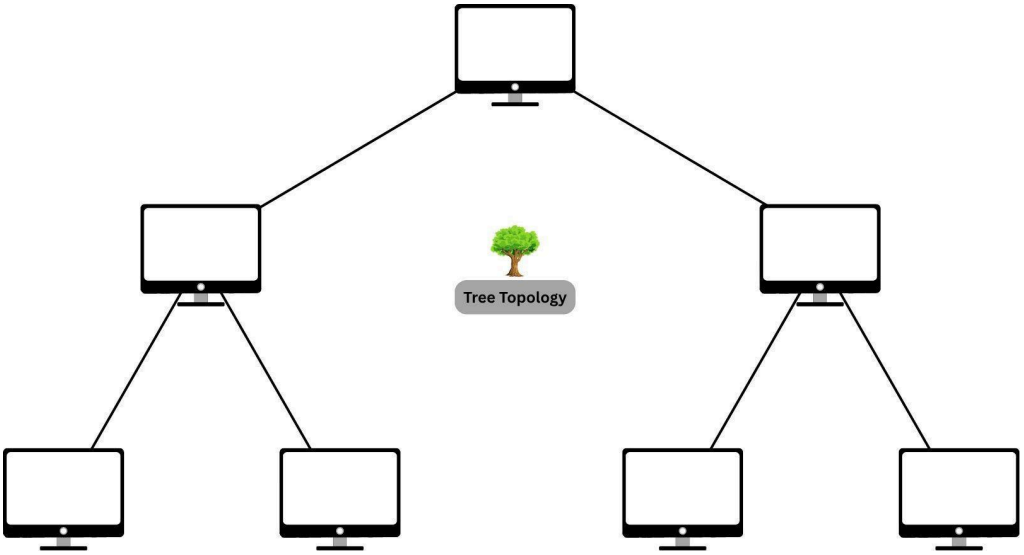
Disadvantages:

- Cost of installation is high.
- Expensive to use.
- If the hub is affected then the whole network is stopped because all the nodes depend on the
- hub.
- Performance is based on the.

Tree Topology:

A tree topology is a type of network topology that resembles a tree, with a root node at the top and leaves at the bottom. In computer networking, tree topologies are often used to create virtual LANs (VLANs).

In a tree topology, there is one central node (the "trunk"), and each node is connected to the central node through a single path. Nodes can be thought of as branches coming off of the trunk. Tree topologies are often used to create large networks.



Advantages:

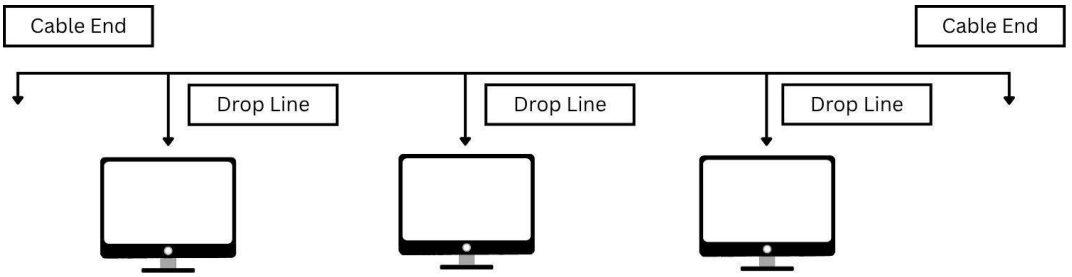
- It can support a large number of nodes.
- It can be easily expanded.
- Additionally, tree topologies are highly scalable and can be easily reconfigured.

Disadvantages:

- It can be difficult to troubleshoot issues in a tree topology as each node is connected to multiple other nodes. This can make it hard to identify where the issue is located.
- Tree topology can be less reliable than other topologies such as star or mesh as there are more potential points of failure. If one node goes down, it can affect the entire network.

Bus Topology:

It carries transmitted data through the cable because data reaches each node, the node checks the destination address (MAC/IP address) to determine if it matches their address. If the address does not match with the node, the node does nothing more. But if the addresses of nodes match to addresses contained within the data then they process knowledge. In the bus, communication between nodes is done through a foremost network cable



Advantages:

- It is the easiest network topology for linearly connecting peripherals or computers.
- It works very efficiently well when there is a small network.
- The length of cable required is less than a star topology.

