Mobile Technology

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Mobile Computing :

It refers a technology that allows transmission of data, video and voice via a computer or any other wireless enabled device. It is free from having a connection with fixed physical link. It facilitates the users to move from one physical location tothe anotherphysical location during communication.

The basic concept of Mobile Computing can be divided into three parts:

1. Mobile Communication
2. Mobile Hardware
3. Mobile Software

1. **Mobile Communication :**

   It specifies a framework that is responsible for the working of mobile computing technology. It refers to an infrastructure that ensures reliable and seamless communication among wireless devices. This framework ensures the reliability and consistency of communication between wireless devices. The mobile communication framework consists of communication devices such as protocols, bandwidth, services, and portals necessary to support and facilitate the stated services. These devices are responsible for delivering a smooth communication process.

Mobile communication can be divided in 4 main category:

1. Fixed and Wired
2. Fixed and Wireless
3. Mobile and Wired
4. Mobile and Wireless
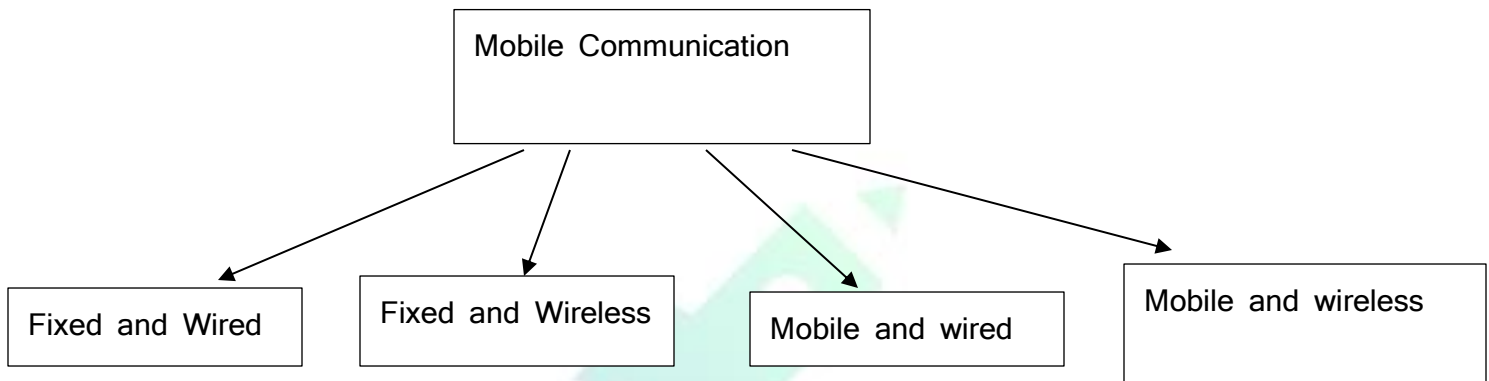
a. **Fixed and Wired:**In this configuration, the devices are fixed at a position, and they are connected through a physical link to communicate with other devices. Example of this type is desktop computer
b. **Fixed and Wireless:**In this configuration, the devices are fixed at a position, and they are connected through a wireless link to make communication with other devices. Example: communication towers and WiFi router.
c. **Mobile and Wired:**In this configuration, some devices are wired, and some are mobile. They altogether make the communication with other devices. Example : Laptops
d. **Mobile and Wireless:** In this configuration, the devices can communicate with each other irrespective of their position. They can also connect to any of the network without the use of any wired device. Example : WiFi Dongle

2. **Mobile Hardware:**

   Hardware consists of mobile devices or device components that can be used to receive or access the service of mobility. Examples of mobile hardware can be smartphones, portable PCs, tablet PCs, laptops,Personal Digital Assistants, etc.

3. **Mobile Software :**

It is a program that runs on mobile hardware. This is designed to deal capably with the requirements and characteristics of mobile applications. This is the OS for the appliance of mobile devices. In other words, you can also say it is the heart of the mobile systems. This is anmain component that operates the mobile device.

Mobile Network Provider :

There are basically two types of mobile network whenever the user think about the network providers i.e. GSM and CDMA .

