COMPUTER COMMUNICATION AND NETWORKS

BCA III SEM(NEP)

NOTES

Prepared By

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UNIT – II

The Physical Layer: Transmission Media – Twisted pair, coaxial cable, optical fiber, radio transmission, microwaves and infrared transmission, Switching – message switching, Multiplexing.

Transmission Media

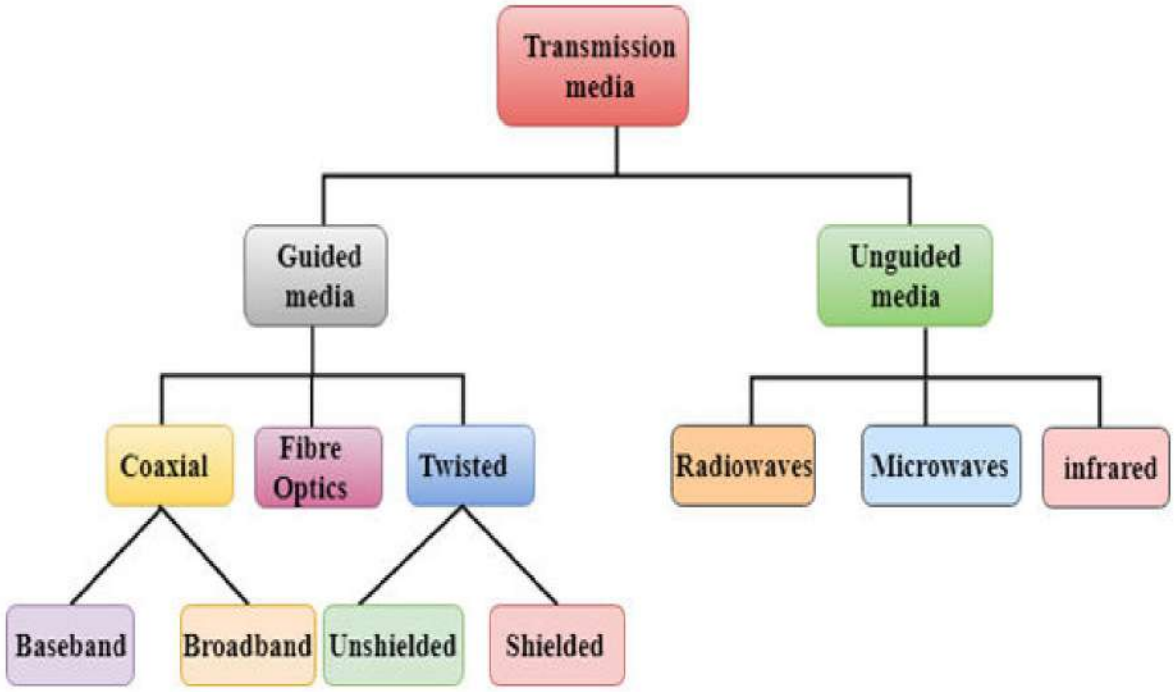
Transmission media is a communication channel that carries the information from the sender to the receiver. Data is transmitted through the electromagnetic signals or in the form light.

The main functionality of the transmission media is to carry the information in the form of bits through LAN(Local Area Network).

Design factors of the transmission media:

- **Bandwidth:** All the factors are remaining constant, 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 get destroyed due to transmission impairment.
- **Interference**: An interference is defined as the process of disrupting a signal when it travels over a communication medium on the addition of some unwanted signal.

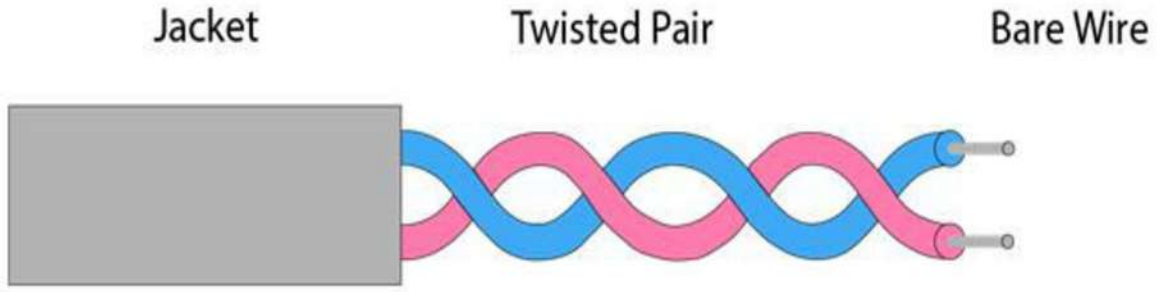
Classification Of Transmission Media:

