⊛ Mobile Computing & Wireless Communication ⊛

⊛ Chapters :-

(1) Introduction, Transmission Fundamentals Communication Networks
(2) Cellular Wireless Networks
Antennas and Propagation
Spread Spectrum
Coding and Error Control
(3) Multiple access in wireless system
Global System for Mobile Communication
General packet radio service (GPRS)
Wireless System Operations & Standards
Mobile IP and wireless Application protocol.
(4) WiFi & the IEEE 802.11 wireless LAN standard.
(5) Bluetooth
(6) Android (Mobile Application development)

⊛ Chapter : (1) : Introduction, Transmission Fundamentals, Communication Networks ⊛

Q.(1) What is MC we?

- "Mobile computing is a technology that allows transmission of data, voice & video via a computer or any other wireless enabled device without having to be connected to a fixed physical Link."

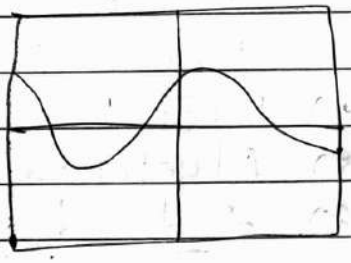
Q.② Electronic signals:

- The signals which are used ~~to~~ as means to transmit information are known as Electronic Signals.

- it can be expressed as:
  - Function of Time (L)
  - Function of Frequency

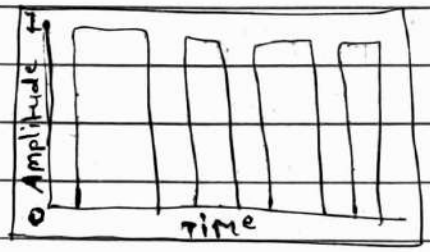
Q.③ Time Domain Concepts:

(*) Analog Signal:



- signal intensity varies in a smooth fashion over time.
- The No breaks or discontinuities in signal
- Application: audio & video transmission.
- Ex: Temperature sensors, FM Radio, Photocells, Light sensor, etc.

(*) Digital Signal:



- Signal intensity maintains a constant level for some period of time and then changes to another constant level.
- Application: computing & digital electronics
- Example: Computers, CDs, DVDs.

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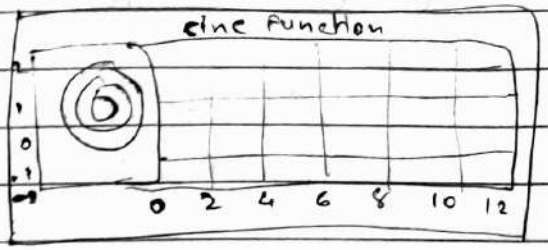
⊛ Periodic Signal:

- An Analog or digital signal pattern that repeats over time.

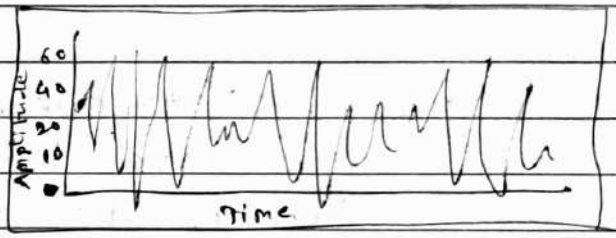


Equation: $S(t) = S(t+T), \quad -\infty < t < \infty$

where, T is the periodic signal.

⊛ Aperiodic Signal:

- An Analog or digital signal pattern that doesn't repeat over time.



⊛ Peak Amplitude (A):

- Maximum value or strength of the signal over time
- typically measured in volts

⊛ Frequency (F):

- Rate, in cycles per second, or Hertz (Hz), at which the signal repeats.

⊛ Phase (ϕ):

- A measurement of the relative position in time within a single period of a signal.

④ Wavelength (λ):

- A distance occupied by a single cycle of the signal.
- Or, the distance between two points of corresponding phase of two consecutive cycles.

Q.④ Frequency Domain Concepts:

① Fundamental Frequency:

- When all frequency components of a signal are integer multiples of one frequency, it's referred to as the fundamental frequency.
- The period of the total signal is equal to the period of the fundamental frequency.

② Spectrum:

- Range of frequencies that a signal contains.

③ Absolute bandwidth:

- Width of the spectrum of a signal.

(*) Effective bandwidth:

- Narrow band of frequencies that most of the signal's energy is contained in.

Q.(5) Relationship Between Data Rate and Bandwidth:

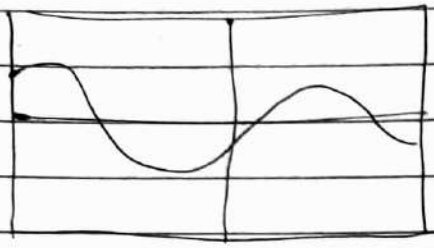
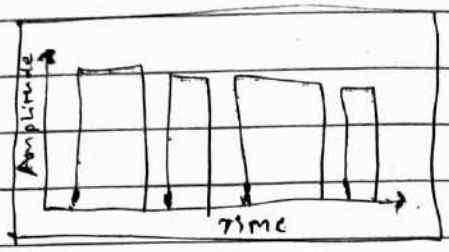
- The greater the bandwidth, the higher the information-carrying capacity.

Conclusion- Any digital waveform will have infinite bandwidth
- BUT the transmission system will limit the bandwidth that can be transmitted.
- AND, for any given medium, the greater the bandwidth transmitted, the greater the cost.
- HOWEVER, limiting the bandwidth creates distortions.

Q.(6) Analog and Digital Data Transmission:

(*) Data Communication Terms:

Data: Data as entities that convey meaning, or information.
Signals: signals are electric or electromagnetic representations of data.
Transmission: Transmission is the communication of data by the propagation and processing of signals.

No.	Analog Transmission	Digital Transmission
(1)		
(2)	Analog signal is a continuous signal which represents physical measurements.	Digital signal are discrete time signals generated by digital modulation.
(3)	Represented by sine wave.	Represented by square waves.
(4)	Stored in the form of wave signal.	Stored in the form of binary bit.
(5)	Analog instrument draws large power.	Digital instrument draws only negligible power.
(6)	Can be used in analog device only. Best suited for audio & video transmission.	Best suited for computing and digital electronics.
(7)	Subjected to deterioration by noise during transmission.	Can be noise-immune without deterioration during transmission.

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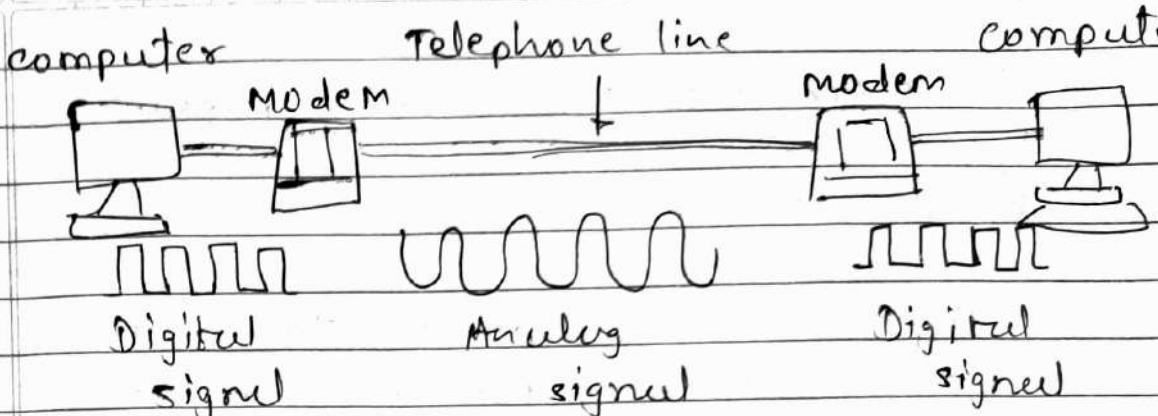
Modulation / Demodulation



Q.7 Reasons for choosing Data & Signal Combinations:

Analog data → [Telephone] → Analog data

Digital data → [Modem] → Analog data

Analog data → [codec] → Digital data

Digital Data → [Digital Transmitter] → Digital signal

Q.8 Channel Capacity:

⊛ channel capacity:

- the maximum rate at which data can be transmitted over a given communication path, or channel, under given conditions.

⊛ Data Rate:

- Rate at which data can be communicated (bps).
- Data rate is the speed at which data is transferred between two devices, measured

in mega bits per second (Mbps).

③ Bandwidth:

- The bandwidth of the transmitted signal as constrained by the transmitter and the nature of the transmission medium (Hertz).

- Bandwidth is measured as the amount of data that can be transferred from one point to another within a network in a specific amount of time.

④ Noise:

- Average level of disturbance over the communication path.

- Noise is an unwanted disturbance in an electrical signal.

⑤ Error Rate:

- Rate at which error occur

- Error = transmit 1 and receive 0;
transmit 0 and receive 1;

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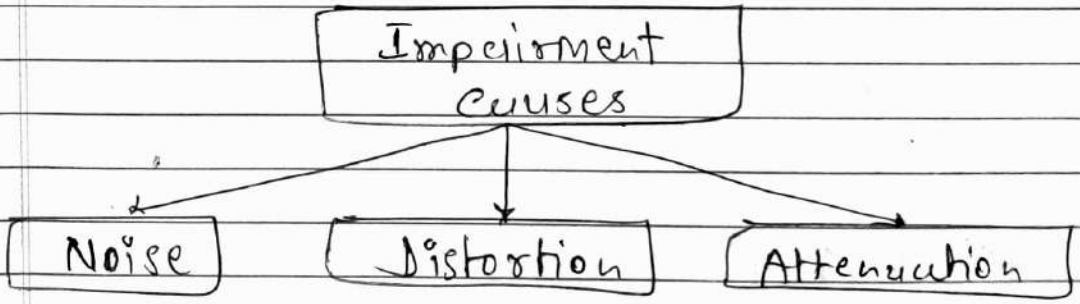
④ Bandwidth Comperision:

Generation	Technology	maximum download speed
2G	GPRS - Global positioning Rudio system, EDGE - Enhanced Data Rates For GSM Evolution	64 Kbps
3G	HSPA - High speed packet Access DcHSPA - Dual Access HSPA	2 Mbps
4G	LTE - Long Term Evolution	2000 Mbps to 1 Gbps
5G	5G	1Gbps & higher

Q. ⑤ Transmission Impairment:



[1] Noise:

- The random / unwanted signal that mixes with the original signal is known as Noise.

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⑧ Types of Noise:

i. Induced Noise:

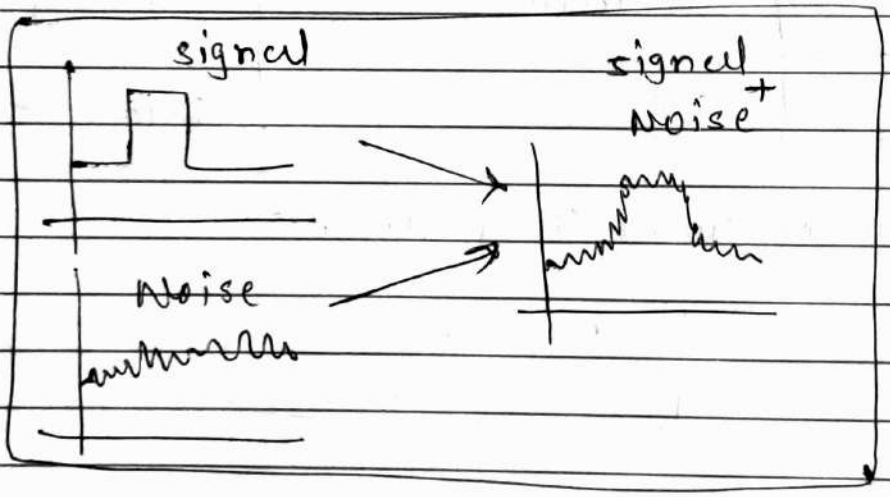
- Noise from sources such as motors and appliances.

ii. Crosstalk Noise:

- Noise generates when one wire affects the other wire.

iii. Thermal Noise:

- Noise from movement of electrons in wire which creates an extra signal.

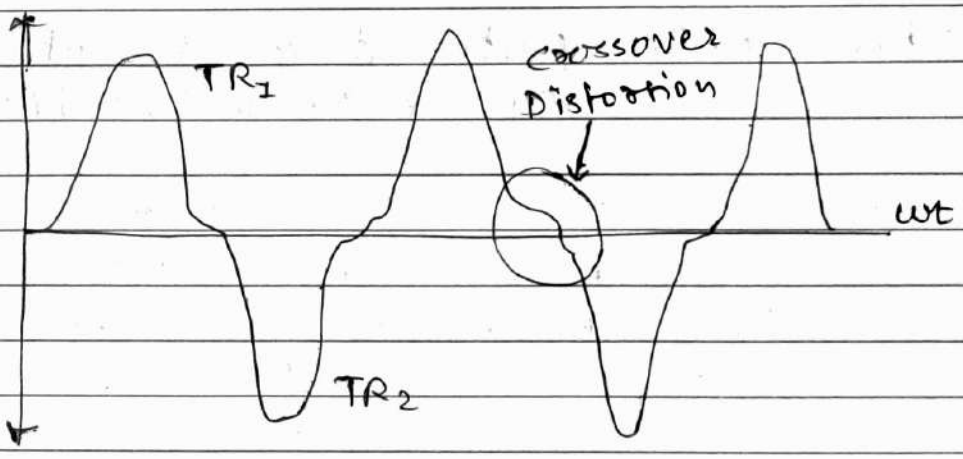


iv. Impulse Noise:

- signal with high energy that comes from lighting or power lines.

[2] Distortion :

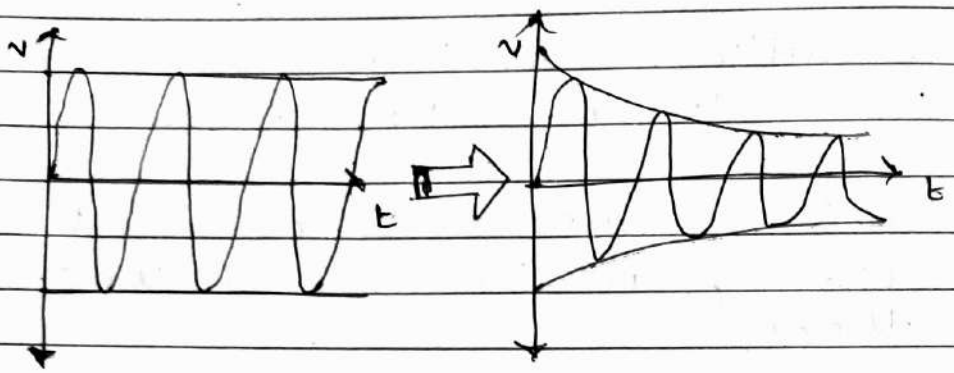
- change in the shape of signal.
- Generally observed in composite signals with different frequencies.
- Each frequency component has its own propagation speed while travelling through a medium.
- Every component arrive at different time which leads to delay distortion.



[3] Attenuation :-

- Loss of energy.
- The strength of signal decreases with increasing while distance which causes loss of energy in overcoming resistance of medium.

- Amplifiers are used to amplify the attenuated signal which gives the original signal back.



Q. (10) Maximum Data Rate for Noiseless and Noisy Channels:

- Data Rate: Rate at which data can be communicated (bps).

- Data rate is speed at which data is transferred between two devices, measured in mega bits per second (Mbps).

- Data rate depends upon 3 factors:

1. Bandwidth available
2. Number of levels in digital signal
3. The quality of the channel i.e. level of Noise.

- To calculate data rate 2 theoretical formulas were developed:

1. Nyquist Bandwidth → Noiseless channel.
2. Shannon Capacity Formula → Noisy

[1] Noisy Nyquist Bandwidth Noiseless channel:

For

- Nyquist Bandwidth is relationship between bandwidth and its information carrying capacity.
- Nyquist's theorem specifies the maximum data rate for Noiseless condition.
- Nyquist's theorem states that if the rate of signal transmission is 2B (Bandwidth), then a signal with Frequency no greater than B is ~~diff~~ sufficient to carry the signal rate.
- There are two types of signal:
  - Binary Signals (Two level: 0 & 1)
  - Multilevel signals (more than two level)
- Nyquist formula for maximum bitrate in bits per second (bps) for noiseless channel.
- For binary signals:

$$C = 2B$$

C: channel capacity
B: Bandwidth

- For multilevel signaling:

$$C = 2B \log_2 M$$

M: Number of discrete signal or voltage levels
C: channel capacity
B: Bandwidth

Ex. ① If the signal transmitted is binary and bandwidth is 3200 Hz then calculate the channel capacity.

Soln: given.

$B = 3200$ Hz.

Formula for binary signal:

$$C = 2B$$
$$= 2 \times 3200$$
$$\boxed{C = 6200 \text{ bps}}$$

- Therefore, channel capacity C is 6200 bps if bandwidth B is 3200 Hz.

Ex. ② If the signal transmitted is multilevel & bandwidth is 3200 Hz with 8 possible signal levels are used then calculate the channel capacity.

Soln: given.

Bandwidth $B = 3200$ Hz
Signal level $M = 8$

- Formula for multilevel signal:

$$C = 2B \log_2 M$$

$= 2 \times 3200 \times \log_2 8$

$= 2 \times 3200 \times 3$

$C = 18,600$ bps

- Therefore, for a given bandwidth, the data rate can be increased by increasing the number of different signal elements (M).

- Nyquist's formula indicates that, doubling the bandwidth doubles data rate.

(11) Signal-to-Noise Ration:

- Ratio of the power in a signal to the power contained in the noise that's present at a particular point in the transmission.

- Typically measured at a receiver end

- signal-to-Noise ratio (SNR, or S/N)

$$(SNR) = 10 \log_{10} \frac{\text{Signal Power}}{\text{noise Power}}$$

- A high SNR means a high-quality signal, low number of required intermediate repeaters.

- SNR sets upper bound on achievable data rate.

- A high SNR means a high-quality level.

[2] Shannon Capacity Formula for noisy channel :-

- In real, we cannot have a noiseless channel ; the channel is always noisy

- Shannon capacity specifies the theoretical highest data rate for a noisy channel.

- Shannon capacity formula:

$$C = B \log_2 (1 + SNR)$$

Where C : channel (bps)
B : Bandwidth (Hz)

- In practice, only much lpower rate achieved.

- Formula assumes white noise
- Impulse noise is not accounted fo
- Attenuation distortion or delay distortion not accounted for.

⑧ Nyquist and Shannon Formulations:

Eg. ① the spectrum of channel is between 3MHz and 4MHz and SNR is 24_{dB}. Find out channel capacity using shannon formula.

Sol^n: Bandwidth

$B = 4MHz - 3MHz$

$= 1MHz$

$SNR = 24_{dB}$

$= 10 \log_{10} (SNR)$

$24 = 10 \log_{10} (SNR)$

$= 251$

Note:

$SNR_{dB} = 10 \log_{10} (SNR)$

$24 = 10 \log_{10} (SNR)$

$\frac{24}{10} = \log_{10} (SNR)$

$SNR = 10^{2.4}$

$= 251$

$\because \log_b x = y \leftrightarrow b^y = x$

Using shannon's formula:

$C = B \log_2 (1 + SNR)$

$= 1MHz \log_2 (1 + 251)$

$= 10^6 * \log_2 (252)$

$= 10^6 * 8$

$C = 8 Mbps$

Ex. ② We have a channel with 1 MHz bandwidth. The SNR = 63. What are the appropiate Bit rate and signal level using Shannon's & Nyquist formula?

Soln: Given: Bandwidth B = 1MHz
SNR = 63

(*) Bit rate C.

Using Shannon's Formula:

$C = B * \log_2(1+SNR)$
$= 1MHz \log_2(1+63)$
$= 1MHz \log_2(64)$

$C = 6Mbps$

(*) Signal level M, if C = 6Mbps

Using Nyquist's Formula,

$C = 2B * \log_2 M$
$6 \times 10^6 = 2(2 \times 10^6) \log_2 M$
$3 = \log_2 M$
$\therefore M = 2^3$
$\therefore M = 8$

Ex. ③ A typical voice channel has SNR as 30 dB and Bandwidth as 2.7 KHz. Calculate the approximate maximum information capacity of the channel?

Soln: Given: Bandwidth B = 2.7 KHz
SNR = 30dB = $10 \log_{10}(SNR) = 1000$

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Using Shannon's Formula:

$$C = B * \log_2(1+SNR)$$
$$= 2.7\ kHz * \log_2(1+1000)$$
$$= 2.7 \times 10^3 * \log_2(1001)$$

$$= 2700 * 9.967$$
$$= 27000$$

$$\boxed{C = 27\ kbps}$$

Ex.

Ex. ④ If the SNR of wireless channel 30 dB then calculate maximum data rate through channel with bandwidth of 200kHz.

Soln: Given: Bandwidth $B = 200\ kHz$

$SNR = 30\ dB = 30 \log_{10}(SNR) = 10$

Using shannon's Formula:

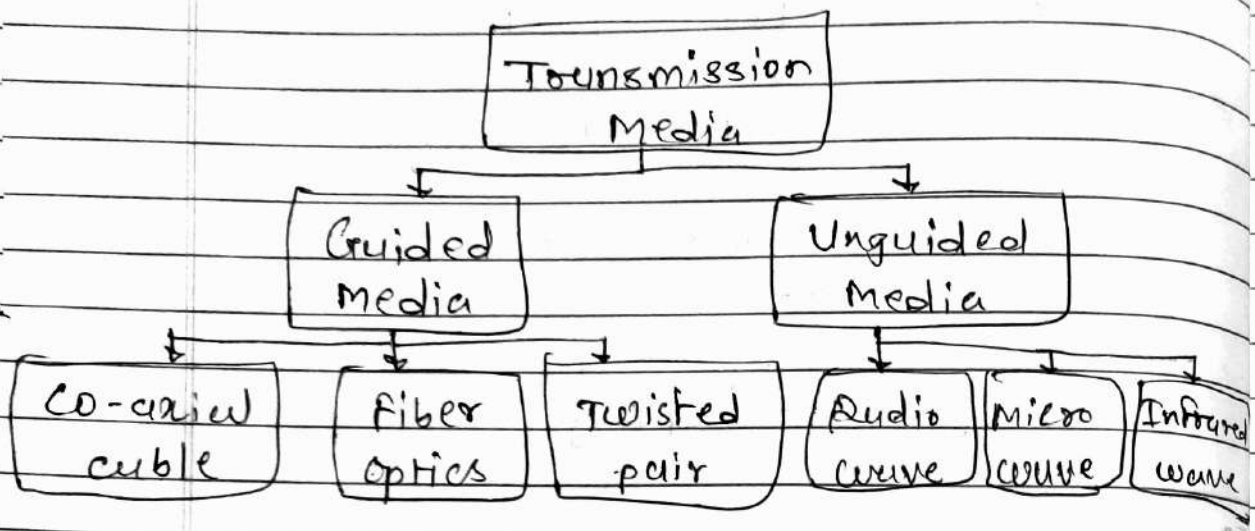
$$C = B * \log_2(1+SNR)$$
$$= 200\ kHz * \log_2(1+10)$$
$$= 200 \times 10^3 * \log_2(11)$$

$$= 200 \times 10^3 * 3.45943$$

$$= 691.89 * 10^3$$

$$\boxed{C = 691.89\ kbps}$$

Q.(12) Classification of Transmission Media.



→ Darshan Notes.

Q.(13) Communication Networks:

- LAN, MAN & WAN → Darshan.

(a) Switching Techniques:

- For transmission of data beyond a a local area, communication is typically achieved by transmitting data from source to destination through a network of intermediate switching nodes.

- purpose is to provide a switching facility that will move the data from node to node until they reach thier destination.

- The nodes are connected to each other in some topology by transmission links.

- Each station attaches to a node, and the collection of nodes is reffered to as a communication network.

- Two types of switching Techniques:

1. Circuit switching
2. packet Switching

[1] Circuit Switching:

- Connection-oriented networks
- Dedicated communication path between two stations.
- the path is reserved for the signal pair of end users.
- This technique is suitable for long continuous transmission, like voice calls.

Ex. publick telephone network.

[2] Packet Switching:

- Connectionless networks
- Each node determines next leg of transmission for each packet.
- Message is divided and grouped into a number of units called packets that are

individually routed from the source to the destination.

- This technique guarantees better source utilization.

Eg: data transfer.

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② Difference Between Circuit & Packet Switching:

	Circuit Switching	Packet Switching
(1)	It is a connection oriented network switching technique.	It is a connectionless network switching technique.
(2)	Dedicated path has to be established between the source & destination before transfer of data.	There is no need to establish a dedicated path from source to destination.
(3)	Data Packets are routed along the same dedicated path.	Different Data packets follow different paths.
(4)	It is not a store and forward transmission.	It is store and forward transmission.

(5)	Initially designed for voice transfer.	Initially designed for Data transfer
(6)	Data is proceed & transmitted by the source station only.	Data is proceed and transmitted by not only by the source station but at each Switching station.
(7)	there are three phases in CS. → (i) Connection Establishment (ii) Data transfer (iii) Connection Released	~~Hel~~ In packet switching directly data transfer takes place.

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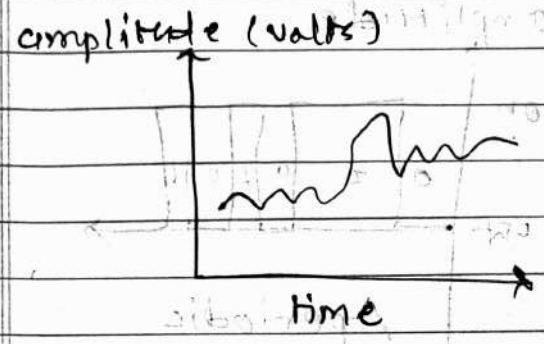
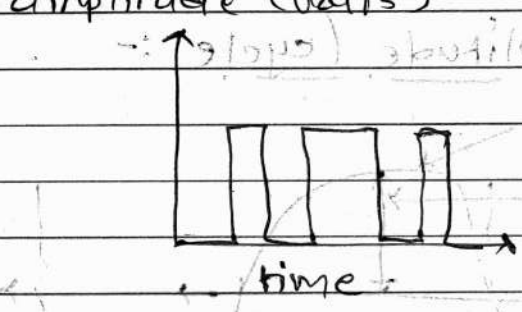
✱ chapter : ①

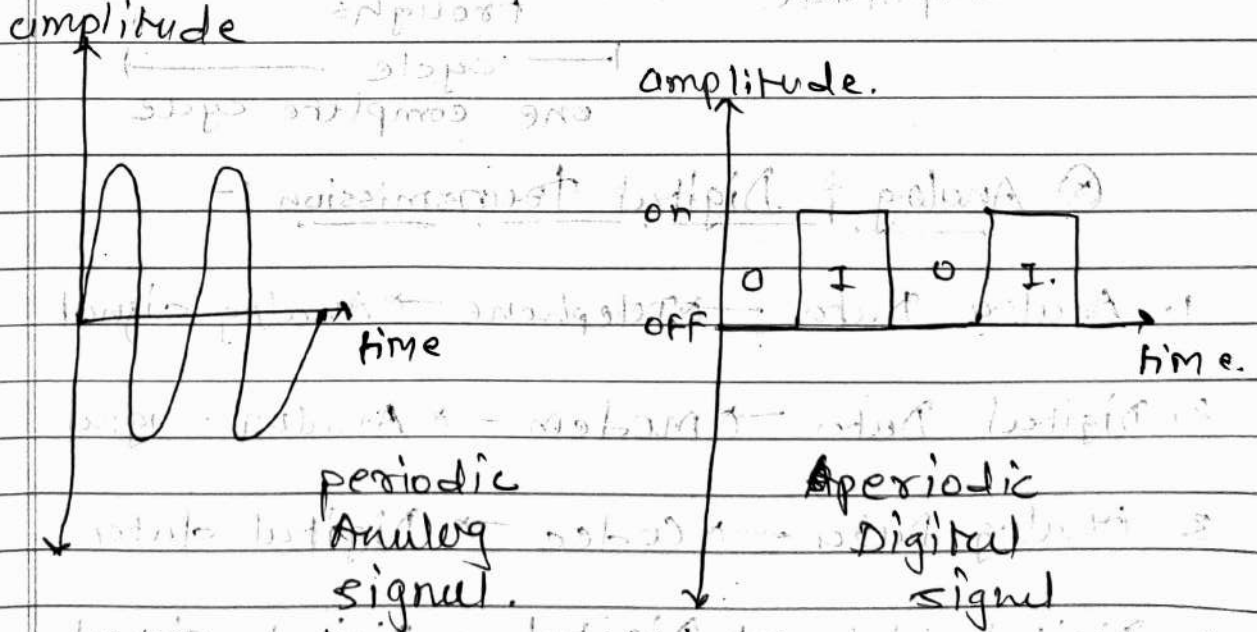
✱ Analog signal :-



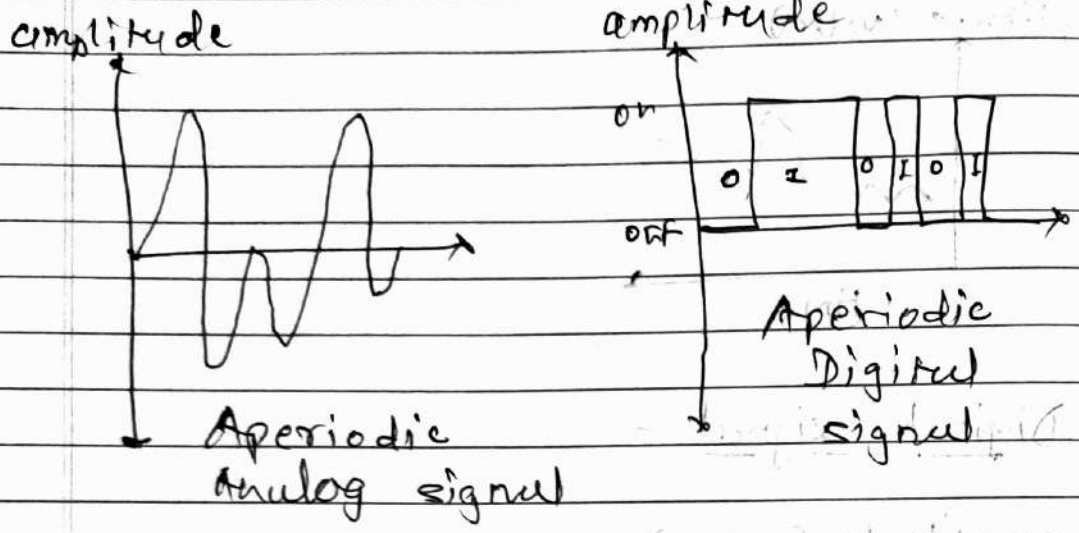
✱ Digital signal :-



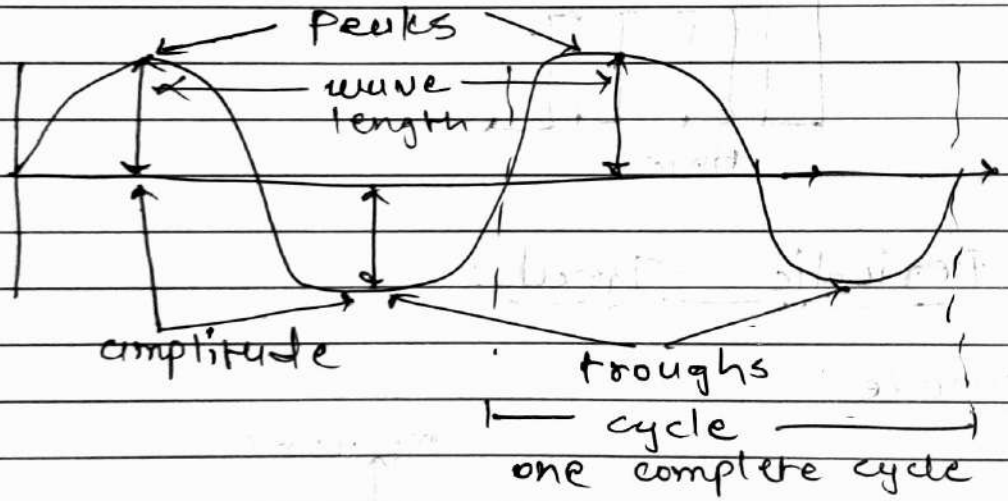
✱ Periodic signal :-



① Aperiodic signal :-



② Wavelength / amplitude / cycle :-



③ Analog & Digital Transmission :-

1. Analog Data → Telephone → Analog signal
2. Digital Data → Modem → Analog signal
3. Analog Data → Codec → Digital data
4. Digital data → Digital → Digital signal
   Transciever

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⊛ channel capacity :-

- affecting features :- - Data Rate
  - Bandwith
  - Noise
  - Error Rate

⊛ Shannon & Nyquist channel capacity :-

- **Shannon** → for Noisy channel
  - $C = B \log_2(1 + SNR)$
  - $SNR_{db} = 10 \log_{10}(SNR)$
- **Nyquist** → for Noiseless channel
  - Binary → $C = 2B$
  - multilevel → $C = 2B \log_2 M$ (M = Num of levels)

⊛ Transmission media

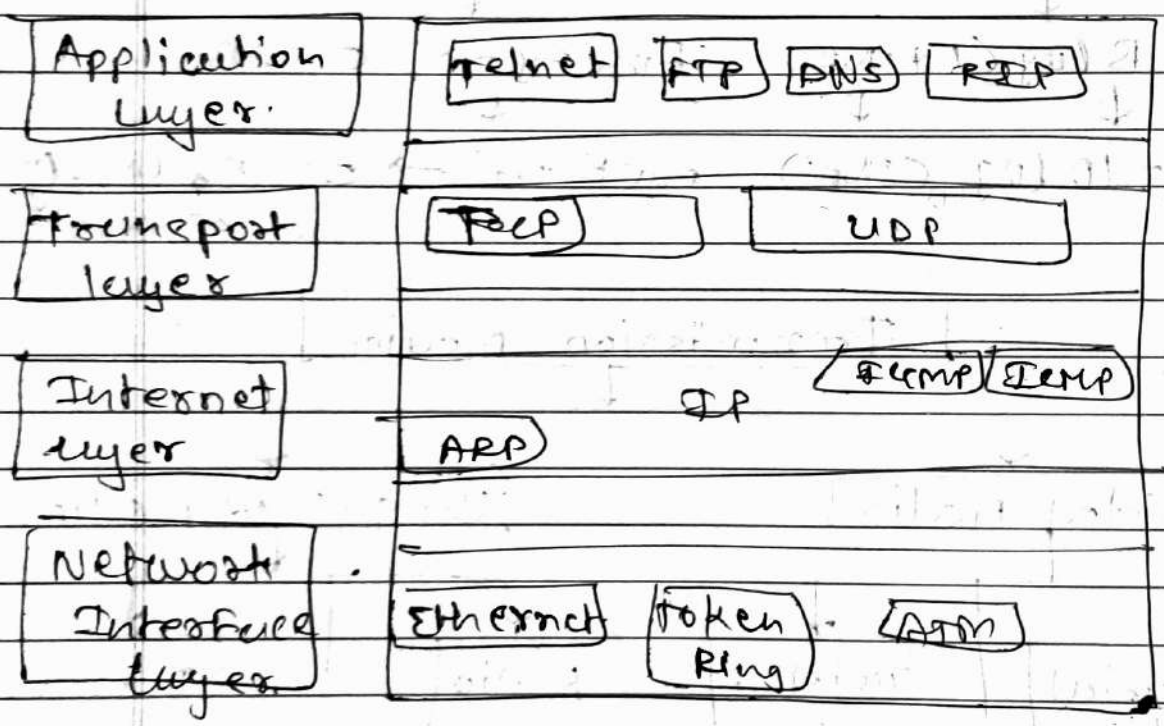
- Guided Media
  - Co-axial cable
  - Twisted pair
  - Fiber Optics
- Unguided Media
  - Radio wave
  - Infrared wave
  - Micro wave

⊛ LAN (Local Area Network)
MAN (Metropolitan Area Network)
WAN (Wide Area Network)

① OSI Model :-

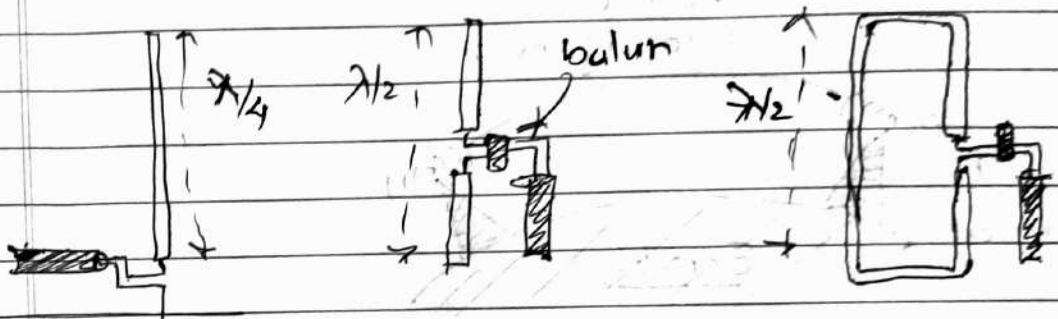
Application layer
presentation layer
session layer
Transport layer
Network layer
Data-link layer
physical layer

② TCP/IP Model :-



⑧ Antenna :-

(1) Dipoles ← Half wave dipole
quarter-wave dipole
Folded dipole.

