

# Sop for msc in electrical engineering

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The idea of the first cellular network was brainstormed in 1947. It was intended to be used for military purposes as a way of supplying troops with more advanced forms of communications. From 1947 till about 1979 several different forms of broadcasting technology emerged. The United States began to develop the AMPS (Advanced Mobile Phone Service) network, while European countries were developing their own forms of communication. 1. 2 History of GSM Technology Europeans quickly realized the disadvantages of each European country operating on their mobile network. It prevents cell phone use from country to country within Europe.

With the emerging European Union and high travel volume between countries in Europe this was seen as a problem. Rectifying the situation the Conference of European Posts and Telegraphs (CEPT) assembled a research group with intentions of researching the mobile phone system in Europe. This group was called Group Special Mobile (GSM). For the next ten years the GSM group outlined standards, researched technology and designed a way to implement a pan-European mobile phone network. In 1989 work done by the GSM group was transferred to the European Telecommunication Standards Institute (ETSI).

The name GSM was transposed to name the type of service invented. The acronym GSM had been changed from Group Special Mobile to Global Systems Mobile Telecommunications. By April of 1991 commercial service of the GSM network had begun. Just a year and half later in 1993 there were already 36 GSM networks in over 22 countries. Several other countries were on the rise to adopt this new mobile phone network and participate in what

was becoming a worldwide standard. At the same time, GSM also became widely used in the Middle East, South Africa and Australia.

While the European Union had developed a sophisticated digital cell phone system, the United States was still operating primarily on the old, analog AMPS network and TDMA. Department of E&C 2010 Lovely Institute of Technology, Phagwara 2 RF OPTIMIZATION AND PLANNING In the end of the end of October 2001, Cingular was the first to announce their switch to the 3G GSM network. This involved switching more than 22 million customers from TDMA to GSM. In 2005 Cingular stopped new phone activation on the TDMA network and began only selling GSM service.

1. History of GSM in brief

- 1982: CEPT (Conference of European Posts and Telecommunications) establishes a GSM group in order to develop the standards for pan-European cellular mobile system
- 1988: Validation of the GSM System.
- 1991: Commercial launch of the GSM service.
- 1992: Enlargement of the countries that signed the GSM-MoU> Coverage of larger cities/airports.
- 1993: Coverage of main roads GSM services start outside Europe.
- 1995: Phase 2 of the GSM specifications Coverage of rural areas.

1. 4 GSM Frequency Band

There are five major GSM frequencies that have become standard worldwide. They are following GSM-1800 GSM-850 GSM-1900 GSM-400

1. 4. 1 GSM-900 and GSM-1800 GSM-900 and GSM-1800 are standards used mostly worldwide. It is the frequency European phones operate on as well as most of Asia and Australia.

1. 4. 2 GSM-850 and GSM-1900 GSM-850 and GSM-1900 are primarily United States frequencies. They are also the standard for Canada GSM service and countries in Latin and South America. Most of the Cingular network operates on GSM 850, while much of T-Mobile operates at

GSM-1900. T-Mobile however, has roaming agreements with Cingular. Meaning in the case of no service at GSM-1900, the phone will switch to GSM-850 and operate on Cingular's network. . 4. 3 GSM-400 GSM-400 is the least popular of the bunch and is rarely used. It is an older frequency that was used in Russia and Europe before GSM-900 and GSM-1800 became available. There are not many networks currently operating at this frequency. . 5 GSM Services . The GSM services are grouped into three categories: 1. Teleservices (TS) 2. Bearer services (BS) 3. Supplementary services (SS) 1. 5. 1 Teleservices Regular telephony, emergency calls, and voice messaging are within Teleservices. Telephony, the old bidirectional speech calls, is certainly the most popular of all services.

An emergency call is a feature that allows the mobile subscriber to contact a nearby emergency service, such as police, by dialing a unique number. Voice messaging permits a message to be stored within the voice mailbox of the called party either because the called party is not reachable or because the calling party chooses to do so. 1. 5. 2 Bearer Services Data services, short message service (SMS), cell broadcast, and local features are within BS. Rates up to 9. 6 kbit/s are supported. With a suitable data terminal or computer connected directly to the mobile apparatus, data may be sent through circuit-switched or packet-switched networks.

