☆ GSM System:- (Global system for Mobile communication)

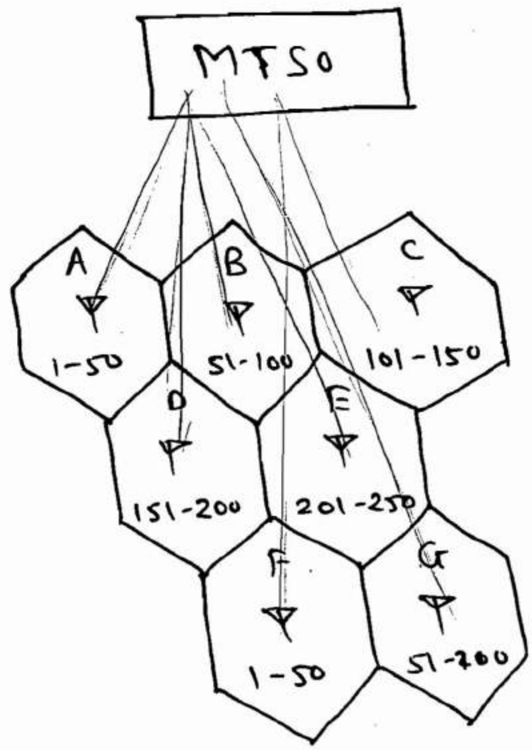
⇒ 800 MHZ

⇒ Global system for Mobile communication.

⇒ Area Coverage is limited but frequency Reuse is possible.

⇒ Working Principle of GSM System:

⇒



A & F = Co-Channel cell site

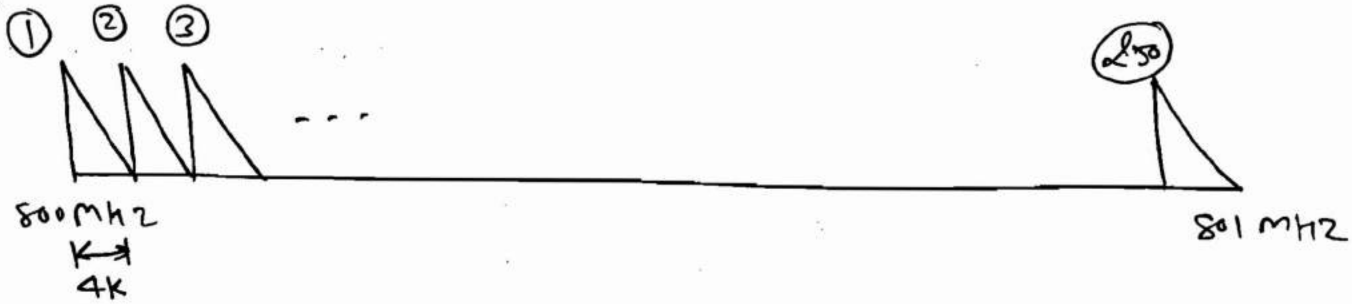
⇒ Let, Considered allotted Spectrum to the cellular operator is 1 MHz.

BW = 1 MHz.

Voice channel BW. = 4 KHz.

$$\Rightarrow \text{Voice channel} = \frac{1\ \text{MHz}}{4\ \text{kHz}} = 250.$$

⇒



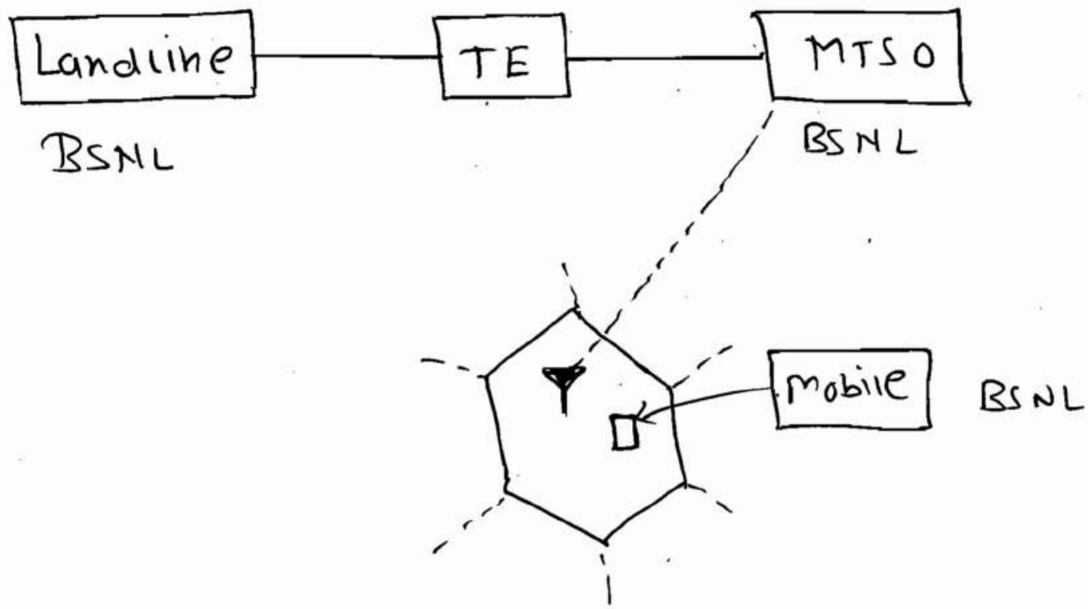
⇒ Let, freq. reuse factor is 5 i.e K = 5.