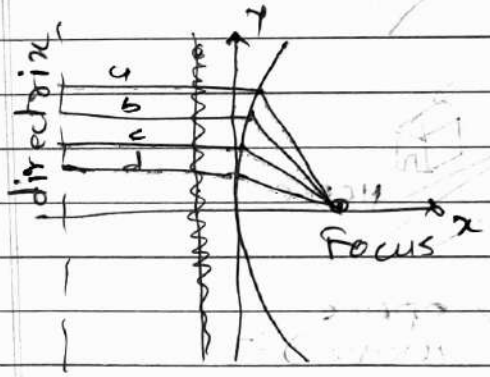


ground plane.
quarter-wave dipole.

half-wave dipole

Folded dipole.

(2) Parabolic Reflective Antenna :-



parabola.

cross-section of parabolic antenna showing reflective property

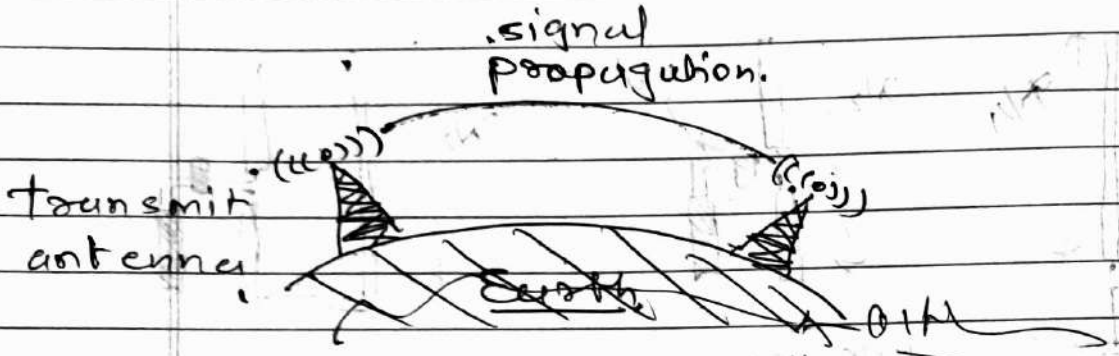
⑨ Antenna Gain :-

$$G_T = \frac{4\pi A_e}{\lambda^2} = \frac{4\pi f^2 A_e}{c^2}$$

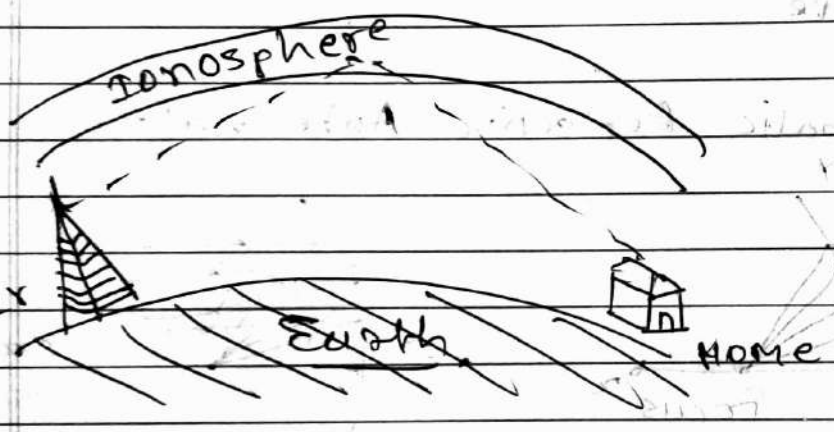
G_T = Antenna Gain c = speed of light
A_e = effective area λ = carrier wave length.
f = carrier Frequency

① Propagation modes:-

(1). Ground wave :-



(2) Sky wave :-



(3) Line-of-sight (space wave) :-

max distance between two antennas : $= 3.057\left(\sqrt{Kh_1} + \sqrt{Kh_2}\right)$

K = adjustment factor

h_1 = height of antenna one

h_2 = " " " two.

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① Free Space loss :-

$$\frac{P_t}{P_r} = \frac{(4\pi d)^2}{\lambda^2} = \frac{(4\pi f d)^2}{c^2}$$

P_t = signal power at transmitting antenna
P_r = " " " receiving "
λ = carrier wavelength
d = propagation distance between antennas
c = speed of light ($3 * 10^8$ m/s).

② Fading :-

(1) Flat Fadding :

$BS << BC$ — BS : signal Bandwidth
$TS >> \sigma T$ — BC : coherence Bandwidth

(2) Frequency selective fading :-

$BS >> BC$ — Ts : symbol period
$TS << \sigma T$ — σT : rms delay spread.

③ Fading Effects Due to Doppler Spread :

(1) Fast Fading :

$TS >> Tc$
$BS >> BD$

(2) Slow Fading :

$TS << Tc$
$BS >> BD$

Tc : coherence time
BD : Doppler spread

⑧ Digital Encoding & Modulation :-

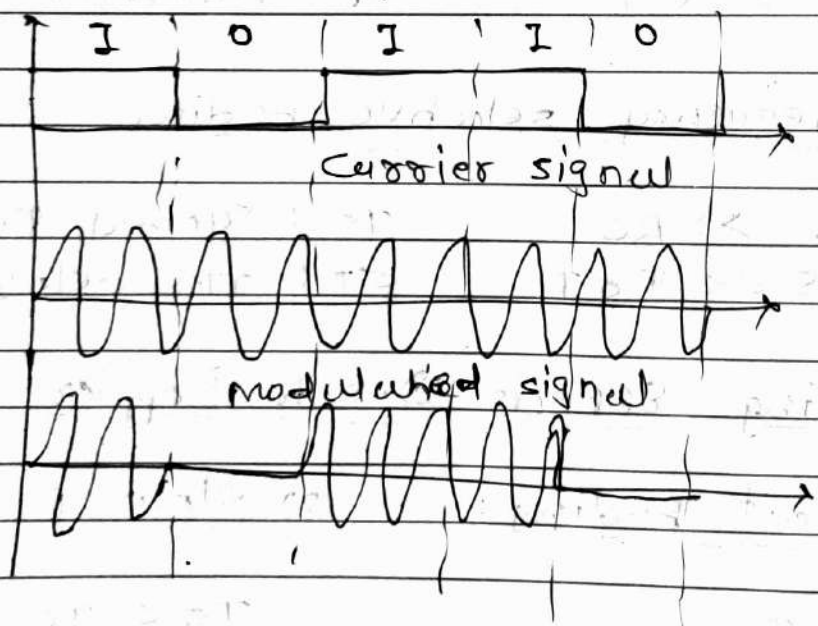
① Encoding / Mapping :-

(1) digital-to-digital
(2) digital-to-Analog
(3) Analog-to-digital
(4) Analog-to-Analog

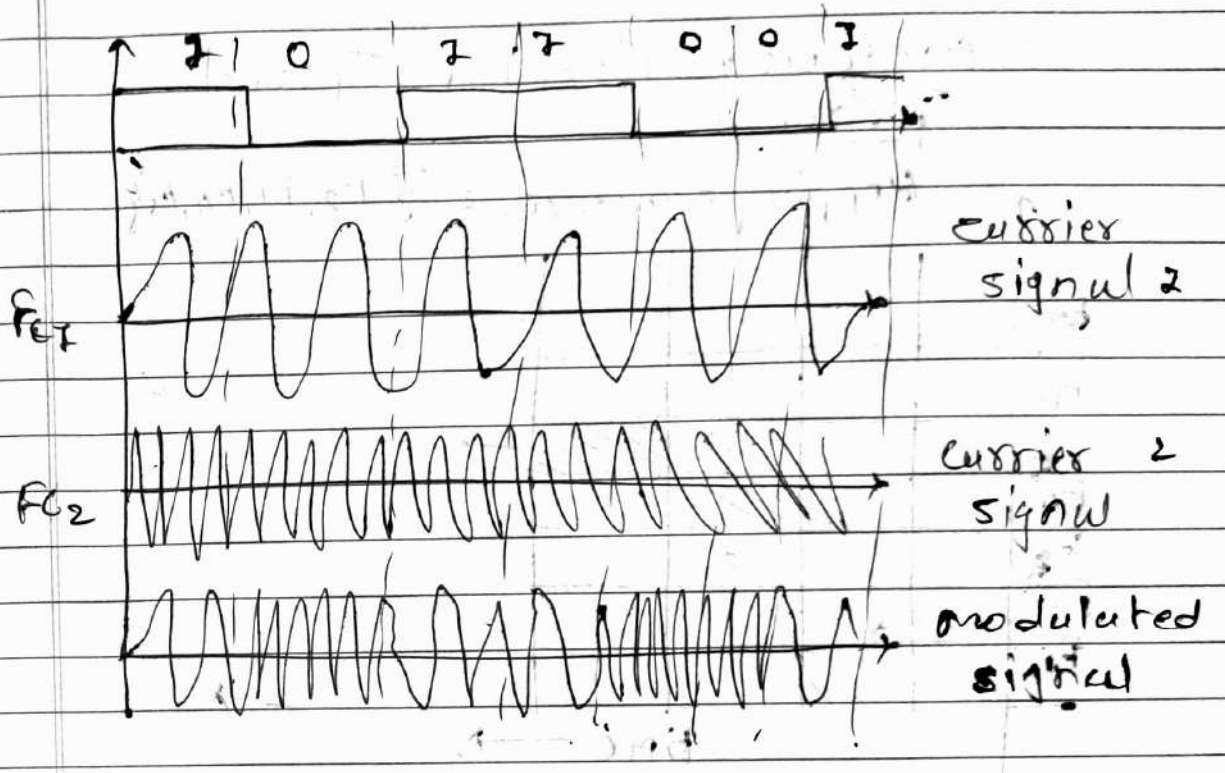
② Modulation :-

(1) Amplitude shift keying (Ask)
(2) Frequency " " (Fsk)
(3) phase " " (Psk)

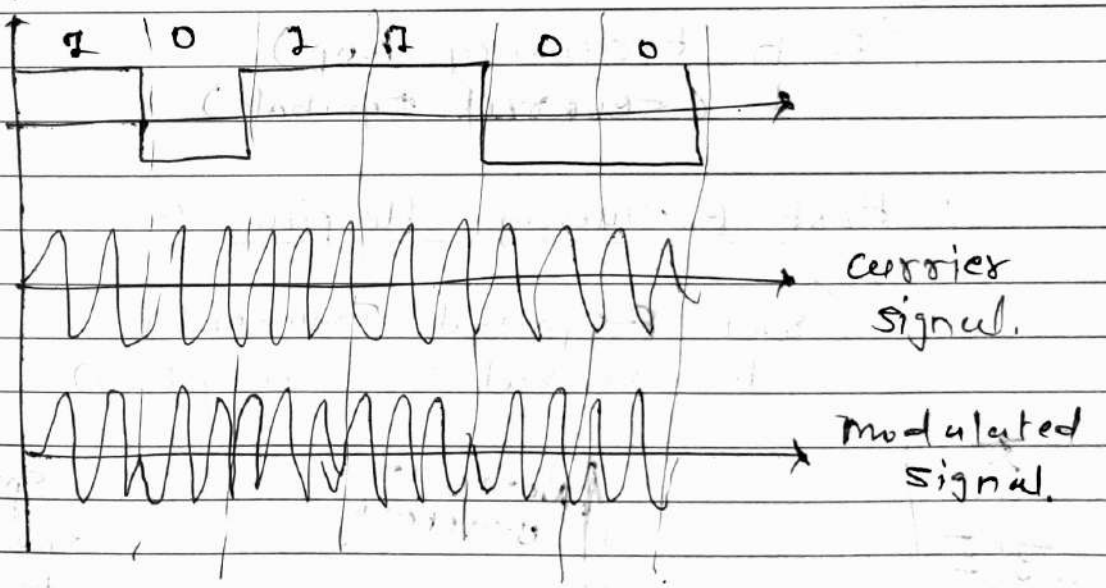
(1) Ask :-



(2) ASK :-


1 0 1 1 0 0 1
carrier signal 1
f_{c_1}
carrier 2 signal
f_{c_2}
modulated signal

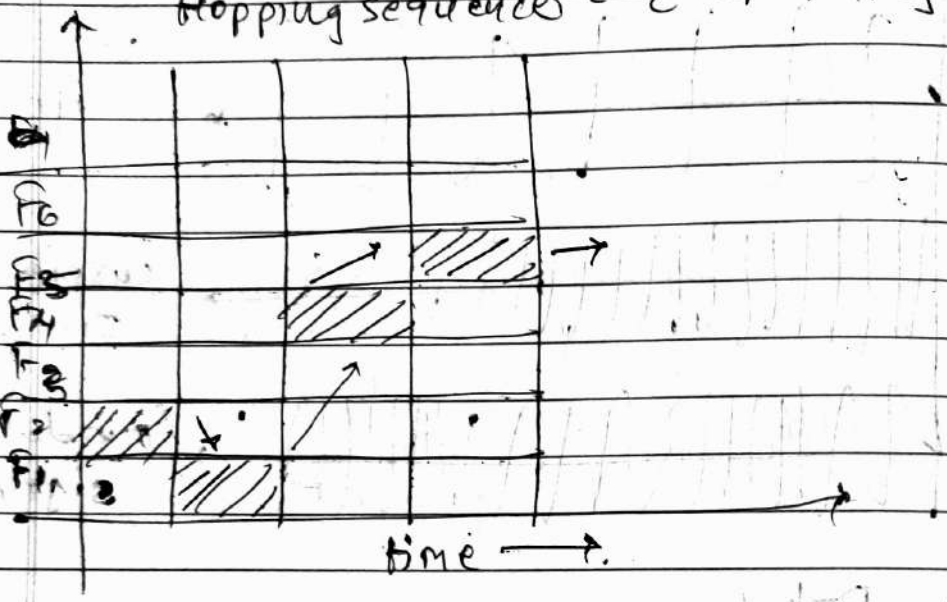
(3) PSK :-


1 0 1 1 0 0
carrier signal.
modulated signal.

⊛ Spread Spectrum :-

- Frequency Hopping Spread Spectrum :-

Hopping sequence = { F_2, F_1, F_4, F_5 }

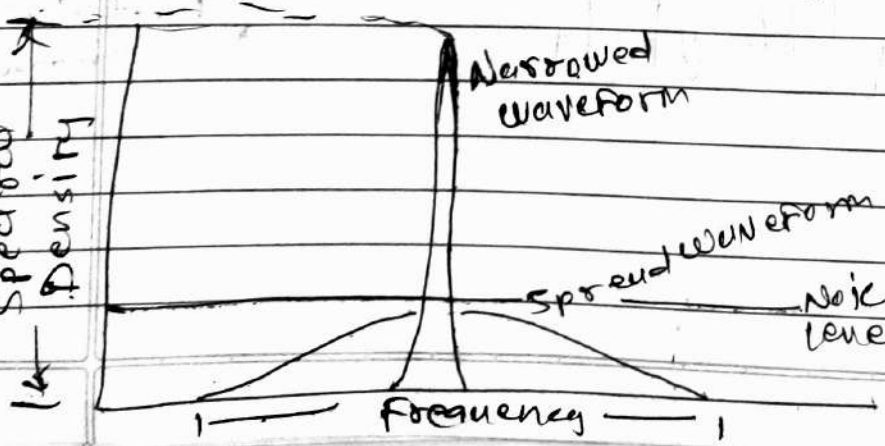


- Slow Frequency Hopping.

(Each Frequency hop)
+ (several symbols)

- Fast Frequency Hopping :-

(Each Symbol Transmit)
+ (several Frequency hop)



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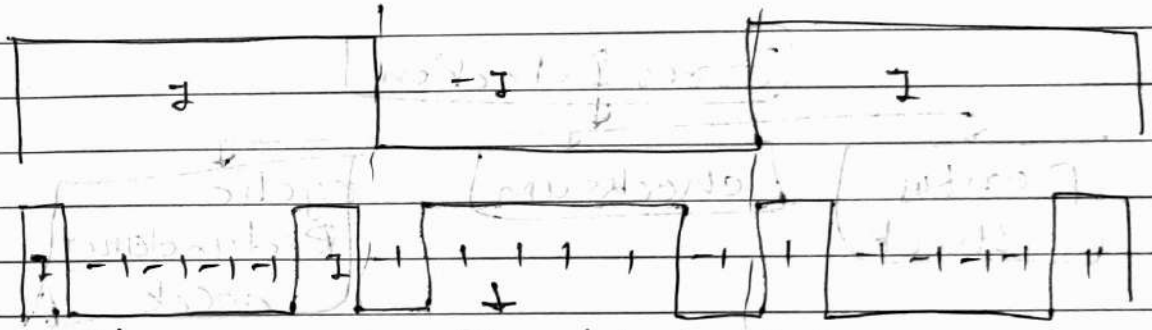
ⓐ Direct sequence spread spectrum :-

Spreading code → (1,0,0,0,1)

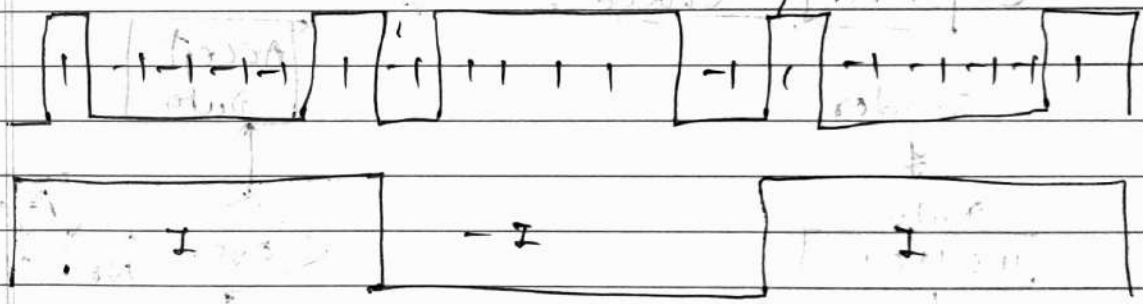
convert ↓ → (1,-1,-1,-1,1)

Data → (1 -1 1 -1 1 -1)

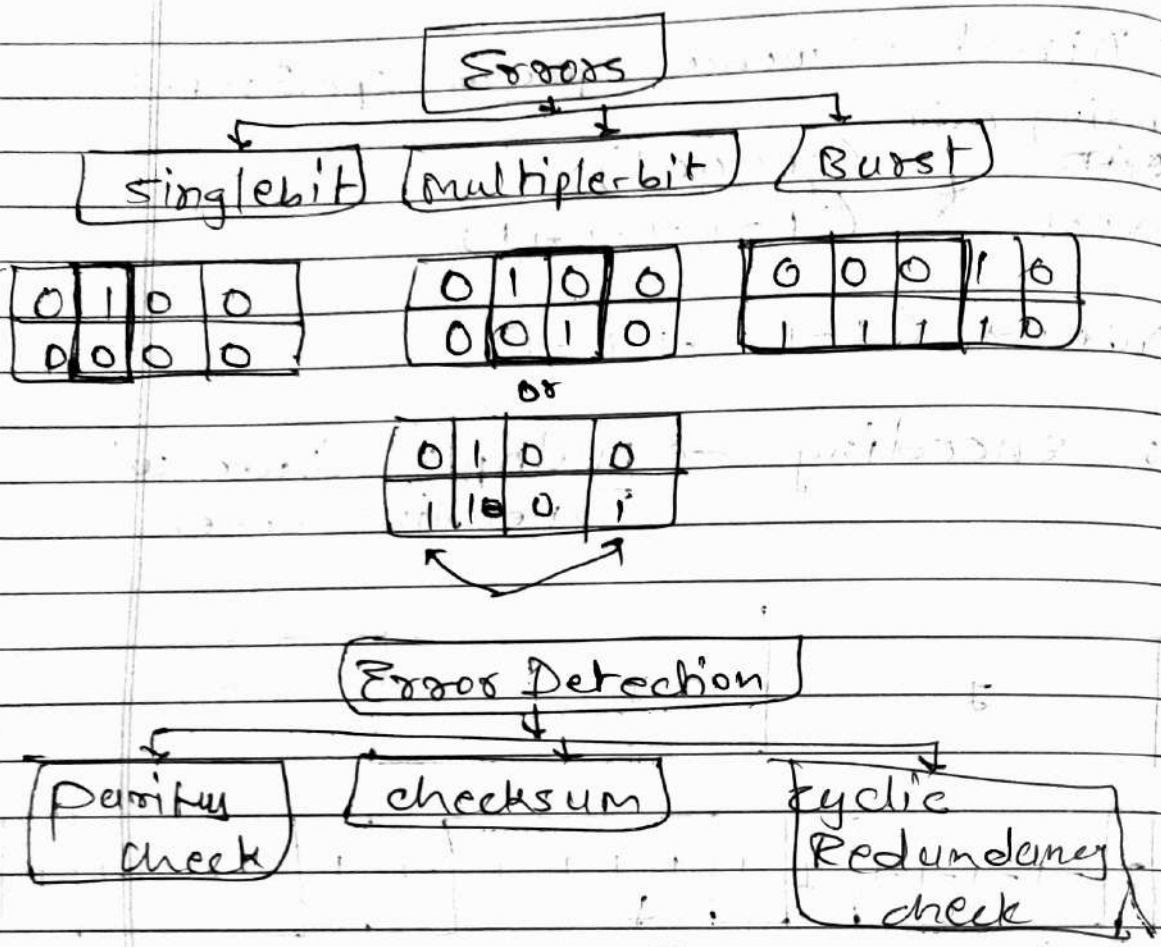
do encoding → multiply Data with Spreading code.



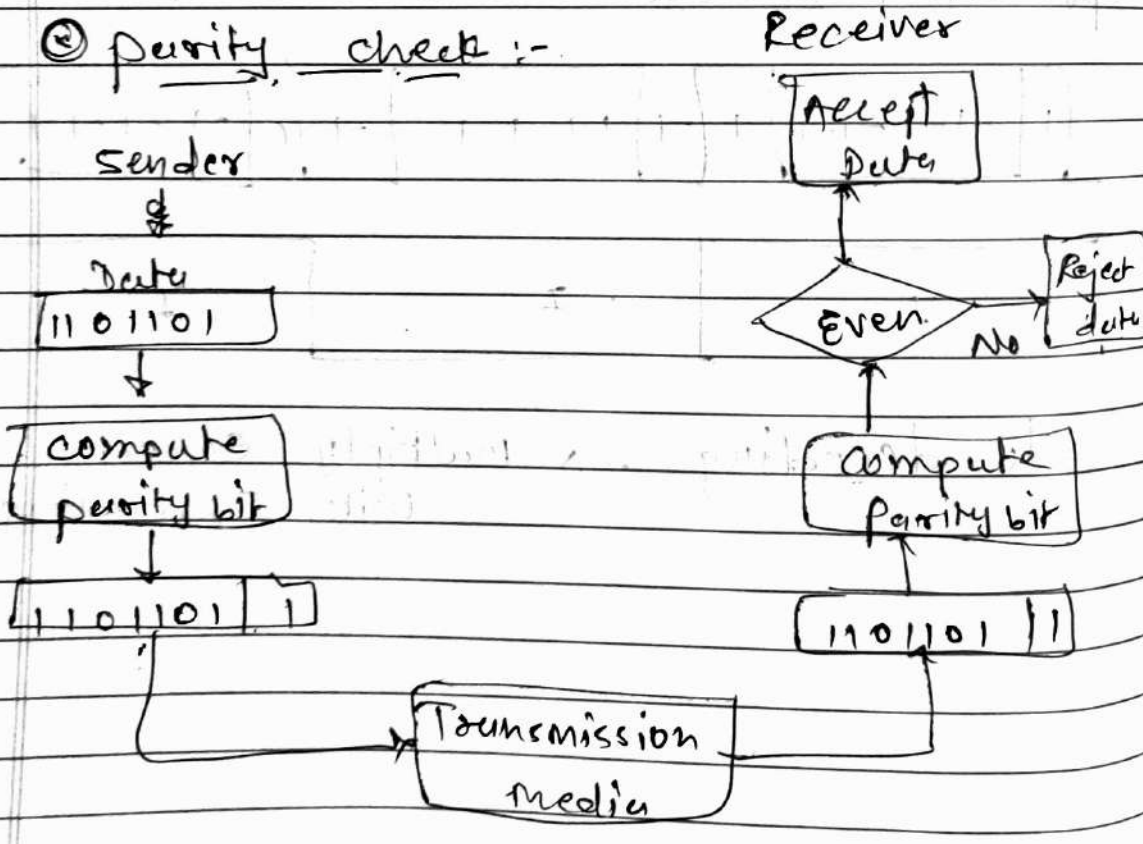
Spreading message = Encoded data



do decoding → multiply encoded code with Spreading code



② parity check :-



② Even parity ②

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⑧ checksum :- k segments, each of 'm' bits

4 segments of 8 bits.

10000000	01000000	00100000	00010000
8	8	8	8

32 bit.

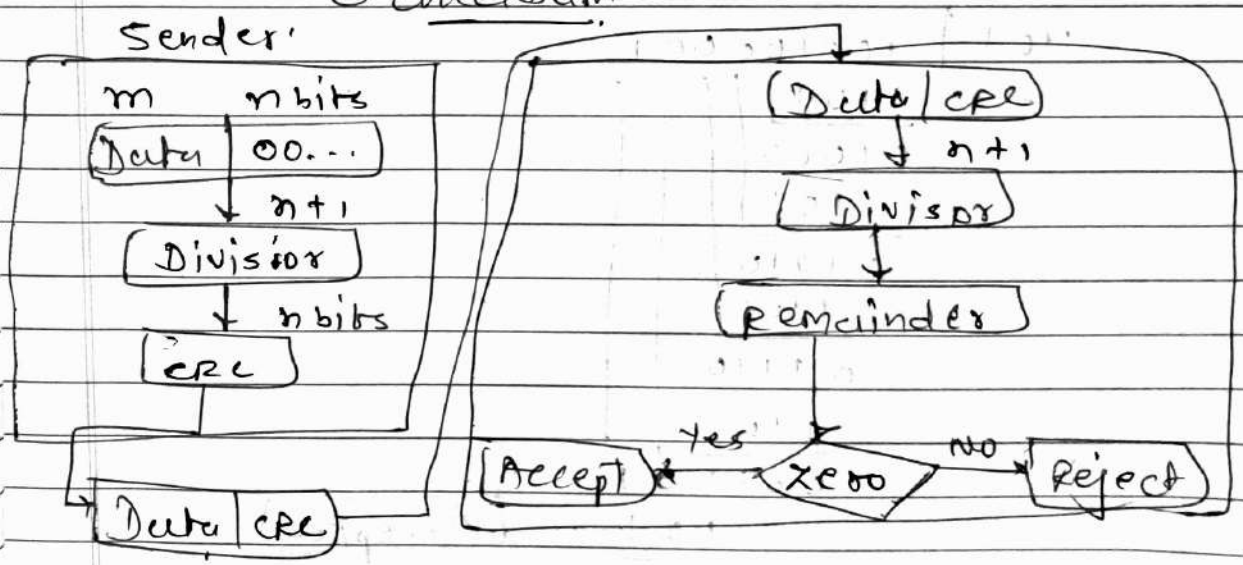
sender :

10000000
01000000
11000000
00100000
11100000
00010000
Sum: 11110000
complement: 00001111

receiver

10000000
01000000
11000000
00100000
11100000
00010000
11110000
00001111
Sum: 11111111
complement: 00000000
Accepted.

⑧ checksum ⑧



⑧ Basic scheme for CRC ⑧

110 | 100100 | 110 | 100000

110

010
110

011
110

000

Data: 100100
key - 1101

1101 | 100100000

1101

01000
1101

01010
1101

01110
1101

00110
1101

0001

Remainder: 001

1101 | 100100000

1101

01000
1101

01010
1101

01110
1101

00110
1101

0000

Accepted

Error Detection & control

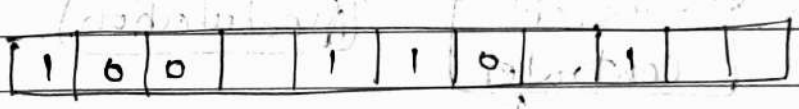
⑧ Hamming code :-

- Redundant bits → $2^r \geq m + r + 1$

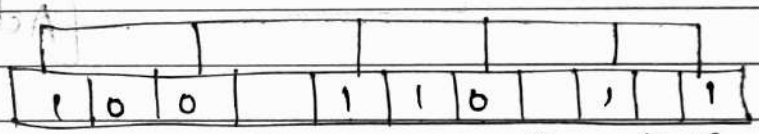
r = redundant bits
m = data bits

Ex: $m = 7$ → $2^4 \geq 7 + 4 + 1$
$\therefore r = 4$

Data : 1001101

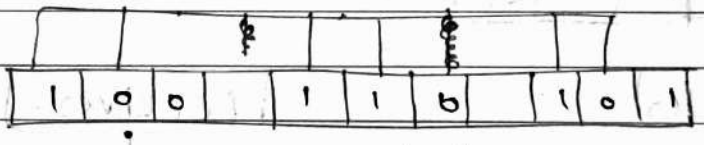


Adding r_1



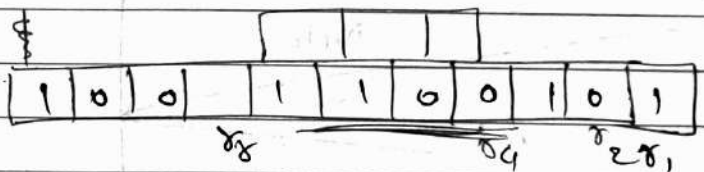
$P_1 \rightarrow d_3 \oplus d_5 \oplus d_7 \oplus d_9 \oplus d_{11} = 1$

Adding r_2



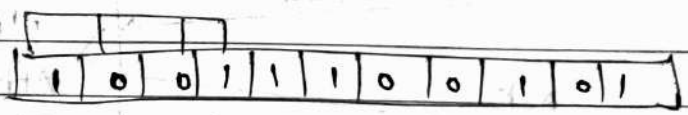
$P_2 \rightarrow d_3 \oplus d_6 \oplus d_7 \oplus d_{10} \oplus d_{11} = 0$

Adding r_3



$P_3 \rightarrow d_5 \oplus d_6 \oplus d_7 = 0$

Adding r_4

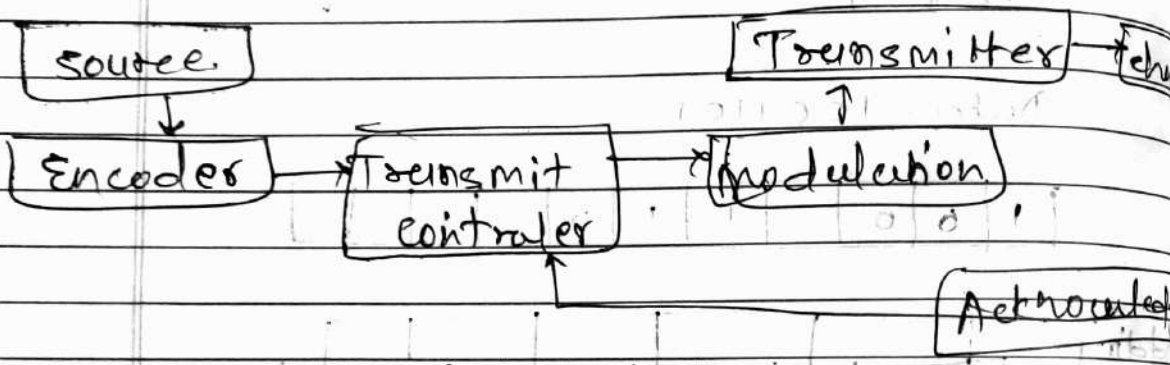


$P_4 \rightarrow d_9 \oplus d_{10} \oplus d_{11} = 1$

Data : 10011100101

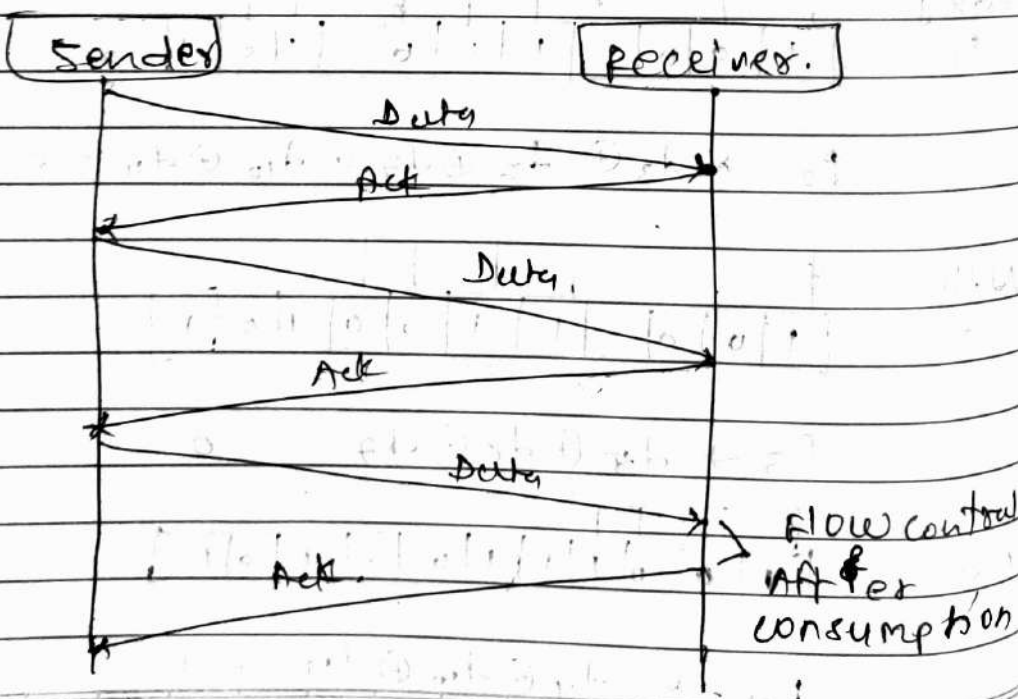
⑧ Automatic Repeat Request/Query (ARQ):-

- use for error control for acknowledgement & timeout achievable reliable data transmission over a unreliable service.



