MOBILE COMPUTING

MODULE 1
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Date

MOBILE COMPUTING - it describes one's ability to use technology while moving. It requires wireless network to support inter mobility & handoff from one network to next network. It is the mobility of physical objects (wireless devices) & virtual objects (data in bits/ bytes)

⇒ Mobile Computing Devices -

1. Personal Digital Assistant (PDA's) - they are handheld devices that combine elements of computing, telephone/ fax, internet & networking in a single device. It can function as a cellular phone / fax, web browser & personal organiser.
   eg: Palm pilot, Sony clie, Compaq iPad, etc.

2. Smartphones - It combine both mobile phone & handheld comp into a single device. it allows usess to store information, install programs, along with using a mobile phone in one device.

3. Tablet PC - A type of notebook computer that has an LCD screen on which we can write using a stylos. The hand-writing is digitalized & can be converted to standard text through handwriting recognizer.

MOBILE COMPUTING FUNCTIONS -

Mobile computing functions can be logically divided into 5 major segments:

① User with device
② Network
③ Gateway
④ Middle-ware
⑤ Content

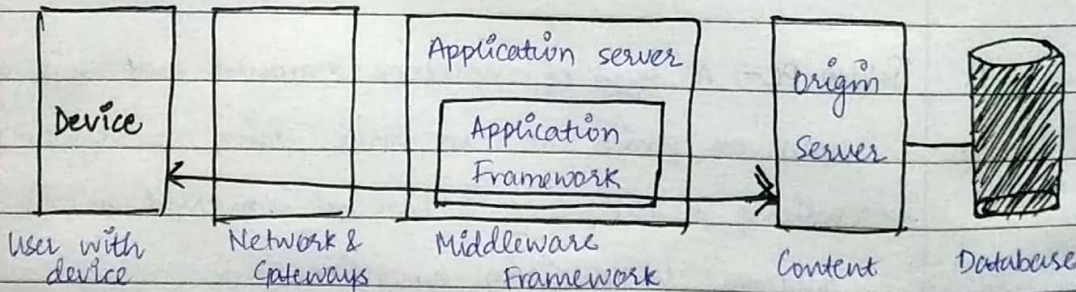
i) **User with device** - it could be a fixed device like desktop, or portable device like mobile.

ii) **Network** - when a user is mobile, he will be using diff. networks at different places at different time. eg: GSM, CDMA.

iii) **Gateway** - it is required to interface different transport bearers. These gateways convert one specific transport bearers to another bearer.

iv) **Middleware** - it is more of function rather than a separate visible node. It handles presentation & rendering of the content on particular devices.

v) **Content** - it depicts the origin server and its contents. Origin server will have some means to access the database & storage device.



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PCS Architecture -

PCS stands for Personal Communication System. The main objective of PCS is to enable communication with a person at any place & in any form.

It is a type of architecture for advanced coverage & connectivity services at a node personal level. It mainly refers to the modern mobile communication that increases the capabilities of service quality & speed.
Its main area of usage are :- a) mobile phones,
b) landlines, etc.

It works similarly to a cellular network in basic operation but require more service provider/infrastructure to cover a wider geographical area. It usually includes wireless communication, mobile PBX, Paging, Wireless Radio, Satelite communication System, etc.

