Q1) Explain various types of Antennas along with their radiation pattern.

→ Types of Antennas :

1) Isotropic Radiation : It is a theoretical concept in which an antenna rediates power uniformly in all directions. It serves as a benchmark for comparing the radiation pattern of real antennas.
While, isotropic antennas don't exist in reality, they are commonly used as refrence. It radiates energy uniformly in all directions from the source point. The radiation pattern looks like a perfect sphere centered around the antenna, indicating equal power distribution in all directions.

2) Simple Dipole = It consist two conductive elements typically metal rods or wries, oriented parallel to each other & perpendicular to the ground. This pattern indicates maximum radiation perpendicular to the antenna elements & minimum radiation along the axis of the elements. The radiation pattern is omnidirectional, meaning it radiates equally in all direections. It is widely used in application such as FM radio broadcasting, television reception & amateur radio.

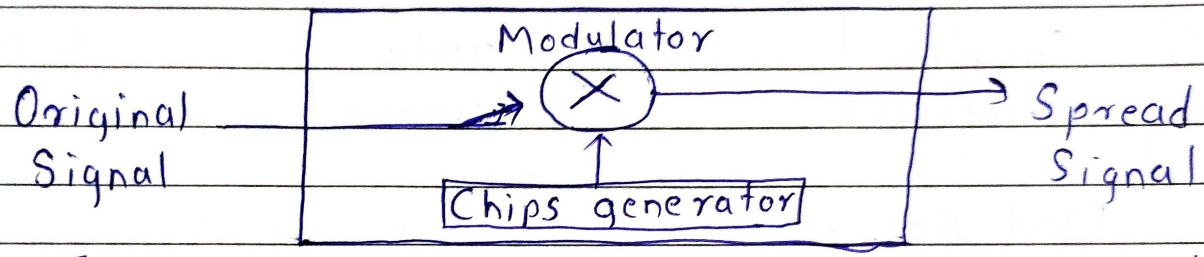
3) Directed Antenna = Directed Antennas, also known as directional antennas, focus their radiation pattern in specific directions, providing enhanced signal strength in those directions. It is used for TV reception & parabolic dish antennas used for satellite communication.

4) Sectorized Antenna = It divides the coverage area into sectors, with each sector served by a separate antenna element or group of elements.
They are frequently used/deployed in wireless communication system, such as cellular networks to effectively provide coverage over specific areas.

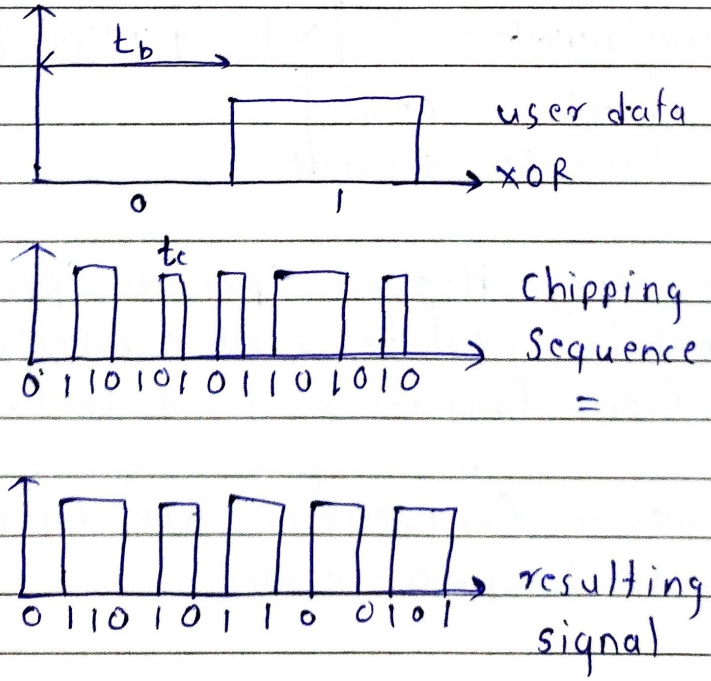
5) Diversity Antenna = Diversity Antenna use multiple antenna elements or configurations to improve signal reliability & quality by mitigating fading & blockage effect.
The radiation pattern of a diversity antenna system depends on the specific diversity technique used.
They are used in Wireless communication & for Satellite Communication.

Q2) Explain DSSS and FHSS in details.

