

GSM Overview

Wireless telephone history

It all started like this

- First telephone (photophone) – Alexander Bell, 1880
- The first car mounted radio telephone – 1921

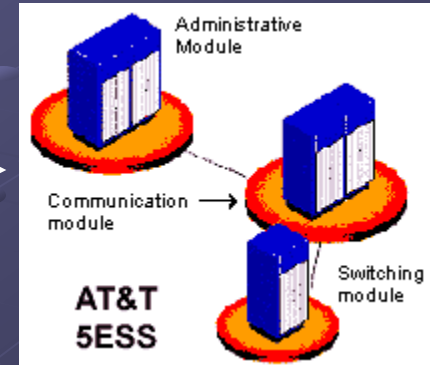


Going further

- 1946 – First commercial mobile radio-telephone service by Bell and AT&T in Saint Louis, USA. Half duplex(PTT)
- 1973 – First handheld cellular phone – Motorola.
- First cellular net
Bahrein 1978

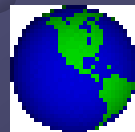


But what's cellular?



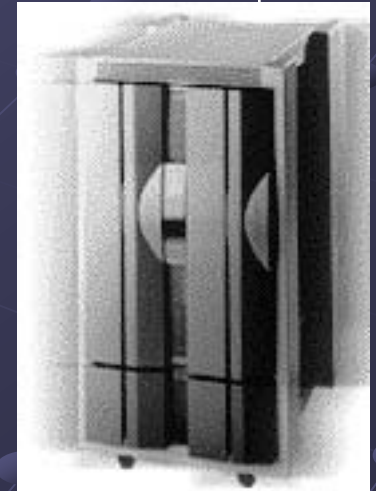
MSC

BS



PSTN

HLR, VLR,
AC, EIR



Cellular principles

- Frequency reuse – same frequency in many cell sites
- Cellular expansion – easy to add new cells
- Handover – moving between cells
- Roaming between networks

Generation Gap

- Generation #1 – Analog [routines for sending voice]
- All systems are incompatible
- No international roaming
- Little capacity – cannot accommodate masses of subscribers

Generation Gap(2)

- Generation #2 – digital [voice encoding]
- Increased capacity
- More security
- Compatibility
- Can use TDMA or CDMA for increasing capacity

TDMA

- ❑ Time Division Multiple Access
- ❑ Each channel is divided into timeslots, each conversation uses one timeslot.
- ❑ Many conversations are multiplexed into a single channel.
- ❑ Used in GSM

CDMA

- ❑ Code Division Multiple Access
- ❑ All users share the same frequency all the time!
- ❑ To pick out the signal of specific user, this signal is modulated with a unique code sequence.

Back to Generations

- Generation #2.5 – packet-switching
- Connection to the internet is paid by packets and not by connection time.
- Connection to internet is cheaper and faster [up to 56KBps]
- The service name is GPRS – General Packet Radio Services

The future is now

- Generation #3
- Permanent web connection at 2Mbps
- Internet, phone and media: 3 in 1
- The standard based on GSM is called UMTS. Not yet implemented.
- The EDGE standard is the development of GSM towards 3G.