Voice channel		Group.
1 – 50	—	1
51 – 100	—	2
101 – 150	—	3

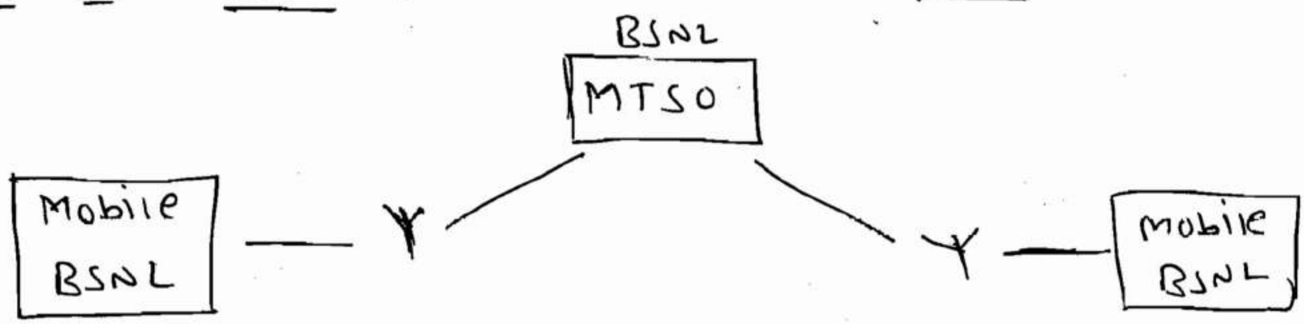
⇒ There are three case :

⊙ Case -(i): BSNL Landline & BSNL mobile Phone.

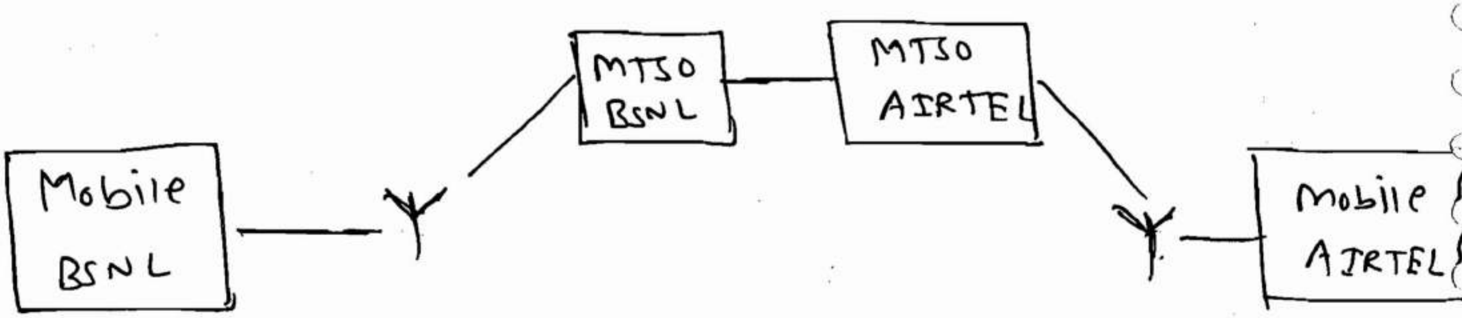
⇒



⊙ Case - ii : BSNL mobile phones of both users.



⊙ Case - iii : BSNL mobile phone & AIRTEL Mobile phone.



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1G ⟶ Analog ⟶ FM

2G ⟶ Digital ⟶ QPSK

2.5G ⟶ Digital ⟶ GMSK

$\left.\begin{array}{l}\text{QPSK} \\ \text{GMSK}\end{array}\right\}$ R_b = Kbps.

(Gaussian minimum Shift Keying).

3G ⟶ Digital ⟶ Mbps video.

4G ⟶ 100 Mbps HD video.

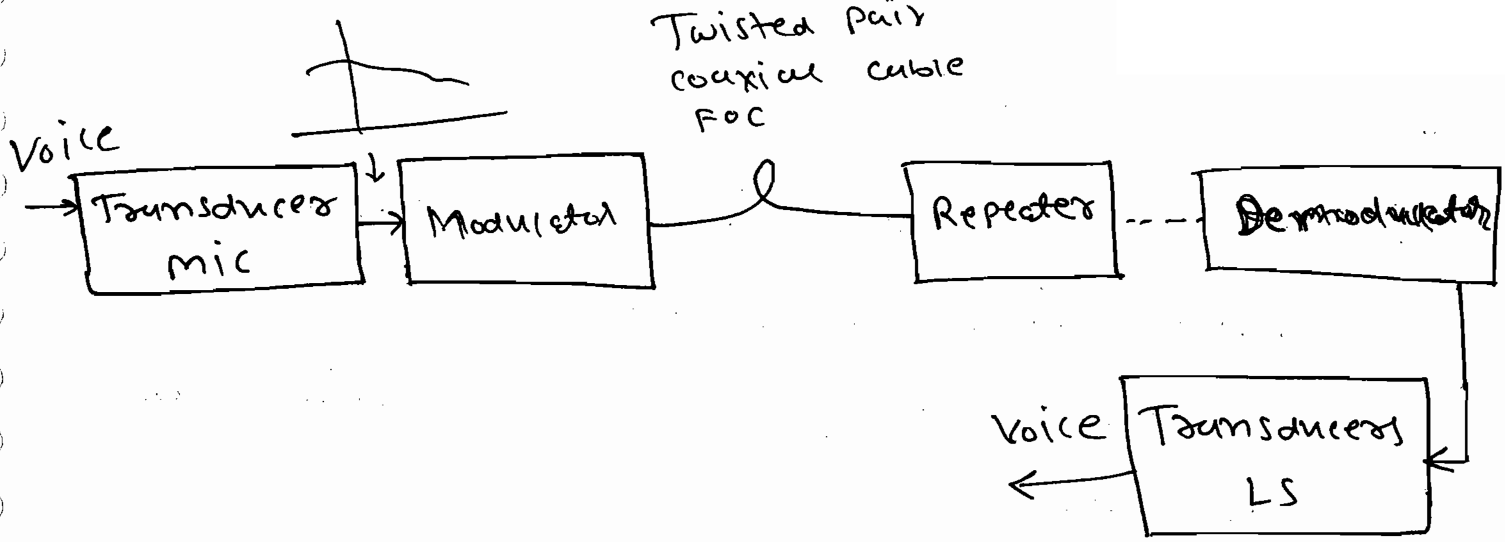
* Objective of Electronic Communication system:

→ objective of Electronic communication system is to transfer information from one place to another place using electrical signals.

