Computer Networks

BCST -502 BCSP- 502

B.Tech (CSE) 5th Semester

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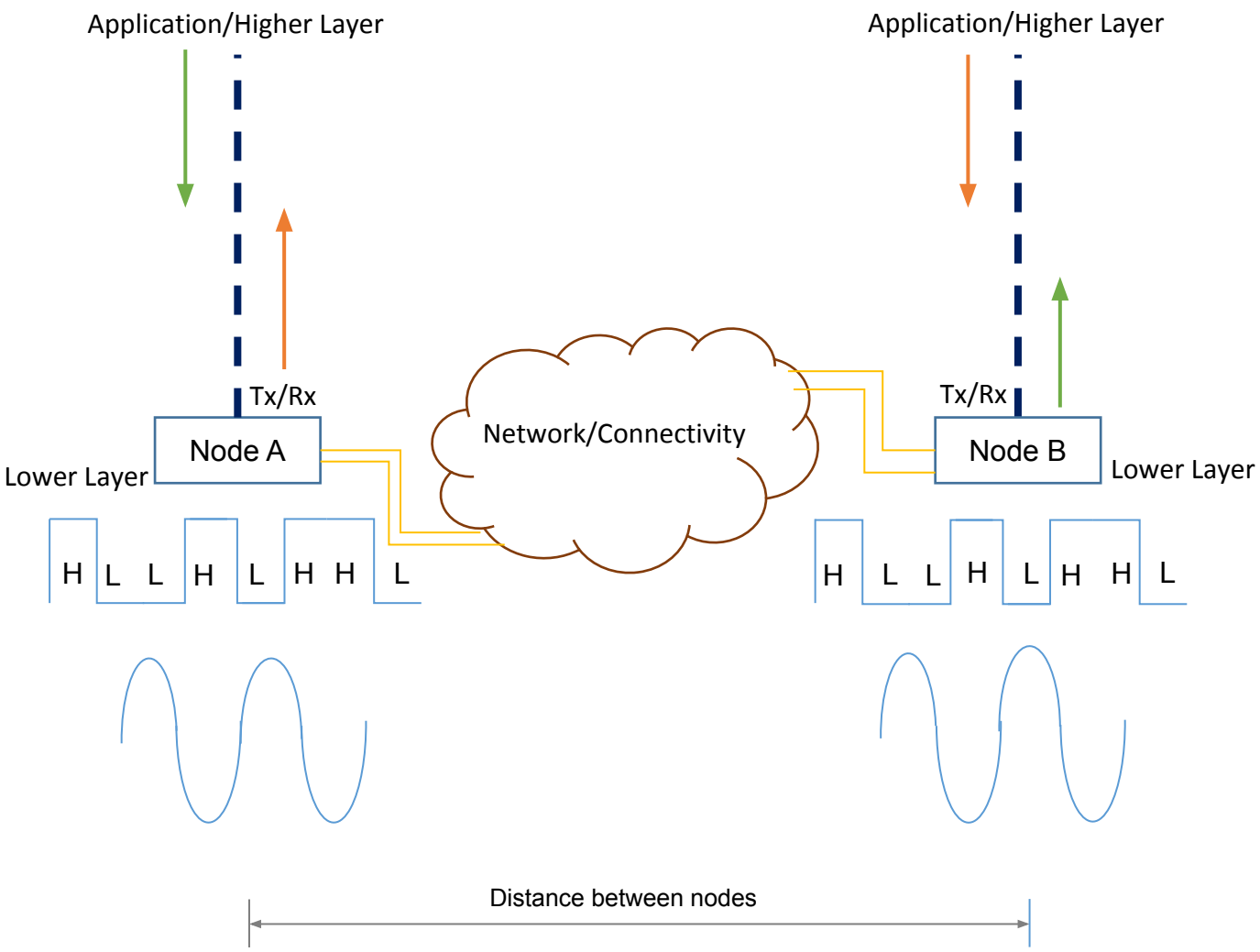
Contents

Physical Layer: Introduction



Physical layer represent the lowest layer of the OSI Model where the actual transfer of data take place.

