Unit III: Global System for Mobile Communications (GSM): GSM architecture – GSM Entities - Call routing in GSM - PLMN Interface – GSM Addresses and Identifiers – Networks aspects in GSM – Mobility Management – GSM frequency allocation – Personal communication service – Authentication and Security. Short Message Service (SMS): Short Message Service (SMS) – Value Added Services through SMS – Accessing the SMS Bearer.

CHAPTER 5

Global System for Mobile Communications (GSM)

GSM: Global System for Mobile communication

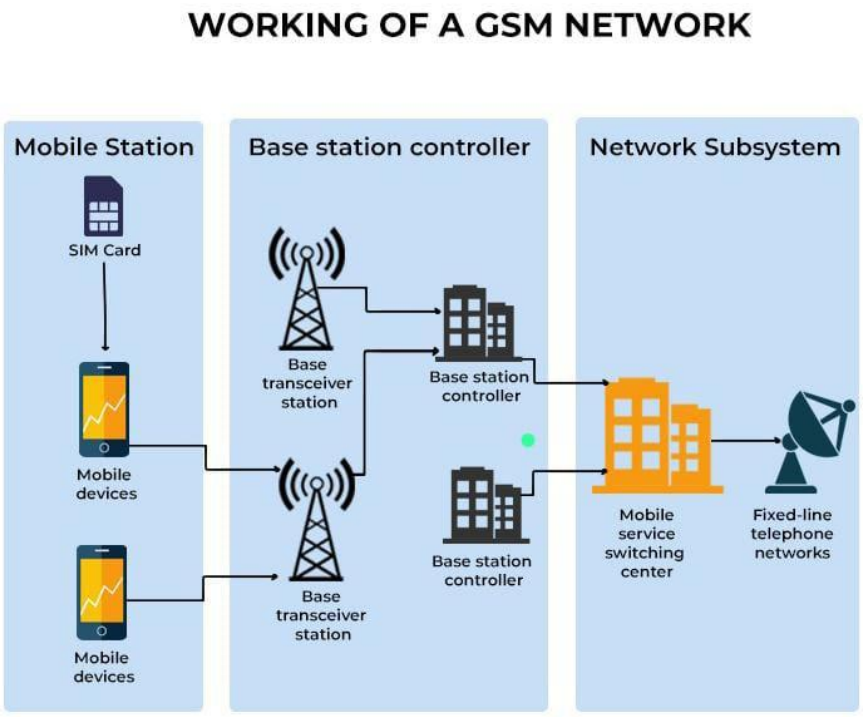
GSM stands for Global System for Mobile communication. It is a standard developed by European Telecommunication Standards Institute (ETSI) to describe protocols for second generation (2G) digital cellular networks. It was a replacement for the first generation (1G) cellular networks. The idea of developing GSM originated from a cell-based mobile radio system at the Bell Laboratories in the early 1970s.

GSM is an open, digital cellular radio network operating in over 200 countries worldwide. It uses narrowband time division multiple access (TDMA) technology. It covers almost complete Western Europe and growing in America and Asia. It is not only used for voice calls, it can also be used for data computing and sending text messages. A user can connect his GSM-enabled phone with his laptop to send or receive e-mails, faxes, browse internet, check security etc.

The GSM standard operates on three different frequencies which are as follows:

- 900 MHz: It was used by the original GSM system.
- 1800 MHz: It was used to support the growing number of subscribers.
- 1900 MHz: It is mainly used in the US.
- The Working of a GSM Network
- GSM is a digital cellular communication standard that is universally accepted. The European Telecommunications Standards Institute created the GSM standard to define the procedures for second-generation digital mobile networks that are used by devices such as mobile phones. It is a wide-area communications technology program that utilizes digital radio channeling to bring forth audio, information, and multimedia communication systems.
- GSM is a mobile network and not a computer networkOpens a new window – this implies that devices interact with it by looking for nearby cells. GSM, including other technological advances, has influenced the evolution of mobile wireless telecommunication services. A GSM system manages communication between mobile stations, base stations, and switching systems.

