This document will be helpful for the telecom engineers who deal with GSM as well as for the fresher /interested readers. This document has some advantages over other GSM texts in that it quickly gets to the point and can be used as a reference source. I hope the readers of this document find it helpful in filling in some of the gray areas on the GSM map. Also I included some procedure for traffic management of GSM network for clear imagination.

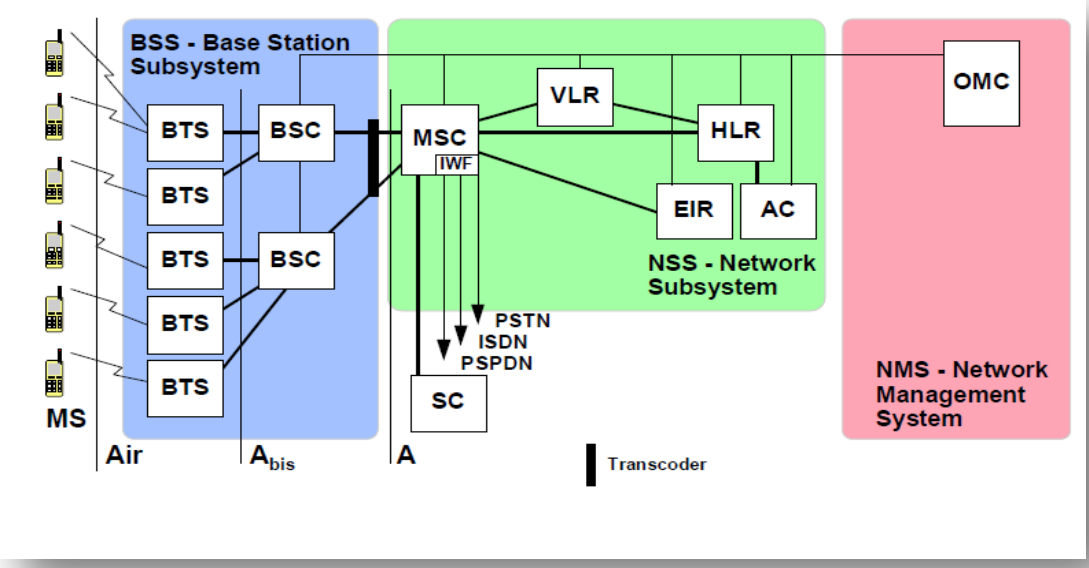
GSM Introduction

GSM stands for global system for mobile communication. It is considered as a 2G standard and a standard was driven by ETSI(European telecommunication standard institute).Purely 3GPP is also owning the GSM standard evolution. Responsibility of GSM standardization resides with special mobile group under ETSI. Full set up specification phase became available in early 1990s under ETSI.

Today many providers all over the world using GSM more than 135 countries in Asia, Africa, America, Australia.GSM is the fully digital system which is evolution of Analog system(1G) using 900,1800 MHZ frequency bands.

GSM System Architecture

In GSM system the mobile handset is called Mobile Station (MS). A cell is formed by the coverage area of a Base Transceiver Station (BTS) which serves the MS in its coverage area. Several BTS together are controlled by one Base Station Controller (BSC). The BTS and BSC together form Base Station Subsystem (BSS).



The combined traffic of the mobile stations in their respective cells is routed through a switch called Mobile Switching Center (MSC). Connection originating or terminating from external telephone (PSTN) are handled by a dedicated gateway Gateway Mobile Switching Center (GMSC).

GSM network elements

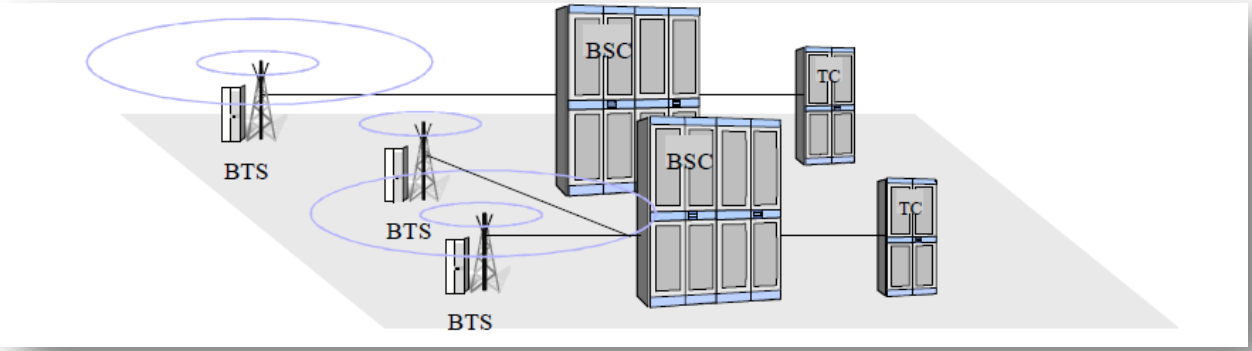
Mobile Equipment (ME). The term Me is used to refer to a handset. A Mobile Station (MS) is comprised of the ME and a Subscriber Identity Module (SIM)

