

Basics of GSM – Part 2

Bearer Services and Supplementary Services

I have already discussed the [basics of GSM network elements](#) and its traffic management in my [previous post](#)

In this article I am going to discuss Bearer Services as well as Supplementary Services provided by GSM network. Later I will discuss the concept of signalling in layer 3 of GSM protocol architecture.

Bearer Services provided By GSM Network

Bearer Services come into the picture when data transmission services are needed and there are a number of different types of data services available which is provided by GSM network.

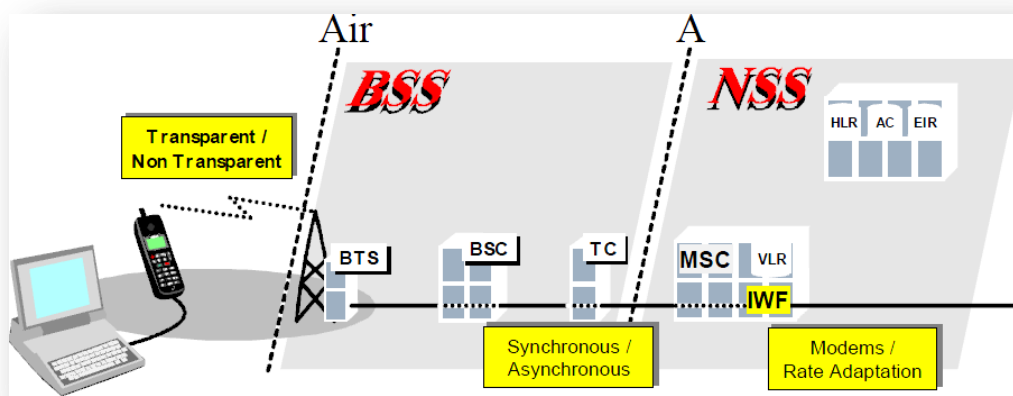
The differences between these data services are based on the GSM subscribers which can be connected to the PSTN, ISDN Network and the mode of transmission (packet or circuit switched, whether end-to-end digital or not).

Bearer Services supported by the GSM network only provide the capability of transmitting signals between the originating and terminating terminals. So that, the bearer services can be divided different categories as mentioned below:

- Circuit Mode unstructured with Unrestricted Digital Capability Transparent.
- Circuit Mode unstructured with Unrestricted Digital Capability Non Transparent.
- Packet Service.

The first two types of bearer services are used for data communication between GSM networks and PSTN.

GSM network and the unrestricted digital data will be forwarded to the mobile user. The modems are located in the MSC.



Supplementary Services provided by GSM network

Supplementary services enhance or supplement the basic telecommunication services.

The following list of services covers most of the common services, as well as the essential Supplementary services.

- Advice of charge - AOC
- Alternate Line Service (ALS) – personal or business
- Barring of all incoming calls - BAIC
- Barring of all Incoming calls when roaming outside the HPLMN
- Barring of Incoming Calls when abroad
- Barring of outgoing calls - BOC
- Barring of outgoing International Calls - BOIC
- Barring of outgoing international calls excluding those directed to the HPLMN country
- Call forwarding on mobile subscriber busy - CFB
- Call forwarding on no answer - CFNA
- Call forwarding unconditional - CFU
- Call Hold
- Call Waiting – CW

Signalling in GSM network

Why we need signalling in GSM network?

Signalling in telecommunication networks has come a long way since the early days when an operator used to sit at the central exchange. Telecommunication networks were relatively simple and the general procedure of setting up a call would go something like this.

An example:

You would pick up the “handset” of your telephone, an electrical current would flow to the exchange and a light would start blinking accompanied by a sound. This would let the person know that you are requiring service. Then we would plug in one connector to the terminal and the other to the “headphone” and inquire about whom you wanted to talk to.

After listening to your answer, we would then try to connect to the person you want to talk with. Then we would pull out the connector from your terminal and connect it to your intended party. He would then hear his phone ringing. After he answers, the person will connect to you.

Signalling Operations

Above example highlights **two** important aspects of signalling. The conversation which is the primary task and what went on behind the scene to make that conversation successful. The functions of signalling are as follows:

- **To set up a call**
- **To supervise the call**
- **To clear a call.**

Basically signalling in telecommunication systems is a set of messages used for setting up, supervising and clearing the call.

There is a uniform set of standard **messages** used in the signalling procedure in GSM network.

The ITU came up with a new recommendation for a signalling system which was the Common Channel Signalling System Number 7.

One of the main advantages of this system was that signalling did not have to go along the same path as the speech.

SS7 was developed in the mid to late '80s and is known as Common Channel Signalling system (CCS) with a signalling path bandwidth of 64Kbits/s.