- Transfer of data in the form of signals.
- It needs a medium of transmission between two communicating nodes.
- Signals can be digital or Analog.
- Encoding of data happens at the physical layer.
- The receiving node should receive the exact signal that was transmitted by the transmitting node making sure that when one side sends a 1 bit, it is received by the other side as 1 bit and not as 0 bit.

Transmission Media

- The transmission medium is defined as a pathway that can transmit information from a sender to a receiver.
- Transmission media are located below the physical layer and are controlled by the physical layer.
- Transmission media are also called communication channels.

Wired or Wireless media

Transmission Media: Types

Transmission media are of two types −

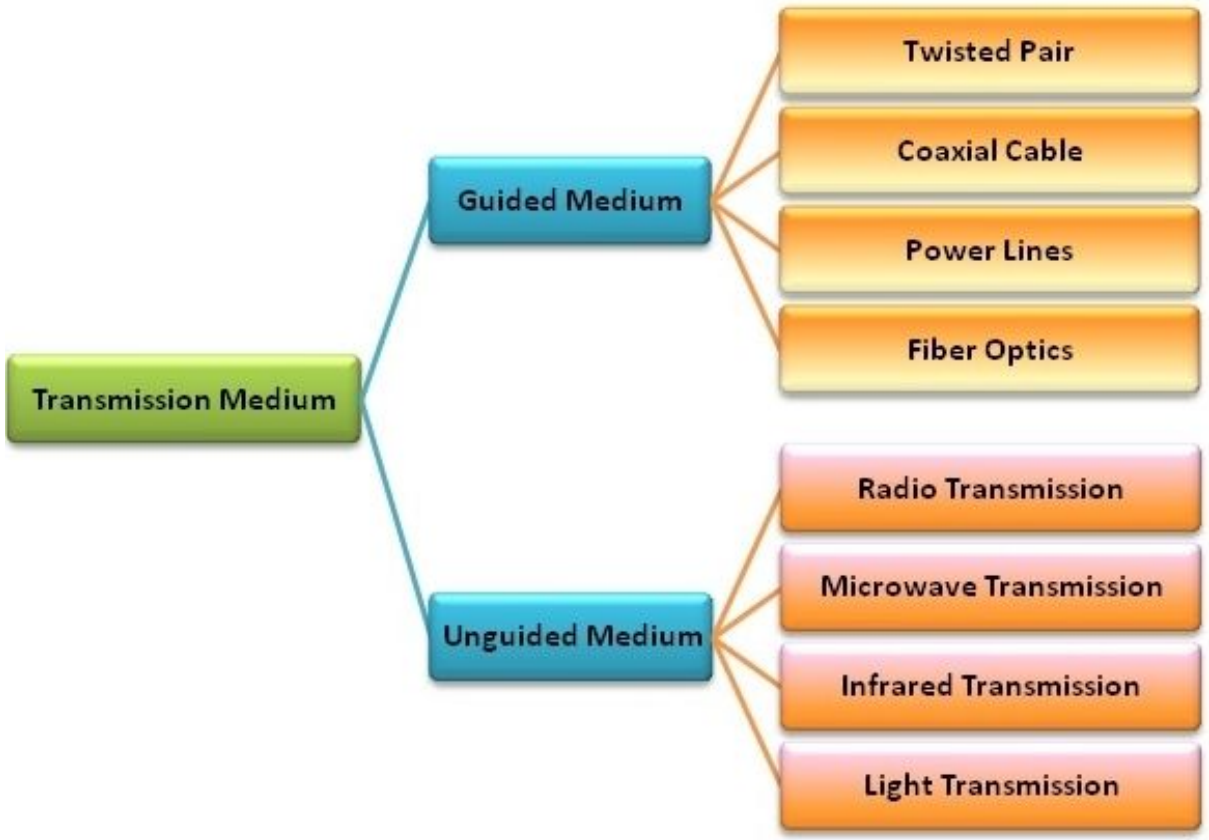
- Guided Transmission Medium
- Unguided Transmission Medium

Guided Medium –

Guided media means that signals is guided by the presence of physical media i.e. signals are under control and remains in the physical wire.