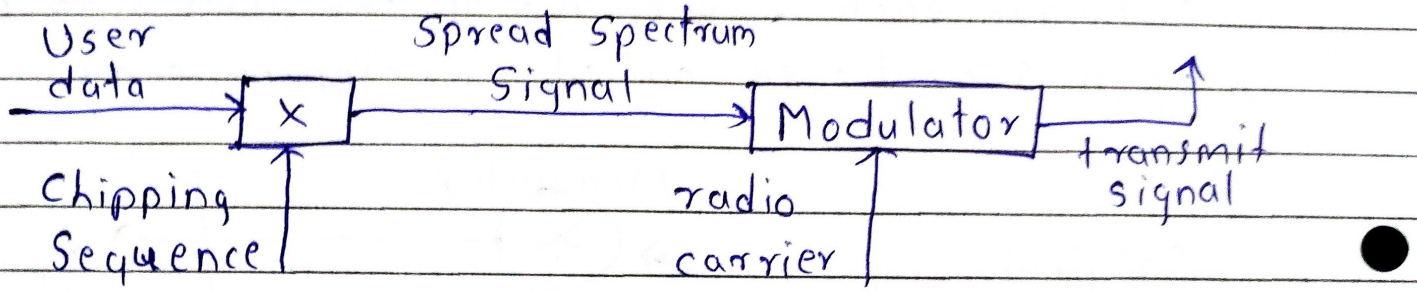
→ Systems take user bit stream & perform an XOR with a so called chipping sequence.
When a user wants to send data using this DSSS technique, each & every bit of the user data is multiplied by a secret code, called as chipping code.



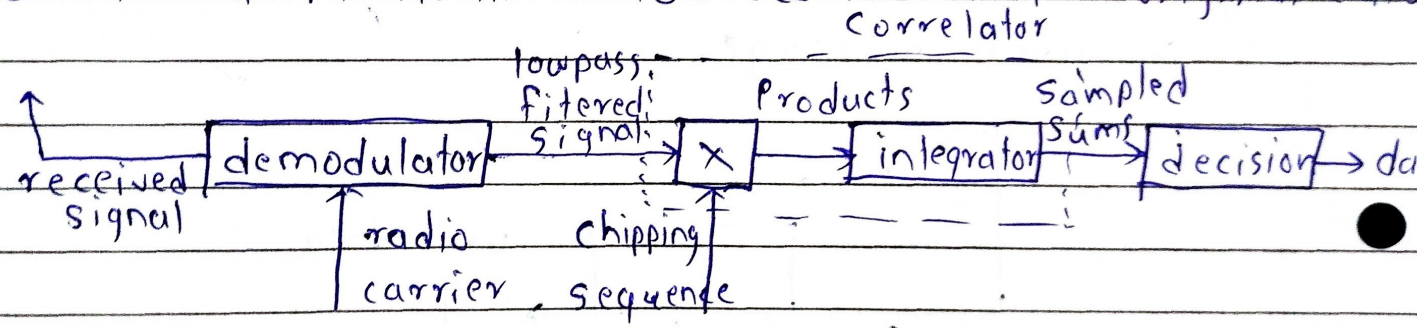
The chipping code is nothing but the spreading code which is multiplied with the original message & transmitted.
The receiver used the same code to retrieve the original message.



DSSS Transmitter =
The first step in a DSSS transmitter is the spreading of the user data with the chipping sequence.
The spread signal is then modulated with a radio carrier



DSSS Receiver =
The receiver only has to perform the inverse functions of the two transmitter modulation steps.
However, noise & multi-path propagation require additional mechanism to reconstruct the original data.

