GSM

GSM, GPRS, UMTS what do all of these expressions mean and what possibilities are there for data communication?

Technical descriptions often contain abbreviations and acronyms. We have chosen to use the technical designations and abbreviations, which although are usually in English have become industry standard.

The history of GSM

At the beginning of the eighties there were numerous analogue systems in use within Europe of varying quality. However, it was quickly realised that the analogue technology would not satisfy future requirements for efficient communication. Consequently the **G**roupe **S**péciale **M**obile (GSM) was formed; this took place in Vienna in 1982. The group was given the task of creating a mobile system that would offer a high audio quality at a low cost.

In 1989, the **E**uropean **T**elecommunication **S**tandards **I**nstitute (ETSI) took over responsibility to continue the development of GSM. The acronym GSM took on a new meaning, **G**lobal **S**ystem for **M**obile communications.

GSM makes the wireless transfer of voice/text/images between different types of equipment possible, but only if that equipment is within the coverage area of a network operator's base transceiver station. After standardisation, the number of users of GSM-equipment has increased explosively and then primarily within voice applications, at the beginning of 1994 there were 1.3 million subscribers, this has now risen to 1024 million throughout the world (February 2004).

A large increase in use is now being seen within industrial M2M applications (**M**achine **to M**achine). This, for example, can be a question of transferring data or alarms from basic slave units to a controlling system, or the transfer of data from/between parking meters. This area of application is almost unlimited and there will be a rapid development of different types of GSM equipment to cover future needs.

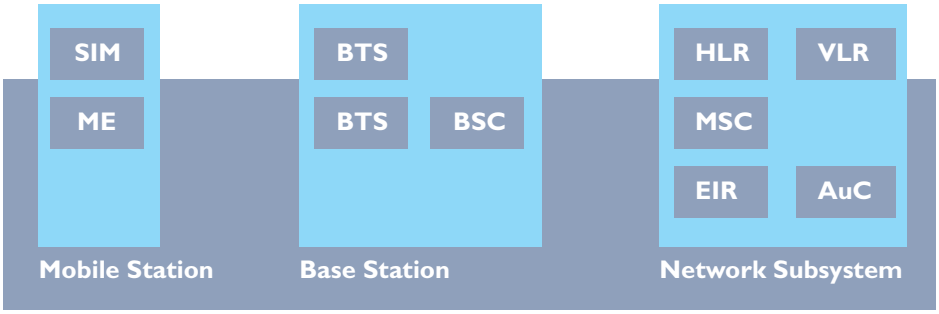
There are many advantages of digital transmission over analogue technology on mobile networks, these include:

- Improved quality of the telephone connection.
- Higher transmission rates.
- Improved utilisation of the bandwidth, which brings an increase in the number of subscribers on the network.
- New services and functions are possible such as, data, text and fax.
- Possibility of data encryption for greater security.
- Less power consumption, which gives longer standby and transmission times on battery powered devices.

Architecture

A GSM network can be divided into three main components:

- **M**obile **S**tation (MS).
- **B**ase **S**tation **S**ystem (BSS).
- **N**etwork **S**ubsystem, with connections to external networks, for example, ISDN or PSTN networks.



Components in the network

ME Represents **M**obile **E**quipment . This is equipment adapted for use on the GSM network. Each ME unit has a unique identification (IMEI-number), International Mobile Equipment Identity. This makes it possible for the network operator to block the use of a unit, e.g. when a ME unit has been stolen.

SIM Stands for **S**ubscriber **I**dentity **M**odule, this is a card used together with the ME-unit. The SIM-card is furnished by the network operator and holds data such as: telephone number, PIN code, address book, etc. The SIM-card can be moved between different ME-units.

BTS Stands for **B**ase **T**ransceiver **S**tation, which is a base radio station, i.e. a transmitter and receiver that makes it possible to communicate with some form of ME.

BSC Stands for **B**ase **S**tation **C**ontroller; this is a substation that communicates with the base radio station. The substation can communicate with a number of base stations.

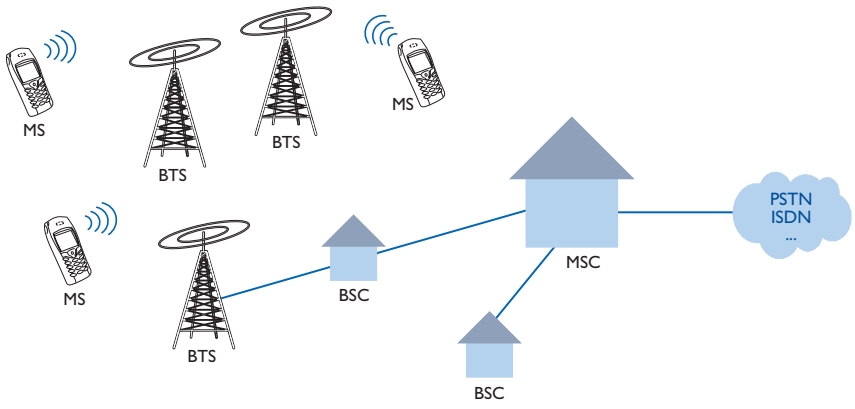
MSC Stands for **M**obile **S**witching **C**entre which makes forwarding to an analogue, PSTN (**P**ublic **S**witched **T**elephone **N**etwork), or an ISDN (**I**ntegrated **S**ervices **D**igital **N**etwork) digital network possible.