- Every GSM radio channel is 200 kHz wide and is additionally divided into frames of 8-time slots. The global system for mobile communication (GSM) was first known as Groupe Special Mobile, which is the reason for the acronym. The GSM system comprises mobile stations, base stations, and intertwining switching systems.
- The GSM program enables 8 to 16 audio users to share every radio channel, and every radio transmission location may have multiple radio channels. Because of its simplicity, affordability, and accessibility, GSM is presently the most commonly used network technology in the Internet of Things (IoT)Opens a new window applications.



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5.1 The Architecture of GSM

The GSM architecture is made up of three central systems. The following are the primary components of the GSM architecture:

- The network switching system (NSS)
- The mobile station (MS)
- The base station system (BSS)
- The operations and support system (OSS)

1. The network switching system (NSS)

NSS is a GSM element that provides flow management and call processing for mobile devices moving between base stations. The switching system consists of the functional units listed below.

- Mobile Services Switching Center (MSC): Mobile Switching Center is integral to the GSM network architecture's central network space. The MSC supports call switching across cellular phones and other fixed or mobile network users. It also monitors cellular services, including registration, location updates, and call forwarding to a roaming user.
- Home Location Register (HLR): It is a set of data items used for storing and managing subscriptions. It provides data for each consumer as well as their last known position. The HLR is regarded as the most significant database because it preserves enduring records about users. When a person purchases a membership from one of the operators, they are enlisted in that operator's HLR.
- Visitor Location Register (VLR): VLR is a database that provides subscriber information necessary for the MSC to service passengers. This includes a short-term version of most of the data stored in the HLR. The visitor location register can also be run as a standalone program, but it is usually implemented as a component of the MSC.
- Equipment Identity Register (EIR): It is the component that determines if one can use particular mobile equipment on the system. This consists of a list of every functioning mobile device on the system, with each mobile device recognized by its own International Mobile Equipment Identity (IMEI) number.
- Authentication Center (AuC): The AUC is a unit that offers verification and encryption factors to ensure the user's identity and the privacy of every call. The verification center is a secure file that contains the user's private key in the SIM card. The AUC shields network operators from various types of fraud prevalent in the modern-day cellular world.

2. The mobile station (MS)

The mobile station is a cell phone with a display, digital signal processor, and radio transceiver regulated by a SIM card that functions on a system. Hardware and the SIM card are the two most essential elements of the MS. The MS (Mobile stations) is most widely recognized by cell phones, which are components of a GSM mobile communications network that the
operator monitors and works.

Currently, their size has shrunk dramatically while their capabilities have skyrocketed. Additionally, the time between charges has been significantly improved.

3. The base station system (BSS)

It serves as a connection between the network subsystem and the mobile station. It consists of two parts:

- The Base Transceiver Station (BTS): The BTS is responsible for radio connection protocols with the MS and contains the cell's radio transceivers. Companies may implement a significant number of BTSs in a big metropolitan area. Each network cell has transceivers and antennas that make up the BTS. Based on the cell's consumer density, every BTS includes anywhere from one to sixteen transceivers.

- The Base Station Controller (BSC): The BSC is responsible for managing the radio resources of one or more BTS(s). This manages radio channel configuration
  And handovers. The BSC serves as the link seen between mobile and MSC. It allocates and emits MS frequency bands and time slots. Additionally, the BSC is responsible for intercell handover and transmits the BSS and MS power within its jurisdiction.

4. The operations and support system (OSS)

The operation support system (OSS) is a part of the overall GSM network design. This is linked to the NSS and BSC components. The OSS primarily manages the GSM network and BSS traffic load. As the number of BS increases due to customer population scaling, a few maintenance duties are shifted to the base transceiver stations, lowering the system's financial responsibility. The essential purpose of OSS is to have a network synopsis and assist various services and maintenance organizations with their routine maintenance arrangements.

