UNIT-2

Telecommunication Systems

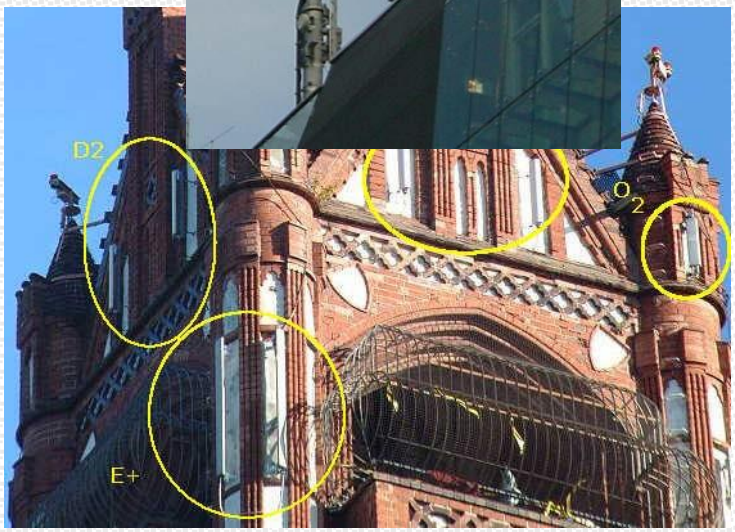
- GSM Architecture

- **Architecture of the GSM system** : GSM is a PLMN (Public Land Mobile Network)
  - components
    - MS (mobile station)
    - BS (base station)
    - MSC (mobile switching center)
    - LR (location register)
- A GSM system consists of three subsystems,
- **radio sub system (RSS):** covers all radio aspects
- **network and switching subsystem (NSS)**: call forwarding, handover, switching
- **operation subsystem (OSS):** management of the network
- Generally, a GSM customer only notices a very small fraction of the whole network –
- the mobile stations (MS) and some antenna masts of the base transceiver stations (BTS).

Ingredients 1: Mobile Phones, PDAs & Co.

The visible but smallest part of the network!

