

PRIVATE TEXTUAL NETWORK USING GSM ARCHITECTURE

* Qurban A. Memon, **Zubair Shaikh and ***Ghulam Muhammad

* Associate Professor; **Associate Professor, ***Senior Year Student

Karachi Institute of Information Technology, ST-2, Sector-X/VII

Gulshan-e-Maymar, Karachi-75340, Pakistan

qurban@kiit.edu.pk

Abstract

Generally, there are two ways to communicate from a mobile phone. 1) SMS 2) Place a call. Furthermore, communication between mobile phone and normal land phone is quite expensive. The first aim of this research is to target this problem i.e. whenever you want to send a message to your home phone, you can use the proposed solution without adding some valuable coins to your mobile phone bill. The second aim of this work is to develop a solution, which can help the clients to reduce their mobile phones bills in addition to providing security on the communicating link. We explore different Internet access technologies under wireless domain to use for the objective under study and compare them in terms of ease of implementation. We present results and show that the proposed architectural approach leads to an easy, cost effective and secured private network using existing wireless technologies.

Keywords: Textual Telephony, Mobile Computing, Private Networks, Secured Communications, Personal Area Network

1. Background Study

Mobile, wireless access and networking has emerged in the last few years as one of the most important directions of Internet growth. After many years of research, wireless networks' industry has reached to the maturity, where standards for wireless networks can be defined. Without standards, the world of wireless networks will become a collection of distant islands i.e. the subscribers of one wireless network, if moved to the island of another network operator won't be able to use the mobile phone service in that island. Mobile technology has faced many kinds of problems. Two such problems are lack of

communication options and high communication rates. These problems may hinder the use of this just born technology. To elaborate the problem: The popularity of mobile, and, more generally, nomadic Internet access is due to many enabling factors including: (a) emergence of meaningful applications tailored to the individual on the move; (b) small form factor and long battery life; (c) efficient middleware designed to support mobility; and, (d) efficient wireless networking technologies. A key player in the mobile Internet access is the nomad, i.e. the individual equipped with various computing and I/O gadgets (cellular phone, earphones, GPS navigator, palm pilot, beeper, portable scanner, digital camera, etc.). These devices form his/her Personal Area Network or PAN or personal bubble. The connectivity within the bubble is wireless (using for example a low cost, low power wireless LAN such as Bluetooth). The bubble can expand and contract dynamically depending on needs. It may temporarily include sensors and actuators as the nomad walks into a new environment. The user may require wireless access to databases anytime anywhere, such as medical and inventory records etc., can simplify workflow management in a business, and reduce or even eliminate the cost of moving paper documents. Moreover, continual progress in wireless access technology promises to provide per-user bandwidths of the order of a few Mbps^[1].

The current Internet systems provide mobile phone call, SMS and Internet access as major services of wireless world. With a decent merger of wireless infrastructure to that of existing land phones, a lot of other opportunities do exist that supplement these three major services^[2]. One such avenue is textual telephony. What actually happens is that the user

writes text on his/her mobile phone and then sends that text to the Telephony Server by using Internet. Once the text reaches the server, it is converted into voice by text to speech server and then sent to the dialing server. The dialing server dials the desired number and plays the sound and/or sends the text to a compatible device. In this way message is sent to a land phone/device without actually calling the phone. There exist a large number of such service provider(s), which provide text-to-speech transfer to land phone(s) through a web site. Since Internet is prone to security hazards, hence a dependent network cannot be trusted for security. For a defense related organization, a highly secured mobile system is very important for a mobile computing environment. We explore security issues in a mobile system, like: protecting mobile hosts from malicious agents, protecting agents from other malicious agents, protecting hosts from other malicious hosts and protecting agents from malicious hosts. Using traditional security mechanisms the first three security problems can be solved. Apart from using trusted hardware, very few approaches exist to protect mobile code from malicious hosts. Some of the approaches to solve this problem are the use of trusted computing, computing with encrypted function, steganography, cryptographic traces, Seal Calculas, etc. This paper focuses on the use of some of these existing techniques. Some new approaches to solve malicious network problem and agent tampering problem are addressed using public key encryption system and steganographic concepts. In this paper, we identify the need for the interconnection of the PAN with other wireless and wired networks in order to achieve cost effective mobile access, and be part of a secured private network. We will overview some key networking and service technologies required to support the proposed network.

Introduction to Our Approach: The objective of our work has been multifold: To explore a system, which is capable of creating independent networks within itself; To provide independence and security within

its umbrella; To provide an independent network with a different set of services; To reduce cost due to increased security and services. The first aim is directly achieved by picking up a mobile system e.g., GSM, and develop a system architecture that is created from within GSM architecture. The services architecture such embedded within GSM radio interface enables to implement various security techniques for offline applications such as textual telephony. The textual telephony service covers our desired objective to offer it in addition to voice and SMS services. Since SMS service is an open protocol, hence it is thus prone to security hazards. Therefore, different system architecture is suggested to overcome existing limitations and is based upon its own specific design layout. Since the use of such messaging does not require to place a call, hence cost factor on the caller is minimal. This whole setup enables to develop SMS sort of service for land phones.