Difference between GSM and CDMA :

S.No.	GSM	CDMA
1.	Stands for Global System for Mobile Communication	Stands for Code Division Multiple Access
2.	FDMA and TDMA technology is used	CDMA Technology is used
3.	It is used and available globally and widely	It is available in fewer countries and carriers
4.	Data speed rate is 42Mbs in HSPA (3G)	Data speed is 3.6Mbps in CDMA
5.	It supports transmitting data and voice both at once	It does not support this feature
6.	Customer information is stored in SIM card	Customer Information is stored in headset or phone .

Services and Architecture of GSM:

A GSM network comprises of different functional units. The GSM network can be divided into:

1. The Mobile Station (MS)

2. The Base Station Subsystem (BSS)

3. The Network Switching Subsystem (NSS)

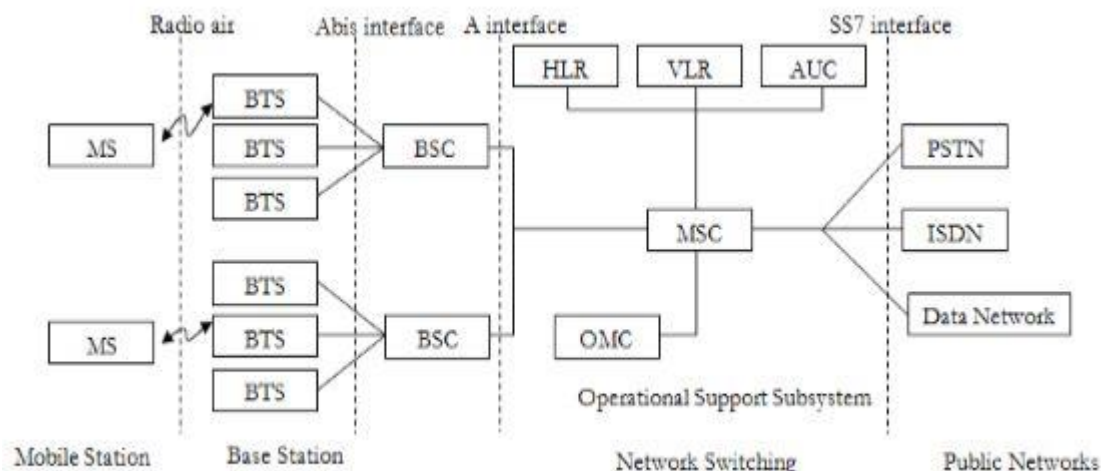4. The Operation Support Subsystem (OSS)

Fig: GSM Architecture

1. **Mobile Stations :** It is made up of two entities:

   A. Mobile equipment (ME):

   - It is a vehicle mounted,portable, hand held device.
   - It is uniquely identified by an IMEI number.
   - It is used for data and voice transmission. It also monitors signal and power quality of surrounding cells foe optimum handover. 160 characters long SMS can be sent using Mobile Equipment.

   B. Subscriber Identity module (SIM):

   - It is a smart card which contains the International Mobile Subscriber Identity (IMSI) number.
   - It allows users toreceive andsend calls and receive other subscriber services.
   - It is protected bythe password or by the PIN.
   - It contains the encoded network identification details, it has key information to activate phone.
   - It can be moved from one mobile to another mobile.

Base Station Subsystem (BSS):

BSS also known as radio subsystem, which provides and manages radio transmission paths between the mobile station and the Mobile Switching Centre (MSC). It also manages interface between the mobile station and all other subsystems of GSM. It is basically consists of two parts.

A. Base Transceiver Station (BTS):

- It encrypts, encodes , multiplexes, modulates and feeds the RF signal to the antenna.
- It consists of transceiver units.
- BTS communicates with mobile stations via radio air interface and also communicates with BSC via Abis interface.

B. Base Station Controller (BSC):

- BSC manages radio resources for BTS. It assigns time and frequency slots for all mobile stations present in its area.
- It handles transcoding, call set up and adaptation functionality handover for each MS radio power control.
- It communicates with MSC via A interface and also with BTS.

Network Switching Subsystem (NSS):

NSS manages the switching functions of the system and allows MSCs to communicate with other networks such as ISDN and PSTN. It consist of

A. Mobile switching Centre(MSC):

- It is also know heart of the network.
- MSC manages communication between GSM and other networks.
- It manages call set up function, basic switching and routing.
- It performs mobility management including location updating, registration and inter BSS and inter MSC call handoff.
- It also provides billing information.
- It does gateway function while its customers roam to other network by using HLR/VLR.

