

# Wireless Short Message Service (SMS)

## Definition

Short message service (SMS) is a globally accepted wireless service that enables the transmission of alphanumeric messages between mobile subscribers and external systems such as electronic mail, paging, and voice mail systems.

## Overview

This tutorial provides an introduction to basic SMS concepts, specifications, networks, and services.

## Topics

1. Introduction: Short Message Service
  2. Benefits of Short Message Service
  3. Network Elements and Architecture
  4. Signaling Elements
  5. Mobile-Terminated Short Message Example
  6. Mobile-Originated Short Message Example
- Self-Test  
Correct Answers  
Glossary

## 1. Introduction: Short Message Service

SMS appeared on the wireless scene in 1991 in Europe, where digital wireless technology first took root. The European standard for digital wireless, now known as the global standard for mobiles (GSM), included short messaging services from the outset.

In North America, SMS was initially made available on digital wireless networks built by early pioneers such as BellSouth Mobility and Nextel. In 1998, when the

buildout of personal communications service (PCS) networks based on GSM, code division multiple access (CDMA), and time division multiple access (TDMA) methods was completed, SMS enjoyed full-fledged deployment.

The point-to-point SMS provides a mechanism for transmitting short messages to and from wireless handsets. The service makes use of a short message service center (SMSC), which acts as a store-and-forward system for short messages. The wireless network provides for the transport of short messages between the SMSCs and wireless handsets. In contrast to existing text message transmission services such as alphanumeric paging, the service elements are designed to provide guaranteed delivery of text messages to the destination.

A distinguishing characteristic of the service is that an active mobile handset is able to receive or submit a short message at any time, independent of whether or not a voice or data call is in progress. SMS also guarantees delivery of the short message by the network. Temporary failures are identified, and the short message is stored in the network until the destination becomes available.

SMS is characterized by out-of-band packet delivery and low-bandwidth message transfer. Initial applications of SMS focused on eliminating alphanumeric pagers by permitting two-way general-purpose messaging and notification services, primarily for voice mail. As technology and networks matured, a variety of services were introduced, including electronic mail and fax integration, paging integration, interactive banking, and information services such as stock quotes. Wireless data applications include downloading of subscriber identity module (SIM) cards for activation, debit, and profile-editing purposes.

## 2. Benefits of Short Message Service

In today's competitive world, differentiation is a significant factor in the success of the service provider. Once the basic services, such as voice telephony, are deployed, SMS provides a powerful vehicle for service differentiation.

The benefits of SMS to the service provider are as follows:

- increased call completion on wireless and wireline networks by leveraging the notification capabilities of SMS
- an alternative to alphanumeric paging services
- enabling wireless data access for corporate users
- provision of value-added services such as e-mail, voice mail, and fax mail integration; reminder service; stock and currency quotes; and airline schedules

- provision of key administrative services such as advice of charge, over-the-air downloading, and service provisioning

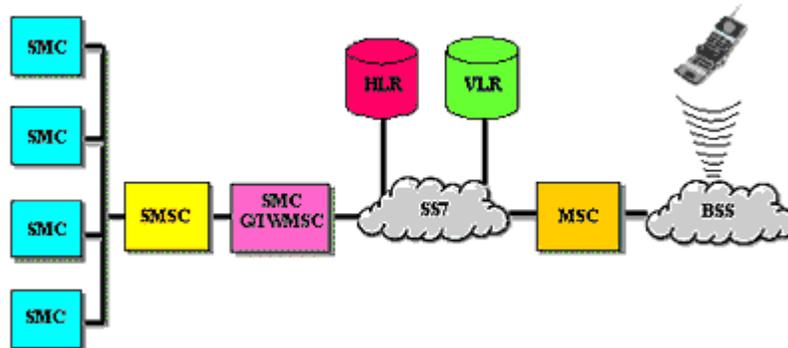
All of these benefits are attainable quickly with modest incremental cost, and typical investment payback periods are less than six months.

The benefits of SMS to subscribers center around convenience, flexibility, and seamless integration of messaging services and data access. From this perspective, the benefit is to be able to use the handset as an extension of the computer. SMS also eliminates the need for separate devices for messaging, as services can be integrated into a single wireless device—the mobile terminal.

### 3. Network Elements and Architecture

The basic network structure of the SMS is depicted in *Figure 1*.

Figure 1. Network Elements and Architecture



#### Short Messaging Entities

Short messaging entity (SME) is an entity which may receive or send short messages. The SME may be located in the fixed network, a mobile station, or another service center.