→ H.B

Voice	→ 300 – 3.5 kHz	e.g. –	Telephone system
Audio	→ 20 – 20 KHz	e.g. –	Radio.
Video	→ 0 – 4.5 MHz	e.g. –	T.V.
Data	→ (pulse width)	e.g. –	Internet

* Block Diagram of Communication System:



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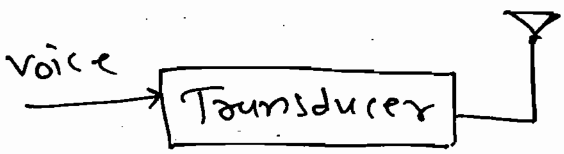


$$\lambda = \frac{c}{f}$$

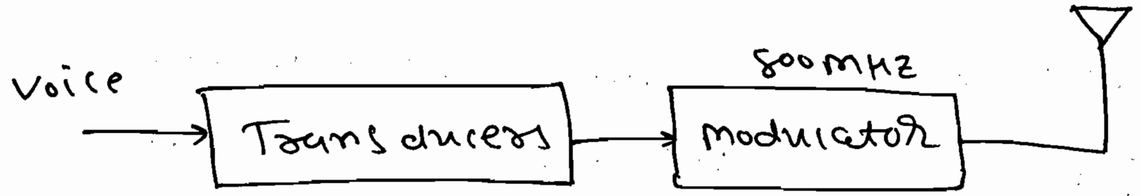
$$\lambda = \frac{3\times10^{8}}{300} = \text{very large}$$

→ Therefore, Antenna size may be very

Very large because antenna length ~~very~~ is to be define in terms of its wavelength (λ) which is practically not possible.

→ Inorder to avoid this problem we should use modulator which convert ~~to~~ Low freq. signal into high freq. signal.

→



$$\therefore \quad \lambda = \frac{3 \times 10^8}{800 \times 10^6}.$$

So, Antenna size reduced very much.

* Advantages:

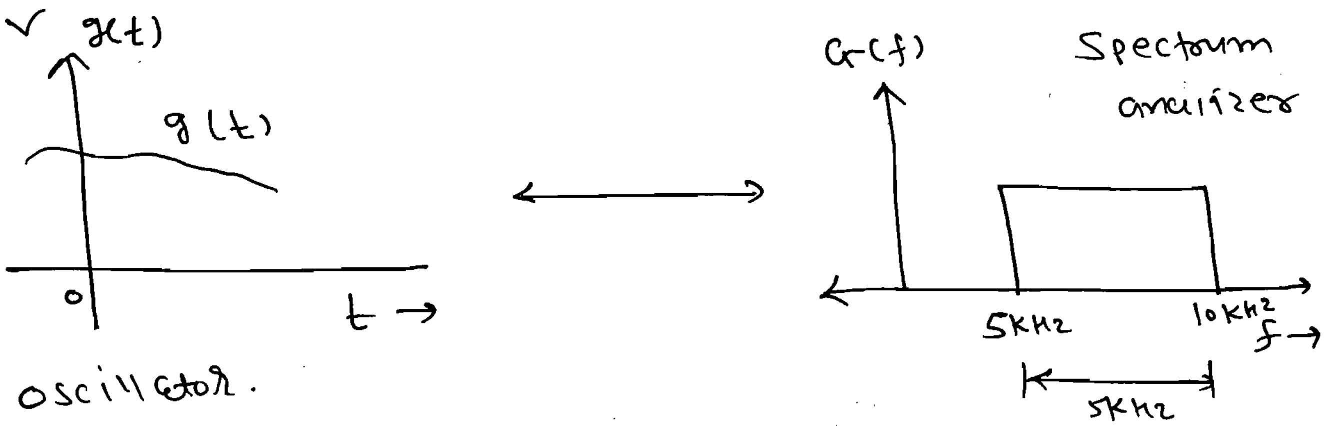
1. To reduce the size of antenna.
2. Multiplexing is possible.
3. To reduce the effect of Noise. and interface.
4. For narrow banding of signals.

* Review of Fourier Transform:

→ Fourier transform concept is used to determine the frequency present in the signal.

→ Fourier transform converts time domain signals into freq. domain signal.

$$g(t) \longleftrightarrow G(f)$$



oscillator.

300 - 20KHz

NOTE:

→ The oscillator will display time domain signal.

→ The spectrum analyizer will display freq. domain spectrum.

* Band width:

→ B Range of the freqiuens occupied by the signal is called as the BW.

→ Mathamatically,

$$BW = f_H - f_L$$

$$BW = 10 - 5$$

$$BW = 5\ kHz$$

* Spectrum:

→ It is a graphical representation of signal in freq. domain.

