

SARDAR PATEL INSTITUTE OF TECHNOLOGY

B. Tech.

Department of Electronics and Telecommunication

Semester VII

ETL71: Mobile and Wireless Technology

Faculty in Charge: Prof. Anand Mane

Experiment No. 01

**To study Hardware Configuration of Mobile
Communication System**

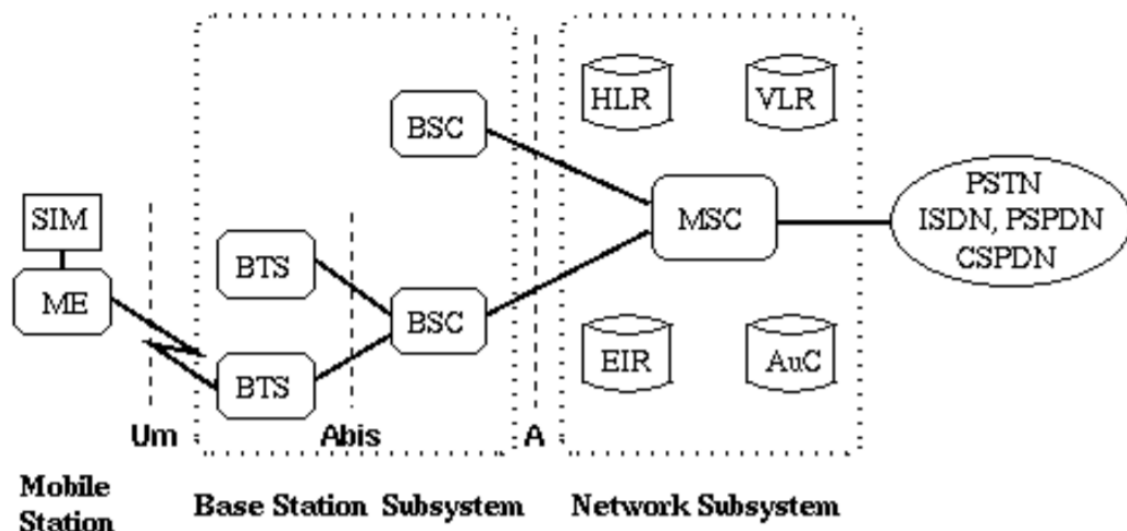
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Batch: A	Date: 24/08/2021

AIM: Prepare a Report on Hardware configuration of Mobile communication System.

1. Mobile Station.
2. Base transceiver station (BTS)
3. Base Station Controller. (BSC)
4. Mobile Switching center (MSC)
5. Gateway to MSC (GMSC)
6. Home Location Register (HLR)
7. Visitor Location Register (VLR)
8. Equipment Identity Register (EIR)

Add detail survey of hardware and software's used in above block.

BLOCK DIAGRAM:



SIM	Subscriber Identity Module	BSC	Base Station Controller	MSC	Mobile services Switching Center
ME	Mobile Equipment	HLR	Home Location Register	EIR	Equipment Identity Register
BTS	Base Transceiver Station	VLR	Visitor Location Register	AuC	Authentication Center

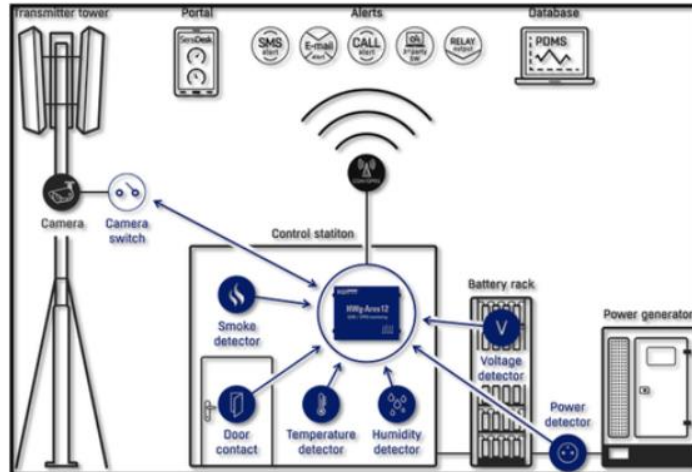
1) Mobile Station

A mobile station comprises all user equipment and software needed for communication with a mobile network. In GSM, a mobile station consists of+ four main components:

- a) Mobile termination (MT) - offers common functions such as: radio transmission and handover, speech encoding and decoding, error detection and correction, signalling and access to the SIM. The IMEI code is attached to the MT. It is equivalent to the network termination of an ISDN access.
- b) Terminal equipment (TE) - is any device connected to the MS offering services to the user. It does not contain any functions specific to GSM.