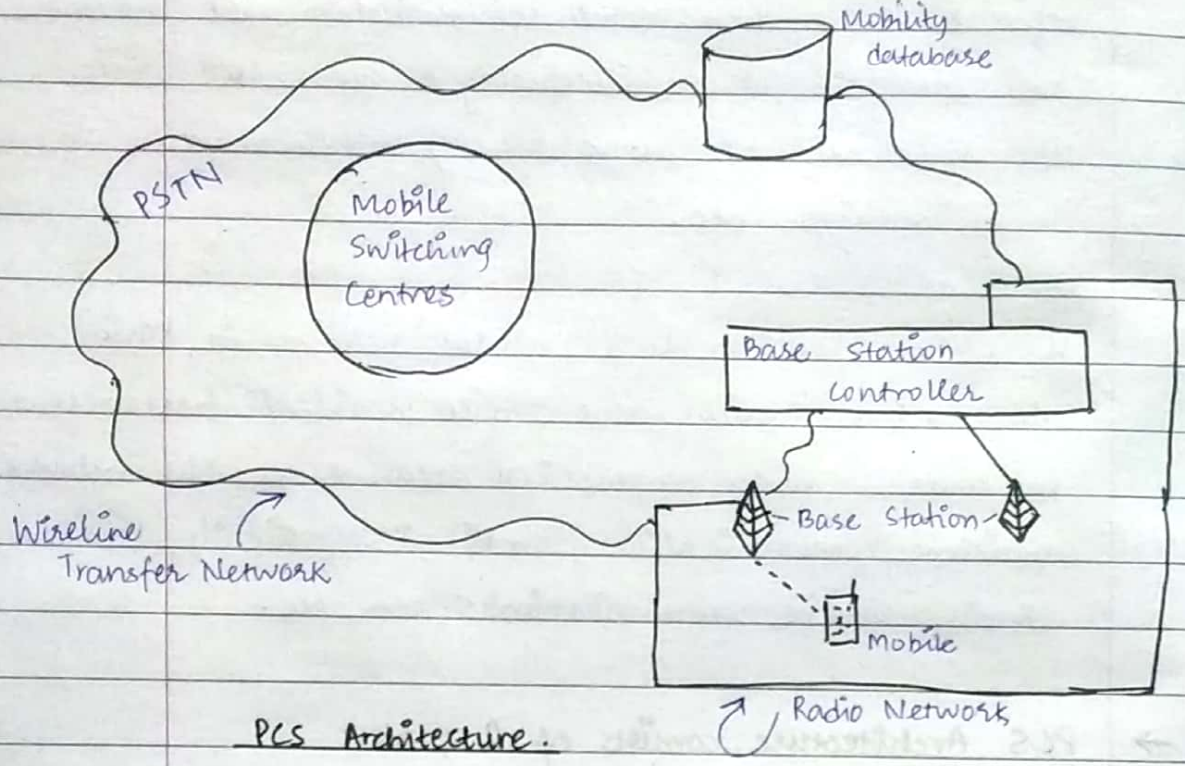
→ PCS Architecture consists of 2 parts :

i) **Radio Network** :- Users carry mobile station (MS) to communicate with a Base Station (BS) in a PCS network. The radio coverage of Base Station is called a cell & each cell is controlled by Base Station Controller (BSC) which are connected to MS through BS. The BSC is connected to Mobile Switching Centres (MSC) through landlines.

ii) **Wireline Transport Network** – It interfaces MSC with PSTN (Public Switch Telephone Network) via BS. MSC's are also connected with mobility database to track the location of MS and roaming management. The database are HLR & VLR.
HLR - Home location Register, it contains authentication information like IMI no, identification info of subscriber, etc

(visitor location register)

VLR gives information about the location area of the subscriber while on roaming & power off status of handset.



PCS Architecture.

MOBILITY MANAGEMENT –

It is a function that facilitates mobile devices operations in GSM or UMTS networks. It handles the functions that arises due to mobility of the ~~function~~ subscriber.

The main objective of mobile management is location tracking and call setup.

There are two aspects of mobility management:

a) Location Management
b) Handoff / Handover.

a) Location Management - Location management scheme are best on user mobility & calls characteristics. The location update procedure allow the system to keep the location knowledge with more or less connectivity.

b) Handoff - It refers to the process of transfessing an active call or data session from one cell in a cellular network to another or from one channel in a cell to another.