Advantages of GSM

- Since GSM service is obtained over 200 countries, so it provides worldwide roaming for its clients to roam throughout the world.

- GSM is extremely secured because its devices and facilities cannot be easily duplicated.
- It has an extensive coverage in all over the world.
- Clear voice calls and efficient use of spectrum.
- Compatible with wide range of handsets and accessories.
- Advanced features such as short messages, caller ID, Call hold, Call forwarding etc.
- Compatible with Integrated Services Digital Network (ISDN) and other telephone company services.

Disadvantages of GSM

- The biggest disadvantage of GSM is that multiple users share the same bandwidth. This may cause interference and due to interference bandwidth limitation occurs.
- The other disadvantage of GSM is that it may cause electronic interference. That is the reason why sensitive locations like hospitals and airplanes require cell phone to be turned off otherwise it can create interference with the equipments of hospitals and airplanes.

5.2 PLMN

What is PLMN?

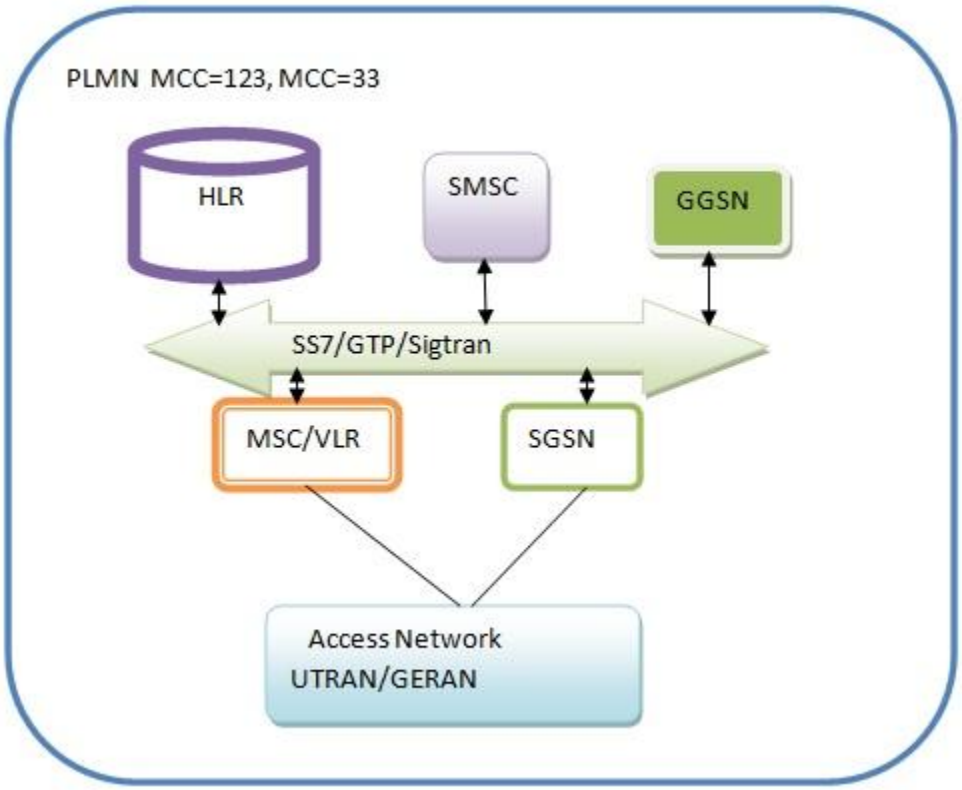
The full form of PLMN is Public Land Mobile Network. it is the geographical area covered by a mobile network operator for voice and data services to a mobile subscriber using a SIM card. For example, an operator may have one PLMN in the whole city. Based on the location it can be a home PLMN or a Visitor PLMN. We will explain each in detail.

A PLMN connects to other PLMNs for providing inter operators roaming, messaging, and data services. Other PLMN may belong to the same operator or another.

How PLMN is addressed in the network?

It is identified by an identifier known as PLMN ID. The identifier has a combination of MCC and MNC. This combination makes it unique globally.