Common Channel Signalling System No.7

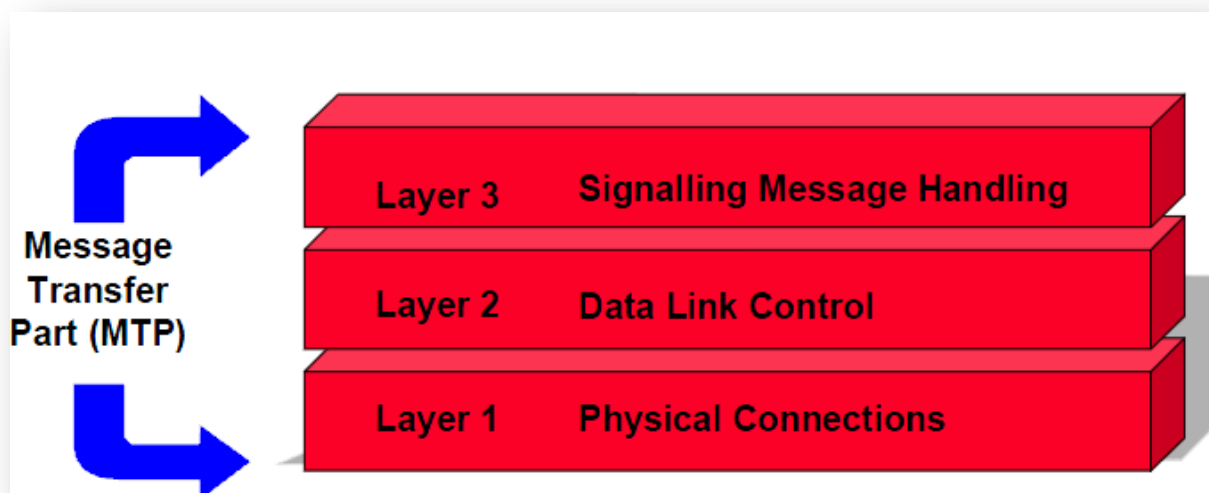
The Common Channel Signalling System No. 7 referred to as SS7 consisted of two parts. The first part was responsible for transferring the message within a signalling network. The second part was the user of these messages.

So that, we can say that the initial phase of SS7 consisted of two parts

- Message Transfer Part - **MTP** (responsible for transferring messages)
- Telephone User Part - **TUP** (user of messages)

Message Transfer Part (MTP)

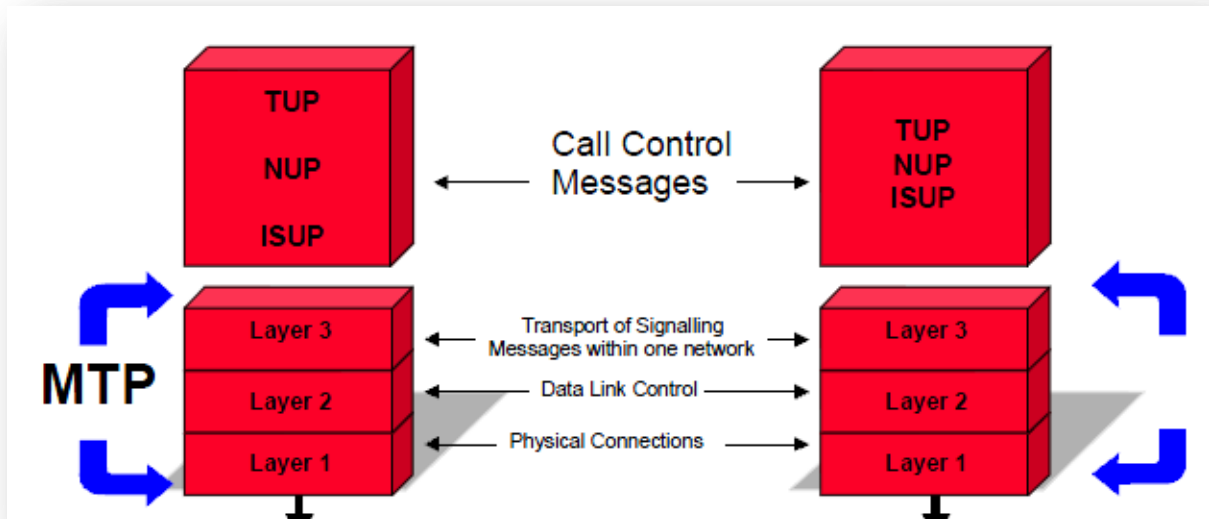
Now we know that signalling is used for setting up calls, and that there are standard sets of messages which are sending back and forth to help facilitate this. The part which is responsible for taking these messages from one network element to other network element is known as the **Message Transfer Part (MTP)**. The entire SS7 is built on the foundation of this MTP which consists of three sub layers as shown.



