

***SMS* Unleashed!**

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Abstract

Articles have been published, speakers have been speaking and many papers have been written too. GSM, CDMA and TDMA have been talked of very oftenly but very few have ever thought of the very famous SMS!

SMS is a medium of delivering short messages over the mobile networks. It is often called by as “store and forward” because the message (text only) from the sending mobile is stored in a central short message center which then forwards it to the destination mobile. This means that in the case that the recipient is not available, the short message is stored and can be sent later. And this one of the strongest pillar that SMS has conquered the wireless world!

This 160 characters (each character 7 bit) message occupying just 140 bytes has been emerging as a wonderful tool for people involved in business and education.

SMS ... *What is it?*

Short Message Service! SMS abbreviation as Short Message Service can no longer be greater than 160 characters which include alphanumeric, binary or Non-text short messages. And an interesting fact is that SMS returns receipts too. Receipts when the recipient receives it on his wireless device. It supports International Roaming without actually activating roaming and just paying the due charges of sending message.

SMS ... *How it works?*

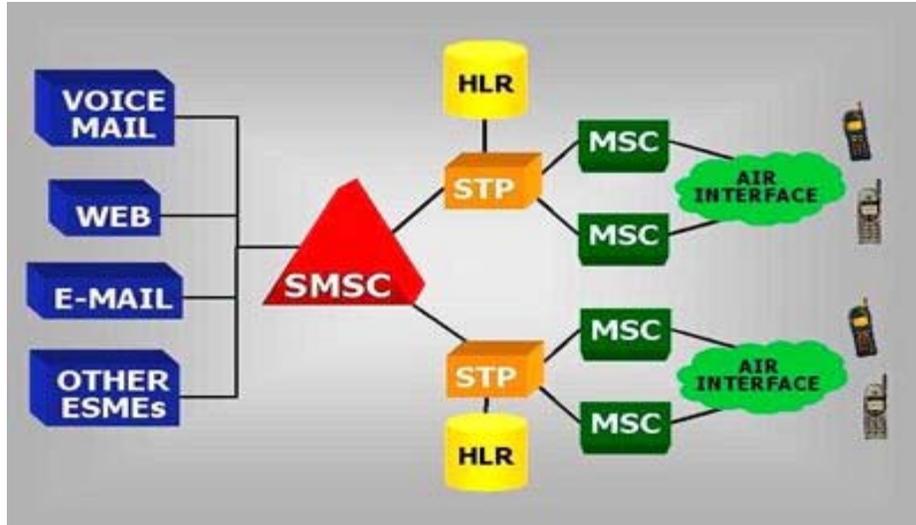
Let us consider a simple GSM network with network elements as shown in Figure 1.

Here the SMSC (Short Message Service Center) is the entity which does the job of store and forward of messages to and from the mobile station. Messages that include Emails, VMS(*Voice Mail System*), Web and other ESMEs (*external short message entities*) first reach SMSC.

The communication of signals that takes place between the wireless network elements and the devices like **Home Location Register(HLR)** and **Mobile Switching Center(MSC)** occurs through a **Signal Transfer Point (STP)**.

Fig 1.

TYPICAL ORGANIZATION OF NETWORK ELEMENTS IN A GSM NETWORK (IS-41)



As said earlier SMSC acts as a store-and-forward system for short messages. Now consider the case that a message of sender using wireless operator (*say for example Airtel*) is to be sent to a receiver using another wireless operator (*say for example Hutch*) then the sender's operator (*here Airtel*) finds the destination station(s) and transports short messages between the SMSCs and wireless stations.

In addition to this, the service elements are designed to provide guaranteed delivery of text messages to the destination. Temporary failures due to unavailable receiving stations are identified, and the short message is stored in the SMSC until the destination device becomes available.

A distinguishing characteristic of this service is that an active mobile handset is able to receive or submit a short message at any time, independent of whether a voice or data call is in progress (*in some implementations, this may depend on the MSC or SMSC capabilities*).

SMS is characterized by out-of-band packet delivery and low-bandwidth message transfer, which results in a highly efficient means for transmitting short bursts of data.

Initial applications of SMS focused on eliminating alphanumeric pagers by permitting two-way general-purpose messaging and notification services, primarily for voice mail. But as technology has advanced SMSC allows the user to do chatting, send SMS as an email, send small sized pictures and sound clippings.

SMS...Understanding Network Components

Lets now see the details of various network elements we have mentioned in Figure 1.