From the IMSI of a SIM card, home PLMN can be identified. The home PLMN of a mobile subscriber is called HPLMN, which has subscription profiles of subscribers in the HLR. A mobile operator may have multiple PLMNs in the same country with a different mobile network code (MNC).



PLMN

VPLMN:

In roaming, a subscriber attaches to the core network via the access network. The roaming core network belongs to a PLMN. This is called Visiting Public Land Mobile Network or VPLMN. The VPLMN and HPLMN can be the same or different, depending upon the location of the mobile phone and the serving mobile operator. A mobile operator has VPLMN based changing and roaming policies.

PLMN network id:

For any network, there is an identifier. PLMN network id for a mobile network identifies the roaming location uniquely. An integer value contains MCC and MNC. To transfer vale on the wire, fixed decoding is done. Decoding is defined in the 3GPP spec.

MCC Digit1	MCC Digit1
MNC Digit 3	MCC Digit1
MNC Digit 2	MNC Digit 1

- The 3GPP has specified a diameter AVP called Visited PLMN id, which contains the MCC-MNC in encoded format. Whenever a UE attaches to the LET network over the 3GPP s6a interface. Messages from MME to the HSS over diameter protocol have Visited PLMN Id AVP.

- In the case of 3G, the PLMN id is present with roaming VLR information.

- The HPLMN network id is derived from the IMSI, and the VPLMN network id is derived from the roaming information present in information while the subscriber attaches to the network.

Elements of PLMN:

There are multiple components of a public land mobile network. These can be divided into two groups. One is the access network, and the other is the core network.

The access network connects the phone to the core network. The phone connects to the access network over a wireless or radio interface. The core network connects to the access network over a wired interface. The common access network is used for packet-switched and circuit-switched services. Each generation of mobile telephony has a different access network. The following mentions the generation and access network types.

GERAN, 2G access network. BTS and BSC are nodes that cover the access network.

UTRAN: This is the access network for 3G. RAN and NodeB are two nodes in the UTRAN access network.

E-UTRAN: It's the access network for LTE. eNodeB is the node that is in the access network.

The Core network does the signaling for the setup of voice and mobile internet communication. A signaling network is the control plane, and the actual data or voice network is the user plane. In 2G/3G, there are separate nodes for circuit and packet services.

MSC is for circuit switching or voice and SGSN is for packet switching or the internet in 2G and 3G. While attaching to a VPLMN, the SIM card sends authentication and update location requests to the HPLNM. The home PLMN has the configuration of the subscriber for authentication, billing, roaming, and messaging.

Home PLMN may have inbound roamers or outbound roamers. If a mobile subscriber roaming in another PLMN, then it's called an inbound roamer for the roaming network. It is

an inbound roamer from the mobile SIM provider's home network. Both network operators should have a roaming agreement.

Call Barring Outside Home PLMN:

Mobile operators can block incoming or outgoing calls if a subscriber is roaming outside the home network. There are two supplementary services described in GSM. HLR has provisioning information for the services. The following is a detailed description.

GSM - Addresses and Identifiers

GSM treats the users and the equipment in different ways. Phone numbers, subscribers, and equipment identifiers are some of the known ones. There are many other identifiers that have been well-defined, which are required for the subscriber's mobility management and for addressing the remaining network elements. Vital addresses and identifiers that are used in GSM are addressed below.

International Mobile Station Equipment Identity (IMEI) :

The International Mobile Station Equipment Identity (IMEI) looks more like a serial number which distinctively identifies 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 –

- Type Approval Code (TAC) − 6 decimal places, centrally assigned.
- Final Assembly Code (FAC) − 6 decimal places, assigned by the manufacturer.
- Serial Number (SNR) − 6 decimal places, assigned by the manufacturer.
- Spare (SP) − 1 decimal place.

