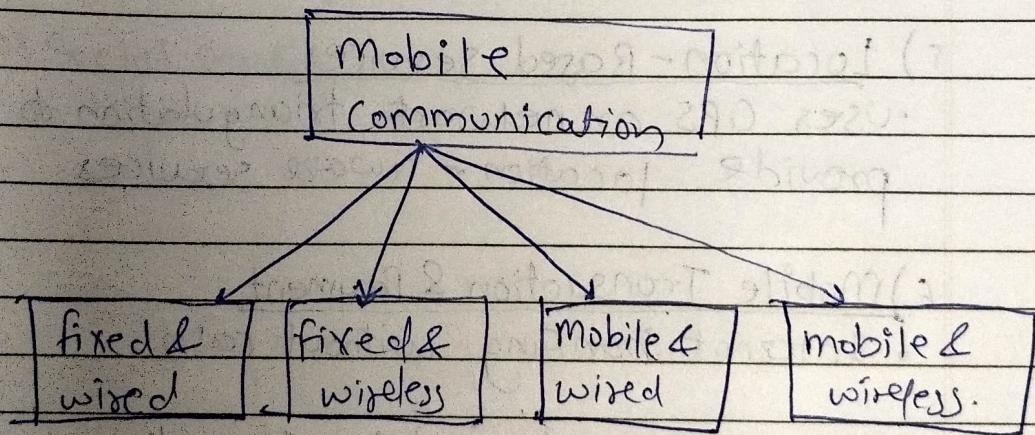


Q) What is mobile computing? Explain various functions of mobile computing. Explain the application of mobile computing.

- Mobile Computing refers to technology that allows people to access network anywhere, anytime.
- Mobile Computing refers to a technology that allows transmission of data, voice & ~~not~~ video over wireless devices without physically link connection.
- Mobile computing allows user to communicate, access through internet & compute task ~~over~~ on being on mobile phone.



Components of MC System

- 1) Mobile hardware
- 2) Mobile Software
- 3) mobile Communication.

Features of mobile Computing

1) Power consumption → Limited battery and need to recharge again & again after some time.

2) Data communication

- Mobile computing devices can send & receive data over wireless networks.

3) Remote Access

- User can connect to remote servers from anywhere at any location.

4) Voice communication

- Supports mobile voice calls without wired connection.

5) Location-Based Services

- Uses GPS or network triangulation to provide location-aware services.

6) Mobile Transaction & Payment

- Internet banking without cash.

Applications of mobile Computing

1) Business work → Work from anywhere, attending online meetings, access company files.

modern mobile technology

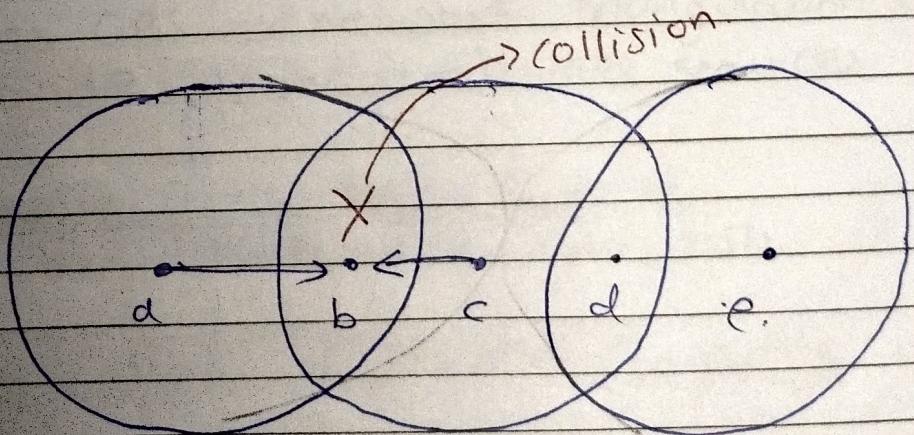
- 2) mobile Banking → check balance, transfer money, pay bills using apps like Gpay, etc..
- 3) Online Shopping
- 4) Healthcare
- 5) Education
- 6) Navigation
- 7) Entertainments
- 8) Defense
- 9) Disaster management
- 10) Social Media

QJ Explain Hidden station problem

→ Wireless LAN is used to transmit data from one device to another without using connected medium. There are normally several problems in wireless LAN two major problems are Hidden station and exposed station problem.