External Short Messaging Entities (*ESME*)

ESME, a device that may receive or send short messages, may be located in the fixed network, a mobile device, or another service center. It includes various features that can be listed as:

- VMS(Voice Messaging System)

Voice Mail is a service that is intended if the recepient is busy or is not able to take a voice call. Hence is based to store voice messages.

- Internet and Emailing

Internet has been an evergrowing tool and it hasn't even left SMS untouched. SMS provides access to World Wide Web (*provided the operator provides this facility*). Even emailing can be done using a simple SMS if SMSC supports interconnection to email servers acting as message input/output mechanisms.

Short Message Service Center (*SMSC*)

Till now we have been seeing SMSC as a storing and forwarding service but its actually a combination of hardware and software to provide this facility.

SMSC hence must have high reliability, subscriber capacity, message throughput and should be robust enough to accommodate the ever expanding demand for SMS.

Again it should be user friendly and a factor of operation and maintenance should be considered at the time of designing so that updatation at later stages should not be a major problem.

Signal Transfer Point (*STP*)

The STP is a network element that allows IS-41 interconnections over signaling system 7 (SS7) links with multiple network elements.

Home Location Register (*HLR*)

HLR is a database used for permanent storage and management of various operators and the service stations in the path. It provides the routing information to SMSC and if

destination was not available when delivery was attempted then HLR informs SMSC that station was not recognized.

Visitor Location Register (VLR)

VLR is a database that contains temporary information about subscribers homed in one HLR who are roaming into another HLR. This information is needed by the MSC to service visiting subscribers.

Mobile Switching Center (MSC)

MSC, that performs the switching functions of the system, controls calls to and from other telephone and data systems. It delivers the short message to the specific mobile operator through the proper base station.

Air Interface

Air Interface defines the wireless technology through which the message is been sent. Currently available wireless technologies are GSM, TDMA and CDMA. The data signals vary between technologies. These standards specify how the voice or data signals are transferred from the MSC to the handset and back, as well as the utilization of transmission frequencies, considering the available bandwidth and the system's capacity constraints.

The Base Station System (BS)

We have been talking of the base station right from the beginning but we would put the terminology in just here. A Base station is a center that performs all functions related to transmission of ELECTROMAGNETIC RADIO signals between MSC and wireless devices. This station consists of base station controllers (BSCs) and the base transceiver stations (BTSs), also known as cell sites or simply "cells."

The BSC may control one or more BTSs and is in charge of the proper resource assignment when a subscriber moves from one sector of one BTS to another, regardless of whether the next sector lies within the same BTS or in a different one.

The Wireless Device

The wireless device (*your mobile*) is the wireless terminal capable of receiving and originating short messages. The wireless network signaling infrastructure is based on SS7.

SMS makes use of the mobile application part (MAP), which defines the methods and mechanisms of communication in wireless networks and employs the services of the SS7 transactional capabilities application part (TCAP). An SMS service layer makes use of

the MAP signaling capabilities and enables the transfer of short messages between the peer entities.

SMS...Protocol behind the technology...!

The MAP layer defines the operations necessary to support SMS. A protocol has been defined using services of SS7 TCAP which is now referred as IS-41 by American Standard or GSM MAP by European Telecommunications Standards Institute (www.etsi.org).

The following basic MAP operations are necessary to provide the end-to-end SMS:

- **Routing Information Request**

Before an attempt of sending message to the recipient is done, the SMSC receives the routing information to determine the serving MSC for the mobile device at the time of the delivery attempt.

This is accomplished by way of an interrogation of the destination handset's HLR, which is accomplished via the use of the *SMSrequest* and *SendRoutingInfoForShortMsg* mechanisms in IS-41 and GSM, respectively.

- **Point-to-Point Short Message Delivery**

By this mechanism, the SMSC transfers a short message to the MSC that is serving the addressed mobile device.

After the station's HLR sends the address of said MSC, the short message delivery operation provides a confirmed delivery service. The operation works in conjunction with the base station subsystem while the message is being forwarded from the MSC to the MS.

The point-to-point short message delivery is accomplished via the use of the short message delivery-point-to-point (SMD-PP) and *forwardShortMessage* mechanisms in IS-41 and GSM, respectively.

- **Short Message Waiting Indication**

This operation gets activated when a delivery attempt by the SMSC fails due to a temporary failure such as:

- the station being unregistered,
- overloaded traffic.

This short message waiting indication is realized via the use of the *SMS_notification* indicator and *set_message_waiting_data* mechanisms in IS-41 and GSM, respectively.

- **Service Center Alert**

This operation provides a means for the HLR to inform the SMSC, which has requested a notification that a specific mobile device is now recognized by the mobile network to be available.