Unguided Medium –

Unguided Media means that there is no physical path for the signal to propagate. Unguided media are essentially electro-magnetic waves. There is no control on the flow of signal.



Problems with Signal Transmission

Generally two kind of problems are associated in transmission of signals.

- ***Attenuation*** : When a signal transmits in a network then the quality of signal degrades as the signal travels longer distances in the wire. This is called attenuation.

- ***Fading***: A time varying deviation of attenuation when a modulated waveform traveling over a certain medium
  Multipath fading: caused by multipath propagation.
  Shadow fading: shadowed by obstacles.

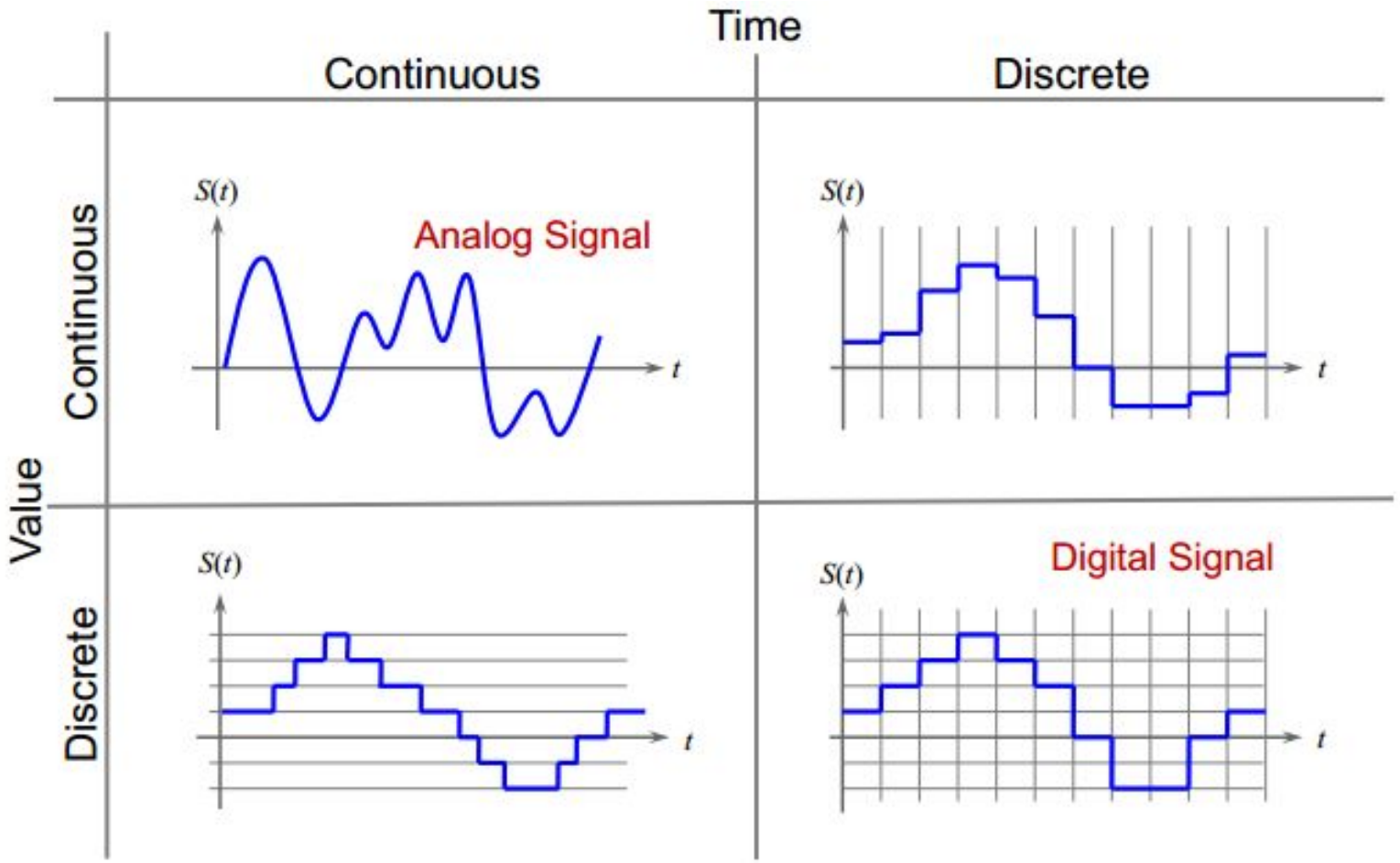
- ***Distortion***: Commonly occurs to composite signals, different phase shifts may distort the shape of composite signals.