- c) Terminal adapter (TA) - provides access to the MT as if it were an ISDN network termination with extended capabilities. Communication between the TE and MT over the TA takes place using AT commands.
- d) Subscriber identity module (SIM) - is a removable subscriber identification token storing the IMSI, a unique key shared with the mobile network operator and other data.

2) Base transceiver station (BTS)



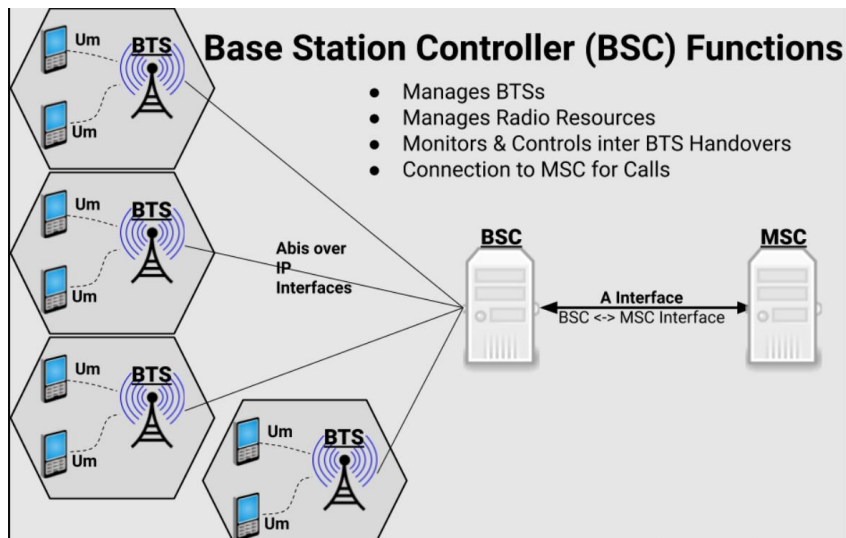
The BTS houses the radio transceivers that define a cell and handles the radio link protocols with the MS. In a large urban area, a large number of BTSs may be deployed. The BTS corresponds to the transceivers and antennas used in each cell of the network. A BTS is usually placed in the center of a cell. Its transmitting power defines the size of a cell. Each BTS has between 1 and 16 transceivers, depending on the density of users in the cell. Each BTS serves as a single cell. It also includes the following functions –

- a) Encoding, encrypting, multiplexing, modulating, and feeding the RF signals to the antenna
- b) Transcoding and rate adaptation
- c) Time and frequency synchronizing
- d) Voice through full- or half-rate services
- e) Decoding, decrypting, and equalizing received signals
- f) Random access detection
- g) Timing advances
- h) Uplink channel measurements

BTS Components:

- a) Transceiver (TRX)
- b) Power amplifier (PA)
- c) Combiner
- d) Multiplexer
- e) Antenna
- f) Baseband receiver unit
- g) Control function
- h) Alarm extension system
- i) Clock Module
- j) Operation and Maintenance module

3) Base Station Controller (BSC)



The BSC manages the radio resources for one or more BTS's. It handles radio channel setup, frequency hopping, and handovers. The BSC is the connection between the mobile and the MSC. The BSC also translates the 13 Kbps voice channel used over the radio link to the standard 64 Kbps channel used by the Public Switched Telephone Network (PSDN) or ISDN. It assigns and releases frequencies and time slots for the MS. The BSC also handles intercell handover. It controls the power transmission of the BSS and MS in its area. The function of the BSC is to allocate the necessary time slots between the BTS and the MSC. It is a switching device that handles the radio resources.