BTS. The Base Transceiver Station is composed of an antenna and a transceiver. The BTS handles the radio interface with the mobile phone. It is the first entity within the GSM network that detects the mobile signal. The parameters of a cell are defined by the transceiver signal strength of the BTS.

BSC. The Base Station Controller is the network node that connects the Base Transceiver Station (BTS) and the Mobile services Switching Center (MSC).

The **TransCoder** (TC) is a BSS element taking care of speech transcoding, i.e. it is capable of converting speech from one digital coding format to another and vice versa.

Figure for Transcoder associated with BSC



Base Station System

In mobile telecommunications, a base station is the central radio transmitter/receiver that maintains communications with the wireless/mobile handsets within range. In cellular and personal communications applications, each cell or microcell has its own base station; each base station in turn is interconnected with other cells' base stations, and with the Public Switched Telephone Network (PSTN).

MSC (Mobile services Switching Center)

The MSC acts as the hub of the network system, its main purpose being the control of calls to and from other telephone and data systems such as the PSTN. It plays a major role in subscriber roaming by providing all the necessary functionality involved in registering, authenticating, location updating, and call routing for a roaming subscriber.

GMSC (Gateway Mobile services Switching Center). The GMSC acts as a gateway for incoming calls in a GSM network.

Home Location Register (HLR) stores the permanent (such as user profile) as well as temporary (such as current location) information about all the users registered with the network. A VLR stores the data about the users who are being serviced currently. It includes the data stored in HLR for faster access as well as the temporary data like location of the user.

MSC/VLR: Mobile Switching Center/Visitor Location Register. The MSC/VLR is a network component within GSM.

AuC (Authentication Center)

It is a component of the infrastructure equipment in the GSM network, the purpose of which is to validate subscribers logging on to the network, by means of a secret key. The AuC contains a unique key (code) for each subscriber in a network, with a copy of this key being kept within the SIM card of each mobile handset. A subscriber is allowed to log on to the network once the AuC makes a successful comparison of these two keys.

EIR (Equipment Identity Register)

It's a database containing a list of all valid IMEIs on the network.
Each IMEI is given a colour code that indicates its status.

- A white-listed IMEI means that the terminal is allowed to connect to the network.
- A grey-listed IMEI indicates that the network is currently monitoring the terminal for possible problems.
- A black-listed IMEI means that the terminal is not allowed to connect to the network, because it has either been reported stolen or is the wrong type of terminal for that particular GSM network.

Note: All the mobile equipment in GSM system are assigned unique id called IMSI (International Mobile Equipment Identity) and is allocated by equipment manufacturer and registered by the service provider. This number is stored in the EIR.

The users are identified by the IMSI (International Module Subscriber Identity) which is stored in the Subscriber Identity Module (SIM) of the user. A mobile station can be used only if a valid

SIM is inserted into equipment with valid IMSI. The real telephone number is different from the above ids and is stored in SIM.

Traffic Management in GSM network
The basic objectives of this module are:

- The three subsystems of GSM Network.
- Mobility concept (handover, location update, paging).
- How mobile originated calls are handled in GSM.
- Services provided by GSM

