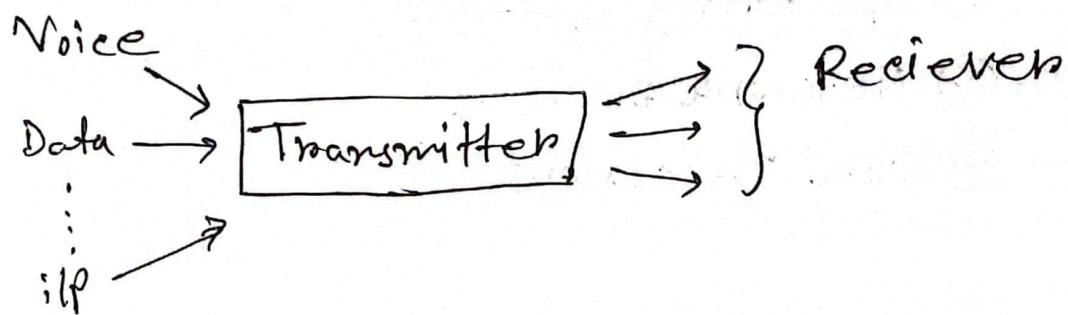


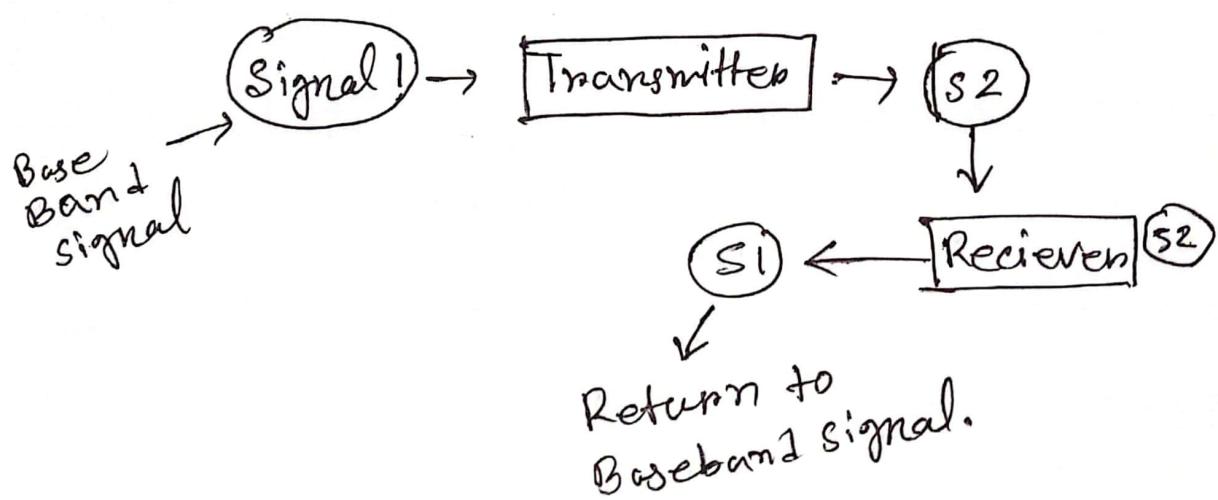
Wireless Communications (L6)

* Components of wireless communication system:

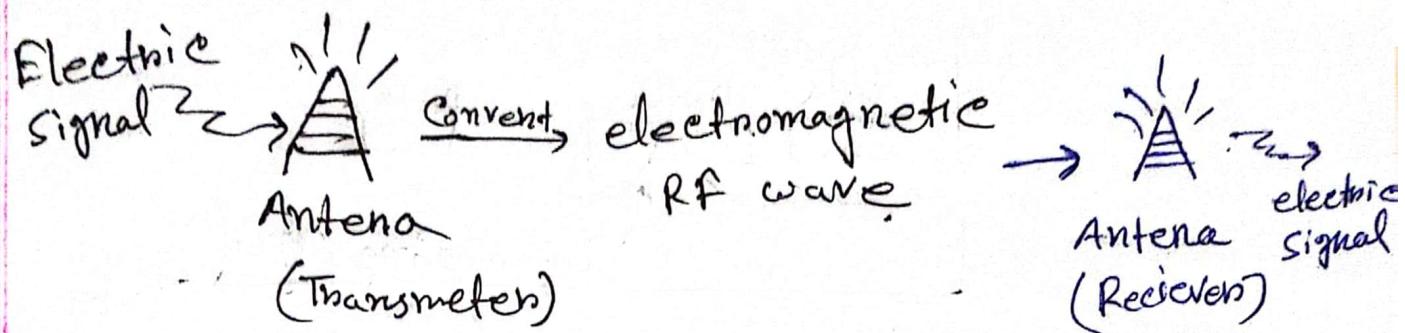
① Transmitter :- Modulates, encodes several base bands signals onto higher frequency analog carrier signal.