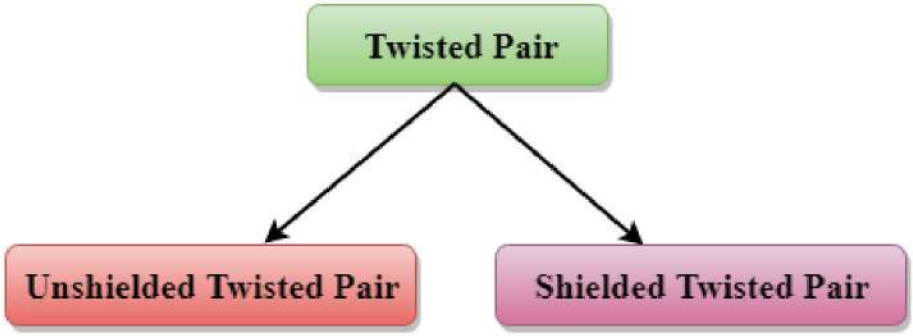


1. Guided Media: It is also referred to as Wired or Bounded transmission media. Signals being transmitted are directed and confined in a narrow pathway by using physical links.

Twisted Pair:

- These are used in local telephone communication and short distance digital transmission.
- Twisted pair is a physical media made up of a pair of cables twisted with each other.
- A twisted pair cable is cheap as compared to other transmission media. Installation of the twisted pair cable is easy, and it is a lightweight cable. The frequency range for twisted pair cable is from 0 to 3.5KHz.





1. Unshielded Twisted Pair:

An unshielded twisted pair is widely used in telecommunication. Following are the categories of the unshielded twisted pair cable:

- **Category 1:** Category 1 is used for telephone lines that have low-speed data.
- **Category 2:** It can support up to 4Mbps.
- **Category 3:** It can support up to 16Mbps.

- **Category 4:** It can support up to 20Mbps. Therefore, it can be used for long-distance communication.
- **Category 5:** It can support up to 200Mbps.

Advantages Of Unshielded Twisted Pair:

- It is cheap.
- Installation of the unshielded twisted pair is easy.
- It can be used for high-speed LAN.

Disadvantage:

- This cable can only be used for shorter distances because of attenuation.

2. Shielded Twisted Pair:

A shielded twisted pair is a cable that contains the mesh surrounding the wire that allows the higher transmission rate.

Characteristics Of Shielded Twisted Pair:

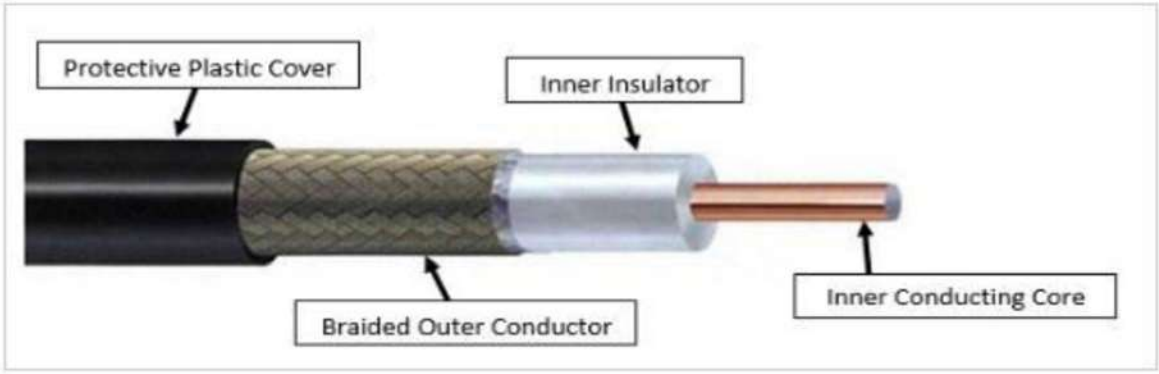
- The cost of the shielded twisted pair cable is not very high and not very low.
- An installation of STP is easy.
- It has higher capacity as compared to unshielded twisted pair cable.
- It has a higher attenuation.
- It is shielded that provides the higher data transmission rate.