B. Home Location Registers (HLR): -
- HLR is a permanent database about mobile subscriber in a large service area.
- Its database contains IMSISDN,IMSI, prepaid/post-paid, roaming restrictions, supplementary services.

C. Visitor Location Registers (VLR): -
- VLR is a temporary database which updates whenever new MS enters its area by HLR database.

- VLR controls mobiles roaming in its area.
- It reduce the number of queries to HLR.
- Its database contains TMSI,IMSI, IMSISDN, MSRN, location, area authentication key.

D. Authentication Centre(AC): -
- AC provides protection against intruders in air interface.
- It maintains authentication keys and algorithms and provides security triplets (SRES,RAND, Ki).

E. Equipment Identity Registry (EIR):
- EIR is a database that is used to track handset using the IMEI number.
- It is mainly made up of three sub classes- the white list, the black list and the gray list.

Operational Support Subsystem (OSS):
OSS supports the operation and maintenance of GSM and allows system engineers to monitor, diagnose and troubleshoot all aspects of GSM system. It also supports one or more Operation Maintenance Centres (OMC) which are used to monitor the performance of each MS, Bs, BSC and MSC within a GSM system. It consists of three main functions:

- Maintain all telecommunication hardware and network operations with a particular market.
- Manage all charging and billing procedures
- Manage all mobile equipment in the system.

Mobile Internet Protocol (Mobile IP):-
It is a communication protocol (created by extending Internet Protocol, IP) that allows the users to move from one network to another with the same IP address. This protocol ensures that the communication will continue without user's sessions or connections being dropped.

Terminologies:

1. **Mobile Node (MN):**
   MN is the hand-held communication device that the user caries e.g. Cell phone.
2. **Home Network (HN):**
   HN is a network to which the mobile node originally belongs to as per its assigned IP address (home address).
3. **Home Agent (HA):**
   HA is a router in home network to which the mobile node was originally connected.
4. **Home Address:**
   Home address is the permanent IP address assigned to the mobile node (within its home network).
5. **Foreign Network:**
   Foreign Network is the current network to which the mobile node is visiting (away from its home network).
6. **Foreign Agent(FA):**
   FA is a router in foreign network to which mobile node is currently connected. The packets from the home agent (HA) are sent to the foreign agent(FA) which delivers it to the mobile node.
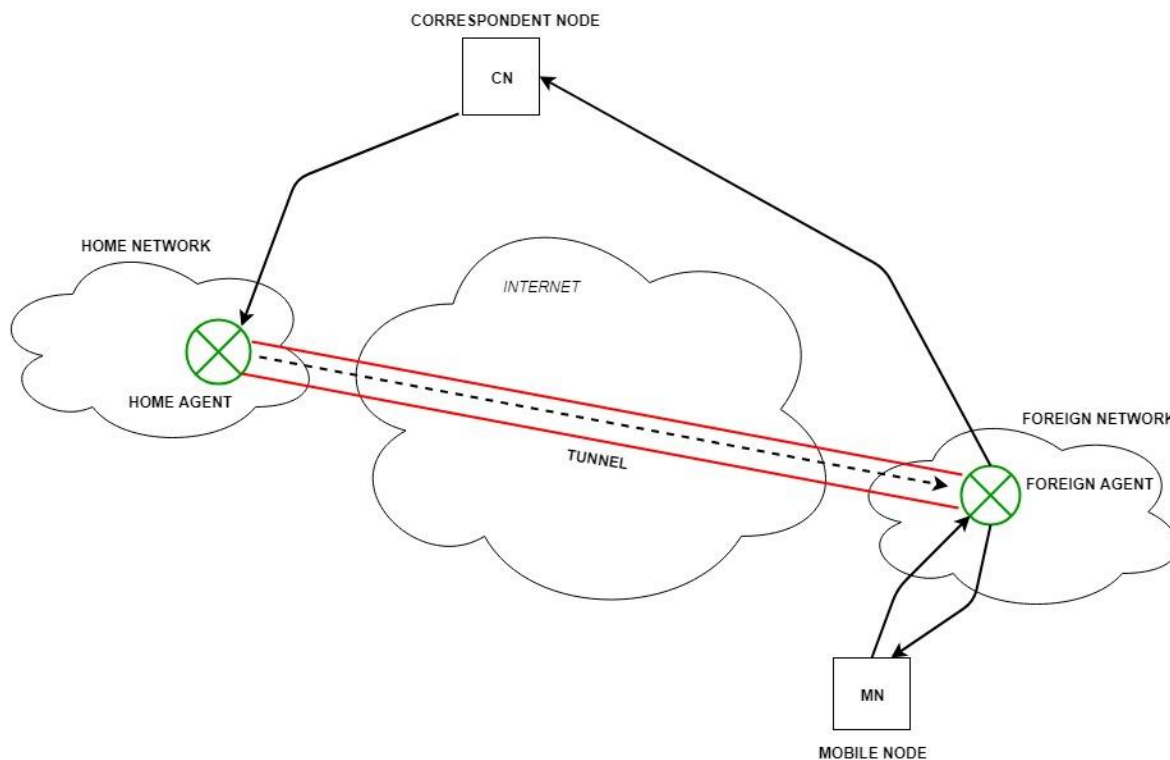7. **Correspondent Node (CN):**