* Receiver :- Receives the modulated signals & reverses transmitter function & recovers baseband signal.



* Antenna :- Convert electric signal from transmitter to propagating electromagnetic (Radio Frequency) RF-wave.

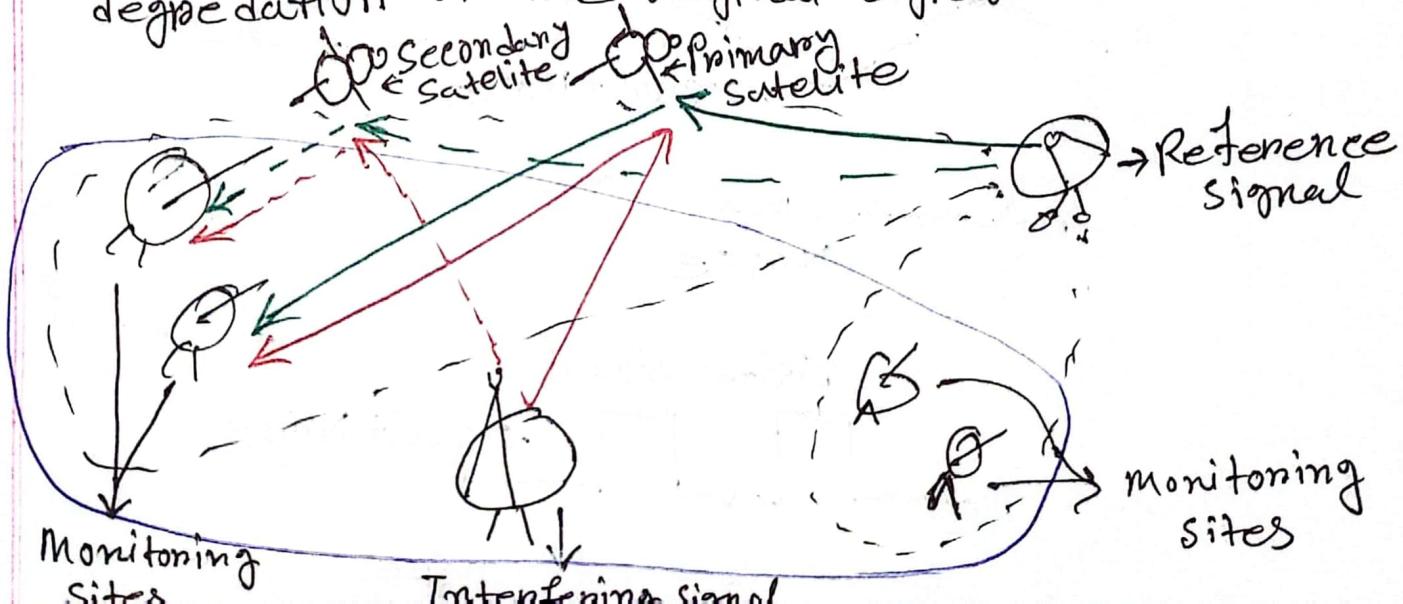


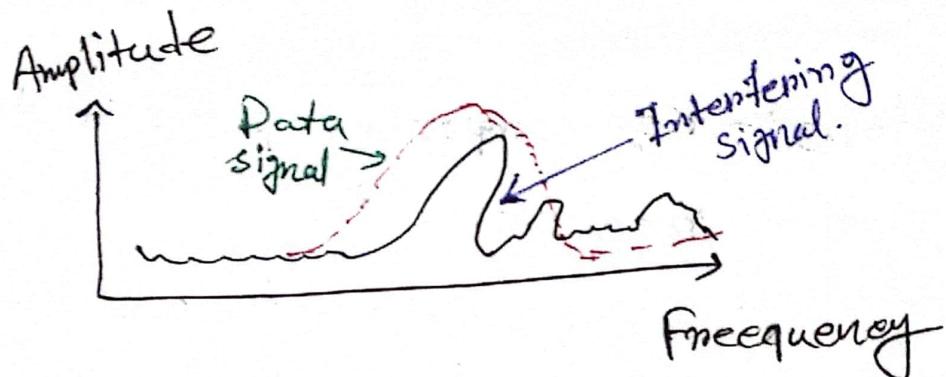
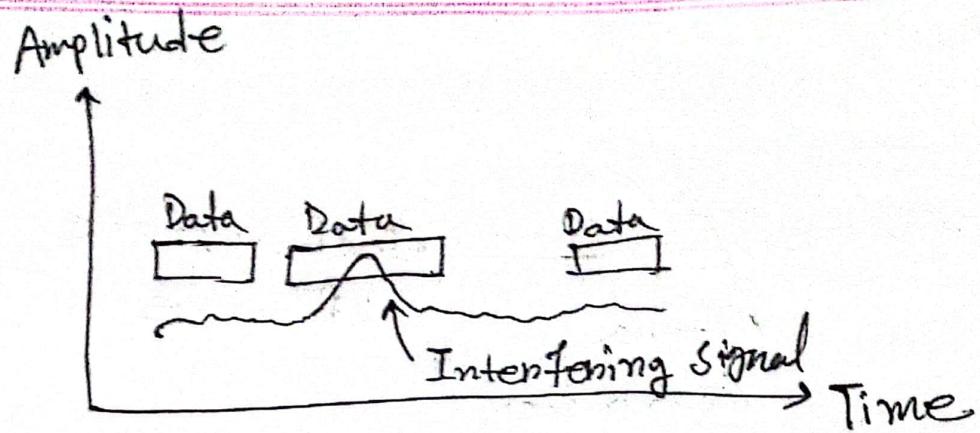
- » Filters :- Key component present in transmitters & receivers both.

Working :- Rejects the unwanted signals.

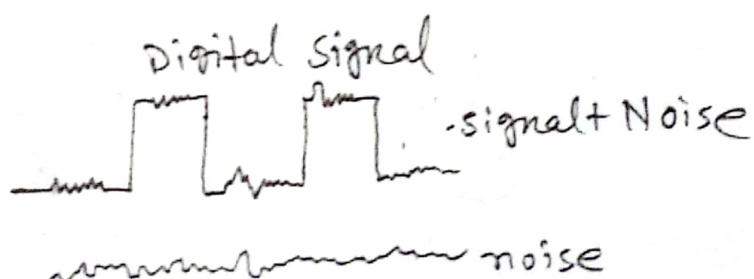
