

IMPLEMENTING SMS-BASED e-GOVERNMENT MODEL

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Abstract

Previous work by the authors has argued that SMS is a more appropriate medium for providing e-government services in developing countries and an SMS-based e-government model has been proposed. The model consists of five levels: Notification, Presentation, Communication, Transaction, and Integration; and provides guidance for governments who want to initially focus on delivering their public services through SMS technology.

This paper investigates the technology requirements of each level of the model and proposes some current technologies and architectures for implementing its SMS-based systems.

1. Introduction

Susanto [6] has argued that it is more appropriate to initially provide e-government services to citizens in developing countries via the short message service (SMS) available on mobile phones. A subsequent paper [5] proposed an SMS-based e-government model for developing countries.

The SMS-based e-government model is a development-stage model for local authorities who want to focus on delivering their public services using SMS technology. The model proposes that local authorities can develop their SMS-based services through five levels: Notification, Presentation, Communication, Transaction, and Integration. Each level describes the e-government services that can be delivered by the SMS system. The later the level, the greater the service value to citizens and the more complex the system. The model does not imply a local authority has to start from the first or a previous level and go through all levels sequentially; rather the local authority can start and stop at the appropriate point as determined by its needs, infrastructure, and public demand. The model indicates that a later level must provide all of the services of the earlier levels.

For governments who have established an e-government channel through the Internet or other media, the communication via SMS proposed by this model is not meant to replace the other communication channels, but rather complement them where SMS is deemed more appropriate, such as providing a channel for reaching people in areas with mobile phone access only.

In this paper, we will present a technology-based view of each level of the SMS-based e-government model, propose current technologies and architecture for implementing the SMS-based systems and outline the generic steps for an implementation project.

An SMS-based e-government system may have four types of SMS delivery (Ray in [3]):

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- *Pull SMS*: Users can request services by SMS from a wireless handset then the requested service is sent back to the handset via SMS. This approach has been demonstrated in other services such as users requesting ring tones or games by SMS.
- *Push – Event based SMS*: an SMS message is sent to the user activated by event-based application; for example a confirmation SMS may be sent to citizens whenever their personal data in the government's database is altered.
- *Push – Scheduled SMS*: an SMS message is sent to a user activated by a time schedule-based application; for example a tax notification-SMS may be sent to particular citizens when nearing the due date (quarterly, half yearly or annually).
- *Push – Personal Profile*: an SMS message is sent to the user activated by applications based on profile and preferences of the user; for example an SMS about childcare benefit information may be sent to parents who satisfy the conditions for receiving childcare benefits.

2. The Implementation of the SMS-Based e-Government Model

The SMS-based e-government model proposes that local authorities develop their SMS-based services through five levels: Notification, Presentation, Communication, Transaction, and Integration. This section will investigate the technology requirements and other issues related to each level.

2.1. Notification Level

In the first level of the SMS-based e-government model, the Notification level, SMS services are limited to one-way delivery of information from Government to public, such as notification or reminder messages. This level is suitable for disseminating official information to the public on a regular basis such as the Meteorology department providing weather reports and disaster warnings, the Transportation office providing commuters details of delayed arrivals of trains or closing of some roads, or notification of a new publication on government policy/regulation or event notifications.

Technology Requirements

Technology requirements for this level include:

a. Database of clients/citizens and their mobile phone numbers

To implement this level, a database of citizens who have mobile phones and wish to use the services is needed. The local authority should provide a simple procedure for registration by SMS, the Internet, or the nearest office. The local authority can also cooperate with all mobile operators in its area to inform mobile subscribers of the new service and how to register.

Even if local authorities can disseminate official information to mobile subscribers in their region without permission, the public should have a choice as to whether or not they receive the SMS messages as well as choosing the information options that are sent to them. Therefore, the number of people who will use the services of this level will depend on the interest and relevance of the government information. Consequently, the government should post information of value to people in their daily lives and provide interesting features for the SMS system, then advertise them on other media.

To ensure many citizens register in the system, the government should address privacy policy issues. Each local authority would need to guarantee that their client's personal data will be used only in connection with its services and secured.

b. *SMS Broadcasting*

The proposed technology for delivering this level is SMS broadcasting, a Point-to-Point SMS system which allows sending a message to multiple recipients. The same message can be sent to thousands of numbers simultaneously. Mail merge can be used to send personalised messages.

To provide the SMS broadcasting service local authorities have two options.

They can use an SMS broadcast provider. Local authorities just need to send/upload the client data and the message to the SMS service provider to broadcast the message.