CN is a device on the internet communicating to the mobile node.

8. **Care of Address (COA):**

COA is the temporary address used by a mobile node while it is moving away from its home network.

Working:

Correspondent node sends data to mobile node. The data packets contains correspondent node's address (Source) and home address (Destination). Data Packets reaches to the home agent. But now the mobile node is not in the home network(HN), it has moved into the foreign network(FN). Foreign agent(FA) sends the care-of-address to the home agent(HA) to which all the packets should be sent. Now, a tunnel will be established between the home agent(HA) and the foreign agent(FA) by the process of tunnelling.

Tunnelling establishes a virtual pipe for the data packets available between a tunnel entry and an endpoint. Tunnelling is the process of sending a packet via a tunnel and it is achieved by a mechanism called encapsulation.

Now, home agent(HA) encapsulates the data packets into new packets in which the source address is the home address(HA) and destination is the care-of-address and sends it through the tunnel to the foreign agent(FA). Foreign agent(FA), on other side of the tunnel receives the data packets, decapsulates them and sends them to mobile node. Mobile node in response to packets received, sends a reply in response to foreign agent(FA). Foreign agent(FA) directly sends the reply to the correspondent node.

Key Mechanisms in Mobile IP:

1. **Agent Discovery:**

   All the Agents advertise their presence by periodically broadcasting their agent advertisement messages. Then the mobile node receiving the agent advertisement messages observes whether the message is from its own home agent and then determines whether it is in the home network(HN) or foreign network(FA).

2. **Agent Registration:**

   Mobile node after discovering the foreign agent(FA), sends registration request (RREQ) to the foreign agent. Foreign agent(FA) in turn, sends the registration request to the home agent with the care-of-address(COA). Home agent(HA) sends registration reply (RREP) to the foreign agent(FA). Then it forwards the registration reply to the mobile node and completes the process of registration.

3. **Tunnelling:**

   Tunnelling establishes a virtual pipe for the packets available between a tunnel entry and an endpoint. Tunnelling 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(HA) to the care-of-address(COA). Whenever home agent(HA) receives a packet from correspondent node, it encapsulates the packet with source address as home address(HA) and destination as care-of-address(COA).

Wireless Network Type:

Wireless personal area network(WPAN):
It have a short range (up to 20–30 feet/7–10 meters), commonly use the 802.15 family of specifications to connect two or a few devices with low power consumption. Bluetooth isangood example of WPAN protocol

Wireless local-area networks (WLAN):
It Consume more power but extend the connection to about 300 feet (100 meters).

Wireless metropolitan-area network (WMAN):
WMAN extend the range to a larger geographic area, such as a city or suburb. The applications vary from point-to-point or point-to-multipoint links to the multiuser coverage. It typically use licensed frequencies (a fee has to be paid for permission to use the frequency), although implementations in the ISM bands can also be found. WiMAX is a good example of WMAN protocol (most WiMAX implementations use licensed bands).

**Wireless wide-area network (WWAN):**
It provide connectivity over a wide geographical area. Usually, WWANs are networks used for data service and mobile phone and are operated by carriers. It typically use licensed frequencies.

Ad hoc Network:
Ad hoc network is one that is spontaneously formed when devices connect and communicate with each other. ad hoc is a Latin word that literally means "for this," implying improvised or impromptu.