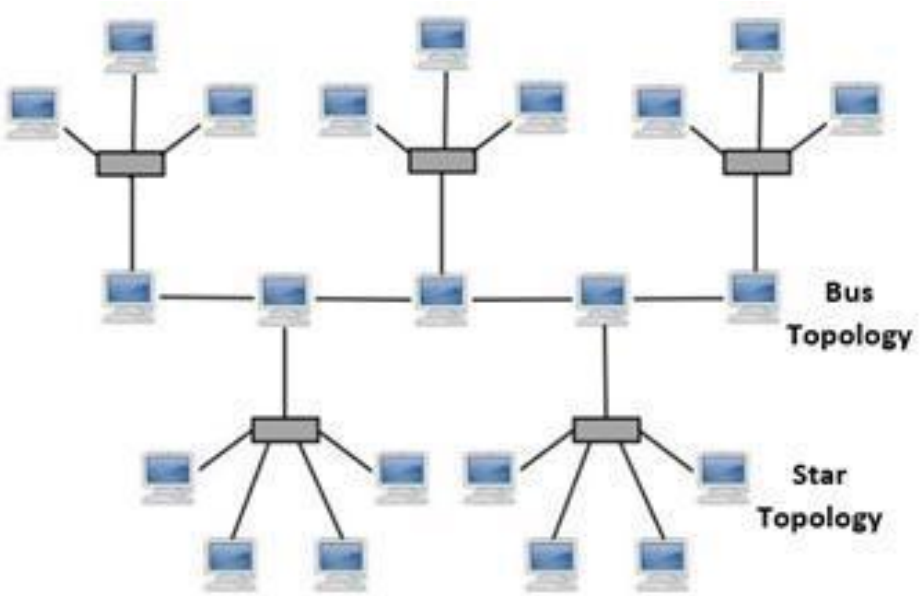
Disadvantages:

- Bus topology is not good for large networks.
- Identification of problems becomes difficult if the whole network goes down.
- Troubleshooting individual device issues is very hard.

Hybrid Topology:

It is a type of network topology that combines or integrates two or more types of topologies like star, bus, mesh, or ring to create a network infrastructure that offers the benefits of each topology while minimizing their disadvantages.

Hybrid topology, or hybrid network, is commonly used in large enterprise networks as it offers a scalable and flexible network infrastructure. However, when deciding on a hybrid topology, network performance and the number and location of computers are essential factors to consider.



Advantages:

- Adding a new node or deleting the existing node is easy in hybrid topologies.
- Hybrid topology is more secure, reliable, and scalable as compared to individual star, ring and mesh topology.
- Error detection and troubleshooting is easier in hybrid topology.

Disadvantages:

- Complex in design.
- Costly.

PRACTICAL : 2

AIM : To study and implement different categories of networks.

Theory:

What is Computer Network ?

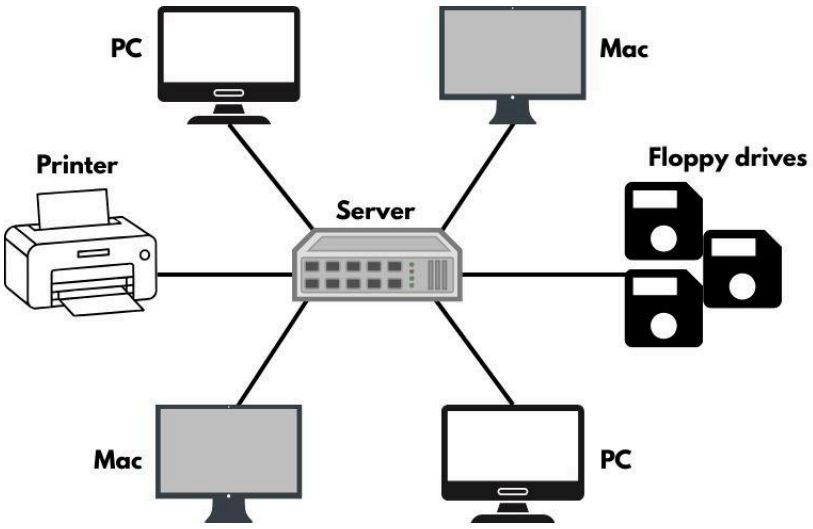
A computer network is a system in which multiple computers are connected to each other to share information and resources. The physical connection between networked computing devices is established using either cable media or wireless media. The best-known computer network is the Internet.