Subsystems of GSM Network

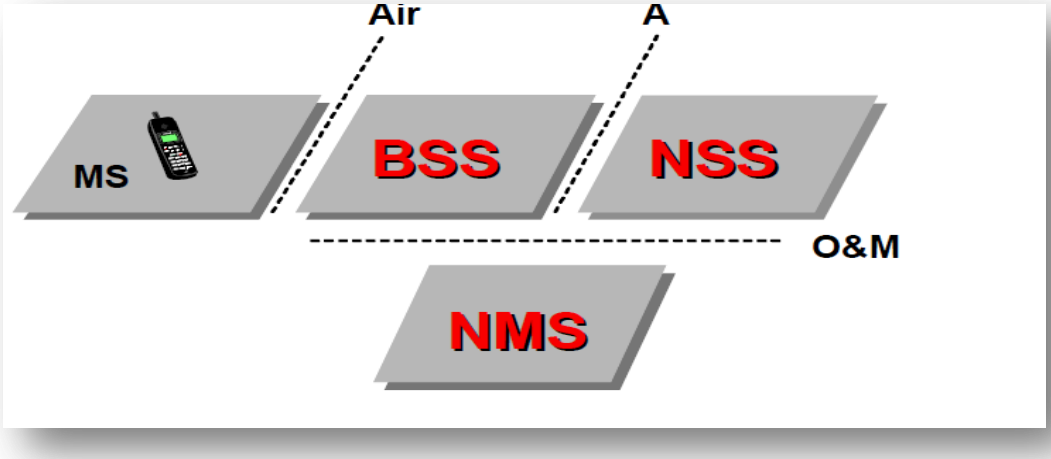
In a GSM network is implemented by dividing the whole network into three separate subsystems:

- Network Switching Subsystem (NSS)
- Base Station Subsystem (BSS)
- Network Management Subsystem (NMS)

The actual network needed for establishing calls is composed of the NSS and the BSS. The BSS is responsible for radio path control and every call is connected through the BSS. The NSS takes care of call control functions. Calls are always connected by and through the NSS.

The NMS is the operation and maintenance related part of the network and it is needed for the control of the whole GSM network. The network operator observes and maintains network quality and service offered through the NMS. The three subsystems in a GSM network are linked by the Air, A and O&M interfaces as shown.

Figure of Subsystems of GSM Network



Location Update

As an owner of a mobile phone, the subscriber does not stay in one place but keeps moving from one place to another. No matter how often or how quickly he moves, the network must be able to locate him continuously in case somebody wants to call him. The transaction that enables the network to keep track of the subscriber is called a Location Update.

Figure for GSM network elements involved in Location Update

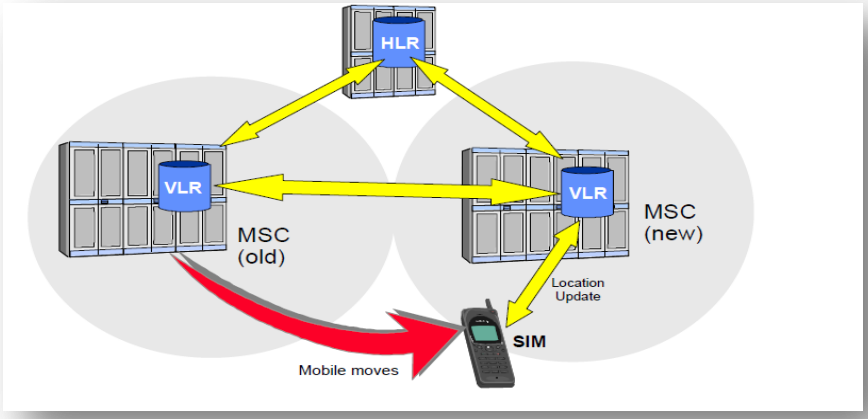
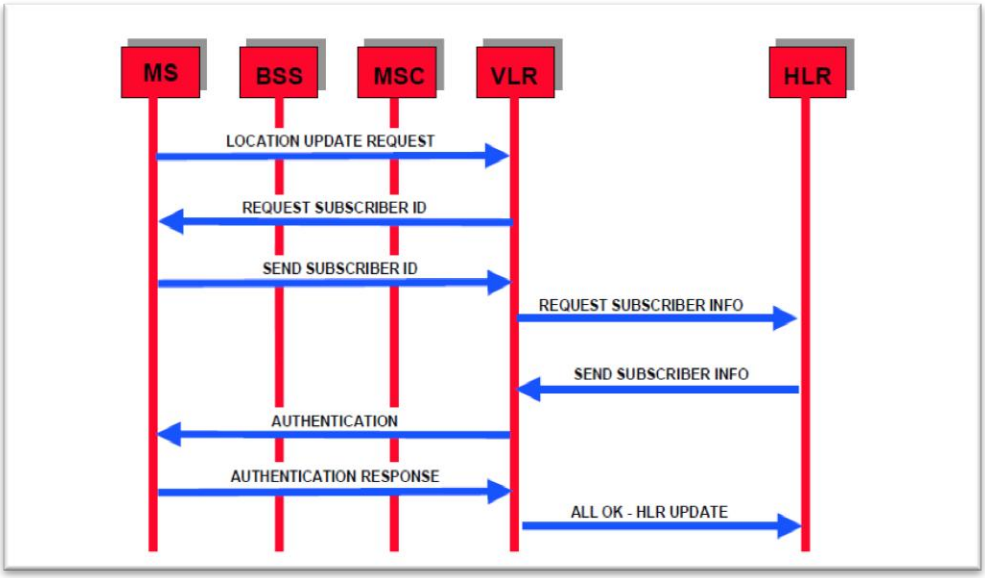


