

# Unit - I DCOM

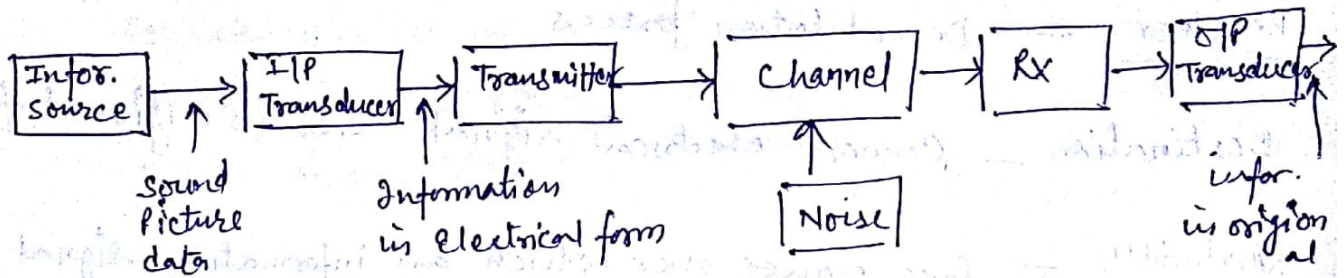
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**Communication** — Basic process of exchanging information.

like Radio broadcasting, point to point comm., Mobile comm.

Radar comm., Radio telephony, Radio telemetry, Radio Telegraphy

**Block diagram of Comm. system**



① **Information Source** — To produce required signal which is to be transmitted.

② **Input Transducer** — when msg. from information source is not in electrical nature then input transducer convert it into time varying electrical signal.  
eg - In radio broadcasting sound convert into electrical signal.

③ **Transmitter** — To process the electrical signal from different aspects.

Modulation is the main fx of the transmitter.

\* In long distance comm., signal amplification is necessary before modulation.

Transmitter (In short) → Restriction of range of audio freq.  
→ Amplification  
→ Modulation

④ **Channel** — medium through which msg travel from Tx. to Rx.

↓  
2 types → Point to point channels eg wire lines, optical fibre.  
Broadcast channels  
In this a physical medium for the transmission of signals from one pt to another pt.  
for local telephone Tx. for long distance telephone connection



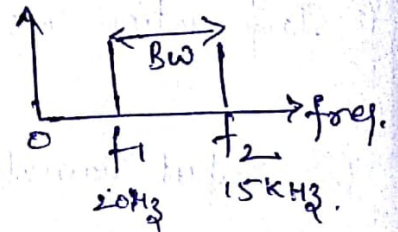
Broadcast Channels - Several receiving stations can be reached simultaneously from a single transmitter.  
 e.g. satellite in geostationary orbit cover  $\frac{1}{3}$  part of earth.

- \* In channel noise is random in nature
- \* Noise may be any pt in comm. system

Receiver - Demodulation process

Destination - Convert electrical signal into its original form.

Bandwidth - freq. range over which an information signal is transmitted.  
 Difference b/w two freq levels.



Passband signals - voice | music | Tv signals etc

Each signals have its own freq. range

This freq. range of a signal is known as its bandwidth.

e.g music signal - 20 Hz to 15 KHz.

Range

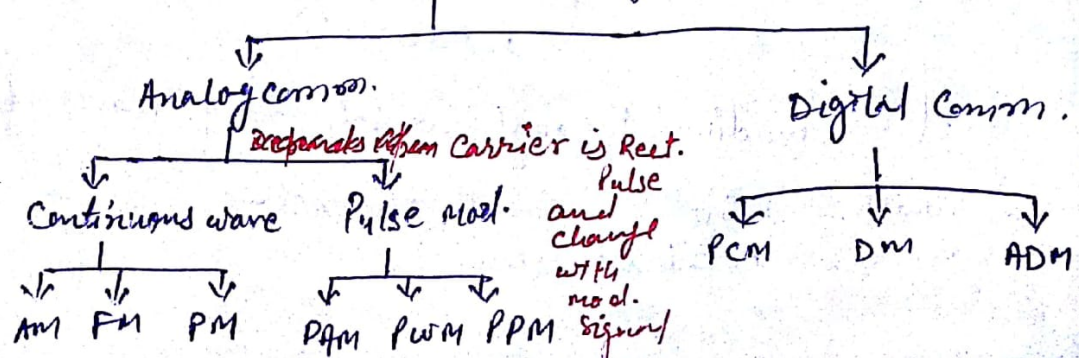
$$BW = 15000 - 20 = 14980 \text{ Hz.}$$

Voice signal - Range 300 - 3400 Hz

Tv signal - 0 - 5 MHz.

Digital data - 300 - 3400 Hz.