Types of Computer Network:

1. Local Area Network (LAN)
2. Metropolitan Area Network (MAN)
3. Wide Area Network (WAN):

LAN (Local Area Network):.

- It is privately-owned networks within a single building or campus of up to a few kilometers in size.
- They are widely used to connect personal computers and workstations in company offices and factories to share resources (e.g., printers) and exchange information.
- LANs are easy to design and troubleshoot
- In LAN, all the machines are connected to a single cable.
- Different types of topologies such as Bus, Ring, Star, and Tree are used.
- The data transfer rates for LAN is up to 10 Gbits/s.
- They transfer data at high speeds. The high transmission rate is possible in LAN because of the short distance between various computer networks.
- They exist in a limited geographical area



Advantages:

- LAN transfers data at high speed.
- LAN technology is generally less expensive.

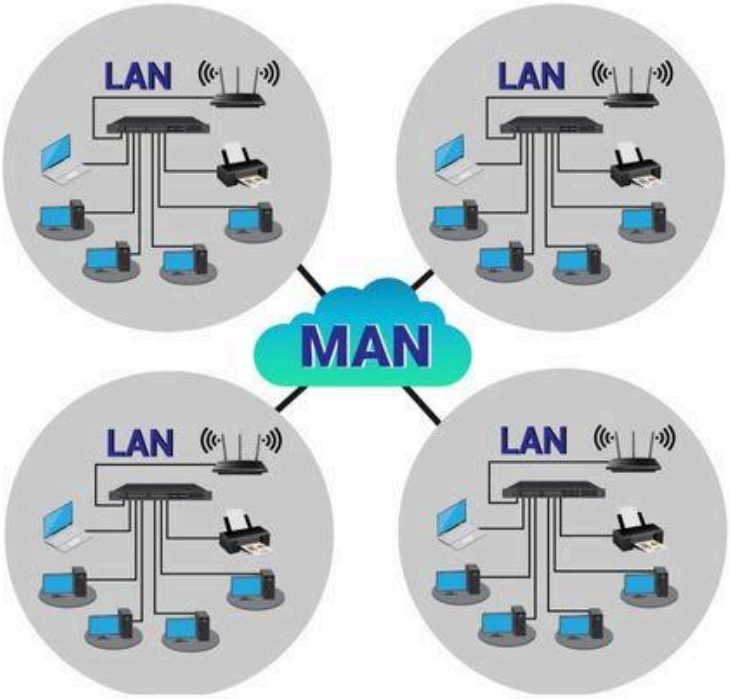
Disadvantages:

- Limited distance: Local area networks are used only in buildings or apartment complexes it cannot be occupied in bigger areas
- Single point of failure: LANs typically have a single point of failure, such as a central server. If this server fails, the entire network can go down.

Metropolitan Area Network (MAN):

- MAN is a larger version of LAN which covers an area that is larger than the covered by LAN but smaller than the area covered by WAN.
- A metropolitan area network or MAN covers a city. The best-known example of a MAN is the cable television network available in many cities.
- MAN connects two or more LANs.
- At first, the companies began jumping into the business, getting contracts from city governments to wire up an entire city.

- The next step was television programming and even entire channels designed for cable only.



Advantage:

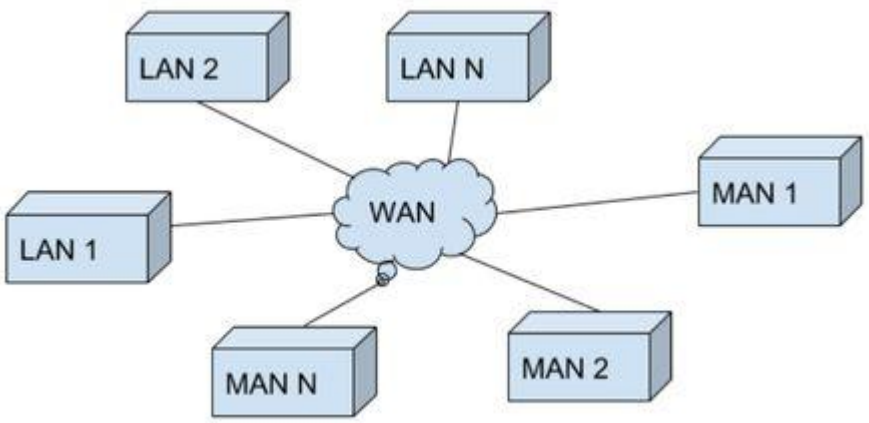
- Cost-effective: Compared to WANs, MANs are more cost-effective to implement and maintain.
- Less expensive: MAN implementation cost is less than WAN because MAN requires fewer resources as compared to WAN. It saves implementation costs.
- Security: MAN provides more security as compared to WAN and it is easy to implement.