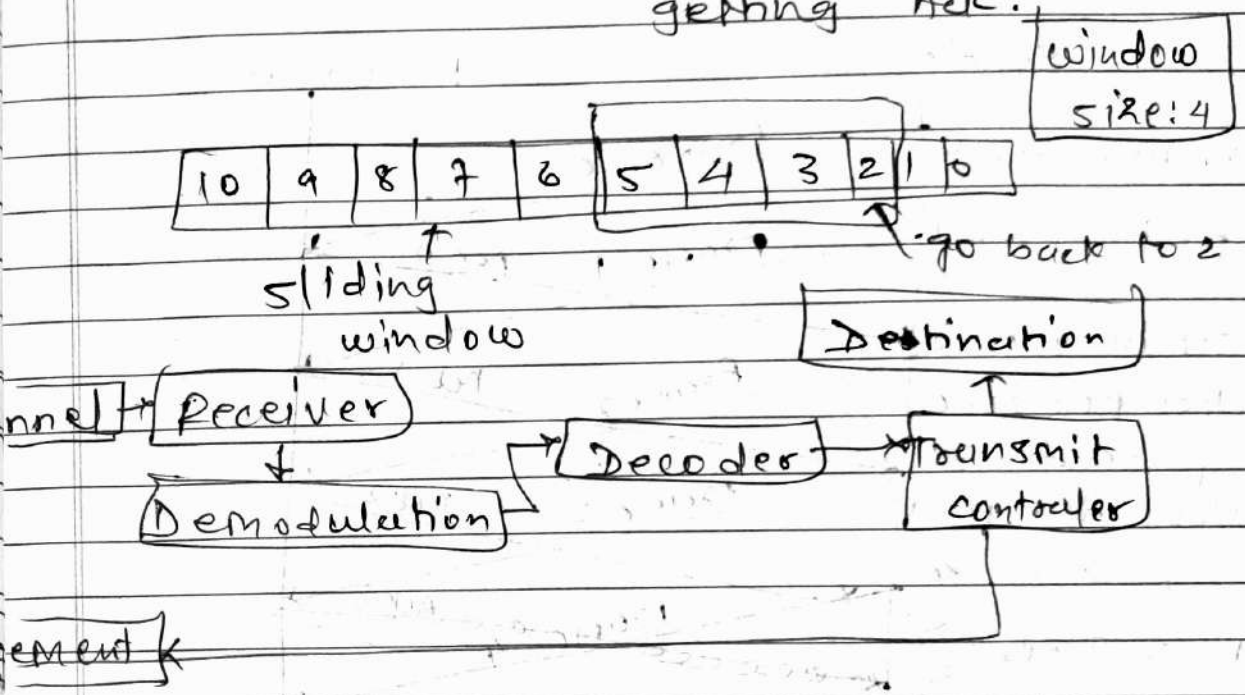
① Types of ARQ:

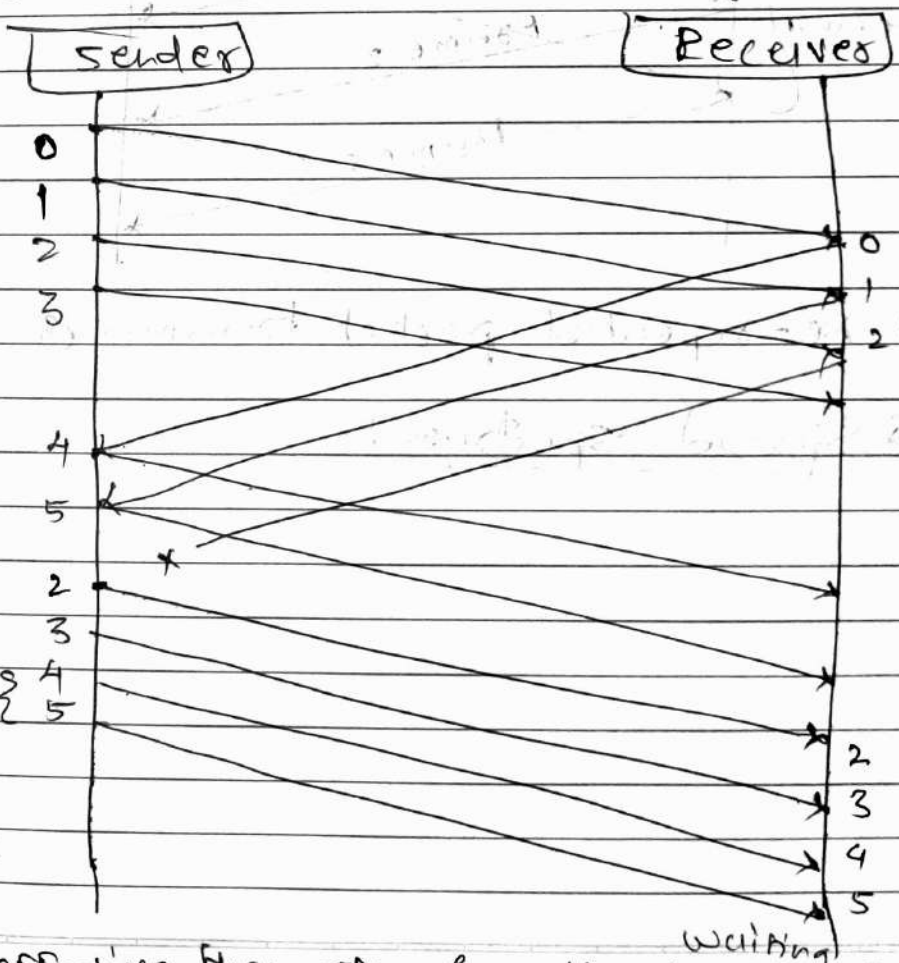
② Stop & Wait :-



③ time consuming ⑧

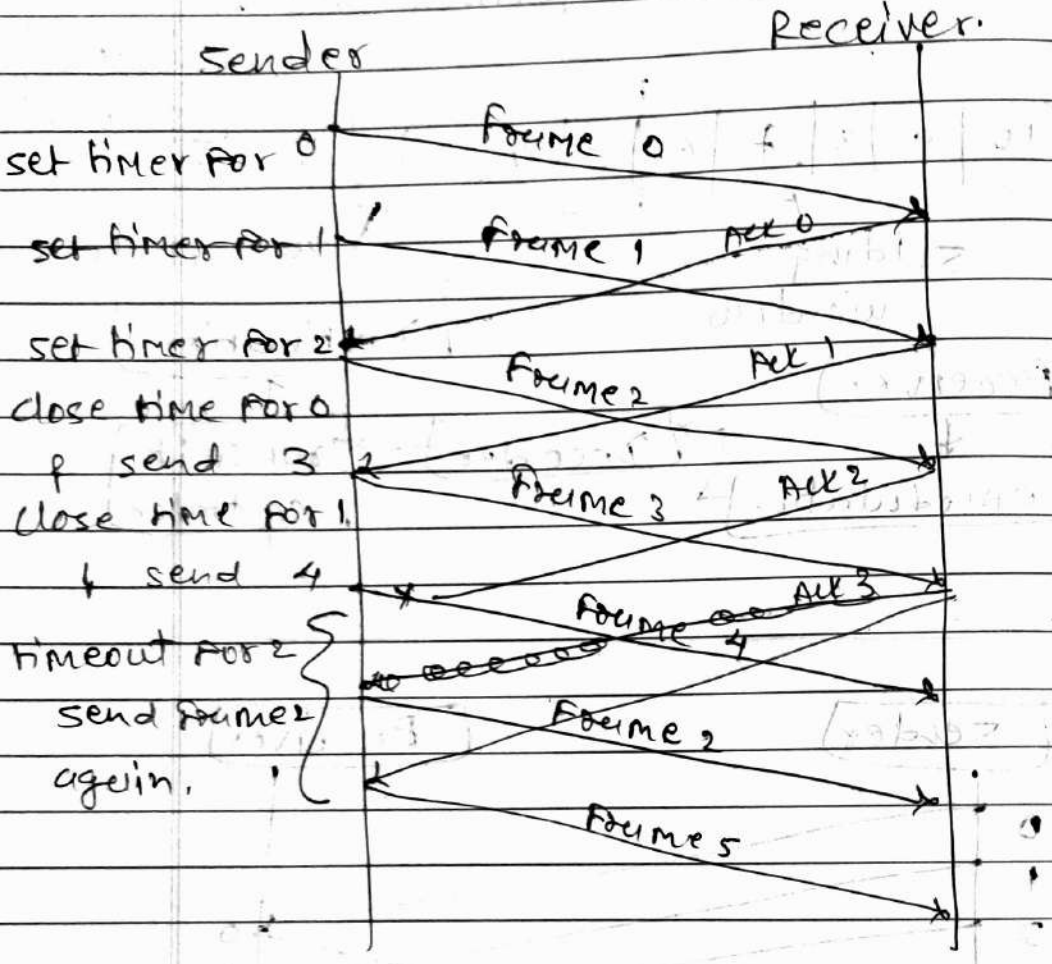
③ Go-Back-N :- sending packet continue without getting Ack.





④ effective then stop & wait No time ⑧.

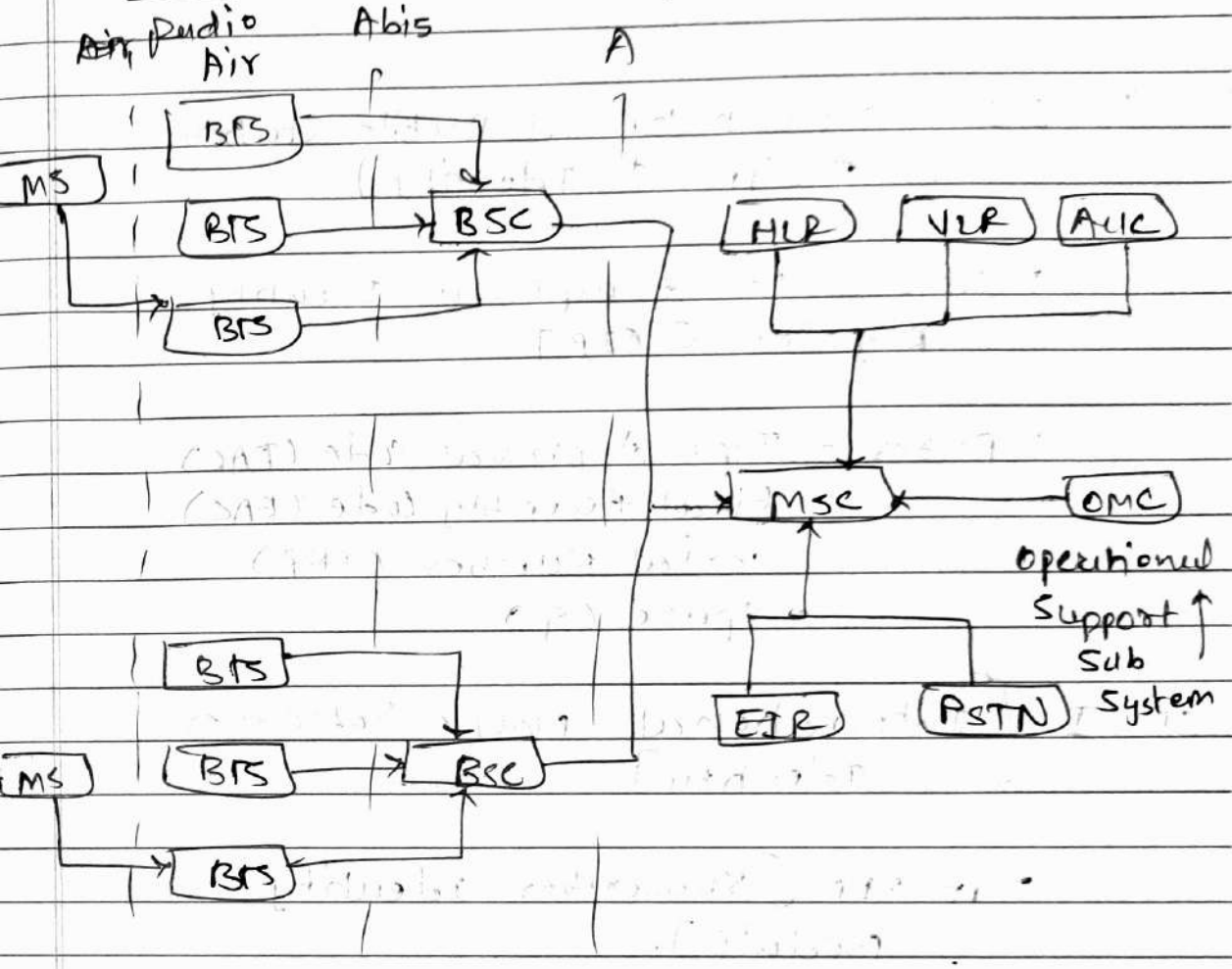
④ Selective Repeat/reject ARQ :-



⑤ No-repeated packet transmission

⑥ Spread Spectrum :-

① GSM :-



Mobile station | Base station | Network switching.

(1) BSS → (Base station subsystem) BTS, BSC

(2) NSS → (Network & switching subsystem) → HLR, VLR, EIC, AUC.

(3) OSS → operating Support subsystem. → OMC.

interface : Radio/Air wave, Abis, A.

GSM

② Identifiers :-

IMEI [International mobile station equipment Identity]

- stored in equipment Identity register [EIR]
- parts - Type Approval code (TAC)
  - Final Assembly code (FAC)
  - serial Number (SNR)
  - spare (sp)

IMSI [International mobile Subscriber Identity].

- in SIM [Subscriber Identity module].
- parts - Mobile country code (MCC)
  - mobile Network code (MNC)
  - mobile Subscriber Identification Number (MSIN)

MSISDN - [mobile Subscriber ISDN Number]

- Authentic telephone Number for mobile station.
- each MSISDN is allocate for each SIM in MS.

parts - Country code (cc)
- National Destination code (NDC)
- Subscriber Number (SN)

MSRN - [Mobile station Roaming Number]

- location dependent ISDN Number of mobile station by regionally responsible visitor location Register (VLR).

- channelled incoming calls to the ms.

parts - same as MSISDN

- cc
- NDC
- SN

LAI [Location Area Identity]

identity.

- own authentic location Area

- Base on international Standard.

parts - Country code (cc)
- Mobile Network code (MNC)
- Location Area code (LAC)

TMSI [Temporary Mobile Subscriber Identity]

- Temporary Number for current location of subscriber handled by VLR.
- stored in network side only in VLR.
- contain 4 x 8 bits.

LMSI [Location Mobile Subscriber Identity]

- Each MS allocated with a LMSI, which is original key, by VLR.
- key can be use for auxilary serching.
- contain 4 x 8 bits.

CI [Cell Identifier]

Recognize individual cell that are within local Area.

* when (LAI + CI) combined then it is uniquely defined

- contain 2 x 8 bits.

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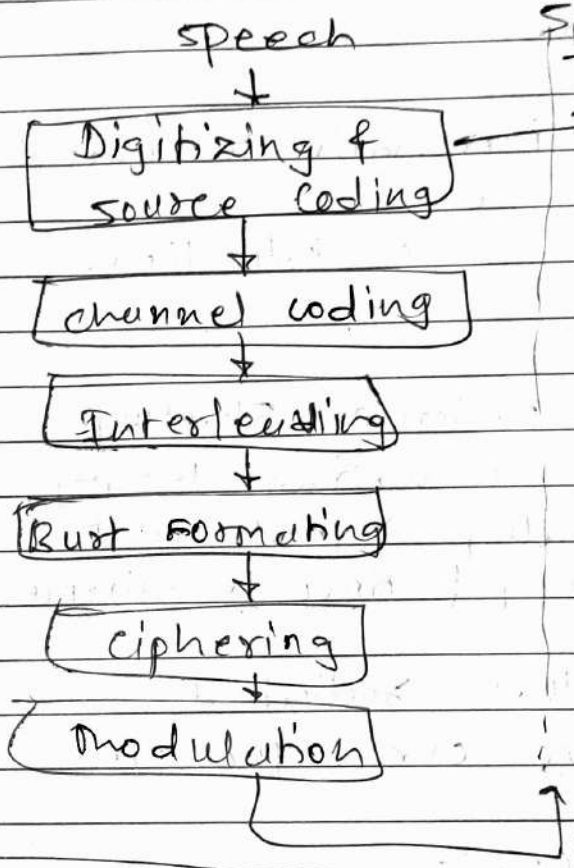
⑧ MSC Call Routing:-



Speech.

→ speech digitized at 8kHz by coder.

↓

digitized data pass to coder with 160 frames ↓ encoder compress 160 to 260 bits GSM frames resulting 1 sec of speech compressed into 1625 bytes & achieving a rate of 13kbits/sec

introduce redundancy ← .

to data for error, correction & detection

→ gross bit rate after channel coding

→ 456 bits

↓

divided into 8 building blocks of 57-bits

→ For protection against burst transmission error

reuring groups. → improve performance.

↓

interleaving decreases possibility of losing whole burst packet by dispersing the error

† encrypts blocks using symmetric key shared by MS & BTS.

↓

adds binary information to ciphered block for use in synchronization & equalization.

† Modulation.

use (Gaussian Minimum Shifting keying) for converting binary data to Analog signal suit bit frequency & time requirements.

- signal is then radiated as radio wave over the air

② GSM Services :-

(1) Teleservices (Telephony services)
(2) Bearer (Data services).
(3) Supplementary services

② tele → utilize Data services & provide

- vide calls
- videotext & facsimile
- short Text message

③ Data → provide reliable Data transfer.

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④ Supplementary → on the top of 3 services provides

- multiparty / conferencing service
- call hold
- call Forwarding
- call Barring

⑤ Bluetooth Security & Application.

- Bluetooth uses publicaly available cipher algorithm known as ~~SAFER~~ + to authen.. dev .if..

- Bluetooth security involves :- Authentication
  - Authorization
  - Encryption.

- Bluetooth Applications - Each App is realize through profile

- File transfer
- Internet Bridge. (dial up networking & Faxing facility
- LAN Access - Ethernet
- synchronization - device-to-device Synchronization
- Headset - audio input-output interface remote devices.

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④ Bluetooth low power energy (BLE).

- set up to 30mA, receive as little as possible to save Battery power

- BLE is embedded in Smartphones, laptops, sesors.....

- benifits -

- low power consumption
- efficienty Discovery
- Reduced memory requirements
- short packet lengths

⑤ modes / states of Bluetooth :-

or.

categorized in standby & connection

↓ ↓

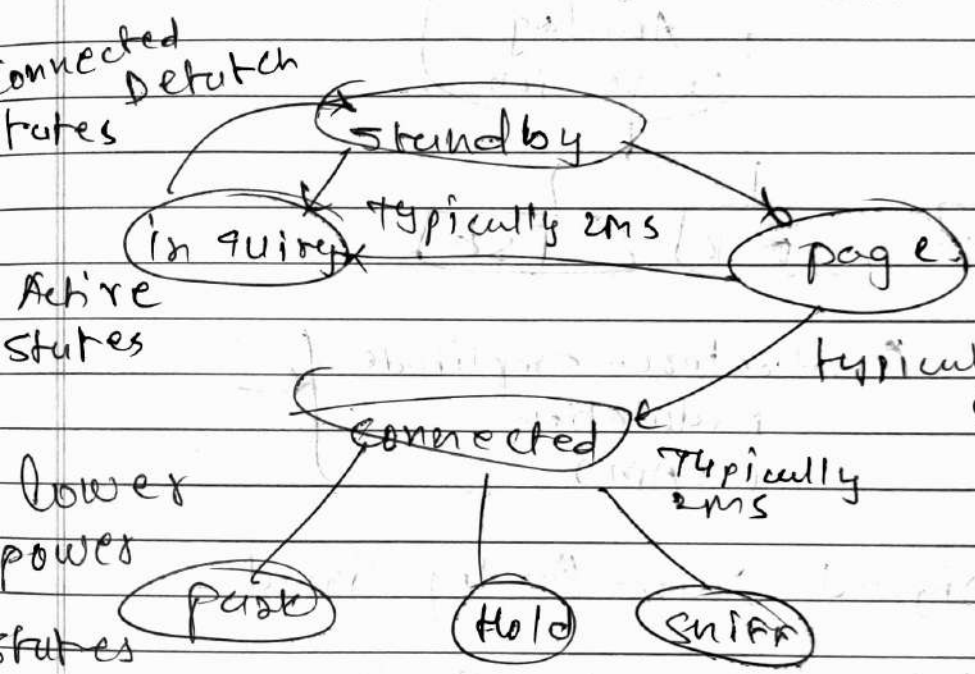
Not Active in Any Network | Active & Synchronized to a piconet

(1) Active mode → Actively participate
(2) Sniff mode in piconet
(3) Hold mode - Every piconet has
(4) Park mode 3-bit distinct (Active Member Address)

→ Highest-Data-cycle in 3 modes.
↓ ∴ least power efficiency
↓ By lowering Data cycle.
↑ ∴ efficiency Attained ↑.

④ Hold ↓ power efficiency. middle in 3
- stay inactive to increase power efficiency.

⑤ park ↓ when slave decide to remain inactive in the piconet. a period of time comparatively to sniff & hold mode. → it enters park mode.



⑥ Digital Modulation Techniques :-.

- provides - more information capacity,
high data security,
quicker system,
great availibity communication.

- great demand for large capacity to convey larger amounts of data.

⑧ Types :-

- Amplitude shift keying (Ask)
- Frequency (Fsk)
- phase (PSK)

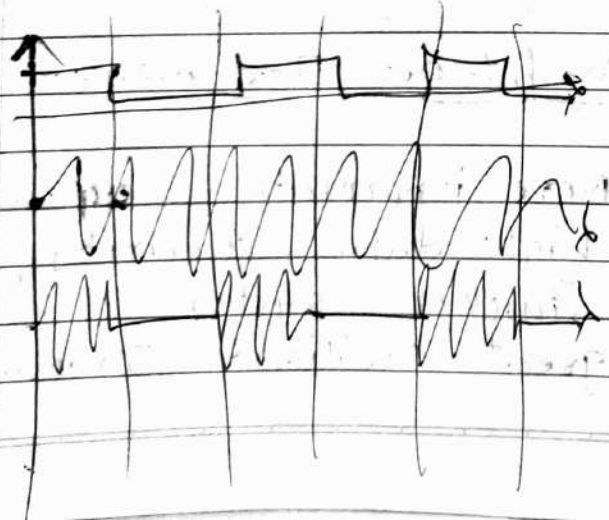
⑧ ~~Ask~~ :- Digital to Analog Conversion

Ask | Fsk | Psk

Quadrature - amplitude modulation (QAM)

⑧ Digital Data - Analog signal

⑧ Ask - binary to Analog



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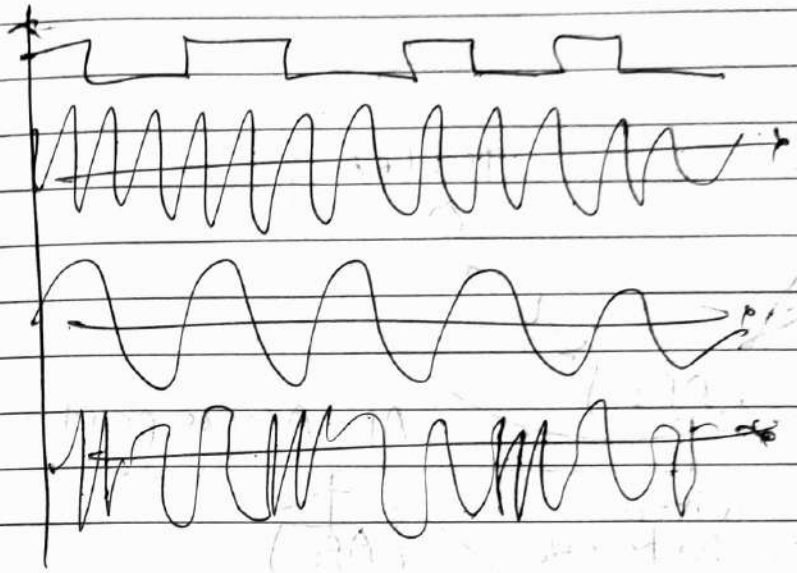
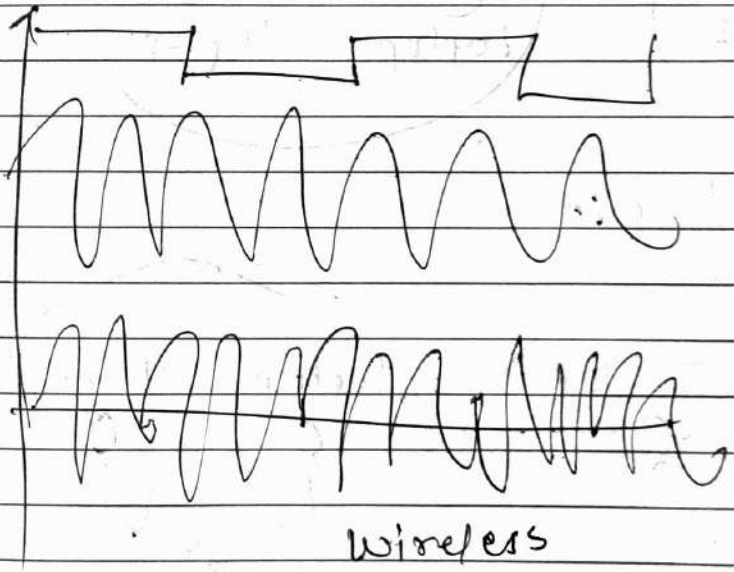
② Fsk :-



② psk :-



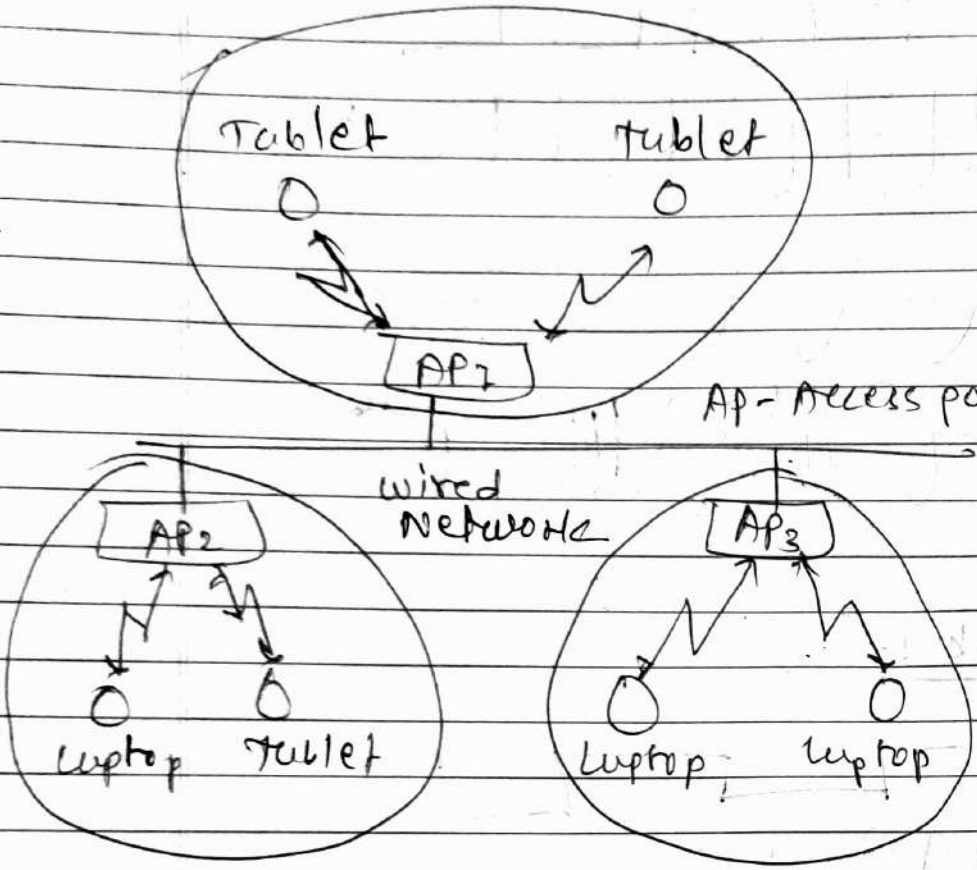
Wireless

① Types of Networks

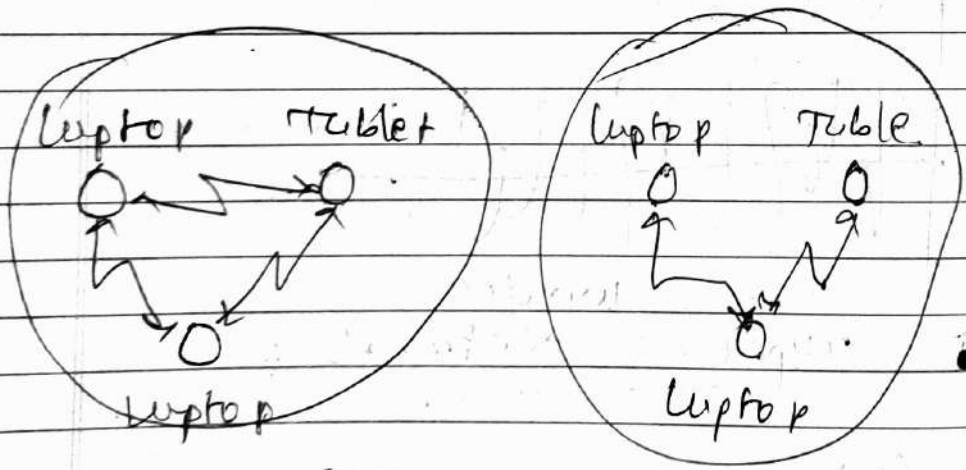
(1) Infrastructure Based Wireless Network

(2) Ad-hoc

① Infrastructure :-



② Ad-hoc :-



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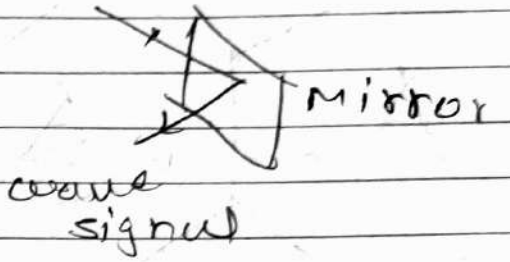
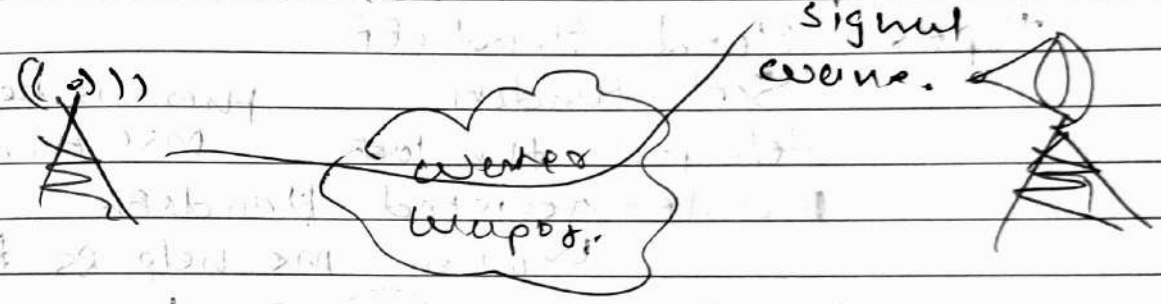
② Radio Frequency Technologies:-

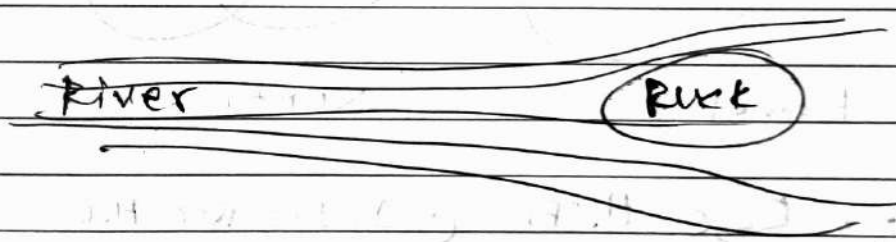
(1) Reflection:



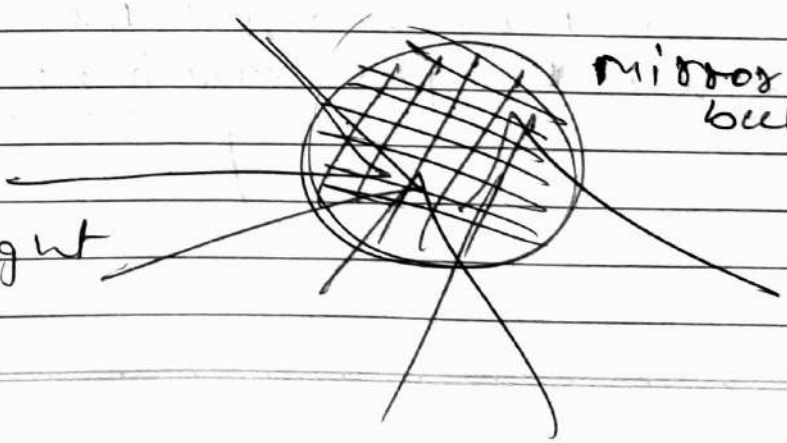
(2) Refraction



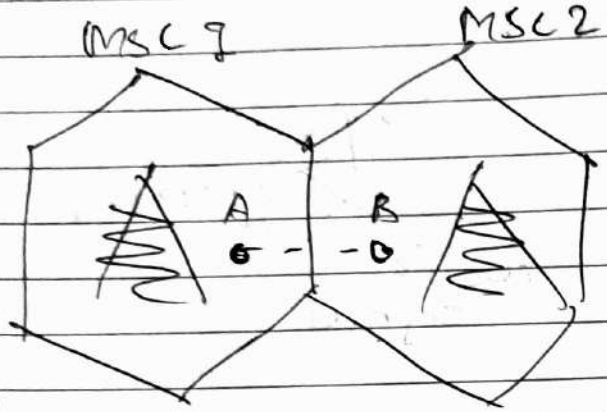
(3) Diffraction



(4) Scattering

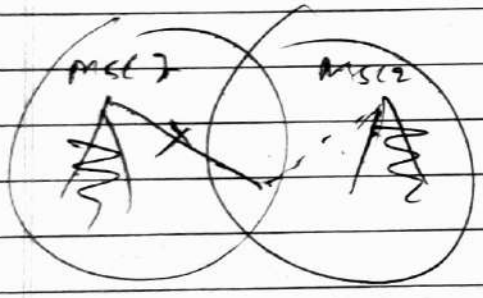


⊙ Handoff / Handover :-

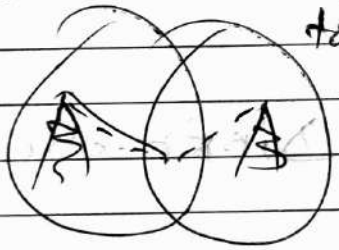


types: Hard Handoff
Soft Handoff
delayed Handoff
Mobile-Assisted Handoff
↳ when MS help BS to transfer call to another BS.

There is no MSC found



Hard



Soft.