Figure for Procedure involved in Location Update



Handover

In a mobile communications network, the subscriber can move around. How can we maintain the connection in such cases? To understand this, we must study the process of handing over the calls.

Maintaining the traffic connection with a moving subscriber is made possible with the help of the handover function. The basic concept is simple. When the subscriber moves from the coverage area of one cell to another, a new connection with the target cell has to be set up and the connection with the old cell has to be released. There are two reasons for performing a handover:

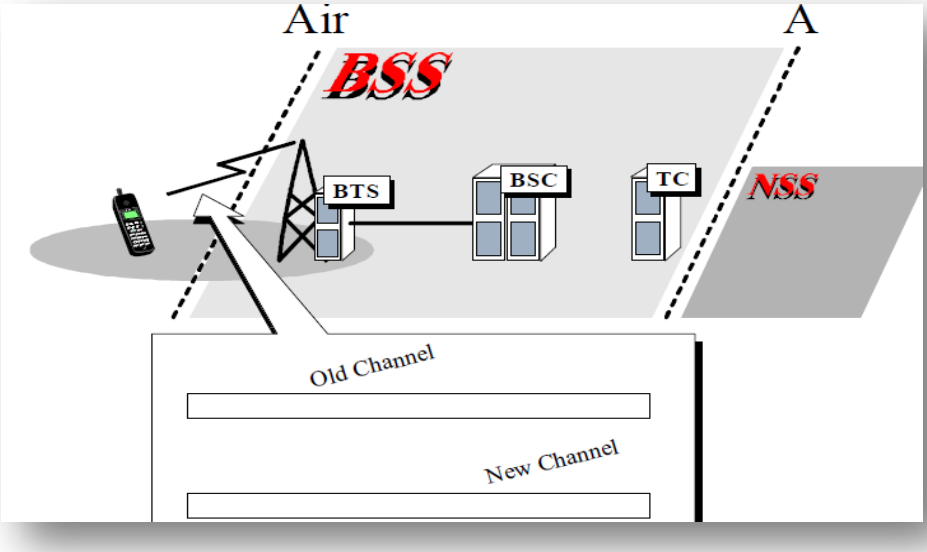
1. Handover due to measurements occurs when the quality or the strength of the radio signal falls below certain parameters specified in the BSC.

2. Handover due to traffic reasons occurs when the traffic capacity of a cell has reached its maximum or is approaching it. In such case, the mobile stations near the edges of the cell may be handed over to neighbouring cells with less traffic load.

The decision to perform a handover is always made by the BSC that is currently serving the subscriber, except for the handover for traffic reasons.

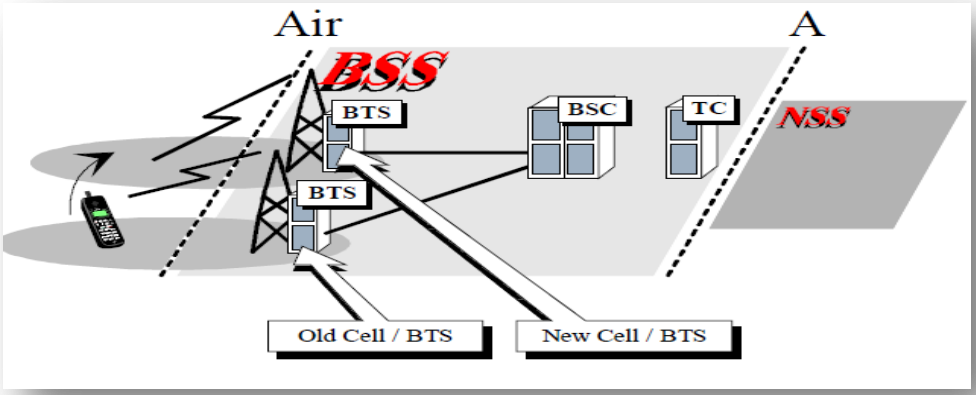
Intra cell - Intra BSC handover

The smallest of the handovers is the intra cell handover where the subscriber is handed over to another traffic channel (generally in another frequency) within the same cell. In this case the BSC controlling the cell makes the decision to perform handover.