Disadvantage:

- Wire required: more cables are required to connect MAN from one place to another. MAN requires fiber optics cables which are quite expensive.
- Technical assistance: Here, skilled technicians and administrators are required. This can overall increase the installation cost.
- Difficult to manage.

Wide Area Network (WAN):

- WAN spans a large geographical area, often a country or region.
- WAN links different metropolitan's countries and national boundaries thereby enabling easy communication.
- It may be located entirely within a state or a country or it may be interconnected around the world.
- It contains a collection of machines intended for running user (i.e., application) programs.
- We will follow traditional usage and call these machines hosts.
- The communication between different users of WAN is established using leased telephone lines or satellite links and similar channels.



Advantages:

- Higher bandwidth: WAN networks usually cover large geographical areas. Ex.1000 km or more than the wide area network has higher bandwidth than LAN and MAN networks.
- **Large area coverage:** WAN covers a large geographical area(1000 km or more than). Ex. If your business office is situated in another country and you live in another country then WAN is a platform to communicate with each other(i.e. you and your office staff members).

Disadvantages:

- **Installation cost:** WANs are default complex and complicated because of large geographical area coverage. Hence there is a set-up cost in expensive WAN that also needs routers, switches, and other security solutions.
- **Troubleshooting issues:** Troubleshoot the big challenge on the WAN network and it requires more time. If any issue occurs in the computer network then it is the most difficult part to find out the proper cause due to their broad coverage area.

PRACTICAL : 3

AIM : To study different types of transmission media.

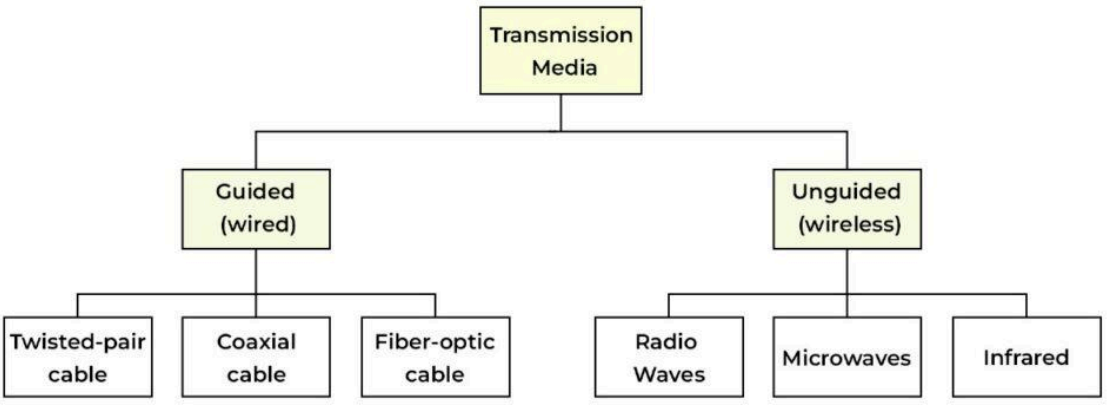
Theory:

What is Transmission media ?

A transmission media can be defined as anything that can carry information from a source to a destination. On the basis of transmission of data, the transmission media can be classified into two categories:

1. Guided (Physical) transmission media
2. Unguided (Wireless) transmission media

Classification of Transmission Media:



Guided Transmission Media:

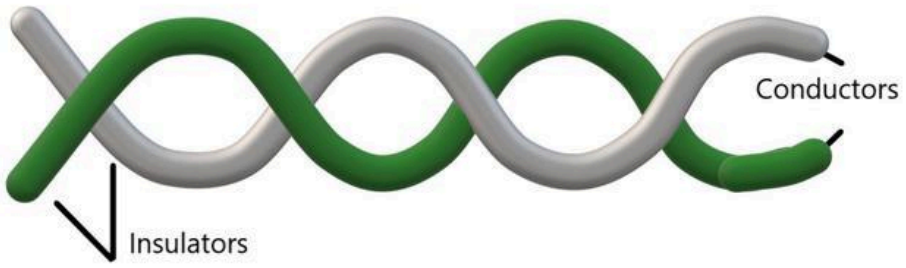
Guided media are those that provide a channel from one device to another.