#### Short Message Service Center

Short message service center (SMSC) is responsible for the relaying and store-and-forwarding of a short message between an SME and mobile station.

## SMS–Gateway/Interworking Mobile Switching Center

The SMS–gateway mobile switching center (SMS–GMSC) is an MSC capable of receiving a short message from an SMSC, interrogating a home location register (HLR) for routing information, and delivering the short message to the visited MSC of the recipient mobile station. The SMS interworking MSC (SMS–IWMSC) is an MSC capable of receiving a short message from the mobile network and submitting it to the appropriate SMSC. The SMS–GMSC/SMS–IWMSC are typically integrated with the SMSC.

## Home Location Register

The HLR is a database used for permanent storage and management of subscriptions and service profiles. Upon interrogation by the SMSC, the HLR provides the routing information for the indicated subscriber. The HLR also informs the SMSC, which has previously initiated unsuccessful short message delivery attempts to a specific mobile station, that the mobile station is now recognized by the mobile network to be accessible.

## Mobile Switching Center

The MSC performs the switching functions of the system and controls calls to and from other telephone and data systems.

## Visitor Location Register

The visitor location register (VLR) is a database that contains temporary information about subscribers. This information is needed by the MSC to service visiting subscribers.

## The Base Station System

All radio-related functions are performed in the base-station system (BSS). The BSS consists of base-station controllers (BSCs) and the base-transceiver stations (BTSs), and its primary responsibility is to transmit voice and data traffic between the mobile stations.

## The Mobile Station

The mobile station (MS) is the wireless terminal capable of receiving and originating short messages as well as voice calls. The wireless network signaling

infrastructure is based on signaling system 7 (SS7). SMS makes use of the mobile application part (MAP), which defines the methods and mechanisms of communication in wireless networks, and uses the services of the SS7 transaction 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.

## 4. Signaling Elements

The MAP layer defines the operations necessary to support the SMS. Both American and international standards bodies have defined a MAP layer using the services of the SS7 transaction capabilities part. The American standard is published by the Telecommunication Industry Association and is referred to as IS-41. The international standard is defined by the European Telecommunication Standards Institute and is referred to as GSM MAP.

The following basic MAP operations are necessary to provide the end-to-end short message service:

- **routing information request**—Before attempting short message delivery, the SMSC must retrieve routing information to determine the serving MSC for the mobile station at the time of the delivery attempt. This is done by way of an interrogation of the 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**—The mechanism provides a means for the SMSC to transfer a short message to the MSC that serves the addressed mobile station and attempts to deliver a message to an MS whenever the MS is registered, even when the MS is engaged in a voice or data call. The short message delivery operation provides a confirmed delivery service. The operation works in tandem with the base-station subsystem while the message is being forwarded from the MSC to the MS. Therefore, the outcome of the operation comprises either success (i.e., delivery to the mobile) or failure caused by one of several possible reasons. 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**—The operation is activated when a short message delivery attempt by the SMSC fails due to a temporary failure and provides a means for the SMSC to request the HLR to add an SMSC address to the list of SMSCs to be informed when

the indicated mobile station becomes accessible. 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**—The operation provides a means for the HLR to inform the SMSC, which has previously initiated unsuccessful short-message delivery attempts to a specific mobile station, that the mobile station is now recognized by the mobile network to be accessible. This service-center alert is accomplished via the use of the SMS notification and alert service-center mechanisms in IS-41 and GSM respectively.

## Service Elements

SMS comprises several service elements relevant to the reception and submission of short messages.

- **validity period**—The validity period indicates how long the SMSC shall guarantee the storage of the short message before delivery to the intended recipient.
- **priority**—Priority is the information element provided by an SME to indicate the priority message.

In addition, SMS provides a time stamp reporting the time of submission of the message and an indication to the handset of whether there are more messages to send (GSM) or the number of additional messages to send (IS-41).

## Subscriber Services

SMS comprises two basic point-to-point services.

- mobile-originated short message (MO-SM)
- mobile-terminated short message (MT-SM)

MO-SMs are transported from the handset to the SMSC and can be destined to other mobile subscribers or for subscribers on fixed networks such as paging networks or electronic mail networks. MT-SMs are transported from the SMSC to the handset and can be submitted to the SMSC by other mobile subscribers via MO-SM or other sources such as voice-mail systems, paging networks, or operators.

