Mobile Computing

UNIT V:

GPRS – GPRS and packet data network – GPRS network architecture – GPRS network operations– Data services in GPRS – Application for GPRS.SMS: Mobile Computing Over SMS-Short Message Service-Value Added Services through SMS.

TEXT BOOK

“Mobile Computing”, Asoke K Talukder ,Roopa R Yavagal, TMH, 2005.

Prepared By: Dr. D. DEVAKUMARI

GPRS

- General Packet Radio Service
- Step to efficiently transport high-speed data over the current GSM and TDMA-based wireless network infrastructures
- Deployment of GPRS networks allows a variety of new applications ranging from mobile e-commerce to mobile corporate VPN access
- GPRS allows for data speeds of 14.4 KBps to 171.2 KBps, which allow for comfortable Internet access
- Allows for short 'bursty' traffic, such as e-mail and web browsing, as well as large volumes of data

QoS in GPRS

- Allows definition of QoS profiles using the parameters of service precedence, reliability, delay and throughput
- Service precedence is the priority of a service in relation to another service which can be either high, normal or low
- Reliability indicates the transmission characteristics required by an application and guarantees certain maximum values for the probability of loss, duplication, mis-sequencing and corruption of packets
- Delay parameters define maximum values for the mean delay and the 95-percentile delay
- Throughput specifies the maximum/peak bit rate and the mean bit rate

GPRS Network Architecture

- GPRS uses the GSM architecture for voice
- To offer packet data services through GPRS, a new class of network nodes called GPRS support nodes (GSN) are introduced
- GSNs are responsible for the delivery and routing of data packets between the mobile stations and the external packet data networks (PDN)
- Two main GSNs are Serving GSN (SGSN) and Gateway GSN (GGSN)