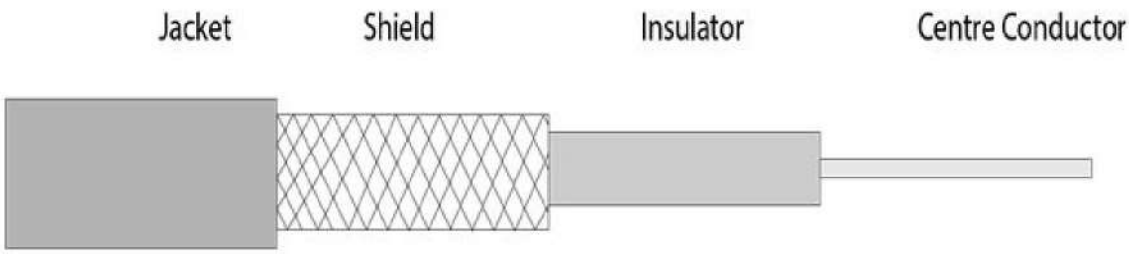
Disadvantages

- It is more expensive as compared to UTP and coaxial cable.
- It has a higher attenuation rate.

Sheilded Twisted Pair (STP)

Coaxial Cable:





Coaxial cables, commonly called coax, are copper cables with metal shielding designed to provide immunity against noise and greater bandwidth. Coax can transmit signals over larger distances at a higher speed as compared to twisted pair cables.

- Coaxial cable is very commonly used transmission media, for example, TV wire is usually a coaxial cable.
- The name of the cable is coaxial as it contains two conductors parallel to each other.
- It has a higher frequency as compared to Twisted pair cable.
- The inner conductor of the coaxial cable is made up of copper, and the outer conductor is made up of copper mesh. The middle core is made up of non-conductive cover that separates the inner conductor from the outer conductor.
- The middle core is responsible for the data transferring whereas the copper mesh prevents from the **EMI**(Electromagnetic interference).

Structure of coaxial cable:

Coax has a central core of stiff copper conductor for transmitting signals. This is covered by an insulating material. The insulator is encased by a closely woven braided metal outer conductor that acts as a shield against noise. The outer conductor is again enclosed by a plastic insulating cover.

Advantages Of Coaxial cable:

- The data can be transmitted at high speed.
- It has better shielding as compared to twisted pair cable.
- It provides higher bandwidth.

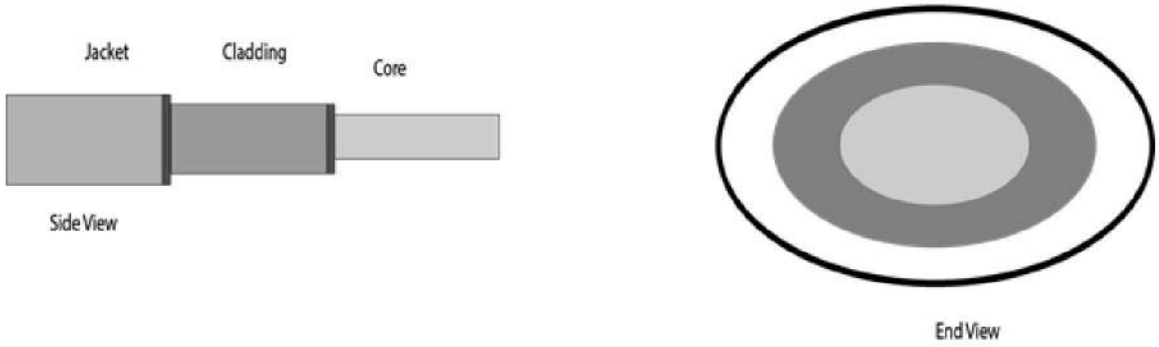
Disadvantages Of Coaxial cable:

- It is more expensive as compared to twisted pair cable.
- If any fault occurs in the cable causes the failure in the entire network.

Optical Fiber:

- Fibre optic cable is a cable that uses electrical signals for communication.
- Fibre optic is a cable that holds the optical fibers coated in plastic that are used to send the data by pulses of light.
- The plastic coating protects the optical fibers from heat, cold, electromagnetic interference from other types of wiring.
- Fibre optics provide faster data transmission than copper wires.