① Intra BSC H.Off ② Inter BSC H.O

↓

change in BTS
No change in BSC
No change in MSC

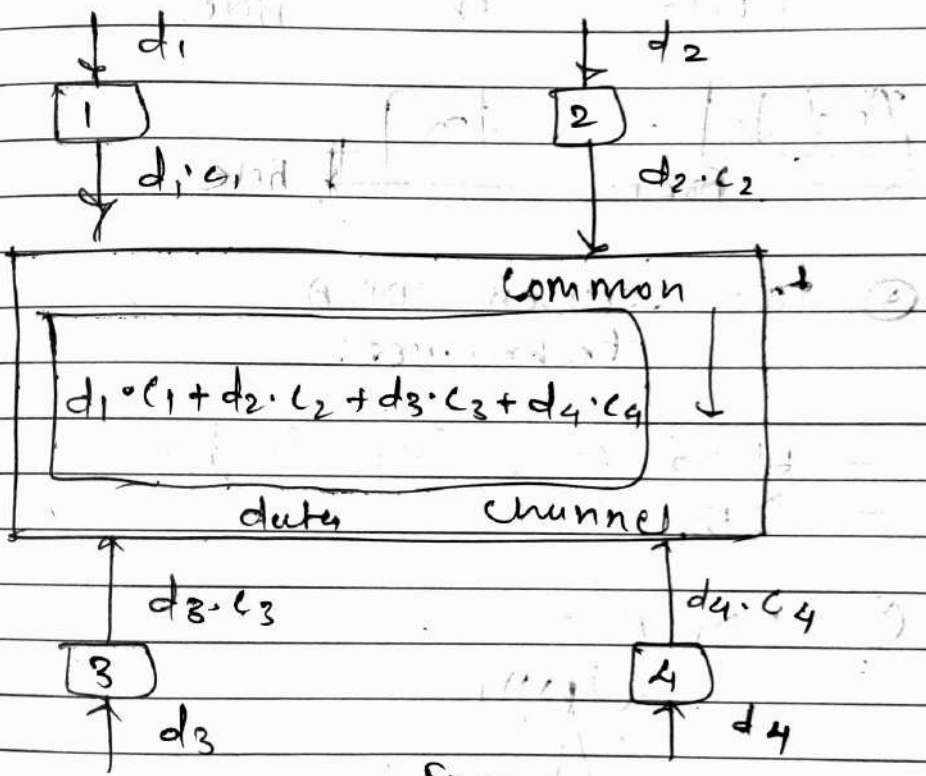
change in BTS
Change in BSC
No change in MSC

③ Inter MSC H.O
change in BTS
Change in BSC
Change in MSC

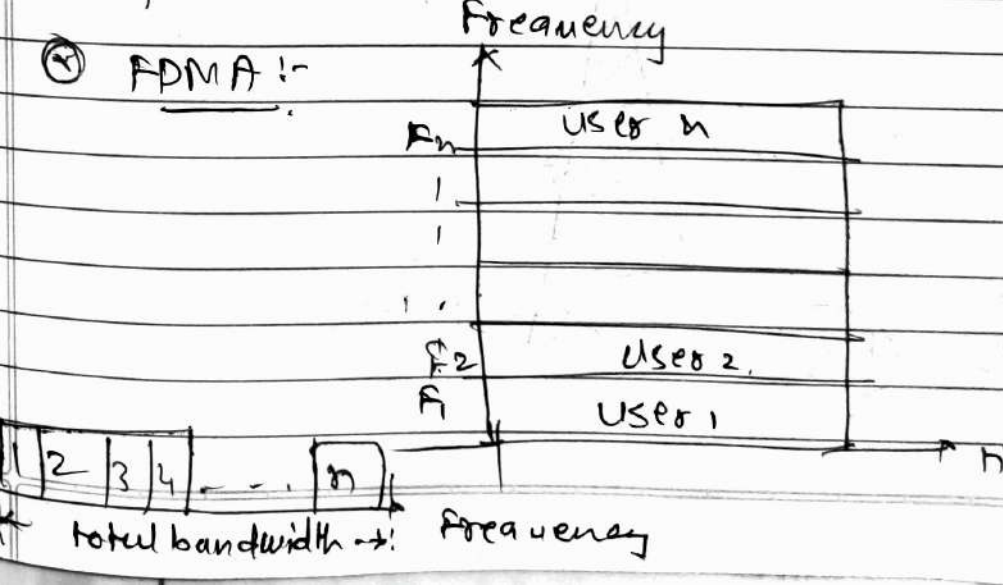
① Multiple Access Techniques :-

(1) FDMA
(2) TDMA
(3) CDMA
(4) SDMA.

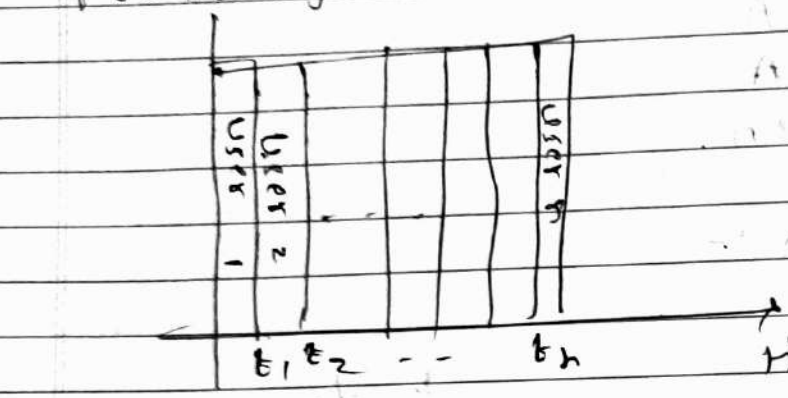
② CDMA :-

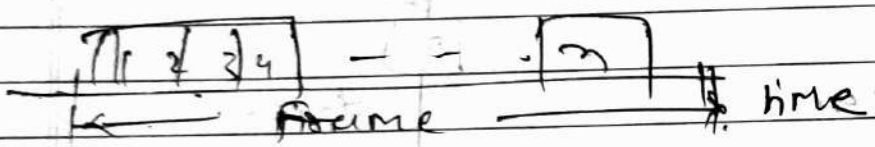


③ FDMA :-



TDMA :-

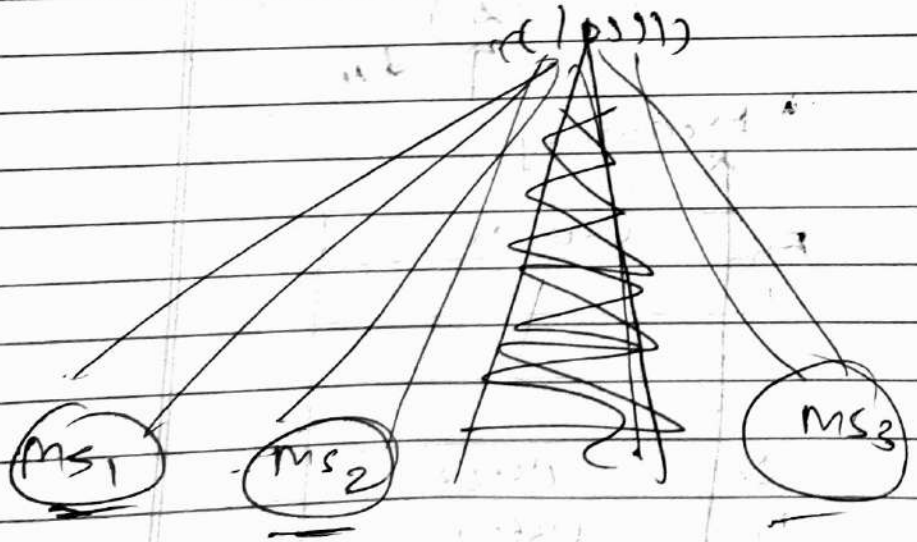




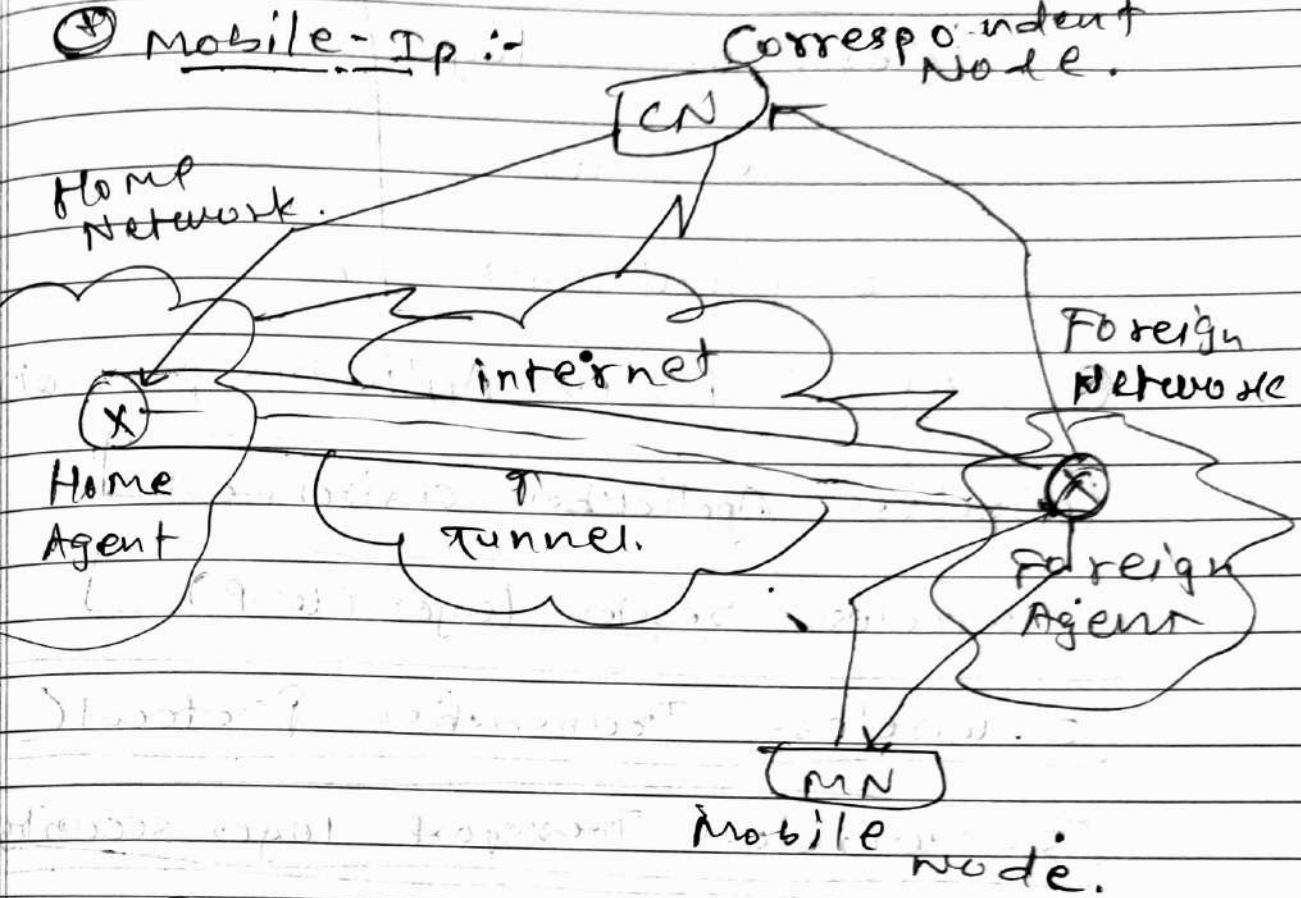
- two common CDMA techniques:
  - FHSS
  - DSSS

TDMA F.

SDMA :-

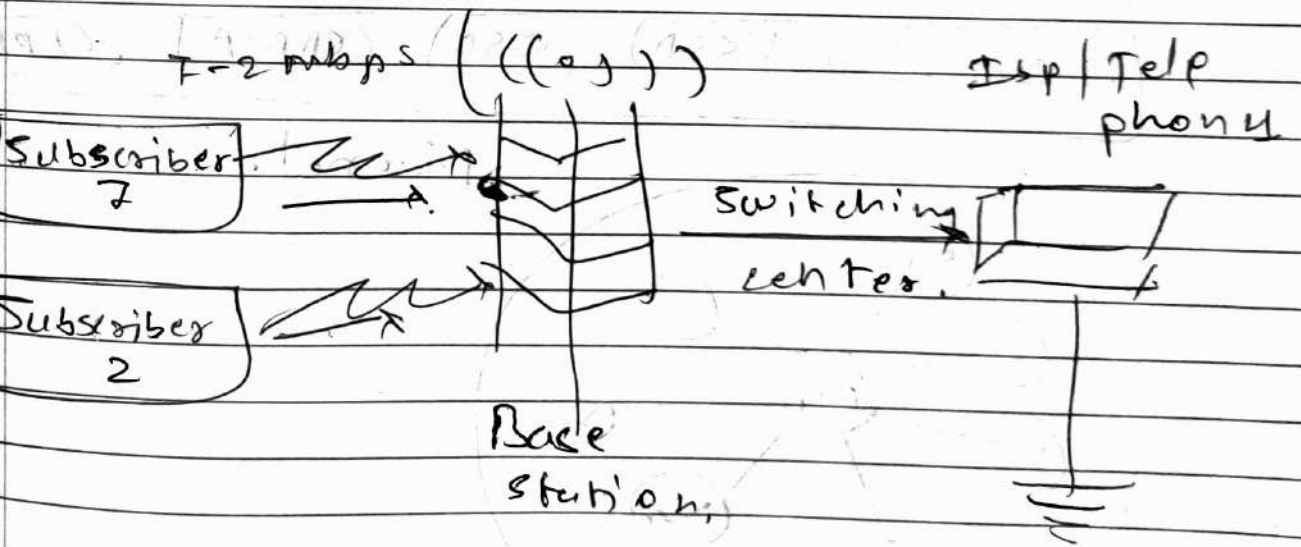


⊛ Mobile-Ip :-



⊛ Mobile Ip ⊛

⊛ wimax Architecture :-



⊛ wimax Architecture ⊛

ATM

Convergence layer
MAC layer.
physical layer

② WAP :- (Wireless Application protocol)

(Wireless Application environment.)

1. wireless session layer (WSP)

2. wireless Transaction Protocol (

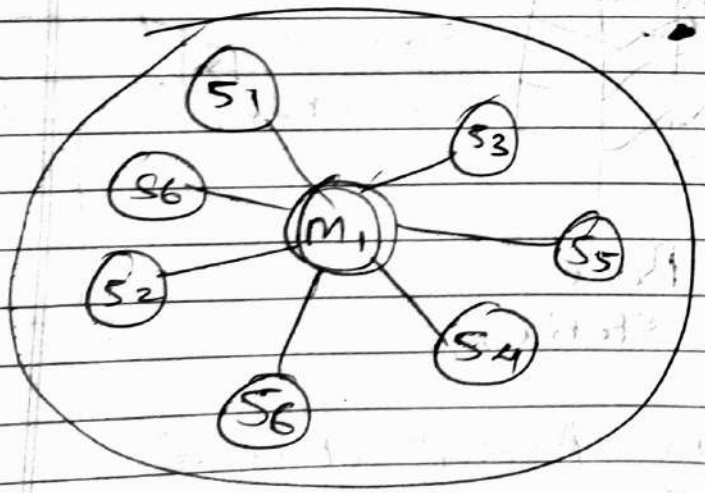
3. wireless Transport layer security

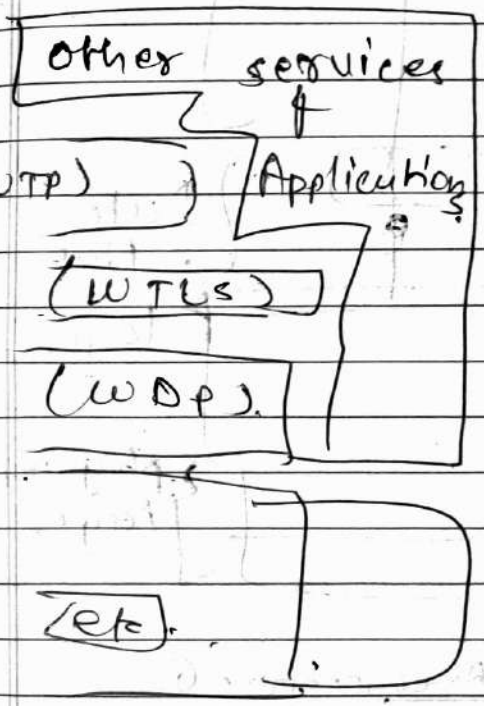
4. wireless Datagram protocol

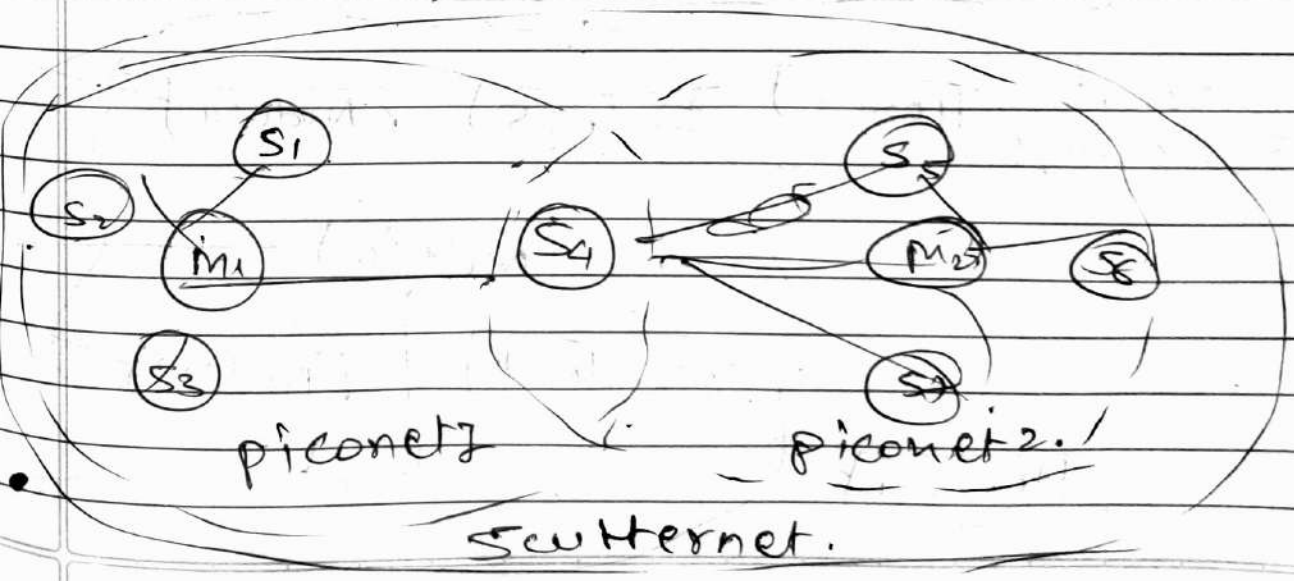
Bearer:

SMS | USSD | CSD | CDMA | GPRS

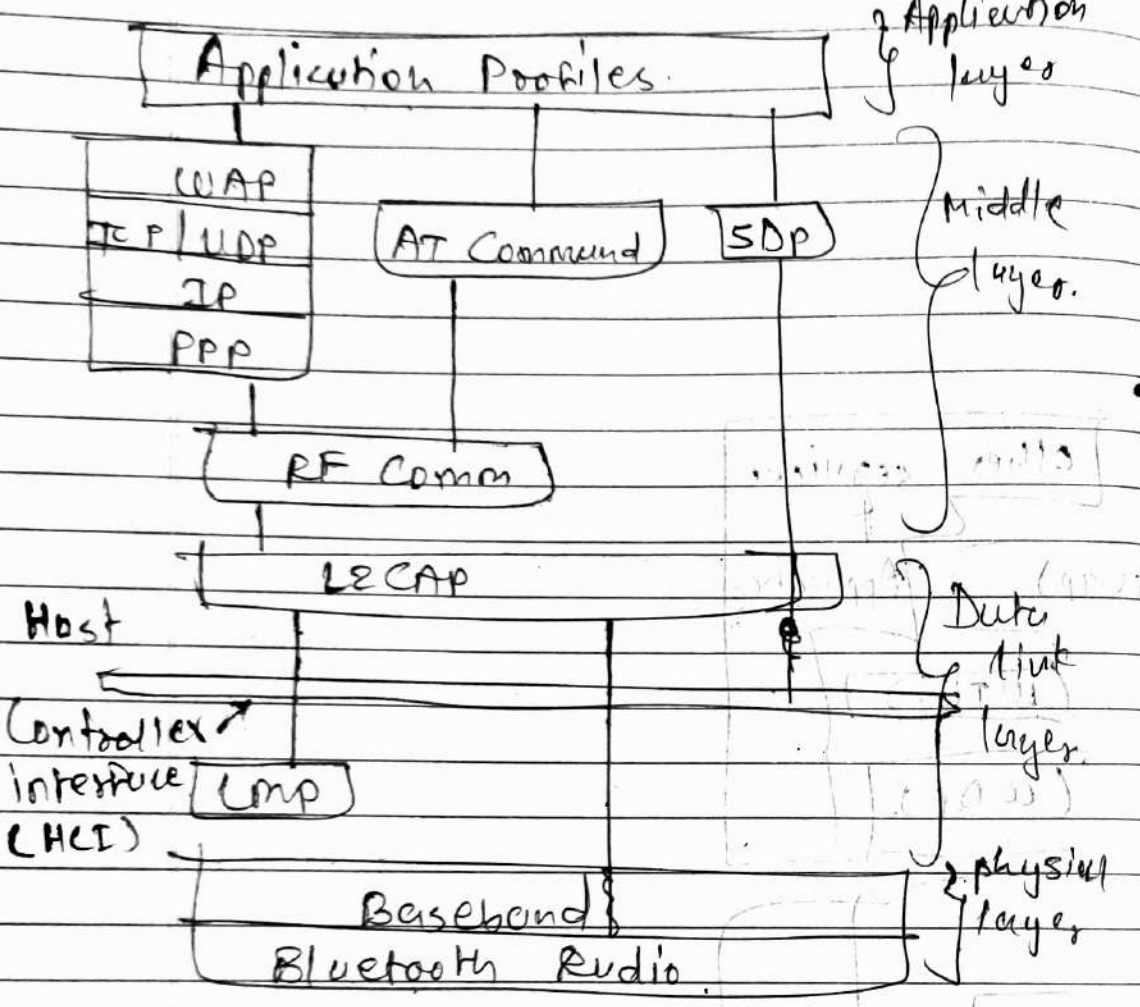
Piconet.




Other services
(WTP)
Applications
(WTLS)
(WDP).
etc.

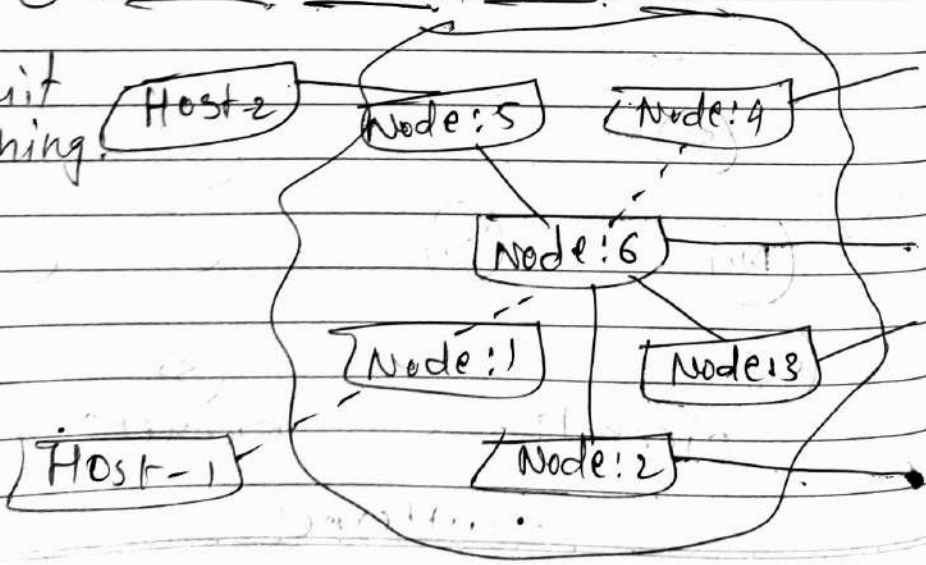

S1
S2
M1
S3
S4
S5
M2
S6
S7
piconet1
piconet2.
Scatternet.

① Bluetooth Protocol stack :-

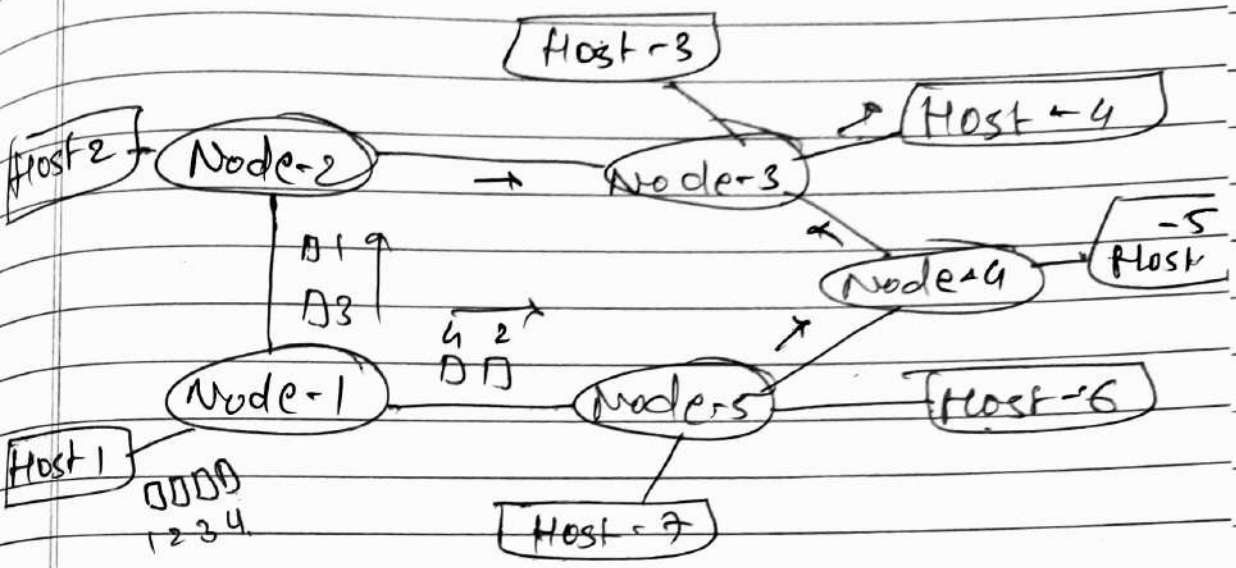


② Bluetooth Protocol Architecture ②

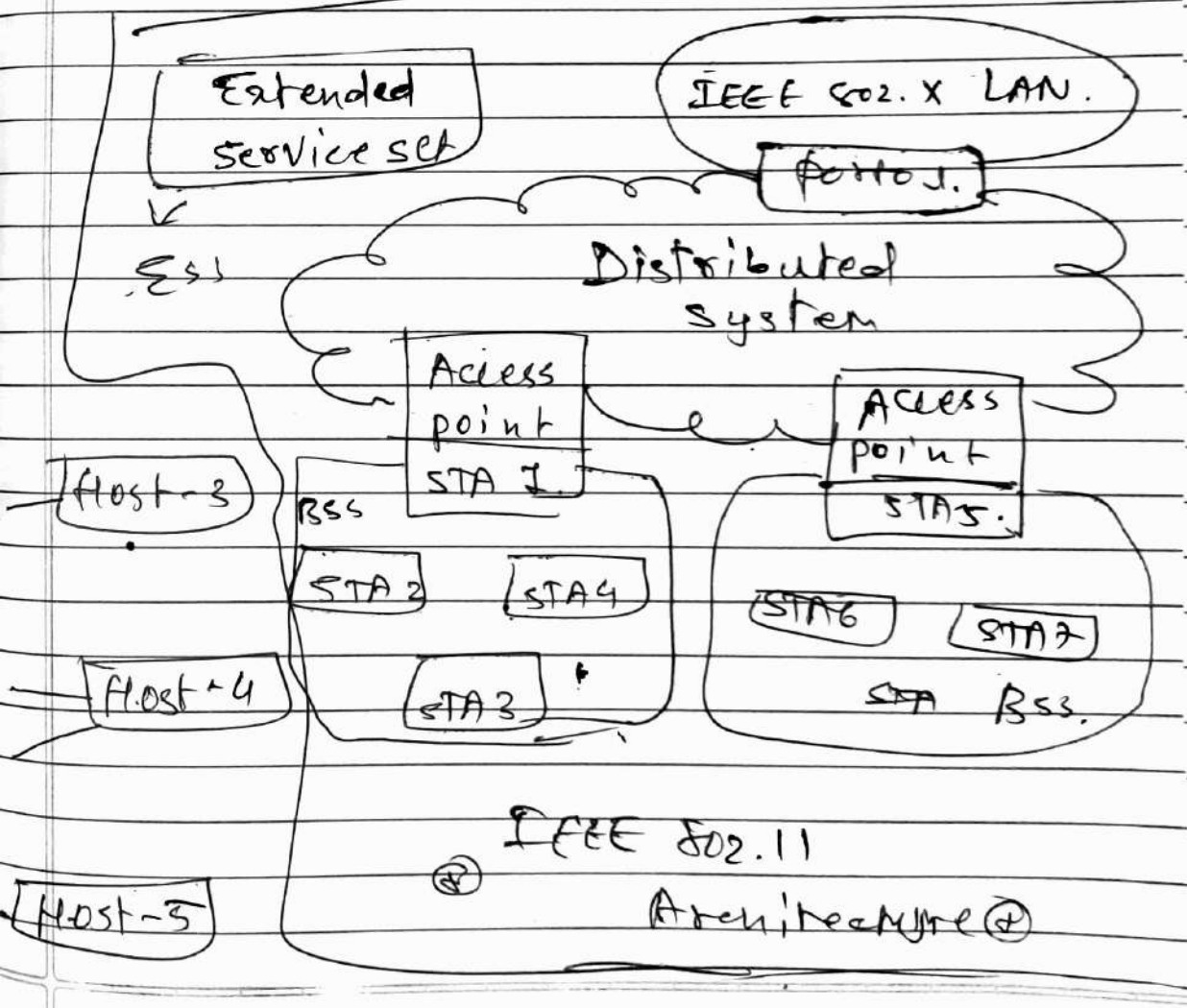
④ Circuit Switching



⑧ Packet Switching :-

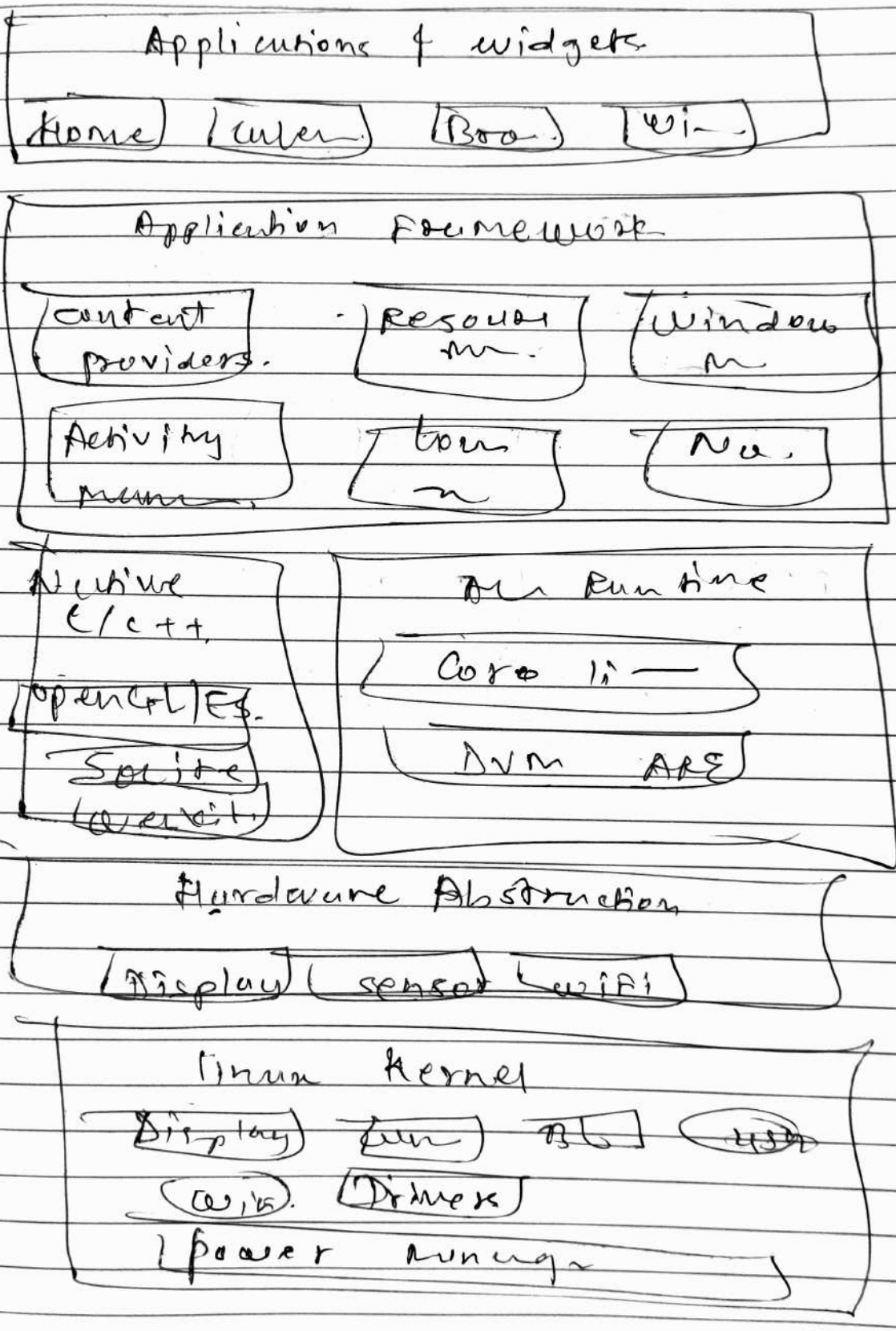


⑨ IEEE 802.11 :-



IEEE 802.11 ⑨ Architecture ⑨

Android Architecture



Page No.
Date

Q.1 (a) Draw & Explain GSM Architecture with roles of its components. (7)

- GSM stands for Global System for Mobile Communication.
- GSM is an open & digital cellular technology used for mobile communication. it uses 4 different frequency bands of 850MHz, 900MHz, 1800 MHz & 1900 MHz.
- it uses combination of FDMA & TDMA. This article includes all the concepts of GSM architecture & How it works.

→ GSM is having 4 different size of cells are used in GSM:

(1) Macro: in this size of cell, Base station antenna is installed.

(2) Micro: in this size of cell, antenna height is less than the average roof Level.

(3) Pico: Small cell's diameter of few meters.

(4) Umbrella: it covers the shadowed regions.