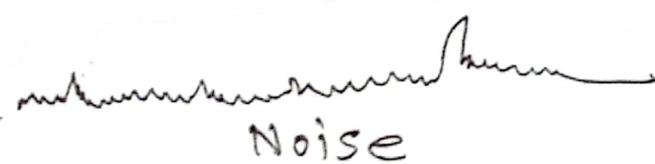
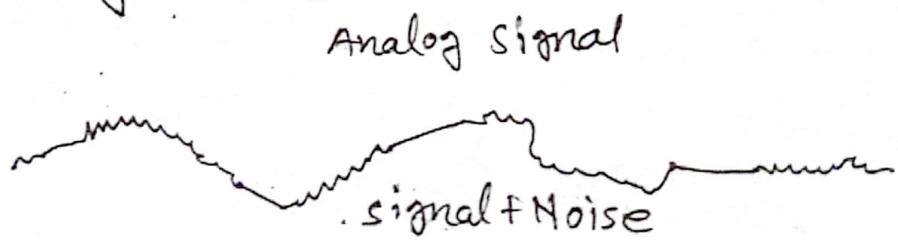
- Interfering Signals lying outside operating band.
- Unwanted noise signal.

- » Interfering signals are unwanted signals that disrupt a desired signal, causing distortion or degradation of the original signal: information.





- Unwanted noise signal is any undesirable signal that interferes with or degrades an information-bearing signal during capture, storage, transmission, or processing.