Diagrammatic representation of fibre optic cable:



Basic elements of Fibre optic cable:

- **Core:** The optical fibre consists of a narrow strand of glass or plastic known as a core. A core is a light transmission area of the fibre. The more the area of the core, the lighter will be transmitted into the fibre.
- **Cladding:** The concentric layer of glass is known as cladding. The main functionality of the cladding is to provide the lower refractive index at the core interface as to cause the reflection within the core so that the light waves are transmitted through the fibre.
- **Jacket:** The protective coating consisting of plastic is known as a jacket. The main purpose of a jacket is to preserve the fibre strength, absorb shock and extra fibre protection.

Following are the advantages of fibre optic cable over copper:

- **Greater Bandwidth:** The fibre optic cable provides more bandwidth as compared copper. Therefore, the fibre optic carries more data as compared to copper cable.

- **Faster speed:** Fibre optic cable carries the data in the form of light. This allows the fibre optic cable to carry the signals at a higher speed.
- **Longer distances:** The fibre optic cable carries the data at a longer distance as compared to copper cable.
- **Better reliability:** The fibre optic cable is more reliable than the copper cable as it is immune to any temperature changes while it can cause obstruct in the connectivity of copper cable.
- **Thinner and Sturdier:** Fibre optic cable is thinner and lighter in weight so it can withstand more pull pressure than copper cable.

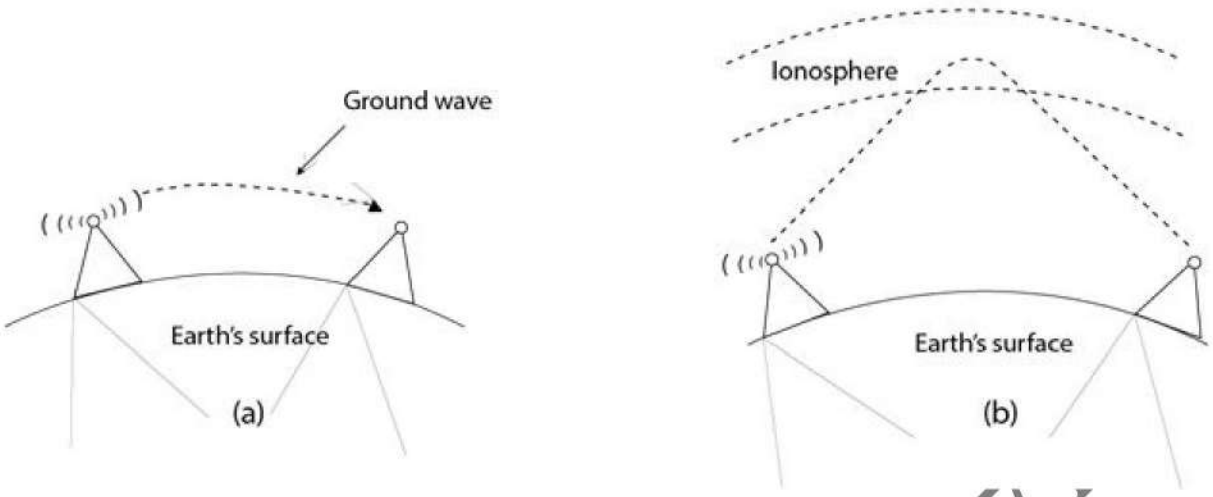
2. Unguided media (Radio Transmission):

It is also referred to as Wireless or Unbounded transmission media. No physical medium is required for the transmission of electromagnetic signals.

- An unguided transmission transmits the electromagnetic waves without using any physical medium. Therefore, it is also known as **wireless transmission**.
- In unguided media, air is the media through which the electromagnetic energy can flow easily.

Radio waves

- Radio waves are the electromagnetic waves that are transmitted in all the directions of free space.
- Radio waves are omnidirectional, i.e., the signals are propagated in all the directions.
- The range in frequencies of radio waves is from 3Khz to 1 khz.
- In the case of radio waves, the sending and receiving antenna are not aligned, i.e., the wave sent by the sending antenna can be received by any receiving antenna.
- An example of the radio wave is **FM radio**.



