

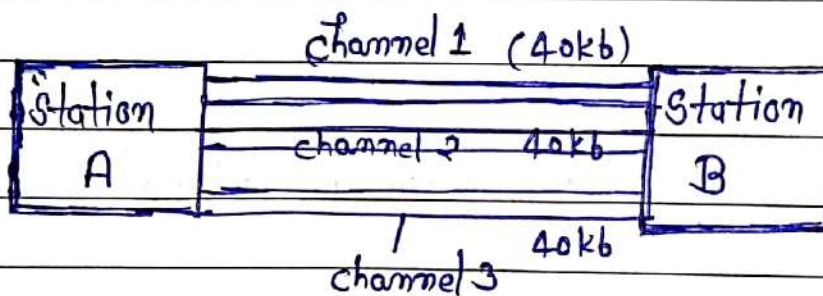
# "Mobile Communication"

## "Evolution of wireless communication" →

wireless communication is Transmitting / Receiving voice and data using electromagnetic waves in open space.

In wireless comm the information from sender to receiver is carried over a well defined frequency Band called channel. Each channel has a fixed frequency bandwidth and capacity.

सूचना को एक साथ Parallel में Transmitt करने के लिये अलग-अलग चैनल प्रयुक्त किये जाते हैं।



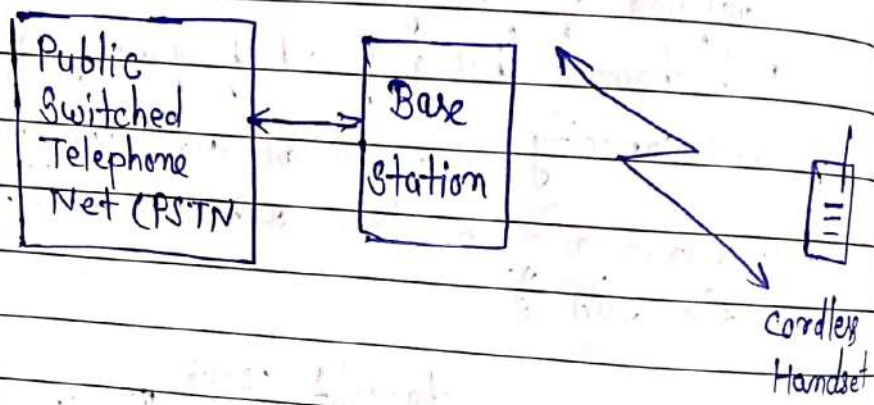
Suppose we have Spectrum of 120 kHz is allocated over a freq. of communication between stations A and B.

Each channel occupies 40 kHz.

A cellular system based on code division multiple access (CDMA) has been developed by qualcomm Inc as an Interim standard (IS 95).

In late 1991 the US Digital cellular (USDC) system hardware was installed in major US cities and subsequently US carriers can phase out AMPS.

