Bandwidth of Signals:

↳ How information is transmitted from one point to another.

Message signals — can be audio, video, image, data

All these signals are transmitted in the electrical signals.

The type of communication system needed for a given signal depends on the band of frequencies which is ~~cond~~ considered for the communication process.

Speech signals, frequency range → 300Hz to 3100Hz.

↓

Bandwidth → 2800Hz for commercial telephonic conversations.

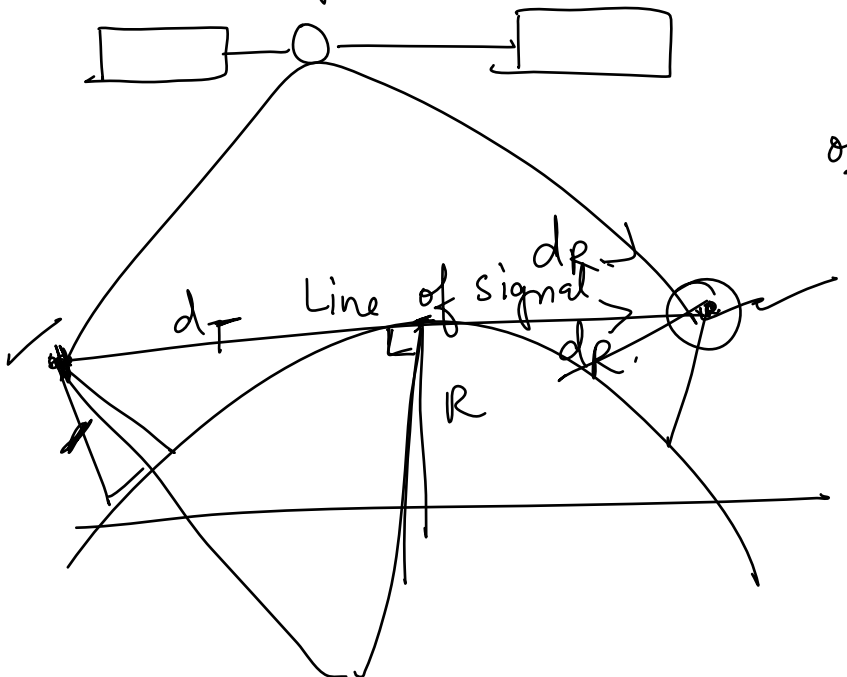
To transmit Music, Bandwidth of 20 KHz is required.

Video signals, → requires 4.2MHz of Bandwidth.

TV signals → contains both voice & pictures → 6MHz.

Space Wave propogation:

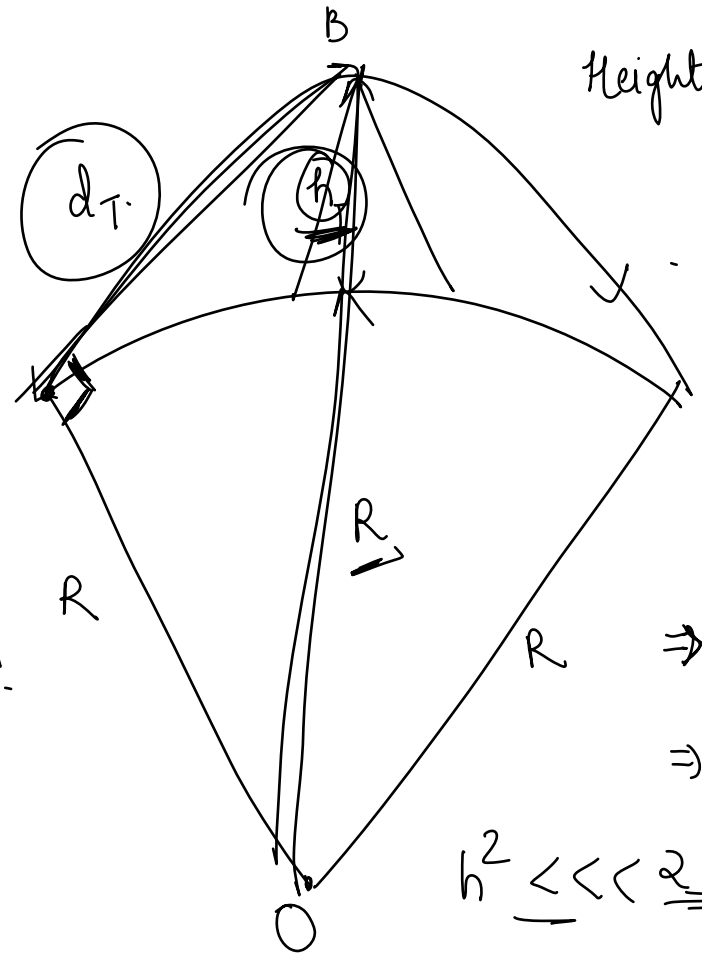
Radio wave of frequency > 30 MHz.



