Chapter 6
Mobile Network Protocols of GSM and GPRS

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ABSTRACT
Starting in the 1990s, mobile communication became one of the most explosion-like developing areas of telecommunications. The first worldwide used digital cellular radio system was the GSM. Primarily, GSM was suitable for voice communication and for circuit-switched data transfer at a very slow bit rate only. This data transfer type was not only slow, but was quite expensive to the users as well. Aiming to eliminate the drawbacks of the data transfer of GSM, the packet-switched service (GPRS) was introduced.

The goal of this chapter is to give an overview about the architecture of GSM and GPRS networks, and introduce to the reader the protocols used for mobility management and call control at the core network. To make it easier to understand the way in which the protocols work, we give many examples to help the readers in his studies. We show how the location update takes place, how the calls are originated and terminated, how the short messages are handled, et cetera.

INTRODUCTION
In this chapter, we introduce to the reader the architecture of GSM. We explain the functions of the most important network elements. After the brief architectural overview, we discuss the protocols used in the Network and Switching Subsystem (NSS). At the end of this chapter, we show the new network elements as well as the core network protocol of the GPRS.
**Structure of the GSM Network**

The user terminals of the mobile networks are the Mobile Stations (MS). An MS consists of the mobile phone itself (Mobile Equipment – ME) and a smart card identifying the subscriber (Subscriber Identity Module – SIM). Each SIM card has a worldwide unique identifier, the International Mobile Subscriber Identity (IMSI). The IMSI consists of a Mobile Country Code (MCC), a Mobile Network Code (MNC), and a Mobile Subscriber Identity Number (MSIN). Each MS has a telephone number referred to as Mobile Station ISDN Number (MSISDN).

A GSM network can be functionally divided into three subsystems:

- Base Station Subsystem (BSS),
- Switching and Management Subsystem (SMSS),
- Operation and Maintenance Subsystem (OMSS).

The BSS is the physical equipment used to give radio coverage to cells and contain the equipment needed to communicate with the MSs at the radio interface. The SMSS includes the functions required to handle signaling protocols by which calls and mobility of the subscribers are controlled. The OMSS performs functions related to system security (authentication and mobile equipment identity check) as well as it is in charge of remote operations and maintenance of the PLMN (ETSI, 1998). The description of the Operation and Maintenance Center (OMC) is out of scope of this chapter. The SMSS extended with the Authentication Center (AuC) and the Equipment Identity Register (EIR) from the OMSS is often referred to as Network and Switching Subsystem (NSS), thus we will use this term as well (Figure 1).

**Base Station Subsystem**

The Base Station Subsystem provides connections between the MSs and the GSM network through the radio interface. A BSS consists of the following elements:

- Base Transceiver Stations (BTS),
- a Base Station Controller (BSC),
- a Transmission and Rate Adaptation Unit (TRAU).

![Figure 1. GSM architecture and protocols](image-url)
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