### Cordless Telephone System →



### "Advantages of wireless communications" →

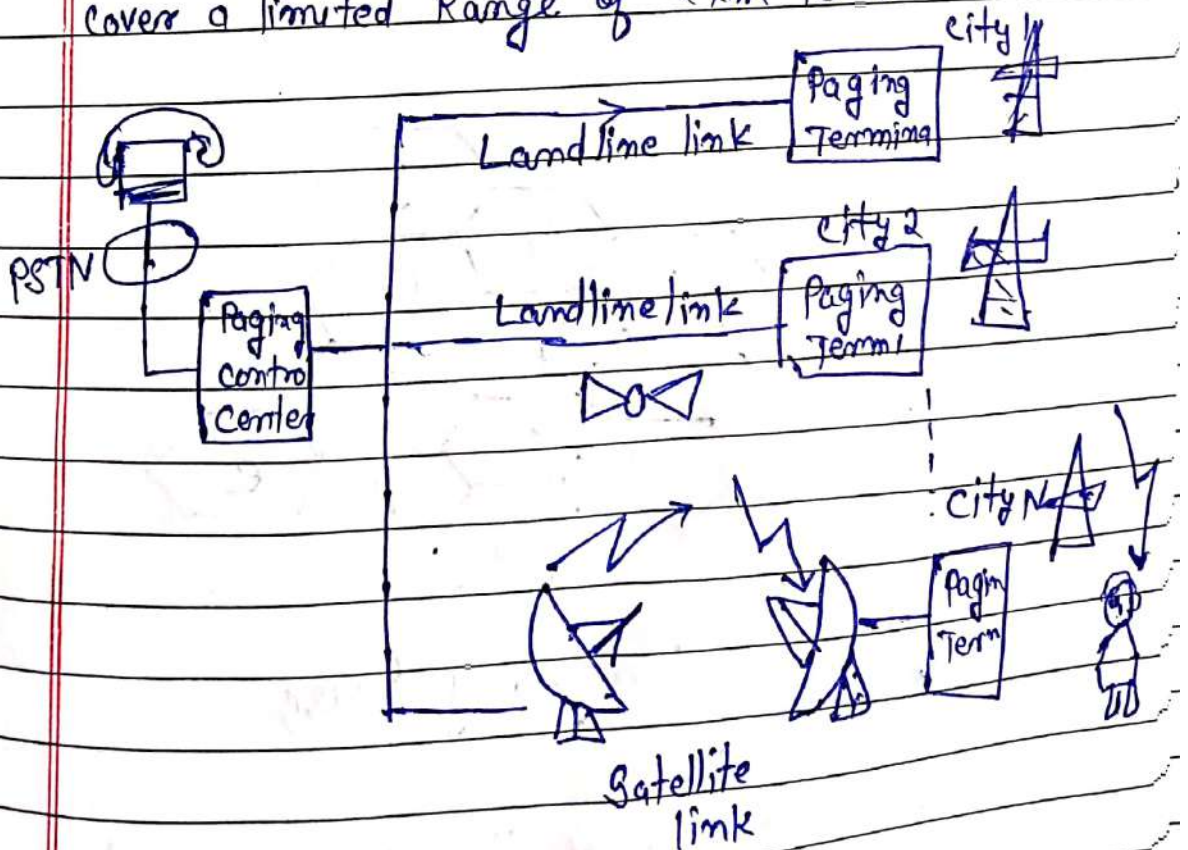
- (1) Wireless Networks are cheaper to install and maintain.
- (2) Data is transmitted faster and at high speed.
- (3) Reduced maintenance and installation cost.
- (4) Can be accessed from anywhere any time.
- (5) It permits professionals to complete their work from remote locations.

(6) - Medical professionals working in remote area can be in touch with medical centers located elsewhere through wireless comm.

(7) Through wireless comm. in emergency situations one can get help.

**"Paging System"** → Paging System are communication system that send brief messages to a subscriber. Message may be either a numeric message, an alphanumeric message or a voice message.

A simple paging system may cover a limited range of 2 km to 5 km.



"Cellular System" → A cell is a basic geographic unit of a cellular system.

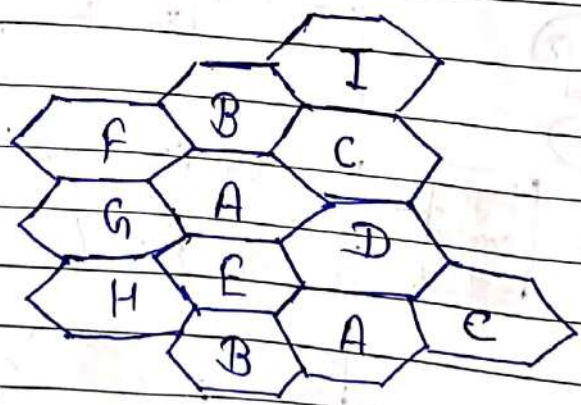
covered by Radio frequency.

The cell is a hexagonal shape represent a small geographical area.

The area covered by Base Station is called cell. At the center of cell there is a omnidirectional antenna. Cell is in the shape of hexagon.

The cellular system works on the principal of frequency Reuse.

Base stations in adjacent cell are assigned channel groups which contains completely different channels than neighbouring cells.



Frequency Reuse

Above fig shows the concept of the

Frequency Reuse where the cell labeled with the same letter uses same group of channels. The group of cells which uses set of frequency that does not repeat is called cluster. After some distance same set of freq are used which is called freq Reuse.

"channel capacity"  $\Rightarrow$  Consider a cellular system which has a total of  $S$  duplex channels available to use. If each channel is allocated a group of  $k$  channels ( $k < S$ ) and if  $S$  channels are divided among  $N$  cells

$$S = kN$$

if the cluster is replicated  $M$  times within the system.

Total capacity  $C = M \cdot kN = MS$

Size of the cluster can have the only values which satisfy the equation

$$N = i^2 + j^2 + i \cdot j$$

where  $i$  and  $j$  are non negative integers.