Applications Of Radio waves:

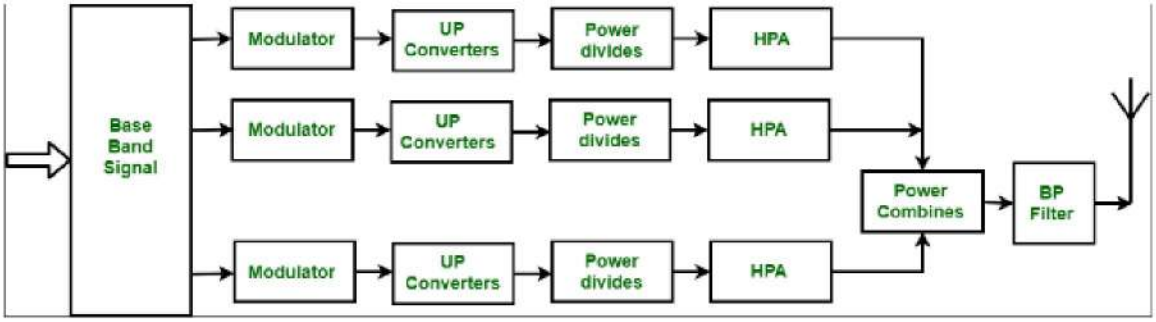
- A Radio wave is useful for multicasting when there is one sender and many receivers.
- An FM radio, television, cordless phones are examples of a radio wave.

Advantages Of Radio transmission:

- Radio transmission is mainly used for wide area networks and mobile cellular phones.
- Radio waves cover a large area, and they can penetrate the walls.
- Radio transmission provides a higher transmission rate.

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.



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.

Differences:

S.No	Basis	Radiowave	Microwave	Infrared wave
1.	Direction	These are omni-directional in nature.	These are unidirectional in nature.	These are unidirectional in nature.
2.	Penetration	At low frequency, they can penetrate through solid objects and walls but high frequency they bounce off the obstacle.	At low frequency, they can penetrate through solid objects and walls. at high frequency, they cannot penetrate.	They cannot penetrate through any solid object and walls.
3.	Frequency range	Frequency range: 3 KHz to 1GHz.	Frequency range: 1 GHz to 300 GHz.	Frequency range: 300 GHz to 400 GHz.
4.	Security	These offers poor security.	These offers medium security.	These offers high security.
5.	Attenuation	Attenuation is high.	Attenuation is variable.	Attenuation is low.

Switching:

Switching is the mechanism in computer networks that helps in deciding the best route for data transmission if there are multiple paths in a larger network.

Larger networks may have multiple routes to link the sender and receiver. So, whenever we send any information between the sender and receiver then the information switches through multiple routes.

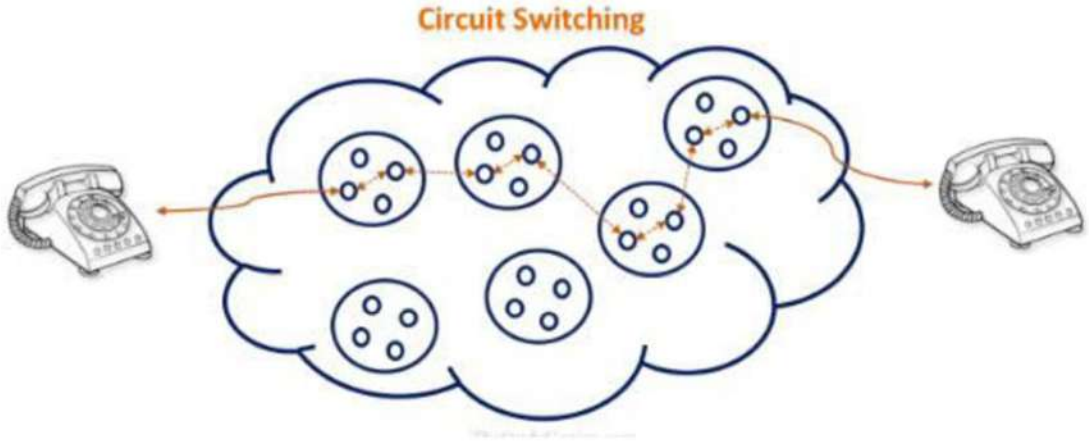
Whenever we the send the information from one device to another, that information does not directly reach that device. There are many intermediate nodes in the middle, and the information switches through these nodes.

Types of switching techniques:

1. **Circuit Switching:**
2. **Message Switching:**
3. **Packet switching:**

1. Circuit Switching:

In circuit switching a **dedicated channel** is established for a single connection where the sender and receiver can communicate during the communication session.



In circuit switching technique that creates a pre-specific route between the sender and receiver and this route is reserved for both these devices as the connection is active.

This type of network switching was designed and used in the early analog telephone network.