Telephone User Part (TUP)

Above we explained the MTP. But who is the user who receives, sends and acts on these messages? The answer is the **Telephone User Part (TUP)**.

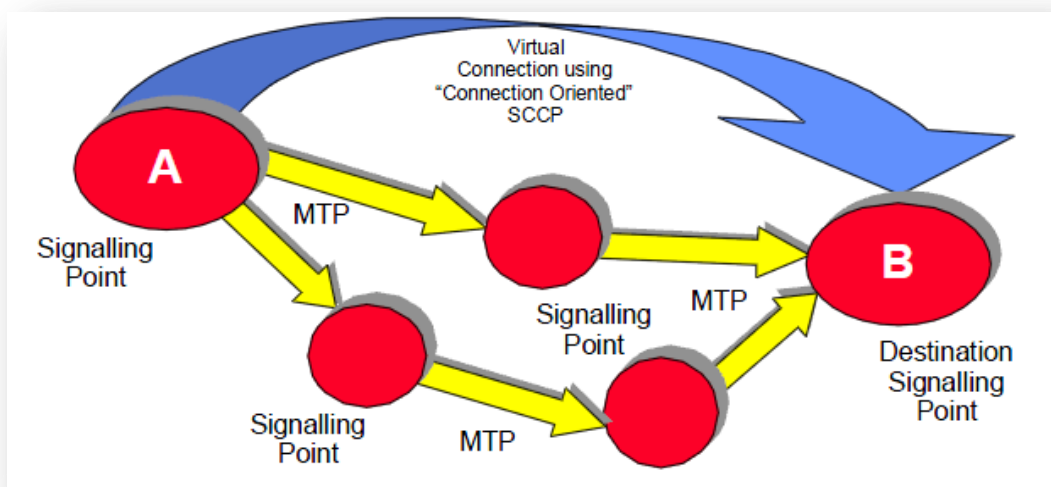
Those standard sets of messages that were mentioned previously are the standard TUP messages which help to set up the call, to supervise and clear it.



Signalling Connection and Control Part (SCCP)

The structure of SS7 with TUP on top of MTP is for call handling. Later it was realised that the TUP/MTP combination alone was not sufficient when "virtual connections" became necessary. MTP guarantees the transfer of messages from any "signalling point" in the signalling network to any other "signalling point", safely and reliably.

The signalling goes leg by leg according to the call. But in the absence of a call, MTP cannot route a signalling message across multiple networks.



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The solution to these problems was the creation of another protocol layer on top of MTP which was called the **Signalling Connection and Control Part (SCCP)**. SCCP takes care of virtual connections and connectionless signalling.

Note that the tasks of TUP and SCCP are different, and thus they are parallel to each other, but both use the services of MTP.

SS7 Layers in GSM Elements

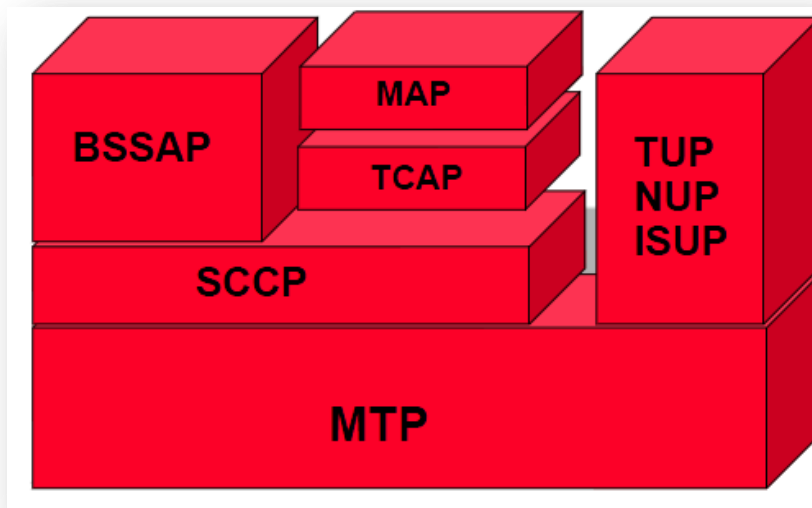
In the above discussion explained why SS7 was needed in GSM and what are the protocol layers that are used. It is useful to note that not all the GSM elements have all the protocols in the SS7 stack.

For example, a **BSC would never need TUP because call control is not the task of the BSC.**

Protocol Stack in MSC

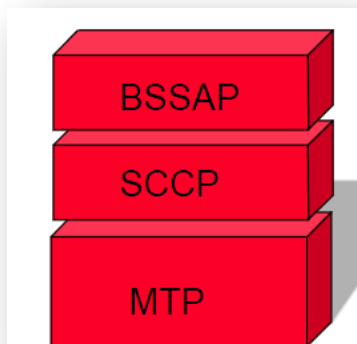
The MSC is the element in GSM networks which is responsible for call control therefore, TUP/ISUP sits on top of the MTP for that purpose. The MSC/VLR is also responsible for location updates and communication as I discussed in the previous article with the BSC and the HLR.