For MT-SM, a report is always returned to the SMSC either confirming the short-message delivery to the handset or informing the SMSC of the short-

message delivery failure and identifying the reason for failure. Similarly, for MO-SM, a report is always returned to the handset either confirming the short-message delivery to the SMSC or informing the handset of the encountered failure and identifying the reason.

Depending on the access method and the encoding of the bearer data, the point-to-point SMS conveys up to 190 characters to an SME. For messages requiring immediate delivery, only one message delivery attempt is made per service request. For messages not requiring immediate delivery, one or more delivery attempts are made until an acknowledgment is received.

In GSM networks, the type of messaging service is identified by the protocol identifier information element, which identifies the higher-level protocol or interworking being used. Examples are telex, group 3 telefax, X.400 messaging, ERMES, and voice telephone.

In IS-41 networks, the service type is distinguished by use of the teleservice identifier. Basic teleservices include the following:

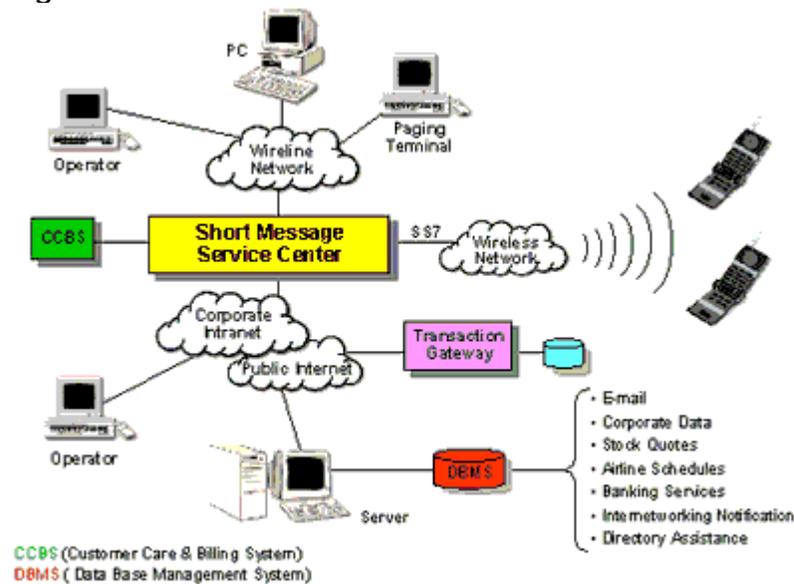
- cellular messaging teleservice (CMT)
- cellular paging teleservice (CPT)
- voice-mail notification teleservice (VMN)

CMT differs from the CPT as a result of the inclusion of a reply mechanism that enables a user or network acknowledgment to be selected on a per-message basis. The user acknowledgment includes a response code that paves the way for powerful interactive services between SMCs.

Many service applications can be implemented by combining these service elements. Besides the obvious notification services, SMS can be used in one-way or interactive services providing wireless access to any type of information anywhere. Leveraging emerging technologies that combine browsers, servers, and new markup languages designed for mobile terminals, SMS can enable wireless devices to securely access and send information from the Internet or intranets quickly and cost-efficiently.

A generic network infrastructure for realizing the innovative SMS services is depicted in *Figure 2*.

Figure 2. Network Infrastructure



Some of the potential applications of SMS technology, utilizing both MT–SM and MO–SM where appropriate, are as follows:

- **notification services**—Notification services are currently the most widely deployed SMS services. Examples of notification services using SMS include the following: voice/fax message notification, which indicates that voice mail messages are present in a voice mailbox; e-mail notification, which indicates that e-mail messages are present in an e-mail mailbox; and reminder calendar service, which enables reminders for meetings and scheduled appointments.
- **e-mail interworking**—Existing e-mail services (e.g., SMTP, X.400) can be easily integrated with SMS to provide duplex e-mail to short messaging.
- **paging interworking**—Paging services (e.g., TAP, TNPP, TDP) integrated with SMS would allow digital wireless subscribers to be accessible via existing paging interfaces.
- **information services**—A wide variety of information services can be provided by the SMS, including weather reports, traffic information, entertainment information (e.g., cinema, theater, concerts), financial information (e.g., stock quotes, exchange rates, banking, brokerage services), and directory assistance.

## Mobile Data Services

The SMSC also can be used to provide short wireless data. The wireless data may be in interactive services where voice calls are involved.