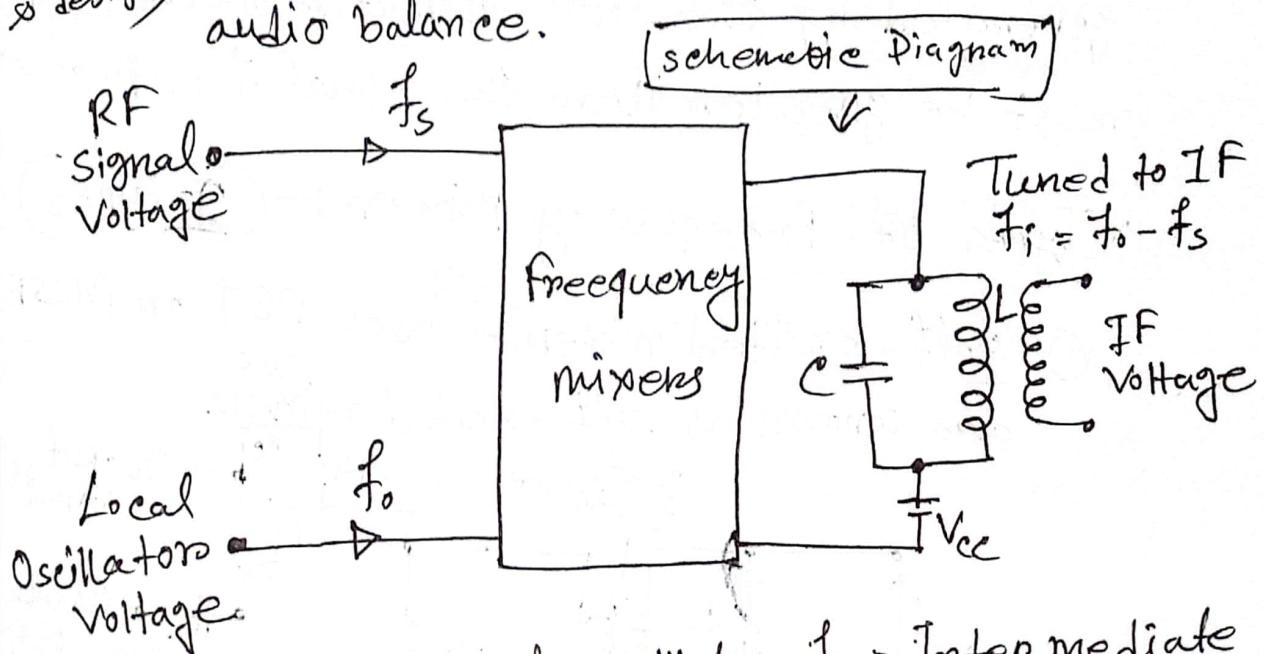


* Amplifiers :-

- Amplifies strength of signal.
- Signal can travel longer distance.
- Voltage increase or amplify.

* Mixers :- Used to achieve frequency conversion at transmitters & receivers.

* Signal Mixers:- Both electronic & audio, work by combining & processing multiple input signals to create a new output signals often in RF technology at a different frequency or a new design to create a new audio balance.



Characteristics:

- ① non-linear device
- ② non-linear dynamic

So, we told the reason why the two input voltage after heterodyning within the mixer produce an output current.