This networks are mostly wireless local area networks (WLANs). Devices communicate with each other directly instead of relying on a base station or access points as in wireless LANs(WLANs) for data transfer co-ordination. Each device participates in the routing activity, by determining the route using the routing algorithm and forwarding data to other devices via this route.
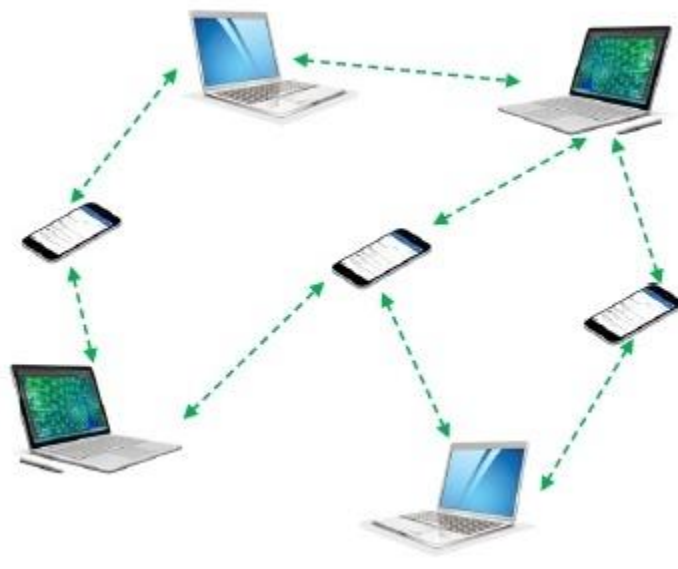
Classification of Ad hoc Netwrok :

Ad hoc is classified into several types , depending upon the nature of application :
1. Mobile adhoc network: This network is self-organising,self-configuring   wireless network of mobile device
2. Vehicular ad hoc netwroks (VANETs) : VANET is formed by communication between moving vehicle and other roadside devices
3. Wireless mesh networks : The devices connected to these networks forms a wireless mesh , depending upon the neture of device , mobility patterns and inter-device distances
4. Smart phone Ad hoc Networks(SPANs): These are peer-to-peer networks created by smartphones within range of each other without requiring any wireless access points , cellular carrier networks.
5. Wireless Senseor Network(WSN) : Sensors are portable devices that capture specific informartion from environment like humidity , traffic voulme , temprature etc. WSNs form ad hoc networks to capture information on the fly.

GPRS :
GPRS stands for General Packet Radio Service, it is an expansion of the Global System for Mobile Communication. Itis basically a mobile data standard which is packet-oriented and based on the cellular communication of 2G and 3G network's global system for mobile communication. European Telecommunications Standards Institute (ETSI) built up GPRS. It was one of the main advances that empowered the interfacing of a cell system with Internet Protocol systems.

Features of GPRS :

- It was one of a great step towards the path of 3rd Generation(3G) Network
- It provides Dynamic TDMA
- Removed the Dial-up process which created difficulty
- Provides Spectrum Efficiency

Advantages of GPRS :

- Can keep up voice consistency even on the move.
- Provides cheaper communication services as compared to GSM Network.
- It has no limit on the length of login sessions for users.
- It enables customers to acquire data irrespective of their location.

Disadvantages of GPRS :

- The capacity is limited for users.
- Lower speed in reality than expectations.
- Difficult to receive GPRS calls while using GPRS Network.

Short Message Service (SMS)

It is the most basic communications technology for mobile data transfer and is characterized by the exchange of short alphanumeric text messages between digital line and mobile devices. Messaging's key influential factor is affordability.

It messages hold up to 140 bytes (1,120 bits) of data, which allows a 160-character alphanumeric message in the default 7-bit alphabet or a 70-character message in a non-Latin language.

It is also known as text messaging.

It is supported by all (GSM) mobile phones and is also available on 3G wireless networks.

Messages are also sent via Web-based browser applications, instant message (IM) applications and Voice over Internet Protocol (VoIP) applications, like Skype. An SMS message is sent from a device to a Short Message Service Center (SMSC), which, in turn, communicates with mobile networks to determine the subscriber's location. Then, the message is forwarded as small data packet to destination device. Subsequent messages sent by the original source device undergo the same process, called as store and forward.

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