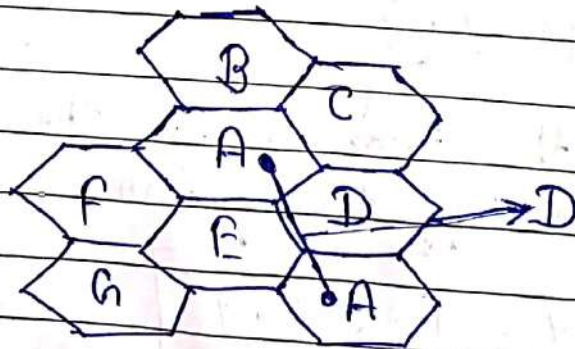
## "Interferences and System capacity" → Interference

is a major limiting factor in the performance of a cellular Radio system. Sources of Interference includes another mobile in the same cell.

Interferences mainly divided into two categories

- ①:- Co-channel Interference
- ② Adjacent channel Interference

Co-channel Interference → Freq Reuse implies that in a given coverage area there are several cells that uses same set of freq. these cells are called co-channels cells and interference b/w them is called co-channel Interference.

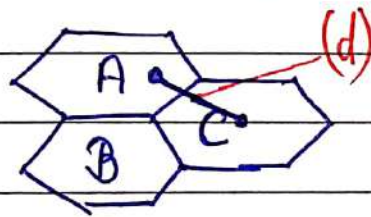


$$Q = \frac{D}{R} = \sqrt{3N}$$

Smaller value of  $Q$  provides larger capacity since the cluster size  $N$  is small

whereas a large value of  $\alpha$  improves the transmission quality.

"Adjacent Channel Interference"  $\rightarrow$  Interference Resulting from the neighbouring cells is called adjacent channel interference. It results from imperfect receiver filters which allows nearby freq to leak into the passband.



Adjacent channel Interference can be minimized through careful filtering and channel assignments.

"Handoff Strategies"  $\rightarrow$  when a mobile moves into a different cell while a conversation is in process the MSC automatically transfers the call to a new channel belonging to new base station.

The handoff process not only involves identifying a new base station but also requires that the voice

and control signals be allocated to channel associated with the new base station.

Handoff Process is of two types

- ① Hard Hand off
- ② Soft Hand off

In Hard Hand off call get disconnected once and then Reconnected.

In Soft Handoff the call transfer is smooth and get is continuous while transfer.



"Improving capacity in cellular system"  $\Rightarrow$  For increasing capacity in cellular system we have following methods

Cell Splitting

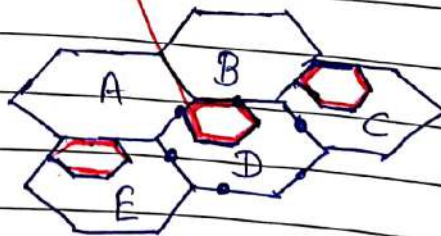
Sectoring

Microcell zone Concept

"Cell Splitting"  $\Rightarrow$  Cell splitting is the process of subdividing the congested cell into smaller cells each its own base station and correspond reduction in antenna height and Transmitter power.

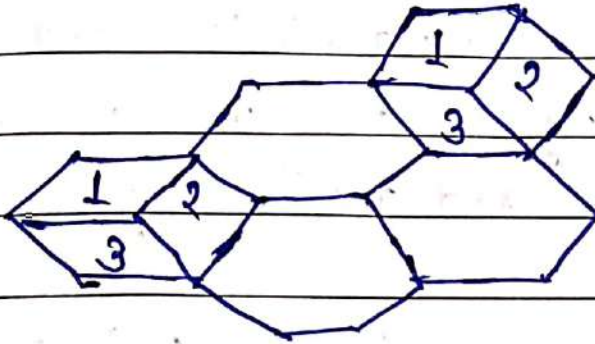
Cell splitting increases the capacity since it increases the number of times the channels are reused.

microcell



"Sectoring"  $\Rightarrow$  In Sectoring method we keep the cell Radius  $R$  unchanged and decreases the co-channel interference.

In this method we replace single omnidirectional antenna by several directional antennas.