- ***Interference***: Usually adds unwanted signals to the desired signal, such as co-channel interference (CCI, or crosstalk), inter-symbol interference (ISI), inter-carrier interference (ICI).

- ***Noise*** : In a communication channel many signals transmits simultaneously, certain random signals are also present in the medium a random fluctuation of an analog signal, such as electronic, thermal, induced, impulse, quantization noises. Due to interference of these signals our signal gets disrupted a bit.

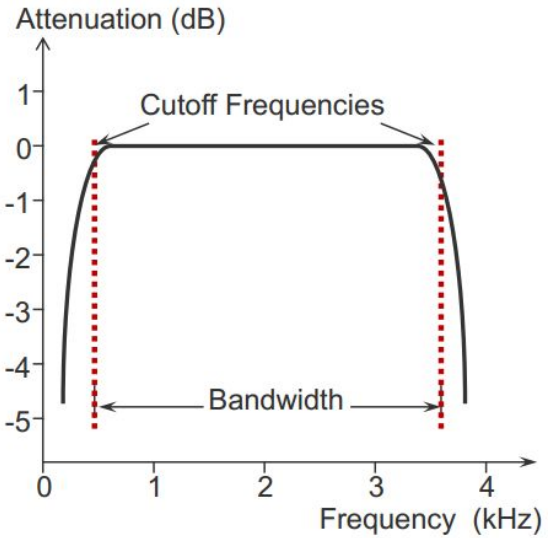
Signal Parameters

Types of Signals



Bandwidth, Baud rate & Bit rate

The bandwidth of a medium is the range of frequencies that pass through it with minimum attenuation. It is a physical property of the medium (usually from 0 to some maximum frequency) and measured in Hz.



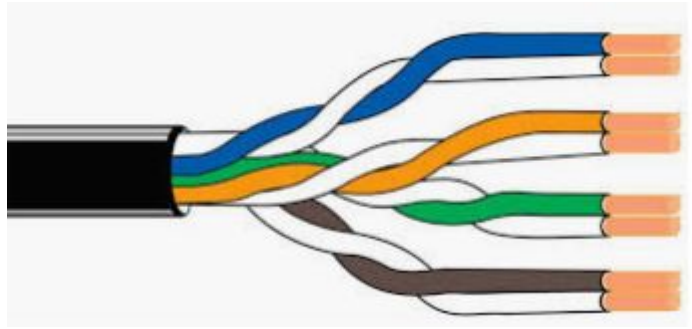
The baud rate is the number of samples/sec made. Each sample sends one piece of information, that is, one symbol. The baud rate and symbol rate are thus the same.

The bit rate is the amount of information sent over the channel and is equal to the number of symbols/sec times the number of bits/symbol.

Transmission Media: Guided

Twisted Pair

- A Twisted pair consists of two insulated copper wires, typically 1mm thick.
- The wires are twisted together in a helical form.
- The purpose of twisting is to reduce signal interference between several pairs.
- Twisted Pair is a low cost guided media of transmission available.
- It is susceptible to noise and electromagnetic interference and attenuation is large.



