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Global System For Mobile Communication

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ABSTRACT: Wireless communications grew at a breakneck pace during the last decade, becoming an indispensable aspect of modern civilization.

Mobile communication has become one of the fastest growing areas of telecommunications due to its ease and flexibility. During the previous two decades, mobile communication networks have seen remarkable expansion in both the number of users and the breadth of services offered. GSM stands for Global System for Mobile Communications, and it is a pan- European mobile communication system that was originally deployed in the early years of this decade in the 900 MHz; band. The survey of GSM for wireless communication, which is one of the most widely deployed second generation wireless cellular systems in the world, is the topic of this paper.

While voice was the primary service supplied by early communication systems, today's systems enable a variety of transmission options. The GSM (Global System for Mobile Communication) standard is the basis for one of the most widely used cellular systems. The GSM System configuration and major attributes are briefly discussed. It covers service and features, SM system architecture, GSM channel and frame structure, GSM security features, and data in the GSM system.

Keywords: GSM Architecture

INTRODUCTION:

The Global System for Mobile Communications (GSM) is a standard. Telecommunications developed by the European Institute (ETSI) to describe the protocols for second-generation (2G) Digital cellular networks used by mobile devices such as mobile phones and tablets. GSM is also a trade mark owned by the GSM Association. GSM may also refer to the Full Rate voice codec. It was first implemented in Finland in December 1991. By the mid-2010s, it became a global standard for mobile communications achieving over 90% market share, and operating in over 193 countries and territories.

2G networks developed as a replacement for first generation (1G) Analog cellular networks.[2] The GSM standard originally described a digital, circuit-switched network optimized for full duplex voice telephony. This expanded over time to include data communications, first by circuit switched transport, then by packet data transport via General Packet Radio Service (GPRS), and Enhanced Data Rates for GSM Evolution (EDGE). Subsequently, the 3GPP developed third generation (3G) UMTS standards, followed by the fourth generation (4G) LTE Advanced and the fifth generation5G standards, which do not form part of the ETSI GSM standard. Beginning in the late 2010s, various carriers worldwide started to shown their GSM networks. Nevertheless, as a result of the network's widespread use, the acronym "GSM" is still used as a generic term for the plethora of *G* mobile phone technologies evolved from its.[3]

GSM ARCHITECTURE

- Network Subsystem
- Radio Subsystem
- Operation and Maintenance Subsystem

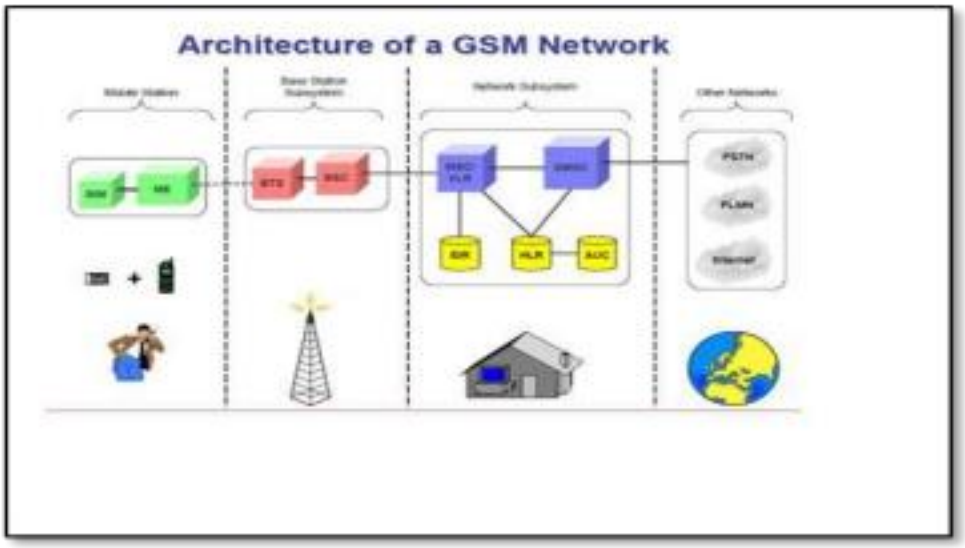

Fig.1 Architecture of GSM Network

A Network Subsystem- Performs call processing and subscriber related functions. It includes: MSC: Mobile Switching Centre HLR: Home