Range = $d_T + d_R$.

↓

of line of sight.



h_T: height of the transmitting antenna.

Height of Antenna / Range of Television Tower

In ΔOAB:

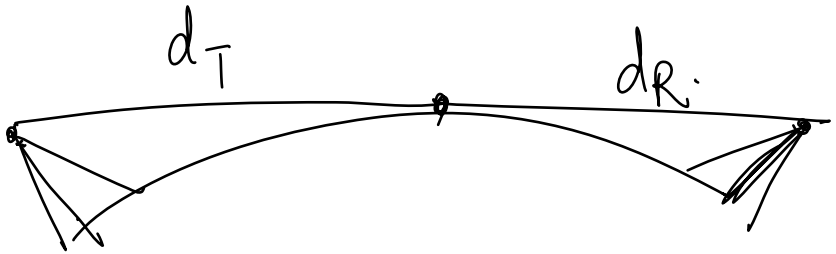
$$(OB)^2 = (AB)^2 + (OA)^2$$

$$\Rightarrow (R+h)^2 = (d_T)^2 + R^2$$

$$\Rightarrow R^2 + h^2 + 2Rh = d_T^2 + R^2$$

$h^2 <<< 2Rh$ $\Rightarrow 2Rh = d_T^2$

$$\Rightarrow d_T = \sqrt{2Rh}$$ hi



Maximum line of sight distance $= d_T + d_R$.

$\Rightarrow \sqrt{2Rh_T} + \sqrt{2Rh_R}$

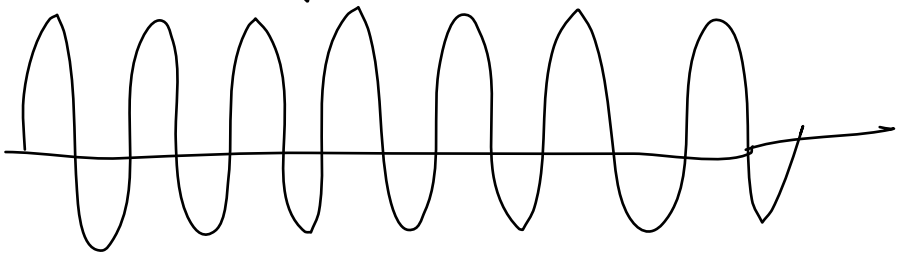
h_T : Height of the transmitting antenna

h_R : Height of receiving antenna.

Modulation :

Message signals are also called baseband signals.
No signal is a single frequency sinusoid, but it spreads over a range of frequencies called the signal bandwidth.

Modulation can be defined as the process of superimposing low-frequency signal on a high frequency carrier signals.



Modulated wave is a process by which one of the characteristics of carrier wave changes according to the instant value of the modulating signal.

Need for Modulation:

a) To ~~reduce~~ avoid the mixing up of signal transmitted from different transmitters.

b) To reduce the height of antenna to a practical suitable size.

3.) Power radiated by antenna $\propto \left(\frac{1}{\lambda^2}\right)$, to increase the effect of power radiated, the high carrier frequency should be used.

$\propto f$

a) Amplitude Modulation:

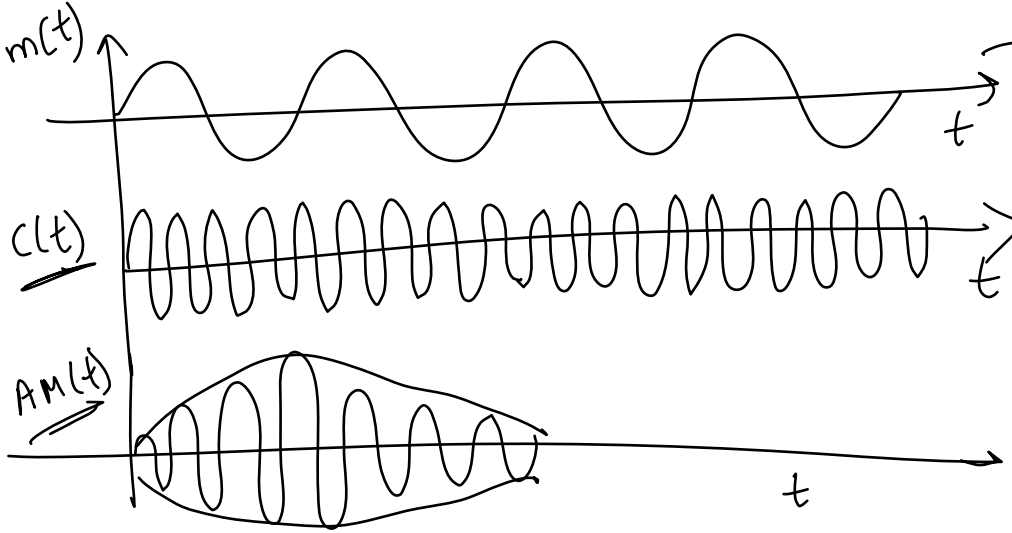
$$c(t) = A_c \sin(\omega_c t + \phi).$$

In amplitude modulation, the amplitude of the carrier wave is varied in accordance with the information signal.

b) Frequency Modulation.

c) Phase Modulation.