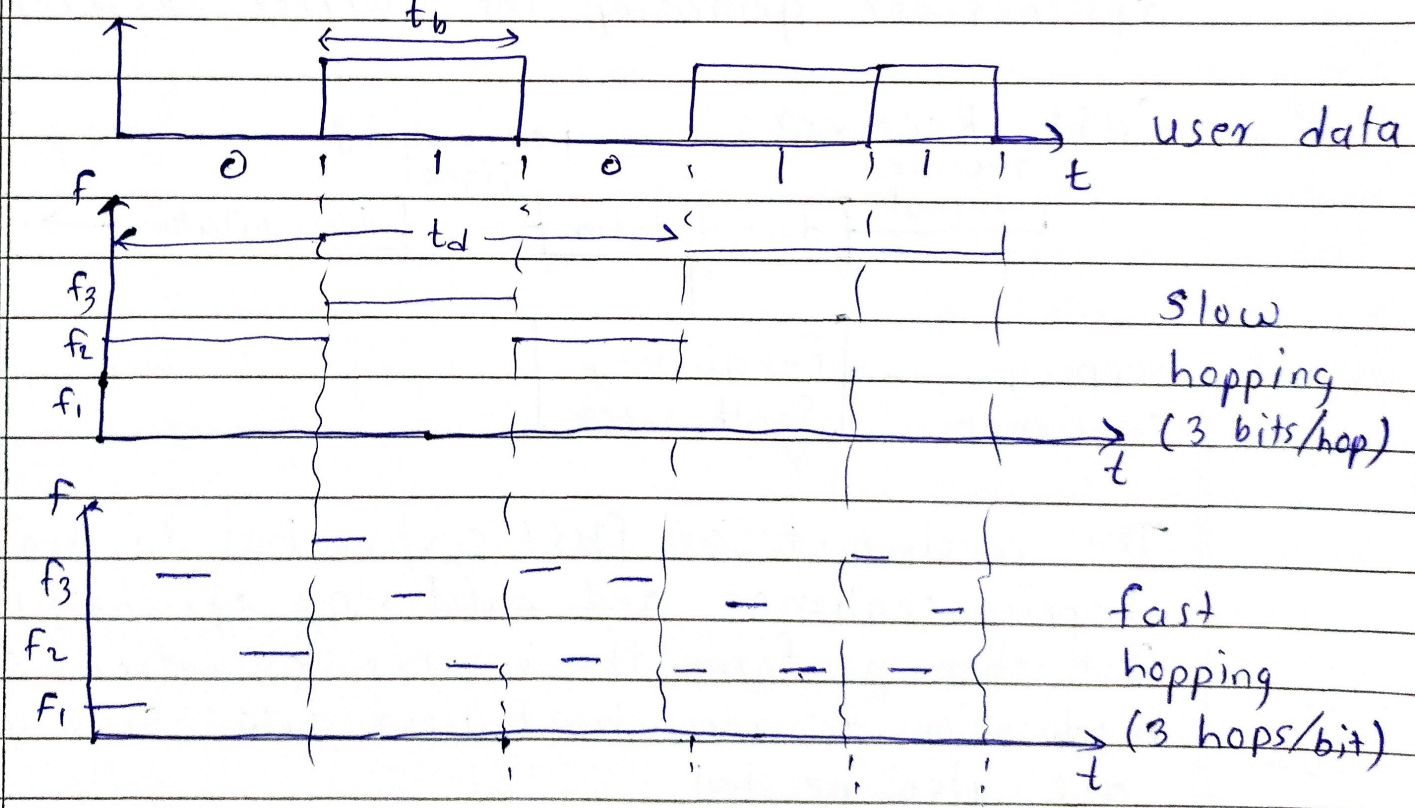


FHSS (Frequency Hopped Spread Spectrum) =
Digital signal is modulated with a narrowband signal that hops from frequency band to frequency band, over time.
The transmission frequencies are determined by spreading, or hopping code

Fixed frequency communication have three problem interface, jamming & interception. This is frequency hopping technique, where the users are made to change the frequencies of usage, from one to another in a specified time interval, hence called as frequency hopping.