HLR Stands for **H**ome **L**ocation **R**egister, which is a database that among others contains basic information about the user such as the type of subscription.

VLR Stands for **V**isitor **L**ocation **R**egister, which is a database that stores information about an ME that is in a cell not controlled by HLR.

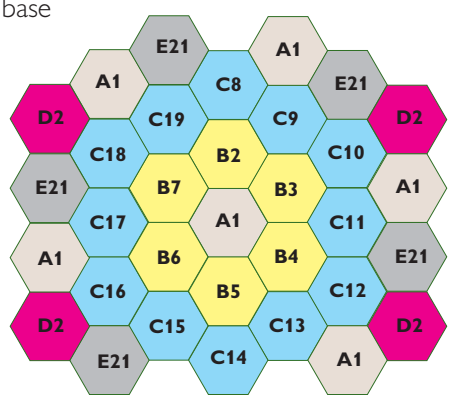
EIR Stands for **E**quipment. **I**dentity **R**egister, which registers all users on the network. Identification takes place by means of the ME-unit's IMEI-number.

AuC Stands for **Au**thentication **C**entre and is a database that contains data about the network operator and the user's type of subscription.



Cell structures

Base stations are positioned to give maximal coverage. The area covered by a base station is called a cell.



The entire GSM network is organised with cells of varying sizes. A cell can cover areas with a radius of 200 metre (656 ft) up to areas with a radius of ~30 km (18.64 mi). This depends on where the base station is located and the surrounding environment.

Other factors that affect the installation are, among others, the output power and whether the base station is located in an environment that is problematic for radio traffic. The cell structure results in the reuse of frequencies in the base stations. In the figure opposite the frequency A1 can be reused in the third ring without the risk of crosstalk between cells with the same frequency.

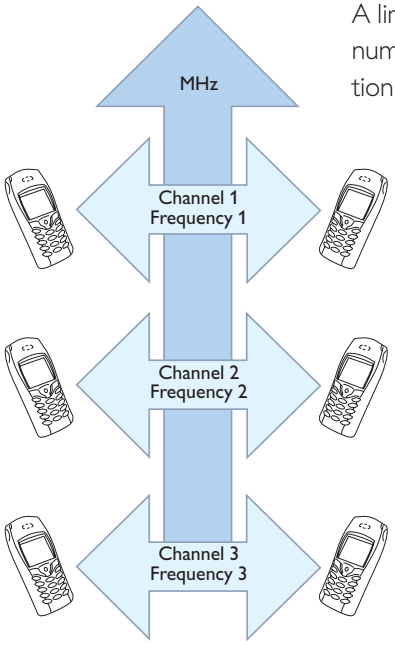
If you travel through an area it is necessary to switch between the cells through which you pass. This is known as handover.

Radio transmissions between MS and BSS

In the eighties when the GSM specification was drawn up, the ITU (**I**nternational **T**elecommunication **U**nion) reserved two frequency bands of 25 MHz for GSM radio transmissions:

- 880–915 MHz "uplink" transfer from MS to BSS.
- 925–960 MHz "downlink" transfer from BSS to MS.

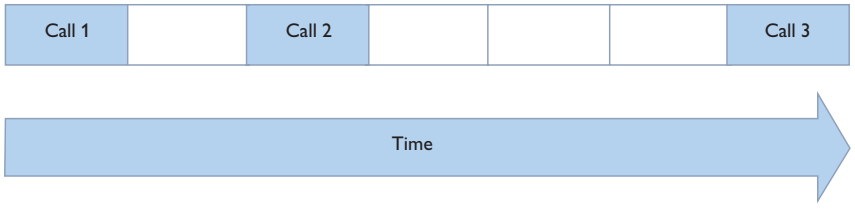
The development within mobile communication has resulted in the need to use multiple frequencies to satisfy demand. Today there are five standardised frequencies 400, 850, 900, 1800 as well as 1900 MHz. The latter frequency is generally used in the USA and in some parts of Asia, while 900 and 1800 are more globally used.



Frequency division

A limitation in bandwidth has resulted in the use of techniques so that a maximum number of simultaneous users can be supported. This is achieved through a combination of TDM, *Time Division Multiplexing* and FDM, *Frequency Division Multiplexing*.

Frequency division (FDM) means the available 25 MHz band is divided into 200 KHz bands. In the above description of frequency utilisation between cells, A1, B2, B3, etc are examples of frequency division.



Time division multiplexing

Compilation

Frequency for transmitting from ME to the base station	880-915	MHz
Frequency for transmitting from the base station	925-960	MHz
Bandwidth	35+35	MHz
Access method	TDMA/FDMA	
Frequency per radio channel	200	KHz
Distance in frequency between the downlink/uplink	45	MHz
Maximal radius for a cell	30	km
Minimum radius for a cell (microcell)	30	m
Maximal output power from the mobile terminal	2	W @ 900 MHz