Short messages containing as many as 160 alphanumeric characters can be transmitted to or from a mobile phone. In this case, a message center is necessary. The broadcast mode (to all subscribers) in a given geographic area may also be used for short messages of up to 93 alphanumeric characters. Some local features of the mobile terminal may be used. These

may include, for example, abbreviated dialing, edition of short messages, repetition of failed calls, and others. . 5. 3 Supplementary Services Some of the Supplementary Services are as follows: 1.

Advice of charge:- This SS details the cost of a call in progress. 2. Barring of all outgoing calls: - This SS blocks outgoing calls. 3. Barring of international calls:- This SS blocks incoming or outgoing international calls as a whole or only those associated with a specific basic service, as desired. 4. Barring of roaming calls: - This SS blocks all the incoming roaming calls or only those associated with a specific service. 5. Call forwarding:- This SS forwards all incoming calls, or only those associated with a specific basic service, to another directory number.

The forwarding may be unconditional or may be performed when the mobile subscriber is busy, when there is no reply, when the mobile subscriber is not reachable, or when there is radio congestion. 6. Call hold: - This SS allows interruption of a communication on an existing call. Subsequent reestablishment of the call is permitted. 7. Call waiting: - This SS permits the notification of an incoming call when the mobile subscriber is busy. 8. Call transfer: - This SS permits the transference of an established incoming or outgoing call to a third party. 9.

Completion of calls to busy subscribers: - This SS allows notification of when a busy called subscriber becomes free. At this time, if desired, the call is reinitiated. 10. Closed user group:- This SS allows a group of subscribers to communicate only among themselves. 11. Calling number identification presentation/restriction: - This SS permits the presentation or restricts the presentation of the calling party's identification number (or additional

address information). 12. Connected number identification presentation: - This SS indicates the phone number that has been reached Chapter 2 GSM Identities 2.

Classification of GSM IDENTITY NUMBER ;Mobile Station ISDN Number (MSISDN) ;International Mobile Subscriber Identity (IMSI) ;Mobile Station Roaming Number (MSRN) ;International Mobile Station Equipment Identity (IMEI) ;Location Area Identity (LAI) . 2. 1 Mobile Station ISDN Number (MSISDN) The MSISDN is a number which uniquely identifies a mobile telephone subscription in the public switched telephone network numbering plan. According to the CCITT recommendations, the mobile telephone number or catalogue number to be dialled is composed in the following way:  

$$\text{MSISDN} = \text{CC} + \text{NDC} + \text{SN}$$

$$\text{CC} = \text{Country Code}$$

$$\text{NDC} = \text{National Destination Code}$$

$$\text{SN} = \text{Subscriber Number}$$
 E. g. 919822012345 = 91 + 98 + 22 + 012345 A National Destination Code is allocated to each GSM PLMN. In some countries, more than one NDC may be required for each GSM PLMN. The international MSISDN number may be of variable length. The maximum length shall be 15 digits, prefixes not included. 2. 2 International Mobile Subscriber Identity (IMSI) The IMSI is the information which uniquely identifies a subscriber in a GSM/PLMN. For a correct identification over the radio path and through the GSM PLMN network, a specific identity is allocated to each subscriber.

This identity is called the International Mobile Subscriber Identity (IMSI) and is used for all signalling in the PLMN. It will be stored in the Subscriber Identity Module (SIM), as well as in the Home Location Register (HLR) and in the serving Visitor Location Register (VLR). The IMSI consists of three

different parts: IMSI = MCC + MNC + MSIN  
MCC = Mobile Country Code (3 digits)  
MNC = Mobile Network Code (2 digits)  
MSIN = Mobile Subscriber Identification Number (max 10 digits) e. g. 404 + 22 + 0000123456  
According to the GSM recommendations, the IMSI will have a length of maximum 15 digits.

All network-related subscriber information is connected to the IMSI.  
2.3 Mobile Station Roaming Number (MSRN)  
HLR knows in what MSC/VLR Service Area the subscriber is located. In order to provide a temporary number to be used for routing, the HLR requests the current MSC/VLR to allocate and return a Mobile Station Roaming Number (MSRN) for the called subscriber. At reception of the MSRN, HLR sends it to the GMSC, which can now route the call to the MSC/VLR exchange where the called subscriber is currently registered.