For this reason it also needs to have **BSSAP and MAP** which sit on top of SCCP. The MSC also has TCAP to provide services for MAP. It can be seen therefore, the MSC/VLR has all the SS7 protocol stacks implemented in it.



Protocol Stack in BSC

The BSC only needs BSSAP, but since BSSAP needs the services of the SCCP which in turn needs the MTP, the BSC contains MTP, SCCP and BSSAP.

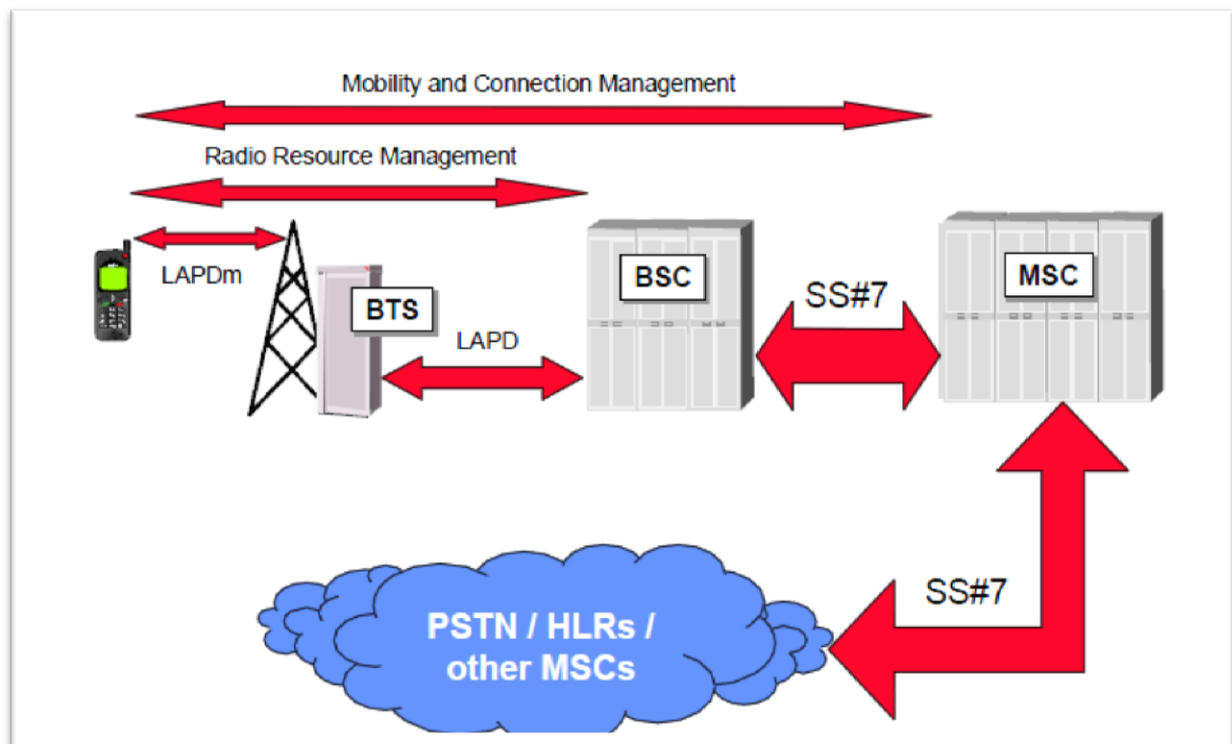


Other Signalling Protocols in GSM

As we have already discussed, the GSM core network elements use SS7 (Signalling System No. 7) to pass signalling messages between BSC and the BTS, a signalling protocol is used known as LAP-D (Link Access Procedure for the ISDN "D" channel). This is the same protocol that is used in ISDN networks between the customer and the network.

Between the mobile station and the BTS, the same signalling protocol is used with small modifications and with the characteristics of the radio transmission medium. This protocol is known as **LAP-Dm** where the "m" denotes modified.

Protocols for **Radio Resource (RR)** management are passed using LAP-Dm and LAP-D. Other protocols for **Mobility Management (MM)** and **Connection Management (CM)** are passed between the Mobile Station and the MSC.



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Now I guess you have got some basic idea of GSM network, Signalling as well as various network element protocol stacks.

In the next article ***I am going to discuss Basics of GPRS and its network elements***. Actually the GPRS network acts in parallel with the GSM network. The GPRS network providing packet switched connections to the external networks.

References:

Wikipedia and Nokia Siemens network (NSN)

About the document:

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