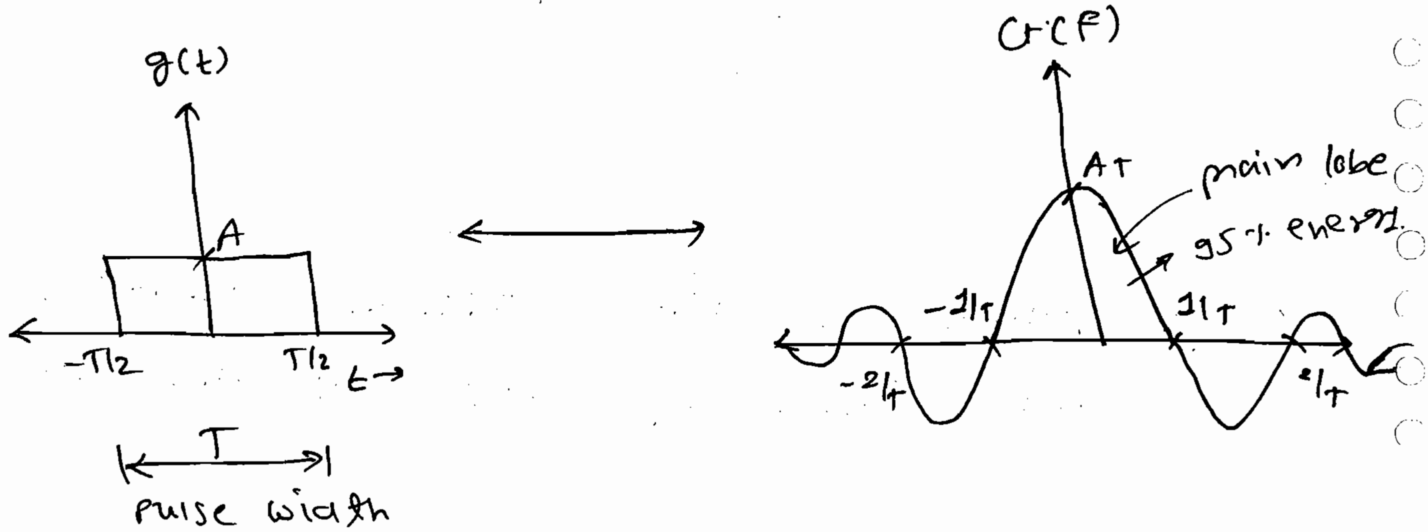
NOTE:

→ Practically the Bandwidth of signal should be low as possible and channel BW should be as high as possible.

⇒ $g(t) \xleftrightarrow{FT} G(F)$.

$$\boxed{G(F) = \int_{-\infty}^{\infty} g(t) \cdot e^{-j2\pi f t} \cdot dt}$$

⇒



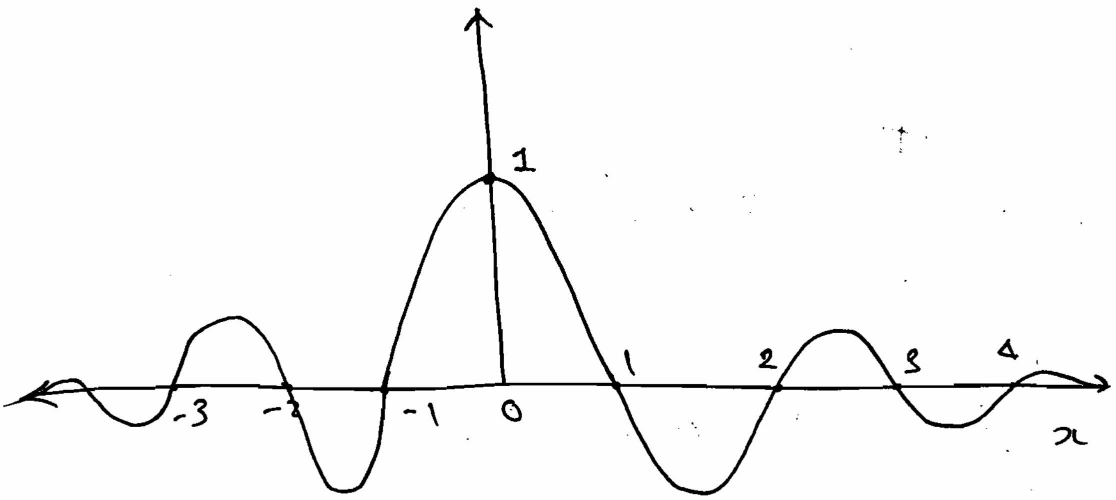
$$G(F) = \int_{-T/2}^{T/2} A \cdot e^{-j2\pi f t} \cdot dt.$$

$$\therefore G(f) = AT \frac{\sin(\pi f T)}{\pi f T}.$$

$$\therefore \boxed{G(f) = AT\, \text{sinc}(fT).}$$

* $$\text{Sinc}(x) = \frac{\sin(\pi x)}{\pi x}.$$

$$= 0, \quad x = \pm 1, \pm 2, \pm 3, \pm 4, \ldots$$



$\Rightarrow \quad G(f) = AT\text{sinc}(fT).$

$\therefore \quad f = 0, \pm \frac{1}{T}, \pm \frac{2}{T}, \pm 3/T, \ldots$

Practically (-ve) freq. do not exist.

$\Rightarrow$ BW of a signal is:

$\Rightarrow \quad BW = f_H - f_L$

$$= \infty - 0$$

$\boxed{BW = \infty}$ Theoretical.

⇒ Signal which is having finite duration is called Energy signal.

⇒ Signal which is having Infinite duration is called Power signal.

→ $$E = \int_{-\infty}^{\infty} g^2(t)\, dt = A^2 T \text{ Joules.}$$

$$E = \int_{-\infty}^{\infty} |G(f)|^2 \, df = A^2 T \text{ Joules.}$$

$$\therefore \quad E = \int_{-1/T}^{1/T} |G(f)|^2 \, df.$$

$$\therefore \quad \boxed{E = 0.95\, A^2 T} \text{ J.}$$

⇒ So, Energy present in main lobe,

$$\boxed{E = 0.95\, A^2 T \text{ J}}$$

⇒ 95 % of energy is contained by only main lobe.