The three Guided (Physical) media commonly used for data transmission are:

1. Twisted-Pair
2. Coaxial
3. Fiber Optics

1.Twisted Pair:

- A twisted pair consists of two insulated copper wires, typically about 1 mm thick.
- The wires are twisted together in a helical form, just like a DNA molecule.
- Twisting is done because two parallel wires constitute a fine antenna.
- When the wires are twisted, the waves from different twists cancel out, so the wire radiates less effectively.



Why cable is twisted?

If the two wires are parallel, the effect of these unwanted signals is not the same in both wires because they are at different locations relatives to the noise or crosstalk sources.

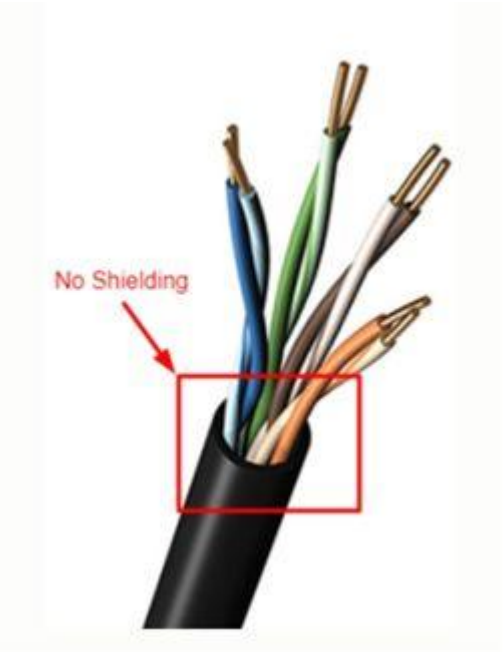
This results in a difference at the receiver. By twisting the pair, a balance is maintained.

Types of Twisted-Pair Cable :

1) Unshielded twisted-pair (UTP):

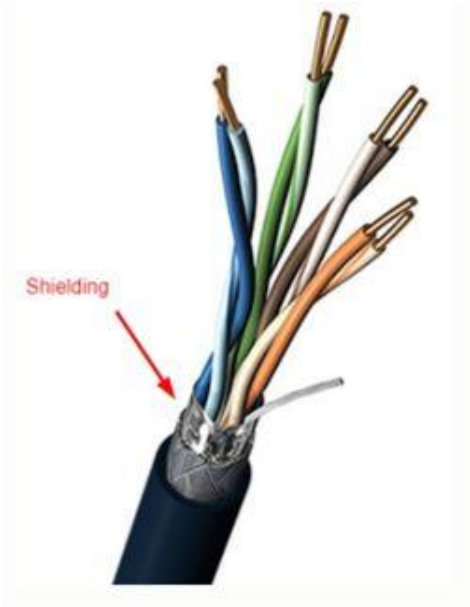
- Twisted pair cabling comes in several varieties, two of which are important for computer networks.
- Category 3 twisted pairs consist of two insulated wires gently twisted together.
- Most office buildings had one category 3 cable running from a central wiring closet on each floor into each office.
- Category 5 is the more advanced twisted pairs were introduced.

- They are similar to category 3 pairs, but with more twists per centimeter, which results in less crosstalk and a better-quality signal over longer distances, making them more suitable for high - speed computer communication.
- Up-and-coming categories are 6 and 7, which are capable of handling signals with bandwidths of 250 MHz and 600 MHz



2) Shielded twisted-pair (STP).

- STP cable has a metal foil or braided mesh covering that encases each pair of insulated conductors.
- Metal casing improves the quality of cable by preventing the penetration of noise or crosstalk.
- It is bulkier and more expensive.