Location Register

VLR: Visitor Location Register
AUC: Authentication Centre
EIR: Equipment Identity Register
GMSC: Gateway MSC

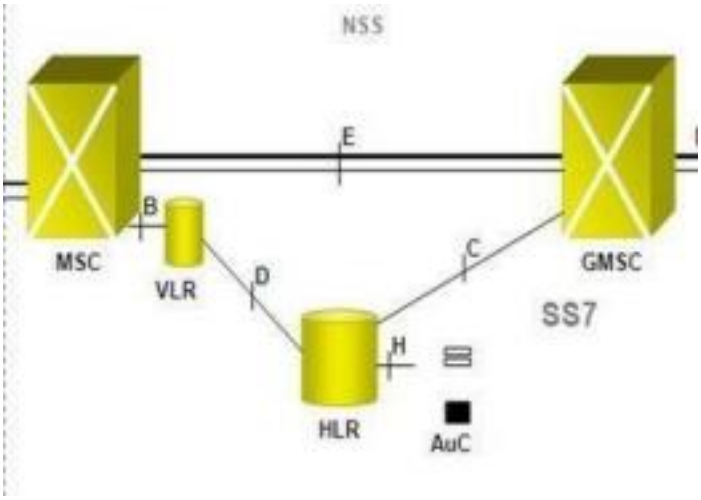

FIG.2 GSM TECHNOLOGY

It is included in the GSM system for call switching. Its overall purpose is the same as that of any telephone exchange. The functions carried out by the MSC are listed below: Call Processing Includes control of data/voice call setup, interBSS and inter-MSC handovers and control of mobility management (subscriber validation and

location). Operations and Maintenance Support Includes database management, traffic metering and measurement, and a man–machine interface. Internetwork Interworking Manages the interface between the GSM network and the PSTN. When the MSC provides the interface with the other networks in the GSM network it is known as a Gateway MSC.

Reference database for subscriber parameters. Subscriber ID (IMSI & MSISDN). Current location of subscriber. Subscriber status (registered/unregistered) Authentication key and AUC functionality. Mobile subscriber roaming number.[6]

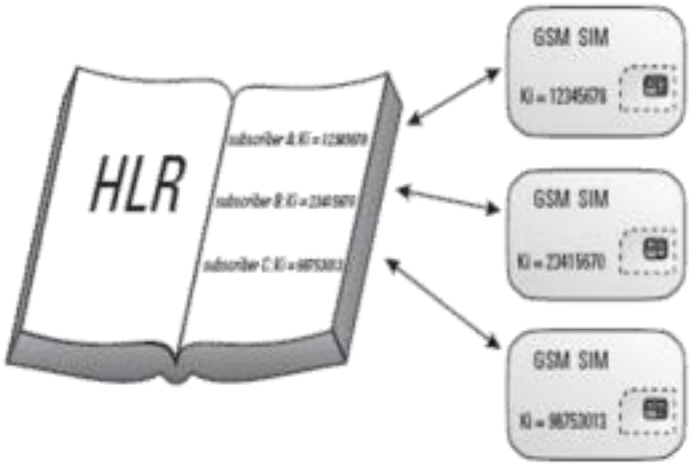

FIG.3 GSM SIM

It provides local database for the subscribers wherever they are physically located within a PLMN, this may or may not be the "home" system. It is a local database and contains copy of most of the data stored in HLR. It contains: Mobile status (busy/free/no Ans) Location area identity (LAI) TMSI AND MSRN[10].