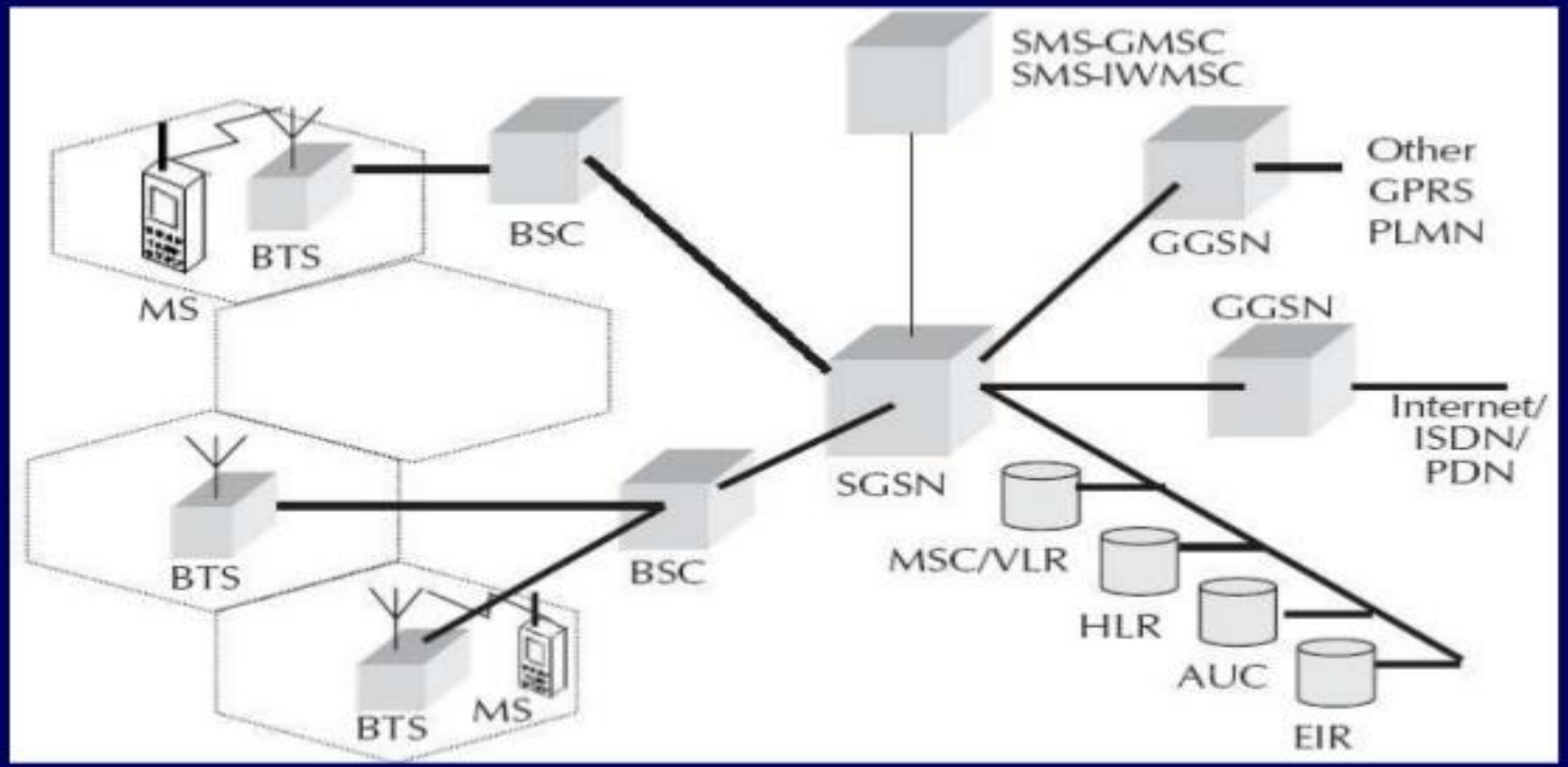
SGSN

- SGSN is at the same hierarchical level as the MSC and so, whatever MSC does for voice, SGSN does for packet data
- SGSN's tasks include packet switching, routing and transfer, mobility management, logical link management, authentication and charging functions
- SGSN processes registration of new mobile subscribers and keeps a record of their location inside a given service area
- Location register of the SGSN stores location information (like current cell, current VLR, etc.) and user profiles of all GPRS users registered with this SGSN
- SGSN sends queries to HLR to obtain profile data of GPRS subscribers

GGSN

- GGSN acts as an interface between the GPRS backbone network and the external packet data networks and functions like a router in a LAN
- GGSN maintains routing information that is necessary to tunnel Protocol Data Units (PDUs) to the SGSNs that service particular mobile stations
- GGSNs convert the GPRS packets coming from the SGSN into the appropriate packet data protocol (PDP) format for the data networks like Internet or X.25
- GGSN stores the current SGSN address of the user and user's profile in its location register while performing authentication and charging functions related to data transfer