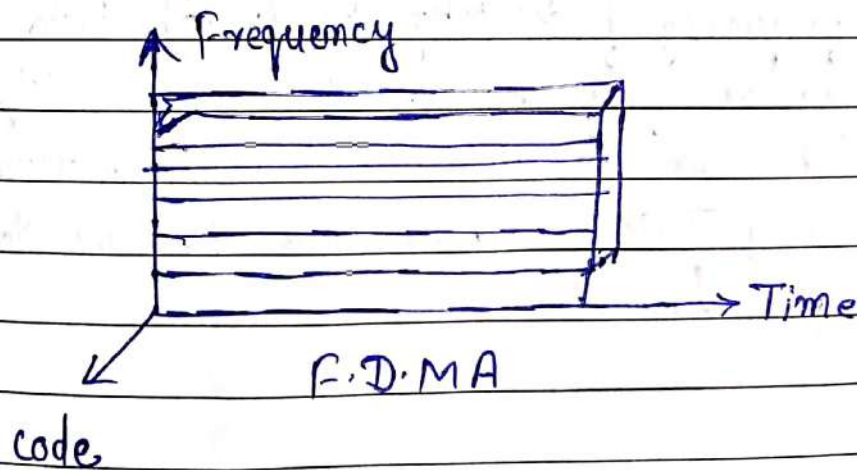
Sectoring method.

**"Multiple Access Techniques"**  $\Rightarrow$  Multiple access is the use of multiplexing techniques to provide communication service to multiple users over a single channel.

It allows for many users at one time by sharing a finite amount of spectrum.

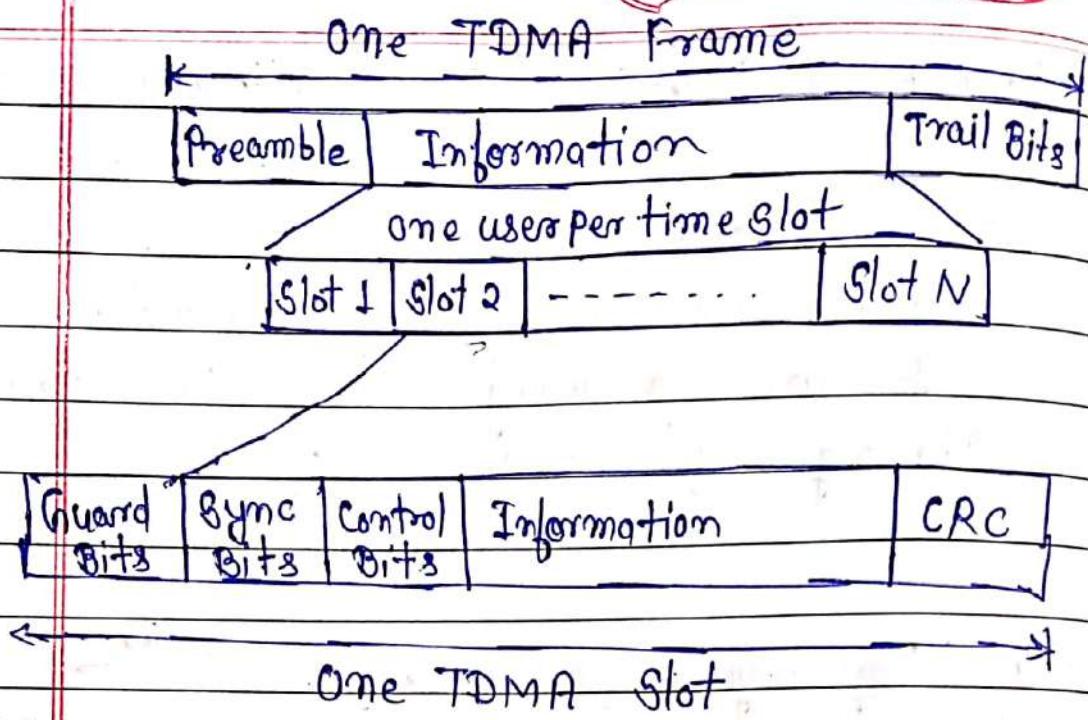
**"F.D.M.A (Frequency Division Multiple Access)"**  $\Rightarrow$

In FDMA the available bandwidth is subdivided into a number of narrower band channels. Each user is allocated a unique freq band in which to transmit and receive on.



**Time Division Multiple Access (TDMA)"**  $\Rightarrow$  In TDMA

frames are used to allow the communication receivers to be able to determine where each users data is located within the bit stream it receives



GSM uses a combination of both TDMA and FDMA techniques.

~~GSM uses a~~

The FDMA element divides the assigned frequency of 25 MHz Bandwidth into 124 carrier frequencies, all spaced 200 kHz apart. The carriers are also divided in time using TDMA. There are 8 time slots per channel.

Code Division Multiple access  $\rightarrow$  The CDMA standard was originally designed by Qualcomm in the US.