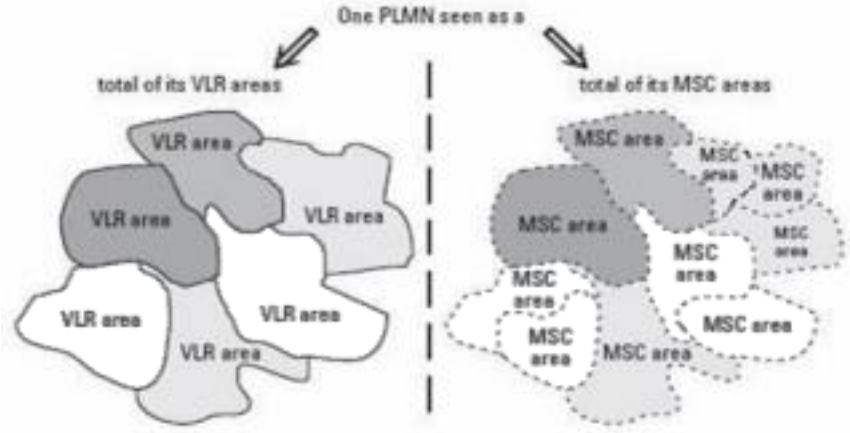

FIG.4 VISITOR LOCATION REGISTER

It provides authentication and encryption parameters for verification of subscriber identity. It ensures confidentiality of each cell. It protects network operators from frauds in today's cellular world. It is associated with HLR. The authentication process will usually take place each time the subscriber "initializes" on the system. The EIR contains a centralized database for validating the International Mobile Equipment Identity (IMEI). **It contains three lists:**

White List Contains those IMEIs which are known to have been assigned to valid MS equipment. Black List Contains IMEIs of MS which have been reported stolen or which are to be denied service for some other reason.

Grey List Contains IMEIs of MS which have problems (for example, faulty software). These are not, however, sufficiently significant to warrant a ''black listing [10]

B. RADIO SUBSYSTEMR

As the name implies, the radio subsystem (RSS) comprises all radio specific entities, i.e., the mobile stations (MS) and the base station subsystem (BSS). A GSM network is composed of several functional entities, whose functions and interfaces are specified. The GSM network can be divided into three broad parts. The Mobile Station is carried by the subscriber.[7] The Base Station

Subsystem controls the radio link with the Mobile Station.

The Network Subsystem.

The Mobile Station and the Base Station Subsystem communicate across the Um interface, also known as the air interface or radio link.

The Base Station Subsystem communicates with the Mobile services Switching Center across the A interface.[9] Mobile Station: The mobile station (MS) consists of the mobile equipment (the terminal) and a smart card called the Subscriber Identity Module (SIM). Base Station Subsystem: The Base Station Subsystem is composed of two parts: The Base Transceiver Station (BTS) and The Base Station Controller (BSC).

These communicate across the standardized Absi interface, allowing (as in the rest of the system) operation between components made by different suppliers. The Base Transceiver Station houses the radio transceivers that define a cell and handles the radio link protocols with the Mobile Station.

In a large urban area, there will potentially be a large number of BTSs deployed, thus the requirements for a BTS are ruggedness, reliability, portability, and minimum cost. The Base Station Controller manages the radio resources for one or more BTS It handles radio channel setup, frequency hopping, and handovers, as described below. The BSC is the connection between the mobile station and the Mobile service Switching Center (MSC). [1]

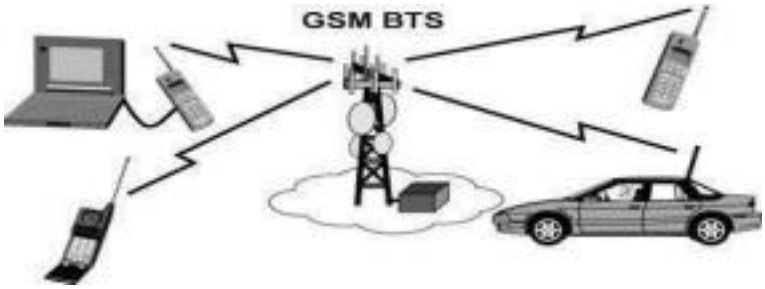

FIG.5 GSM BTS

Operations and Maintenance Subsystem

The Operation and Support Subsystem (OSS) is a critical part of the GSM architecture in mobile communication. It serves as the backbone for managing, monitoring, and maintaining the network's infrastructure and services. OSS plays a central role in ensuring that the GSM network operates efficiently, reliably, and securely. Here's a detailed description of the Operation and Support Subsystem (OSS) in GSM:

Network Management:

OSS is primarily responsible for network management, encompassing the planning, deployment, operation, and optimization of the GSM network.