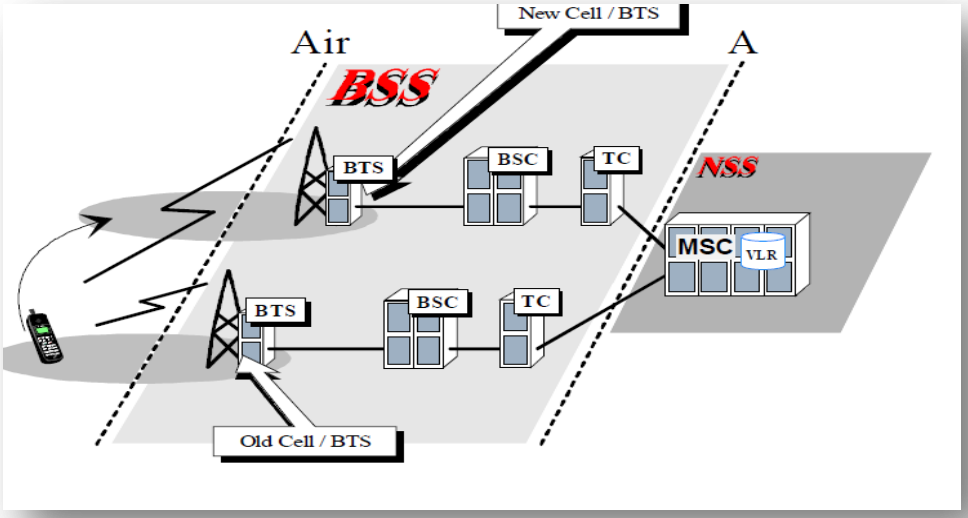
Inter cell - Intra BSC handover

The subscriber moves from cell 1 to cell 2. In this case the handover process is controlled by BSC. The traffic connection with cell 1 is released when the connection with cell 2 is set up successfully.



Inter cell - Inter BSC handover

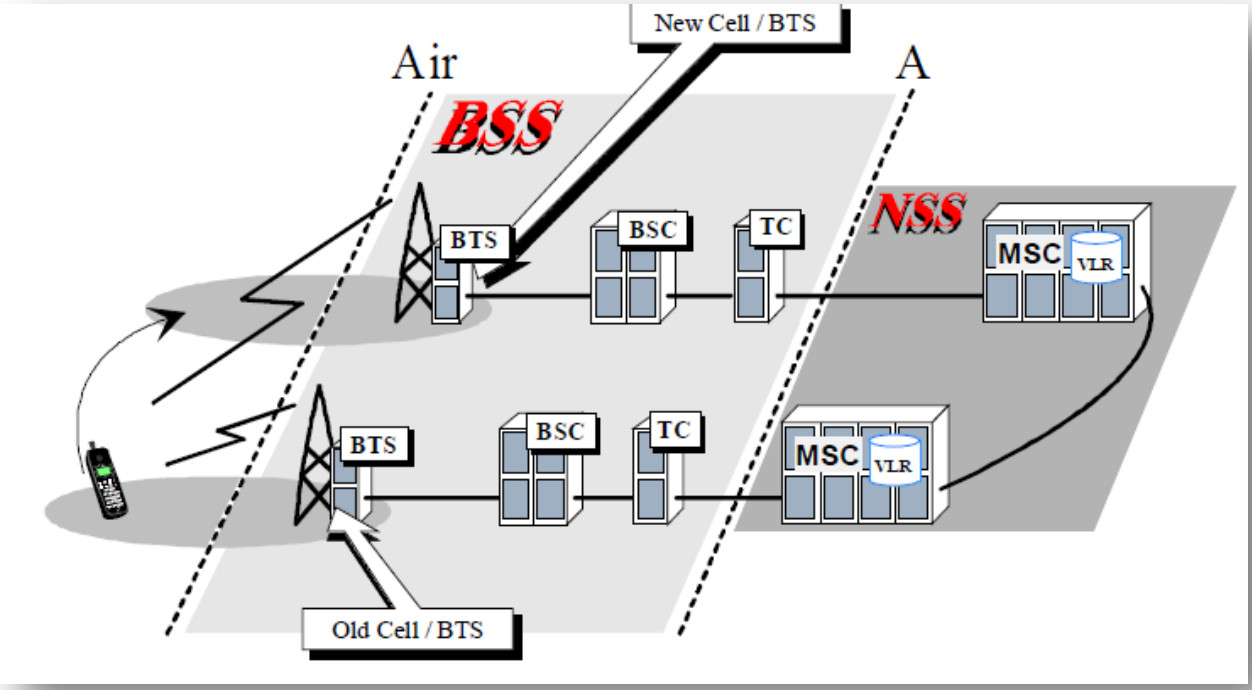
The subscriber moves from cell 2 to cell 3, which is served by another BSC. In this case the handover process is carried out by the MSC, but, the decision to make the handover is still done by the first BSC. The connection with the first BSC (and BTS) is released when the connection with the new BSC (and BTS) is set up successfully.