The interrogation call routing function (request for an MSRN) is part of the Mobile Application Part (MAP). All data exchanged between the GMSC - HLR - MSC/VLR for the purpose of interrogation is sent over the No. 7 signalling network. The Mobile Station Roaming Number (MSRN), according to the GSM recommendations, consists of three parts: MSRN = CC + NDC + SN  
CC = Country Code  
NDC = National Destination Code  
SN = Subscriber Number  
e. g. : 91 + 98 + 22 + 005XXX where, 005XXX is sent by MSC. 00 is for Pune MSC, 20 is for Nagpur MSC, 10 is for Goa MSC.

Note: In this case, SN is the address to the serving MSC. The IMEI is used for equipment identification. An IMEI uniquely identifies a mobile station as a piece or assembly of equipment. (See IMEI, chapter 5. )  
IMEI = TAC + FAC + SNR + sp  
TAC = Type Approval Code (6 digits), determined by a central GSM

body FAC = Final Assembly Code (2 digits), identifies the manufacturer SNR = Serial Number (6 digits), an individual serial number of six digits uniquely identifying all equipment within each TAC and FAC sp = spare for future use (1 digit) e. g. 52518 + 00 + 581976 + 3 Where, 35 is for Nokia Handsets According to the GSM specification, IMEI has the length of 15 digits. 2. 5 Location Area Identity (LAI) LAI is used for location updating of mobile subscribers. LAI = MCC + MNC + LAC MCC = Mobile Country Code (3 digits), identifies the country. It follows the same numbering plan as MCC in IMSI. MNC = Mobile Network Code (2 digits), identifies the GSM/PLMN in that country and follows the same numbering plan as the MNC in IMSI. LAC = Location Area Code, identifies a location area within a GSM PLMN network.

The maximum length of LAC is 16 bits, enabling 65 536 different location areas to be defined in one GSM PLMN. E. g. 404 +22 + 10000 where 10000 is the LAC for Pune. 2. 6 Cell Global Identity (CGI) CGI is used for cell identification within the GSM network. This is done by adding a Cell Identity (CI) to the location area identity. CGI = MCC + MNC + LAC + CI CI = Cell Identity, identifies a cell within a location area, maximum 16 bits e. g. 404 + 22 + 10000 + 726 Where, 404 + 22 + 10000 is the LAI for Pune and 726 are the CI of one of the cells of Pune. CI is different for all the three sectors of the cell. . 7 Base Station Identity Code (BSIC) BSIC allows a mobile station to distinguish between different neighbouring base stations. BSIC = NCC + BCC NCC = Network Colour Code (3 bits), identifies the GSM PLMN. Note that it does not uniquely identify the operator. NCC is primarily used to distinguish between operators on each side of border. BCC = Base Station Colour Code (3 bits), identifies the Base Station to help distinguish between BTS using the



same BCCH frequencies e. g. 71 Where 7 is the NCC for IDEA Operator. and 1 is the BCC. BCC can range from 0 to 7 Chapter 3 GSM Network Elements

GSM stands for Global System for Mobile communication & is a globally accepted standard for digital cellular communication. GSM is the name of a standardization group established in 1982 to create a common European mobile telephone standard that would formulate specifications for a pan-European mobile cellular radio system operating at 900 MHz. It is estimated that many countries outside of Europe will join the GSM partnership. GSM provides recommendations, not requirements. The GSM specifications define the functions and interface requirements in detail but do not address the hardware.

The reason for this is to limit the designers as little as possible but still to make it possible for the operators to buy equipment from different suppliers. The GSM network is divided into three major systems: ? The switching system (SS) ? The base station system (BSS) ? The operation and support system (OSS) 3. 1 GSM BASIC BLOCK DIAGRAM Department of E&C 2010 Lovely Institute of Technology, Phagwara 14 RF OPTIMIZATION AND PLANNING 3. 2 BASIC GSM NETWORK ARCHITECTURE 3. 2. 1 SWITCHING CENTRE Department of E&C 2010 Lovely Institute of Technology, Phagwara