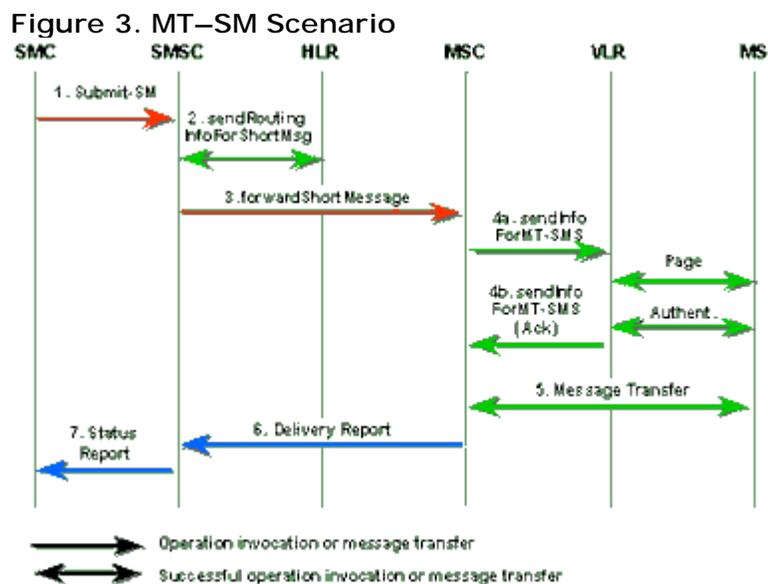
Some examples of services of this nature include fleet dispatch, inventory management, itinerary confirmation, sales order processing, and customer contact management.

## Customer Care and Management

The SMSC also can be used to transfer binary data which can be interpreted by the mobile station without presentation to the customer. This capability allows the operators to administer their customers by providing capabilities for programming the mobile station. Examples of such services include mobile station programming, which allows customer profiles and subscription characteristics to be downloaded to the mobile station (customers can be activated/deactivated based on the data downloaded), and advice of charge, which enables the SMS to be used to report charges incurred for the phone call (e.g., taxi pay phone).

## 5. Mobile-Terminated Short Message Example

Figure 3 depicts the successful MT-SM scenario. For convenience, the GSM method is illustrated. However, the IS-41 method is similar.





1. The MS transfers the SM to the MSC.
2. The MSC interrogates the VLR to verify that the message transfer does not violate the supplementary services invoked or the restrictions imposed.
3. The MSC sends the short message to the SMSC using the forwardShortMessage operation.
4. The SMSC delivers the short message to the SME.
5. The SMSC acknowledges to the MSC the successful outcome of the forwardShortMessage operation.
6. The MSC returns to the MS the outcome of the MO–SM operation.

## 7. SMS Applications

SMS was initially designed to support limited-size messages, mostly notifications and numeric or alphanumeric pages. While these applications are and will continue to be widely used, there are more recent niches that SMS still can exploit.

Short bursts of data are at the heart of many applications that were restricted to the world of data networks with fixed terminals attached to a local-area network (LAN) or wide-area network (WAN). However, many of these applications are better served if the data communication capabilities could be added to the mobility of the station. Thus, a waiter who can charge a customer's credit card right at the table, at any time, instead of going to a fixed POS terminal located by the register will be able to help customers in a faster, more convenient way.

Also, the ability to track the location of a moving asset such as a truck or its load is very valuable for both providers and clients. This application, again, just needs to interchange small amounts of information, such as the longitude and latitude at a current time of the day, and perhaps other parameters like temperature or humidity.

This application does not necessarily require the monitored entity to be in movement. The requirements are basically short, bursty data and a location that has digital network coverage. For example, in a neighborhood, it would be faster, easier, and cheaper to drive a truck from the local power company, which interrogates intelligent meters to obtain their current readings and then forwards them via short message to a central data processing center to generate the billing. Similarly, delivery trucks could be alerted of the inventory of a customer running low, when the truck is close to the customer's facilities. The truck driver could place a quick phone call to the customer to offer a short-time replenishment at a low cost for the distributor.

Another family of applications that can use SMS as a data transport mechanism is banking. It is no secret that automated teller machine (ATM) and Internet transactions are less costly than transactions completed at a branch. Internet transactions are even cheaper than ATM transactions. Therefore, enabling wireless subscribers to check their balances, transfer funds between accounts, pay their bills and credit cards is valuable, not only for the subscriber but also for financial institutions.