CDMA is based on the spread spectrum technique.

In CDMA every channel uses the full available spectrum.

Individual conversations are encoded with pseudo random digital sequence and then transmitted.

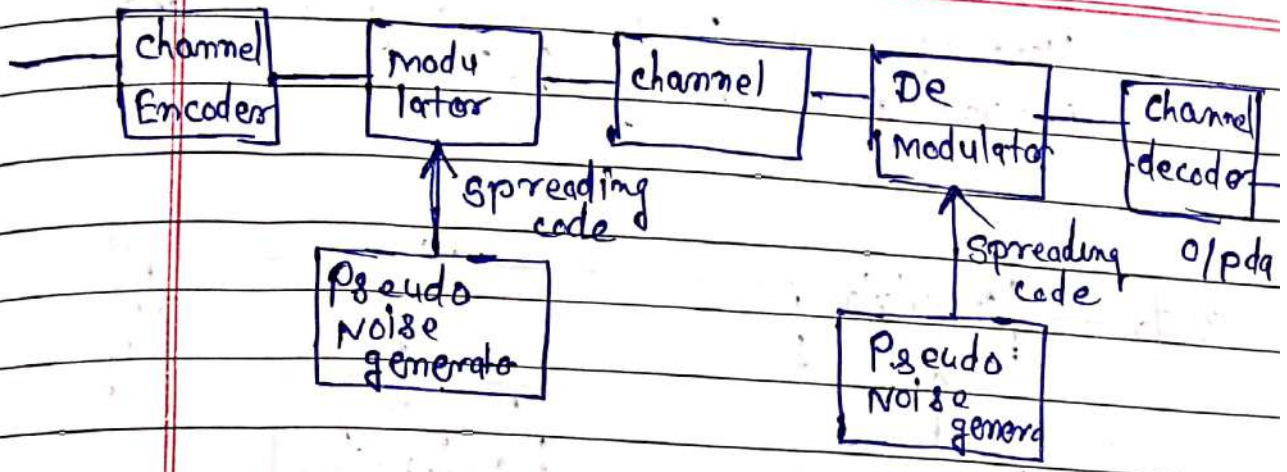
CDMA consistently provides better capacity for voice and data communication, allowing more subscribers to connect at any given time.

CDMA is the most common platform on which 3G technologies are built.

Spread Spectrum Systems  $\rightarrow$  Spread Spectrum is a wideband modulation and uses a PN sequence.

This techniques provide data and message security

It is Resistance to interference and Jamming, and it allows for band sharing.



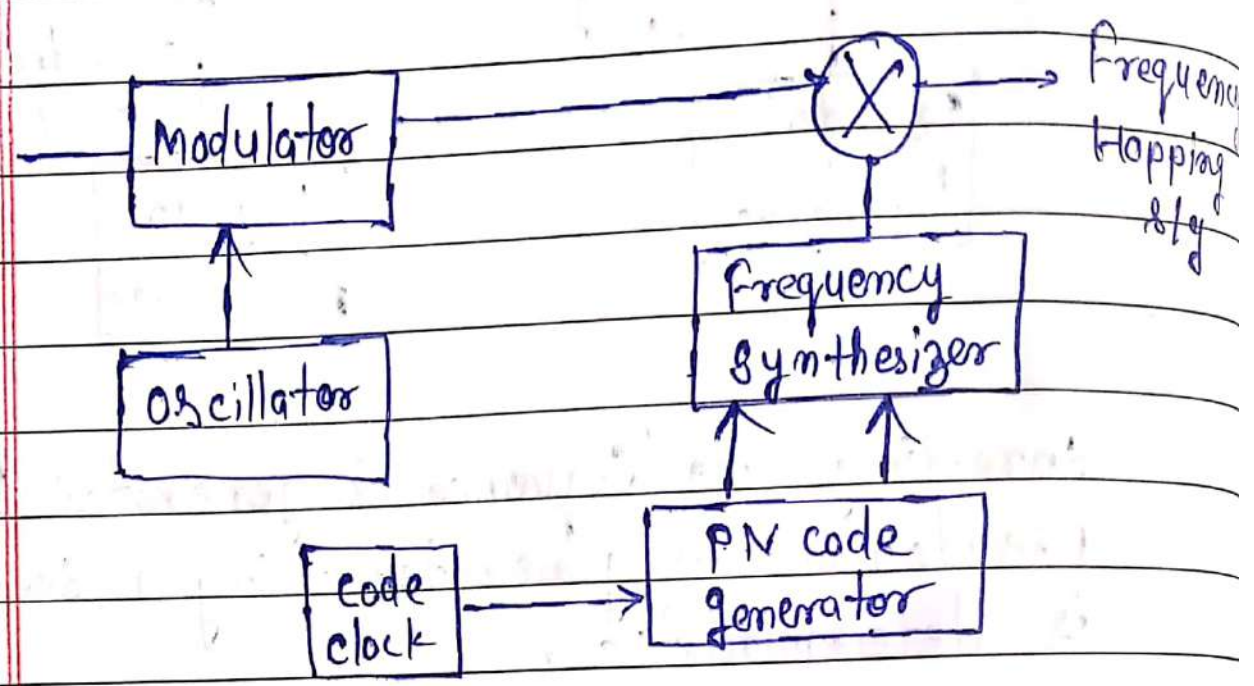
Spreading code/Sequence is generated by a Pseudorandom generator using a Seed and is deterministic.