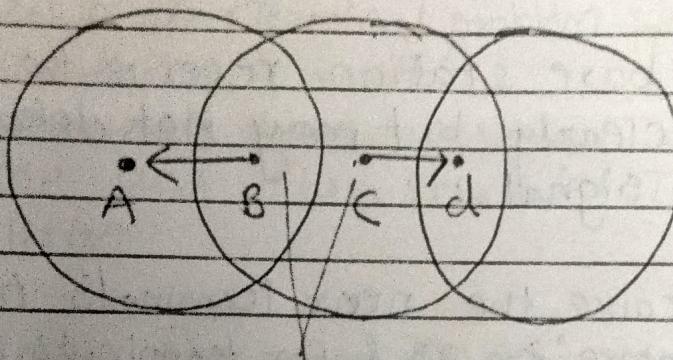
1] Hidden station problem ↴

- The hidden station problem occurs when two devices (stations) are within range of an access point (AP) but not within range of each other. This leads to collision at the AP because both stations might transmit data simultaneously without knowing about each other's transmission.



2] Expose station problem

Expose station problem occurs when station unnecessarily interferes transmission due to sensation of nearby transmission that would not actually cause interference



X → expose station problem

Solution for this two problems ~~are~~ is -

- Use RTS / CTS mechanism.
- Before sending data a station sends an RTS signal to the AP.
- The AP responds with CTS to inform all nearby station to stay silent while the sender transmits.

8J
→

Explain Far & Near terminal problem.

1] Near Terminal problem

- Occurs when a terminal close to Base Station (BS) transmits with a strong signal, & a terminal far away transmit with a weak signal simultaneously.
- The base station receive the strong signal clearly but may not detect the weak signal.
- This cause the near terminal's transmission to "capture" the BS & far terminal's data is lost.

2] Far Terminal problem

- Happens when two terminals far apart cannot hear each other's transmission but both can reach the base station.
- Both terminal may transmit simultaneously causing collision at base station.
- This problem is similar to hidden station problem but uplink communication

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Solution for near far terminal problem

To solve Near station Terminal problem, power control is used.

- Terminals adjust their transmission power so the base station receive approx. equal strength.

2) To solve far Terminal problem, time division or scheduling is used.

- Terminals are assigned with specific time and then scheduled to avoid collision.

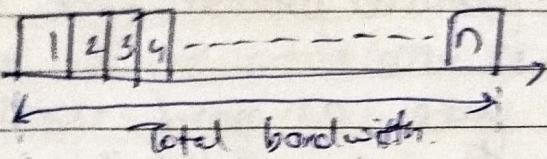
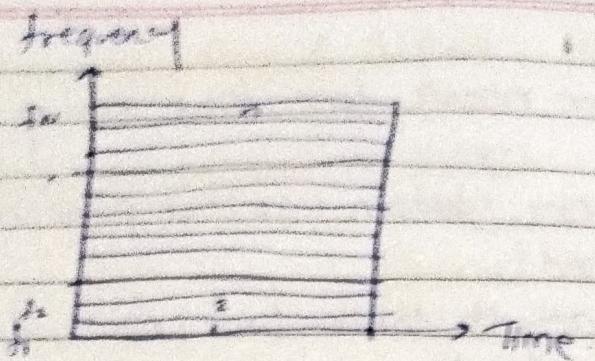
Q] Explain frequency Division multiple Access

- In FDMA The frequency is distributed in multiple channels allows the user to access or transmit the data simultaneously through this channel.

- The entire frequency is split into multiple smaller frequency bands.

- Each user is assigned with one frequency band.

- User can transmit simultaneously but on different frequencies so their signals don't interfere.



Advantages of FDMA:

- 1] Using well established technology
- 2) No need for network timing
- 3) Simple & easy to implement
- 4) Continuous transmission

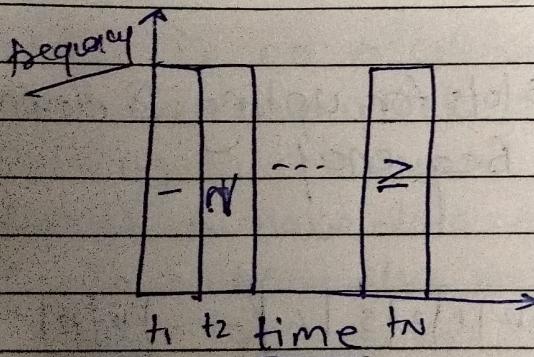
Disadvantages →

- 1) wastage of bandwidth.
- 2) required Guard bands that requires overall efficiency.
- 3) limited no of users by available bandwidth.

g) Time-Division Multiple Access

→ TDMA is a method where multiple users share same frequency channel by dividing time into smaller slots.