Twisted Pair can be further classified in two categories:

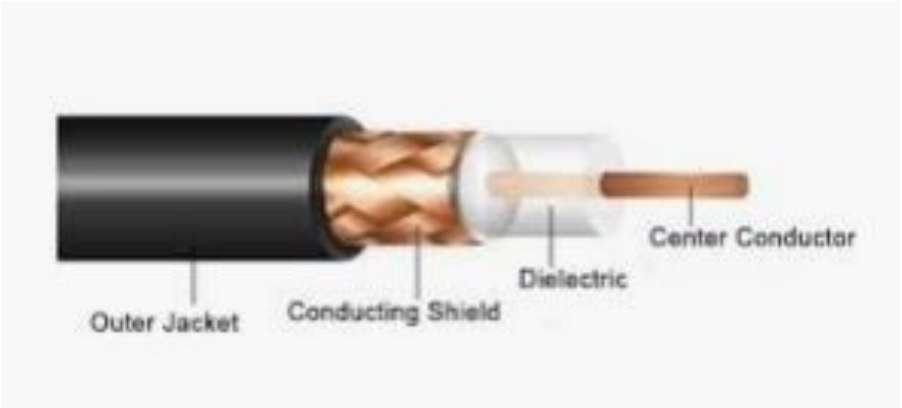
Unshielded twisted pair: In this no insulation is provided, hence they are susceptible to interference.

Shielded twisted pair: In this a protective thick insulation is provided but shielded twisted pair is expensive and not commonly used.

Usage: The most common application of twisted pair is the telephone system. Nearly all telephones are connected to the telephone company office by a twisted pair.

Shielded Twisted Pair

Transmission Media: Guided

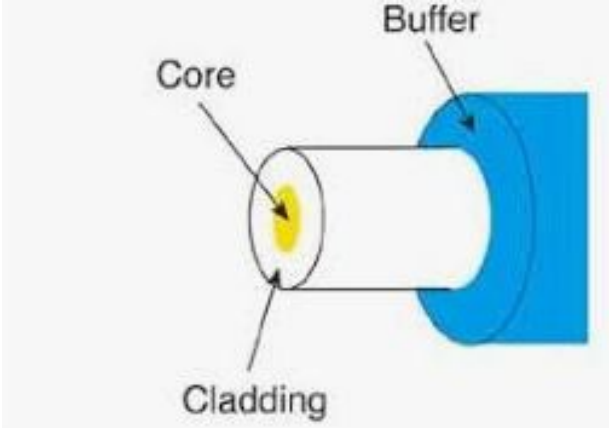


Coaxial Cable

- Coaxial cable consists of 2 conductors.
- The inner conductor is contained inside the insulator with the other conductor weaves around it providing a shield.
- An insulating protective coating called a jacket covers the outer conductor.
- It is named coaxial because the two conductors are coaxial.
- Higher bandwidth of 1-2 Gbps and good noise immunity.

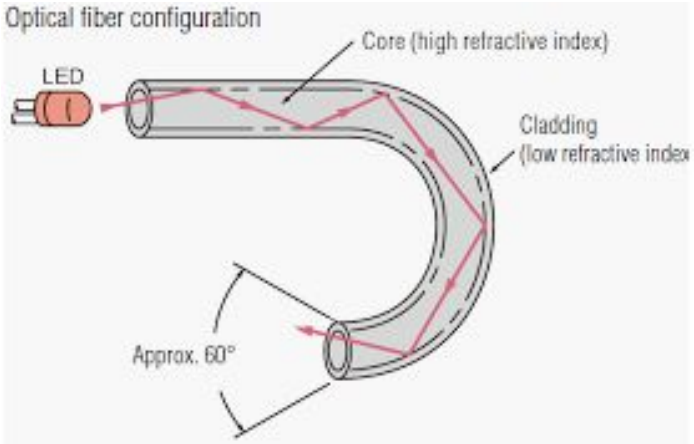
Usage: The most application of coaxial cable is cable T.V. The coaxial cable has high bandwidth and attenuation is less.

Transmission Media: Guided



Optical Fiber

- Optical fiber consists of inner core of either glass or plastic.
- Core is surrounded by cladding of the same material but of different refrective index.
- This cladding is surrounded by a plastic jacket which prevents optical fiber from electromagnetic interference.
- It uses the principle of total internal reflection to transfer data over optical fibers.
- The device generating the message has it in electromagnetic form (electrical signal); this has to be converted into light (i.e. optical signal) to send it on optic fiber cable.
- The process of converting light to electric signal is done on the receiving side.