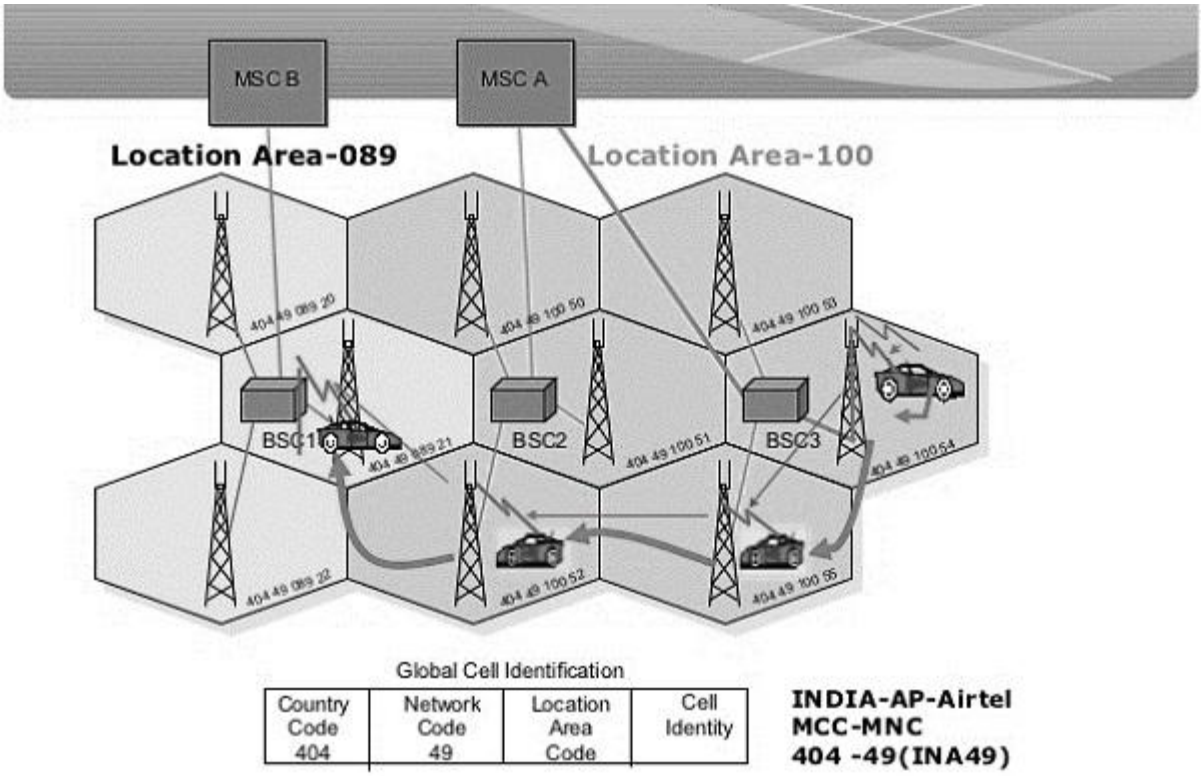
Thus, IMEI = TAC + FAC + SNR + SP. It uniquely characterizes a mobile station and gives clues about the manufacturer and the date of manufacturing.

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).

IMSI comprises of the following parts−

- Mobile Country Code (MCC) − 3 decimal places, internationally standardized.
- Mobile Network Code (MNC) − 2 decimal places, for unique identification of mobile network within the country.
- Mobile Subscriber Identification Number (MSIN) − Maximum 10 decimal places, identification number of the subscriber in the home mobile network.



Mobile Subscriber ISDN Number (MSISDN)

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 separate MSISDN to their SIM respectively.

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

- Country Code (CC) − Up to 3 decimal places.
- National Destination Code (NDC) − Typically 2-3 decimal places.
- Subscriber Number (SN) − Maximum 10 decimal places.

Mobile Station Roaming Number (MSRN)

Mobile Station Roaming Number (MSRN) is an interim location dependent ISDN number, assigned to a mobile station by a regionally responsible Visitor Location Register (VLA). Using MSRN, the incoming calls are channelled to the MS.