- Each user gets a specific time slot to send data, & users take turns in a repeating cycle.
- Each user transmit ~~on~~ only during given time slot & remains silent in others.
- This process repeats quickly, so it feels like all users are talking at the same time ; but in reality they are taking turns



Advantages

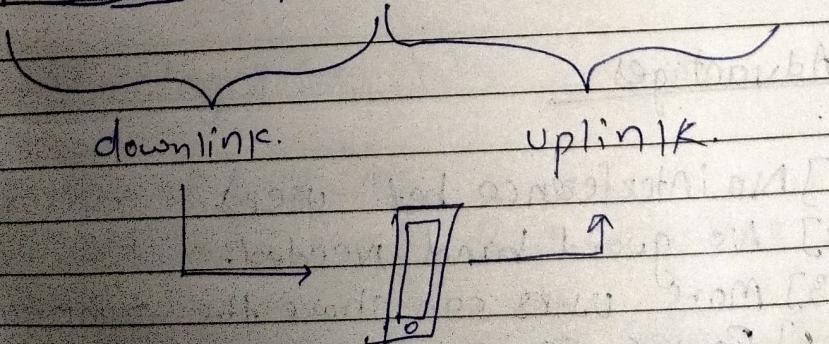
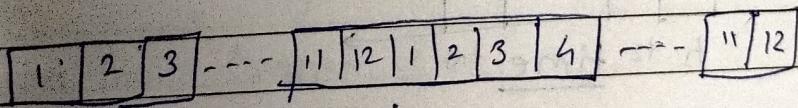
- 1] No interference bet" users.
- 2] No guard band needed.
- 3] More users can share the same channel.
- 4] Power saving.

Disadvantages:

- 1] Needs precise time \Rightarrow synchronization.
- 2] Time can be wasted
- 3) Higher complexity.
- 4) Slight delay because users wait for their turn.

Q] Fixed TDM

- The simplest algorithm for using TDM is allocating time slots for channel in fixed pattern.
- Assign diff slots for uplink & downlink using same frequency.



eg →

- One microphone in a classroom
- Every student gets 2 sec to say something
- After your 2 seconds, the next student talks.
- The cycle repeats again & again.

~~algorithm based on 2 major 3 [2]~~

Q] Explain Classic Aloha (pure Aloha) & slotted Aloha.

- • Aloha is random access protocol used in wireless & shared medium network
- Classic Aloha is also called as pure aloha
- It is simple wifi - like system where device send data whenever they want
- There is no central control
- But here many collision occurs

Working

- If you have data → send immediately
- If someone else sends → crashed
- Wait for random time after crashed → try again

2) Slotted aloha

- Time is divided into fix slots (like time intervals)
- Station can only transmit at the start of a slot.
- Still random but less collision than pure aloha

- Slotted aloha works well for light load but they cannot work on hard transaction.

Q] Explain Demand Assigned Multiple Access (DAMA) with its working principle.

- • Demand Assigned multiple access is also called as assigned aloha.

- Channel efficiency for pure / classic aloha is 18%, for Slotted aloha it is 36% & Reservation Aloha (DAMA) increase it upto 80%.

- User sends a request to base station.
- Base station checks if channel is free.
- If free, assigns the channel to the user for the required time.
- Once the transmission is complete the channel is released for other users.

mode 1 → Aloha mode for reservation Aloha :

- Terminal sends reservation request to channel.

- If two terminal collide, they wait a random time & ~~retry~~ retry.

mode 2 → Reserva mode for data transmission

- When the collision occurs transmission do not fails, instead it retrans for retransmission again
- Once reservation successful no other channel is allowed to transmit at the reserved time of other terminal. No collision occurs here.

e.g. = PRMA

Q3) PRMA

- The implicit example of Reservation scheme is packet reservation multiple access.
- PRMA is used in multiple access protocol used in wireless systems where users send data in packets.
How it works
- Step 1 → Time slots → Channel is divided into equal time slots.
- Step 2 → When user wants to send data it tries to send it in next available slot.
- If successful (no collision), the slot becomes reserved.