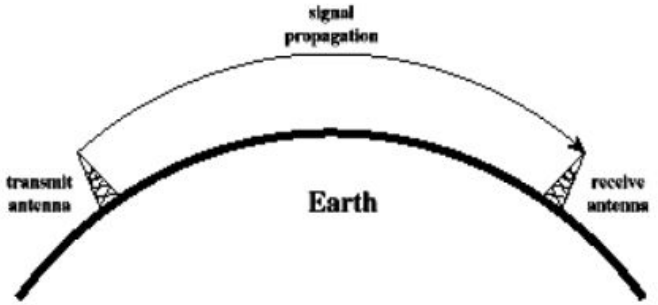
Optical fiber is much better in bandwidth as compared to copper wire, since there is hardly any attenuation or electromagnetic interference in optical wires.

Usage: Optical fiber is used as a medium for telecommunication, long distance communications, submarine cables.

Transmission Media: Unguided/Wireless

Before understanding the different types of wireless transmission medium, let us first understand the ways in which wireless signals travel. These signals can be sent or propagated in the following three ways:

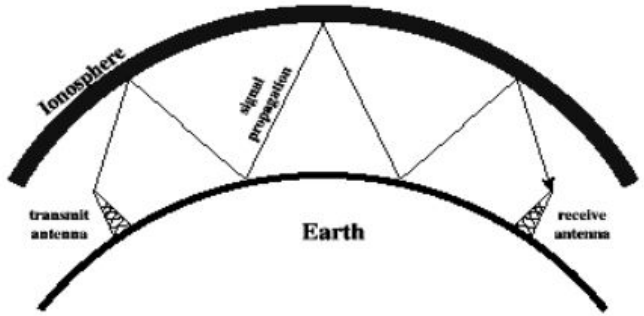
1. Ground-wave propagation



Characteristics

i. Follows contour of the earth
ii. Can Propagate considerable distances.
iii. Frequencies up to 2 MHz
iv. Example a. AM radio

2. Sky-wave propagation



Characteristics:

I. Signal reflected from ionized layer of atmosphere back down to earth
II. Signal can travel a number of hops, back and forth between ionosphere and earth‘s surface
III. Examples
Amateur radio, CB radio

3. Line-of-sight propagation

Characteristics:

i. Transmitting and receiving antennas must be within line of sight

a. Satellite communication – signal above 30 MHz not reflected by ionosphere
b. Ground communication – antennas within effective line of site due to refraction

Transmission Media: Unguided/Wireless

Radio Waves

- Radio waves are omni-directional when an antenna transmits radio waves they are propagated in all directions.
- This means that sending and receiving antenna do not have to he aligned.
- A sending antenna can send waves that can be received by any receiving antenna.
- Radio waves particularly those of low and medium frequencies can penetrate walls.
- Electromagnetic wave ranging in frequencies between 3 KHz and 1GHz are normally called radio waves.

Usage: They are used in standard broadcast radio and television, shortwave radio, navigation and air-traffic control, cellular telephony, and even remote-controlled toys

Transmission Media: Unguided/Wireless

Terrestrial microwave

- In terrestrial microwave two antennas are used for communication.
- A focused beam emerges from an antenna and is received by the other antenna, provided that antennas should be facing each other with no obstacle in between.
- For this reason antennas are situated on high towers.
- Due to curvature of earth terrestrial microwave can be used for long distance communication with high bandwidth.
- Telecom department is also using this for long distance communication.
- An advantage of wireless communication is that it is not required to lay down wires in the city hence no permissions are required.
- Electromagnetic waves having frequencies between 1 and 300 GHz are called microwaves.
- Microwaves propagation is line-of-sight, since the towers with the mounted antennas needs to be in direct sight of each other.