The MSRN has the same structure as the MSISDN.

- Country Code (CC) − of the visited network.
- National Destination Code (NDC) − of the visited network.
- Subscriber Number (SN) − in the current mobile network.

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 −

- Country Code (CC) − 3 decimal places.
- Mobile Network Code (MNC) − 2 decimal places.
- Location Area Code (LAC) − maximum 5 decimal places or maximum twice 8 bits coded in hexadecimal (LAC < FFFF).

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 and is not passed to the Home Location Register (HLR).

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

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 HLR. LMSI comprises of four octets (4x8 bits).

Cell Identifier (CI)

Using a Cell Identifier (CI) (maximum 2 × 8) bits, the individual cells that are within an LA can be recognized. When the Global Cell Identity (LAI + CI) calls are combined, then it is uniquely defined.

Chapter 6

Mobility Management , frequency & communication service

Mobility Management

What Does Mobility Management Mean?

Mobility management is a functionality that facilitates mobile device operations in Universal Mobile Telecommunications System (UMTS) or Global System for Mobile Communications (GSM) networks. Mobility management is used to trace physical user and subscriber locations to provide mobile phone services, like calls and Short Message Service (SMS).

Techopedia Explains Mobility Management

UMTS and GSM are each made up of separate cells (base stations) that cover a specific geographical area. All base stations are integrated into one area, allowing a cellular network to cover a wider area (location area).

The location update procedure allows a mobile device to notify a cellular network when shifting between areas. When a mobile device recognizes that an area code differs from a previous update, the mobile device executes a location update, by sending a location request to its network, prior location and specific Temporary Mobile Subscriber Identity (TMSI). A mobile device provides updated network location information for several reasons, including reselecting cell location coverage due to a faded signal.

Location area includes a group of base stations assembled collectively to optimize signaling. Base stations are integrated to form a single network area known as a base station controller (BSC). The BSC manages allocation of radio channels, acquires measurements from cell phones, and handles handovers from one base station to another.

Roaming is among the basic procedures of mobility management. It enables subscribers to use mobile services when moving outside of the geographical area of a specific network.

GSM Standard	Regions	Frequency Range

6.1 GSM frequency allocation

Frequency bands are the most fundamental part of the radio network for any cellular technology. When second-generation (2G) GSM networks started, they were initially limited to the 900 MHz frequency band, but they have expanded and can operate in various frequency bands.

- GSM networks use multiple frequency bands, including 900 MHz, 1800 MHz, 850 MHz and 1900 MHz. The 900 MHz/1800 MHz combination is primarily used in Europe, Asia, Africa, the Middle East and Australia, whereas the 850 MHz/1900 MHz combination is used mainly in North and South America.

- The frequency spectrum is one of the most crucial resources for a mobile network operator. It is the means for allowing mobile operators to transmit and receive signals in any geographical location so that their customers can get access to cellular services.

- The spectrum defines the frequency bands allocated to mobile network operators (MNO) within a country, which they can use to create frequency channels. These frequency channels allow our mobile phones to send and receive communication to and from the nearest base stations at specified radio frequencies.

GSM frequency bands for different parts of the world

- GSM mobile networks are one of the most widely deployed second-generation cellular technology standards around the globe. GSM can operate in multiple frequency bands, including but not limited to the 900 MHz, 1800 MHz, 850 MHz and 1900 MHz bands. The 900 MHz band ranges from 880 to 960 MHz, and the 1800 MHz band ranges from 1710 to 1880 MHz. The 850 MHz band ranges from 824 to 894 MHz, and the 1900 MHz band ranges from 1850 to 1990 MHz.

- The 900 MHz and 1800 MHz, GSM frequency bands, are primarily used in Europe, the Middle East, Africa, Asia and Australia, including GSM 900 Primary (P-GSM) and GSM 900 Extended (E-GSM) bands; the 850 MHz and 1900 MHz GSM frequency bands are used mainly in North America and South America.

