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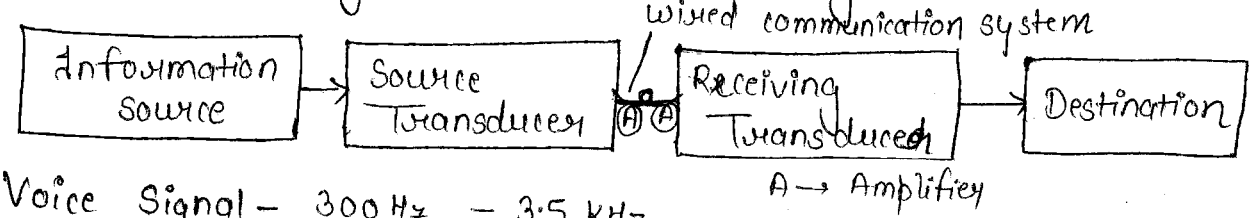
Communication

"Communication is the process of transmitting information from one place to another."

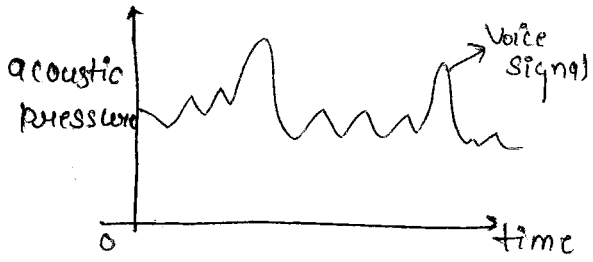
Basic block diagram of communication system:



Voice Signal – 300 Hz – 3.5 kHz

Audio Signal – 20 Hz – 20 kHz

Video Signal – 0 – 4.5 MHz



Source Transducer:

It converts physical signal into electrical equivalent.

e.g. – microphone

Wired communication system:

It is prefered only for short distance communication.

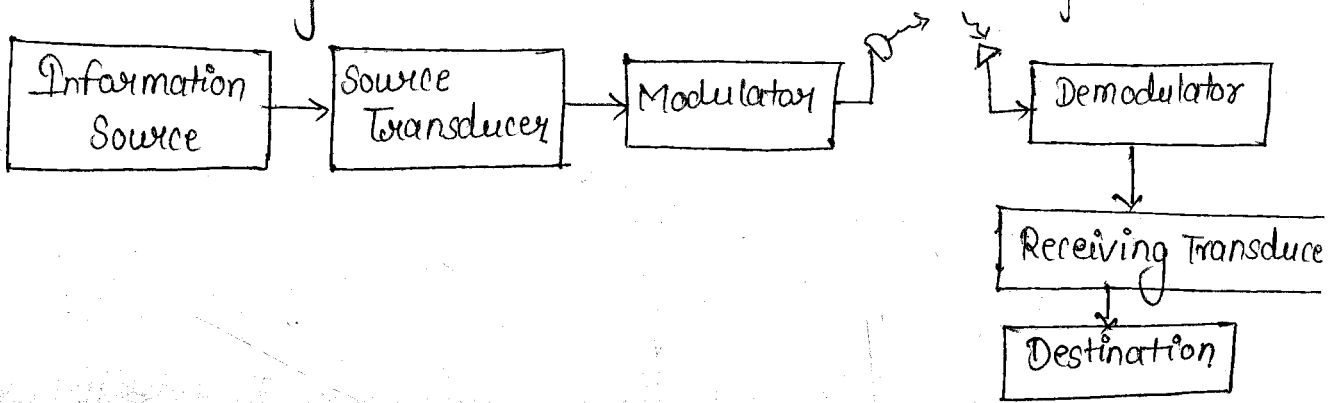
For long distance communication 'wireless Transmission' is preferred in which signal propagates through 'free space'.

Receiving Transducer:

It converts electrical signal into physical equivalent.

e.g. – loudspeaker.

Block Diagram of wireless communication system:



Generally without modulation long distance communication through free space is not possible.

Need for modulation -

1) Reducing antenna height :

$$h_t = \frac{\lambda}{4}$$

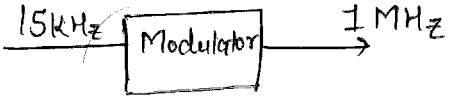
$$\lambda = \frac{v}{f} \qquad v = c$$

$$\lambda = \frac{c}{f}$$

$$h_t = \frac{c}{4f}$$

i) $f = 15\ KHz$

$$h_t = \frac{3 \times 10^8}{4 \times 15 \times 10^3} = 5\ Km$$ (Practically not possible to construct antenna with this height)

ii) 

$$h_t = \frac{3 \times 10^8}{4 \times 10^6} = 75\ m.$$ (Possible)

- For faithful radiation of a signal antenna height should be atleast of '$\lambda/4$'.
- Transmitting antenna converts electrical signal into electro magnetic, resulting propagates with light velocity.

NOTE -

Modulation is the process of increasing frequency of the signal to reduce antenna height requirements.

2) Multiplexing : It is the process of transmitting multiple number of signal through a single channel.

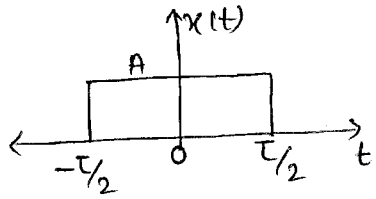
- Generally without modulation, multiplexing is not possible.

Fourier Transform:

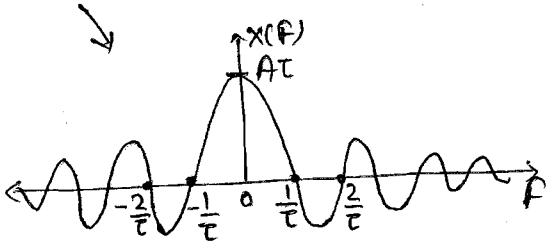
Fourier transform is basically used to find frequencies present in the given time domain signal.

$$x(t) \longrightarrow X(f)$$

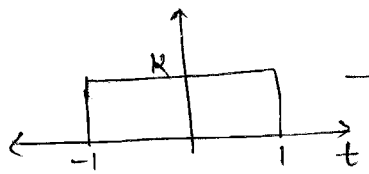
$$X(f) = \int_{-\infty}^{\infty} x(t)\, e^{-j2\pi ft}\, dt$$



$$X(f) = A\tau \,\text{sinc}(f\tau)$$



E.g.



$\longrightarrow 2K\,\text{Sinc}(2f)$

Signal Bandwidth = Highest +ve freq. − Lowest +ve freq.

Channel bandwidth ≥ Signal bandwidth.

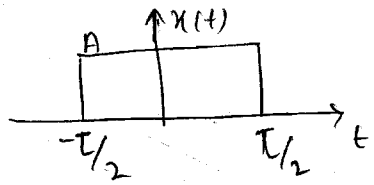
Channel standards -

Co-axial cable - 0 - 600 MHz

Parallel wire - 0 - 200 K

Fiber optic cable - GHz $= 10^9$ Hz $= 1000$ MHz

- For proper transmission of above signal, channel bandwidth of infinite is required but bandwidth offered by practical channel will be finite only so that before transmission it should be bandlimited by using 'Band Limiting Process'.



$$E = \int_{-\infty}^{\infty} x^2(t)\, dt = A^2\tau = \int_{-\infty}^{\infty} |X(f)|^2 df$$