Amplitude Modulation:

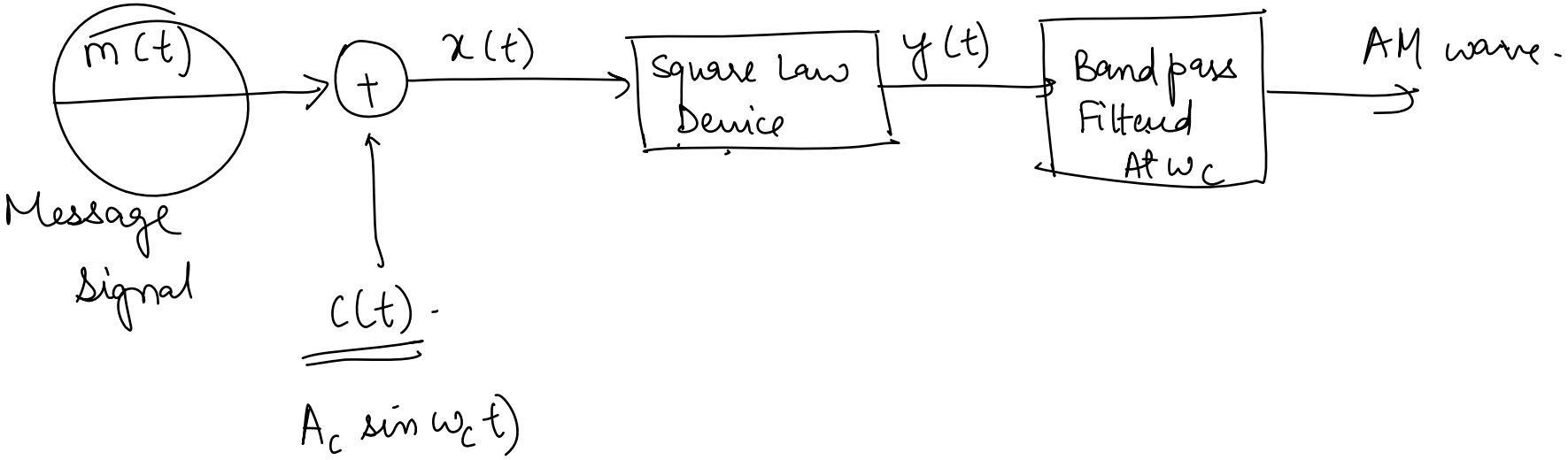


$m(t) = V_m \cos \omega t$.

$C(t) = V_C \cos \omega_c t$.

$V_{AM} = m(t) + C(t)$.

Production of Amplitude Modulated Wave:



$m(t) = A_m \sin(\omega_m t)$

$\omega_m = 2\pi f_m$.

$c(t) = A_c \sin(\omega_c t)$.

Amplitude Modulation Wave $= (m(t) \wedge c(t))$

$= (A_m \sin(\omega_m t) + A_c) \sin(\omega_c t)$.

$\Rightarrow A_c \left[1 + \frac{A_m}{A_c} \sin \omega_m t\right] \sin \omega_c t$.

$\mu = \frac{A_m}{A_c}$ [Index]

carrier wave frequency.

$$= A_c \sin \omega_c t + \frac{A_m}{A_c} \sin \omega_m t \sin \omega_c t.$$

$$\sin A \sin B = \frac{1}{2}\left[\cos\left(\frac{A+B}{2}\right) - \cos\left(\frac{A-B}{2}\right)\right]$$

$$\cos\left[\frac{(\omega_m + \omega_c)t}{2}\right] - \cos\left(\frac{(\omega_m - \omega_c)t}{2}\right) \Leftarrow \sin \omega_m t \sin \omega_c t.$$

$$\checkmark C_m(t) = A_c \sin \omega_c t + \frac{\mu A_c}{2}\cos\left(\frac{\omega_m + \omega_c}{2}\right)t - \frac{\mu A_c}{2}\cos\left(\frac{\omega_m - \omega_c}{2}\right)t$$