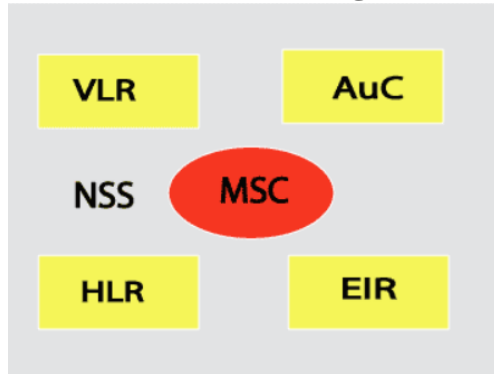
The additional functions include—

- a) Control of frequency hopping
- b) Performing traffic concentration to reduce the number of lines from the MSC
- c) Providing an interface to the Operations and Maintenance Center for the BSS
- d) Reallocation of frequencies among BTSs
- e) Time and frequency synchronization
- f) Power management
- g) Time-delay measurements of received signals from the MS

Hardware/Software: A BSC is often based on a distributed computing architecture, with redundancy applied to critical functional units to ensure availability in the event of fault conditions. Redundancy often extends beyond the BSC equipment itself and is commonly used in the power supplies and in the transmission, equipment providing the interface to PCU.

The databases for all the sites, including information such as carrier frequencies, frequency hopping lists, power reduction levels, receiving levels for cell border calculation, are stored in the BSC. This data is obtained directly from radio planning engineering which involves modelling of the signal propagation as well as traffic projections.

4) Mobile Services Switching Center (MSC)

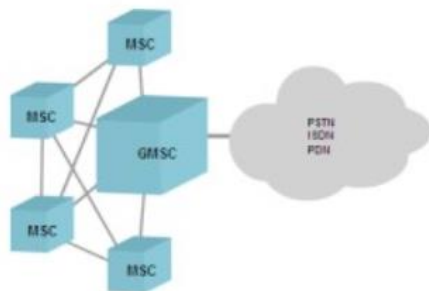


The central component of the Network Subsystem is the MSC. The MSC performs the switching of calls between the mobile and other fixed or mobile network users, as well as the management of mobile services such as registration, authentication, location updating, handovers, and call routing to a roaming subscriber. It also performs such functions as toll ticketing, network interfacing, common channel signalling, and others. Every MSC is identified by a unique ID.

MSC does the following functions:

- a) It acts like a normal switching node for mobile subscribers of the same network (connection between mobile phone to mobile phone within the same network)
- b) It acts like a normal switching node for the PSTN fixed telephone (connection between mobile phone to fixed phone) 2. It acts like a normal switching node for ISDN
- c) It provides all the functionality needed to handle a mobile subscriber, such as registration, authentication, location updating, handovers and call routing
- d) It includes databases needed in order to store information to manage the mobility of a roaming

5) Gateway to MSC (GMSC)



The Gateway MSC (GMSC) is the point in the PLMN where calls to mobile subscribers enter the GSM network. Therefore, each mobile terminating call must be routed via a GMSC in the home PLMN of the called MS. The GMSC contains the interrogation facility. That is, the GMSC contains signalling functions for retrieving information from the concerned HLR, which tells how to proceed with call Set-up. Depending on the interrogation result, the call is either rerouted by GMSC to the MSC where the mobile subscriber is located or forwarded according to the forward-to number. Charging and accounting functions are also implemented in the GMSC.

6) Home Location Register (HLR)

The HLR is a database used for storage and management of subscriptions. The HLR is considered the most important database, as it stores permanent data about subscribers, including a subscriber's service profile, location information, and activity status. When an individual buys a subscription in the form of SIM, then all the information about this subscription is registered in the HLR of that operator.

It contains the following information:

- a) Authentication information like International Mobile Subscriber Identity (IMSI)
- b) Identification information like name, address, etc. of the subscriber
- c) Identification information like Mobile Subscriber ISDN (MSISDN) etc.
- d) Billing information like prepaid or post-paid
- e) Operator selected denial of service to a subscriber
- f) Handling of supplementary services like for CFU (Call Forwarding Unconditional), CFB (Call Forwarding Busy), CFNR (Call Forwarding Not Reachable) or CFNA (Call Forwarding Not Answered)
- g) Storage of SMS Service Center (SC) number in case the mobile is not connectable so that whenever the mobile is connectable, a paging signal is sent to the SC
- h) Provisioning information like whether long distance and international calls allowed or not
- i) Provisioning information like whether roaming is enabled or not

Hardware/Software:

- a) No hardware to deploy
- b) Fully virtual
- c) Standards-based
- d) Web-API control and access
- e) Cloud-based, in a secure environment with global reach

7) Visitor Location Register (VLR)

The VLR is a database that contains temporary information about subscribers that is needed by the MSC in order to service visiting subscribers. The VLR is always integrated with the MSC. When a mobile station roams into a new MSC area, the VLR connected to that MSC will request data about the mobile station from the HLR. Later, if the mobile station makes a call, the VLR will have the information needed for call setup without having to interrogate the HLR each time.