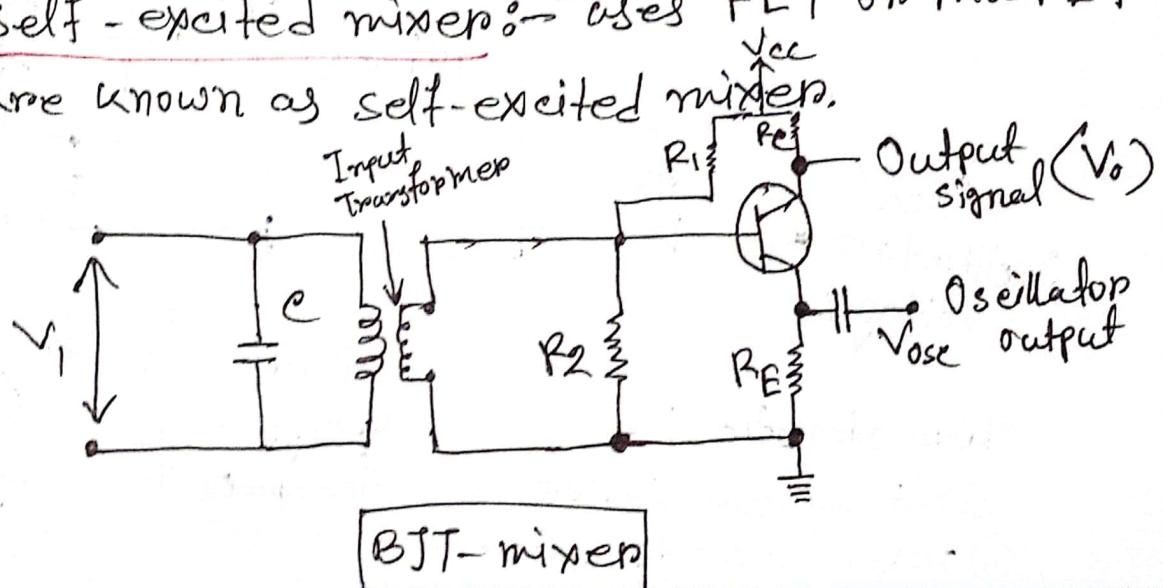
$$f_i = f_o - f_s$$

→ Perspective of intermediate signal we say that every RF signal voltage is reduced to an intermediate frequency & its standard value is 455 kHz for AM (Amplitude)

Otherwise, mixer simply mixes the carriers frequency with the frequency of the signal generated by the local oscillator which frequency must be greater than the signal frequency.

* Types of frequency mixer :- (2-types)

① self-excited mixer :- uses FET or MOSFET
are known as self-excited mixers.



BJT-mixer

Here,

$$\text{Input signal voltage, } V_i = V_{m1} \sin \omega_L t$$

$$\text{Local Oscillator Signal Voltage, } V_{osc} = V_{m2} \sin \omega_H t$$

Now, V_i is at a lower frequency as compared to the local oscillator signal voltage. The low frequency input signal is applied to the base & the oscillator signal is given at the unbypassed emitter of the transistor.

So,

$$V_o = V_i \times V_{osc}$$

$$V_o = V_{m1} \sin \omega_L t \times V_{m2} \sin \omega_H t$$

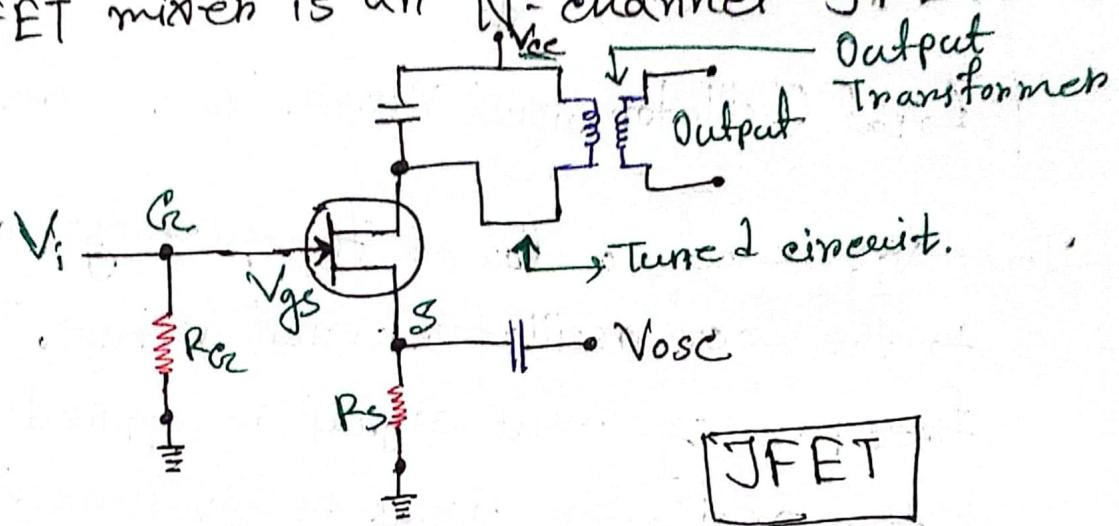
$$V_o = V_{m1} V_{m2} \times \frac{1}{2} [\cos(\omega_H - \omega_L)t - \cos(\omega_H + \omega_L)t]$$

We, say output has two frequency component.