Step 3 → When user sends data on reserved slot it becomes repeatedly for same user until user have no data to send

Step 4 → When data is send successfully the channel is released for other users

Advantages :

- Reduces collision compared to CSMA or Aloha.
- Efficient.

AM 99 10

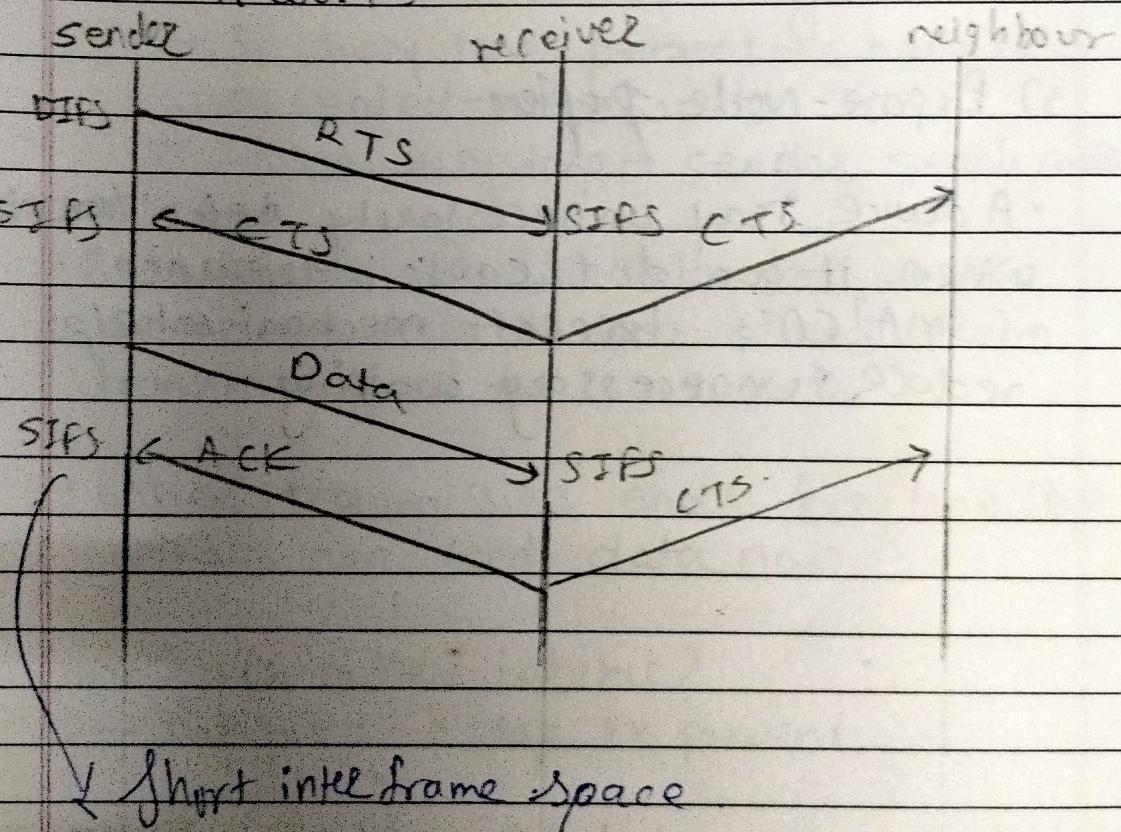
Disadvantages :

- Needs synchronization of time slots
- Reservation overhead if traffic is light.

Q) Explain CSMA/CA

- CSMA/CA that is Collision Carrier Sensing multiple access with collision detection is the network protocol used in wireless network to regulate data transmission & avoid collision between multiple devices trying to communicate simultaneously.
- Unlike CSMA/CD which detects collision after they occur, CSMA/CA detects it before they happen.

How it works



Explain Upper process

Why CSMA/CD is used in wireless network

- 1) In wireless networks, a transmitting device cannot simultaneously listen for collision.

CSMA/CD is not possible to use in wireless.

- 2) Hidden Node problem.