GSM

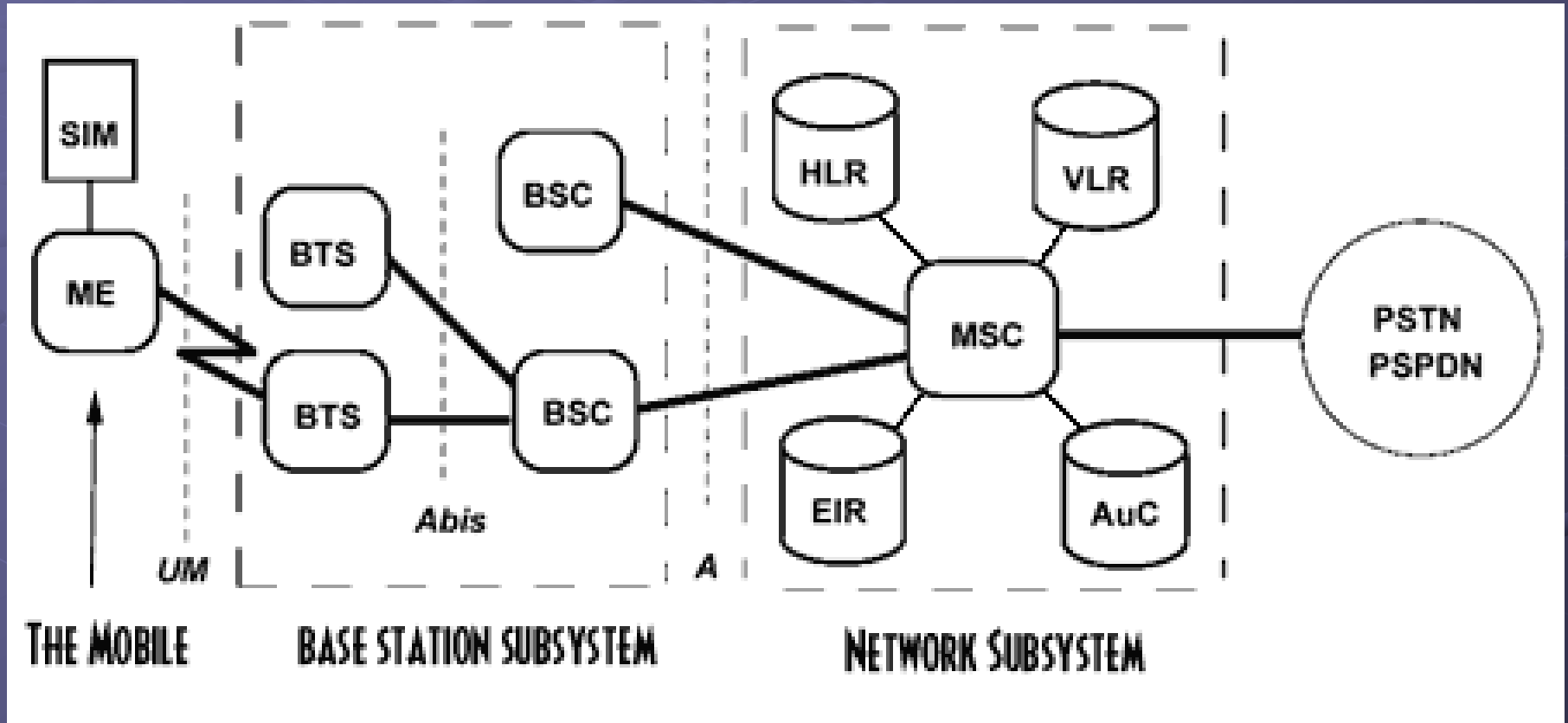
More than 800 million end users in 190 countries and representing over 70% of today's digital wireless market.

- source: GSM Association

Israel

- Orange uses GSM
- Pelephone and Cellcom are about to use GSM

GSM Overview



Into the architecture

- Mobile phone is identified by SIM card.
- Key feature of the GSM
- Has the “secret” for authentication

Into the architecture(2)

- BTS – houses the radiotransceivers of the cell and handles the radio-link protocols with the mobile
- BSC – manages radio resources (channel setup, handover) for one or more BTSs

Into the architecture(3)

- MSC – Mobile Switching Center
- The central component of the network
- Like a telephony switch plus everything for a mobile subscriber: registration, authentication, handovers, call routing, connection to fixed networks.
- Each switch handles dozens of cells

Into the architecture(4)

- HLR – database of all users + current location. One per network
- VLR – database of users + roamers in some geographic area. Caches the HLR
- EIR – database of valid equipment
- AuC – Database of users' secret keys

More GSM

- GSM comes in three flavors(frequency bands): 900, 1800, 1900 MHz. 900 is the Orange flavour in Israel.
- Voice is digitized using Full-Rate coding.
- 20 ms sample => 260 bits . 13 Kbps
bitrate

Sharing

- GSM uses TDMA and FDMA to let everybody talk.
- FDMA: 25MHz freq. is divided into 124 carrier frequencies. Each base station gets few of those.
- TDMA: Each carrier frequency is divided into bursts [0.577 ms]. 8 bursts are a frame.

Channels

- The physical channel in GSM is the timeslot.
- The logical channel is the information which goes through the physical ch.
- Both user data and signaling are logical channels.

Channels(2)

- User data is carried on the traffic channel (TCH) , which is defined as 26 TDMA frames.
- There are lots of control channels for signaling, base station to mobile, mobile to base station (“aloha” to request network access)

SS7

- Signaling protocol for networks
- Packet – switching [like IP]
- GSM uses SS7 for communication between HLR and VLR (allowing roaming) and other advanced capabilities.
- GSM's protocol which sits on top of SS7 is MAP – mobile application part