3 phases of circuit switching:

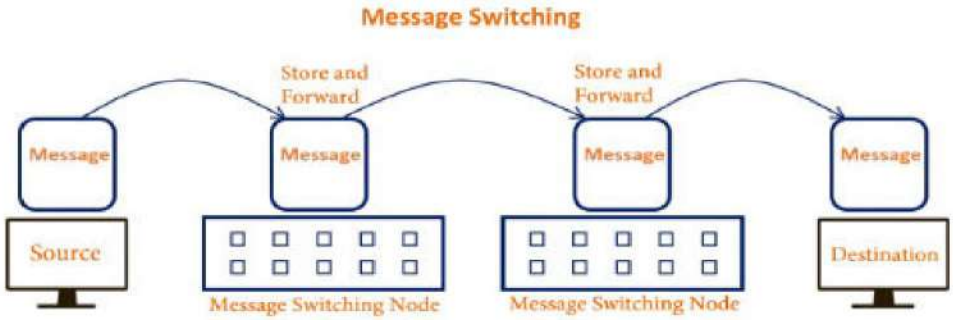
1. Establish a circuit: In the first phase a circuit (dedicated link) is established between sender and receiver through several switching nodes.
2. Transfer the data: Once the connection is established, now communication devices can transfer the data.
3. Disconnect the circuit: Once the connection

2. Message Switching – store and forward network

There is no dedicated path established between the sender and receiver in message switching, as in circuit switching.

For sending the message there are many intermediary messages switching nodes that are responsible for transferring the message, and the message is transmitted as a whole from the source node to destination node.

In message switching, when the source node sends a message the destination address is appended to the message. So, in message switching there is no need to establish a dedicated path between the communication nodes.



Whenever sender sends a message , the message sends as a whole to the next message switching, store it in its entirely on the disk, and then transmit the whole message to the next switching node and so on, until the message reaches the destination. If the next switching node does not have enough space to store the message, the previous switching node has to wait.

3. Packet switching:

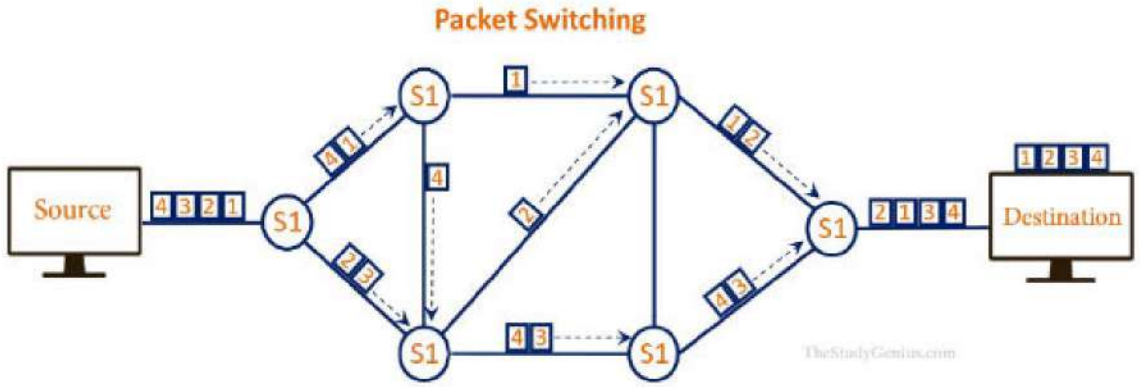
In this network type, no specific path is used for data transfer. Instead, the data is chopped up into small pieces called packets and sent over the network.

The packets can be routed, combined, or fragmented, as required to get them to their eventual destination.

There are two major types of packet switching:

Connectionless Packet Switching: This classic type of packet switching includes multiple packets, each individually routed. This means each packet contains complete routing information—but it also means different paths of transmission and out-of-order delivery are possible,

Connection-Oriented Packet Switching: In connection-oriented packet switching, also called virtual circuit switching or circuit switching, data packets are first assembled and then numbered. They then travel across a predefined route, sequentially. Address information is not needed in circuit switching, because all packets are sent in sequence.