Ingredients 2: Antennas



Ingredients 3: Infrastructure 1

Base Stations

Cabling

Microwave links

Ingredients 3: Infrastructure 2

Switching units

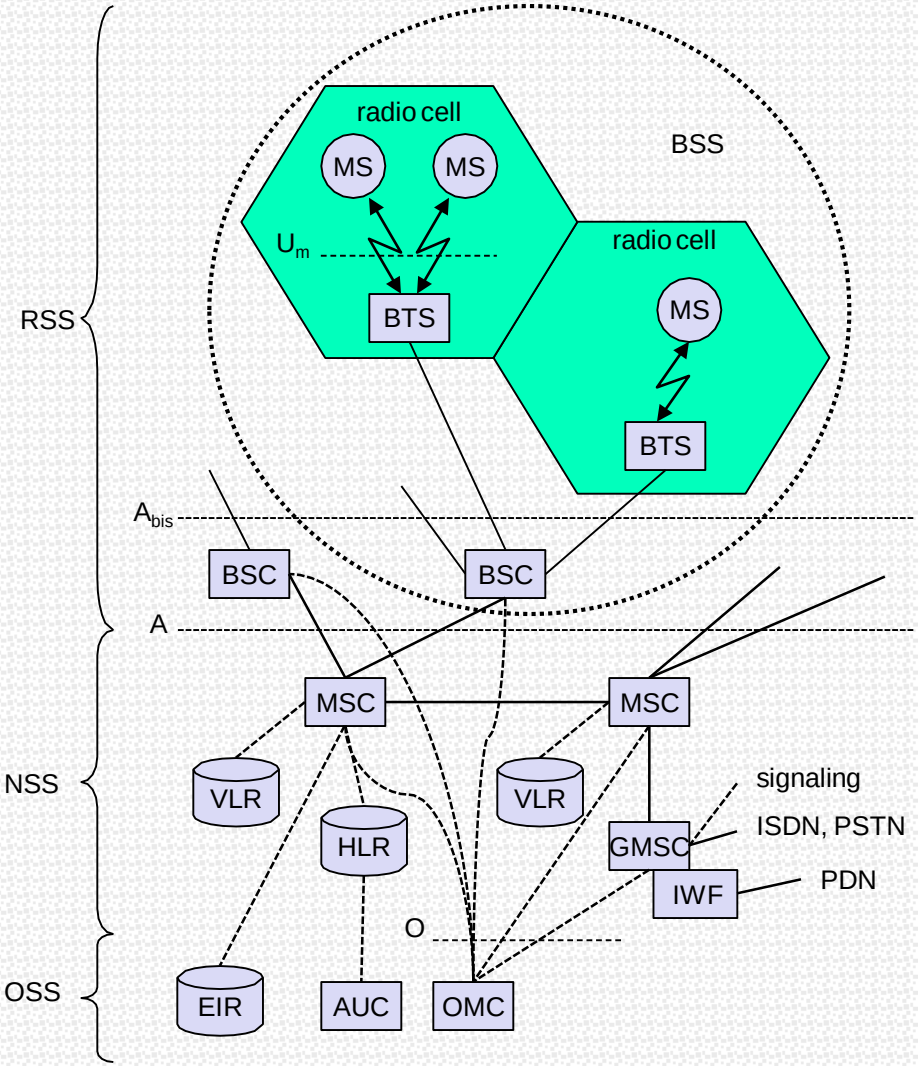
Management

Data bases

Monitoring

Not „visible“, but comprise the major part of the network

GSM: elements and interfaces

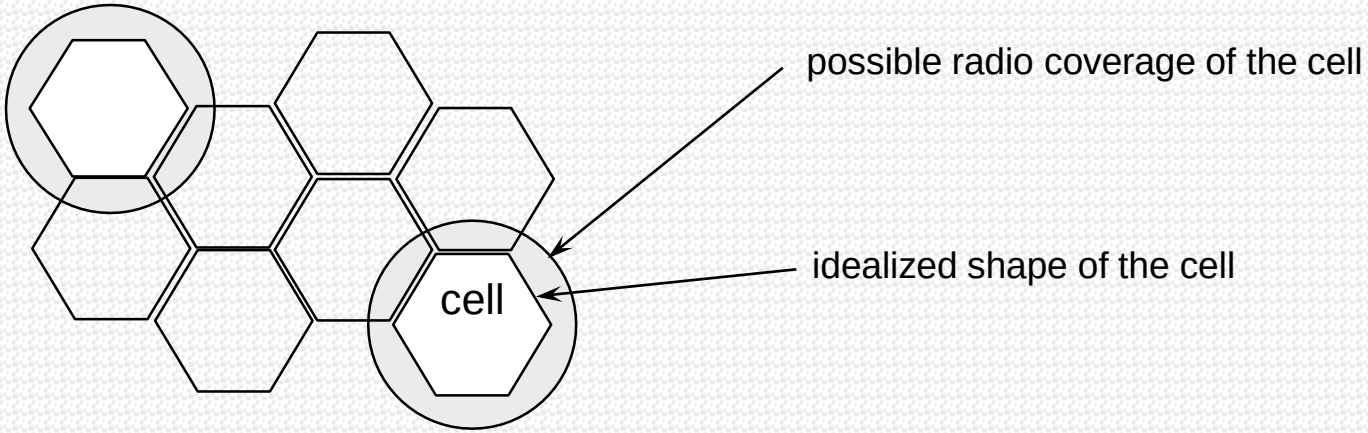


1. Radio subsystem (RSS) comprises all radio specific entities, i.e., the **mobile stations (MS)** and the **base station subsystem (BSS)**

- **Base station subsystem (BSS)**: A GSM network comprises many BSSs, each controlled by a base station controller (BSC). The BSS performs all functions necessary to maintain radio connections to an MS, coding/decoding of voice, and rate adaptation to/from the wireless network part. Besides a BSC, the BSS contains several BTSs.
- **Base transceiver station (BTS)**: A BTS comprises all radio equipment, i.e., antennas, signal processing, amplifiers necessary for radio transmission. A BTS can form a radio cell or, using sectorized antennas, several cells and is connected to MS via the **Um interface** (ISDN U interface for mobile use), and to the BSC via the **Abis interface**. The Um interface contains all the mechanisms necessary for wireless transmission (TDMA, FDMA etc.). The Abis interface consists of 16 or 64 kbit/s connections.