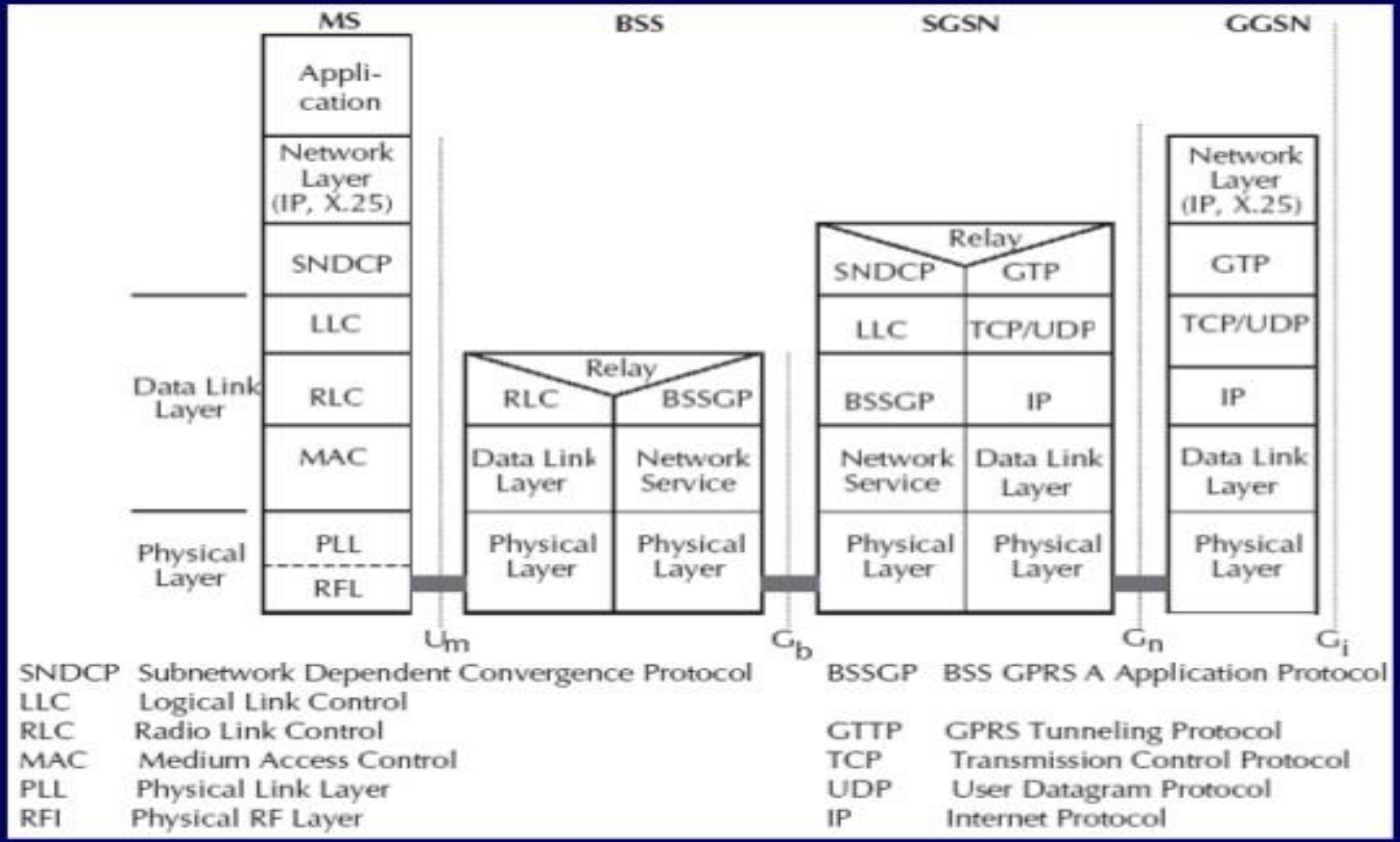
GPRS System Architecture



GPRS Network Enhancements

- Base Station System (BSS) needs enhancement to recognize and send packet data and this includes BTS upgrade to allow transportation of user data to the SGSN. BTS, too, needs to be upgraded to support packet data transportation between BTS and MS (mobile station).
- HLR needs enhancement to register GPRS user profiles and respond to queries originating from GSNs regarding these profiles.
- MS (mobile station) for GPRS is different from that of GSM.
- SMS-GMSCs and SMS-IWMSCs are upgraded to support SMS transmission via the SGSN.

Transmission Plane Protocol Architecture



SNDCP	Subnetwork Dependent Convergence Protocol	BSSGP	BSS GPRS A Application Protocol
LLC	Logical Link Control		
RLC	Radio Link Control	GTTP	GPRS Tunneling Protocol
MAC	Medium Access Control	TCP	Transmission Control Protocol
PLL	Physical Link Layer	UDP	User Datagram Protocol
RFI	Physical RF Layer	IP	Internet Protocol

GPRS Network Operations

Attachment and Detachment in GPRS

- MS registers itself with SGSN of GPRS network through a GPRS attach which establishes a logical link between the MS and the SGSN.
- Network checks if MS is authorized to use the services; if so, it copies the user profile from HLR to SGSN and assigns a Packet Temporary Mobile Subscriber Identity (P-TMSI) to the MS.
- To exchange data packets with external PDNs after a successful GPRS attach, an MS must apply for an address which is called PDP (Packet Data Protocol) address.
- For each session, a PDP context is created which contains PDP type (e.g. IPv4), PDP address assigned to the mobile station (e.g. 129.187.222.10), requested QoS and address of the GGSN that will function as an access point to the PDN.