A visitor location register may also perform the following functions:

- a) Monitor the subscriber's location within the VLR's jurisdiction
- b) Determine whether a subscriber may access a particular service
- c) Allocate roaming numbers during incoming calls
- d) Delete the records of inactive subscribers
- e) Accept information passed to it by the HLR
- f) To inform the HLR that a subscriber has arrived in the particular area covered by the VLR.
- g) To track where the subscriber is within the VLR area (location area) when no call is ongoing.
- h) To allow or disallow which services the subscriber may use.
- i) To allocate roaming numbers during the processing of incoming calls.
- j) To purge the subscriber record if a subscriber becomes inactive whilst in the area of a VLR. The VLR deletes the subscriber's data after a fixed time period of inactivity and informs the HLR (e.g., when the phone has been switched off and left off or when the subscriber has moved to an area with no coverage for a long time).
- k) To delete the subscriber record when a subscriber explicitly moves to another, as instructed by the HLR.

8) Equipment Identity Register (EIR)

The Equipment Identity Register (EIR) is a database that contains a list of all valid mobile equipment on the network, where its International Mobile Equipment Identity (IMEI) identifies each MS. An IMEI is marked as invalid if it has been reported stolen or is not type approved.

EIR Functions:

- a) Synchronizing lists with CEIR. CEIR systems are not described by a standard, so the protocols and exchange mode may differ from country to country.
- b) Supporting additional lists – IMEI white list, IMEI grey list, list of allocated TACs, etc.
- c) Support in lists not only IMEI but also bindings – IMEI-IMSI, IMEI-MSISDN, IMEI-IMSI-MSISDN.
- d) Supporting the customized logic of lists applying.
- e) Automatic adding the item to a list in separate scenarios.
- f) Sending SMS notifications to subscribers in separate scenarios.
- g) Integration with the billing system to receive IMSI-MSISDN bundles.
- h) Accumulating the subscribers' profiles (history of device changing).
- i) Long-term storage of processing of all CheckIMEI requests.

Hardware/ Software:

The BroadForward EIR runs on any off-the-shelf hardware or in a virtualized environment. It is a 100% software-based solution, supporting virtualization and cloud deployment (VMware, KVM, OpenStack, Amazon etc.) as well as containerized application deployment (Docker, Kubernetes). The EIR does not rely on specialist hardware or proprietary operating systems. The ability to deploy the BroadForward EIR on a common (shared) platform

(e.g., With the 5G EIR) supports operators and vendors in migrating away from proprietary based appliance systems to a standard based, hardware agnostic, software only infrastructure.

Conclusion:

- 1) A mobile station comprises all user equipment and software needed for communication with a mobile network
- 2) A base transceiver station (BTS) is a fixed radio transceiver in any mobile network. The BTS connects mobile devices to the network. It sends and receives radio signals to mobile devices and converts them to digital signals that it passes on the network to route to other terminals in the network or to the Internet.
- 3) A base station controller (BSC) is a network element that controls and monitors a number of base stations and provides the interface between the cell sites and the mobile switching center (MSC)
- 4) The MSC connects calls between subscribers by switching the digital voice packets between network paths. It also provides information needed to support mobile service subscribers.
- 5) The Gateway Mobile Switching Center (GMSC) is a type of Mobile Switching Center (MSC) that is used to route calls outside the mobile network. Mobile Switching Center Servers (MSC-S) provide control of high-capacity switching in mobile circuit core networks for operators to control services and switching.
- 6) A Home Location Register (HLR) is a database that contains subscriber information such as the International Mobile Subscriber Identity (IMSI), the phone number associated with the subscriber (the MSISDN), their account status, and their last known location.
- 7) A visitor location register (VLR) is a server in a cellular network that supports roaming functions for users outside the coverage area of their own HLR.
- 8) The Equipment Identity Register (EIR) is a network entity used in GSM networks that stores lists of International Mobile Equipment Identity (IMEI) numbers, which correspond to physical handsets (not subscribers).