Inter MSC handover

The subscriber moves from a cell controlled by one MSC/VLR to a cell in the domain of another MSC/VLR. This case is a bit more complicated. Considering that the first MSC/VLR is connected to the GMSC via a link that passes through PSTN lines, it is evident that the second MSC/VLR cannot take over the first one just like that.

The MSC/VLR currently serving the subscriber (also known as the anchor MSC), contacts the target MSC/VLR and the traffic connection is transferred to the target MSC/VLR. As both MSCs are part of the same network, the connection is established smoothly. It is important to notice, however, that the target MSC and the source MSC are two telephone exchanges. The call can be transferred between two exchanges only if there is a telephone number identifying the target MSC.



Paging Process

Paging is a signal that is transmitted by all the cells in the Location Area (LA). It contains the identification of the subscriber. All the mobile stations in the LA receive the paging signal, but only one of them recognises the identification and answers to it. As a consequence of this answer, a point to point connection is established.

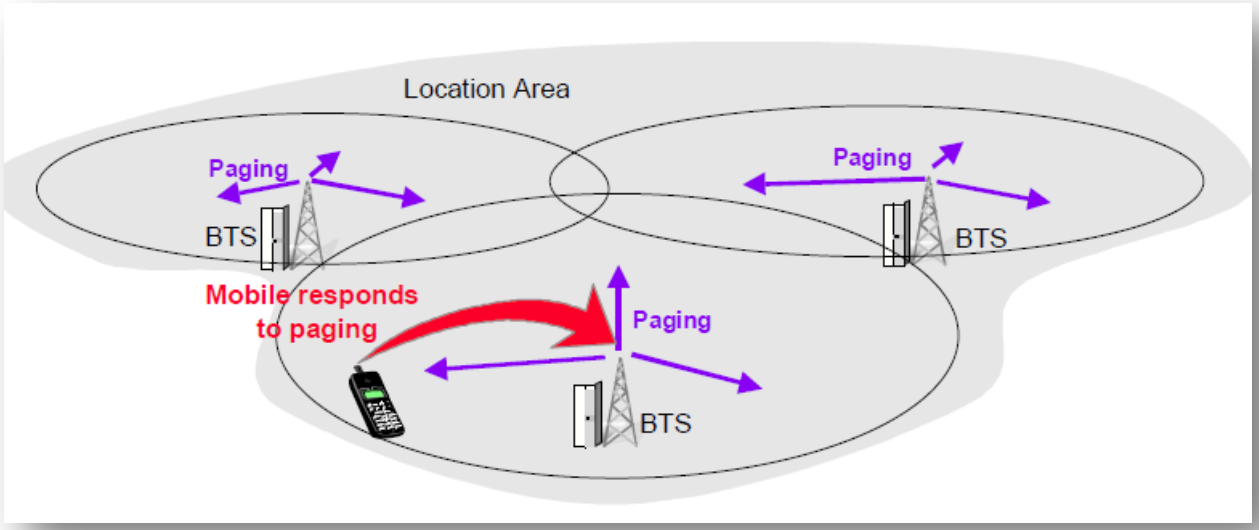


Figure for The paging process

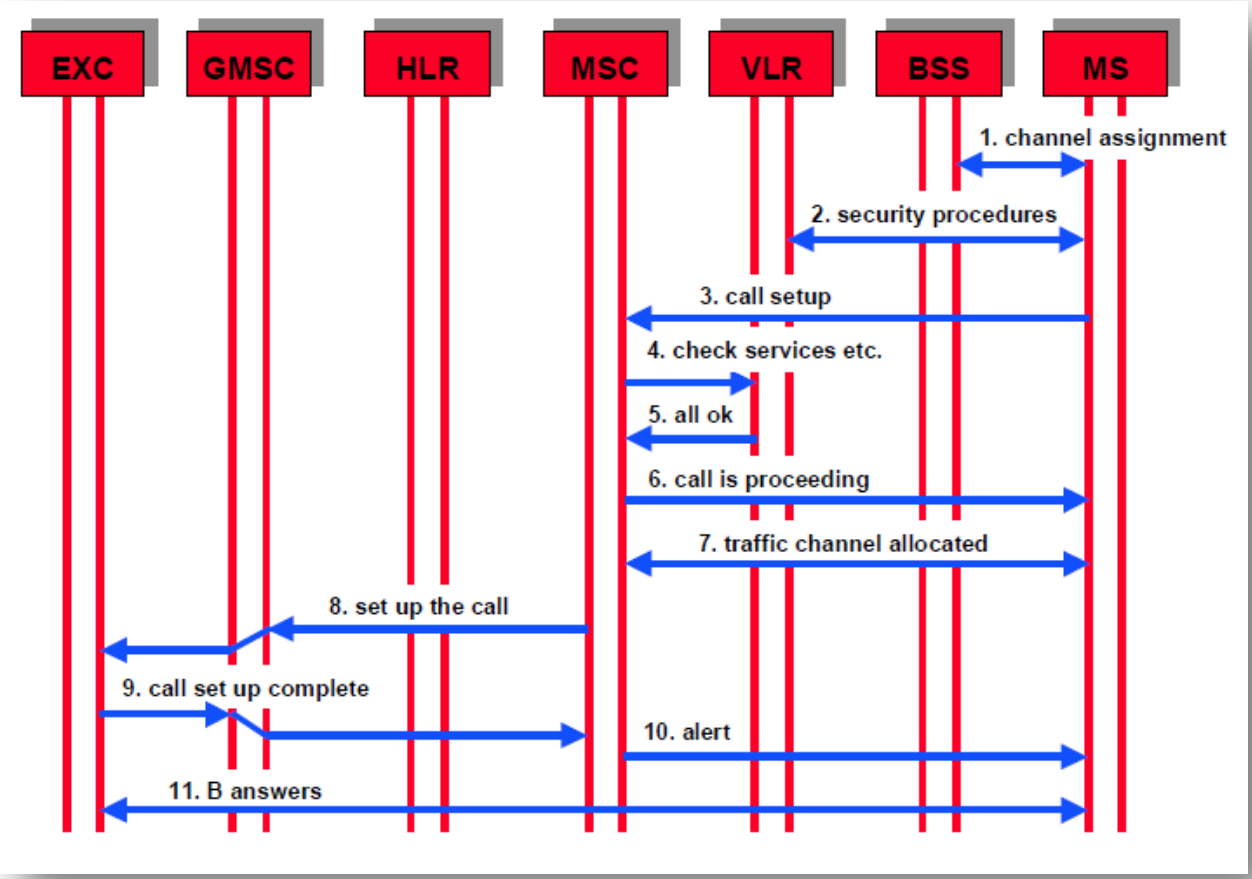
Mobile Originated Call

The mobile subscriber dials a number. In other words the subscriber issues a service request to the network in which he is currently registered as a visitor. After receiving the request, the network analyses the data of the calling subscriber in order to do three things:

- Authorise or deny the use of the network.
- Activate the requested service.
- Route the call.

The call may have two types of destinations: a mobile station or a telephone in a fixed network. If the call is addressed to a telephone in a fixed telephone network, it is routed to the PSTN, which in turn routes it to the destination. If the called number is another mobile station in the same network, the MSC starts the HLR Enquiry procedure which is processed in the same way as in the example of a PSTN originated call.

Figure for Mobile Originated Call procedure.