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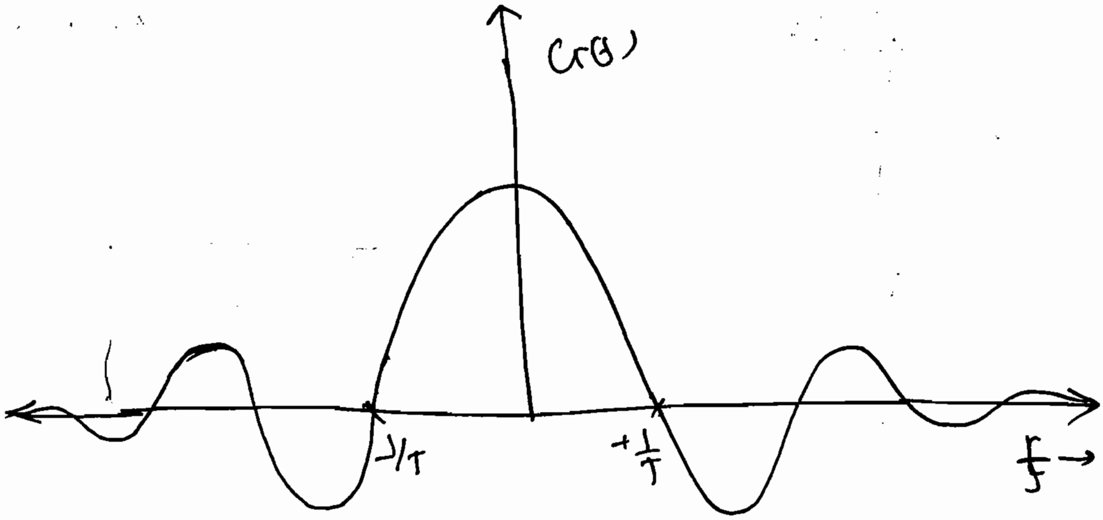

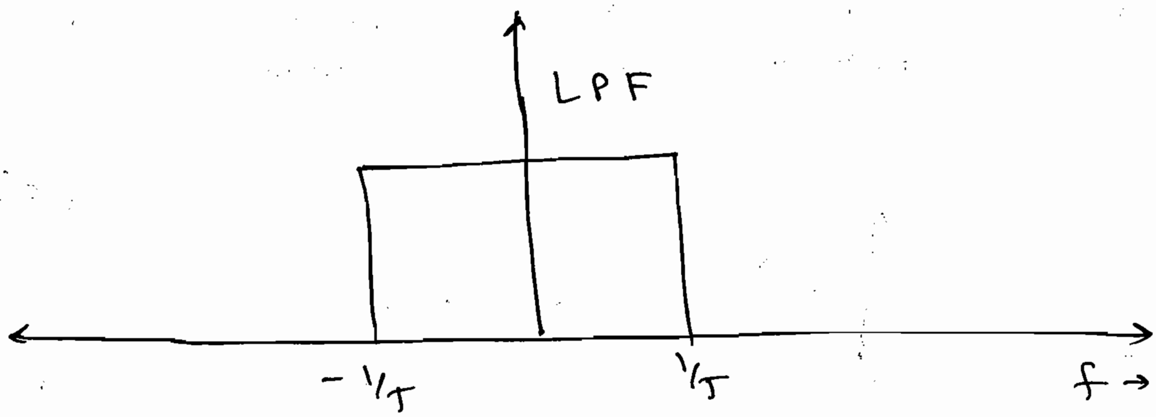

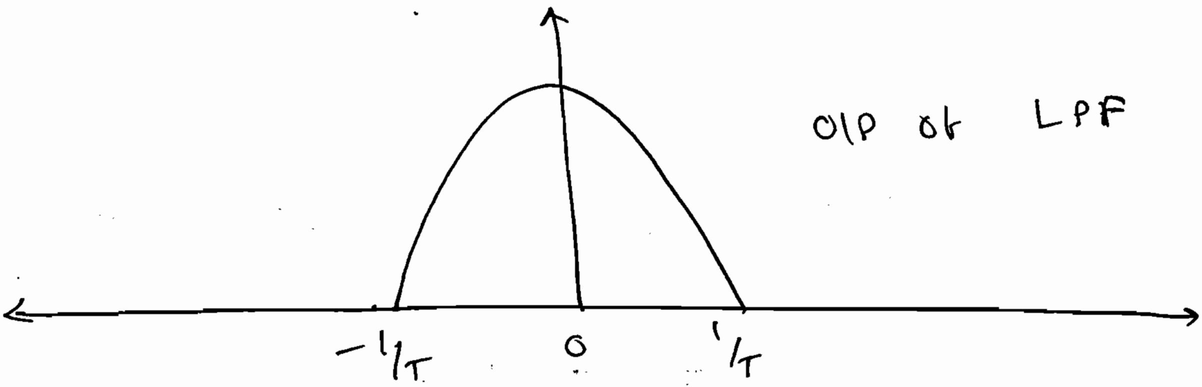

$$\Rightarrow \quad BW = f_H - f_L$$

$$= \frac{1}{T} - 0$$

$$\boxed{BW = 1/T} \quad \text{(Practical BW)}$$

⇒ Practical BW of Rectangular pulse is inversely proportional to the pulse width.

