ANALYSIS OF NETWORK ASPECTS

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Annotation: *The article publishes control channels are used by the mobile station in the passive state to exchange the signal information necessary to switch to the dedicated state. In the dedicated state, mobile stations are engaged in monitoring "visible" base stations in order to obtain various kinds of information, including information necessary for moving between cells and changing channels (handover).*

Keywords: *Visible, base station, handover, cellular mobile network, data transmission, location updating.*

Ensuring the necessary quality of voice and data transmission through a radio connection is only one part of the functions of a cellular mobile network. The fact that the geographical area covered by the network is divided into cells makes it necessary to implement a mechanism for changing the cell and channel (handover). In addition, the fact that a mobile station can move within a State and between states requires the specification of the functions of registration, authorization, call routing and change of residence (location updating)
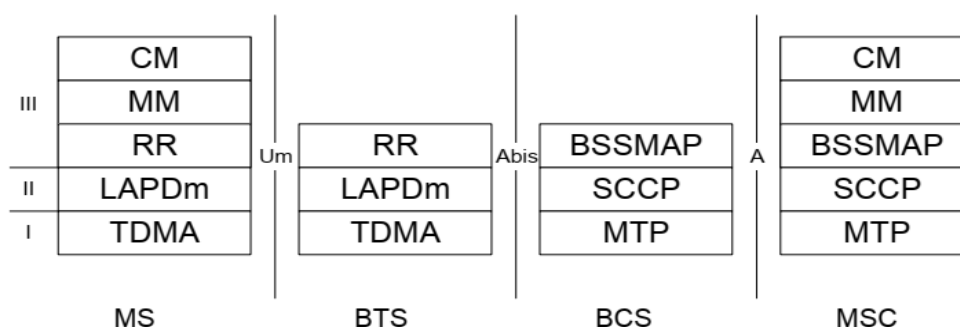
Fig. 3 The structure of signal protocols in GMS.

The signal exchange protocol in GMS is based on a three-level model (as shown in Figure 3). The first layer is the physical layer that uses the channel structure discussed earlier. The second level is the data linking level. When considering the Um interface, the data linking layer is a modified version of the LAND protocol, the ISDN used, the so-called LAPDm. In the case of the A-interface, the Message Transfer Part Of The Signaling System Number 7 (Signaling System Number 7) is used. The

third level of the GSM signal exchange protocol is divided into three sublevels:

Radio Resources Management sublevel. Responsible for the initial installation, maintenance and termination of radio channels and fixed channels, including procedures for changing the cell and channel (handover).

• Sublevel Of Mobility Management. Responsible for the procedures of change of residence (location updating) and registration

(registration) of the subscriber. Manages access secrecy and subscriber authorization procedures.

• Connection Management Sublevel. Responsible for the general call management procedure (very similar to Q.931), manages

Additional Services and a Short Message Service.

The exchange of signals between different entities in a fixed part of the network (such as between HLR and VLR) is described in the recommendations part called the Mobile Application Part. MAP It is "superimposed" over a Part of Possible Transactions (Transaction Capabilities Application Part (TCAP - the upper level of the Signaling System Number 7 (Signalling System Number 7)). The MAP specification is one of the most voluminous parts in the GSM recommendations.

Radio resource management

The Radio Resource Management layer oversees the establishment of radio connections and fixed connections between the Mobile Station and

Switching and Control Center. The main functional elements included in the scope of activity of this level are: Mobile Station, Base Station and Switching and Control Center.

The RR layer deals with the management of the RR session, which is a period of time during which the mobile station is in a dedicated state, and in addition, it is engaged in the configuration of radio channels, including the creation of dedicated channels.

The RR session is always initiated by the mobile station through an access procedure (both for outgoing calls and in response to a paging message). Management of access procedures and procedures related to paging (such as: allocation of a dedicated channel mobile station, determination of the structure of the Paging Channel subchannels) occurs at the RR level. In addition to the above, the control of such radio connection-related capabilities as voltage level, intermittent transmission and radio transmission also occur at the RR level.

Procedures for changing the cell and channel (handover)

In cellular networks, the necessary radio connections and fixed connections are not allocated permanently, for the entire duration of the connection. The cell or channel change procedure (handover or handoff - in North America) switches

the connection to other channels or cells. Performing procedures for changing cells or channels is one of the main functions of the RR-level.

There are four main types of such procedures in GSM systems:

• Channels (time slots) belong to one cell.

• The cells (BTS) are controlled by the same BSC.