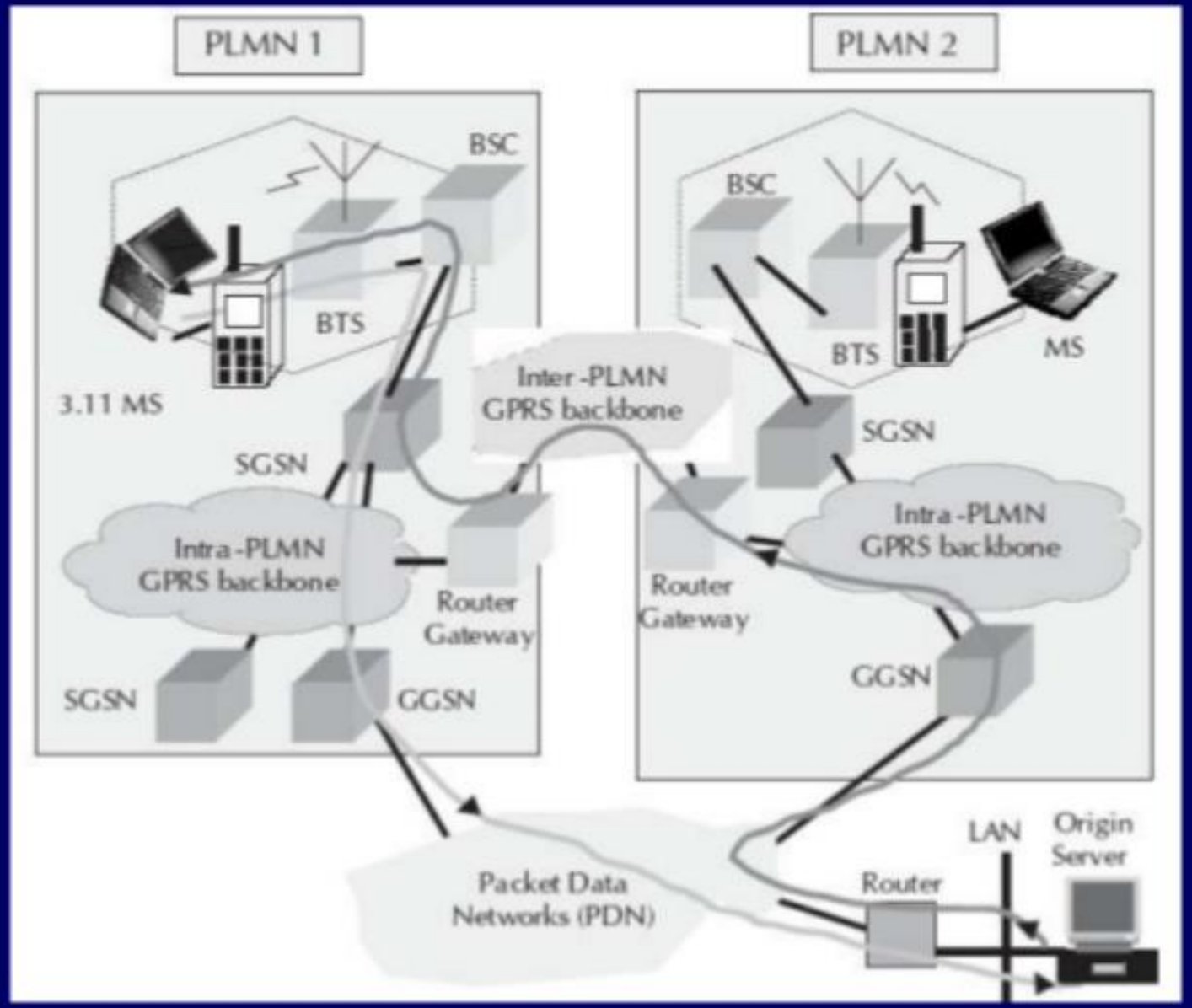
Mobility Management

- Mobility Management functions are used to track its location within each PLMN in which SGSNs communicate with each other to update the MS's location in the relevant registers.

