3 Mobile Access Network Technologies

In this part, there is introduced basic technology specification of the mobile wireless access networks, which provide access to a communication network by radio channel.

In term of used technology and radio channel, mobile access networks can be divided into two main units:

- Terrestrial access networks – access points are situated in the surface of the Earth and the communication with them is realized over radio channel in the lower part of the atmosphere.
- Satellite access networks – access points are either terrestrial stations or satellites in their orbits. Communication is realized by passing of radio signal through different layers of the atmosphere.

Mobile communication networks were taken as a part of wired telecommunication networks since the beginning of the mobile communication networks development. For this reason communication protocols and interfaces were solved to satisfy requirements of networks interconnection. Characteristic element of the public and private radio communication networks is mobile switching center, which is the gateway to the wired telecommunication network [24], [25].

3.1 Terrestrial Mobile Access Networks

In the present there are used for this type of the networks so called trunking radio networks – the pack of channels is conjugate into common pool. The pool of channels is used together by several users [26], [27]. Trunking principle is the basic principle of all modern radio communication networks. These networks are divided into:

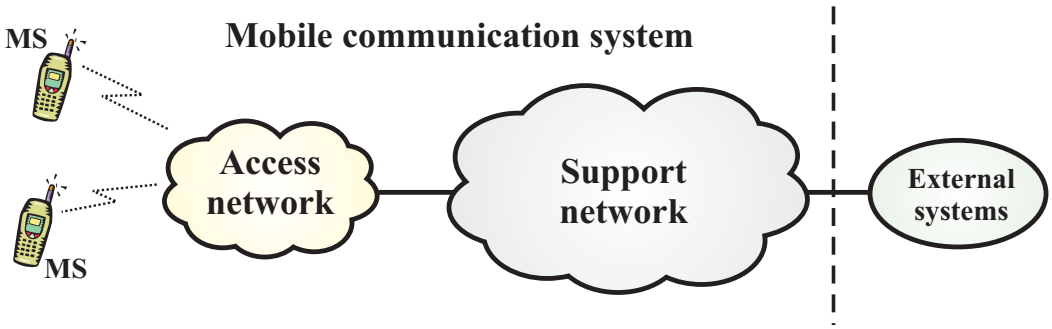
- Public radio networks (e.g. GSM, UMTS).
- Private radio networks (e.g. MPT 1327, SMARTNET, TETRA, TETRAPOL).

Besides this division, radio networks can be divided according to their coverage:

- Large coverage radio networks (full-area public networks),
- Medium coverage radio networks (local private networks),
- Small coverage radio networks (local ad-hoc networks).

3.2 Public Mobile Cellular Networks

Public mobile cellular networks are typical representatives of large coverage radio networks. The basic communication principle is the individual connection (dispatching type of network traffic is not considered). This type of network is designed as a network with a big throughput (a lot of parallel connections). The representatives of these networks are cellular mobile networks, e.g. GSM and UMTS. Mobile communication system is created of two basic networks types.



Mobile communication system

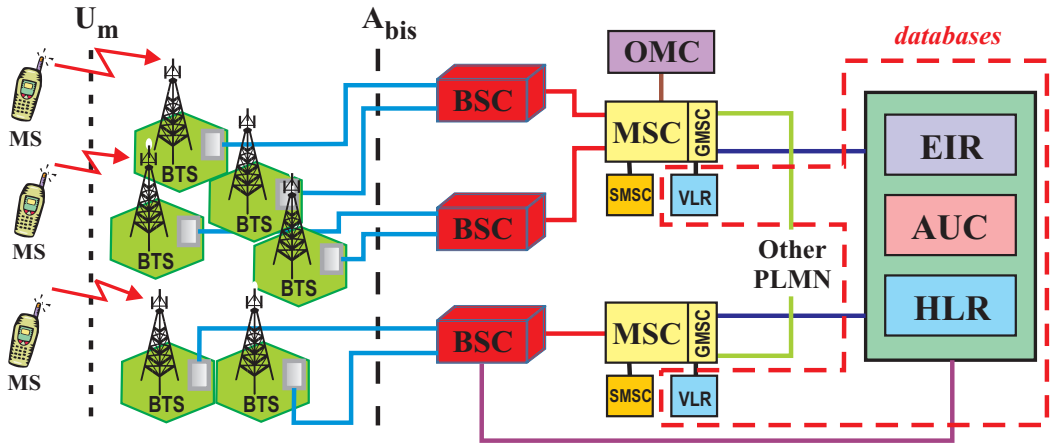
Radio Access Network (**RAN**) performs basic functions of connection control with a mobile terminal. RAN consists of fixed base stations (access points), which are interconnected by fixed or radio relay links.