Alternatively local authorities can develop their own system using an SMS server and SMS Broadcasting application, and negotiate with network providers for access to their networks. For an even simpler system local authorities just need to provide an SMS server, an SMS Broadcasting application, and a mobile phone or GSM modem connected to an SMS server for broadcasting the messages.

c. *SMS-Cell Broadcast (CBS)*

In case of emergency information, another alternative technology for delivering the notification level is the *SMS-Cell Broadcast* or *Cell Broadcast Service (CBS)*. Sending CBS messages is similar to sending SMS messages except that it doesn't need to choose recipients. Unlike a point-to-point messaging system, CBS does not use a dedicated link. It allows messages to be sent to all Mobile Stations (MS) in a particular targeted area, including every mobile phone, fax machine, or IP address in the particular cell. Even though some of them may be in poor radio coverage areas, the probability of reaching many recipients is high. Because cell broadcast messages are repeated at intervals over a period of time, an MS can receive the message even if entering the cell after the first transmission. Another advantage is that the data can be sent either as binary data or ASCII text up to 15 pages in length with a page being up to 93 characters in length that will be broadcasted as one message, compared to the actual size limit of one SMS which is 160 characters if Latin alphabets are used or 70 characters if non-Latin alphabets like Chinese or Arabic are used [7].

The services in this level are *Push* services, either *Push – Event*, *Push – Scheduled*, or *Push – Personal Profile*. Examples of each type of service are: the *Push – Event based SMS* system at the Meteorology department which could automatically send a warning message about predicted disasters to citizens in relevant areas; the *Push – Scheduled SMS service* at the Tax department could automatically send a reminder message to citizens near the due date for paying tax; and the *Push – Personal Profile* system at the workforce department could automatically send present job vacancies to particular citizens who are recorded as unemployed.

2.2. Presentation Level

The second level is the Presentation level. In this level a two way messaging system is added to the notification level. The Presentation level allows the public to access the Government SMS servers at any time by SMS to obtain information. In this level, the query statements for getting information are standard and are provided by the SMS servers; the public choose from the information options provided, such as information about transportation services, weather, news and due dates for submission of documents. The successful information services in this level should be simple in use, timely, personalized and localized. In order to develop and update the service options of the system, the government should conduct regular surveys.

Technology Requirements

To establish the system, local authorities should negotiate with network operators to provide an access number to the services for their subscribers. Local authorities will be responsible for providing the content, such as the client database, options and the information, and the infrastructure including the SMS gateway server and the SMS gateway applications.

The mechanism for obtaining information from a local authority's SMS system is described in Figure 1.

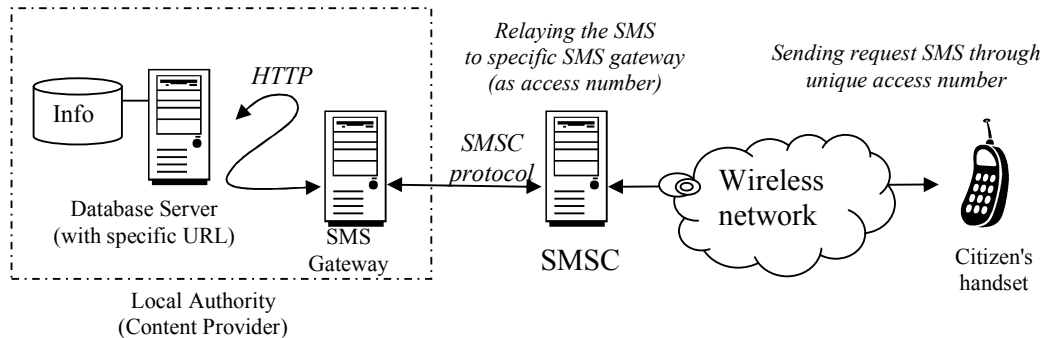


Fig. 1. SMS Gateway And Mechanism for Obtaining Information in SMS-Based System

In this level information can be delivered by two mechanisms: *push-based* as in level 1 and *pull-based* when the information is requested by the user.

2.3. Communication Level

In addition to the services provided by the first two levels, the communication level provides a facility for citizens to send questions and get replies a short-time later. For example, citizens can ask questions related to tax, government policy or the status of a complaint.

For this level to be successful, answers must be received quickly. New and difficult questions should be acknowledged and information sent as to when the answer will be given, by whom, and how. (Questions needing detailed answers may need to be answered by letter, email if available, phone, or meeting).

Technology Requirement

An SMS-based system for requesting information and receiving answers can use an SMS gateway, the application software for the SMS gateway, a database of clients, and a database of questions and answers. If the predicted traffic for the SMS system is low, the SMS gateway can be built by connecting a PC to a mobile phone or GSM modem (Figure 2).