Circuit Switching	Message Switching	Packet Switching
There is physical connection b/w transmitter and receiver	No physical path is set in advance b/w transmitter and receiver	No physical path is established b/w transmitter and receiver
All the packet uses same path	Packet are stored and forward	Packet travels independently
Need an end to end path before the data transmission	No need of end to end path before data transmission	No need of end to end path before data transmission
Reserves the entire bandwidth in advance	Does not reserve the bandwidth in advance	Does not reserve the bandwidth in advance
Waste of bandwidth is possible	No waste of bandwidth	No waste of bandwidth
It cannot support store and forward transmission	It support store and forward transmission	It support store and forward transmission
Not suitable for handling interactive traffic	Suitable for handling interactive traffic	Suitable for handling interactive traffic

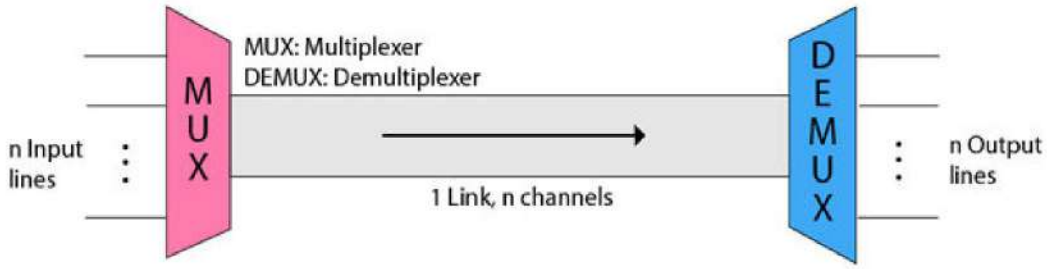
Multiplexing: Multiplexing is a technique used to combine and send the multiple data streams over a single medium. The process of combining the data streams is known as multiplexing and hardware used for multiplexing is known as a multiplexer.

Multiplexing is achieved by using a device called Multiplexer (**MUX**) that combines n input lines to generate a single output line. Multiplexing follows many-to-one, i.e., n input lines and one output line.

Demultiplexing is achieved by using a device called Demultiplexer (**DEMUX**) available at the receiving end.

Why multiplexing?

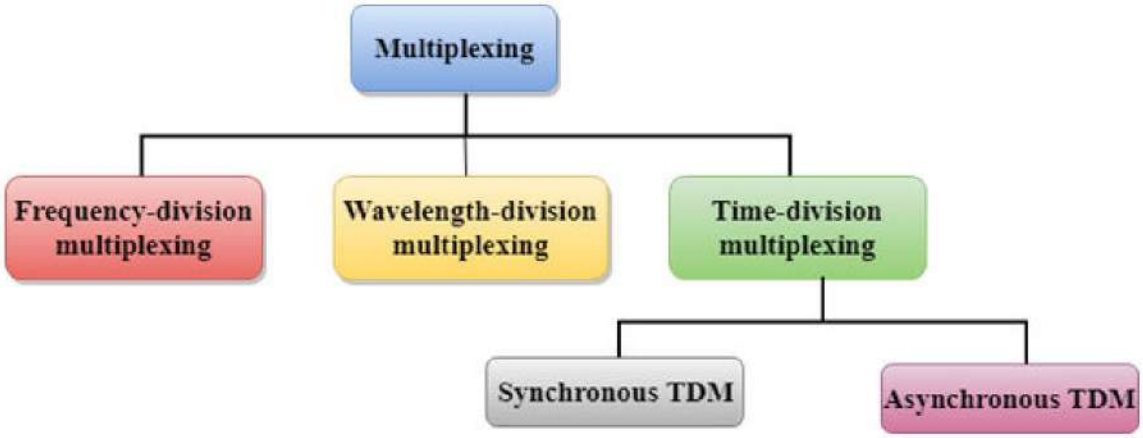
- The transmission medium is used to send the signal from sender to receiver. The medium can only have one signal at a time.
- If there are multiple signals to share one medium, then the medium must be divided in such a way that each signal is given some portion of the available bandwidth.



- The 'n' input lines are transmitted through a multiplexer and multiplexer combines the signals to form a composite signal.
- The composite signal is passed through a Demultiplexer and demultiplexer separates a signal to component signals and transfers them to their respective destinations.

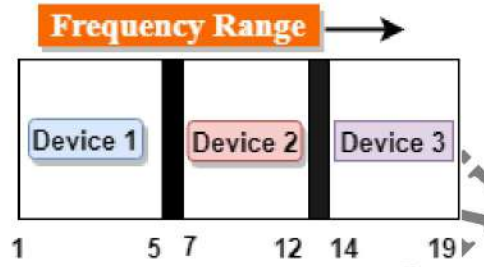
Advantages of Multiplexing:

- More than one signal can be sent over a single medium.
- The bandwidth of a medium can be utilized effectively.