Transmission Media: Unguided/Wireless

Infrared

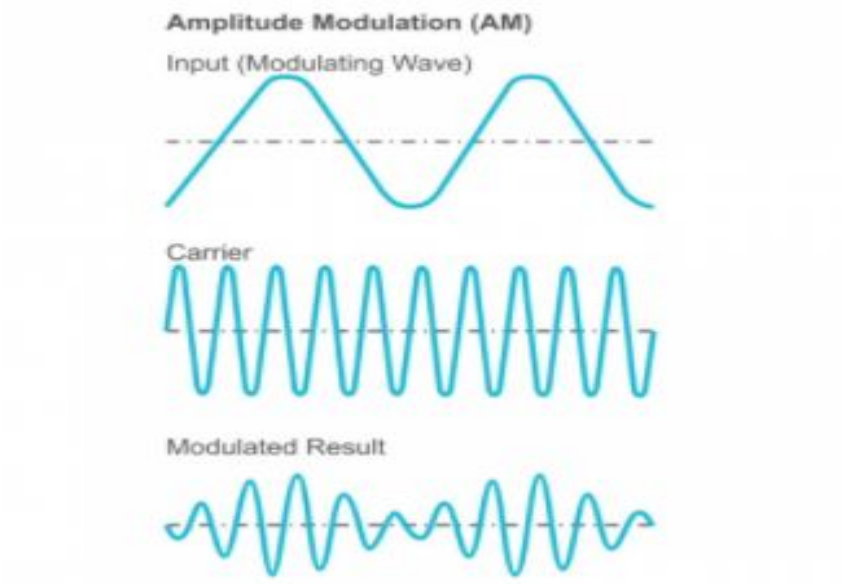
Infrared signals, having high frequencies.
They cannot penetrate walls.
This helps to prevent interference between one system and another.
Infrared band, has an excellent potential for data transmission.
Transfer digital data is possible with a high speed with a very high frequency.

Usage: There are number of computer devices which are used to send the data through infrared medium e.g. keyboard mice, PCs and printers.
short range communications (as your TV remote control), small network for one room (regular reflectors at ceiling form “transmitters” array).

Modulation

Digital signal can be transmitted in the following two ways:

1. Baseband transmission
2. Broadband transmission



- In the baseband transmission the signal is transmitted without making any change to it has faces high attenuation and propagation speed is frequency dependent.
- It is undesirable to have a wide range of frequencies in the signal.
- To avoid such problem with signal transmission we change the signal to before transmitting it using another signal as a carrier signal, this technique is called as broadband transmission and the mixing of signals is called as modulation.

Modulation

Modulation are generally classified into three categories:

1. Amplitude Modulation
2. Phase Modulation
3. Frequency Modulation

ASK

- Amplitude Shift Keying ASK is a type of Amplitude Modulation which represents the binary data in the form of variations in the amplitude of a signal.

- Any modulated signal has a high frequency carrier. The binary signal when ASK modulated, gives a zero value for Low input while it gives the carrier output for High input.

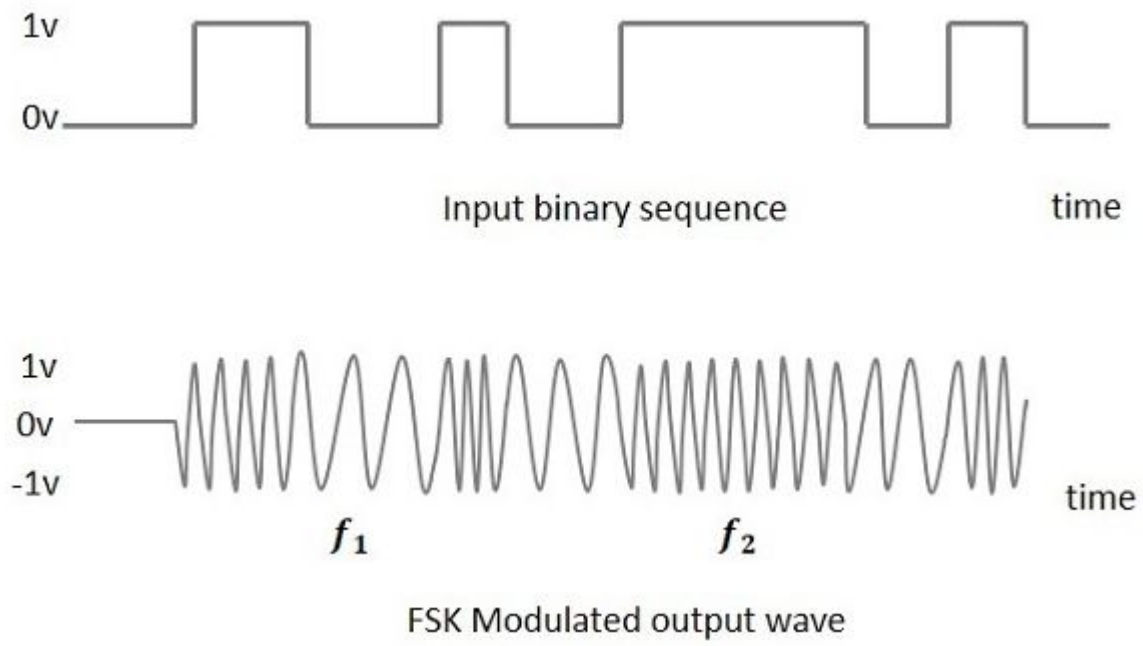
- The following figure represents ASK modulated waveform along with its input.