- Two devices cannot ~~sense~~ sense each other and ends up with collision.
- CSMA/CD uses RTS/CTS to avoid collision.

- 3) Expo-Node problem

- A device may unnecessarily defer transmission when it wouldn't cause interference.
- CSMA/CD's backoff mechanism helps reduce unnecessary waiting.

Q] Explain ISMA

→ ISMA → inhibit sense multiple access protocol is centralized channel access protocol used mainly in satellite & wireless networks.

- It is designed to avoid collisions by using an inhibit signal sent from a central station (Base station) to other stations.

★ Working ★

- When user wants to send data.
- Base station checks for busy tone
 - If busy tone present → channel is occupied → user waits
 - If no busy tone → sender sends code.
- Base station sends a busy tone while receiving data to stop others from transmitting at the same time.
- When transmission ends busy tone stops others can send data now.

Why it is called inhibit?

→ Inhibit = • stop or prevent.

- If busy tone detected, sending is inhibited.
- If no busy tone, sending is allowed.

UNIT-II

Mobile Telecommunication System.

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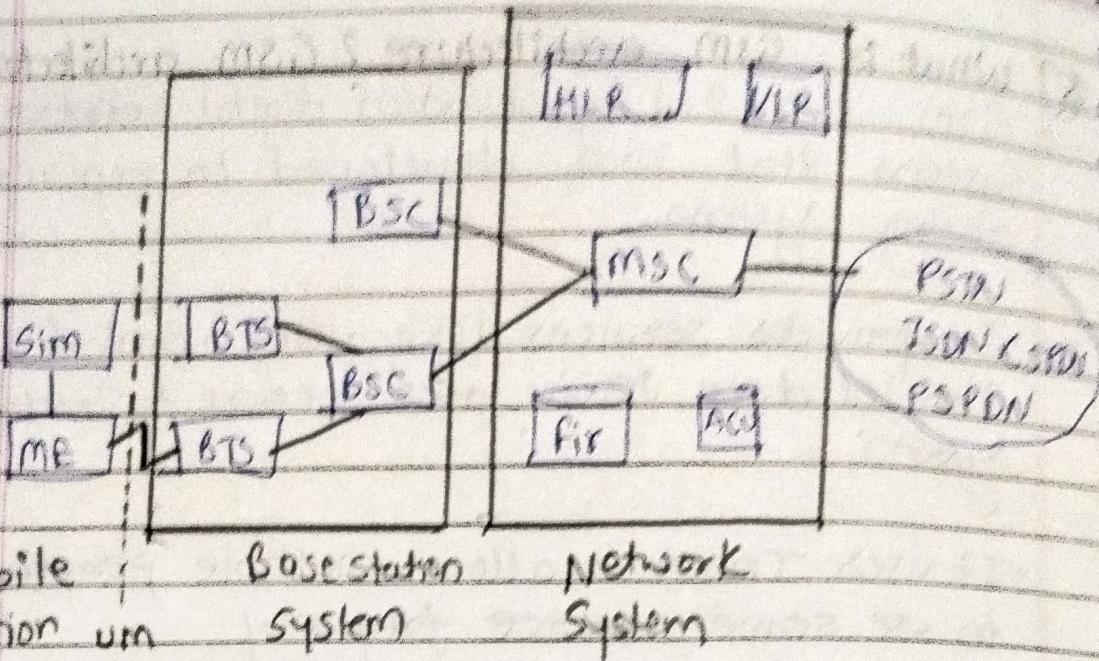
Q] What is GSM architecture? GSM architecture.

→ GSM is a 2nd generation digital ~~cellular~~ system that was developed to replace analog system.

- It provides services like voice, SMS & limited data service over secure & standardized system.
- It uses TDMA to allow multiple people users to use same ~~service~~ frequency.
- Introduced ~~SMS~~ SIM concept which stores subscriber info and allows mobility betw' devices.

★ GSM architecture →

- GSM architecture consists of three parts:
 - 1) mobile station - carried by subscriber
 - 2) Base Station System - controls the radio link with mobile station.
 - 3) Network System → performs switching of calls between mobile users.



1] Mobile Station (MS)

- The mobile station consists of mobile equipment (terminal) & smart card called as SIM (Subscriber Identity Module).
- The user insert the SIM in another mobile equipment from which the calls can be received & can make the calls.
- Mobile equipment have unique IMEI number. The SIM card contain IMSI to identify user.