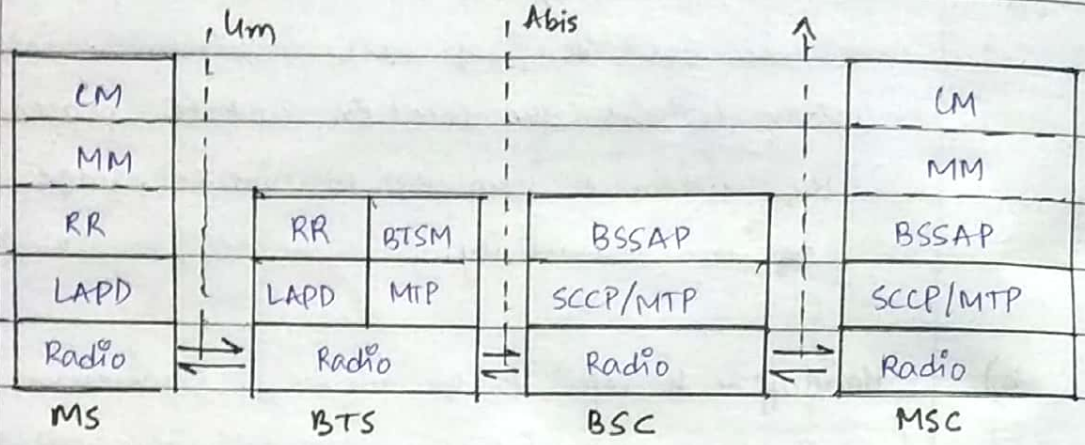
- Hard Handoff - In a hard handoff, an actual break in the connection occurs while switching from one cell to another. The radio links from the mobile station to the existing cell is broken before establishing a link with next cell. It is generally an interfrequency hand off. It is a "break-before-make" policy.

- Soft-Handoff - In soft handoff, at least one of the links is kept when radio links are added & removed to mobile station. This ensures that during the handoff, no break occurs. This is generally adopted in co-located sites. It is a "make-before-break" policy.

⇒ issues due to mobility -

1. Radio resource management
2. Security
3. Temporary loss of connectivity.
4. Low Battery Power.
5. Reaction to sudden change in environment due to bandwidth & other changes.

NETWORK SIGNALLING-



LAPD – Link Access Procedure D-channel

RR – Radio Resource

MM – Mobility Management

CM – Call Management

BTSM – BTS (Base Transciever Station) Management

BSSAP – BSS (Base Station Subsystem) Application Protocol.

SCCP – Signaling Connection Control Part

MTP – Message Transfer Protocol.

The signaling protocol is structured into 3 layers:

1. Layer 1 – Physical layer.
2. Layer 2 – Datalink layer.
3. Layer 3 – Network layer.

- The physical layer is between MS & BTS, and it is called Um interface. It perform foll functions:
  - i) Full or half-duplex access
  - ii) Provides CDMA, FDMA (Code / Frequency Division Multiple Access)
  - iii) Framing of data.

- The datalink layer is present between MS & BTS. It controls the flow of packets to & from network layer and provides functions like:
  a) Data flow control
  b) Acknowledged / unacknowledged data transmission.
  c) Address & Sequence no. check
  d) Segmentation.

- The network layer has 3 sublayers:

→ CM (Call Management) -
* supports call establishment, maintenance & termination
* supports functioning of SMS.
* Supports DTMF (Dual Tone Multiple Frequency) Signaling

→ MM (Mobility Management) -
* controls the issue regarding mobility management, location updation & registration.

→ RRM (Radio Resource Management) -
* manages radio resource such as frequency assignment, signal measurement.
* functions relating to the development of physical connection for the purpose of transmitting call related signal info.

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HISTORY OF WIRELESS COMMUNICATION -

Wireless communication is the use of information over a distance without the use of electrical conductors or wires.

1. 1982 - CEPT
2. 1986 - Basic GSM Radio Transmission Technique chosen.
3. 1988 - The Telecommunication standard institute define GSM.
4. 1989 - Explanation is finished for GSM Generation 1.
5. 1991 - First call in GSM.
6. 1992 - First GSM Network in the world.
7. 1993 - GSM network raised.
8. 1994 - First GSM network in africa.
9. 1995 - GSM network reached 117 countries.
10. 1998 - 120 millions users in the world.
11. 1999 - 1st GPRS introduced.
12. 2003 - 863 million users in the world.
13. 2004 - 3G world congress.
14. 2007 - 2.4 billion users in the world.
15. 2010 - GSM standard served 80% of mobile market in more than 5 billion across more than 212 countries.
16. 2012 - 4G was introduced.