GSM 900 Primary (P-GSM)	Europe, Asia, Africa, the Middle East, and Australia	890 MHz to 960 MHz
GSM 900 Extended (E-GSM)	Europe, Asia, Africa, the Middle East, and Australia	880 MHz to 960 MHz

6.2 Personal Communication Services

Personal Communications Services is a general term for digital cellular phone technologies that are used for personal wireless mobile communication. Personal Communications Services (PCS) technologies were developed in the early 1990s because the existing Advanced Mobile Phone Service (AMPS) technologies were running out of available bandwidth in the electromagnetic frequency spectrum. PCS systems are end-to-end digital in nature and are more secure than analog cellular systems. PCS networks can be used for voice, fax, and data applications such as e-mail and file transfers. PCS systems are generally circuit-switched, although some are being migrated to packet-switched networks.

- (TDMA) digital cellular systems based on the TDMA IS-136 standard. TDMA divides frequency bands into time slots and then multiplexes user conversations within these slots. TDMA operates in both the 800-MHz and 1900-MHz frequency bands, but only frequencies at 1900 MHz are specifically referred to as PCS, while those in the 800-MHz range are referred to as cellular.
- Code Division Multiple Access (CDMA) digital cellular systems based on the CDMA IS-95 standard, which was developed by QUALCOMM. CDMA uses spread-spectrum transmission technologies and assigns codes to individual users transmitting within the same broad frequency spectrum. CDMA operates at both the 800-MHz and 1900-MHz frequencies, but only frequencies at 1900 MHz are specifically referred to as PCS, while those in the 800-MHz range are referred to as cellular.
- Global System for Mobile Communications (GSM) digital cellular systems based on the GSM 1900 standard. GSM is based on TDMA technologies and divides frequency bands into time slots. GSM has the advantage of supporting roaming between Europe and North America. GSM operates in the 1900-MHz frequency range (or the 1800-MHz range in Europe).

6.3 Authentication and Encryption:

The GSM network 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 the RAND with the authentication algorithm (A3) using the individual subscriber authentication key (Ki). Upon receiving the SRES from the subscriber, the GSM network repeats the calculation to verify the identity of the subscriber.

The individual subscriber authentication key (Ki) is never transmitted over the radio channel, as it is present in the subscriber's SIM, as well as the AUC, HLR, and VLR databases. If the received SRES agrees with the calculated value, the MS has been successfully authenticated and may continue. If the values do not match, the connection is terminated and an authentication failure is indicated to the MS.

The calculation of the signed response is processed within the SIM. It provides enhanced security, as confidential subscriber information such as the IMSI or the individual subscriber authentication key (Ki) is never released from the SIM during the authentication process.

Signalling and Data Confidentiality

The SIM contains the ciphering key generating algorithm (A8) that is used to produce the 64-bit ciphering key (Kc). This key is computed by applying the same random number (RAND) used in the authentication process to ciphering key generating algorithm (A8) with the individual subscriber authentication key (Ki).

GSM provides an additional level of security by having a way to change the ciphering key, making the system more resistant to eavesdropping. The ciphering key may be changed at regular intervals as required. As in case of the authentication process, the computation of the ciphering key (Kc) takes place internally within the SIM. Therefore, sensitive information such as the individual subscriber authentication key (Ki) is never revealed by the SIM.

Encrypted voice and data communications between the MS and the network is accomplished by using the ciphering algorithm A5. Encrypted communication is initiated by a ciphering mode request command from the GSM network. Upon receipt of this command, the mobile station begins encryption and decryption of data using the ciphering algorithm (A5) and the ciphering key (Kc).

Subscriber Identity Confidentiality

To ensure subscriber identity confidentiality, the Temporary Mobile Subscriber Identity (TMSI) is used. Once the authentication and encryption procedures are done, the TMSI is sent to the mobile station. After the receipt, the mobile station responds. The TMSI is valid in the location area in which it was issued. For communications outside the location area, the Location Area Identification (LAI) is necessary in addition to the TMSI.