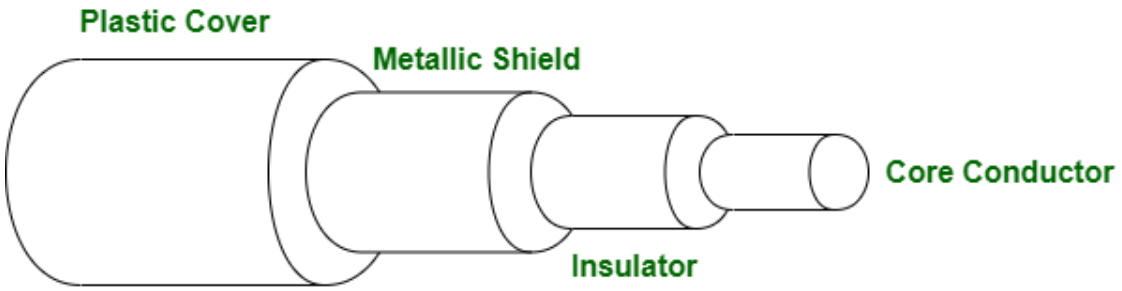


Applications:

- Used in telephone lines to provide voice and data channels.
- The DSL lines use by telephone companies use the high-bandwidth capability of UTP cables.
- LANs, such as 10Base-T, 100Base-T also uses twisted-pair cables.

2. Coaxial Cable

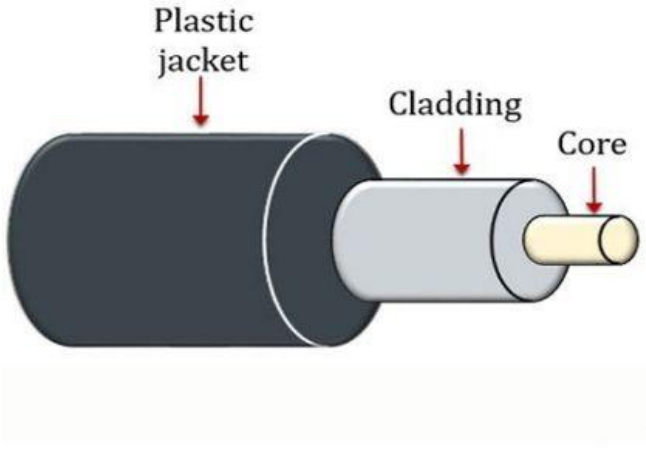
- It has better shielding than twisted pairs, so it can span longer distances at higher speeds.
- Two kinds of the coaxial cable are widely used. One kind is a 50-ohm cable which is commonly used when it is intended for digital transmission from the start.
- The other kind is a 75-ohm cable which is commonly used for analog transmission and cable television but is becoming more important with the advent of the Internet over cable.
- A coaxial cable consists of stiff copper wire as the core surrounded by an insulating material.
- The insulator is encased by a cylindrical conductor, often as a closely-woven braided mesh.
- The outer conductor is covered in a protective plastic sheath.
- The construction and shielding of the coaxial cable give it a good combination of high bandwidth and excellent noise immunity.
- The bandwidth possible depends on the cable quality, length, and signal-to-noise ratio of the data signal. Modern cables have a bandwidth of close to 1 GHz.



Coaxial Cable

3. Fiber Optics

- A fiber-optic cable is made of glass or plastic and transmits signals in the form of light.
- Optical fibers use reflection to guide light through a channel.
- A glass or plastic core is surrounded by a cladding of less dense glass or plastic.
- The figure shows a single fiber viewed from the side. At the center is the glass core through which the light propagates.
- The core is surrounded by a glass cladding with a lower index of refraction than the core, to keep all the light in the core.
- Next comes a thin plastic jacket to protect the cladding. Fibers are typically grouped in bundles,
- protected by an outer sheath. The figure shows a sheath with three fibers.



Unguided (Wireless) Transmission Media:

Unguided media transport electromagnetic waves without using a physical conductor. This type of communication is often referred to as wireless communication.