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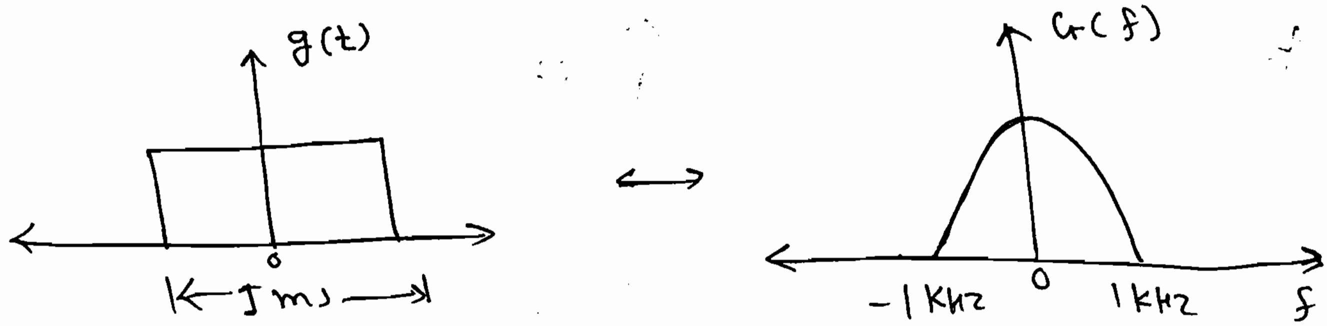
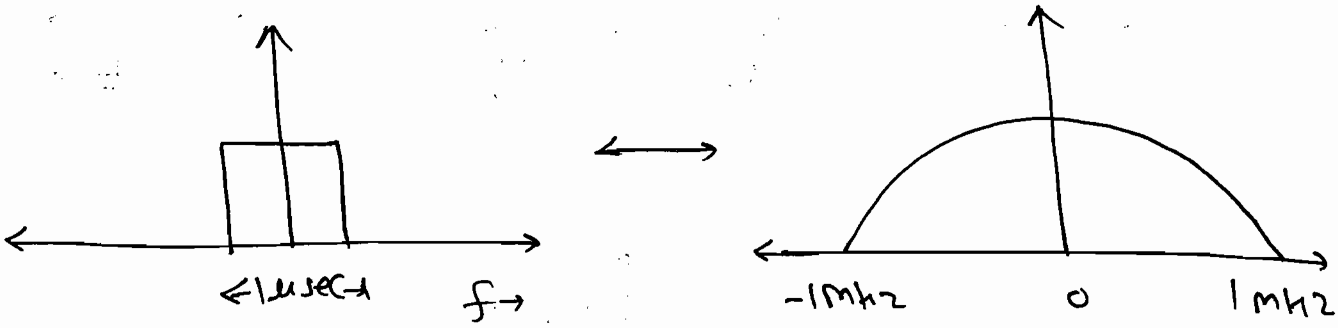
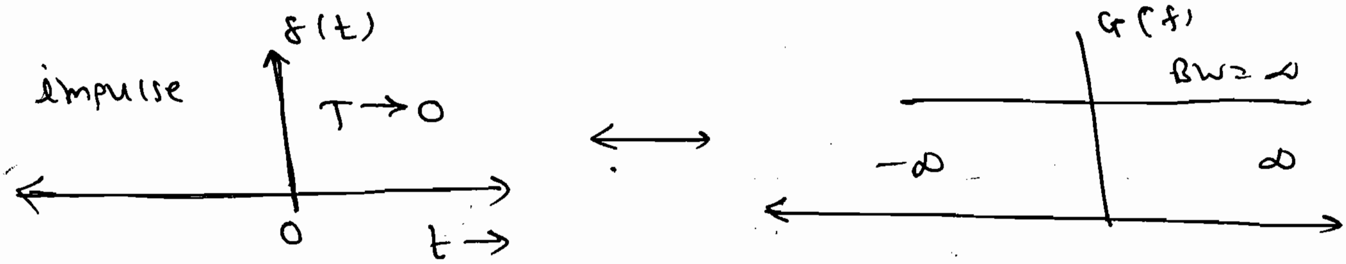






⇒ BW of impulse is infinite.

* Freq. Shifting Property: [Modulation property]:

$$g(t) \longleftrightarrow G(f).$$

N.B.

$$g(t) . \cos 2\pi f_c t \longleftrightarrow \frac{G(f - f_c) + G(f + f_c)}{2}$$

Carrier

f_c: Carrier freq.

Mobile: 800 MHz

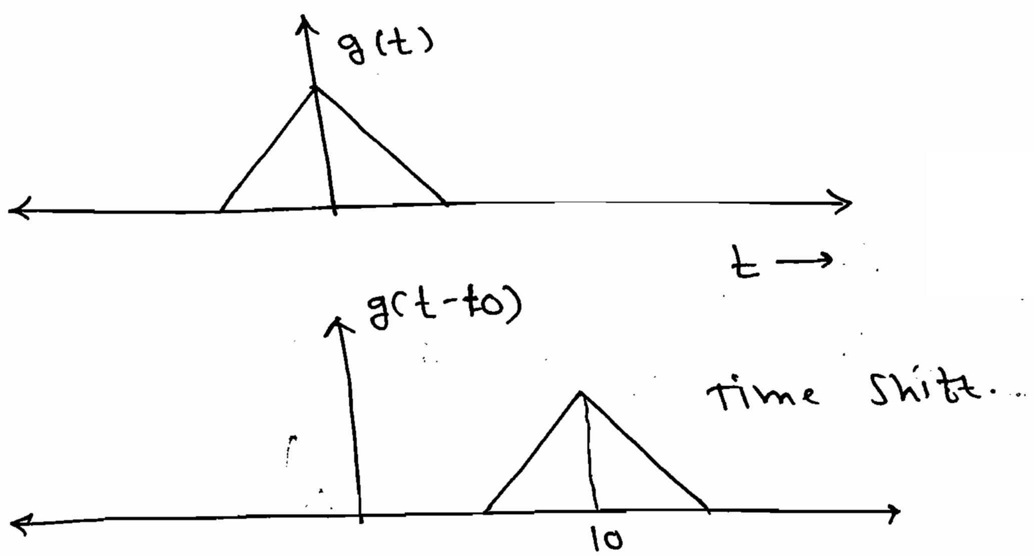
FM: 88 - 108 MHz

Radio: order of GHz

⟹ HB If a signal is Multiplied with carrier, the spectrum is shifted to the left and Right side, by f_c. The amplitude decreses by a factor of '2'.