$(\omega_H + \omega_L) \rightarrow \text{Sum of frequency}$

$(\omega_H - \omega_L) \rightarrow \text{Difference or Intermediate frequency}$

⑯ FET mixer:- The active device in case of FET mixer is an N-channel JFET.



As, we can see the low-frequency input signal (V_i) is applied at the gate terminal & the oscillator signal is applied to the source. The drain current (I_D) is related to gate source voltage (V_{GS}). This gate to source voltage depends on the difference between input & oscillator voltage.

$$\text{So, } I_D = I_{DSS} \left[1 - \frac{V_{GS}}{V_p} \right]^2$$

Here,

I_{DSS} = Maximum Drain Current

V_{GS} = Gate to source voltage.

V_p = Pinch off voltage. (G)

$$\text{But, } V_{GS} = V_{Gc} - V_s$$

$$V_{Gc} = V_i - V_{osc} = V_1 \sin \omega_1 t - V_2 \sin \omega_2 t$$

» Advantages:

- ① FET mixers are less noisy as compared to BJT
- ② In case of high frequency applications, JFET-mixers are used. As JFET is a fast device.

③ Separately Excited Mixers:-

- a) Balanced mixer.
- b) Diode-ring mixer.

Cellular Network

» Cellular network is a radio network distributed over land areas called cells, each served by at least one fixed location transceiver known as cell site or Base station. [Voice & Data]

→ Area of coverages is divided into cells as every cells has one transceiver.

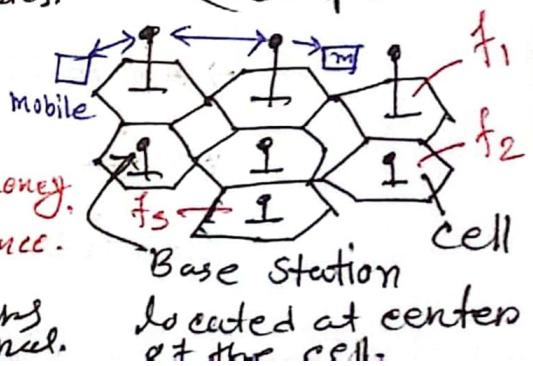
→ Every cells operates in different frequencies.

Advantage:

- ① Increased Capacity
- ② Reduced Power use
- ③ Larger Coverage Area
- ④ Reduced Interference from others signal.

* Adjacent cells
operates in
different frequency.
Reduce
Interference.