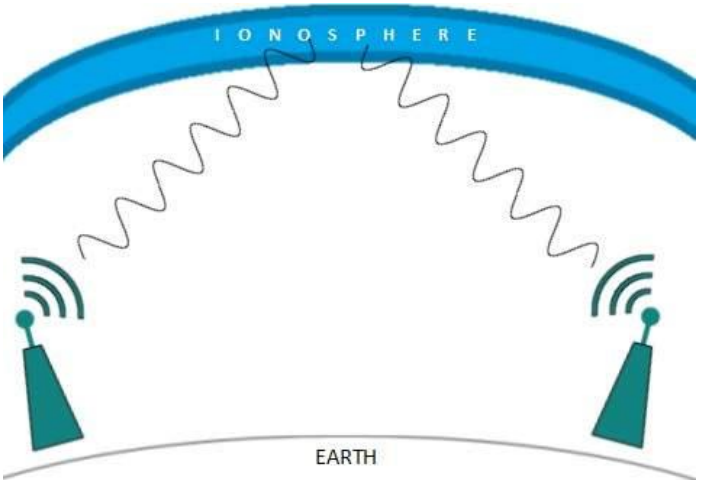
1. Radio Transmission

2. Microwave Transmission

3. Infrared

1. Radio Transmission:

- Radio waves are easy to generate, can travel long distances, and can penetrate buildings easily, so they are widely used for communication, both indoors and outdoors.
- Radio waves also are omnidirectional, meaning that they travel in all directions from the source, so the transmitter and receiver do not have to be carefully aligned physically.
- The properties of radio waves are frequency dependent.
- At low frequencies, radio waves pass through obstacles well, but the power falls off sharply with distance from the source, roughly as 1/r2 in the air.
- At high frequencies, radio waves tend to travel in straight lines and bounce off obstacles. They are also absorbed by rain.
- At all frequencies, radio waves are subject to interference from motors and other electrical equipment.



2. Microwave Transmission:

- Since the microwaves travel in a straight line, if the towers are too far apart, the earth will get in the way. Consequently, repeaters are needed periodically.
- Unlike radio waves at lower frequencies, microwaves do not pass through buildings well. In addition, even though the beam may be well focused at the transmitter, there is still some divergence in space.
- Above 100 MHz, the waves travel in straight lines and can, therefore, be narrowly focused.
- Concentrating all the energy into a small beam using a parabolic antenna gives a much higher signal to noise ratio.

Advantages:

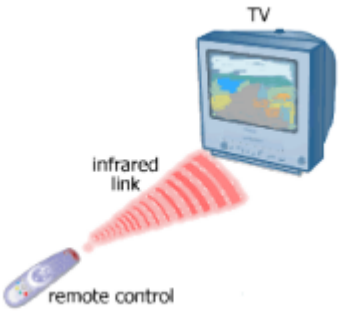
- No right way is needed (compared to wired media).
- Relatively inexpensive.
- Simple to install.

Disadvantages:

- Do not pass through buildings well.
- Multipath fading problem (the delayed waves cancel the signal).
- Absorption by rain above 8 GHz.
- A severe shortage of spectrum.

3. Infrared:

- Unguided infrared and millimetre waves are widely used for short-range communication.
- The remote controls used on televisions, VCRs, and stereos all use infrared communication.
- They are relatively directional, cheap, and easy to build but have a major drawback: they do not pass through solid objects (try standing between your remote control and your television and see if it still works).
- In general, as we go from long-wave radio toward visible light, the waves behave more and more like light and less and less like a radio.