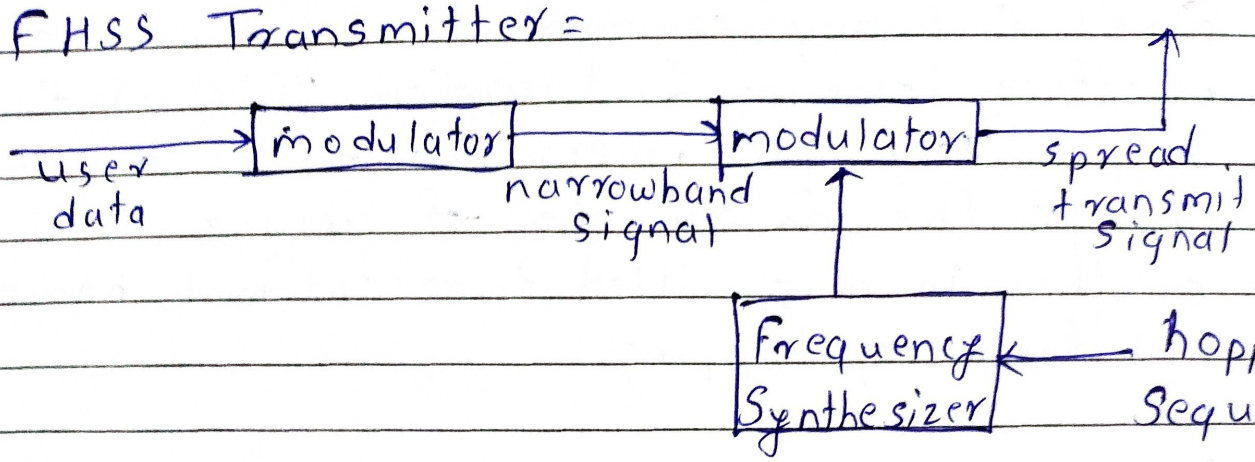
Versions =

1) Fast Hopping
   Several Frequencies per user bit
2) Slow Hopping
   several user bits per frequency.



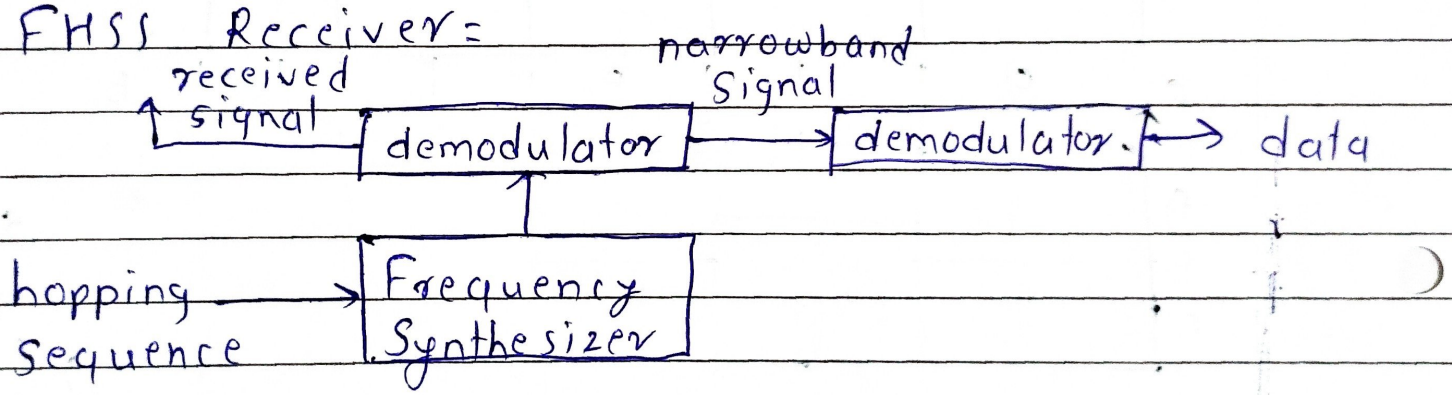
t_b : bit period t_d : dwell time

FHSS Transmitter =



The first step is to modulate the user data acc? to one of the digital-to-analog modulation scheme Next step, frequency hopping is performed, based on hopping sequence. This fed into frequency synthesizer genrating the carrier frequencies fi

FHSS Receiver =



The receiver of an FHSS system has to know the hopping sequence and must stay synchronized. It then perform the inverse operations of the modulation to reconstruct user data. several filter are also needed.