Routing

- Routing is the process of how packets are routed in GPRS.
- Here, the example assumes two intra-PLMN backbone networks of different PLMNs. Intra-PLMN backbone networks connect GSNs of the same PLMN or the same network operator.
- These intra-PLMN networks are connected with an inter-PLMN backbone while an inter-PLMN backbone network connects GSNs of different PLMNs and operators. However, a roaming agreement is necessary between two GPRS network providers.

Routing


PLMN 1
PLMN 2
BSC
BTS
3.11 MS
SGSN
Intra-PLMN
GPRS backbone
Router
Gateway
SGSN
GGSN
Inter-PLMN
GPRS backbone
BSC
BTS
MS
SGSN
Intra-PLMN
GPRS backbone
Router
Gateway
GGSN
LAN
Origin
Server
Router
Packet Data
Networks (PDN)

Data Services in GPRS

- Any user is likely to use either of the two modes of the GPRS network: application mode or tunneling mode.
- In application mode, user uses the GPRS mobile phone to access the applications running on the phone itself. The phone here acts as the end user device.
- In tunneling mode, user uses GPRS interface as an access to the network as the end user device would be a large footprint device like laptop computer or a small footprint device like PDA. The mobile phone will be connected to the device and used as a modem to access the wireless data network.

GPRS Handsets

- GPRS terminal can be one of the three classes: A, B or C.
- Class A terminal supports GPRS data and other GSM services such as SMS and voice simultaneously. This includes simultaneous attach, activation, monitoring and traffic. As such, a class A terminal can make or receive calls on two services simultaneously while supporting SMS.
- Class B terminal can monitor GSM and GPRS channels simultaneously, but can support only one of these services at any time. Therefore, a Class B terminal can support simultaneous attach, activation, and monitoring but not simultaneous traffic. Users can make or receive calls on either a packet or a switched call type sequentially but not simultaneously. SMS is supported in class B terminals.
- Class C terminal supports only non-simultaneous attach. The user must select which service to connect to. Therefore, a class C terminal can make or receive calls from only the manually selected network service (and so, the service that is not selected is not reachable). The GPRS specifications state that support of SMS is optional for class C terminals.

Bearers in GPRS

- Bearer services of GPRS offer end-to-end packet switched data transfer.
- GPRS supports two different kinds of data transport services: point-to-point (PTP) services and point-to-multipoint (PTM) services.
- GPRS continues to support SMS as a bearer.
- Wireless Application Protocol is a data bearer service over HTTP protocol, supported by GPRS.
- Multimedia Messaging Service, too, is supported by GPRS.

Applications for GPRS

1) **Generic Applications –** Eg: Information services, Internet access, Email, web browsing etc
2) **GPRS Specific applications –**

i) Chat – using Internet, using SMS

ii) Multimedia Service – photographs, pictures, postcards, greeting cards. Presentations and web pages can be sent and received over the mobile network

iii) Virtual private network – Many bank ATM machines use VSAT (Very Small Aperture Terminal) to connect the ATM system with the bank's server

iv) Personal Information Management – personal diary, address book, appointments, engagements etc. are useful for a mobile individual

v) Job sheet Dispatch – assign and communicate job sheets from office based staff to mobile field staff

vi) Unified Messaging – use a single mail box for all messages like voice mail, fax, email, SMS, MMS etc

vii) Vehicle Positioning – integrate with GPS

viii) Location based services and Telematics – hotels and restaurants finders, roadside assistance, city specific news and information

Short Message Service (SMS)