In Analog Comm. - Electronic Comm. System



Adv. of Analog comm.

- Tx. / Rx simple
- Low BW requirement
- FDM can be used

Dis Advantage of analog comm.

- Noise affects the signal quality
- It is not possible to separate noise and signal
- Repeater cannot be used b/w Tx. / Rx.
- Coding is not possible
- not suitable for secure comm.



## Digital Comm

- Technique in which the transmitted signal is in the form of digital pulse of constant amplitude | freq. | Phase.
- eg. PCM, DM

### Advantage of Digital Comm.

- ✓ Better noise immunity
- ✓ Due to channel coding it is possible to detect the errors and correct the errors during transmission.
- ✓ Repeaters can be used
- ✓ Due to digital nature of signal
  - DSP
  - Image Processing
  - Data Compression.
- TDM - Transmit many voice channels over single common transmission channel
- ✓ Secure Comm. - used in military
- simpler | cheaper (due to high speed computer | FCS)

### Drawbacks of Digital Comm.

- Excess Bit rates of digital techniques are high therefore they require a large channel B.W.
- Digital modulation needs synchronization in case of synchronous modulation.

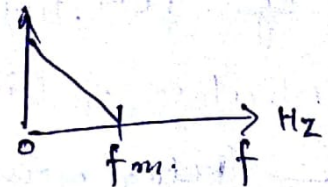
### Applications -

- Satellite Comm.
- Long distance Comm. - b/w earth and space
- Data and Computer Comm.
- Telephone systems



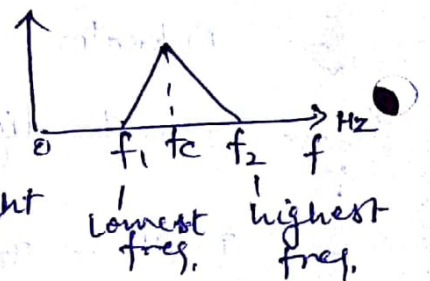
### Baseband Signal

- It signal may be analog or digital form - like sound, picture, computer data
- Electrical equivalent of this original information signal is known as the baseband signal.