2] Base station Subsystem

It contains two parts →

- 1) Base Transceiver Station (BTS)
- 2) Base Station Controller (BSC)

BTS

- It handles radio communication with ms
- Converts digital data to radio signal & vice versa
- .

BSC

- Handles radio resource management
- Controls multiple BTS Unit.

2] Network Switching System (NSS)

It includes

- It acts as switching node
- The central component of NSS is mobile Service Switching center (msc)
- It also includes.
 - Home location Register
 - Visitor Location Register
 - Equipment entity register
 - Authentication Center (AUC)

1] mobile Switching Center (msc)

- msc is central switching node in the gsm network.
- It is responsible for call setup, routing & termination.
- Billing info is collected here.
- Controls access to database like HLR, VLR

MSC & EIR.

2) Home Location Register (HLR)

with MSC

- HLR & VLR together provides the cell routing & roaming capabilities of GSM.
- It is permanent database that stores subscriber details along with the current location of mobile station.
- The HLR database maintains unique IMSI of each subscriber.
- There is generally one HLR per GSM.

• HLR are of two types.

1) Dynamic DB.

- Location info for each subscriber.

2) Permanent database.

- IMSI
- Service restriction
- Supplementary services

3) Visitor Location Register (VLR)

- Temporary database for subscribers currently in the MSC area.
- stores subscriber info from HLR when they enter the MSC area.
- Contains Temporary mobile subscriber identity (TMSI) for security.
- Deleted subscriber record when they move out of the area.

4) Equipment Identity Register (EIR)

- Equipment Identity Register (EIR) is a database that contains a list of all valid mobile equipment on a network where each mobile station is identified by its IMEI : reported
- IMEI is marked as "
- IMEI is marked as invalid if reported stolen or is not approved.
- EIR is divided into three types
 - i) Whitelist → Valid IMEI number → Valid equipment
 - e) Grey list → IMEI under scan → suspected mobile under observation
 - 3) Blacklist → prohibited IMEI number → List of mobile for which service is barred.

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5) Authentication Center

- Authentication Center is protected dB that stores a copy of the secret key stored in each SIM card.
- Authentication maintains authentication keys & algorithms & provide security triplets (RAND, SRES & Kc) to the VLR.

Q] Explain GSM Signalling protocol architecture.



Q] What do you mean by security in GSM.

→ Security in GSM refers to the set of techniques and mechanisms used to protect communication between a mobile user and the network.

Main goals are —

- To prevent unauthorized access to the network.
- To ensure confidentiality.
- To prevent user identity from being misused.

1) Authentication

- Its main purpose is to confirm that the person trying to connect to the network is valid.
- Each sim has a secret key stored in it and in the network.
- Network sends a random number (RAND) to mobile.
- Sim uses A3 algo & Ki to create a reply. (SRES)
- If network matches → user accepted
otherwise → rejected.

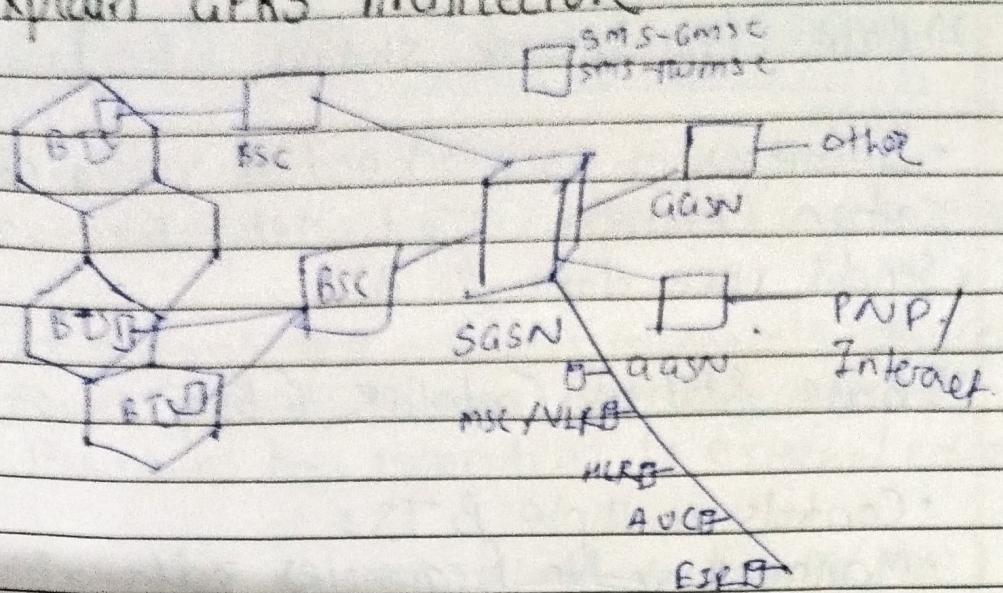
2) Radio Path Encryption (Privacy)