This service center alert is accomplished via the use of the *SMS_notification* and *alert_service_center* mechanisms in IS-41 and GSM, respectively.

SMS...Its Applications

This boon to human has widespread applications and some of the common applications are:

- ❑ **Personal Usage**
Few templates that are ready available in the wireless devices like “I am late, I will be there at...” or “See you at 8.30 tonight at xyz” have been hot favourites because SMS is cheaper than calling some one and giving the same short message.
- ❑ **Receiving emails.**
Almost all operators offer the emailing service over SMS. On request, a user is assigned an email address at signup and a password for authentication. Any message delivered to that email is converted to short messages and delivered to the mobile.
- ❑ **Sending emails.**
It is possible to send e-mail messages (less than 160 characters) from a mobile phone to any e-mail address via SMS.
- ❑ **Current Affairs.**
Information services like news, weather, entertainment and stock prices etc. can be availed just by sending a keyword like NEWS, WEATH etc to the short message center number which are normally of 4 numbers (*like 8888,5555 etc*).
- ❑ **Operator Use**
SMS can be used by the network operators to provide services like balance enquiry in case of prepaid cards using SMS. SMS can also be used to get the latest rates of STD/ISD calls and that too free of cost!

- ❑ **Chatting Sessions**
SMS has enabled mobile chatting and this is one of the hottest in the market demands.
- ❑ **Ringtones.**
SMS has enabled downloading new ring tones of songs of our own choice. Though it doesn't add any value to life, but it does add a healthy method of entertainment.
- ❑ **Banking.**
SMS can be used as a data transport mechanism in banking. Automated teller machine (ATM) and Internet transactions are less costly than transactions completed at a branch and using wireless connections we can check our balances, transfer funds between accounts and even pay bills.

SMS...Its Limitations

Despite its widespread applications, what still it carries with itself is many limitations. And many of these limitations are the driving force behind the developments and initiatives being taken in the field of short messaging. Some of the limitations of SMS are:

- ❑ **The Vanilla Structure.**
You can only send simple text messages. There is no scope for any graphics or audio.
However EMS would help fill this gap.
- ❑ **Size Limitation.**
An SMS message can't exceed 160 characters. *(This limitation is due to the limitation in the MAP protocol in GSM)*

In case of longer e-mails or information service messages like news, the messages need to be broken down into more than one message. The need to break the messages into several smaller segments could make SMS comparatively costlier in comparison to GPRS (for the same kind of service). Also, This doesn't look very appealing on a mobile device!
However
MMS would remove the limitation of small messages
- ❑ **Message Typing.**
The limitation of easy input mechanisms in mobile devices makes it very uncomfortable sending messages larger than even 5-6 words.
However
Predictive text input algorithms implemented in a mobile phone can greatly

help. Voice recognition systems can further help ease the situation

❑ **Data rate and latency.**

GPRS and USSD provide better data rates and lower latency compared to SMS. This is because SMS uses the slow signaling channel, which is used for many other things also in GSM.

However

MMS will use data channels and hence higher rates and lower latency.

SMS...Conclusion

Limitations and Boons both! Though it has variety of limitations, the usage of SMS is increasing day by day because it provides a very convenient method of exchanging small bits of information between mobile users. The reasons for the enormous popularity of SMS have been the fact that this mechanism of sending and receiving messages not only saves time but costs less as well. But SMS should not be just considered as a means of sending messages, as it is providing a pillar base to different ideologies and technologies like WAP, EMS and MMS.

Some Abbreviations!

ATM	asynchronous transfer mode
BS	base station
BSC	base station controller
BTS	base transceiver station
CDMA	code division multiple access
ESME	external short message entities
ETSI	European Telecommunications Standards Institute
GSM	Global System for Mobile Communications
HLR	home location register
IP	Internet protocol
LAN	local-area network
MAP	mobile application part
MSC	mobile switching center
PDA	personal digital assistant
PP	point to point
SM	short message
SMD	short message delivery
SMD-PP	short message delivery-point to point

SME	short messaging entity
SMS	short message service
SMSC	short message service center
SS7	signaling system 7
STP	signal transfer point
TDMA	time division multiple access
VLR	visitor location register
VMN	voice-mail notification
VMS	voice-mail system
WAN	wide-area network
WAP	wireless application protocol

Further Reading and References:

- European Telecommunications Standards Institute (www.etsi.org)
- GSM World, (www.gsmworld.com)
- Mobile Data Association (www.mda-mobiledata.org)