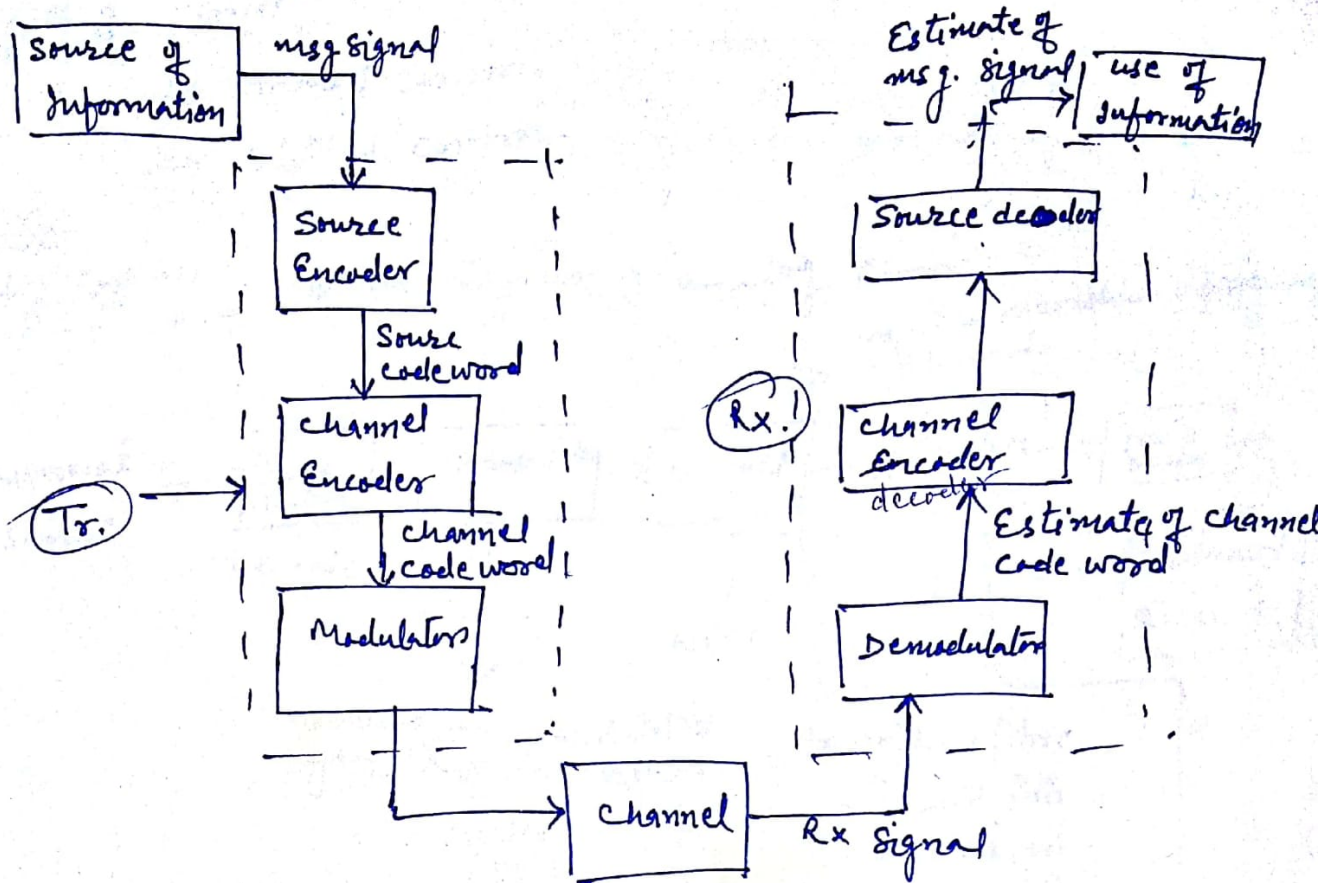
### Band pass signal

- A signal which has a non zero lowest freq in its spectrum.
- It is possible by shifting the baseband signal in freq. domain.
- It may be modulated / naturally
- e.g. radio waves, ultrasound waves, visible light



# Digital Communication

## Block diagram of Digital Comm.



① Discrete Information source — Analog information source may be transformed into a discrete information source through sampling and quantizing. Some parameters

- (a) Source Alphabet — It may be letter, digit or special char. available from the information source.
- (b) Symbol rate — Rate at which information source generates source alphabets. Represented by symbol/sec.
- (c) Source alphabet Probabilities :- Each source alphabet from the source has independent occurrence rate in the sequence



# Digital Comm.

## Introduction Part of Comm.

→ Information Exchanging is called Comm.

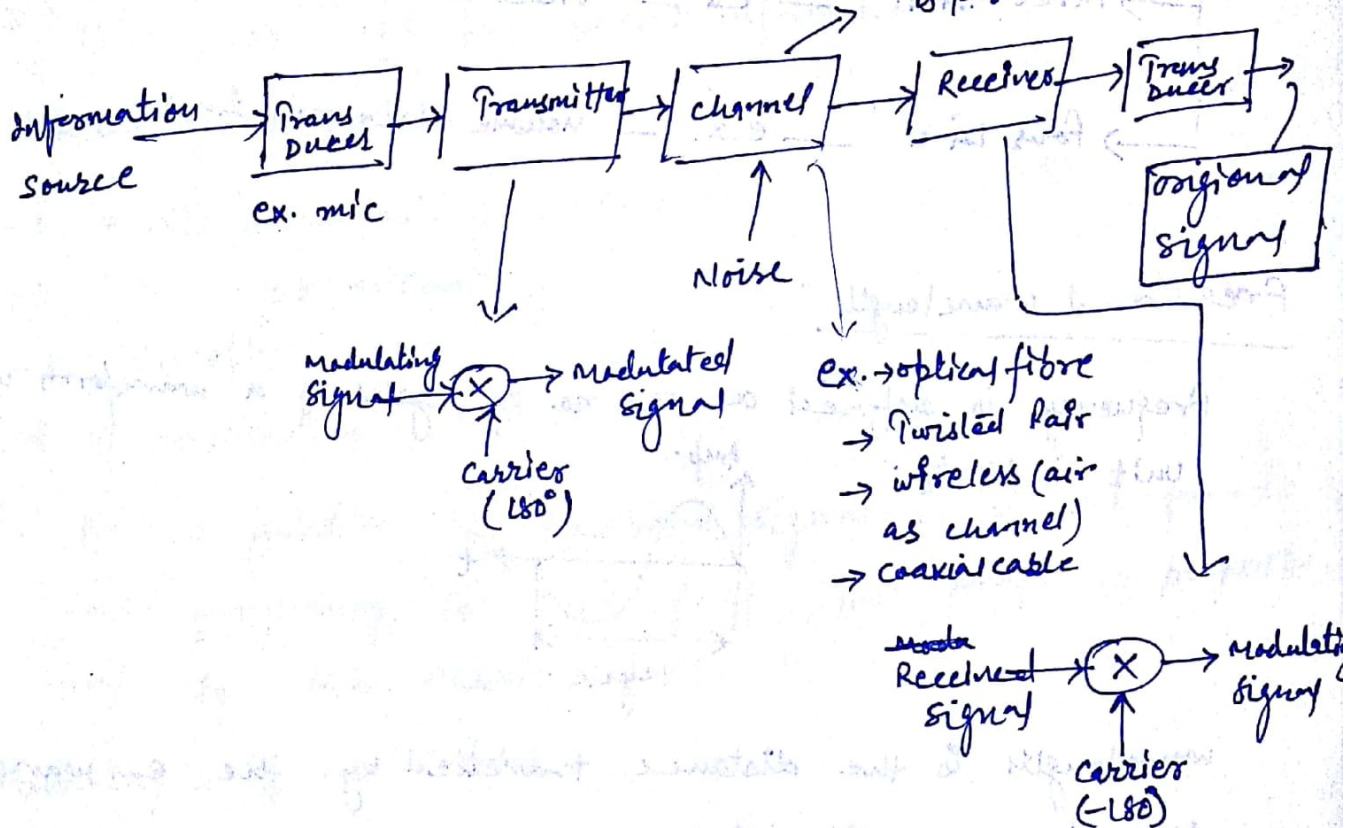
## Types of Comm.