GSM: cellular network

- segmentation of the area into cells



- use of several carrier frequencies
- not the same frequency in adjoining cells
- cell sizes vary from some 100 m up to 35 km depending on user density, geography, transceiver power etc.
- hexagonal shape of cells is
- if a mobile user changes cells handover of the connection to the neighbor cell

Base Transceiver Station and Base Station Controller

- Tasks of a BSS are distributed over BSC and BTS
- BTS comprises radio specific functions
- BSC is the switching center for radio channels

Functions	BTS	BSC
Management of radio channels		X
Frequency hopping (FH)	X	X
Management of terrestrial channels		X
Mapping of terrestrial onto radio channels		X
Channel coding and decoding	X	
Rate adaptation	X	
Encryption and decryption	X	X
Paging	X	X
Uplink signal measurements	X	
Traffic measurement		X
Authentication		X
Location registry, location update		X
Handover management		X

- **Base station controller (BSC)**: The BSC basically manages the BTSs. It reserves radio frequencies, handles the handover from one BTS to another within the BSS, and performs paging of the MS. The BSC also multiplexes the radio channels onto the fixed network connections at the A interface.
- **Mobile station (MS)**:An MS consists of user independent hard- and software and of the **subscriber identity module (SIM)**, which stores all user-specific data that is relevant to GSM.3 While an MS can be identified via the **international mobile equipment identity (IMEI)**,
- The SIM card contains many identifiers and tables, such as card-type, serial number, a list of subscribed services, a **personal identity number (PIN)**, a **PIN unblocking key (PUK)**, an **authentication key Ki**, and the **international mobile subscriber identity (IMSI)**
- The MS stores dynamic information while logged onto the GSM system, such as, e.g., the **cipher key Kc** and the location information consisting of a **temporary mobile subscriber identity (TMSI)** and the **location area identification (LAI)**. Typical MSs for GSM 900 have a transmit power of up to 2 W, whereas for GSM 1800 1 W is enough due to the smaller cell size. ***MS can also offer other types of interfaces to users…….examples***

2. Network and switching subsystem

- The "heart" of the GSM system is formed by the **network and switching subsystem (NSS)**. The NSS connects the wireless network with standard public networks, performs handovers between different BSSs, supports charging, accounting, and roaming of users between different providers in different countries. The NSS consists of the following switches and databases:
- **Mobile services switching center (MSC)**: MSCs are high-performance digital ISDN switches. They set up connections to other MSCs and to the BSCs via the A interface, and form the fixed backbone network of a GSM system.
- A **gateway MSC (GMSC)** has additional connections to other fixed networks, such as **PSTN** and **ISDN**. Using additional **interworking functions (IWF)**, can also connect to **public data networks (PDN)** as X.25.

  Tasks of MSC: An MSC handles all signaling needed for connection setup, connection release and handover of connections to other MSCs using SS7*.

- **Home location register (HLR)**:
- This comprises static information, such as the **mobile subscriber ISDN number (MSISDN)**, subscribed services (e.g., call forwarding, roaming restrictions, GPRS), and the **international mobile subscriber identity (IMSI)**. Dynamic information is also needed, e.g., the current **location area (LA)** of the MS, the **mobile subscriber roaming number (MSRN)**, the current VLR and MSC HLRs can manage data for several million customers.
- **Visitor location register (VLR)**: The VLR associated to each MSC is a dynamic database which stores all important information needed for the MS users currently in the LA that is associated to the MSC (e.g., IMSI, MSISDN, HLR address). If a new MS comes into an LA the VLR is responsible for, it copies all relevant information for this user from the HLR.
- **3. Operation subsystem:**
- The third part of a GSM system, the **operation subsystem (OSS)**, contains the necessary functions for network operation and maintenance

- **Operation and maintenance center (OMC)**: The OMC monitors and controls all other network entities via the O interface (SS7 with X.25). Typical OMC management functions are traffic monitoring, status reports of network entities, subscriber and security management, or accounting and billing. OMCs use the concept of **telecommunication management network (TMN)** as standardized by the ITU-T.
- **Authentication centre (AuC)**: As the radio interface and mobile stations are particularly vulnerable, a separate AuC has been defined to protect user identity and data transmission. The AuC contains the algorithms for authentication as well as the keys for encryption and generates the values needed for user authentication in the HLR. The AuC may, in fact, be situated in a special protected part of the HLR.
- **Equipment identity register (EIR)**: The EIR is a database for all IMEIs, i.e., it stores all device identifications registered for this network. The EIR has a blacklist of stolen (or locked) devices. The EIR also contains a list of valid IMEIs (white list), and a list of malfunctioning devices (gray list).

GSM: system architecture