→ FIRST GENERATION -

1. It came to use in 1989.
2. Call forwarding feature was introduced.
3. No answer feature introduced
4. Unreacheable feature introduced
5. Outgoing calls barring introduced
6. Global Roaming feature introduced.

→ **SECOND GENERATION OF GSM -**

1. SMS featured introduced.
2. Multiparty calling
3. Call waiting
4. Call holding
5. Mobile Data Service
6. Mobile Fax Service
7. Call broadcast

→ **THIRD (TWO +) GENERATIONS OF GSM -**

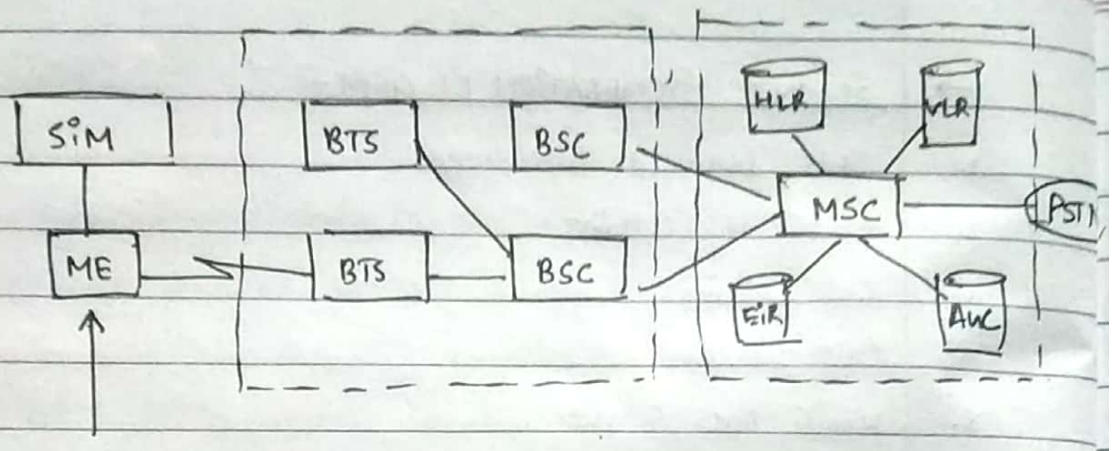
1. it came to use in 1998.
2. Services developed
3. GSM
4. VPN
5. Packet Radio
6. Sim development

IMPO

GSM Overview -

GSM is a cellular network, which means that mobile phones connect to it by searching for cells in the immediate vicinity.

It digitizes & compresses data & then sends it down a channel with two other streams of user data each in its own time slot.



The Mobile | Base Station Subsystem | Network Subsystem

- **ME (Mobile Equipement)** – it is cellular phone without SIM card. It has unique international mobile equipement identity (IMEI).

- **SIM (Subscriber Identity Module)** – It possesses a processor and a small memory. It stores permanent & temporary data about the mobile, the subscriber & the network.

- **BSS (Base Station Subsystem)** – It is responsible for all the radio related functions in the system like
  - * Radio communication with mobile unit in certain area.
  - * Handover of calls
  - * Control of power transmitted by BTS or MS.
  - * Monitors quality.

BSS has 2 components –

a) **BTS (Base Transciever Station)** – it consists of all radio equipements (eg: antenna, signal amplifier, etc) It manages radio resource and handles & handover

the radio frequency. The functions of BTS are:

* Signal processing.
* Synchronisation
* Local maintenance handling.

b) BSC (Base Station Controller) – It manages radio resource for one or more BTS. It handles & handover the radio frequency, radio channel setup from one BTS to another.

Functions of BSC are –

* Radio Network Management
* BTS Management
* Handling MS connection.

- Network Subsystem – It combines the call rotating switches with data base registered required to keep track of subscriber's movements & use of the system.