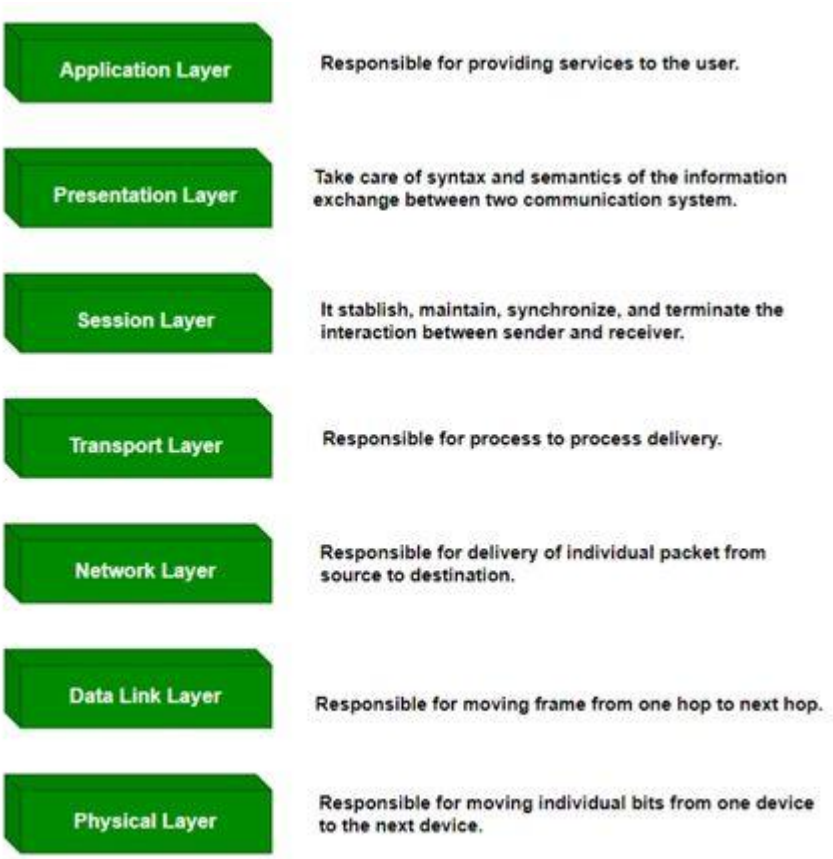
PRACTICAL : 4

AIM : To compare OSI and TCP/IP protocol Model.

Theory:

What is OSI model ?

OSI stands for Open Systems Interconnection.It has 7 layers Physical layer, Data Link layer, Network layer, Transport layer, Session layer, Presentation layer, and Application layer. Each layer performs its task independently. It was developed in 1984 by the International Organization for Standardization (ISO).



How does Data Flow in OSI Model ?

The data flow in the OSI (Open Systems Interconnection) model describes how data is transmitted from one device to another through the seven layers of the OSI model. This process involves encapsulation and decapsulation at each layer to ensure proper data transmission and reception.

The data flow in the OSI model involves encapsulating data at each layer on the sender side, transmitting it over the network, and decapsulating it at each layer on the receiver side to ensure the data reaches its intended destination correctly and reliably.

Advantages

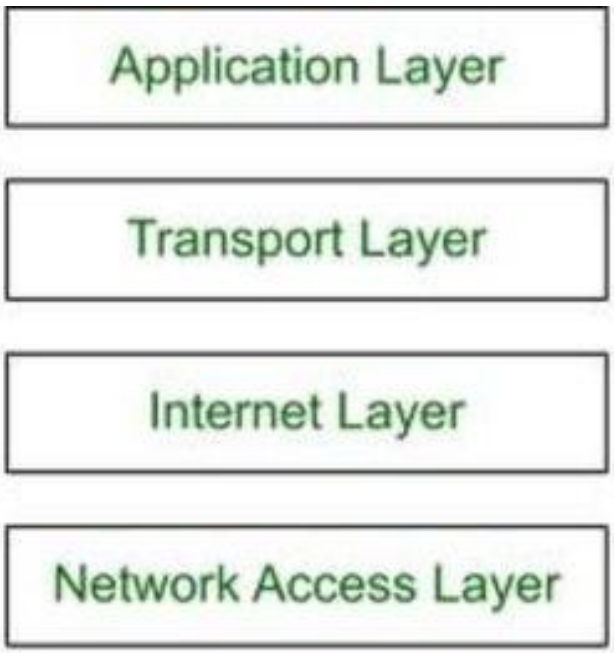
- Both connection-oriented services and connectionless services are supported.
- It is quite flexible.
- All the layers work independently.

Disadvantages

- Setting up a model is a challenging task.
- Sometimes, it becomes difficult to fit a new protocol into this model.
- It is only used as a reference model.

What is TCP/IP Model ?

TCP/IP stands for Transmission Control Protocol/Internet Protocol. It has 4 layers named as Physical layer, Network layer, Transport layer, and Application layer. It also can be used as a communications protocol in a private computer network. It was designed by Vint Cerf and Bob Kahn in the 1970s.



When Sending Data (From Sender to Receiver):

- Application Layer: Prepares user data using protocols like HTTP, FTP, or SMTP.
- Transport Layer (TCP/UDP): Breaks data into segments and ensures reliable (TCP) or fast (UDP) delivery.
- Internet Layer (IP): Adds IP addresses and decides the best route for each packet.
- Link Layer (Network Access Layer): Converts packets into frames and sends them over the physical network.

When Receiving Data (At the Destination):

- Link Layer: Receives bits from the network and rebuilds frames to pass to the next layer.

- Internet Layer: Checks the IP address, removes the IP header, and forwards data to the Transport Layer.
- Transport Layer: Reassembles segments, checks for errors, and ensures data is complete.
- Application Layer: Delivers the final data to the correct application (e.g., displays a web page in the browser).

Advantages

- Many Routing protocols are supported.
- It is highly scalable and uses a client-server architecture.
- It is lightweight.

Disadvantages

- Little difficult to set up.
- Delivery of packets is not guaranteed by the transport layer.
- Vulnerable to a synchronization attack.

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