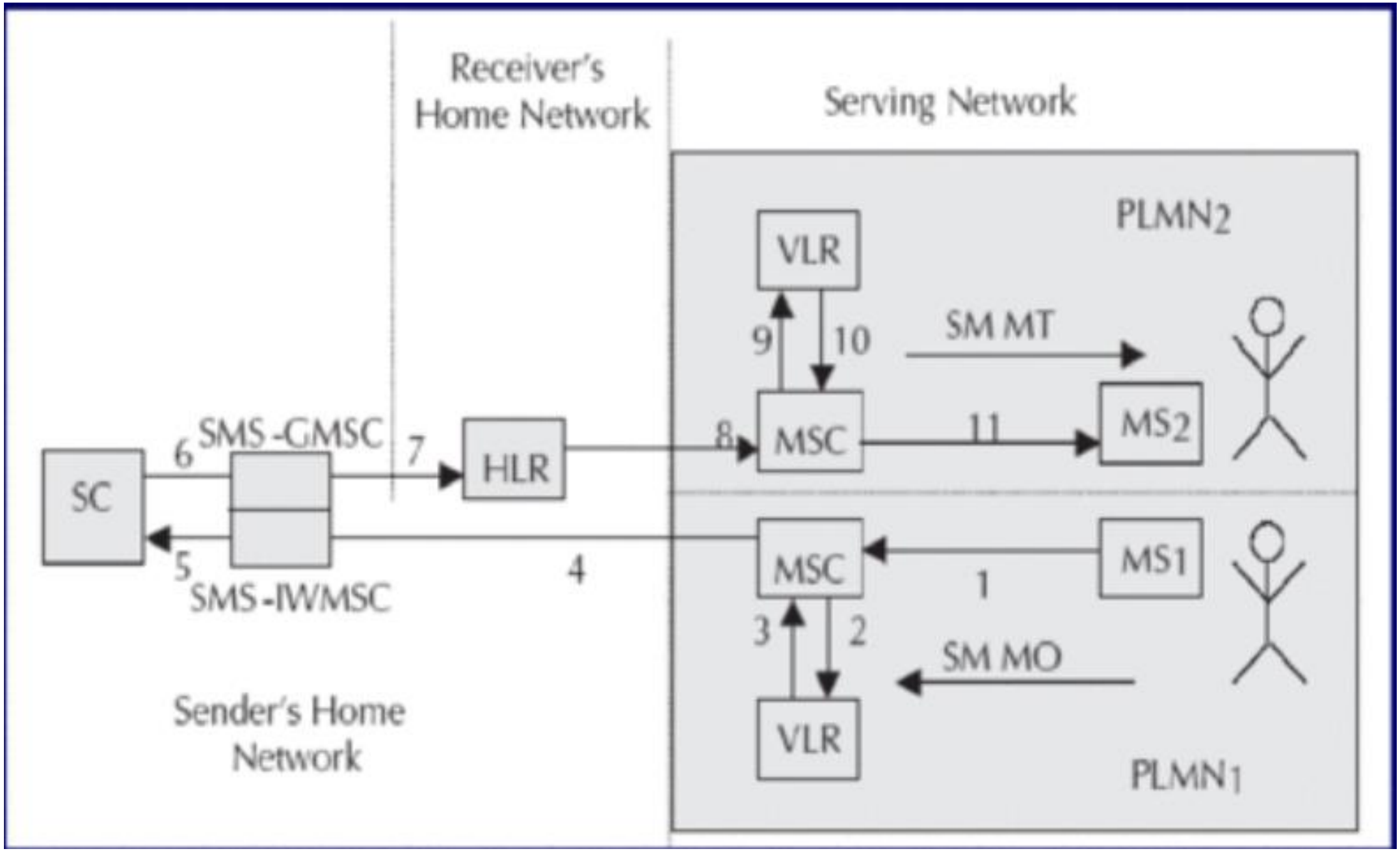
- A unique data service of GSM, not found in older analog systems is the SMS
- SMS enables sending and receiving text messages to and from GSM mobile phones

Strengths of SMS (Characteristics of SMS)

1. **Omnibus nature of SMS –** can be used throughout the world even without long distance subscription
2. **Stateless –** unidirectional and independent of any context
3. **Asynchronous –** Even if the recipient is out of service the transmission will not be abandoned
4. **Self configurable –** can access the SMS without any change in the phone settings
5. **Non Repudiable –** Non deniable. SMS can prove beyond doubt the origin of itself because it carries the service center (SC) and the source MSISDN as part of the message header
6. **Always connected –** user cannot switch off, bar or divert any SMS message. When a call is in progress, SMS is delivered to the MS without any interruption to the call