Support networks of the mobile communication systems are divided into two classes:

- Core Network. This is the part of the system, which provides an interconnection. Support network of the first and the second generation is created only by this core network.
- Backbone Network. This network provides the interconnection of several networks and consists of equipment and transmission paths to offer high-speed data transfer rates. For this reason, backbone network is often called as high-speed data network. In 3G-support network, core network and backbone network are usually used together.

3.3 GSM

GSM standard (*Global System for Mobile Communication*) is, at the present, the most extended public mobile communication system of the second generation (2G), which has almost global coverage [28], [29]. GSM standard uses for creation of multiple accesses the combination of FDMA and **TDMA** technology (frequency division and *time division multiple access*) where one carrier signal is divided in time domain to eight time slots. Combination of frequency duplex and time duplex (FDD/TDD) is used for assurance of the duplex transmission and for uplink (from mobile to base station) and downlink (reversal way) directions separation. The width of channels is 200 kHz. Two frequency bands are devoted to GSM system, with width of 25 MHz (890 – 915 MHz for downlink and 935 – 960 MHz for uplink), i.e. the system provides up to 124 FDMA channels or 992 transmission channels. Between upper and lower band is the guard band, but this band is usually not used. Besides GSM 900 standard, the standard called GSM 1800 (before DCS 1800) is also used in Europe. GSM 1800 is a derivate of GSM 900 standard and it is used as a complement system of GSM 900 for providing the huge intensity traffic in hot spots (shopping centers, administrative centers, bus and railway stations, airports and moreover).



GSM network architecture

3.4 HSCSD and GPRS

GSM common data services are based on the circuit switching technology with maximum transmission data rate 9.6 kbps. In the upgrade of GSM network (phase 2+) ETSI defined new and faster style of data transfer. One of the main characters of GSM phase 2+ is GPRS and HSCSD standard. While the HSCSD standard represents application of circuit switching in data transfer, GPRS standard is the technology, which uses packet switching. Both standards represent 2.5-generation standard.

In **HSCSD** (*High Speed Circuit Switched Data*) standard is the data transfer realized without error correction code. This makes possible to increase data rate from 9.6 kbps to 14.4 kbps per channel. HSCSD standard also supports time slots combination and final data rate is a combination of 9.6 kbps or 14.4 kbps channels. Operators will be able to provide variant data rates from 9.6 kbps to 57.6 kbps. Operators can achieve data rates up to 200 kbps with the data compression. HSCSD standard has possibility to provide an asymmetric and symmetric data traffic. In term of resource allocation, HSCSD standard is not effective for packet data transfer, because resources are allocated only in time when the packet transfer is required.

ETSI made a standardization of a new service in GSM phase 2+. This service is based on a packet switching and it is called **GPRS** (*General Packet Radio Service*). GPRS speeds up data rates in GSM network, provides a better compatibility with LAN and WAN networks and with Internet. GPRS network uses radio resources only in a case when the data are received or sent. GPRS network provides immediate connection and high level of throughput. Whereas GSM system was originally designed for voice services, the main goal of GPRS network is to offer the access to standard data networks, working under TCP/IP protocol. GPRS network is a sub network of such networks.