Chapter 7

Short Message Service (SMS)

7.1Short Message Service (SMS)

- Short Message Service (SMS) 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. SMS messaging's key influential factor is affordability.

- SMS 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, such as Chinese.

- SMS is also known as text messaging.
- Techopedia Explains Short Message Service
- SMS is supported by all Global System for Mobile Communications (GSM) mobile phones and is also available on third generation (3G) wireless networks.
- SMS messages are also sent via Web-based browser applications, instant message (IM) applications and Voice over Internet Protocol (VoIP) applications, such as 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 a small data packet to the destination device. Subsequent messages sent by the original source device undergo the same process, also known as store and forward.

SMS streamlines communication on many levels, as follows:

- Quick communication: Brief updates between family and friends
- Alerts: Voicemail, sales lead inquiries, appointments, meetings or deliveries
- Enhanced messaging service (EMS): Facilitates ring tone, image and simple media transfer

SMS adoption continues to expand globally since the first SMS message was sent in 1992 via Vodafone's GSM network. Over 2.4 billion users, or nearly 75 percent of mobile subscribers, use SMS.

The SMS boom generated sweeping commercial market success. According to the International Telecommunications Union (ITU), the SMS industry achieved a global worth of over $81 billion as of 2006. In 2008, approximately four trillion SMS messages were transmitted worldwide.

7.2 Bearer Services

Data services or Bearer Services are used through a GSM phone. to receive and send data is the essential building block leading to widespread mobile Internet access and mobile data transfer. GSM currently has a data transfer rate of 9.6k. New developments that will push up data transfer rates for GSM users are HSCSD (high speed circuit switched data) and GPRS (general packet radio service) are now available.

Supplementary Services

Supplementary services are additional services that are provided in addition to teleservices and bearer services. These services include caller identification, call forwarding, call waiting, multi-party conversations, and barring of outgoing (international) calls, among others. A brief description of supplementary services is given here −

Conferencing − It allows a mobile subscriber to establish a multiparty conversation, i.e., a simultaneous conversation between three or more subscribers to setup a conference call. This service is only applicable to normal telephony.

- Call Waiting − This service notifies a mobile subscriber of an incoming call during a conversation. The subscriber can answer, reject, or ignore the incoming call.

- Call Hold − This service allows a subscriber to put an incoming call on hold and resume after a while. The call hold service is applicable to normal telephony.

- Call Forwarding − Call Forwarding is used to divert calls from the original recipient to another number. It is normally set up by the subscriber himself. It can be used by the subscriber to divert calls from the Mobile Station when the subscriber is not available, and so to ensure that calls are not lost.

- Call Barring − Call Barring is useful to restrict certain types of outgoing calls such as ISD or stop incoming calls from undesired numbers. Call barring is a flexible service that enables the subscriber to conditionally bar calls.

- Number Identification − There are following supplementary services related to number identification −

- Calling Line Identification Presentation − This service displays the telephone number of the calling party on your screen.

- Calling Line Identification Restriction − A person not wishing their number to be presented to others subscribes to this service.

Connected Line Identification Presentation − This service is provided to give the calling party the telephone number of the person to whom they are connected. This service is useful in situations such as forwarding's where the number connected is not the number dialed.

Connected Line Identification Restriction − There are times when the person called does not wish to have their number presented and so they would subscribe to this person. Normally, this overrides the presentation service.

Malicious Call Identification − The malicious call identification service was provided to combat the spread of obscene or annoying calls. The victim should subscribe to this service, and then they could cause known malicious calls to be identified in the GSM network, using a simple command.

Advice of Charge (AoC) − This service was designed to give the subscriber an indication of the cost of the services as they are used. Furthermore, those service providers who wish to offer rental services to subscribers without their own SIM can also utilize this service in a slightly different form. AoC for data calls is provided on the basis of time measurements.

Closed User Groups (CUGs) − This service is meant for groups of subscribers who wish to call only each other and no one else.

Unstructured supplementary services data (USSD) − This allows operator-defined individual services.