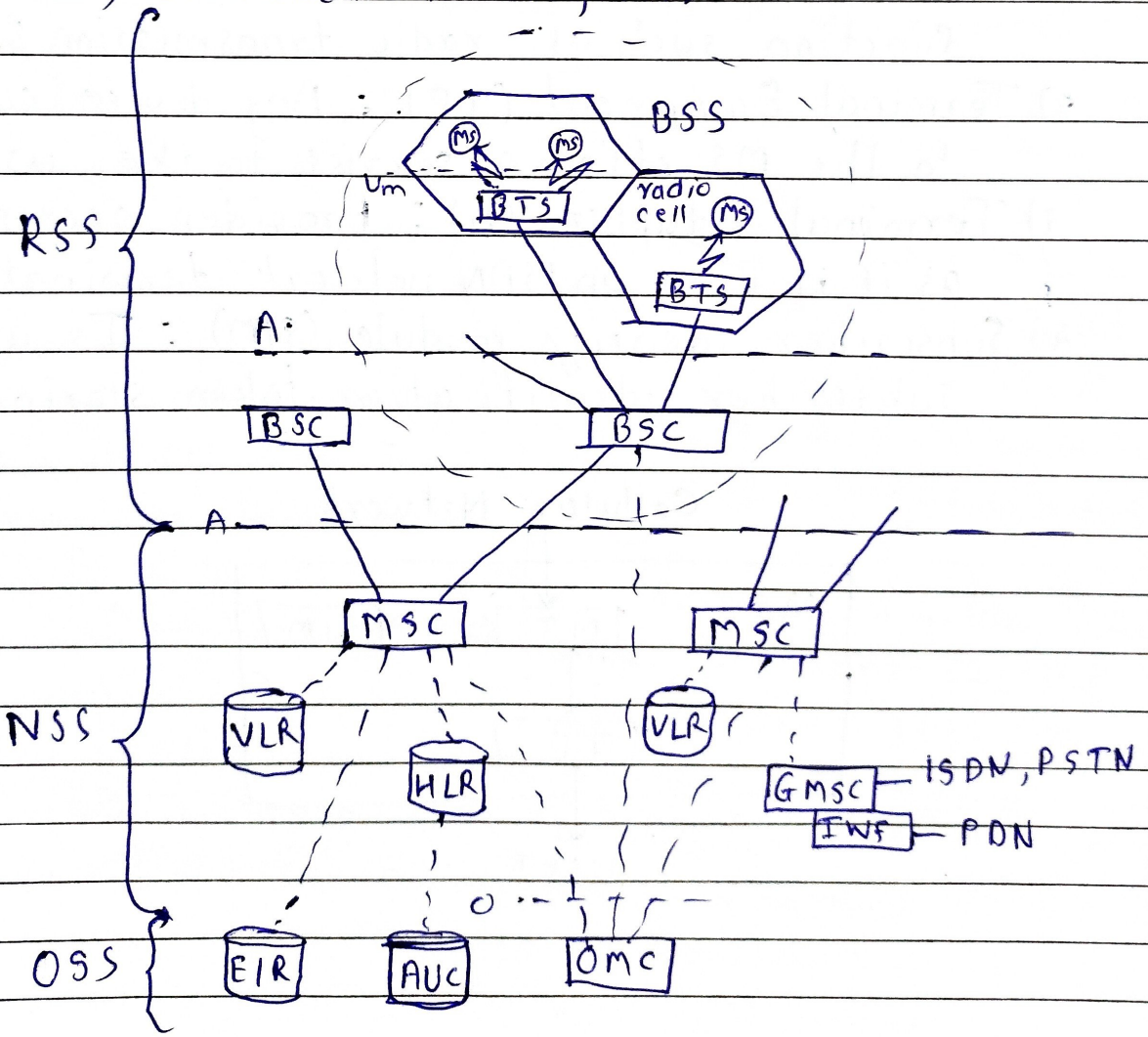
Q3) Explain GSM system Architecture in details.

→ A GSM system consists of three subsystem.

1) Radio Subsystem (RSS)
2) Network switching subsystem (NSS)
3) Operation Support Subsystem (OSS)

A GSM consists of different components,

1) MS (mobile station)
2) BS (base station)
3) MSC (mobile switching center)
4) LR (Location Register

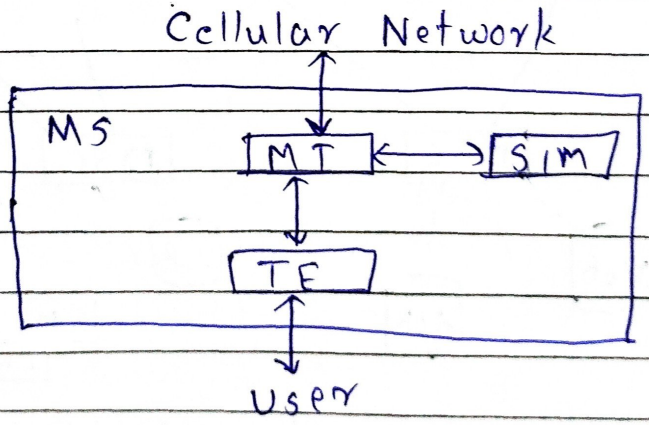


RSS = The RSS comprises all radio specific entities, i.e. the mobile ~~servu~~ stations (MS) & the base station subsystem (BSS), Um is interface, Base station controller (BSC), Base transfer station (BTS)

Mobile station (MS) : It comprises all user equipment & software needed for communication with mobile network.