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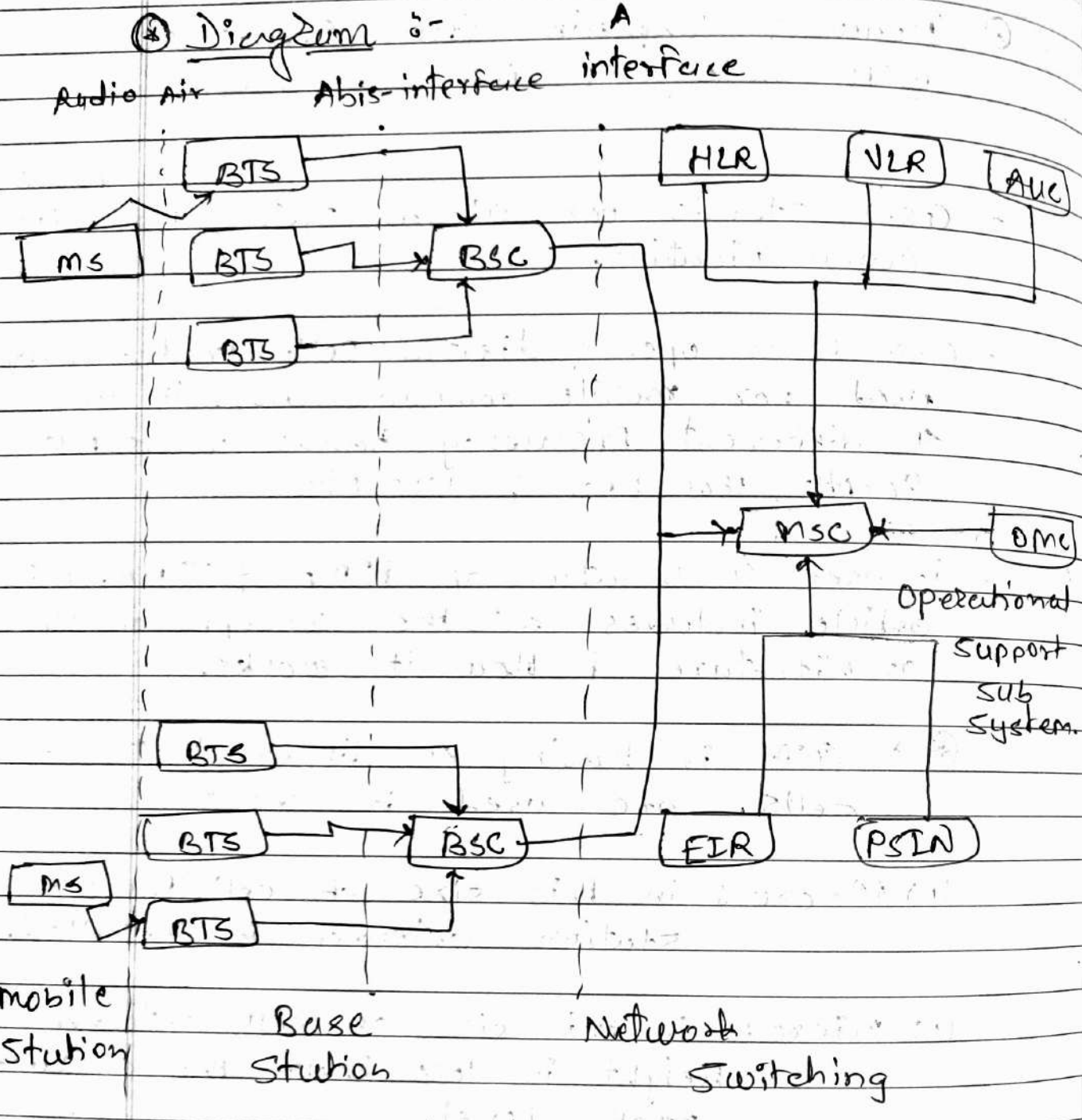
(*) Diagram :-



(*) → GSS is nothing but a larger system which is divided into further 3 subsystem.

(1) BSS :
(2) NSS :
(3) OSS :

(1) BSS:

- BSS stands for Base station Subsystem. BSS handles traffic & signaling between a mobile phone & the network switching subsystem.

- BSS having two components BTS & BSC.

(2) NSS:

- NSS stands for Network & switching subsystem. NSS is the core network of GSM.

- Must carried out call and mobility management functions for mobile phone present in network.

- NSS have different components like VLR, HLR & EIR.

(3) OSS:

- OSS stands for Operating subsystem. OSS is a functional entity which the network operator monitor & control the system. OMC is the part of OSS.

(4) → Suppose there are 3 mobile stations which are connected with the tower and that tower is connected to BTS through RTX, TRX, then further connected to

BSC & MSC.

(x) components of GSM Architecture :-

(1) MS :

- MS stands for mobile system, MS comprises user equipment & software needed for communication with a mobile network.

mobile station (MS) = Mobile (ME) Equipment + Subscriber Identity module (SIM).

(2) BTS :

- BTS stands for Base station controller. which facilitates wireless communication between user equipment & a network. Every tower has BTS. Transceiver station

(3) BSC :

- BSC stands for Base Station controller. BSC has multiple BTS. You can consider the BSC as a local exchange of your area which has multiple BTS. towers and multiple towers have

(4) MSC :

- MSC stands for mobile switching center.

- MSC is associated with communication switching functions such as call setup, call release & routing.

- MSC is having further components like VLR, HLR, AUC, EIR & PSTN.

(1) VLR - visitor location Register.
(2) HLR - Home location Register.
(3) AUC - Authentication Center.
(4) EIR - Equipment Identity Register.
(5) PSTN - public switched Telephone Network.

(5) OMC :

- OMC stands for operation Maintenance Center.

- OMC monitor & to maintain the performance of each MS, BSC & MSC within a GSM system.

- Three subsystem BSS, NSS & OSS are connected with each other via some interfaces.

Total three interfaces are there :

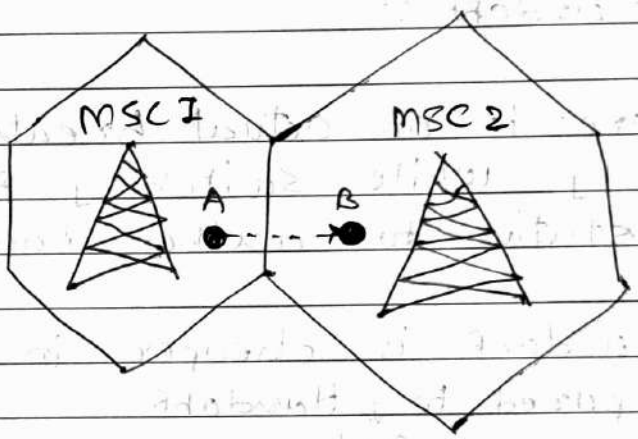
(1) Air Interface
(2) Abis Interface
(3) A Interface

Q.② Compare GSM & CDMA Technology.

No.	GSM	CDMA
(1)	GSM stands for Global System for mobile communication.	Code Division Multiple Access.
(2)	FDMA & TDMA Technology are used in GSM.	CDMA technology used in CDMA.
(3)	GSM is Globally widely used & Available.	CDMA is available in fewer Countries & carriers.
(4)	Data speed rate is 42 Mbps in HSPA (3G).	Data Speed rate is 3.6 Mbps in CDMA.
(5)	GSM supports transmitting Data & Voice both at once.	CDMA doesn't support this feature.
(6)	Customer information stored in a sim card.	Customer information stored in a headset or phone.
(7)	GSM doesn't provide built-in encryption is available.	CDMA provides built-in encryption.
(8)	Offers secure communication less.	Offer secure communication.
(9)	GSM enables worldwide roaming.	CDMA enables limited roaming.
(10)	GSM supports 2*2 MIMO.	CDMA supports cooperative & multi-user MIMO.

Q.③ What is Handoff ? Explain types of it in brief.

- In cellular telecommunications, the terms handover or handoff refers to the process of transfering an ongoing call or data connectivity from one Base Station to Another Base Station.



- when a mobile moves into a different cell while the conversation is in process then the MSC transfer the call to a new channel belonging to the new Base Station.

- when a Mobile User A moves from one cell to another cell then BSC 1 Signal te strength loses for the mobile user A & the signal strength of BSC 2 increases & thus ongoing cell or data connectivity for mobile users goes on without interupting.

⊛ Types of Handoff ⊛

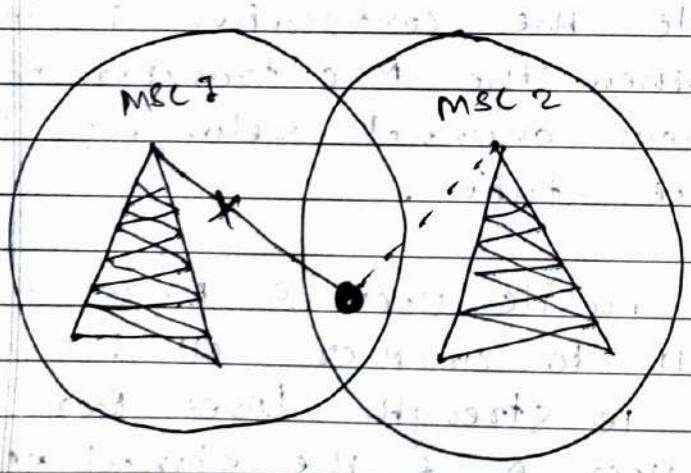
(1) Hard Handoff
(2) Soft Handoff
(3) Delayed Handoff
(4) Mobile-Assisted Handoff

[1] Hard Handoff :-

- when there is an actual break in the connectivity while switching from one base station to another Base station.

- Hard Handoff is cheaper in cost as compared to Soft Handoff.

- it is more efficient then soft Handoff.



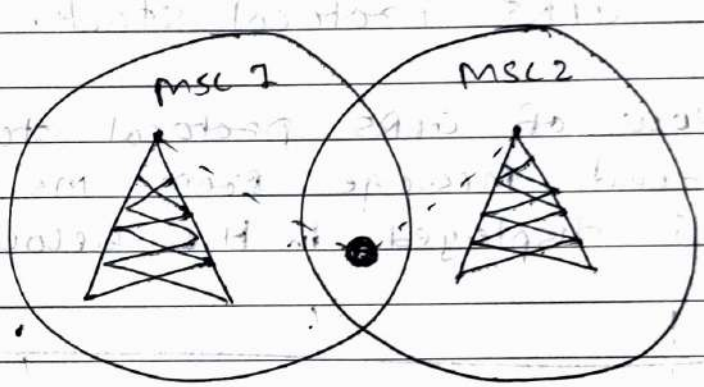
- High Delay in signals.

[2] Soft Handoff :-

- Soft Handoff is a mechanism in which the device get connected with two or more

base stations at the same time.

- At least one of the links is kept when radio signals are added or removed to the Base station.
- High transmission speed.
- very low delay in signals.



[3] Delayed Handoff :-

- Delayed Handoff occurs when no base station is available for accepting the transfer.
- The call continues until the signal strength reaches a threshold, & after that, the call is dropped.

[4] Mobile-Assisted Handoff :-

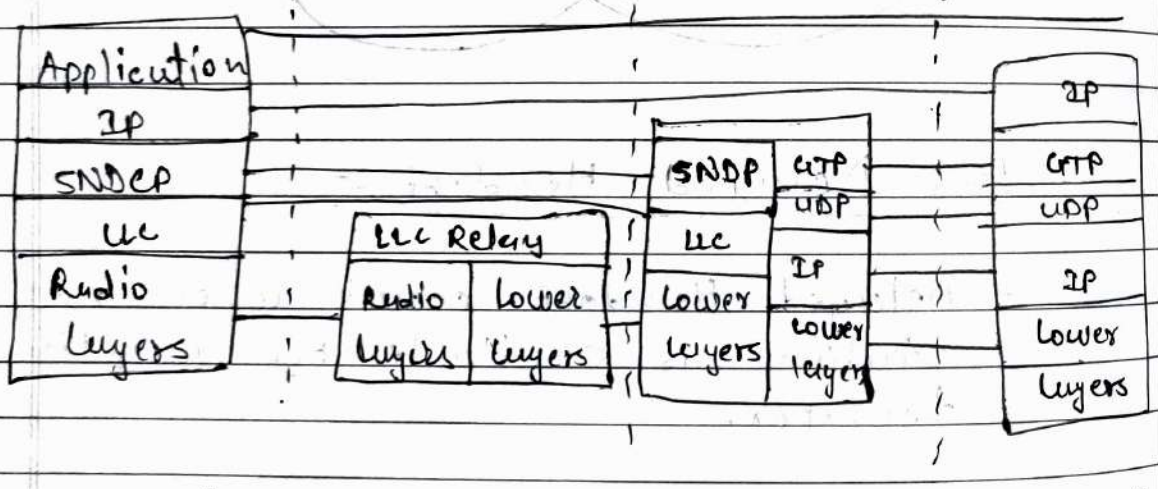
- Mobile-Assisted Handoff is generally used when a mobile phone helps a base station

- to transfer the call to another base station with better-improvised connectivity and more signal strength.

- This handoff is used in TDMA technique - based GSM devices.

Q.(4) Explain GPRS Protocol stack.

- The flow of GPRS protocol stack and end-to-end message from MS to the GGSN is displayed in the below diagram.



- GTP is the protocol used between the SGSN and GGSN using the Gn interface. This is a layer 3 tunneling protocol.

- The process that takes place in the application looks like a normal IP sub-network for the users both inside & outside the network.

- The vital thing that needs attention is the application communicates via standard IP, that is carried through the GPRS Network. & out through the gateway GPRS.

- The packets that are mobile between the GGSN and the SGSN use the side of the GPRS Network do not have deal with the internet backbone. UDP and IP are run by GTP.

- SubNetwork Dependent Convergence Protocol (SNDCP) and logical link control (LLC) combination used in between the SGSN and the MS.

- The SNDCP flattens data to reduce the load on the radio channel. A safe logical link by encrypting packets is provided by LLC and the same LLC link is used as long as a mobile is under a single SGSN.

- In case, the mobile moves to a new routing area that lies under a different SGSN; then, the old LLC link is removed and a new link is established with the new serving GSN X.25.

- Services are provided by running X.25 on top of TCP/IP in the internal backbone.

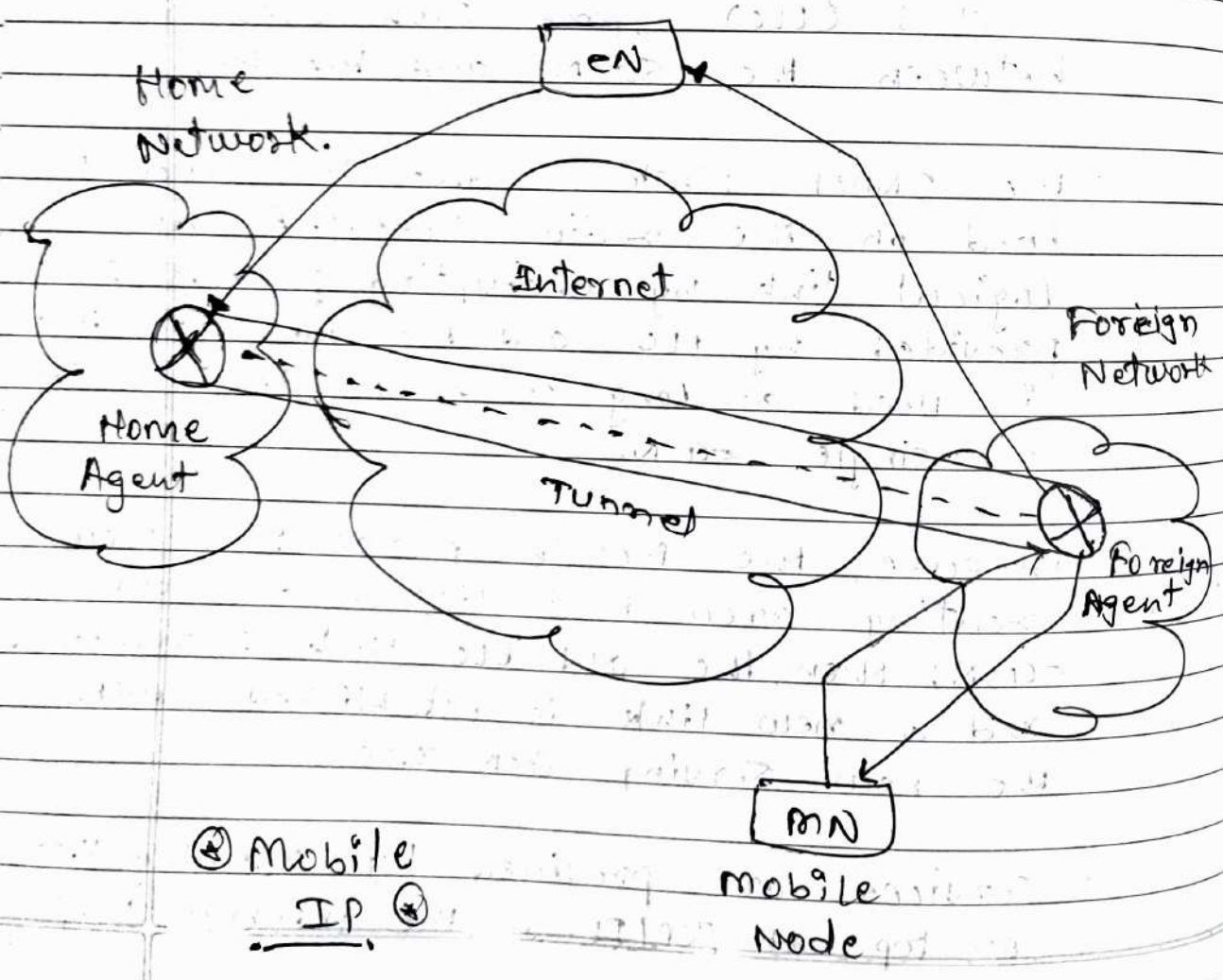
* * *

Q.6 Explain Mobile IP. (7)

- Mobile IP is a communication protocol (created by extending Internet protocol) that allows the users to move from one network to another with the same IP address.

- It ensures that the communication will continue without the user's sessions or connections being dropped.

Diagram :-



Mobile IP

⑧ Technologies :-

(1) Mobile Node (MN) :

- Mobile Node (MN) is the hand-held communication device that the user carries, eg. cell phone.

(2) Home Network :-

- Home Network is a Network to which the Mobile node originally belongs as per its assigned IP address (Home Address).

(3) Home Agent (HA) :-

- Home Agent is a router in home network to which the Mobile node was orginally connected.

(4) Home Address :-

- Home Address is the permenant IP Address assigned to the mobile node.

(5) Foreign Network :-

- Foreign Network is the current net work to which the Mobile node is visiting.

(6) Foreign Agent (FA):-

- Foreign Agent (FA) is a router in a foreign network to which the mobile node is currently connected.

(7) Correspondent Node (CN):-

- Correspondent Node is a device on the internet communicating to the mobile node.

(8) Care-of Address (CoA):-

- Care-of Address is the temporary address used by a mobile node while it is moving away from its home network.

④ Working:-

- The correspondent node sends the data to the mobile node.

- Data packets contain the correspondent node's address & home Address.

- Packets reach the home agent. But now mobile node is not in the home network, it has moved into in the foreign network.

Now, a tunnel will be established between the Home agent & the foreign agent by the process of Tunneling. → Continue Q. 6 chap-3.

- The foreign agent sends the care-of-address to the home agent to which all the packets should be sent.

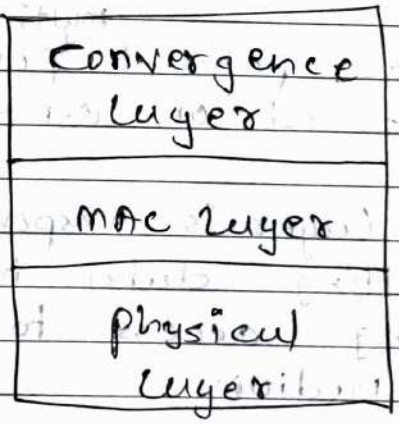
Q. (6) What is WiMAX. Explain WiMAX architecture

- WiMAX stands for Worldwide Inter-operability for Microwave Access. This technology is based on IEEE 802.16.

- It is used to provide higher data rates with increased coverage. it is based on MAN & M technology.

- it range is upto 50km. it may provide speed up to 70 Mbps and it can operate in Non-Line-of-sight. This Technology is fast, convenient & cost effective.

(*) Architecture :-



[1] physical layer :-

- This layer specifies frequency band, synchronization between transmitter and receiver data rate & multiplexing scheme.

- This layer is responsible for encoding and decoding of signals & manages bit transmission & reception.

- it converts MAC layer frames into signals to be transmitted. Modulation schemes which are used on this layer includes : QPSK, QAM-16 & QAM-64.

[2] MAC layer :-

- This layer provides a interface between convergence layer & physical layer of WiMAX protocol stack.

- it provides point to multi point communication and is based on 'CSMA/CA.

- The MAC layer is responsible for transmitting data in frames & controlling access to shared wireless medium.

- The MAC protocol defines how and when a subscriber may initiate a transmission on the channel.

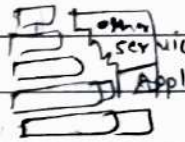
[3] Convergence Layer :-

- This layer provides the information of the external network.

- it accepts higher layer protocol data unit (PDU) and converts it to lower layer PDU. it provides functions depending upon the service being used.

Q. ⑦ Explain WAP (Wireless Application Protocol) Layered Architecture.

⑦ WAP - Architecture :-



provides

(WAE) Wireless Application Environment

Data exchange

1. Wireless Session layer (WSP)

2. Wireless Transaction Protocol (WTP)

(WTLS)

3. Wireless Transport Layer Security

it is network & device independent.

4. Wireless Datagram Protocol (WDP)

Bearers : Bearer :

SMS | USSD | CSD | CDMA | EDPD | Etc.

⑦ WAP Architecture ⑦

- WAP is designed in a layered fashion so that it can be extensible, flexible and scaleable. As a result, the WAP protocol stack is divided into five layers:

[1] - Application layer :-

- wireless Application Environment (WAE). This layer is of most interest to content developers because it contains among other things, device specifications and the content development programming languages, WML and WML Scripts.

[2] Session layer :-

- Wireless Session Protocol (WSP). Unlike HTTP, WSP has been designed by the WAP Forum to provide fast connection suspension & reconnection.

[3] Transaction layer :-

- wireless Transaction protocol (WTP). The WTP runs on top of a datagram service, such as User Datagram protocol (UDP) and is part of the standard suite of TCP/IP protocols used to provide a simplified protocol suitable for low bandwidth wireless stations.

[4] Security Layer :-

- Wireless Transport Layer Security (WTLS). WTLS incorporates security features that are based upon the established Transport Layer Security (TLS) protocol standard.

- It includes data integrity checks, privacy, service denial & authentication services.

[5] Transport Layer :-

- Wireless Datagram protocol (WDP). The WDP allows WAP to be bearer-independent by adapting the transport layer of the underlying bearer.

- The WDP presents a consistent data format to the higher layers of the WAP protocol stack, thereby offering the advantage of bearer independence to application developers.

Q.⑧ Explain Direct Sequence Spread Spectrum.

- Direct-sequence spread spectrum in wireless Network is a technique that transmits a data signal over a range of frequencies, spreading it uniformly across the allocated spectrum.

- Direct sequence spectrum is used to ensure that a particular frequency band is kept free from interference.
- This technique can be related to escaping the problem of co-channel interference & cross-talk interference.

- Dsss can also be used as an alternative approach to orthogonal frequency division multiplexing, where the baseband signal is encoded and transmitted across a quantity of fixed, predetermin channels.

- Dsss is a communication system that was developed in 1980s. it divides the bandwidth of a radio channel into wide frequency bands & transmits these signals over separate frequenci in this frequency-hopping process, such each signal is assigned a different orthogonal sequence or frequencies.

Q. (9) Explain Bluetooth Protocol Architecture. (7)

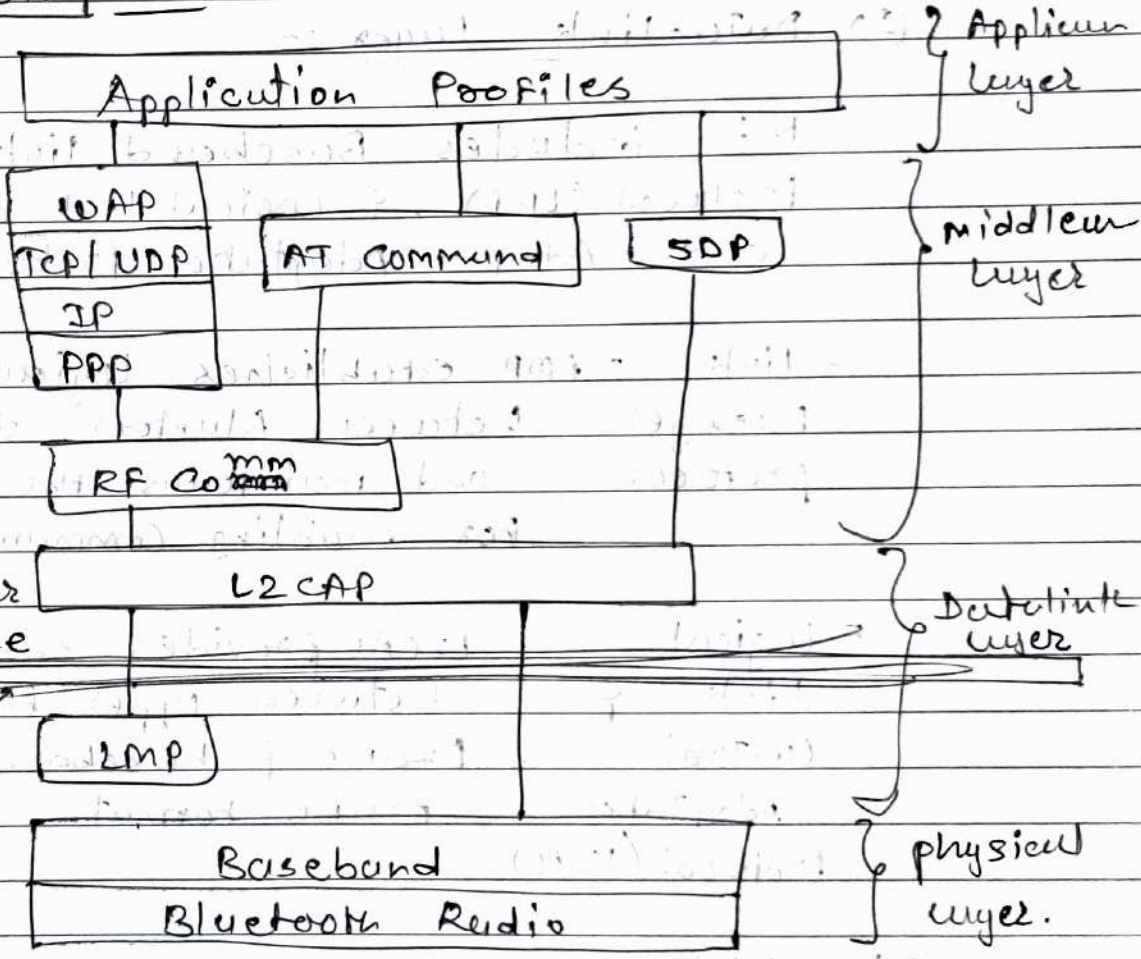
- Bluetooth network Technology connects mobile devices wirelessly over a short-range to form a personal area network (PAN).

- the Bluetooth Architecture has its own independent model with a stack of protoco

instead of following the standard OSI model or TCP/IP model.

- The protocols in the Bluetooth standard can be loosely grouped into physical layer, Data link layer, middleware layer, & application layer as shown below:

⊛ Diagram :-



⊛ Bluetooth Protocol Architecture ⊛

(1) physical layer -

- This includes Bluetooth radio and Baseband.

- Rudio - This is a physical layer equivalent protocol that lays down the physical structure and specifications for the transmission of radio waves.

- Basebend - This protocol takes the services of radio protocol.

(2) Data-link layer :-

- This includes Basebend, link Manager Protocol (LMP), & Logical link control and Adaptive Adaptation Protocol (L2CAP).

- Link Manager protocol - LMP establishes logical links between Bluetooth devices and maintains the links for enabling communications.

- Logical link control Adaptation Protocol (L2CAP) - L2CAP provides adaptation between upper layer frame & baseband layer frame format.

(3) Middleware layer :-

- This includes Radio Frequency Communications (RFComm) protocol, adopted protocols, SDP & AT commands.

- RFComm - it is short for Rudio Fronted Component & provides serial interface with WAP.

- Adopted Protocols - these are the protocols that are adopted from standard models. the commonly adopted protocols used in Bluetooth are
  - point-to-point protocol (PPP)
  - Internet protocol (IP),
  - User Datagram Protocol (UDP),
  - Transmission control protocol (TCP),
  - wireless Application Protocol (WAP).

- Service Discovery Protocol (SDP) - SDP takes care of service-related queries like device information so as to establish a connection between contending Bluetooth devices.

- AT COMMands - Attention ATtention Command set.

(4) Applications layer :-

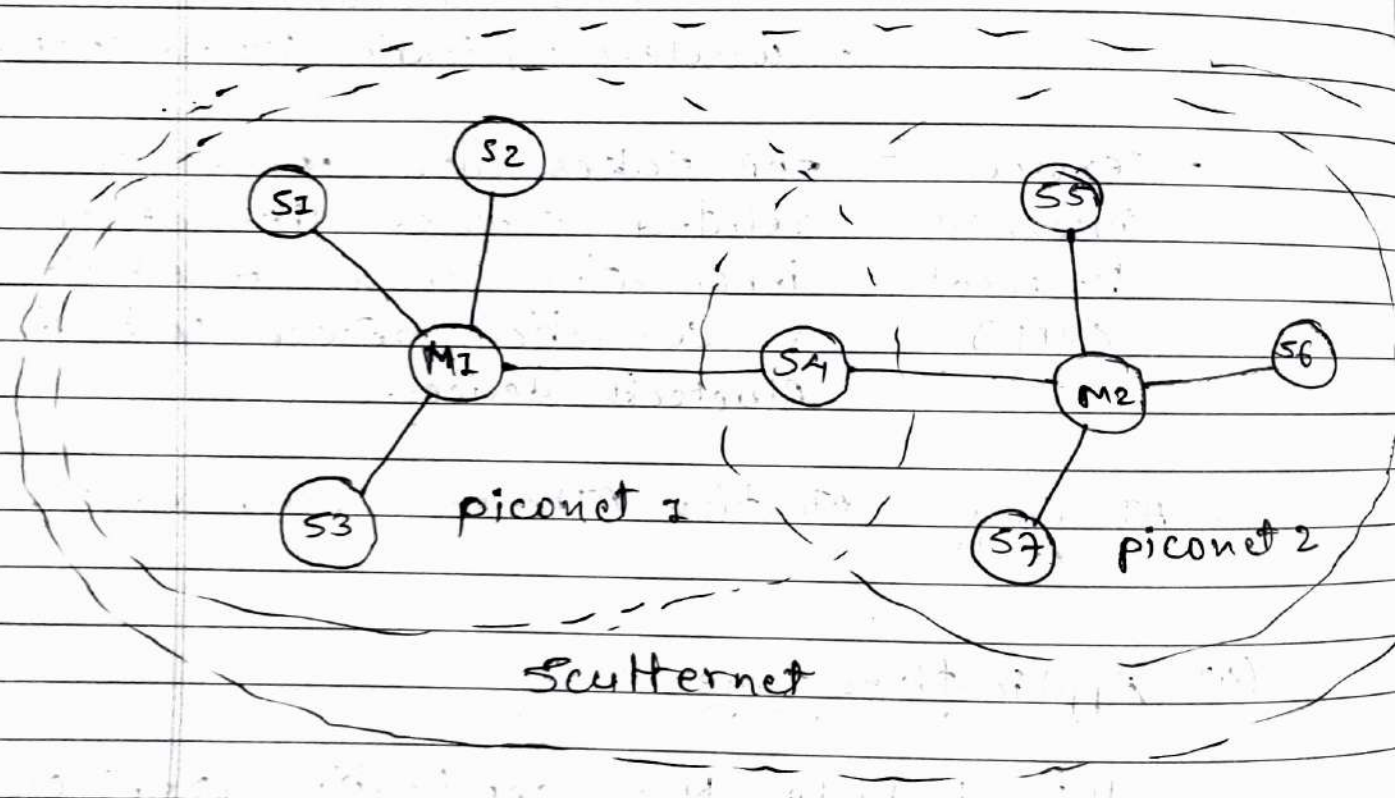
- This includes the application profiles that allow the user to interact with the Bluetooth applications.

* * *

Q. (10) Write a note on Piconet & Scatternet.

(A) Piconet :-

- piconet is a type of Bluetooth network that contains one primary node called the master node & seven active secondary nodes called slave nodes. Thus, we can say that of 8 there is a total of 8 active nodes which are present at a distance of 10 meters.



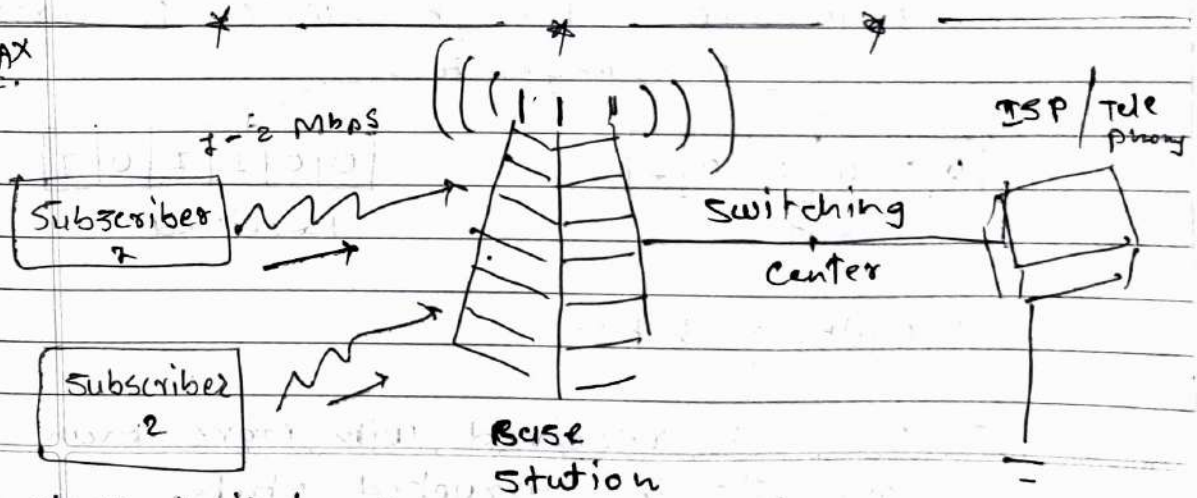
- The communication between the primary and secondary nodes can be one-to-one or one-to-many.

- possible communication is only between the master & slave; Slave-slave communication is not possible.

- it also has 255 parked nodes, these are secondary nodes and cannot take participation in communication unless it gets converted to the active state.

④ Scatternet :-

- it is formed by using various piconets.
- A slave that is present in one piconet can act as master or we can say primary in another piconet.
- This kind of node can receive a message from a master in one piconet and deliver the message to its slave in the other piconet where it is acting as a master.
- This type of node is referred to as a bridge node. A station cannot be mastered in two piconets.



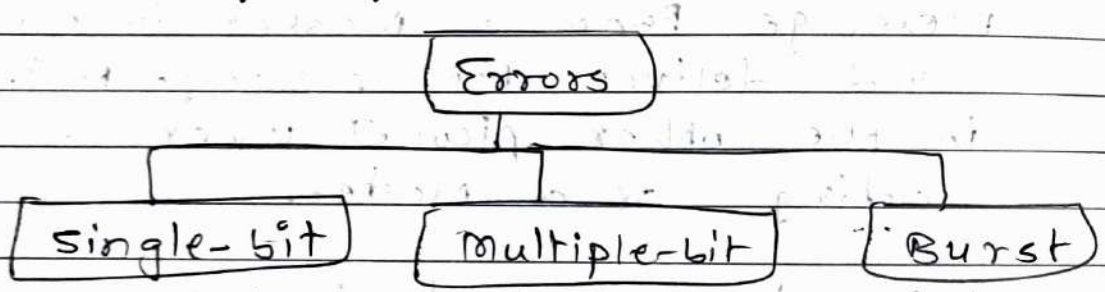
③ WiMAX Architecture ③

⊛ Chapter: 2 ⊛

Q.1 Explain Errors & its types with Methods of error detection.

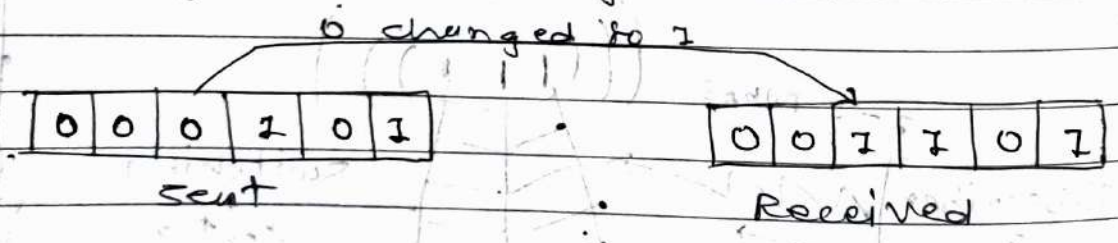
- Error is a condition when the receiver's information does not match the sender's information.
- During transmission, digital signals suffer from noise that can introduce errors in the binary bits traveling from sender to receiver.