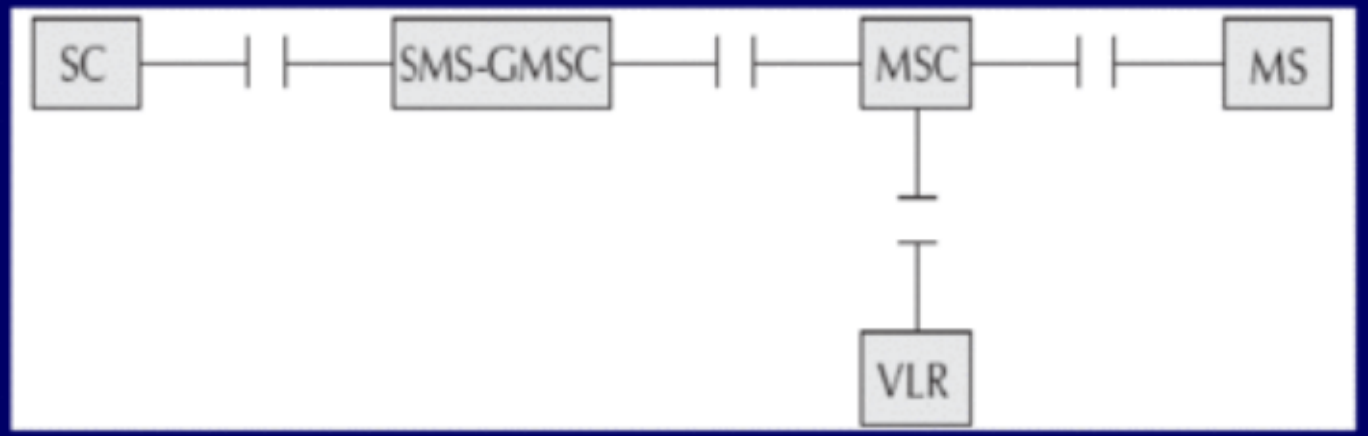
SMS Architecture

- Two types of SMS - **SM MT** (Short Message Mobile Terminated Point-to-Point) and **SM MO** (Short Message Mobile Originated Point-to-Point)
- SM MT is an incoming short message from the network and is terminated in the MS
- SM MO is an outgoing message originated in the MS and forwarded to the network for delivery
- For an outgoing message, the path is from MS to SC via the VLR and the IWMSC (Inter Working MSC) function of the serving MSC whereas for an incoming message the path is from SC to the MS via HLR and the GMSC (Gateway MSC) function of the home MSC


Receiver's
Home Network
Serving Network
PLMN2
VLR
9
10
SM MT
MS2
8
MSC
11
6
SMS-GMSC
7
HLR
SC
5
SMS-IWMSC
4
MSC
MS1
1
3
2
SM MO
VLR
Sender's Home
Network
PLMN1

Short Message Mobile Terminated (SMMT)

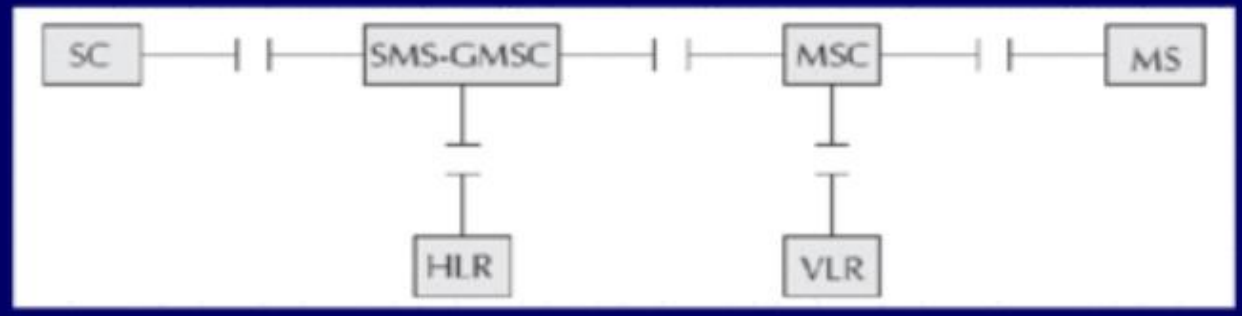
- Message is sent from SC to the MS.
- For the delivery of MT or incoming SMS messages, the SC of the serving network is never used which implies that a SMS message can be sent from any SC in any network to a GSM phone anywhere in the world.