It consist 4 main components =

1) Mobile Termination (MT) : Provide common function such as radio transmission & handover
2) Terminal Equipment (TE) : Any device connected to the MS offering service to the user
3) Terminal Adapter (TA) : Provides access to the MT as if it were an ISDN network termination.
4) Subscriber Identity module (SIM) : Is a removable subscriber identification token storing the IMSI



- BSS performs all function necessary to maintain radio connections to an MS, coding/decoding of voice, & rate adaptation to/from the wireless network part
- BTS comprises all radio equipment, i.e antennas, signal processing, amplifiers necessary for radio transmission.
  BTS can form a radio cell or, using sectorized antennas, several cell & is connected to MS via Um & Abis interface.
- BSC switching between BTSs, controlling BTSs, managing of network resources, mapping of radio channels (Um) onto terrestrial channel (A interface)

NSS =
- It is the 'heart' of the GSM system.
- The MSS connects the wireless network with standard public networks, performs handover between different BSSs, comprises function for worldwide localization of users & support charging, accounting & roaming of users between different providers in different countries.

MSC = It is high performance digital ISDN switching. They set up connection to other MSCs & to the BSCs via the A interface & form the fixed backbone network of GSM system.

GMSC (Gateway MSC) = has additional connections to other fixed networks, such as PSTN & ISDN

Using additional interworking functions (IWF) an MSC can also connects to Public data network (PDN)

Data Base in NSS:

1) Home Location Register: It stores all user-relevant information. This comprises static information, such as Mobile subscriber ISDN Number (MSISDN) & the International mobile subscriber identity (IMSI)
Dynamic information is also needed eg. Location Area (LA) & mobile subscriber roaming number (MSRN)

2) VLR: Visitor Location Register: It contains the exact location of all mobile subscribers currently present in the service area of the MSC. This information is necessary to route a call to right base station.

OSS = It contains the necessary functions for network operation & maintenance.

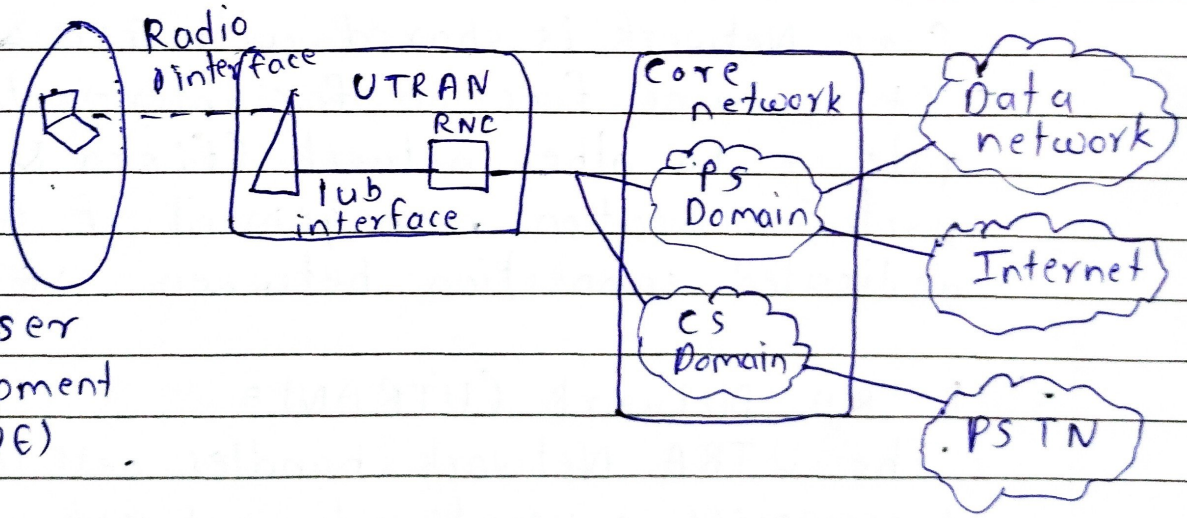
1) Operation & Maintenance Center (OMC) = It monitors & controls all other network entities via the O interface
Functions = i) Traffic monitoring
ii) Status reports of network entities
iii) Subscriber & security management
iv) accounting v) billing.

2) Authentication Centre (AuC) =
- AuC has been defined to protect user identity & data transmission.
- It contains algorithms for authentication as well as the keys for encryption & genrates the values needed for user authentication in the HLR

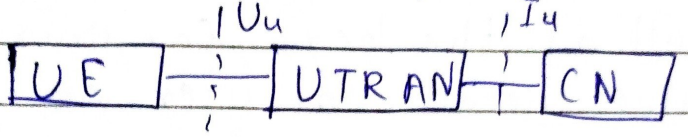
3) Equipment identity register (EIR):
- The EIR is a database for all IMEIs, it stores all devices identifications registered for this network.
- EIR also contains a list of valid IMEI & a list of malfunctioning devices.