⊛ Types of Errors :-



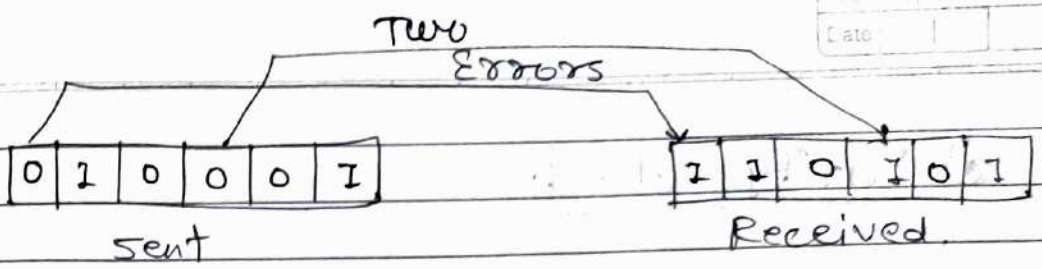
(1) Single-bit :-

- in a frame, there is only one bit, anywhere though, which is corrupt.



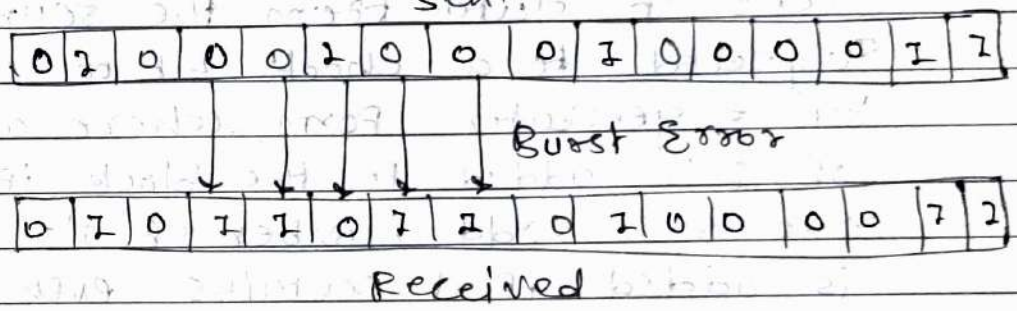
(2) Multiple bit :-

- Frame is received with more than one bits in corrupted state.



(2) Burst :-

- Frame contains more than 1 consecutive bits corrupted.



(*) Error Detection methods :-

- Error Detection means to decide whether the received data is correct or not without having a copy of the original message.

- Error Detection uses the concept of redundancy ; which means adding extra errors at the destination.

(*) Detection Methods :-

(1) Parity check
(2) Cyclic Redundancy check
(3) Checksum

① Parity check :-

- in this technique, a redundant bit called parity bit, is appended to every data unit so that the number of 1s in the unit including the parity becomes even.

- Blocks of data from the source are subjected to a check bit or parity bit generator form, where a parity of 1 is added to the block if it contains an odd number of 1's & 0's is added if it contains even number of 1's.

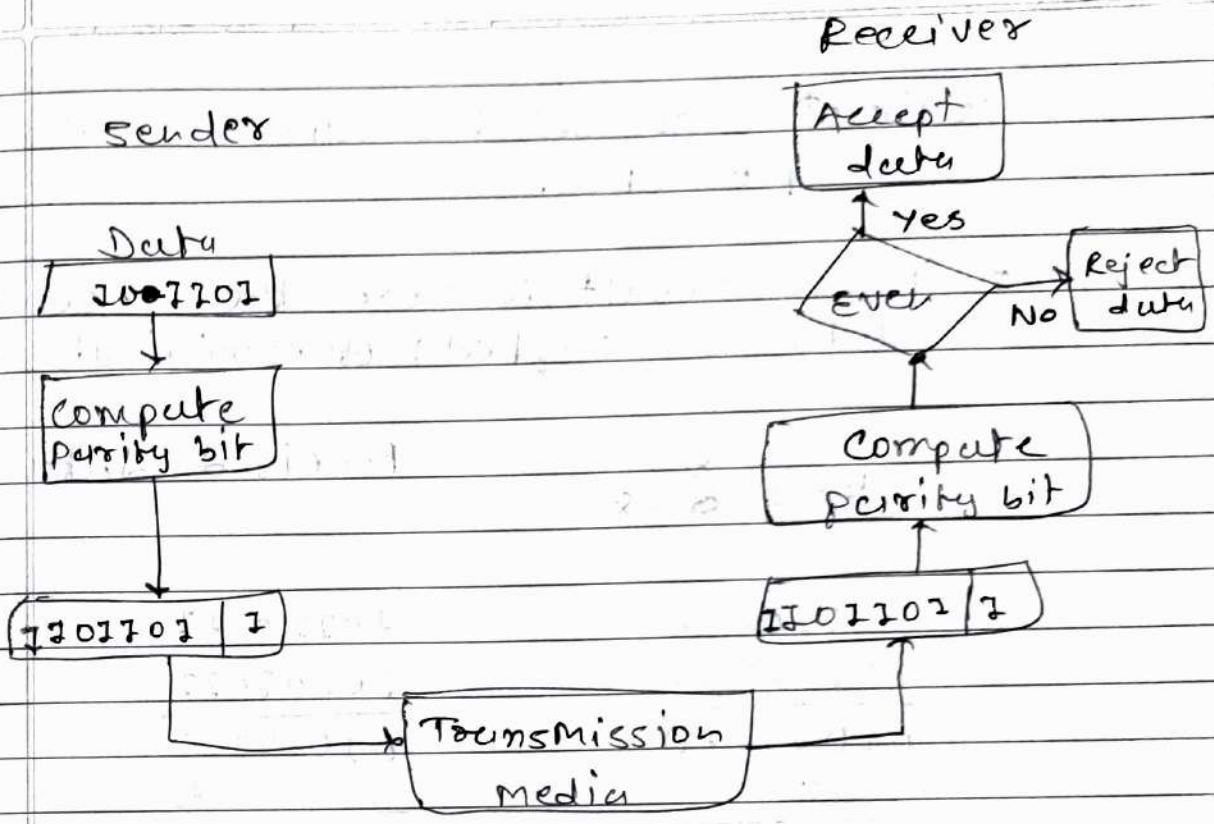
- At the receiving end the parity bit is computed from the received data bits and compared with the received parity bit.

- This scheme makes the total number of 1's even, that is why it is called even parity checking.

② Performance :-

- A receiver can detect all signal single bit errors in each code word.

- Errors in more than one bit cannot be detected.



(*) Even parity checking scheme (*)

(*) checksum :-

- Here, the data is divided into k segments each of m bits.
- in the sender's end the segments are added using 1's complement arithmetic to get the sum.
- The sum is complemented to get the checksum.
- The checksum segment is sent along with the data segments.
- At the receiver's end, all received segments are added using 1's complement

arithmetic to get the sum. The sum is complemented.

- if the result is zero, the received data is accepted; otherwise discarded.

Received data.

k = 4, n = 8

10110011
10101011
01011110
1
01011111
01011010
10111001
1
Sum: 10001111
Complement: 01110000

10110011
10101011
01011110
1
01011111
01011010
10111001
1
10001110
1
10001111
01110000
Sum: 11111111
complement: 00000000

⊛ checksum ⊛

⊛ performance :-

- The checksum detects all errors involving an odd number of bits.
- it also detects most errors involving even number of bits.

⊛ Cyclic Redundancy checks (CRC) :-

- CRC is the most powerful and easy to implement technique.

- CRC is based on binary division.

- in CRC, a sequence of redundant bits, are appended to the end of data unit so that the resulting data unit becomes exactly divisible by a ~~record~~ a second, predetermined binary number.

- At the destination, the incoming data unit is divided by the same number.

- if at this step there is no remainder, the data unit is assumed to be correct and is therefore accepted.

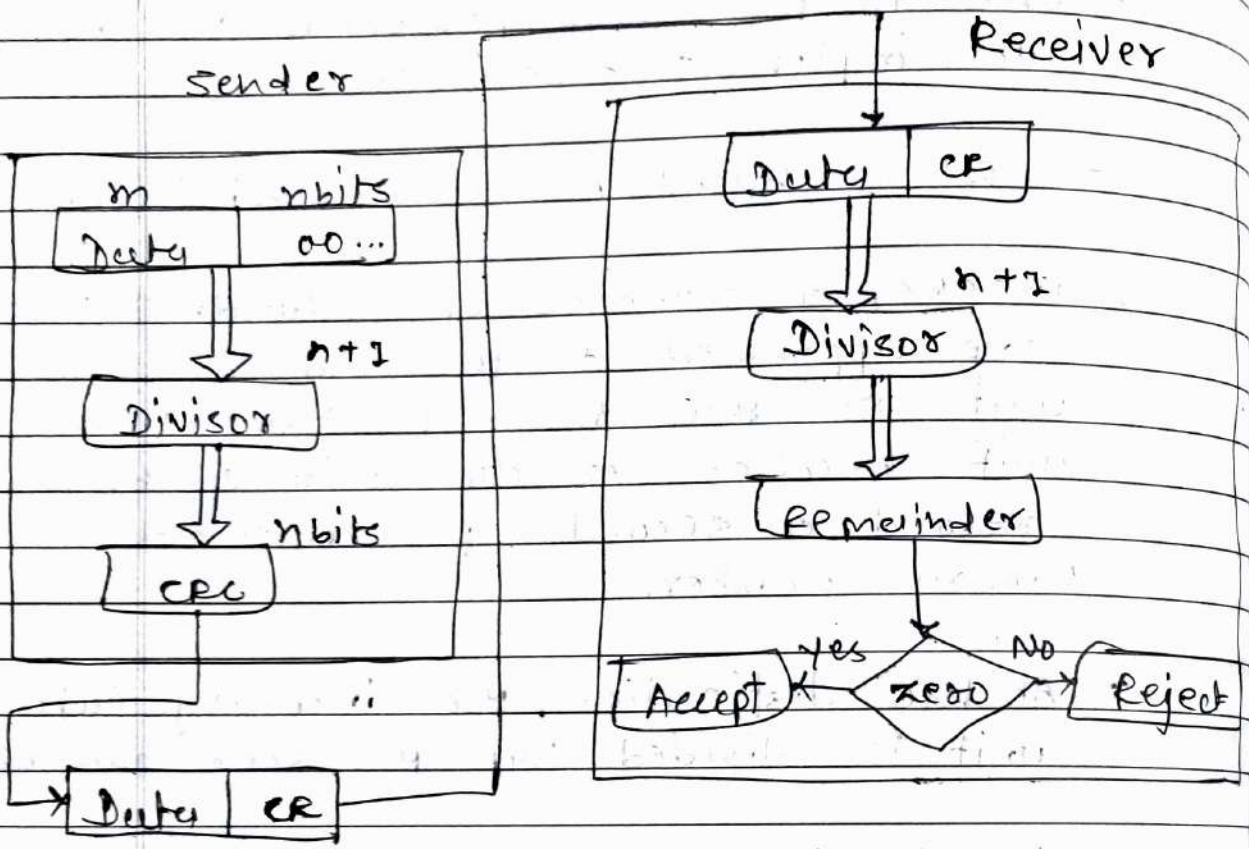
- A remainder indicates that the data unit has been damaged in transit & therefore must be rejected.

- The binary number, which is (n+1) bit in length, can also be considered as the coefficient of a polynomial, called Generator Polynomial.

⊛ Performance :-

- CRC is very effective error detection technique.

- CRC can detects all single & double bit errors.



(*) Basic scheme for CRC (*)

Ex. Frame: 1101011011

Generator: 10011

Message After appending 4 zero bits:

11010110110000

```
10011 | 11010110110000
        10011
        -----
        01001 1
         10011
         -----
         00000 . . . .
```

1110 ← Remainder

Transmitted Frame : 11010110111110

(2) Error Correction code :-

(*) Hamming code :-

- Hamming code is a set of error-correction codes that can be used to detect and correct the errors that can occur when the data is moved or stored from the sender to the receiver.

- Redundant bits are extra binary bits that are generated and added to the carrying bits of data transfer.

- The number of redundant bits can be calculated by :

$$2^r \geq m + r + 1$$

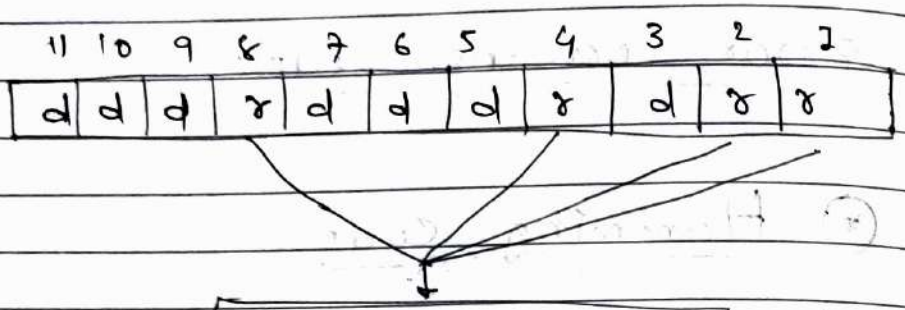
- where, r = redundant bit, m = data bit

- Example, the number of data bits is 7, then the number of redundant bits can be calculated using ;

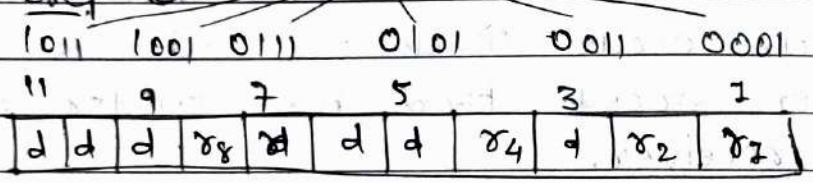
$$2^4 \geq 7 + 4 + 1$$

- Thus, the number of redundant bits = 4

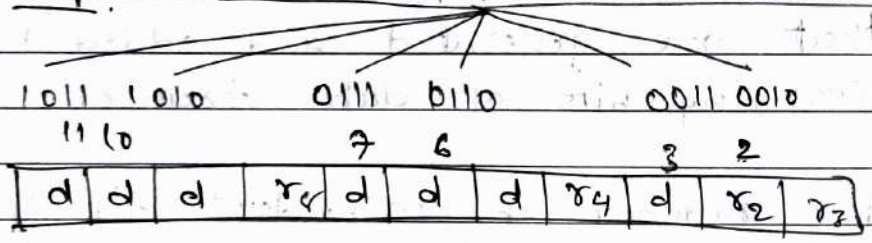
* step: (1)



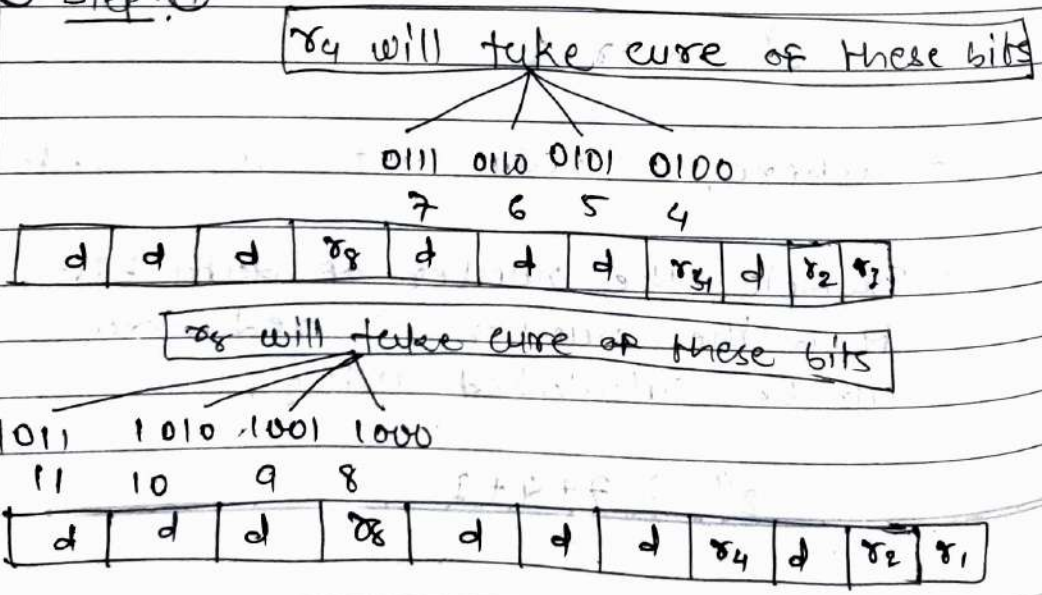
* step: (2)



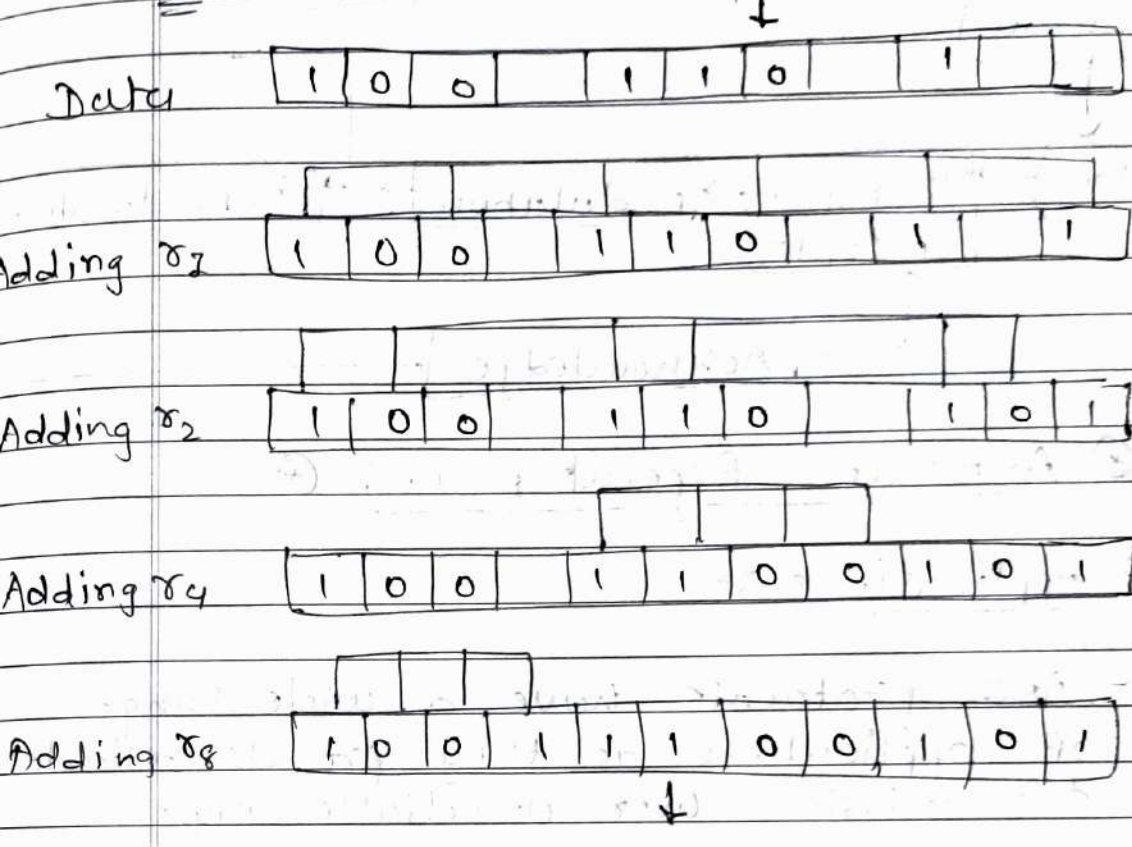
* step: (3) r2 will take care of these bits



* step: (4)



Ex:

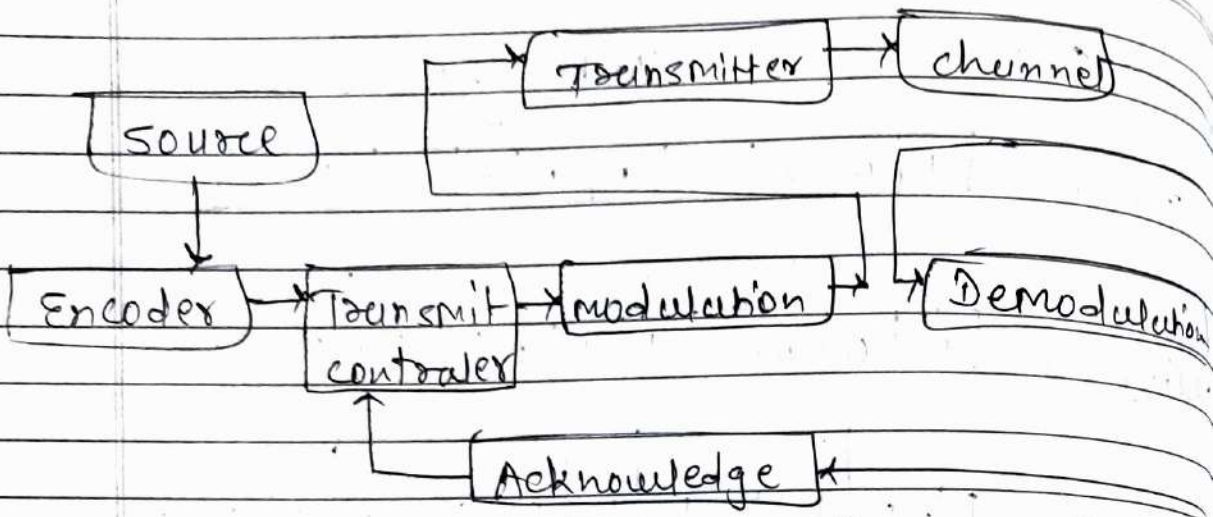


Data : 10011100101

Q.③ (*) Automatic Repeat Request :-

- Automatic Repeat Request (ARQ), also known as automatic repeat query, is an error-control method for data transmission that uses acknowledgements and timeouts to achieve reliable data transmission over an unreliable service.

- if the sender does not receive an acknowledgement before timeout, then re-transmits the frame/packet until the sender receives an acknowledgment.



⊛ Automatic Repeat Request ⊛

⊛ Applications :-

- ARQ protocols have a wide range of applications as they provide reliable transmission over unreliable upper sources.

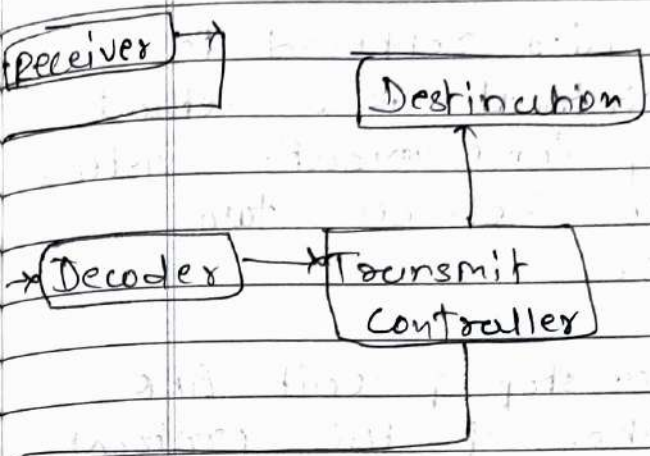
- These protocols are mainly functional on shortwave radio to ensure reliable delivery of signals.

- For the same function of ARQ, there are various applications:

  (1) Transmission control Protocol (TCP)
  (2) High-level Data link protocol.
  (3) XModem: modem file transfer protocol

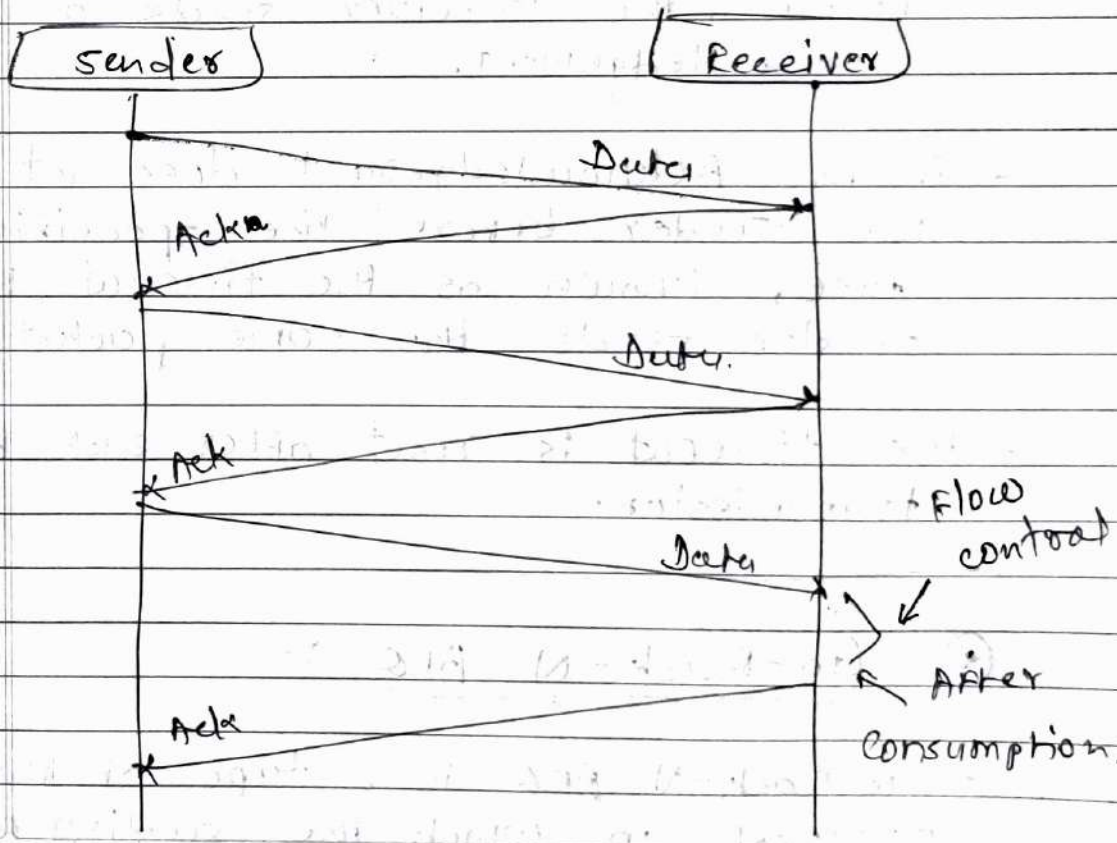
⊛ Types of ARQ :-

- There are several types of ways in which these protocols functions in data link



(1) Stop-and-wait ARQ
(2) Go-Back-N ARQ
(3) Selective-Repeat ARQ / Selective Reject ARQ

① Stop-and-wait ARQ :-



- stop & wait ARQ is also reffered to as the alternating protocol is a method used in two-way communication systems to send information between two connected devices.

- it is reffered to as stop & wait ARQ because the function of this protocol is to send one frame at a time.

- After sending a frame or packet, the sender doesn't send any further packets until it receives an acknowledgement from the receiver.

- After ~~sending~~ receiving the desired frame, the receiver sends an acknowledgement.

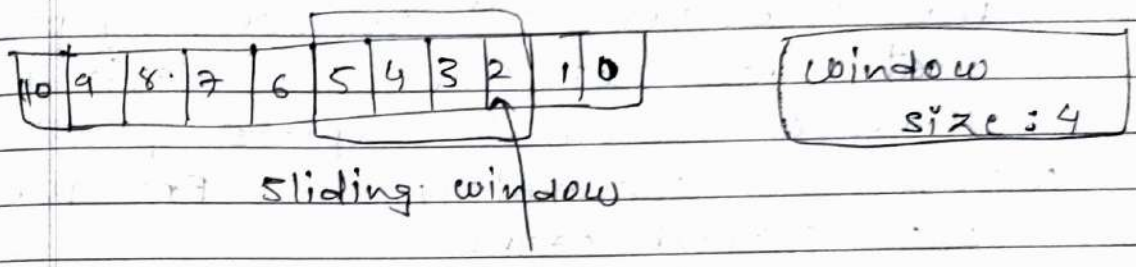
- if the Acknowledgement does not reach the sender before the specified time, known as the timeout, the sender sends the same packet again.

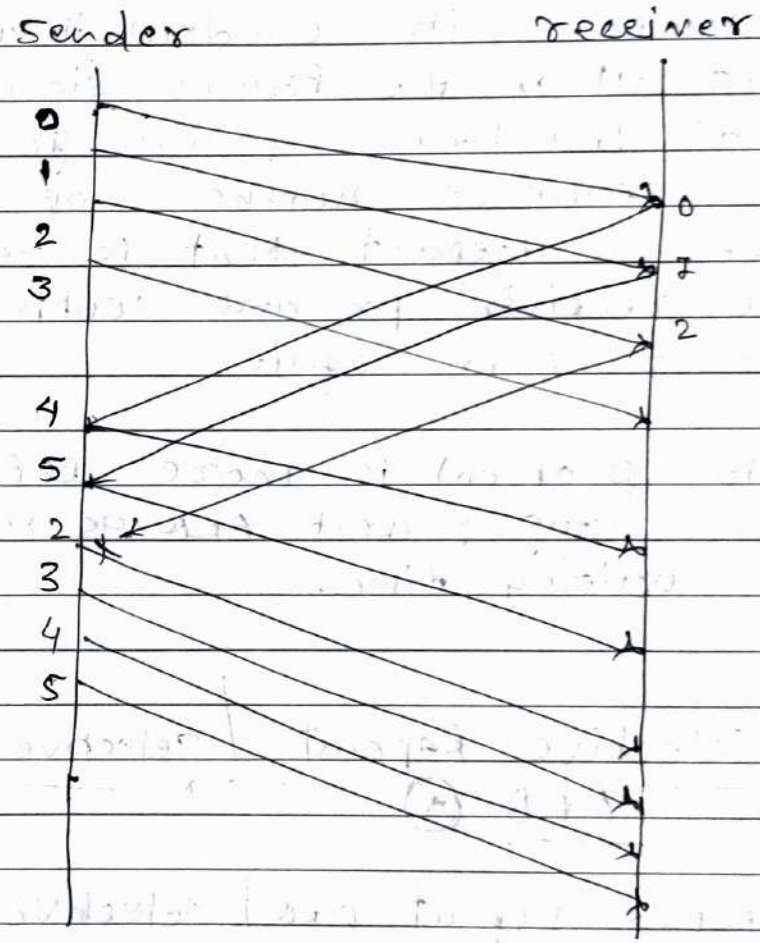
- the timeout is reset after each frame transmission.

⊛ Go-Back-N ARQ :-

- Go-Back-N ARQ is a type of the ARQ protocol, in which the sending process continues to send several frames or

packets even without receiving an Ack packet from the receiver.





⊛ Go-Back-N ARQ ⊛

- The receiver process keeps track of the sequence number of next packet it expects to receive & sends that sequence

number with every Acknowledgement to the sender.

- The receiver will remove any packet that does not have the desired sequence number it expects & will resend an acknowledgement for the last correct frame.

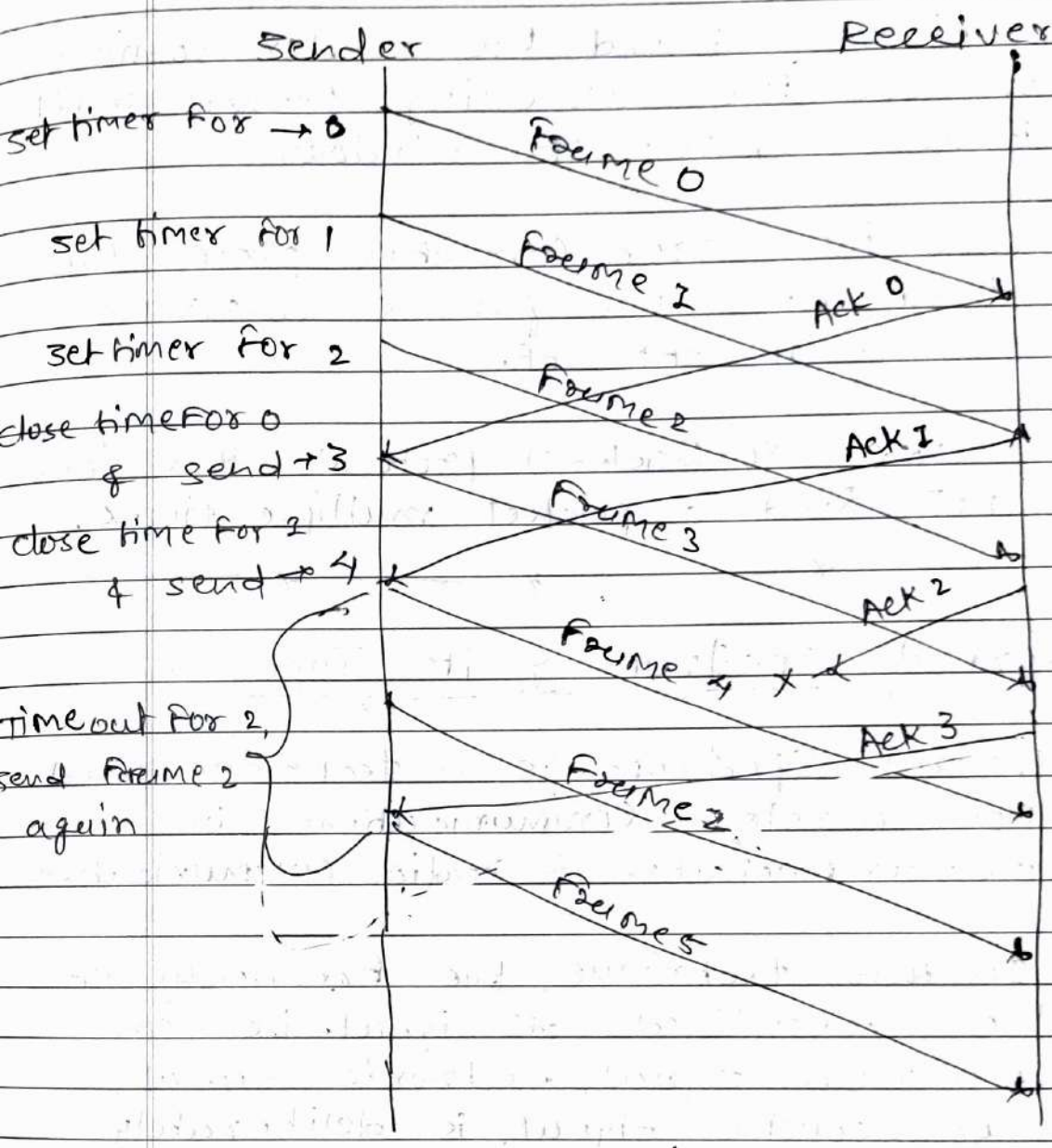
- Once the sender has sent all of the frames in its window, it will identify that all of the frames since the first lost frame, & will go back to the sequence number of the last acknowledgement that is received from the receiver pr and continue the process over again.

- This protocol is more efficient than stop & wait ARQ as there is no waiting time.

---

④ Selective - Repeat / selective Reject — ARQ ④

- Selective Repeat ARQ / selective Reject ARQ protocol mechanism is similar to the Go-Back-N protocol but in selective Repeat ARQ the sending process continues even after a frame is found to be corrupt or lost.



④ Selective Repeat / Reject ARQ ⑤

- This is achieved : the receiver process keeps track of the sequence number ~~with~~ of the earliest frame it has not received & sends the respective sequence number with the Ack signal.