Frequency-division Multiplexing (FDM)

- It is an analog technique.
- **Frequency Division Multiplexing** is a technique in which the available bandwidth of a single transmission medium is subdivided into several channels.



- In the above diagram, a single transmission medium is subdivided into several frequency channels, and each frequency channel is given to different devices. Device 1 has a frequency channel of range from 1 to 5.
- The input signals are translated into frequency bands by using modulation techniques, and they are combined by a multiplexer to form a composite signal.
- The main aim of the FDM is to subdivide the available bandwidth into different frequency channels and allocate them to different devices.
- Using the modulation technique, the input signals are transmitted into frequency bands and then combined to form a composite signal.

- The carriers which are used for modulating the signals are known as **sub-carriers**. They are represented as f1,f2..fn.
- **FDM** is mainly used in radio broadcasts and TV networks.

Advantages Of FDM:

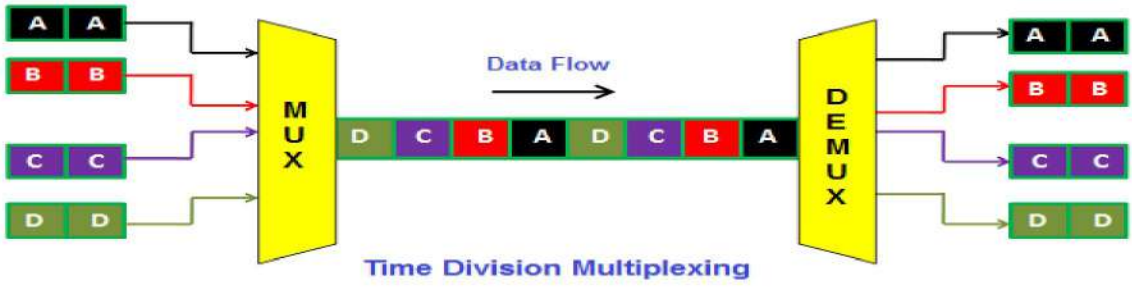
- FDM is used for analog signals.
- FDM process is very simple and easy modulation.

Disadvantages Of FDM:

- FDM technique is used only when low-speed channels are required.
- It suffers the problem of crosstalk.

Time Division Multiplexing

- It is a digital technique.
- In Frequency Division Multiplexing Technique, all signals operate at the same time with different frequency, but in case of Time Division Multiplexing technique, all signals operate at the same frequency with different time.
- In **Time Division Multiplexing technique**, the total time available in the channel is distributed among different users. Therefore, each user is allocated with different time interval known as a Time slot at which data is to be transmitted by the sender.
- A user takes control of the channel for a fixed amount of time.
- In Time Division Multiplexing technique, data is not transmitted simultaneously rather the data is transmitted one-by-one.
- In TDM, the signal is transmitted in the form of frames. Frames contain a cycle of time slots in which each frame contains one or more slots dedicated to each user.



COMPUTER COMMUNICATION AND NETWORKS

BCA III SEM(NEP)

UNIT-WISE

QUESTION BANK

UNIT-I & II

Submission Due Date: 24/11/2022

2 Marks

1. Mention the applications of networks.
2. Differentiate guided and unguided transmission media.
3. Define the term protocol.
4. What is network topology? Mention the types of it.
5. List the functions of data link layer.
6. Define communication network? Give example.
7. What is a wireless LAN?
8. Mention various network topologies.
9. Expand LAN, WAN, MAN
10. Write the advantages and disadvantages of ring topology.
11. What is multiplexing? List types of switching techniques.
12. What is message switching?
13. What is packet switching?
14. What is connection oriented packet switching & connectionless packet switching?.
15. Differntiate Circuit switching, packet switching, message switching.
16. What is multiplexing? Types of multiplexing.
17. Define demultiplexing?
16. What FDM & TDM? Explain.

5/10 Marks

1. Describe the optical fiber transmission medium with a neat diagram.
2. Write a short note on WAN.
3. Explain TCP/IP reference model.
4. Explain OSI reference model. (imp)
5. Write a note on twisted pair and coaxial cable.
6. What are guided and unguided transmission media? Explain coaxial cable medium.
7. Write a note on LAN.
8. Discuss the advantages of networks.
9. Explain optical fiber and coaxial cable transmission media.
10. Differentiate packet and circuit switching.
11. Differentiate LAN, MAN and PAN.
12. What is network topology. Explain types of topologies.
13. Write a note on ring and mesh topology.