* Time Shift:

*



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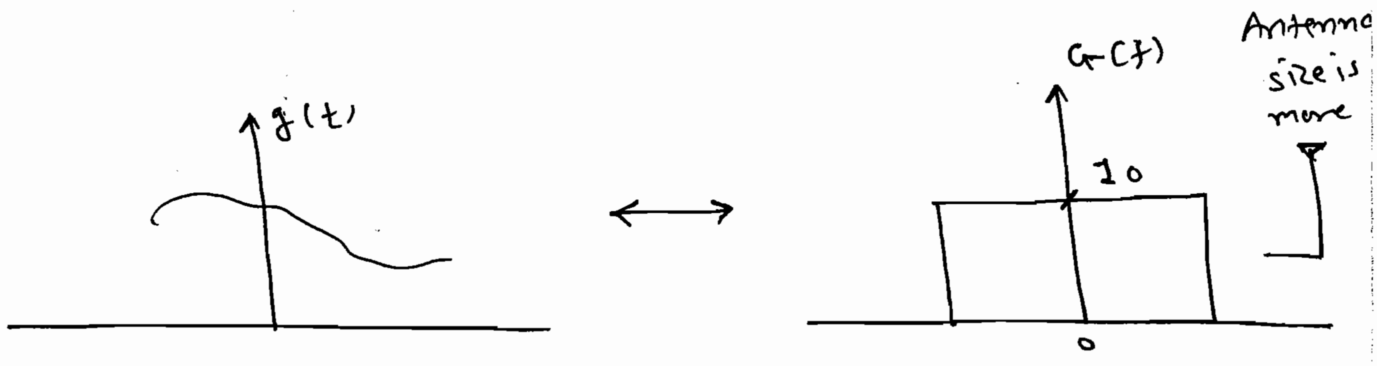

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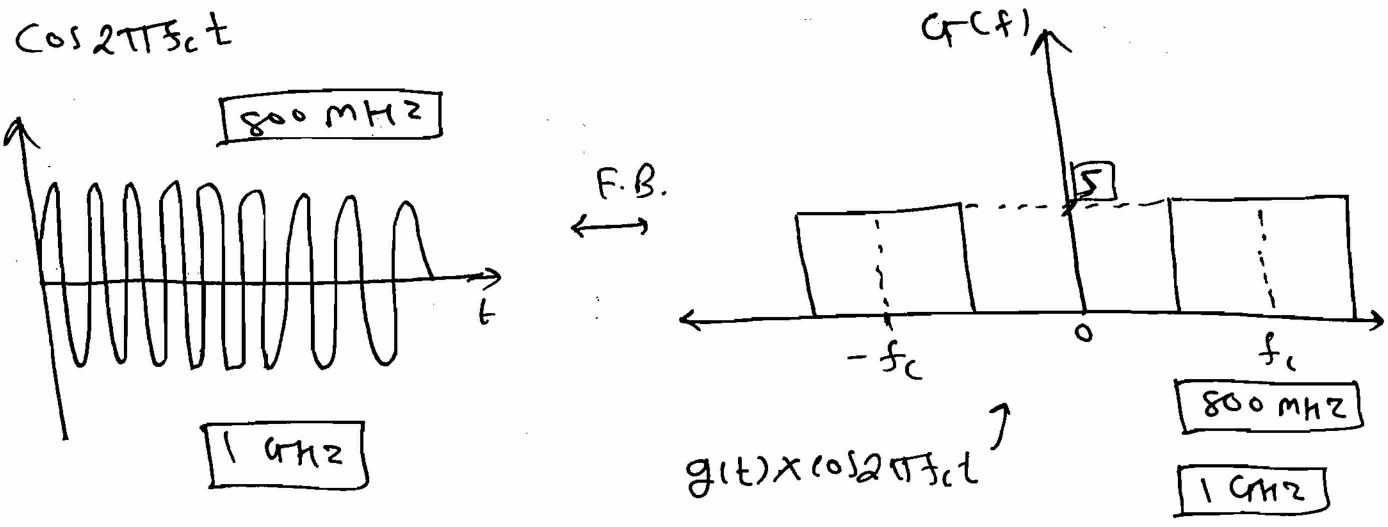
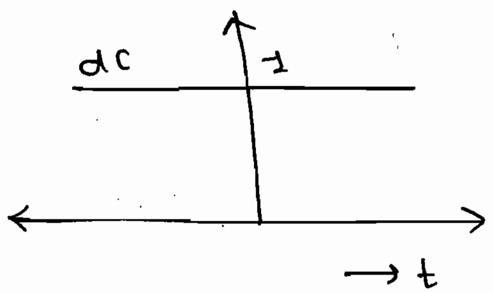


* Modulation :-

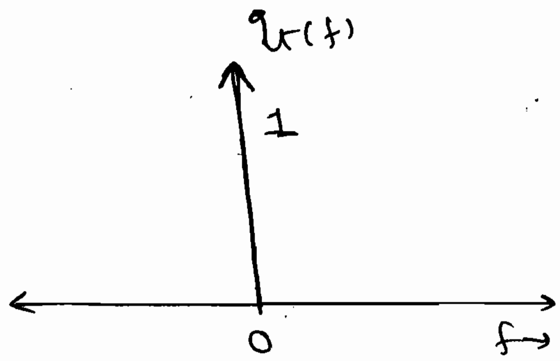
→ Modulation is defined as a process of freq. translation by modulating a signal. The spectrum is shifted from low freq. region to the high freq. region. In order to modulate a signal it should be multiplied with a carrier. (high freq. sinusoidal signal).

$$\Rightarrow \quad \delta(t) \xleftrightarrow{FT} 1.$$

$$1 \xleftrightarrow{FT} \delta(f). \Rightarrow 2\pi\delta(\omega).$$



FT ⟷



$f=0$ of Dc

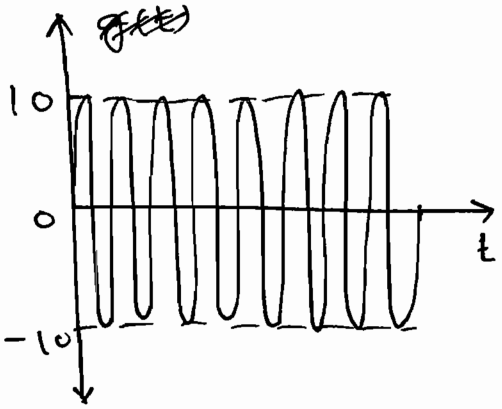
Impulse:

$$1.\ \cos 2\pi f_c t \xleftrightarrow{FT} \frac{\delta(f-f_c)+\delta(f+f_c)}{2}$$