It allows network operators to configure, monitor, and control network elements, ensuring they operate as intended and meet service quality standards. [3][4]

Performance Monitoring and Optimization: OSS continuously monitors the performance of network components, such as Base Transceiver Stations (BTS), Base Station Controllers (BSC), and Mobile Switching

Centers (MSC). Performance data, including call quality, traffic levels, and network capacity, is collected and analyzed to optimize network resource allocation and improve overall network efficiency.

I. Fault Management:

OSS provides real-time monitoring and fault detection capabilities. It identifies and responds to network failures, errors, or irregularities promptly.

When issues arise, OSS can trigger alarms, notifications, and automated actions to ensure rapid troubleshooting and problem resolution. [8]

Configuration Management: OSS allows network operators to configure and manage network elements, ensuring that they are properly provisioned and configured to deliver services efficiently. Changes in network configurations, such as adding new cells or modifying network parameters, can be carried out through OSS interfaces.

Security Management: Security is a paramount concern in the GSM network, and OSS plays a role in managing security measures. It assists in implementing and maintaining security protocols, access control, and authentication mechanisms to safeguard the network against threats and vulnerabilities. Billing and Charging:

OSS interfaces with the billing and charging systems to collect usage data for subscribers. It helps track usage patterns and generate accurate bills.

It also supports the implementation of various charging models, including prepaid and postpaid billing. **Inventory Management:** OSS keeps track of network equipment, including their locations, configurations, and maintenance histories. This helps network operators manage and plan equipment upgrades, replacements, and maintenance schedules effectively.

II. Subscriber Management:

OSS supports subscriber management functions, such as subscriber registration, provisioning, and deactivation. It helps ensure that subscribers can access the services they have subscribed to and manages their profiles within the network. III. Traffic Engineering:

OSS assists in optimizing network traffic by adjusting network

parameters, such as channel allocation and

load balancing, to ensure efficient resource utilization.

Interoperability and Vendor Independence: OSS is designed to work with network elements from different vendors, ensuring vendor independence and flexibility in network deployment and management. **Reporting and Analysis:**

OSS generates reports and analytics on network performance, traffic patterns, and service quality. This data is valuable for making informed decisions about network upgrades and enhancements. In summary, the Operation and Support Subsystem (OSS) in GSM is an integral part of the network infrastructure responsible for the management, monitoring, and maintenance of the GSM network. It encompasses a wide range of functions, including network management, performance monitoring, fault management, configuration management, security management, billing, and subscriber management.

OSS ensures that the GSM network operates efficiently, delivers high-quality services, and remains secure and reliable for subscribers[8]

III. Features Provided by GSM

Call Waiting - Notification of an incoming call while on the handset Call Hold - Put a caller on hold to take another call Call Barring - All calls, outgoing calls, or incoming calls Call Forwarding - Calls can be sent to various numbers defined by the user Multi Party Call Conferencing - Link multiple calls together

Calling Line ID - incoming telephone number displayed Alternate Line Service - one for personal calls - one for business calls Closed User Group - call by dialing last for numbers Advice of Charge - tally of actual costs of phone calls Fax & Data Virtual Office / Professional Office Roaming -services and features can follow customer from market to market [2] .

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IV.Advantages of GSM

Crisper, cleaner quieter calls Security against fraud and eavesdropping International roaming capability in over 100 countries Improved battery life Efficient network design for less expensive system expansion Efficient use of spectrum Advanced features such as short messaging and caller ID A wide variety of handsets and accessories High stability mobile fax and data at up to 9600 baud Ease of use with over the air activation, and all account information is held in a smart card which can be moved from handset

to handset.