Interfaces in SMMT

Short Message Mobile Originated

- For a MO message, the MSC forwards the message to the home SC.
- MO message works in two asynchronous phases. In the first phase, the message is sent from the MS to the home SC as a MO message. In the second phase, the message is sent from the home SC to the MS as a MT message.



Interfaces in SMMO

Operator Centric Pull

- Operators offer different information on demand and entertainment services through connecting an Origin server to the SC via a SMS gateway.
- Such service providers are known as Mobile Virtual Network Operator(s) (MVNO).
- Let' s say few banks offer balance enquiry and other low security banking services over SMS and customers need to register for the service.
- During the registration, the customer needs to mention the MSISDN of the phone which will be used for a banking service.
- Once a user is registered for the service, he enters `BAL' and sends the message to a service number (like 333) as a MO message and then SC delivers this MO message to the SMS gateway (known as SME-Short Message Entity) connected to this service number.
- SMS gateway then forwards this message to the enterprise application and response from the enterprise application is delivered to the MS as a MT message from the SME.

Operator Independent Pull

- Here, too, SMS is sent to the SME connected to the home SC. If a SMS service is operator dependent, the cellular operator can use this to its advantage.
- Enterprises need operator independent pull as enterprises have customers around the world subscribing to different GSM networks
- Above scenario can also be achieved through Intelligent Network.

Operator Independent Push

- Any push, which may be an alert, notification or even response from a pull message generated by an application, can be serviced by any network and delivered to any GSM phone in any network without any difficulty.
- If appropriate roaming tie-ups are in place, an enterprise can use SMS to send business alerts or proactive notifications to its customer anywhere, anytime on his phone.

Value Added Services through SMS

- Value Added Services (VAS) can be defined as services, which share one or more of the following characteristics:

1. Supplementary service (not a part of basic service) but adds value to total service offering
2. Stimulates incremental demand for core services offering
3. Stands alone in terms of profitability and revenue generation potential
4. Can sometimes stand-alone operationally
5. Does not cannibalize basic service unless clearly favorable
6. Can be an add-on to basic service, and as such, may be sold at a premium price

- VAS over SMS are entertainment and information on demand which is further categorized into:

1. Static information which does not change frequently
2. Dynamic information which changes in days
3. Real-time information which changes continually

- Some of the common VAS examples are:

1. News/Stock Quotes Service
2. Session-based Chat Application
3. Email through SMS
4. Health Care Services
5. Micro-Payment Services

Alert services through VAS

- Proactive alert services can be of the two kinds ± Time based and Watermark based
- Time based proactive alerts are sent to the mobile phone at a pre-assigned time of the day
- Watermark based proactive alerts are sent when some event occurs

Location based services through SMS

- Location based services could be road direction, restaurant guide, shopping alerts, etc.
- In location based services, only the information relevant to the current location of the mobile phone (or the subscriber) is provided.
- The location of a mobile phone can be determined either from the network or from the device.

- To find out the location from the device either of the following technologies are used - Cell ID (CID) based system and Global Positioning System (GPS) based system.

Cell ID based system

- CID of the current BTS is determined and then mapping of the cell identifier to the geographical location is performed.
- For CID based system, the signal strength from all the different CIDs are extracted from the device and sent to the server through a SMS.

GPS based system

- GPS is Global Positioning System.
- Location is determined through a GPS receiver installed within the phone.
- GPS provides facility to compute position, velocity and time of a GPS receiver.