- if a frame is not received at the

receiver and end, the sender continues to send the succeeding frames until it has emptied its window.

- once this error-correction process has been done the process continues where it left off.

- Unlike Go-Back-N protocol this does not send a packet multiple times.

Q. (4) Spread Spectrum & its Types :-

- Spread Spectrum is a technique used for wireless communications in telecommunication & radio communication.

- In this technique, the frequency of the transmitted signal. i.e, an electrical signal, electronic signal, or acoustic signal, is deliberately varied & generates a much greater bandwidth than the signal would have if its frequency were not varied.

- it is mostly used in radio signals transmission. because it can easily reduce noise and other signal issues.

⊛ Types of Spread Spectrum :-

(1) Frequency Hopping spread spectrum
(2) Direct sequence spread spectrum.

⊛ Frequency Hopping Spread spectrum (FHSS):-

- The Frequency Hopping spread spectrum or FHSS allow us to utilize bandwidth properly & maximum.

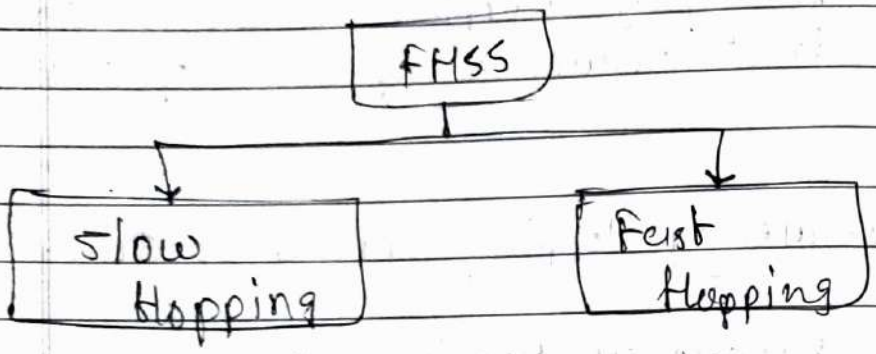
- In this technique the whole available bandwidth is divided into many channels & spread between channels, arranged continuously.

- The frequency slots are selected randomly and frequency signals are transmitted according to thier occupancy.

- The transmitters & receivers keep on Hopping on channels available for a particular amount of time in miliseconds.

- So, you can see that it implements the frequency division multiplexing and time-division multiplexing - simultaneously in Frequency Hopping spread spectrum.

- The FHSS can be classified into two types :-

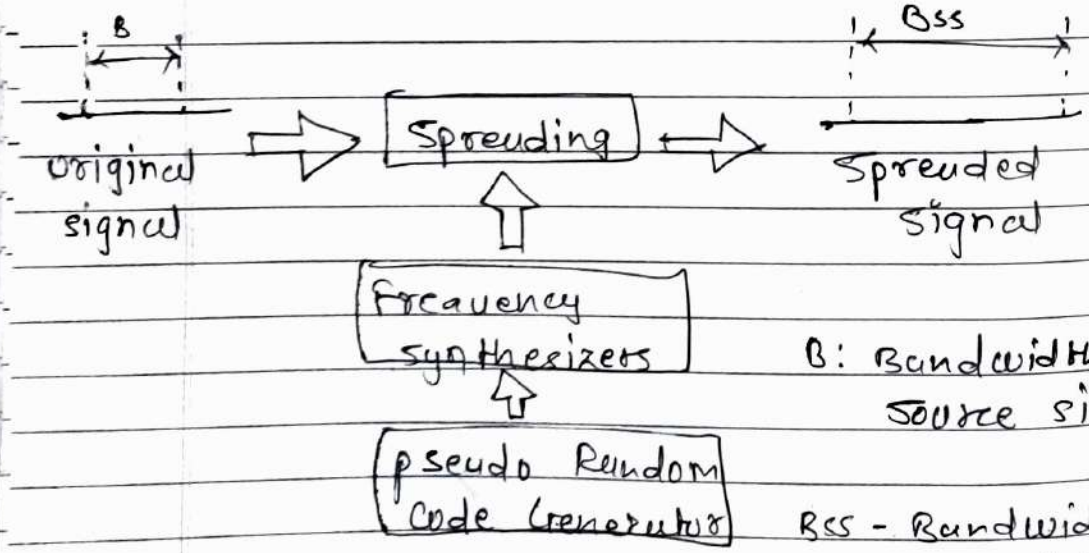


(1) Slow Hopping :-

- In slow Hopping, multiple bits are transmitted on a specific frequency or some frequency.

(2) Fast Hopping :-

- In fast Hopping, individuals bits are split and then transmitted on different frequencies.



B: Bandwidth of source signal

Bss - Bandwidth of Spreaded signal

④ FHSS ④

(*) Advantages of FHSS :-

(1) The Biggest Advantages of FHSS is its high efficiency.

(2) it requires shorter time for acquisition.

(3) it provides a very large Bandwidth

(4) it can be simply implemented as compared to DSSS.

(*) Disadvantages of FHSS :-

(1) FHSS is less Robust.

(2) FHSS needs complex Frequency Synthesizers.

(*) Applications of FHSS :-

(1) FHSS is used in wireless local area Networks (WLAN) standard for wifi.

(2) FHSS is also used in the wireless personal are Network (WPAN) standard for Bluetooth.

(*) Direct Sequence Spread Spectrum (DSSS) :-

- The Direct sequence Spread spectrum (DSSS) is a spread spectrum modulation technique primarily used to reduce overall signal interference in telecommunication.

- The Dsss modulation makes the transmitted signal wider in bandwidth than the information bandwidth.

- In Dsss, the message bits are modulated by a bit sequencing process known as a spreading sequence.

- This spread-sequence bit is known as a chip. it has a much shorter duration than the original message bits.

② Features of Dsss :-

- in Dsss technique, the data that needs to be transmitted is split into smaller blocks.

- After that, each data block is attached with a high data rate bit sequence & is transmitted from the sender end to the receiver end.

- Data Blocks are recombined again to generate the original data at the receiver's end, which was sent by the sender with the help of data rate bit sequence.

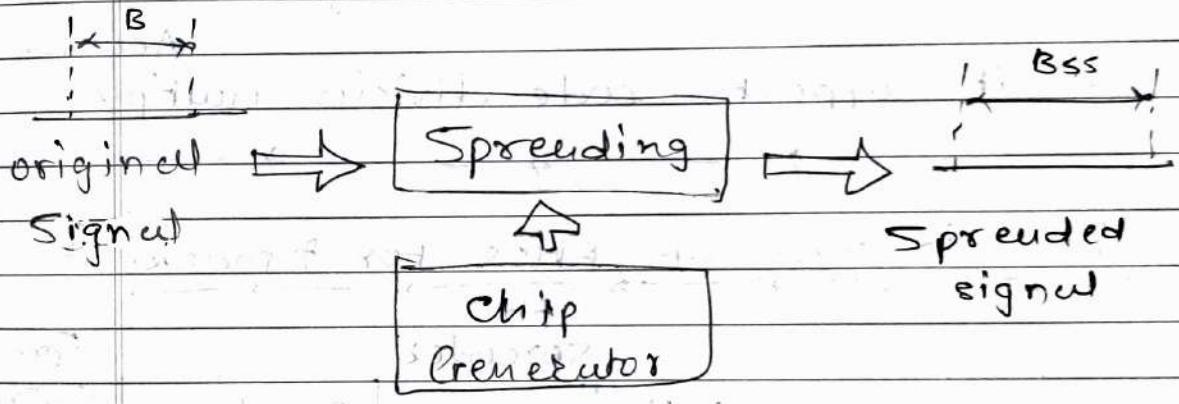
- if somehow data is lost, then data blocks can also be recovered with those

data rate bits.

- The main advantage of spliting the data into smaller blocks is that it reduces the noise & unintentional inter inference.

⊛ Dsss can also be classified into two types :-

(1) Wide Band spread spectrum
(2) Narrow Band spread spectrum.



⊛ Dsss ⊛

⊛ Advantages of Dsss :-

(1) Dsss Performance is Better than FHss.

(2) Dsss signals are challenging to detect.

(3) it provides the best discrimination against multipath signals.

⊛ Disadvantages of Dsss :-

(1) take large acquisition time.

(2) it requires wide-band channels with small phase distortion.

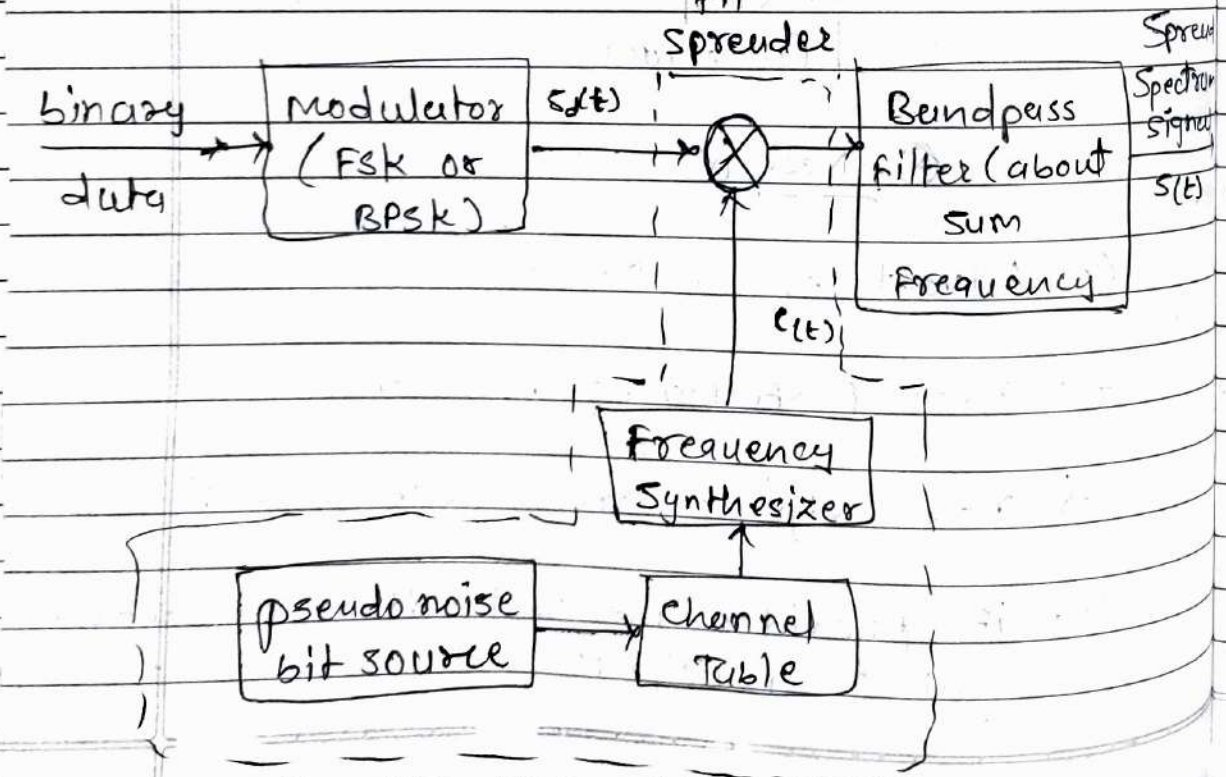
⊛ Applications of Dsss :-

(1) Dsss is used in LAN technology.

(2) Dsss is also used in satellite communication technology.

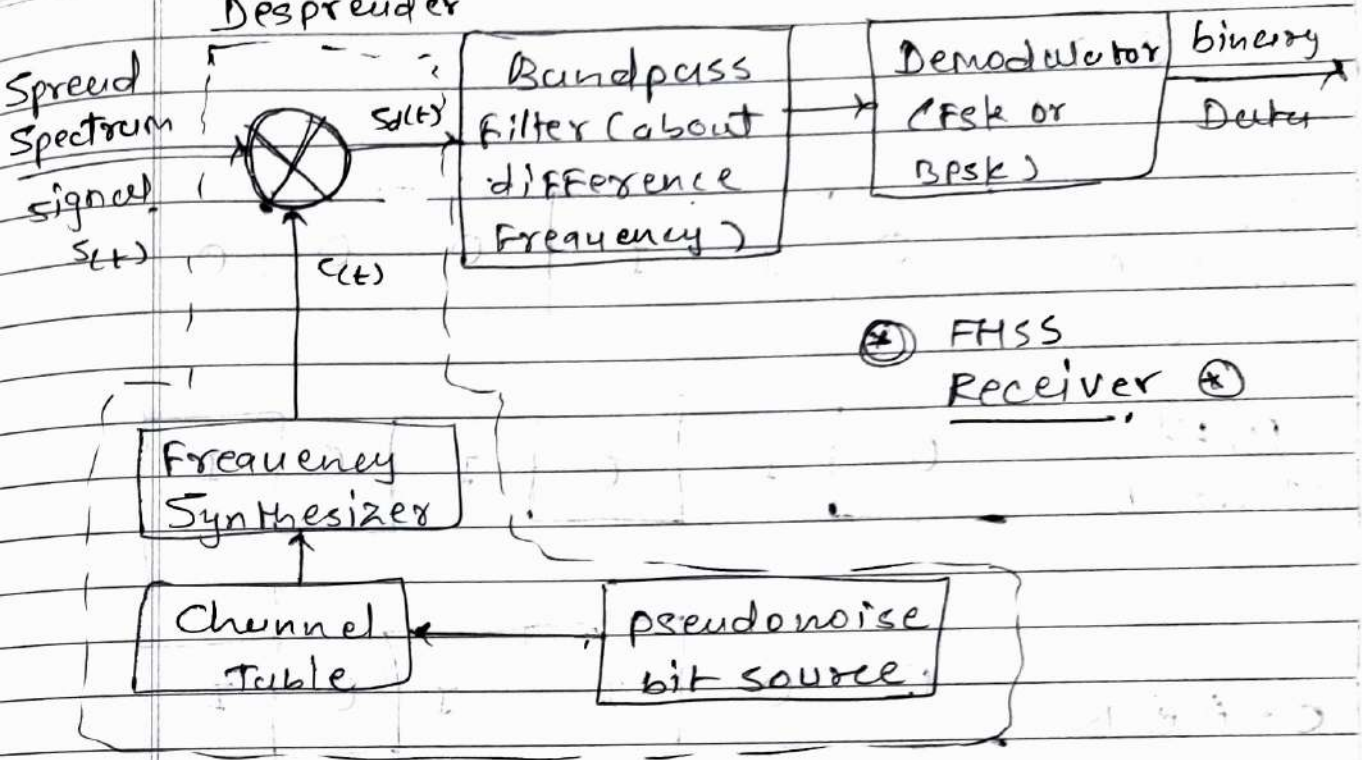
(3) it supports code division multiple Access.

⊛ main Diagram of FHSS for 7 marks :-



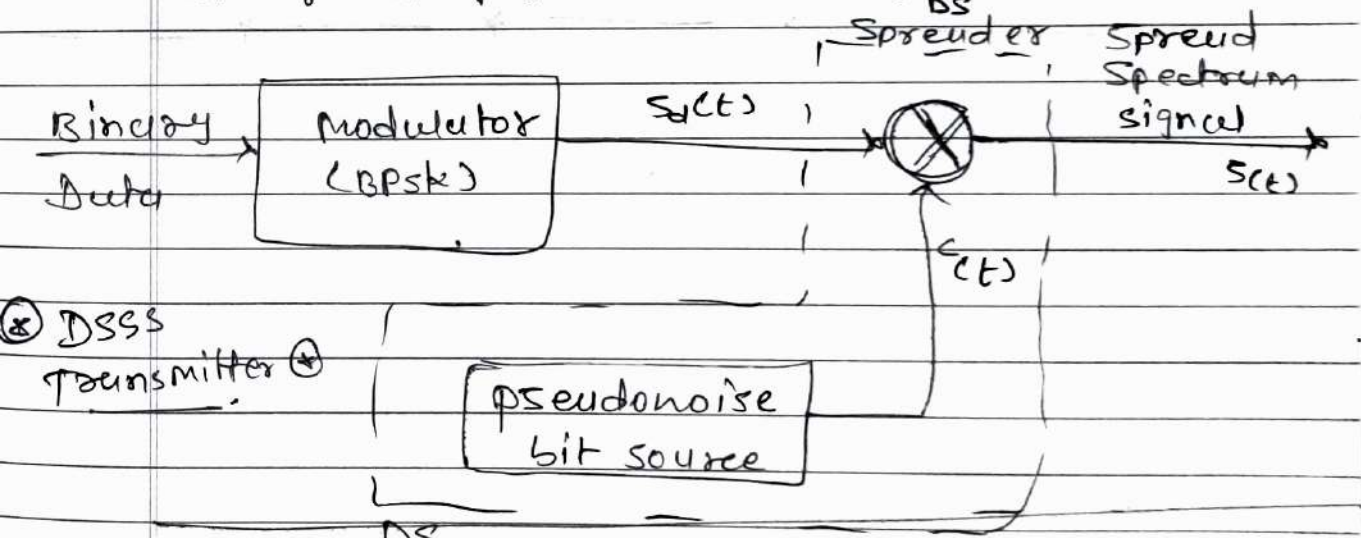
⊛ FHSS Transmitter ⊛

FH Despreader

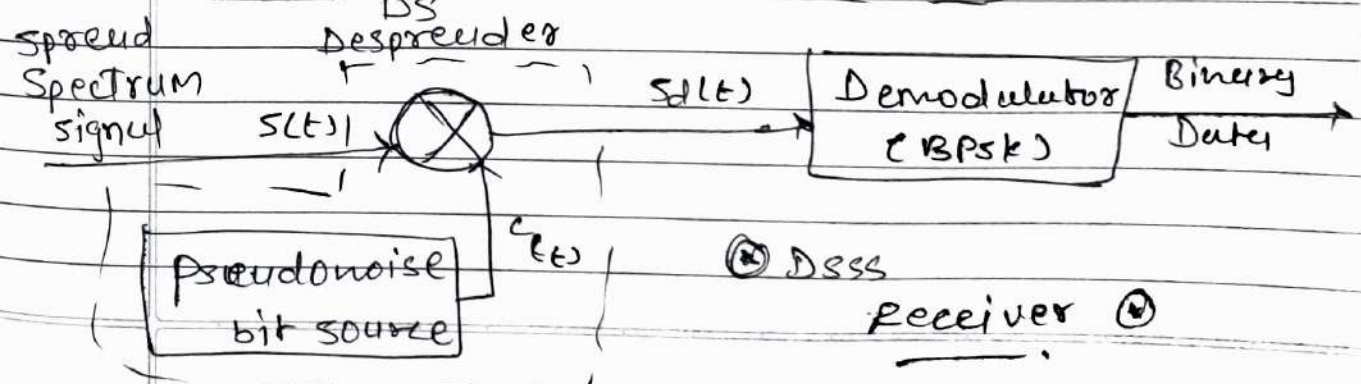


FHSS Receiver

Main Diagram of DSSS for 7 marks :-

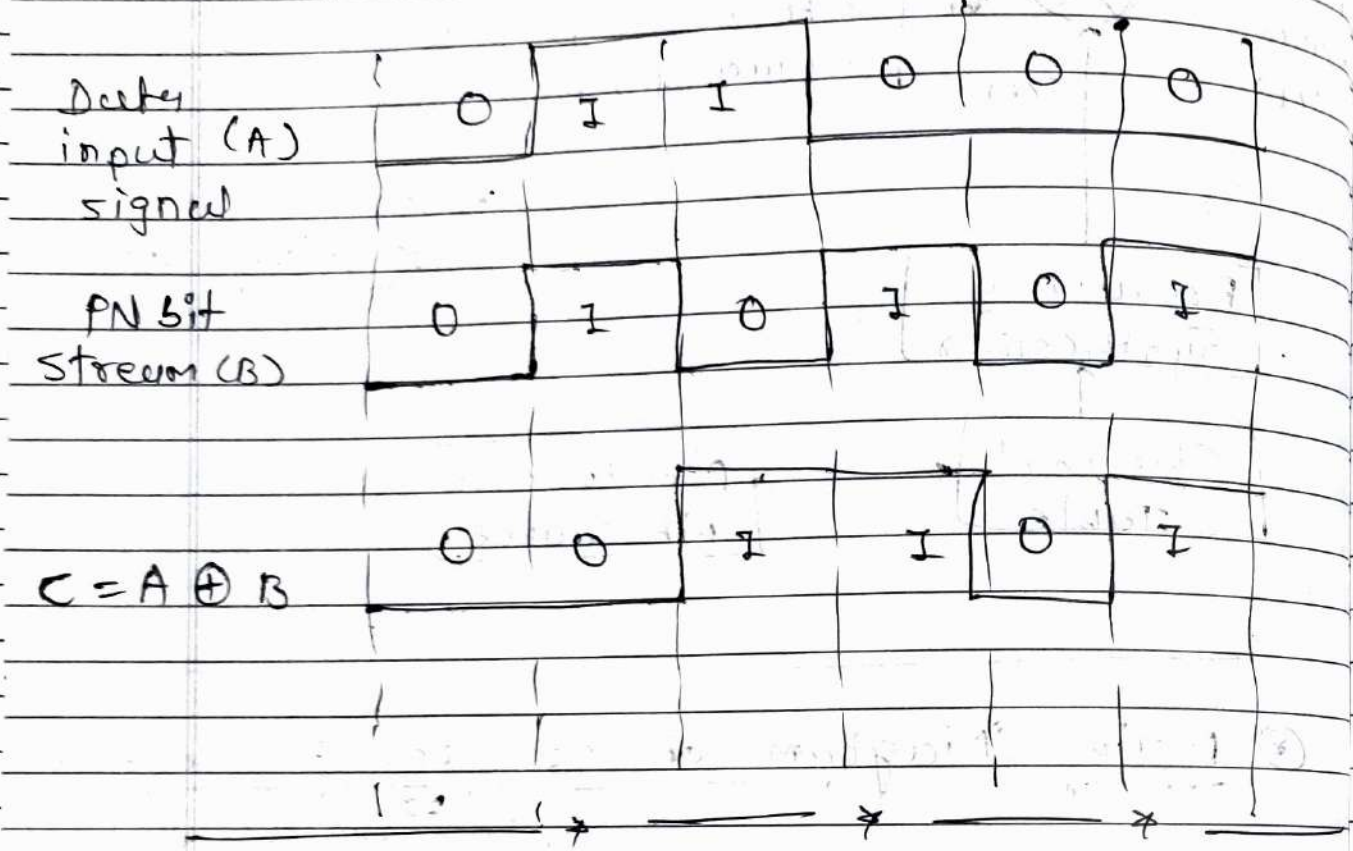


DSSS Transmitter



DSSS Receiver

⑧ Dsss



Page No.
Date

⊛ chapter: ③④

Q. ① GSM Addresses & Identifiers with example.

- GSM treats the users & the equipment in different ways.
- phone Numbers, Subscribers, & equipment identifiers are some of the known ones.
- there are many other identifiers that have been well-defined, which are required for the subscribers mobility management & for addressing the remaining network elements.
- Vital Addresses & identifiers that are used in GSM are addressed below:

(1) International Mobile Station Equipment Identity (IMEI)
(2) International Mobile Subscriber Identify (IMSI)
(3) Mobile Subscriber ISDN Number (MSISDN)
(4) Mobile Station Roaming Number (MSRN)
(5) location Area Identity (LAI)
(6) Temporary Mobile Subscriber Identity (TMSI)
(7) local mobile Subscriber Identity (LMSI)
(8) Cell Identifier (CI)

(1) International Mobile Station Equipment Identity (IMEI):-

- The International Mobile Station Equipment Identity (IMEI) looks more like a serial Number which distinctively identifiers a mobile station internationally.

- This is allocated by the equipment manufacturer and registered by the network operator who stores it in the equipment Identity Register (EIR).

- By means of IMEI, one recognizes obsolete, stolen, or non-functional equipment.

(*) Following are the parts of IMEI-

(1) Type Approval Code (TAC) - 6 decimal places, centrally assigned.

(2) Final Assembly Code (FAC) - 6 decimal places, to assigned by the manufacturer

(3) Serial Number (SNR) - 6 decimal places, assigned by the Manufacturer.

(4) Spare (SP) - 1 decimal place.

- thus, IEMI = TAC + FAC + SNR + SP.

- It uniquely characterizes a mobile station and gives clues about the manufacturer and the date of manufacturing.

(2) International Mobile Subscriber Identity (IMSI) :-

- Every registered user has an original International Mobile Subscriber Identity (IMSI) with a valid IMEI stored in their Subscriber Identity Module (SIM).

(*) Following are the parts of (IMSI):-

(1) Mobile Country code (MCC) - 3 decimal places, Internationally Standardized.

(2) Mobile Network code (MNC) - 2 decimal, for unique identification of mobile network within the country.

(3) Mobile Subscriber Identification Number (MSIN) -

- Maximum 10 decimal places, identification number of the subscriber in the home mobile Network.

(MSISDN)

(3) Mobile Subscriber ISDN Number :-

- The authentic telephone Number of a mobile station is the Mobile Subscriber ISDN Number (MSISDN).

- Based on the SIM, a Mobile station can have many MSISDNs, as each subscriber is assigned with a seperate MSISDN to their SIM respectively.

- Listed below is the structure followed by MSISDN categories, as they are defined based on International ISDN number plan-

(1) Country code (cc) - upto 3 decimal places.

(2) National Destination code (NDC) - Typically 2-3 decimal places.

(3) Subscriber Number (SN) - maximum to Decimal places.

(MSRN)

(4) Mobile Station Roaming Number :-

- Mobile Station Roaming Number (MSRN) is an interim location dependent ISDN number, assigned to a mobile station by a regionally responsible visitor location Register (VLR).

- Using MSRN, the incoming calls are channelled to the MS.

- The MSRN has the same structure as the MSISDN.

(1) Country code (cc) - of the visited Network.

(2) National Destination Code (NDC) - of the visited network.

(3) Subscriber Number (SN) - in the current Mobile Network.

(5) Location Area Identity (LAI) :-

- Within a PLMN, a location Area Identifies its own authentic location Area Identity (LAI).

- The LAI hierarchy is based on international standard and structured in a unique Format as mentioned below -

(1) country code (cc) - 3 decimal places.

(3) Mobile Network code (MNC) - 2 decimal places.

(3) Location Area Code (LAC) - Maximum 5 decimal places or maximum twice 8

bits coded in hexadecimal (1AE 2 FFFF).

(6) Temporary Mobile Subscriber Identity (TMSI) :-

- Temporary Mobile Subscriber Identity (TMSI) can be assigned by the VLR, which is responsible for the current location of a subscriber.

- The TMSI needs to have only local significance in the area handled by the VLR.

- This is stored on the network side only in the VLR & is not passed to the Home location Register (HLR).

- Together with the current location area, the TMSI identifies a subscriber uniquely. It can ~~obta~~ contain up to 4 x 8 bits.

(7) Local Mobile Subscriber Identity (LMSI) :-

- Each mobile station can be assigned with a local Mobile Subscriber Identity (LMSI), which is an original key, by the VLR.

- this key can be used as the auxiliary searching key for each mobile station within its region.

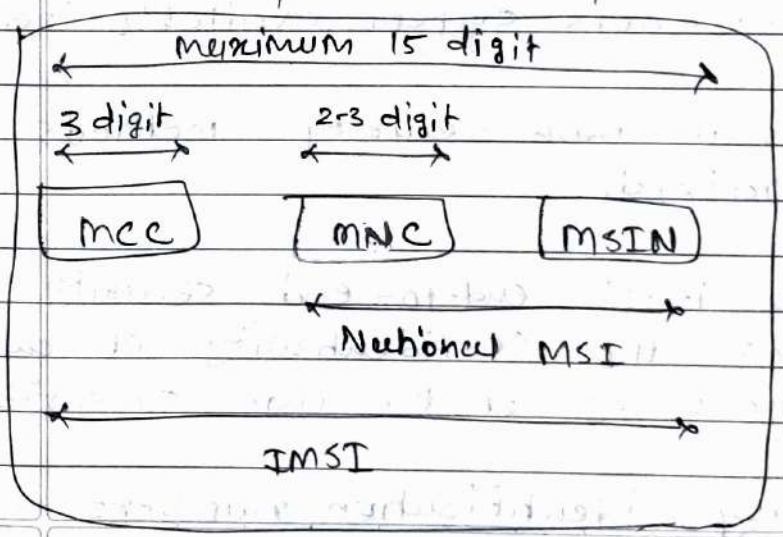
- it can also help accelerate the database access. An LMSI is assigned if the mobile station is registered with the VLR and sent to the mobile HLR.

- LMSI comprises of four octets (4*8 bits).

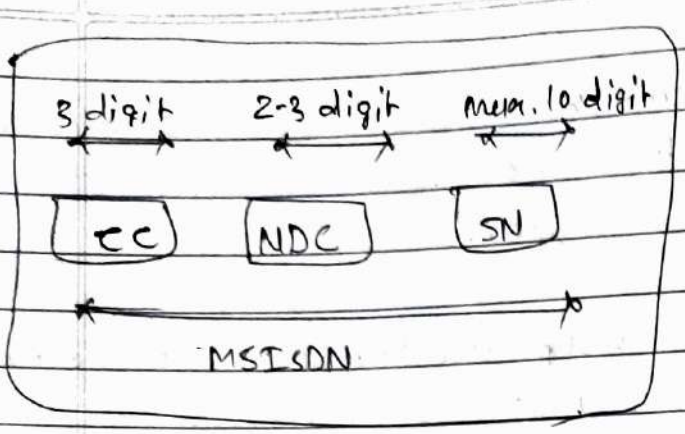
(8) Cell Identifier (CI) :-

- Using a cell Identifier (CI) (maximum 2 x 8) bits, the individual cells that are within an LA can be recognized.

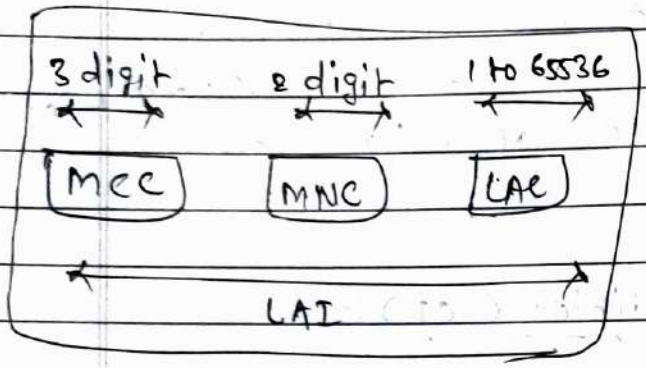
- When the Global cell Identity (LAI + CI) cells are combined, then it is uniquely defined.



→ Diagram for IMSI.



→ Diagram for MSISDN



→ Diagram for LAI.

② GSM Security & Authentication.

(*) Security :-

- GSM is the most secured cellular telecommunications system available today.
- GSM Has its own security methods standardized.
- GSM maintains end-to-end security by retaining the confidentiality of calls & anonymity of the GSM subscriber.
- Temporary identification numbers are assigned to the subscriber's number

to maintain the privacy of the user.

- the privacy of the communication is maintained by applying encryption algorithms & frequency hopping that can be enabled using digital systems & signalling.

- the Authentication centre is responsible for all security aspects & its function is closely linked with HLR.

⊛ Authentication :-

- GSM Handset contains ciphering Algorithm

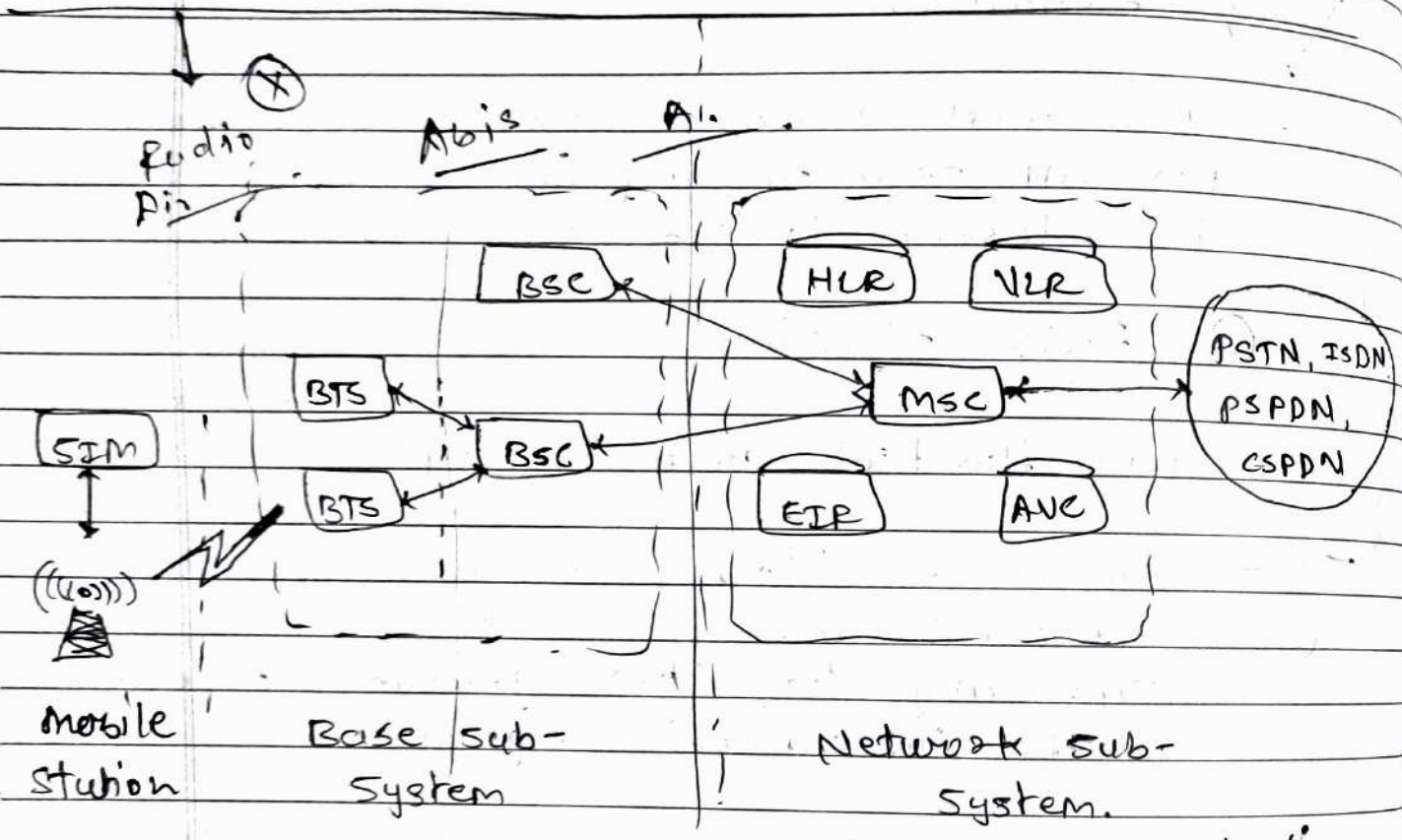
- Subscriber identity module (SIM) contains authentication key Ki (64-bit), ciphering key (Kc) generating Algorithm, and Authentication Algorithm.

* the GSM Networks Authenticates the identity of the Subscriber through the use of a challenge-response mechanism.

- A 128-bit Random Number (RAND) is sent to the MS. the MS computes the 32-bit signed Response (SRES) based on the encryption of RAND with the Authentication algorithm (A3) using the individual subscriber authentication key (Ki).