- To keep calls, SMS & data safe from listening
- After authentication, a Key (K_c) is made using A8 algorithm
- K_c is used with A5 algorithm to encrypt data.
- Only the mobile network can decrypt it.

3) User identity protection →

- To hide the real mobile number from being exposed on the air.
- If IMSI is sent openly, hackers can track & misuse it.
- IMSI is stored in SIM
- Network uses Temporary Mobile Subscriber Identity ($TMSI$) instead of IMSI for most communication.
 - So TMSI changes frequency so that even if someone intercepts it, they can't track the user for long.

Q] Explain GPRS Architecture



General packet radio Service is an extension of GSM that allows packet-switching data transmission enabling services like internet browsing, email & multimedia messaging -

• It works with existing GSM architecture with extra elements.

Components in GPRS →

1) mobile Station (ms)

- The user's mobile phone or device.
- must be GPRS-enabled to send and receive packet data.
- Communicates with BTS over the radio interface.

2) Base Transceiver Station (BTS)

- Same as in GSM → handles radio communication between MS & network.
- Sends user data to BSC

3) Base Station Controller (BSC)

- Controls multiple BTSs.
- Manages radio frequencies allocation, radio resources & handovers.

4) Packet Control Unit (PCU)

- A new component introduced for GPRS.
- Can be inside the BTS or BSC.
- It directs packet-switched data to GPRS network instead of GSM voice switching.

5) Serving GPRS Support Node (SGSN)

- It is core element for GPRS packet data.
- Keeps tracks of the location of the mobile station.
- Authenticates users for GPRS services.
- Handles data routing between MS & external network.
- Similar role to MSC in GSM but for data.

6) Gateway GPRS Support Node (GGSN)

- Acts as interface between GPRS and external packet data network (like the internet)
- It assigns IP address to mobile devices
- Routes packets to and from the internet
- Maintains the connection to external networks

7) External packet data networks (PDN)

- Actual destination or source of the user data

flow of data in GPRS.

- 1) Mobile Station sends packet data \rightarrow BTS \rightarrow BSC.
- 2) PCU decides it's packet - switched data \rightarrow forwards to SGSN.
- 3) SGSN checks authentication
- 4) Data is routed to GGSN.
- 5) GGSN sends data to (PDN) internet & vice versa.

Advantages of GPRS

- 1) Always on
- 2) High speed
- 3) Pay as you use
- 4) Supports multimedia
- 5) Easy Internet access.
- 6) Global access.

Q] Explain short Note on UMTS.

→ UMTS is a 3rd generation (3G) mobile communication technology developed under the 3GPP standards.

- It is based on WCDMA as its radio access technology.
- It is designed to provide high-speed voice, video, data services over mobile network.

→ Its main ~~goal~~ is to provide ~~of~~ higher data rather than 2G (GSM, GPRS, EDGE).

• Supports multimedia services like, Gaming, voice calling, mobile TV.

UMTS is divided into three main parts.

A) User Equipment:

- Mobile device used by subscriber.
- USIM (UIM) stores authentication data.

B) UMTS (UTRAN)

- Handles radio communication bet' user or core network.

(Components.

1) NodeB → equivalent to GSM base station.
responsible for radio transmission.

2) Radio Network Controller
Controls multiple B's.

3) Core Network (CN)

• Responsible for switching routing & connecting to external network.

Two domains -

1) Circuit switched domain → for voice calls

• packet-switched domain - for data services.

Advantages -

1) faster internet

2) Worldwide roaming -

3) Better voice quality than GSM.

4) Supports video & live streaming.

5) Can handle more users in same spectrum.

6) Works with both old 2G network & modern 3G network.