FSK

- Frequency Shift Keying FSK is the digital modulation technique in which the frequency of the carrier signal varies according to the digital signal changes. FSK is a scheme of frequency modulation.

- The output of a FSK modulated wave is high in frequency for a binary High input and is low in frequency for a binary Low input. The binary 1s and 0s are called Mark and Space frequencies.

- The following image is the diagrammatic representation of FSK modulated waveform along with its input.



PSK

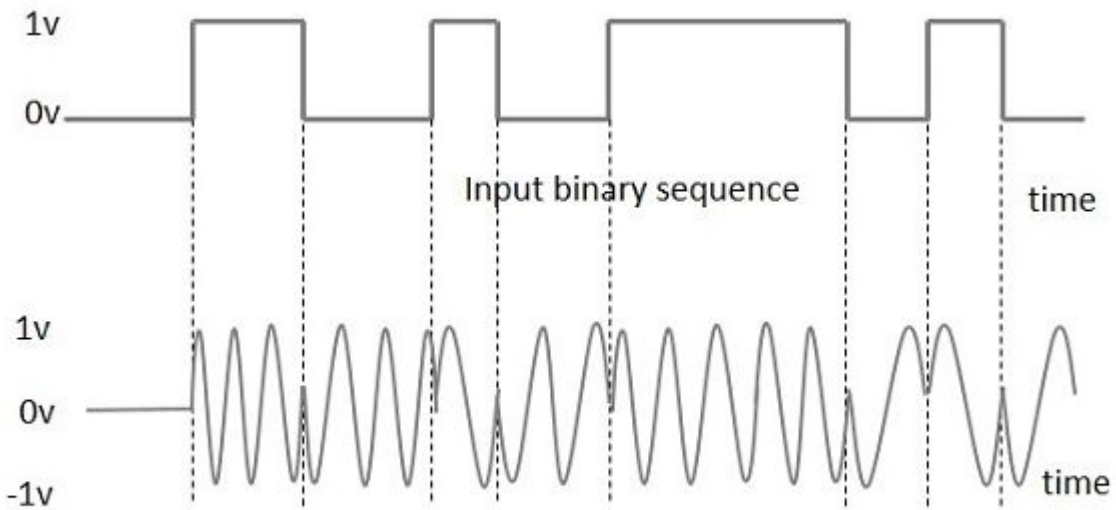
Phase Shift Keying PSK is the digital modulation technique in which the phase of the carrier signal is changed by varying the sine and cosine inputs at a particular time. PSK technique is widely used for wireless LANs, bio-metric, contactless operations, along with RFID and Bluetooth communications.

PSK is of two types, depending upon the phases the signal gets shifted. They are −

Binary Phase Shift Keying BPSK
This is also called as 2-phase PSK or Phase Reversal Keying. In this technique, the sine wave carrier takes two phase reversals such as 0° and 180°.

Quadrature Phase Shift Keying QPSK
This is the phase shift keying technique, in which the sine wave carrier takes four phase reversals such as 0°, 90°, 180°, and 270°.

PSK



BPSK Modulated output wave

Thankyou!!