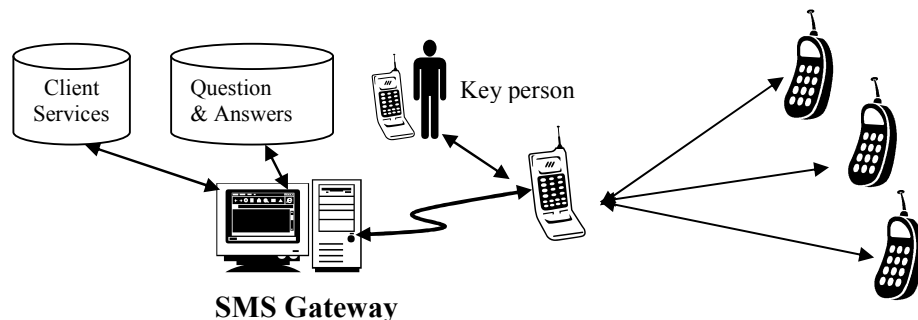


Fig. 2. A Simple System Architecture for An SMS Gateway for The Communication Level

The PC will run the databases and handle the input data and the output data; the mobile phone/GSM modem sends and receives the SMS messages. If the client base and SMS traffic increases to a point where the response time is unacceptably slow, the local authority should negotiate with the network providers to provide faster access.

An incoming SMS message will be handled as follows. The message will be checked to determine the kind of service required. If a question is asked, the SMS Gateway will search for the answer in the Question & Answer Database. If the answer needs client specific data, the Client Services Database will also be accessed. If the answer can not be found in the database, the application will forward the question to the mobile phone of the key person who manages the service. The key person will answer the question and record the new question and answer in the Question and Answer Database.

2.4. Transaction Level

The fourth level is the Transaction level. The transaction level allows citizens to complete by SMS transactions such as applying for a tax number, applying for an identity card, or making a tax payment. This level is more complex as authentication, verification, non repudiation and security issues must be addressed.

Technology Requirement

A system similar to that used in the Communication level can be deployed for providing the services in Transaction level. Security will require additional technology including:

- a. *The Subscriber Identity Module (SIM) Application Toolkit*, which has been agreed and incorporated within the GSM standard. This is the smart card inserted into GSM mobile phones that contains information about the end user which will be used for user authentication at session initiation. The authentication data is exchanged and validated with records stored in the Home Location Register (HLR) network node. The personal information allows security-related functions and identity verification to be carried out, which is essential for secure e-government transactions. Additionally, the SIM Application Toolkit will allow the flexibility to update the SIM, to alter e-government services and to download new services. For example government agencies can cooperate with network operators to remotely modify the user's wireless terminal by sending codes embedded in short messages from the server. Within the SIM Application Toolkit specification, SMS is a key mechanism for personalizing the SIM in each user's GSM phone [1]. To use the SIM Application Toolkit, the SMS servers belonging to government agencies must have installed the server-based software introduced by SimCard platform specialists such as Orga, Gemplus and AU-System. On the client side, the public must use mobile phones which also support SIM Application Toolkit.
- b. *Agent Dispatcher (AD) module*. This is a module in an SMS gateway which is responsible to dispatch the received SMS message (command) from the Short Message Driver (SMD) module to the appropriate Agent based on the SMS content server. The AD module provides a level of security in order to reject unauthorized access by identifying the user from the Mobile Station ISDN number (MSISDN) of the mobile device [2].
- c. *Password*. A Password mechanism can be added as an additional level of security which is implemented in the application level for access to specific parameter information.

- d. *Encryption*. Sending confidential data such as a bank account number, password, social security number via SMS has security problems if the message is readable to any receiver. Most mobile operators have encrypted their SMS messages; but generally even when encrypted, the data is still readable by the operators. A solution to this problem is to install an application that can be used in a mobile device to encrypt messages that are about to be sent and to decrypt the encrypted messages received so that only the designated recipient of the message is able to open the message and understand what it contains. Examples of this type of software include *Xecure Messaging System (XMS)* provided by Network Security Solutions (NSS) company and *SMS 007* developed by CircleTech. In SMS 007, the core of the security engine is the symmetric cipher AES (Advanced Encryption Standard) which uses user-specified keys to encrypt and decrypt the messages that are sent or received by the user [4].
- e. Other mechanisms for supporting transaction security via SMS including Personal Identity Numbers (PINs) for ensuring the right person is using the mobile phone, a receipt for every transaction via SMS, a recording management system for all user transactions, and an SMS notification system for every successful transaction.

Other issues this level must take into account include current legislation in relation to transactions, and design and formatting techniques to maximise data transmission by the limited capabilities of SMS.

2.5. Integration Level

This is the final level of the model when each SMS system is integrated with the other SMS systems and all other e-government systems, including Internet/web-based e-government systems. The public can access all SMS services by sending SMS messages to one number or by accessing the Internet at one web address. This level accommodates the situation when Internet penetration has become much greater and the Internet/web literacy of the public has increased. The government gives the public the choice of continuing to access the e-government systems by SMS or changing to the Internet medium. By this stage of development it is likely that the mobile phones used in developing countries will be virtually mobile computers with Internet access capabilities.

