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rent. This type of SIM card mobility is analogous to terminal mobility, but provides a personal-mobility-like service within the GSM mobile network (refer to chapter 11 for more details).

An MS has a number of identities including the International Mobile Equipment Identity (IMEI), the International Mobile Subscriber Identity (IMSI), and the ISDN number. The IMSI is stored in the SIM. The SIM card contains all the subscriber-related information stored on the user's side of the radio interface.

- **IMSI.** The IMSI is assigned to an MS at subscription time. It uniquely identifies a given MS. The IMSI will be transmitted over the radio interface only if necessary. The IMSI contains 15 digits and includes
  - Mobile Country Code (MCC)—3 digits (home country)
  - Mobile Network Code (MNC)—2 digits (home GSM PLMN)
  - Mobile Subscriber Identification (MSIN)
  - National Mobile Subscriber Identity (NMSI)
- **Temporary Mobile Subscriber Identity (TMSI).** The TMSI is assigned to an MS by the VLR. The TMSI uniquely identifies an MS within the area controlled by a given VLR. The maximum number of bits that can be used for the TMSI is 32.
- **IMEI.** The IMEI uniquely identifies the MS equipment. It is assigned by the equipment manufacturer. The IMEI contains 15 digits and carries
  - The Type Approval Code (TAC)—6 digits
  - The Final Assembly Code (FAC)—2 digits
  - The serial number (SN)— 6 digits
  - A Spare (SP)—1 digit
- **SIM.** The SIM carries the following information (see chapter 11 for more details):
  - IMSI
  - Authentication Key (K_i)
  - Subscriber information
  - Access control class
  - Cipher Key (K_c)*
  - TMSI*
  - Additional GSM services*
  - Location Area Identity (LAI)*
  - Forbidden PLMN

*Updated by the network.

reports, stock data, weather alerts, and the like. The information service provider that originates the information is called the *cell broadcast entity*. The information is transferred to the *cell broadcast center* which relays the information to one or more BSCs. The BSCs in turn forward the message to the *base transceiver systems* for transmission over the air. The transmissions consist of the data and the identity of the mobiles that are to receive the data. The interface between the cell broadcast center and the BSC is not defined in the GSM standards but is left to a matter of agreement between the operators of each network element.

Messages to the MS are transmitted on the CBCH.

The MS and the SIM card have limited amounts of memory. Thus it is possible that messages sent directly to the MS or directly from the MS could be limited in number or length. Therefore, the MS may have a terminal connected to it that is capable of storing and generating the messages [14]. The interface uses mobile termination type 2 (MT2) as described previously in this chapter.

10.5 GSM GPRS

The GSM GPRS extends the packet capabilities of GSM to higher data rates and longer messages. The service supports sending point-to-point and point to multipoint messages. Two new nodes are added to the network to support GPRS (Figure 10.12). The serving GPRS support node communicates with MSs within its service area. The gateway GPRS support node communicates with packet networks that are external to the GSM network.

The protocol architecture of the GPRS system is shown in Figure 10.13. The application in the MS (or its data adjunct) communicates with the application in the distant packet terminal. The communication is through the higher layers and the network layers in the MS, where it is relayed through the BSS to the serving GPRS support node and on to the gateway GPRS node. From the gateway GPRS node, it is sent on to the packet switching network. As the data transverses the network, several protocols are used.