Q4) Draw UMTS block diagram & function of each block?

→



Main Components of UMTS are:
1) User Equipment (UE)
2) Core Network (CN)
3) UTRA Network (UTRAN)



1) User Equipment contains two components:
Mobile Equipment (ME) &
UMTS subscriber identity module (USIM)
- ME is radio terminal connected to radio interface
- USIM is smart card (similar to SIM in GSM) that ~~consist~~ contains the subscriber identity, authentication algorithm, encryption keys, etc.

2) Core Network (CN) =
- Core Network is shared with GSM & GPRS
- It contains function for inter-system handover, gateway to other network (fixed & wireless) & performs location management if there is no dedicated connection between UE & UTRAN.

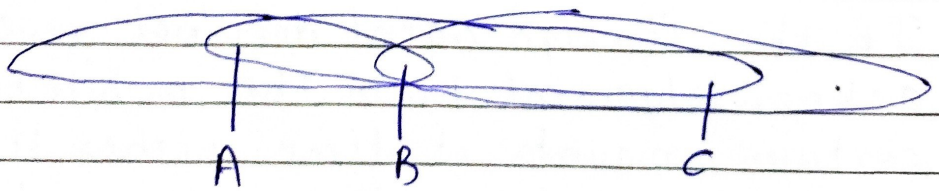
3) UTRA Network (UTRAN) =
- The UTRA Network handles cell level mobility & comprises several radio network ~~s~~ subsystem (RNS).
- The functions of the RNS include radio channel ciphering & deciphering, handover control, radio resource management.

- The UTRAN is connected to UE via the radio interface Uu.
- Via the Iu interface, UTRAN communicates with the core network (CN)

Qs) What do you mean by Hidden & Exposed problems how they can be avoided?

→ Hidden Terminals =
The transmission range of C reaches B, but not A finally the transmission range of B reaches A & C
- A sends to B, C cannot receive A (the detection range does not reach C either)
- C wants to send B, C senses a 'free' medium
- Collision at B, A cannot receive the collision
- A is 'hidden' for C.

Exposed Terminals =
- B sends to A, C wants to send to another terminal (not A or B)
- C has to wait, CS signal a medium in use
- but A is outside the radio range of C, therefore waiting is not necessary
- C is 'exposed' to B



Avoide=

1) Comprehensive Risk Assessment:
Conduct through risk assessments before starting any project or undertaking. Identify potential hidden & exposed problems & develop strategies to mitigate them.

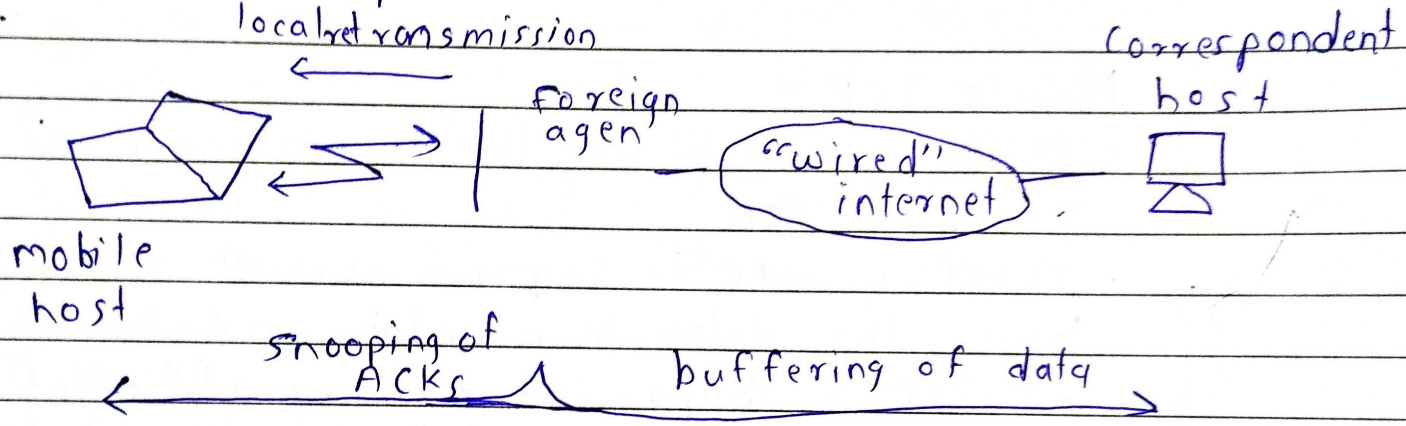
2) Open Communication =
Foster a culture to open communication where team members feels comfortable reporting issues they encounter, whether hidden or exposed.