Q. ③ GSM Call Routing.

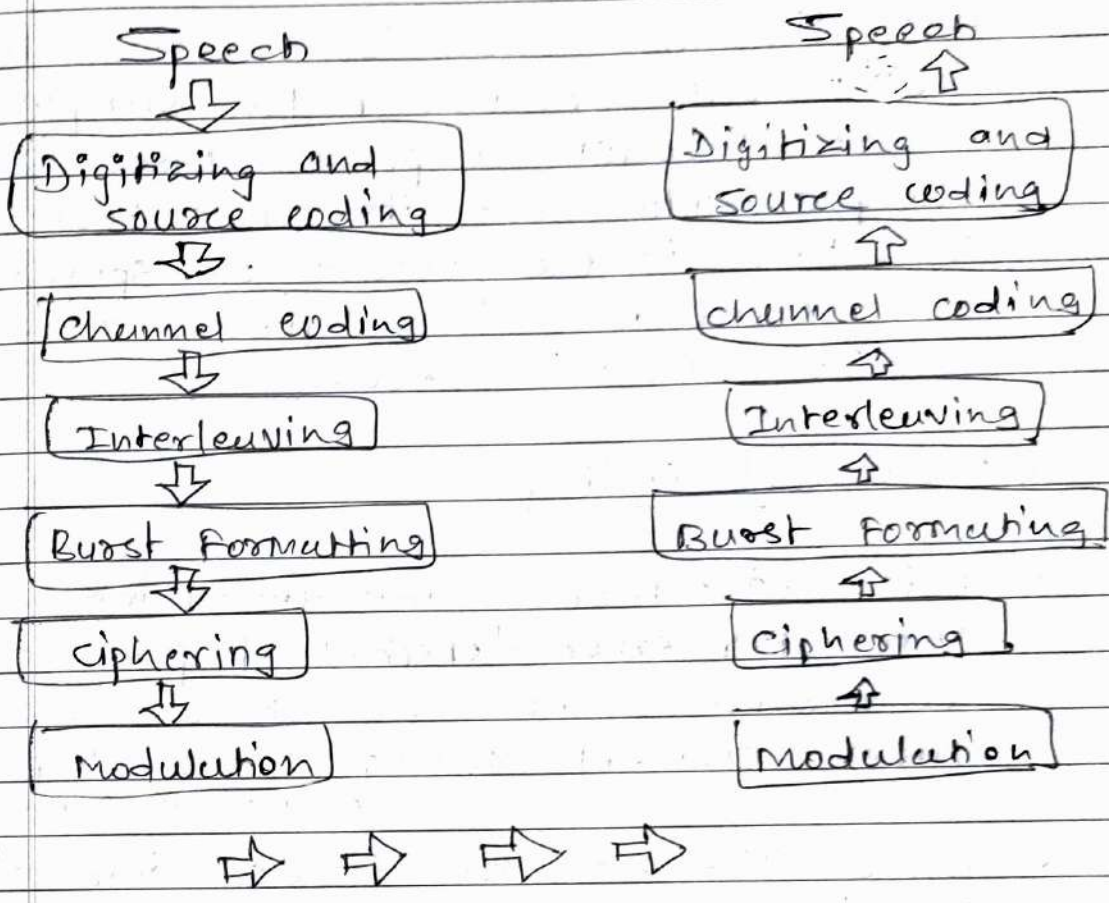
- Human interface is analog. However the advancement in digital technology makes it very convinient to handle information in digital way.



- GSM is the most widely used mobile communication system world wide.

↓

Just Explain GSM or How GSM Network That's it. Works.



(x) Call routing in GSM (x)
from speech to radio waves.

(1) Digitizing and source Coding :-

- The user speech is digitized at 8 kHz sampling rate using regular pulse excited- linear predictive coder (RPE- LPC) with a long term predictor loop where information from previous samples is used to predict the current sample.

- Each sample is then represented in signed 13-bit linear PCM value.

- This digitized data is passed to the coder with frames of 160 samples where encoder compress these 160 samples into 260 bits GSM frames resulting in one second of speech compressed into 1625 bytes & achieving a rate of 13 kbits/sec.

(2) Channel coding :-

- This introduces redundancy into the data for error detection & possible error correction where the gross bit rate after channel coding is 22.8 kbps, (or 456 bits every 20ms)
- These 456 bits are divided into eight 57-bit blocks and the result is interleaved amongst eight successive time slot bursts for protection against burst transmission errors.

(3) Interleaving :-

- This step rearranges a group of bits in a particular way to improve the performance of the error-correction mechanism.
- The interleaving decreases the possibility of losing whole bursts during the transmission by dispersing the errors

(4) Ciphering :-

- This encrypts blocks of user data using a symmetric key shared by the mobile station & the BTS.

(5) Burst Formatting :-

- it adds some binary information to the ciphered block for use in synchronization & equilization of the received data.

(6) Modulation :-

- the modulation technique chosen for the GSM system is the Gaussian Minimum shifting keying (GMSK) where binary data is converted back into analog signal to fit the frequency & time requirements for the multiple Access rules.

- the signal is then radicted as radio wave over the air.

(7) Multipath & equalization :-

- An equalizer is in charge of extracting the 'right' signal from the received signal while estimating the channel impulse response of the GSM system & then it constructs an inverse filter.

- The received signal is then passed through ~~time~~ the inverse filter.

(8) Synchronization :-

- For successful operation of a mobile radio system, time & frequency synchronization are needed.

- Frequency synchronization is necessary so that the transmitter and receiver frequency match (in FDMA) while Time synchronization is necessary to identify the frame boundary and the bits within the frame (in TDMA).

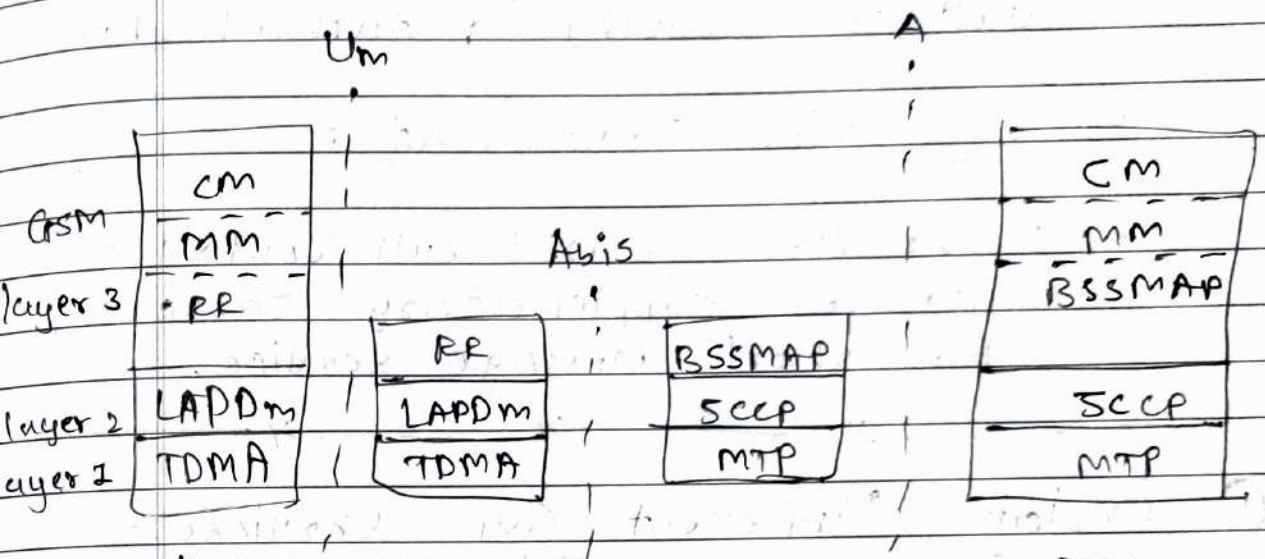
- To avoid collisions of burst transmitted by MS with the adjacent timeslot such collisions, the timing Advance technique is used where frame is advanced in time so that offsets the delay due to greater distance.

Q. (4) Signaling Protocol Structure in GSM.

- Layer 1 is the physical layer which uses the channel structures over the air interface.

- Layer 2 is the data link layer & across the Um interface, the data link layer is a modified version of the LAPD

protocol used in ISDN or X.25, called LAPDm.



⊛ signaling protocol structure in GSM ⊛

- Across the A interface, the message transfer part layer 2 of signaling system number 7 is used.

- layer 3 of the GSM signaling protocol is itself divided into three sub-layers:

(1) Radio Resource Management :-

- it controls the setup, maintenance & termination of radio & fixed channels, including handovers.

(2) Mobility Management :-

- it manages the location updating and registration procedures as well as security & Authentication.

(3) Connection Management :-

- it handles general call control & manages supplementary services & the short message service.

---

(5) Explain Different GSM Services :-

- There are three type of services offered through GSM which are:

(1) Telephony (tele services) services
(2) Data (Bearer services) Services
(3) Supplementary services.

---

(1) Telephony / Tele Services :-

- A teleservices utilizes the capabilities of a Bearer service to transport data, deining which capabilities are required & how they should setup

(1) Video calls : the most basic teleservice supported to GSM is telephony

- This includes full rate speech at

13 kbps and emergency calls, where the nearest emergency service provider is notified by dialing three digits.

(2) Videotext and Facsimile :-

- Another group of teleservices includes videotext access, teletext transmission, and Facsimile alternate speech & Facsimile Group 3, automatic Facsimile Group 3, etc.

(3) Short Text Message :-

- SMS service is a text messaging which allow you to send and receive text message on your GSM mobile phones.

---

(2) Bearer / Data services :-

- Using your GSM phone to receive and send data is the essential building block ~~to~~ leading to widespread mobile internet access & Mobile & Mobile data transfer.

- GSM currently has a data transfer rate of 9.6 k.

- New development that will push up data transfer rated for GSM users HSCSD

are Now Available.

(3) Supplementary Services :-

- Supplementary services are provided on top of teleservices or bearer services, and include feature such as caller identification, call forwarding, call waiting, multi-party conversation.

(1) multiparty Service / conferencing :-

- This service allows a mobile subscriber to be notified of an incoming call during a conversation.

- The subscriber can answer, reject or ignore the incoming call.

- call waiting is applicable to all GSM telecommunication services using circuit switched connection.

(2) call Hold :-

- This service allows a Mobile Subscriber to put an incoming call on hold and then resume this call.

- The call hold service is only applicable to normal telephony.

(3) Call Forwarding :-

- The call forwarding supplementary service is used to divert calls from the original recipient to another number, and is normally set up by the subscriber him self.

(4) Call Barring :-

- The concept of barring certain type of calls might seem to be a supplementary disservice rather than service.

- However, there are times when the subscriber is not the actual user of the mobile station, & as a consequence may wish to limit its functionality, so as to limit charges incurred.

Q.6 (2) Terminologies :- Continued

(9) Foreign agent COA; the COA could be located at the FA. i.e, the COA is an ip address of FA.

- The FA is the tunnel end-point & forwards packets to the MN.

(10) Co-located COA, the COA is co-located if the MN temporarily acquired an additional ip address which acts as COA.

(*) Working :- continued.

- Tunneling establisheds a virtual ~~type~~ pipe for the packets available between a tunnel entry & an endpoint.

- it is the process of sending a packet via tunnel and it is achieved by a mechanism called encapsulation.

- Now, Home Agent encapsulates the data packets into new packets in which the source Address is the Home address and destination is the care-of-address & sends it through the tunnel to the Foreign Agent.

- Foreign Agent, on another side of the tunnel, receiveds the data packets decapsulates them & sends them to the mobile node.

- the mobile node in response to the data packets received sends a reply in response to the Foreign

agent. the Foreign agent directly sends the reply to the correspondent node

Q.④ ⑤ Explain Discovery, Tunneling & Regestration process in Mobile ip:-

(1) Agent Discovery :-

- Agents advertise thier presence by periodically broadcasting thier agent advertisement messages.

- The mobile node receiving the agent advertisement messages observes whether the message is from its own home agent and determines whether it is in the home network or foreign network.

(2) Agent Regestration :-

- Mobile node after discovering the foreign agent sends registration request (RREQ) to the [foreign] agent.

- The foreign agent, in turn, sends the regestration request to the home agent with the care-of-address.

- The Home agent sends a registration by (RREP) to the foreign agent. Then it forwards the registration reply to the mobile node & complete the process of registration.

(3) Tunneling :-

- it establishes virtual pipe for the packets available between a tunnel entry and an endpoint.

- it is the process of sending a packet via a tunnel and it is achieved by a mechanism called encapsulation.

- it takes place to forward an ip datagram from the home agent to the care-of-address.

- whenever the home agent receives a packet from the correspondent node, it encapsulates the packet with source address as home address and destination as care-of-address.

---

(8) Components of MSC :-

- MSC stands for Mobile switching center.

- Components of MSC are:

(1) VLR
(2) HLR
(3) AUC
(4) EIR
(5) PSTN

(1) VLR (Visitor Location Register):-

- VLR stands for Visitor Location Register.

- VLR is a database which contains the exact location of all Mobile subscribers currently present in the service area of MSC.

- if you are going from one state to another state then your entry is marked into the database of VLR.

(2) HLR (Home Location Register):-

- HLR stands for Home Location Register.

- HLR is a database containing pertinent data regarding subscribers authorized to use a GSM Network.

- if you purchase SIM card from in the HLR. HLR is like a home which contains all data like your ID proof, which plan you are taking, which caller tune you are using, etc.

(3) AUC (Authentication Center):-

- AUC stands for Authentication Center.

- AUC authenticates the mobile subscriber that wants to connect in the network.

---

(4) EIR (Equipment Identity Register) :-

- EIR stands for Equipment Identity Register.

- EIR is a database that keeps the record of all allowed or banned in the network.

- if you are banned in the network then you can't enter the network, and you can't make the calls.

---

(5) PSTN (Public Switched Telephone Network):-

- PSTN stands for public Switched Telephone Network.

- PSTN connects with Msc. PSTN originally a Network of fixed line analog telephone systems.

- Now almost entirely digital in its core Network and includes mobile & other networks as well as fixed telephones.

- the earlier landline phones which places at our home is nothing but PSTN.

⑫ Chapter : ⑤ :

Q. ① Bluetooth Security & Applications.

(1) Security :-

- Offers security infrastructure starting from authentication, key exchange to encryption.

- Uses the publicly available cipher algorithm known as SAFER + to authenticate a device's identity.

- Bluetooth security includes authorisation, authentication & optional encryption.

  - Authentication is the proving of identity of one Bluetooth-enabled device to another.

  - Authorisation is the granting or denying of Bluetooth connection access to resources or services from the requesting device.

  - Encryption is the translating ~~the~~ of data into secret code so that eavesdroppers cannot read its content.

(2) Application :-

(1) Each application model in Bluetooth realized through a profile.

- profiles define the protocols & protocol features supporting a particular usage model.

- Some common profiles are:

  - File Transfer
  - Internet Bridge
  - LAN Access
  - Synchronization
  - Headset

(1) File Transfer :-

- refers to object transfer or transfer of files between devices.

(2) Internet Bridge :-

- in this model, a cordless modem acts as a modem to a pc & provides dial-up networking & ~~faxing~~ faxing facilities.

(3) LAN Access :-

- multiple data terminals use a LAN access point (LAP) as a wireless connection

to an Ethernet LAN.

(4) Synchronization :-

- the synchronisation model enables a device-to-device synchronization of data.

(5) Headset :-

- it is wirelessly connected & can act as an audio input-output interface to remote devices.

Q.② Explain Power saving states of Bluetooth.

- the Bluetooth low Energy (BLE) guideline was released in 2010.

- Bluetooth Radio can set up to 30 mA when receiving, it is important that it be used as little as possible to save Battery power.

- Bluetooth low Energy (BLE) is embedded in smartphones, laptops, medical devices, sensors, & other applications that benefit from the technology's key differentiators :

- Lower power consumption
- Reduced Memory Requirements
- Efficient Discovery
- Connection Procedures
- Short Packet lengths
- Simple Protocols & Services

Q.③ Modes / States of Bluetooth :-

- The state of any given Bluetooth unit can broadly be categorized as standby or connection.

- A device in standby state is not active in any network.

- A Bluetooth-enabled device in the connection state is synchronized to a Piconet.

- Such a device can be in a one of the following four modes:

(1) Active Mode
(2) Sniff Mode
(3) Hold Mode
(4) Park Mode

(1) Active Mode :-

- When in Active mode, a Bluetooth device actively participates in the piconet by sending & packet members, each active slave in a piconet is given a distinct 3-bit AM_ADDR (Active Member Address).

(2) Sniff Mode :-

- The Sniff mode on devices has the highest duty cycle of the three power-saving modes or the least power efficiency.

- By lowering the duty cycle, or increasing the listening interval, power efficiency is attained.

(3) Hold Mode :-

- The power efficiency of devices in Hold mode is in the middle of the three power-saving modes.

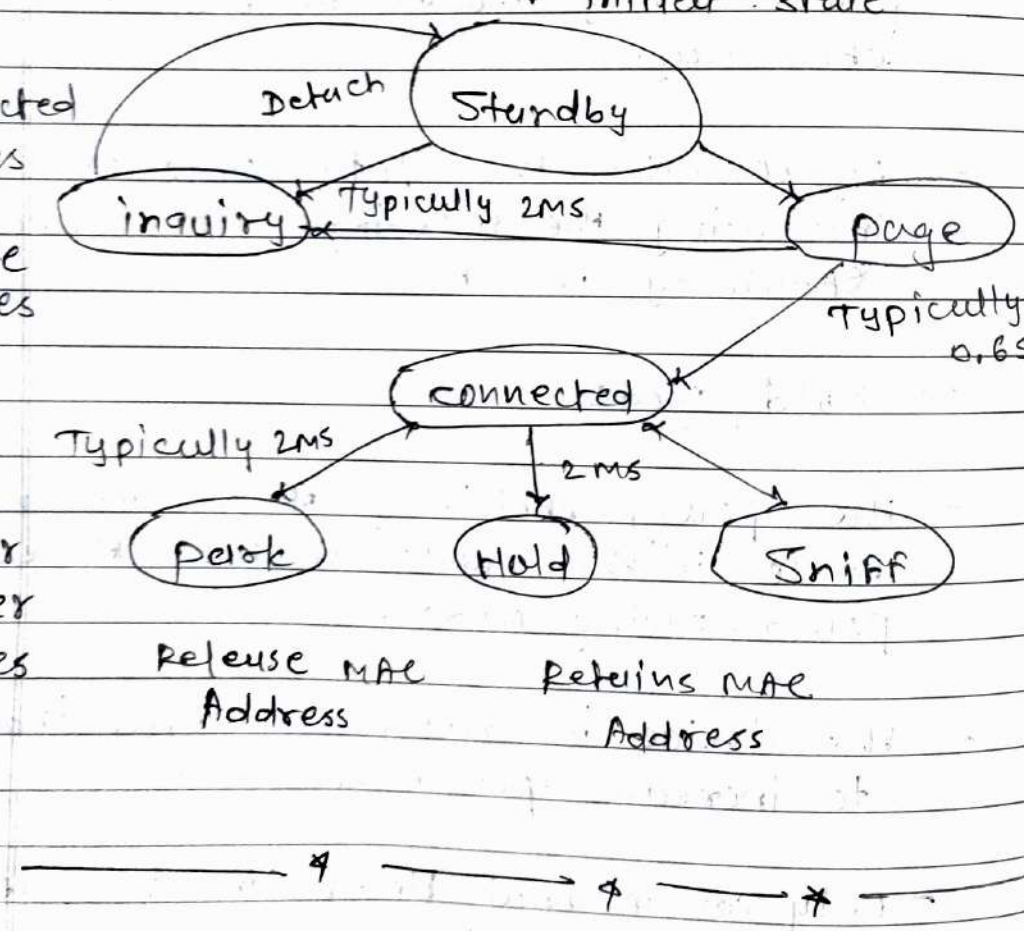
- The device is briefly rendered inactive to increase power efficiency.

- Only an internal timer in the device is operational during a hold.

(4) Park Mode :-

- When a slave decides to remain inactive in the piconet for a period of time that is comparatively longer than the sniff & Hold periods, it enters Park mode.

- in Park mode device maintains its synchronization in the piconet while remaining uninvolved in the traffic.



(*) Unknown Questions (*)

Q.① Digital Modulation Techniques

OR

Explain Ask, Psk and Fsk.

- Digital Modulation provides more information capacity, high data security, quicker system, availability with great quality communication.

- Hence, Digital modulation techniques have a great demand, for their capacity to convey larger amounts of data than analog ones.

(*) Types of Digital Modulation Techniques :-

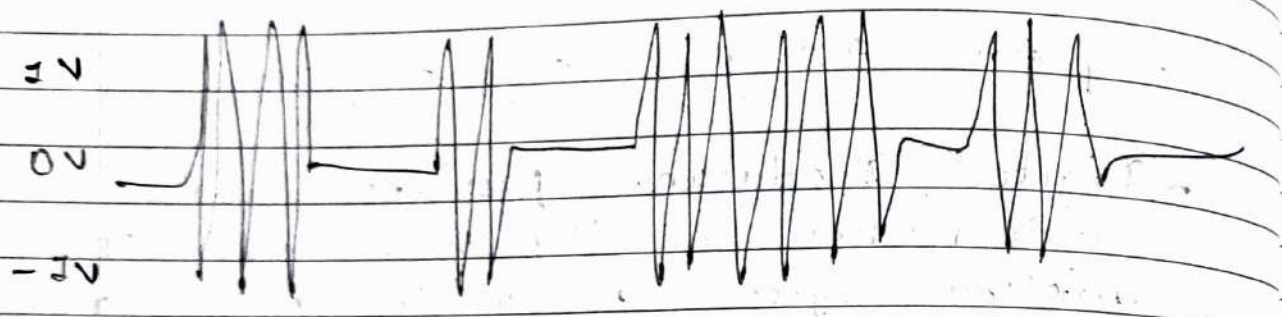
(1) Amplitude shift keying (Ask)
(2) Freaueney shift keying (Fsk)
(3) phase shift keying (Psk)

---

(1) Amplitude shift keying (Ask) :-

- Ask is a type of Amplitude Modulation which Represents the binary data in the form of Variations in the amplitude of a signal.

① Input binary sequence ④



③ Ask modulated output wave ②

- Any modulated signal has a high freqeuncy carrier.

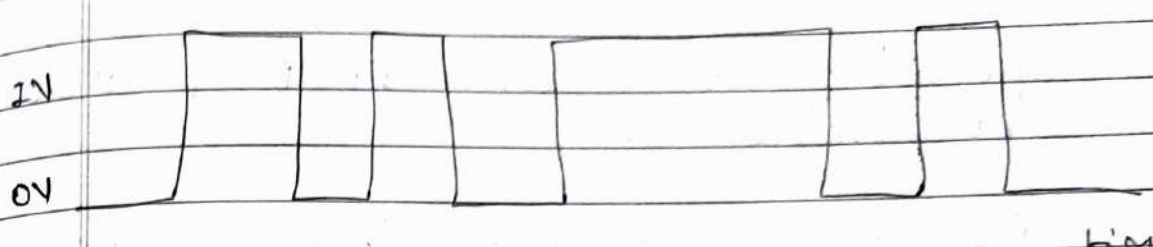
- The binary signal Ask is modulated, gives a zero value for LOW input and gives the carrier output for HIGH input.

---

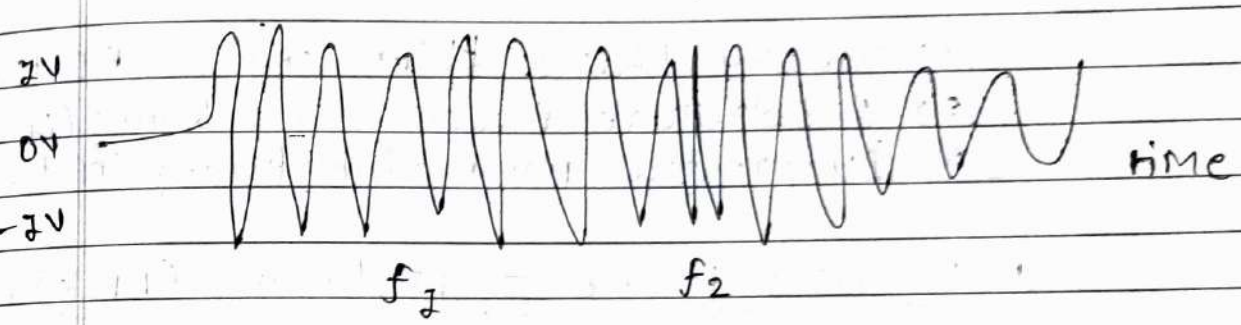
(2) Frequency shift keying (FSK) :-

- FSK is the digital modulation technique in which the frequency of the carrier signal varies according to the discrete digit changes.

- FSK is a scheme of frequency modulation.



Input binary sequence



FSK Modulated output wave

- The output of a FSK modulated wave is high in frequency for a binary HIGH input and is low in frequency for a binary LOW input.

- The binary 1s and 0s are called Mark and Space frequensies.

---

(3) Phase Shift keying (PSK) :-

- PSK is the digital modulation technique in which the phase of the carrier signal is changed by varying the sine and cosine inputs at a particular time.

- PSK technique is widely used for wireless LANs, bio-metric, contact-less

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Date

Operations, along with RFID & Bluetooth communications.

- PSK is of two types, depending upon the phases the signal gets shifted.

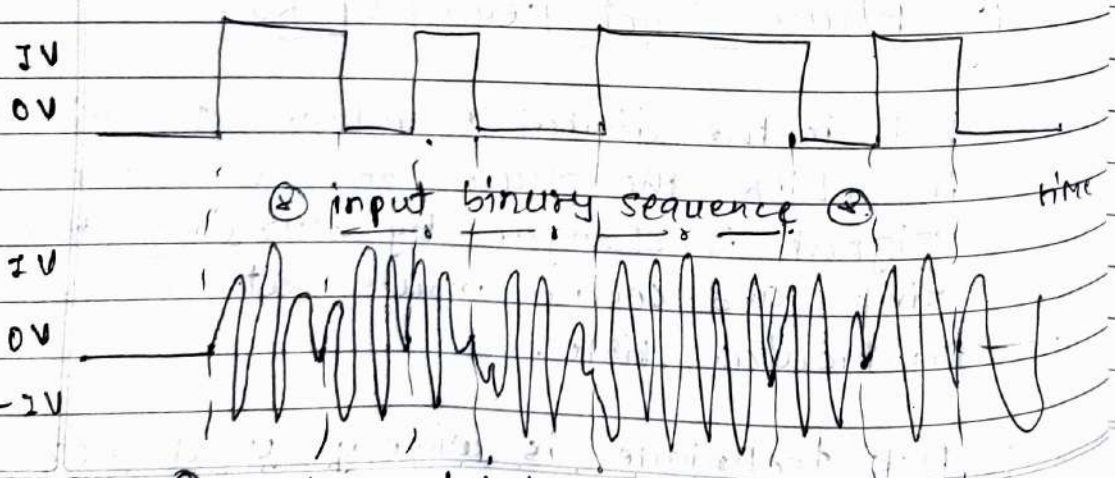
(1) Binary phase shift keying (BPSK)
(2) Quadrature phase shift keying (QPSK)
(3) Differential phase shift keying (DPSK)

(1) Binary Phase Shift Keying (BPSK):-

- This is also called as 2-phase PSK or phase Reversal keying.

- in this technique, the sine wave carrier takes two phase reversals such as 0° and 180°.

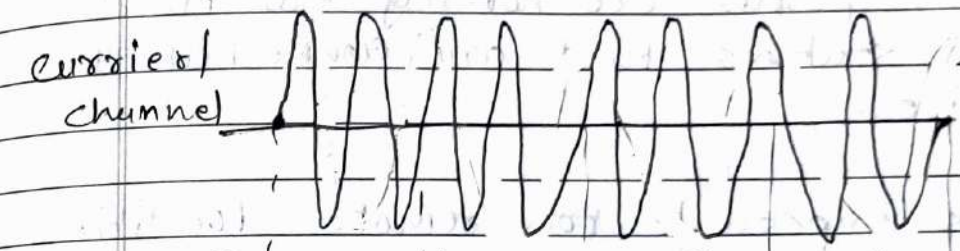
- BPSK is basically a DSB-SC (Double Sideband Suppressed carrier) modulation scheme, for message being the digital information.



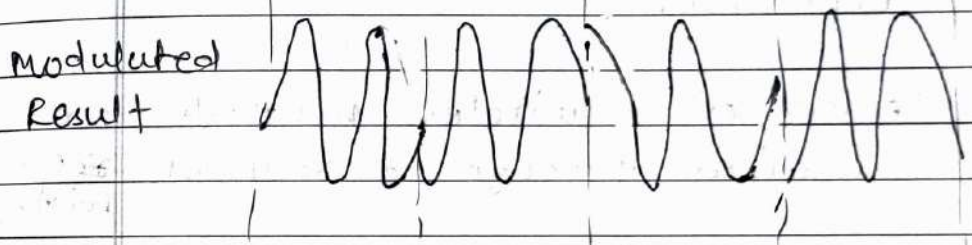
BPSK modulated output wave

(2) Quadrature Phase shift keying (QPSK) :-

- This is the phase shift keying technique, in which the sine wave carrier takes four phase reversals such as 0°, 90°, 180° & 270°.



(2) Modulating value from two bits (2)



- QPSK is a variation of BPSK, and it is also a DSB-SC modulation scheme, which sends two bits of digital information at a time, called as bigits.

Q.(2) Differentiate Infrastructure & (ad-hoc) Infrastructure less Network.

(*) Infrastructure Network :-

- Infrastructure Networks are networks with pre-defined infrastructure & it is made from fixed-size of nodes.

- Here network service is are divided through pre-constructed infrastructures.

- in this network Access point is the central controller for each device.

- Access points are nothing but fixed base stations that are connected by wires.

- it is impossible for remote localities to install such a network as it is too expensive.

- All devices on a wireless network are communicated through a router i.e, access point.

- Examples are wireless LAN, satellite networks, etc.

---

(2) Infrastructure-Less Network (Ad-Hoc Networks) :-

- This type of network is a group of independent terminals that communicates with each other by forming a radio Network.

- The links in between wireless networks have less bandwidth as compared to the wired networks.

- in this network, each node is act as a router and network connection is distributed among ~~nodes~~ nodes.

- In ad-hoc network, the formation of networks takes place dynamically with the help of a collaboration of random nodes.

- Ex of I-less Networks are wireless-sensor Networks (WSN), & Mobile Ad hoc Networks (MANETs).

Q.(3) (*) Radio Frequency Technologies (*)

(1) Reflection
(2) Refraction
(3) Diffraction
(4) Scattering

---

(1) Reflection :-

- When a wave hits a smooth object that is larger than the wave itself, depending on the media, the way may bounce in another direction.

- As a wave radiates from an antenna, it broadens and disperses. if portions of the wave are reflected new wave fronts appear from the reflection points.

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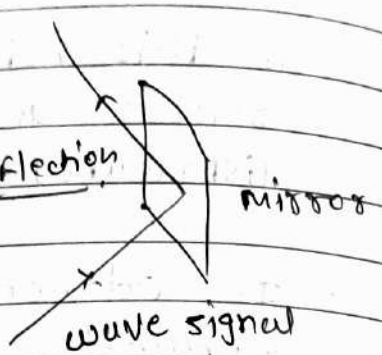
Causes :-

- Buildings
- Roads
- Doors
- Walls



(2) Refraction :-

- Occurs when a RF signal is being bent. This typically can happen as the RF signal passes through a medium with a different density, thus causing the direction of the wave to change.

- A change in refraction can typically appear when dealing with long-distance outdoor ~~bridge~~ bridge links.

- Refraction is measured based on the k-factor. ~~As~~ A k-factor is simply a value to represent the bend that is occuring.

  - k-factor 1 = No bending
  - k-factor < 1 = signal bending away from the earth
  - k-factor > 1 = signal bending toward the earth
  - k-factor 4/3 = signal slightly bending toward the earth.

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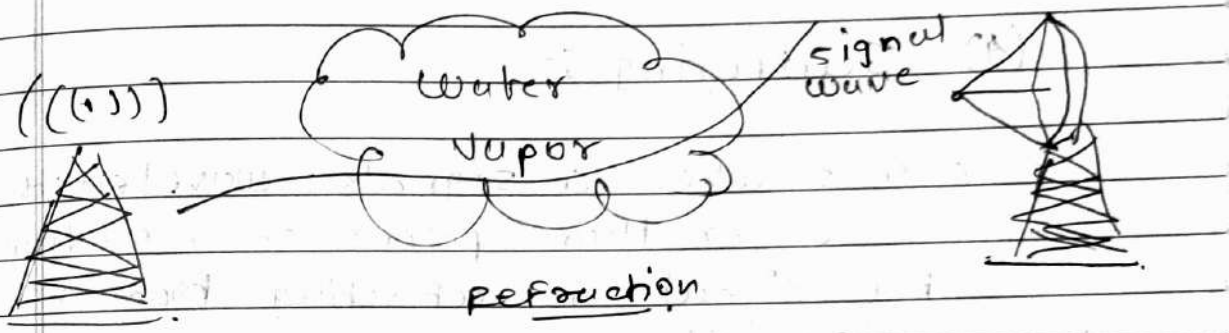
Causes :-

- water vapor
- certain type of glass
- passing through various materials



(3) Diffraction :-

- Diffraction is the bending & spreading around of an RF signal when it encounters an obstruction.
- The waves that encounter the object bend around the object, taking a longer and different path.
- The waves that do not encounter the object do not bend and maintain a shorter and original path.

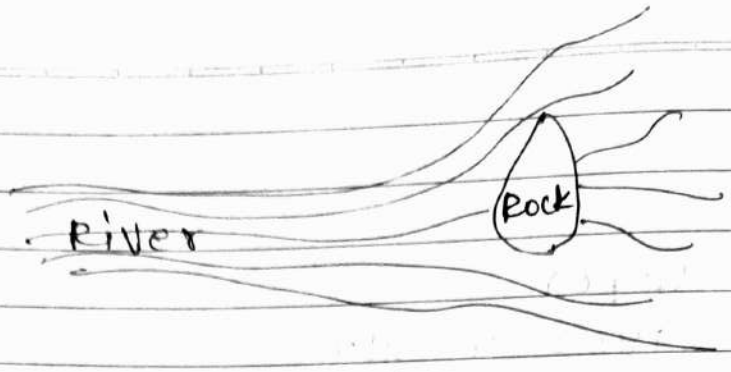
causes :-

- shapes
- size
- Material

↓ obstructing object

- polarization
- phase
- Amplitude.

↓ RF signal.



Diffraction

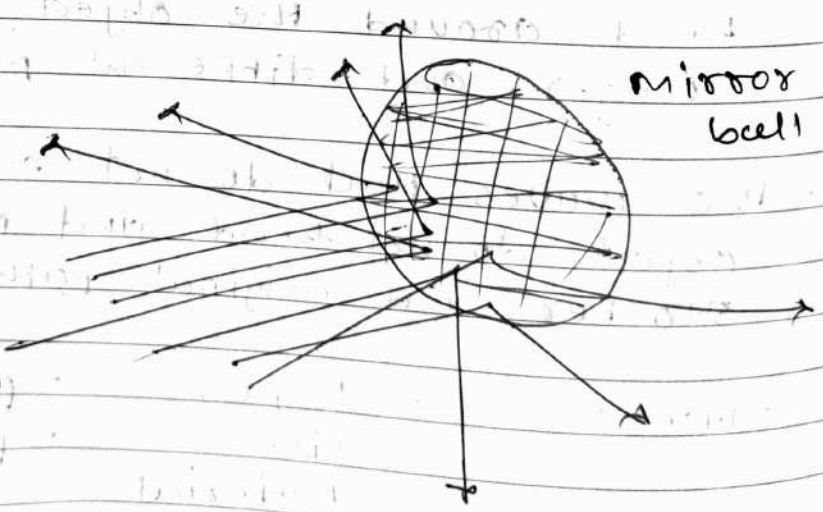
(4) Scattering :-

- occurs when a signals wavelength is larger than pieces of a medium the signal is reflecting from or passing through.

causes :-

- smog
- sandstorms
  ↓
passing substances

- chain link fences
- Rocky terrain
  ↓
Uneven surfaces



Flashlight

Scattering