GSM services

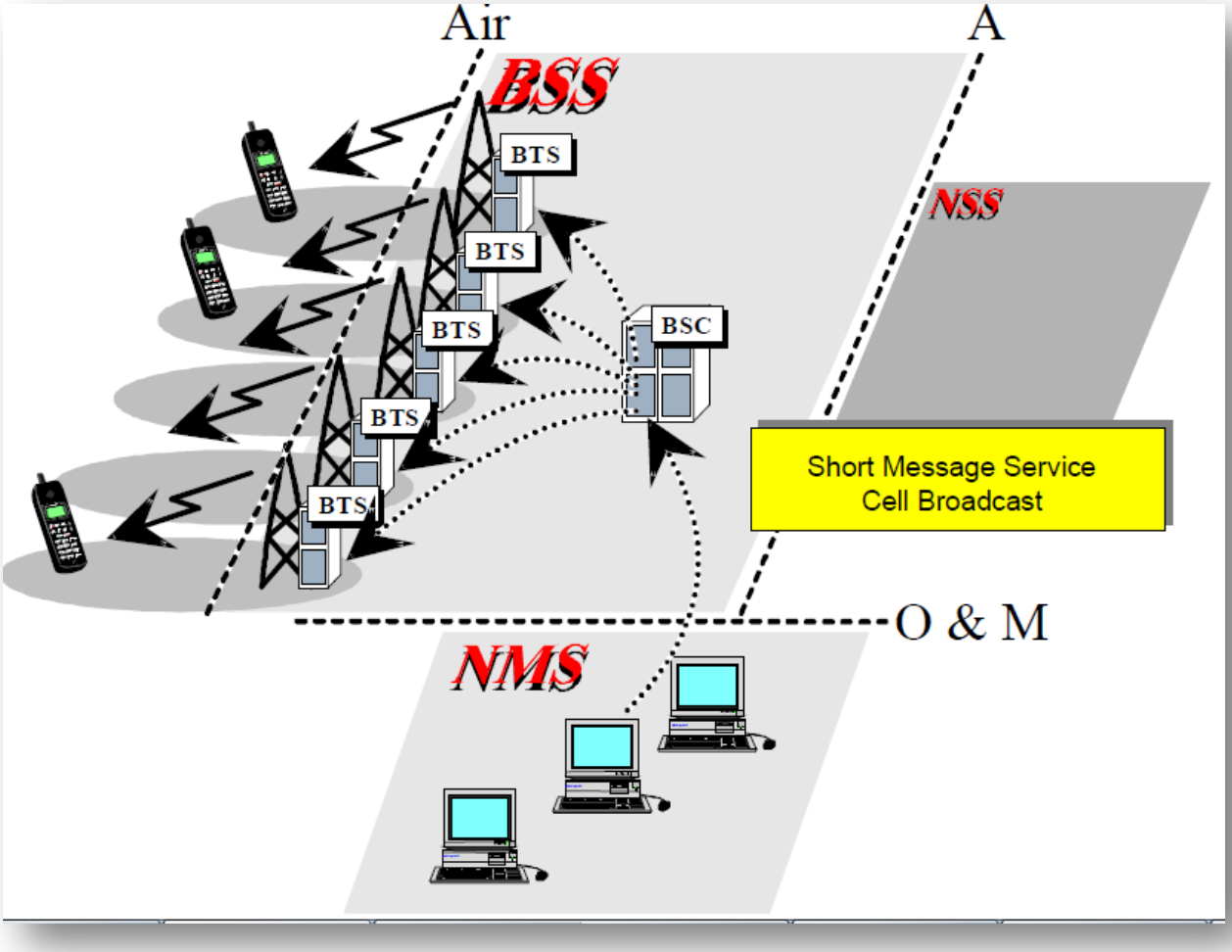
Any subscriber action that uses the facilities provided and supported by the GSM system can be categorised as a service. Therefore, a person who has access to a GSM mobile phone and wishes to make a call is trying to access the speech service provided by the system.

GSM is a multiservice system that allows various types of communication that can be distinguished by the nature of the transmitted information. Generally, based on the nature of the transmitted information, services can be grouped as speech services, where the transmitted data is speech and data services which cover the rest of the information types such as text.

Short Message Services (SMS)

The Short Message Service (SMS) is a service enabling the mobile subscriber to receive and/or send short (max. 160 characters) messages in text format. These messages can be received at any time (also during a conversation).

This service requires dedicated equipment called Short Message Service Centre (SMSC) which may be located in the Network Switching Subsystem or outside the GSM network, but it always has signalling connections to MSC. The SMSC acts as a temporary storing and forwarding centre if the Mobile Station is unreachable.



GSM also provides Bearer Services as well as Supplementary Services. I will cover that later. I will also explain the concept of signalling in layer 3 of GSM protocol architecture. You will also get to know about physical and logical channel along with TDMA and FDMA technique.

Author: Nitesh Kumar
Email: nicsambition@gmail.com
User Profile: http://www.aliencoders.com/users/nitesh
Facebook Page: https://www.facebook.com/aliencoders
Twitter profile: http://www.twitter.com/aliencoders
Official Website: http://www.aliencoders.com
Image Source: Nokia Siemens, Internet
View this article Online: http://www.aliencoders.com/content/basics-gsm-depth