Q6) Explain snooping TCP & Mobile TCP with their merits & demerits.?

→ Snooping TCP =

- It enhance~~s~~ works completely transparently & leaves the TCP end-to-end connection intact.
- In this approach, the foreign agent buffers all packets with destination mobile host & additionally 'snoops' the packet flow in both directions to recognize acknowledgements.
- The forgeign agent buffers every packet until it receives a acknowledgement from the mobile host.
- If the foreign agent does not receive an acknowledgement from the mobile host within a certain amount of time, either the packet or the acknowledgement has been lost.

- Alternatively, the foreign agent could receive a duplicate ACK which also shows the loss of packet.
- Now the foreign agent retransmit the packet directly from the buffer, performing a much faster ~~communicati~~ retransmission compared to the correspondent host.

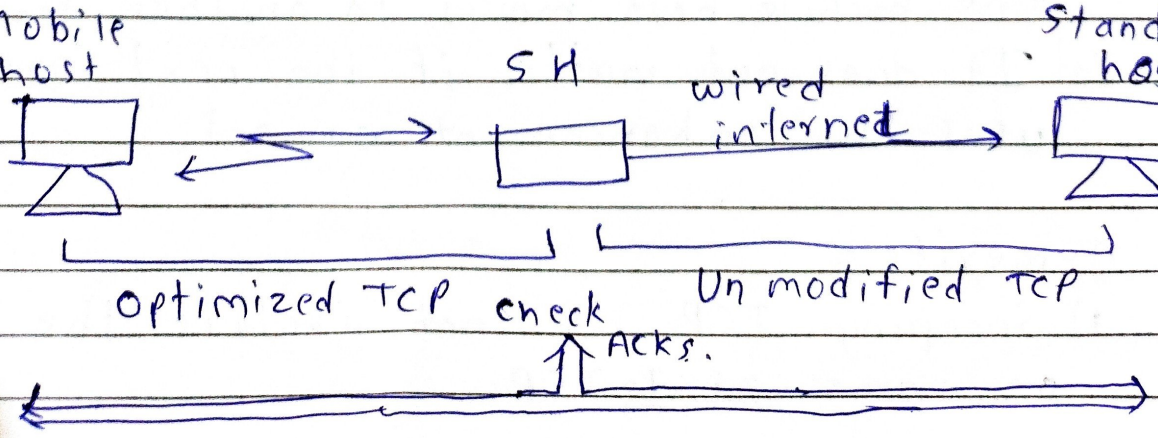


~~Ad~~ Merits =
1) The end-to-end TCP ~~co~~ semantic is preserved
2) The correspondent host does not need to be changed
3) It does not need a handover of state as soon as the mobile host moves to another foreign agent
4) It does not matter if the next foreign agent uses the enhancement or not.

Demerits =
1) Snooping TCP does not isolate the wireless link as same as I-TCP

2) Using negative acknowledgement betⁿ the foreign agent & the mobile host assumes additional mechanisms on the mobile host.
3) All efforts for snooping & buffering data may be useless if certain encryption schemes are applied end-to-end between the correspondent host & mobile host.

Mobile TCP =
- MTCP approach has the same goals as I-TCP & snooping TCP
- MTCP wants to improve overall throughput, to lower the delay, to maintain end-to-end semantics of TCP, & to provide a more efficient handover
- MTCP splits the TCP connection into two parts as I-TCP does
- An unmodified TCP is used on the standard host connection, while supervisory host (SH) an optimized TCP is used on SH-MH connection
- SH is responsible for exchanging data between both parts similar to the proxy in I-TCP.



~~Advantages~~ = Merit =

1) It maintains the TCP end-to-end semantics. The SH does not send any ACK itself but forward the ACK from the MH
2) If MH disconnected it avoid useless retransmissions, slow start or breaking connections by simply shrinking the sender's windw to 0
3) Since it does not buffer data in the SH as I-TCP does, it is not necessary to forward buffers to new SH. Lost packets will be automatically retransmitted to the new SH.

Demerit =

1) As the SH does not act as proxy as in I-TCP, packet loss on the wireless link due to bit errors is propagated to the sender.
2) A modified TCP on the wireless link not only requires modifications to the MH protocol software but also new network elements like the bandwidth manager.