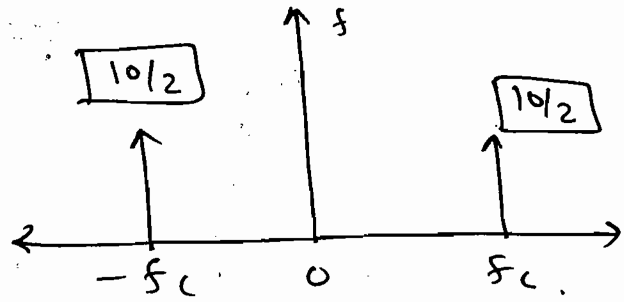
H.B

$$= 2\pi\left[\frac{\delta(\omega-\omega_c)+\delta(\omega+\omega_c)}{2}\right]$$

$$= \pi\left[\delta(\omega-\omega_c)+\delta(\omega+\omega_c)\right].$$



$\longleftrightarrow$



* Concept of Modulation and Demodulation:

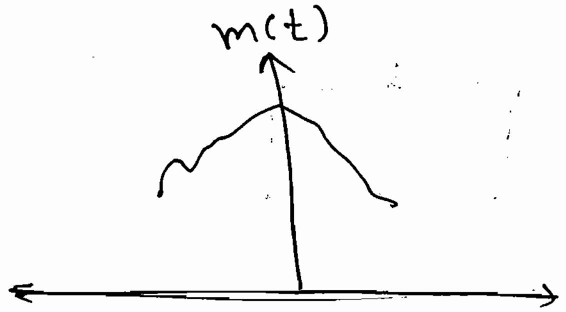
$\Rightarrow$ $m(t)$ = message signal.

= modulating signal

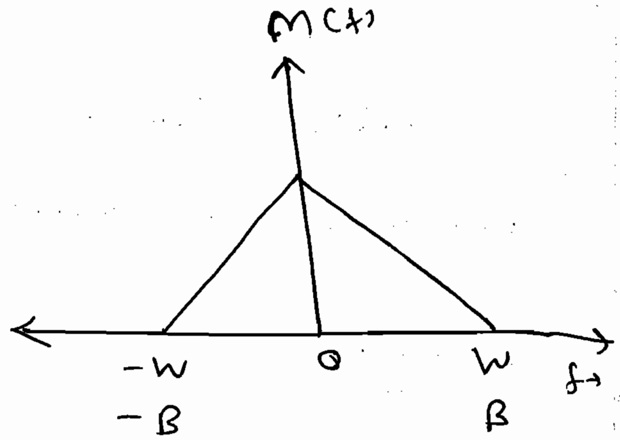
= Base-band signal.

$\rightarrow$ A signal which is having significant low freq. is called base-band signal.

$$m(t) \xleftrightarrow{FT} M(f).$$



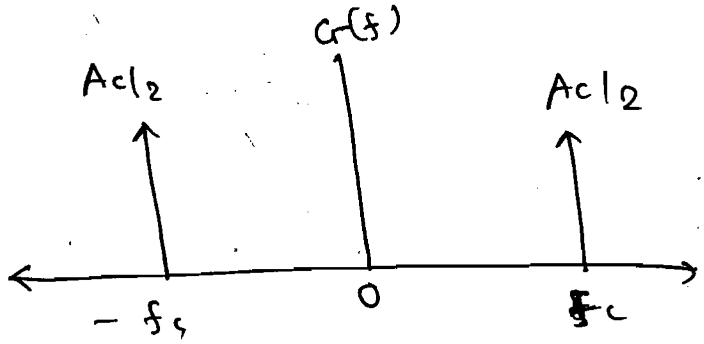
$\longleftrightarrow$



W = highest freq. of signal m(t).

$\Rightarrow$ $c(t)$ = Carrier

$$= A_c \cos 2\pi f_c t \longleftrightarrow \frac{A_c}{2}\left[\delta(f-f_c) + \delta(f+f_c)\right].$$

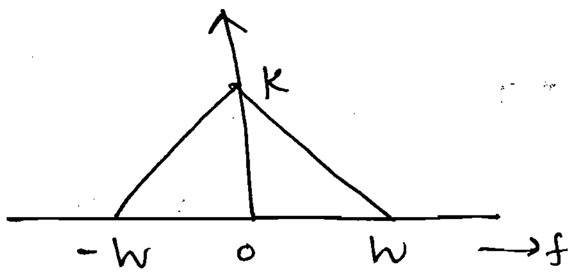


$\Rightarrow$ S(t) = modulated signal.

H.B.

$\therefore \boxed{S(t) = m(t).\, c(t).}$

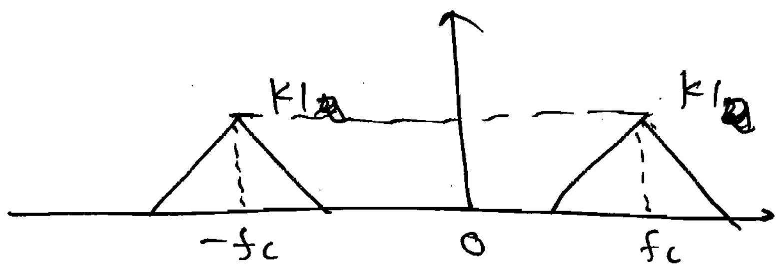
$\Rightarrow$ m(t) $\longleftrightarrow$



Tx

Modulation $\downarrow \times \cos 2\pi f_c t$

$\boxed{S(t) = m(t).\cos 2\pi f_c t}$



Rx

Demodulation $\downarrow \times \cos 2\pi f_c t$

$= m(t).\cos^2 2\pi f_c t$

$= \frac{m(t)}{2} + \frac{m(t) \cos 2\pi f_c 2t}{2}$

$= \frac{m(t)}{2}$