Technology Requirement

In this level, local authorities should provide a server as a portal and gateway for providing a single number or address for accessing e-government services. This server receives messages or web-based requests, and sends them to the appropriate content provider's server, and sends the response through SMS or the Internet, as described in Figure 3.

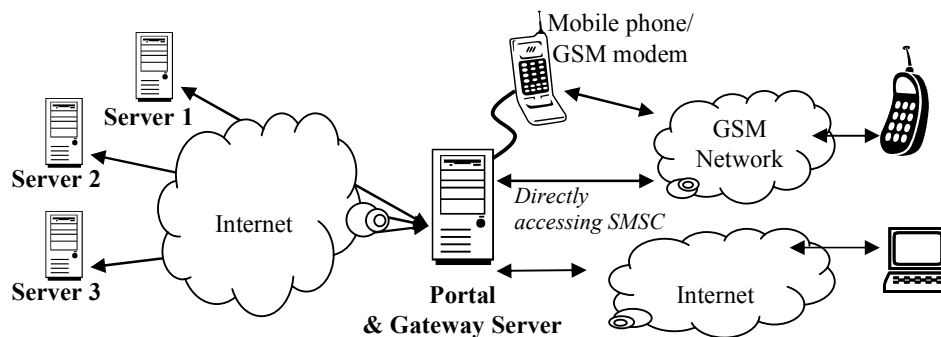


Fig. 3. Integration Level System Architecture

The portal and gateway server, as shown in Figure 4, consists of three parts: (1) a portal/gateway application responsible for service provision, (2) a short message driver responsible for communication between the GSM network and the portal/gateway application, and (3) a web server responsible for communications between the Internet and the portal/gateway application. The communication protocol between the mobile station modem and the short message driver is implemented using the SMS AT command set. In addition, the portal/gateway can connect to an Internet Service Provider (ISP) mail server through cable, ADSL or dial up. The portal/gateway application uses Post Office Protocol-Version 3 (POP3) or Interactive Mail Access Protocol-Version 4 protocol to send/check mails [8].

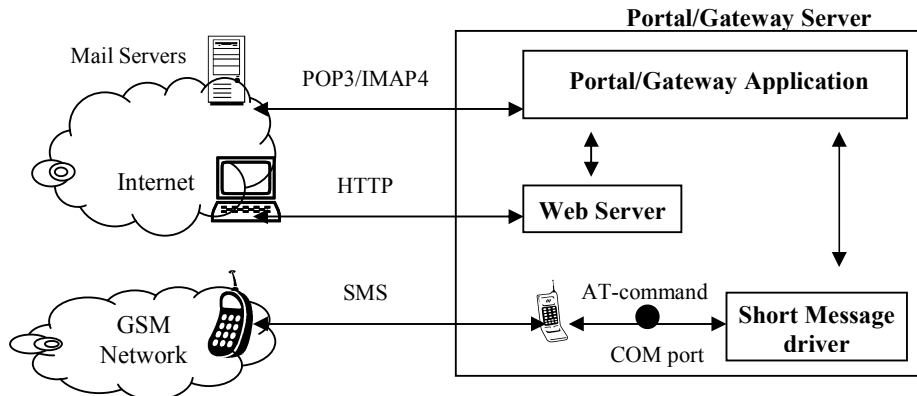


Figure 4. Portal/Gateway Server Architecture

Some software samples for the implementation of the portal and gateway server are: Apache server for the web server as its an open source web server that performs well (details can be accessed at <http://www.apache.org/>); for the short message driver, Gnokii's driver, an open source organization that provides tools and a user space driver for Nokia GSM mobile phones under Linux, various UNIXs and Windows (details can be accessed at <http://www.gnokii.org/>); and for developing the portal/gateway application a computer language such as C, Java, or PHP [2].

Other proposed solutions for connecting citizens' mobile phones to the Internet for obtaining e-government services [2] include:

- Microbrowser (Pocket Internet Explorer), which runs on Microsoft Pocket PC devices. It logs into an ISP from a cellular phones and establishes a data connection for accessing the Web.
- UP browser from Openwave, for accessing Web pages written in Handheld Device Markup Language (HDML).
- Wireless Application Protocol (WAP), a protocol suite on top of mobile networks written in Wireless Markup Language (WML).
- I-Mode, which is based on compact HyperText Markup Language (cHTML) offered by NTT-DoCoMo.
- Web Clipping, a set of predefined agents located on a Palm which can interact with content offered by 3COM Palm VII.

3. Conclusions

Technologies and architectures have been presented for implementing each of the five levels of the SMS-based e-government model. The levels can be implemented sequentially or in parallel as appropriate for requirements. The technologies are appropriate for the skill level and economies of

developing countries. A developing country is now able to implement cost effective e-government services using the mobile phone network.

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