• The cells are controlled by different BSCs, but belong to the same MSC.

• Cells under the control of different MSC.

For the first two types of handover, the so-called internal handovers, only BSC is involved in the procedure. In order to maintain the established signal band, they are controlled only by the BSC (without involving the MSC), except for notification of the completion of the procedure. The last two types of handover are called external handovers, and MSK is involved in them. A very important aspect of GSM is the fact that the MSC, the so-called anchor MSC, is responsible for most of the functions directly related to the connection, with the exception of internal BSC handovers, which are controlled by a certain "new MSC", the so-called trust MSC.

Handovers can be initiated not only by the mobile station, but also by the MSC (for example, in the case of traffic rebalancing). In the passive state, the mobile station scans the Broadcast Control Channels (Broadcast Control Channel) of neighboring cells (up to 16) and forms a list of the 6 best candidates for a possible handover (based on data on the strength of the received signals). This information is transmitted to the BSC and MSC at least once per second and is used in the handover algorithm.

The specific handover selection algorithm is not specified in the GSM recommendations. Two main algorithms are usually used that are directly related to voltage control. This kind of choice is based on the fact that BSC usually does not know what results in poor signal quality: either it is the result of multipath fading, or the mobile station wants to move to another cell. This situation is most typical for small urban cells.

The algorithm "Minimum possible changes" (Minimum Acceptable Performance) gives preference to voltage control: in case of signal attenuation below the set point, the voltage level of the mobile station increases. If the signal quality has not improved as a result of these actions, then consideration of the possibility of a handover begins. This is the simplest and most general method, but it creates a "spot" on the cell boundary for a mobile station transmitting at the highest possible voltage

level, i.e. the mobile station seems to be moving at some distance from the natural boundaries of the cell to another cell.

Mobility Management

The mobility management layer is located above the RR level, and manages functions that follow directly from the subscriber's own mobility and aspects of secrecy and authorization. The management of "residence" is considered here in the sense of procedures that allow the system to find out the current residence of an enabled mobile station in order to route incoming calls.

Changing the "area of residence" (location updating)

The switched-on mobile station is informed about an incoming call using a paging message sent via the PAGCH channel of this cell. Only if absolutely necessary, you can afford to poll every cell in the network for each call. Obviously, this is too wasteful a pleasure. The other extreme: notification of the system by the mobile station, about each change of location (for each cell). Such the approach requires polling messages to be sent to only one cell, and is also very wasteful due to the large number of messages. A compromise solution of GSM is the possibility of grouping cells in the "area of residence" (location area).

Messages about the change of residence are necessary when moving between "areas of residence", and notification by paging messages occurs inside the current "area of residence".

The procedure for changing the place of residence, followed by routing, uses MSC, HLR and VLR. At the moment when the mobile station is switched on in a new "area of residence", or at the time of moving to a new "area of residence" or under the control of another PLMN operator, it is obliged to register on the network in order to reflect the current place of residence. In normal cases, a message about the change of the "area of residence" is sent to new MSC/VLRs, which record information about the "area of residence" and send it to the subscriber's HLR.

Usually, the information sent by the HLR is the SS7 address of the new VLR, although it may also be a route number. The reason that a route number is usually not assigned, even if it reduces signal exchange, is the fact that there is a very limited number of available route numbers in the new MSC/VLR, and they are allocated on request for incoming calls. If a subscriber is subscribed to a certain number of services, HLR sends some subset of subscriber information needed to manage the connection to the new MSC/VLR; except After that, HLR sends a message to cancel the registration of the old MSC/VLR.

For reasons of reliability in GSM" there is also a periodic procedure for changing the "area of residence". If the HLR or MSC/VLR fail while

simultaneously trying to grow registries, the database will be updated as if a change of "area of residence" had occurred. The authorization for this procedure and the setting of the time period are controlled by the network operator (a compromise between traffic and recovery speed is necessary). If the mobile station is not re-registered during the "forced" procedure of changing the "area of residence", its registration is automatically canceled.

The procedure for connecting /disconnecting IMSI is directly related to the procedure for changing the "area of residence". Disconnecting the IMSI means that the mobile station becomes inaccessible to the network, therefore, the network must know that disconnection has occurred in order to avoid channel allocation and sending paging messages to this station.

The IMSI connection is very similar to a simple change of the "area of residence", in addition, the network is informed that the mobile station has moved to the category of findable. Activation The IMSI connection/disconnection procedure is related directly to the operator and takes place on the basis of a specific cell.

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