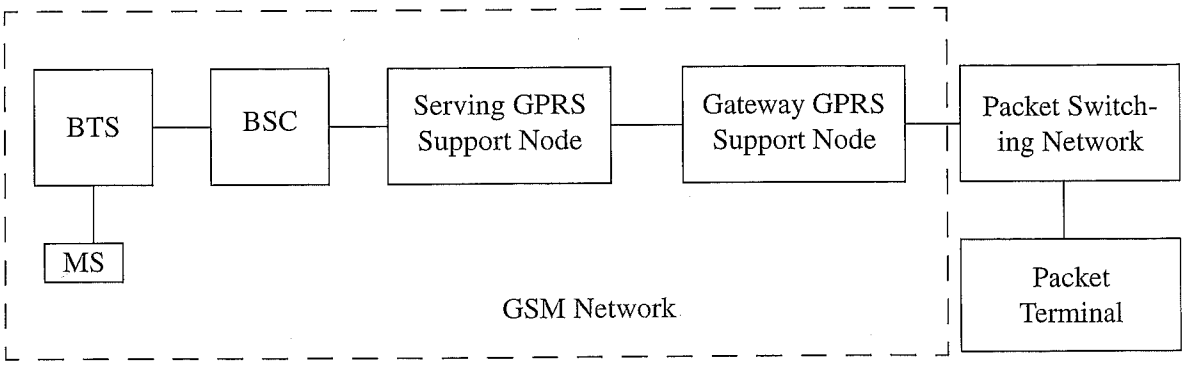

Fig. 10.12 GPRS Network Architecture

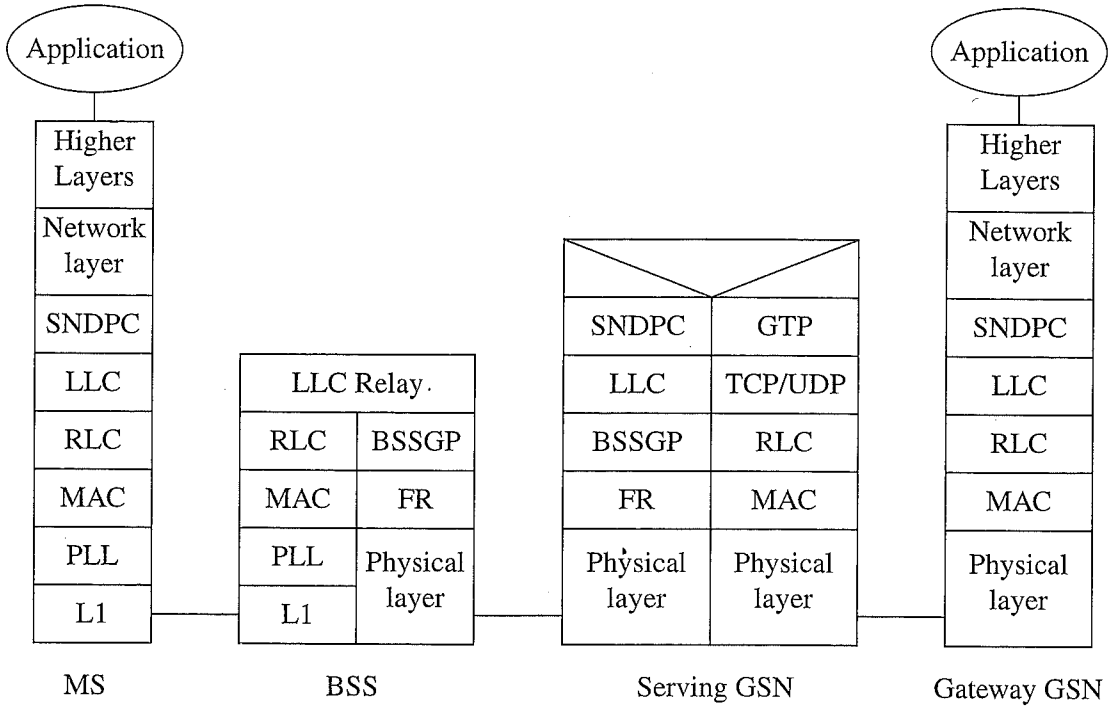

Fig. 10.13 Protocol Stack for GPRS

In the MS and the BSS:

- The **Sub-Network-Dependent Convergence Protocol (SNDCP)** performs header compression on the headers of the network layer.
- The **Logical Link Control (LLC)** provides the link layer control between the MS and GPRS serving node. It is based on LAPD.
- The **Radio Link Control (RLC)** transmits data blocks across the air interface, performs error detection, and performs error correction via an automatic repeat request process.
- The **Media Access Control (MAC)** operates similar to a slotted ALOHA channel.
- The **physical link layer** manages forward error correction, interleaving of frames, and radio channel congestion.
- The **radio frequency layer** manages the physical radio layer of the system, including frequency modulation.

Between the BSS and the serving GPRS node:

- **BSS GPRS Protocol (BSSGP).** This new protocol provides routing and QoS management.
- **Frame relay.** This standard wireline protocol supports packet communication between nodes.
- **Physical layer.** As needed between nodes (e.g., E1 link).

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