Entertainment applications are also good drivers of SMS usage. Examples of these are simple short message exchanges between two parties (“texting”) or between multiple participants (“chat”). Also, delivery of information that the subscriber can tailor to his or her lifestyle represents an attractive proposition for wireless users.

Wireless Web browsing allows the users to search for information without the physical restrictions of a PC. College students certainly appreciate not having to go to the computer lab or their dorm to check e-mail or find out what the required book is for the semester that is about to start.

E-mail continues to be by far the most used wireless data application. However, handsets are evolving quickly and are including more and more functionality that supports newer applications at the same time that user friendliness increases. Probably the next big success beyond wireless Web will be Internet shopping and other e-commerce applications such as electronic coupons, advertising, etc.

The potential for applications is enormous, and new needs appear to arise constantly, demanding a solution that may travel over SMS.

## Self-Test

1. SMS enables a user to receive a message at any time, whether or not a voice or data call is in progress.
  - a. true
  - b. false
  
2. Like alphanumeric paging service, SMS does not guarantee that the message will be delivered.
  - a. true
  - b. false

3. SMS is a delivery-only service and does not provide capabilities for interactive services.
  - a. true
  - b. false
4. The SMSC also can transfer binary data that is never seen by the customer.
  - a. true
  - b. false
5. The SMSC interfaces directly with the BSC to receive the result of the message transmission to the handset.
  - a. true
  - b. false
6. SMS is limited to the transmission of 40 characters.
  - a. true
  - b. false
7. SMS utilizes existing digital cellular infrastructure.
  - a. true
  - b. false
8. The \_\_\_\_\_ provides routing information for mobile subscribers.
  - a. SMSC
  - b. HLR
9. Which access method supports CPT?
  - a. GSM
  - b. CDMA
  - c. TDMA
  - d. all of the above

10. In an MT–SM delivery, the first query is to the \_\_\_\_\_.
- a. VLR
  - b. HLR
  - c. mobile station
  - d. none of the above

## Correct Answers

1. SMS enables a user to receive a message at any time, whether or not a voice or data call is in progress.
- a. true**
  - b. false
- See Topic 1.
2. Like alphanumeric paging service, SMS does not guarantee that the message will be delivered.
- a. true
  - b. false**
- See Topic 1.
3. SMS is a delivery-only service and does not provide capabilities for interactive services.
- a. true
  - b. false**
- See Topic 4.
4. The SMSC also can transfer binary data that is never seen by the customer.
- a. true**
  - b. false
- See Topic 4.

5. The SMSC interfaces directly with the BSC to receive the result of the message transmission to the handset.

a. true

**b. false**

See Topic 3.

6. SMS is limited to the transmission of 40 characters.

a. true

**b. false**

See Topic 4.

7. SMS utilizes existing digital cellular infrastructure.

**a. true**

b. false

See Topic 1.

8. The \_\_\_\_\_ provides routing information for mobile subscribers.

a. SMSC

**b. HLR**

See Topic 3.

9. Which access method supports CPT?

a. GSM

**b. CDMA**

c. TDMA

d. all of the above

See Topic 4.

10. In an MT–SM delivery, the first query is to the \_\_\_\_\_.

a. VLR

- b. HLR**
- c. mobile station
- d. none of the above

See Topic 5.

## Glossary

### **AC**

authentication center

### **AIN**

advanced intelligent network

### **BSC**

base-station controllers

### **BSS**

base-station system

### **BTS**

base-transceiver station

### **CDMA**

code division multiple access

### **CMT**

cellular messaging teleservice

### **CPT**

cellular paging teleservice

### **GMSC**

gateway mobile switching center

### **GSM**

global standard for mobiles

### **HLR**

home location register

### **MAP**

mobile application part

**MIN**

mobile identification number

**MO–SM**

mobile-originated short message

**MS**

mobile station

**MSC**

mobile switching center

**MT–SM**

mobile-terminated short message

**SM**

short message

**SMD–PP**

short message delivery–point-to-point

**SME**

short message entity

**SMS**

short message service

**SMSC**

short message service center

**SMS–GMSC**

SMS gateway mobile switching center

**SMS–IWMSC**

SMS interworking mobile switching center

**SMTP**

simple mail transfer protocol

**SS7**

signaling system 7

**TAP**

telocator alphanumeric protocol

**TCAP**

transaction capabilities application part

**TDMA**

time division multiple access

**TDP**

telocator data protocol

**TNPP**

telocator network paging protocol

**VLR**

visitor location register

**VMN**

voice-mail notification