Key elements are –

a) MSC (Mobile Switching Centers) – It is an exchange which performs all the switching & signalling functions for mobile stations located in a geographic area designated as MSC area.

Functions of MSC are –

* Switching & call routing
* Communication with HLR & VLR
* Direct access to internet services.

b) HLR (Home Location Register) – It is a centralized network database that stores & manages all mobile services belonging to a specific operator. It acts as a permanent store for a person's subscription information until the subscription is cancelled.

Functions are –

* call routing & roaming facility.
* Communication with MSC, VLR, GMSC & AuC
* Subscription of database management.

c) VLR (Visitor Location Register) – it is a temporary storage device of GSM network. It stores subscriber's information for MS which are within the particular MSC service area.

Functions are –

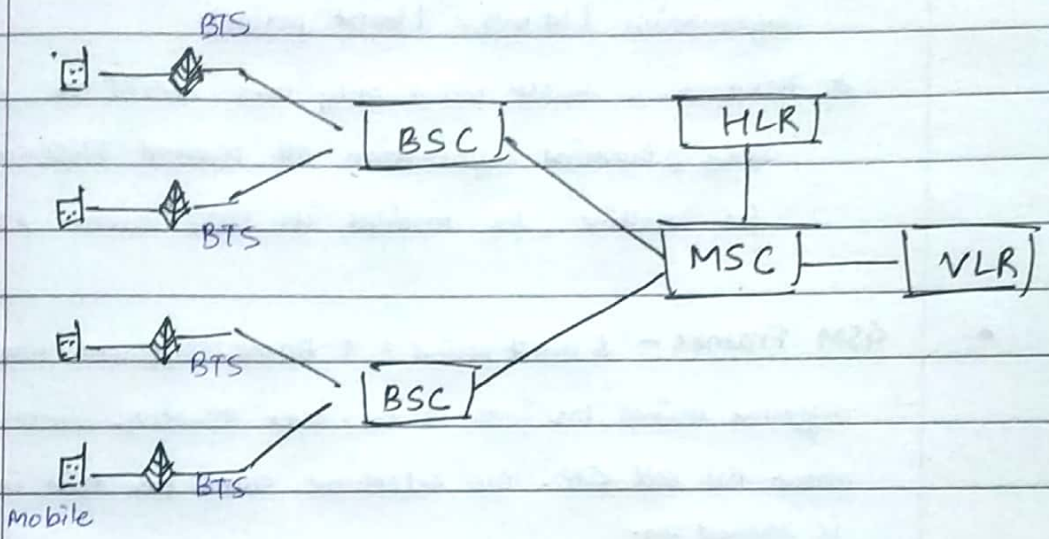
* Stores subscriber's info for mobile including latest location & station (idle).
* checks its database to determine whether or not it has record of subscriber.

d) EIR (Equipement Identity Register) – A database that contains a list of all valid mobile equipement within the network where each MS is identified by IMEI.

e) AuC (Authentication Center) – It is a protected database that stores a copy of secret

information stored in SIM card. These data help to verify user's identity.

GSM Architecture –



- **TDMA – Time Division Multiple Access**
  - * This channel is divided into time slot. Each conversation uses one slot.
  - * Many conversation are connected to a single channel.
  - * Used in GSM.

- **FDMA - Frequency Division Multiple Access**
  - * FDMA is the division of the frequency band allocated for various cellular telephonic conversation into 30 channels.
  - * FDMA is a basic technology in the Analog Advance Mobile Phone Service (AMPS). The most widely installed cellular phone system installed in North America.
  - * It is also used in Total Access Communication System (TACS)

- **GSM Burst Period -**

  * Since GSM is TDMA based, it uses 8 burst periods to make a frame.
  * Burst period is where a phone to get to send digital information (14 bits = 1 burst period)
  * However, a burst period only lasts 0.577 ms, phone are only ~~p~~ bursting information all around 1700 times a sec for landline, for mobiles its 8000 times a sec.

- **GSM Frames -** 8 burst period = 1 frame. Different frames means different things, for instance this data structure contains info about the cell site. The telephone scans for this info when it is turned on.