- Analog Comm.
- Digital Comm.

## Intro Part

### Analog Comm.

Block diagram of analog Comm. -  
medium over which information is passed.

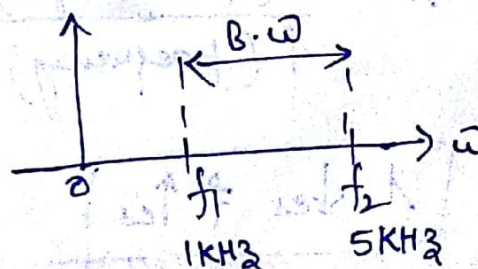


## Discussion about Bandwidth

Range of frequency over which information signal is transmitted. It is the difference b/w upper and lower freq. range. ex.

$$\begin{aligned} B.W &= f_2 - f_1 \\ &= 5 \text{ KHz} - 1 \text{ KHz} \end{aligned}$$

$$B.W = 4 \text{ KHz}$$





⇒ Required B.W in transmission depends upon the rate at which the data is being transmitted.

⇒ Bandwidth ↑es with ↑es in rate of data transmission.

Signal - Time varying quantity having information.

→ one dimensional signal - ex. speech, music, data

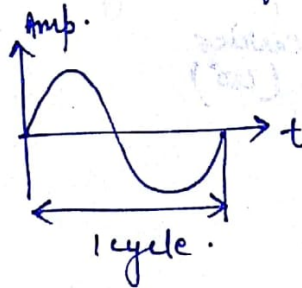
→ Two Dimensional - ex. - Picture

→ Three Dim. - ex - video data

→ Four Dim. - ex. - volume data over time.

### Freq. and wavelength

Frequency is defined as the no. of cycles of a waveform in one sec.  
unit is Hertz.



wavelength is the distance travelled by the em wave during the time of one cycle.

→ EM wave travel at the speed of light in free space or vacuum.

$$\lambda = \frac{c(\text{speed of light})}{f(\text{frequency})} = \frac{3 \times 10^8 \text{ m/s}}{f}$$

$\lambda \downarrow \text{es } f \uparrow \text{es}$



## Advantages of Analog Comm/modulation.

- Tx, Rx are simple
- Low BW requirement
- FDM can be used.

## Dis-Advantages of Analog Comm.

- Noise affect the signal quantity
- It is not possible to separate noise and signal
- Coding is not possible
- It is not safe for secret information.

## Application of Analog Comm.

- Radio Broadcasting (AM, FM)
- TV Broadcasting
- Telephone

## Need of Modulation:

- In modulation the baseband signal is shifted from low frequency to high freq., this freq. is proportional to the carrier freq.

## Advantages of Modulation

- ① Reduction in the height of Antenna.
- ② Avoids mixing of signal.
- ③ Multiplexing is possible
- ④ Improve quality of reception.
- ⑤ ↑ range of Comm.

① Height of Antenna: For Transmission of radio waves height of antenna must be multiple of  $(\lambda/4)$ .



Nyquist Rate - minimum sampling rate

$$f_s = 2f_m$$

Nyquist interval

$$T_s = \frac{1}{f_s} = \frac{1}{2f_m} \text{ seconds}$$

$$f_s = 2 \text{ B.W}$$

$$= 2 (\text{High freq.} - \text{Lower freq.})$$

$$= 2 [f_c + f_m - (f_c - f_m)]$$

$$= 2 (2f_m)$$

$$f_s = 4f_m$$

A Band pass signal whose B.W is  $2f_m$  can be completely represented in to . recovered from its samples if it is sampled at the minimum rate of twice the Band width.

Effect of Under Sampling - Aliasing occur in which a high freq. component of the signal takes identity of a low freq. component in the spectrum of a signal.