1)GSM technology has been matured since long and hence GSM mobile mobile phones and modems are widely available across the world.

2)It provides very cost-effective products and solutions.

3)The GSM based networks (i.e. base stations) are deployed across the world and hence same mobile phone works across the globe. This leverages cost benefits as well as provides seamless wireless connectivity. This will help users avail data and voice services without any disruption. Hence international roaming is not a concern.

4)Advanced versions of GSM with higher number of antennas will provide highspeed download and upload of data. [7]

5)SAIC and DAIC techniques provide very high transmission quality. SAIC stands for Single Antenna Interference Cancellation technique while DAIC stands for Dual antenna interference cancellation. 6)It is easy to maintain GSM networks due to availability of large number of network engineers at affordable cost. This will help in revenue increase by the telecom operators. 7. The phone works based on SIM card and hence it is easy to change the different varieties of phones by users. It also allows to store user data and preferences.

7)The GSM signal does not have any deterioration inside the office and home premises and offers good voice call quality due to digital encoding and error correction techniques used.[5] 8)It is easy to integrate GSM technology stack with other wireless technology-based devices such as CDMA, LTE etc. 9)GSM incorporates encryption and authentication measures, making it more secure than analog systems.

10)GSM introduced SMS which became popular and cost-effective way to communicate. 11)provides limited data rate capability, for higher data rate, GSM advanced version devices are used. GSM specifications enable devices and networks from different vendors to work together without any technical concerns.

12)GSM technology is energy efficient, which is important for mobile devices with limited battery capacity.[5]

V. Disadvantages of GSM

1)Following are more than 5 disadvantages of GSM network :

2)GSM uses FTDMA access scheme and has limited bandwidth. Here multiple users share same bandwidth and hence will lead to interference when a greater number of users are using the GSM service. In order to avoid this situation, robust frequency correction algorithms are used in mobile phones and base stations.

3)GSM uses pulse based burst transmission technology and hence it interferes with certain electronics. Due to this fact airplanes, petrol bunks and hospitals prevent use of GSM based mobile or other gadgets. 4)Despite encryption, GSM networks are vulnerable to hacking and eavesdropping.

5)While it is widespread, GSM coverage may not be available in extremely remote or undeveloped areas and also areas served by other cellular technologies such as 4G LTE and 5G NR (New Radio). [5] 6)The performance of GSM networks depend on quality and capacity of backhaul infrastructure, which may be inadequate in some regions.

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9)Older GSM devices may not be compatible with newer networks and require users to upgrade their devices.[6]

V. Future Of GSM

2nd Generation❑ GSM -9.6 Kbps (data rate)2.5 Generation (Future of GSM) HSCSD (High Speed cut Switched data) ➢ Data rate: 76.8 Kbps (9.6 x 8 kbps) ❑GPRS (General Packet Radio service) ➢ Data rate: 14.4 - 115.2 Kbps ❑EDGE (Enhanced data rate for GSM Evolution) ➢ Data rate: 547.2 Kbps (max) 3 Generation ❑WCDMA (Wide band CDMA) ➢ Data rate: 0.348 – 2.0 Mbps [3]

VI. Conclusion

The communication development and the increase of living standard of people are directly related to the more use of cellular mobile. Cellular mobile radio-the high-end sophisticated technology that enables everyone to communicate anywhere with anybody. The mobile telephony industry rapidly growing and that has become backbone for business success and efficiency and a part of modern lifestyles all over the world.In this thesis work we have tried to give and over view of the GSM system. We hope that we gave the general flavor of GSM and the philosophy behind its design. The GSM is standard that insures interoperability without stifling competition and innovation among the suppliers to the benefit of the public both in terms of cost and service quality. The features and benefits expected in the GSM systems are superior speech quality, low terminal, operational and service costs, a highlevel security, providing international roaming support of low power hand portable terminals and variety of new services and network facilities. In near forth coming days, the thirdgeneration mobile
telephony becomes available whole over the world, which will give the facility of videoconference in mobile telephone

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