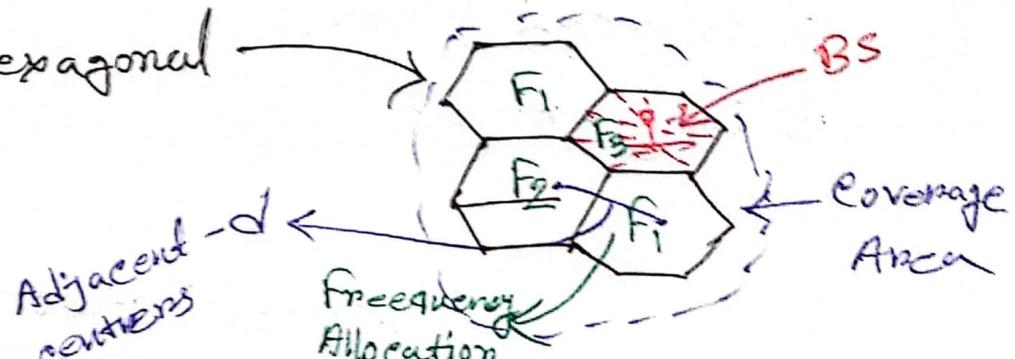
(Hexagonal)
Shape

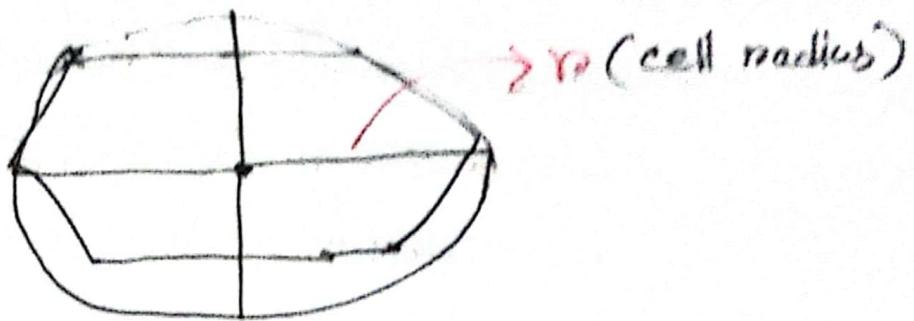


* Factors for determining cell size:-

- Number of users
- Multiplexing & transmission technology used.

* Cell:- It is the basic geographic unit of cellular system.

- Hexagonal
 - Base Stations transmitting over a small geographic areas.
 - Each cell has its own antenna.
 - Adjacent cells are assigned with different frequencies to avoid interference.
 - ** A cell is defined by a radius, that is a radius of the circle that covers the particular area.
- 

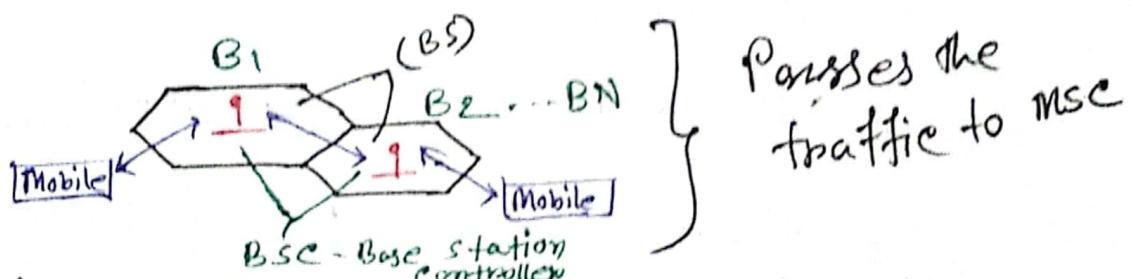


* Distance between adjacent centre is (d)

So,

$$d = \sqrt{3}R \rightarrow \text{cell radius.}$$

* Base Station:- It provides direct communication with the mobile phone.



* Traffic → refers to the volume, diversity, & characteristics of data & communication activity on a cellular network, which includes both user (payload) & signalling traffic.

Two types:

① User traffic → Data users send & receive which generates revenue for service providers.

web browsing, video streaming, social media with HTTP being the

dominant protocol for mobile data traffic.

⑪ Signaling traffic :- Control information used to manage the network, such as user authentication & call setup.

* MSC :- Mobile Switching Station is the

Heart of cellular network.

→ Routing & switching.

→ control numbers of cells.

→ Arrange base station for mobile communication channel.

→ Handling all the connection.

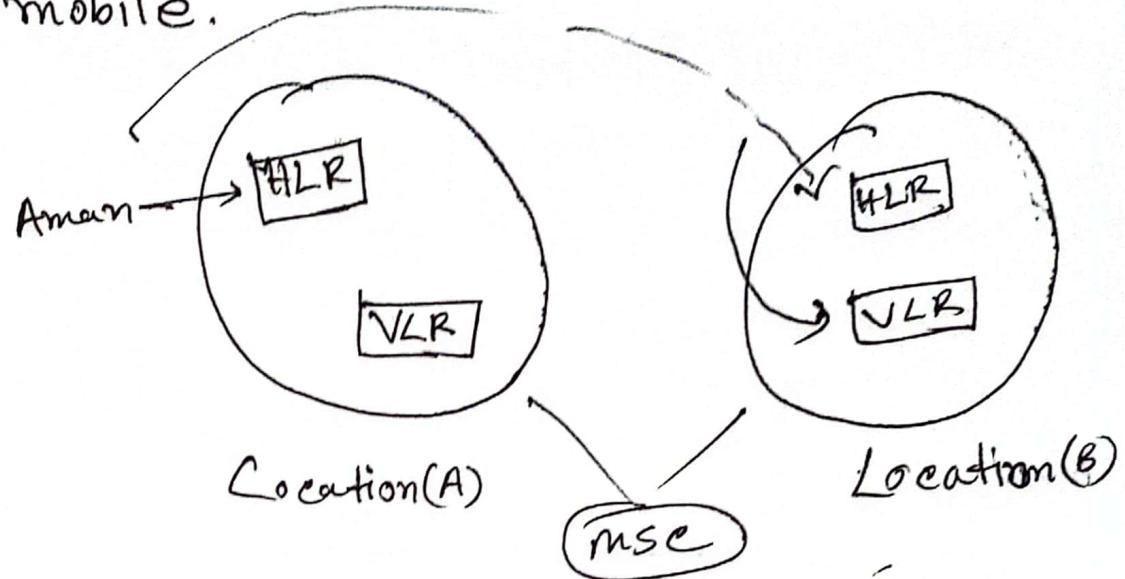
→ Core part of GSM/CDMA network system.