Modulators using the spreading code to modulate its input to a much wider bandwidth o/p for transmission. Demodulator using the same spreading code to demodulate the spread spectrum signal.

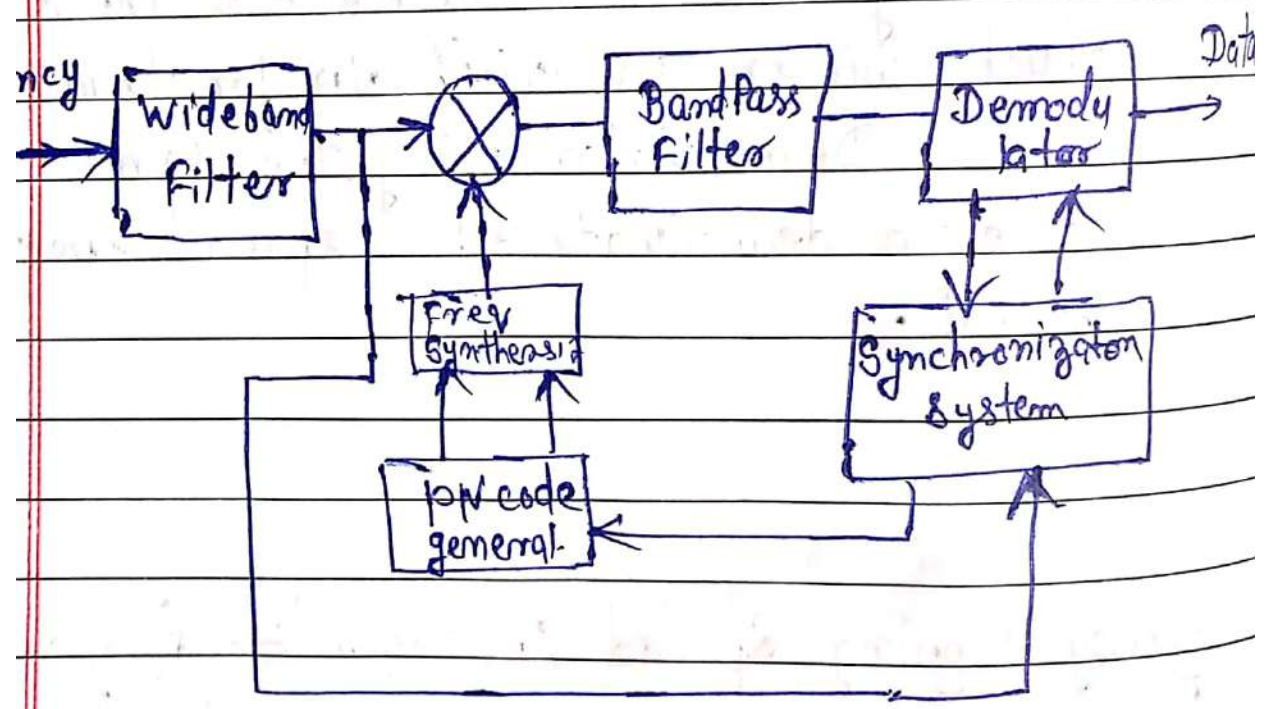
"Frequency Hopping Spread Spectrum" → Frequency hopping involves

a periodic change of Transmission frequency. A frequency Hopping signal may be regarded as a sequence of modulated data bursts with time varying pseudorandom carrier frequencies. The set of possible carrier frequency is called Hopset.

Hopping occurs over a frequency band that includes a number of channels.



**Transmitter**



**Receiver**