→ Consists of HLR (Home Location Register) & Visitor Location Register (VLR)

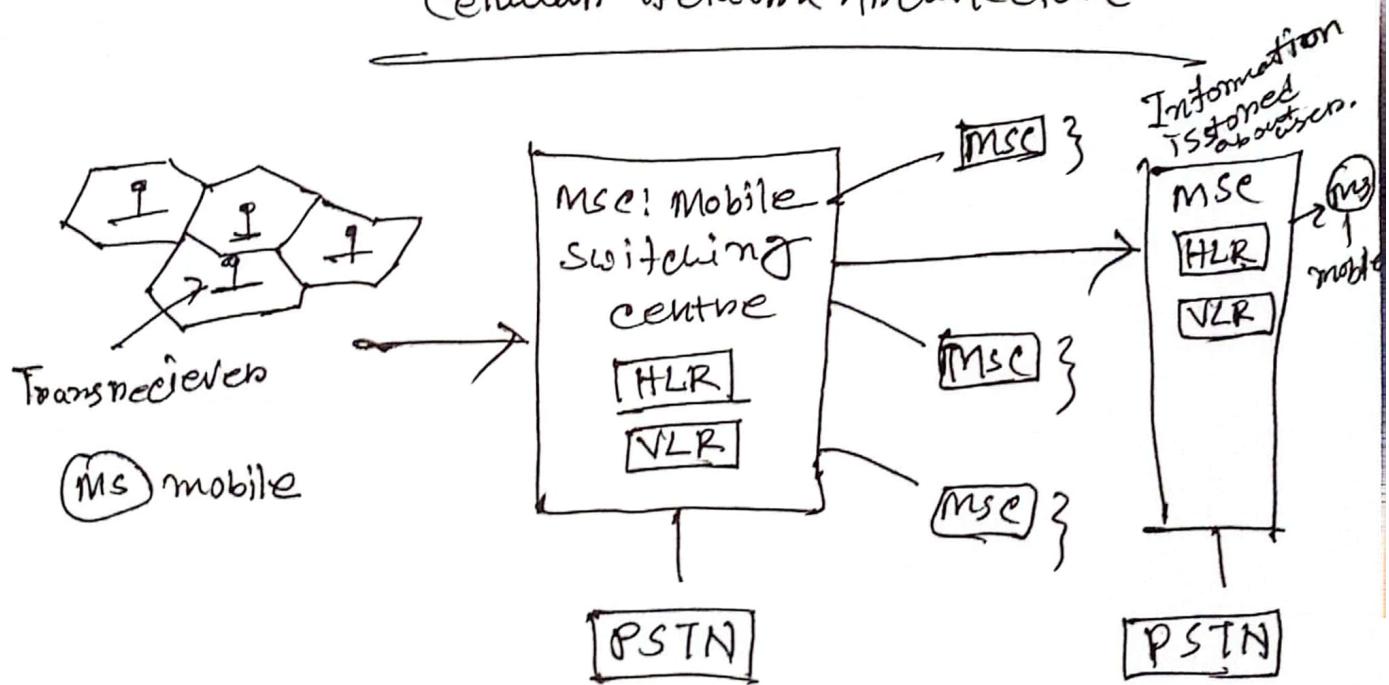
→ Full calling system, transmission path everything control & determine it.

* HLR :- Database that contains current location of each mobile belonging to MSC (NID).

→ VLR :- Records visiting location of each mobile.



Cellular Network Architecture



→ PSTN :- Public Switched Telephone Network.