The research under this work takes care of many components of implementation – client interface, server design, a network architecture, a website development, and a services plan under the same network banner. Furthermore, various layers of encryption scheme are proposed to add security to this domain of communications.

2. Private Textual Network – Proposed Scheme

Architecture: In this work, we propose and develop an architecture, which uses current GSM technology (as a client and a networking platform). The architecture includes current GSM or compatible client machines along with a separate group of servers. Such architecture is shown in Figure 1. The Figure 1 shows a possible implementation of a textual telephony system. The message from a mobile to a land phone can be sent through a set of servers without making a phone call. The set of servers can be placed at one place with connectivity to GSM system and group of landlines. On experimental basis, the client/server side implementations have been carried out using JAVA. The server architecture

includes a Java SERVLET – a server side component of the Telephony Server. It will act as the connection point between the mobile client and the server. The Servlet will simply receive the text from the mobile phone and will pass it for further processing. The other component is a Java MIDlet - a piece of software, which will be installed or downloaded to the mobile phone. This MIDlet will act as an interface to the service. It will allow the client to send a text message to the Telephony Server, which will be later on converted into a voice message. It will also allow the client to view the log of the calls, he has made so far. It will also allow the client to record telephone numbers in the address book maintained by the MIDlet. The second server is TTS Server – a Text to Speech Server is the point where a text message is made suitable for a land-phone i.e. the message from the mobile phone is converted into a male/female voice which will be sent to the phone number provided by the user. TTS Server saves the voice output into a .wav file. The third server required in this architecture is the Dialing Server – a dialing software that communicates with the modem installed on the dialing server and instructs the modem to dial a specified phone number. The Dialing Software tries the specified number for a certain number of times. If it gets the number then it picks the .wav file and play it on the phone. If it cannot connect the number after certain number of tries, then it adds this particular dialing task in a queue and then dials the number later. The Queuing server is a support server depending upon the size of user database and architecture. The proposed architecture has a website with a necessary database, which will allow the administrator to create accounts of clients. Once the account is created, only then the user will be allowed to download the Java MIDlet to his computer. Then, from the computer the MIDlet will be transferred to the mobile phone. So without creating an account nobody can use this service.

Exploring Flexibilities and Corresponding Strategies: By comparing the proposed architecture

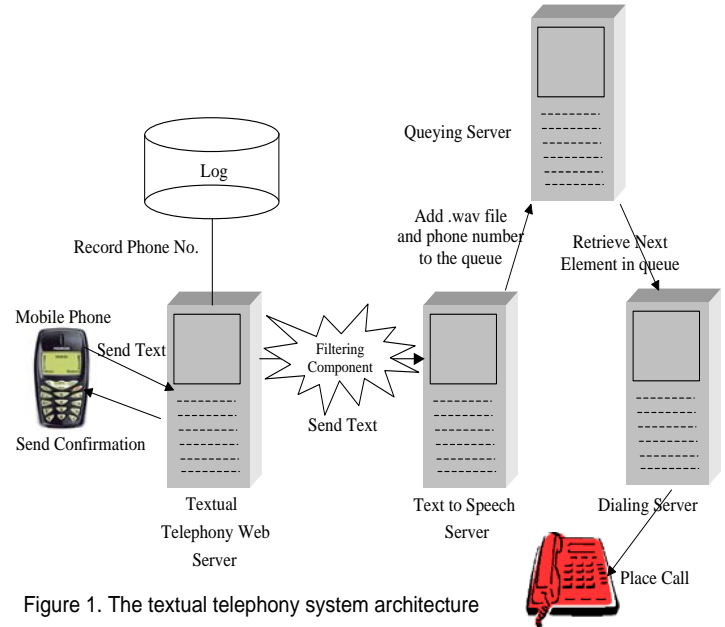


Figure 1. The textual telephony system architecture

with our objectives discussed in previous section, there seems a number of ways the system can be formulated to provide solution to stated objectives. First and foremost is the radio interface between GSM station and Textual Telephony Web server. This link can be operated using WAP or i-mode etc. As compared to other interfaces, i-mode has been picked because of its cost effectiveness, its user-friendly language used for developing applications, and lesser overhead at the gateway. Furthermore, as the link is common for all other services of GSM, a suitable encryption can be applied at the client interface before sending the data to the server. This will be in addition to client authentication, logging, content provider authentication and client lookup being performed by the web server. The second flexibility in the network is the link between text-to-speech server and web server. Here, normally the filtering of content will be applied to extract text to be finally sent to the dialing server. In this link, a private key can be generated for that specific dialed user. That key could be a time related stamp number based upon last successful download of JavaMIDlet to his/her client machine. This adds another security shield for transfer of text/data to the destination. The next process is conversion of text to speech at a specific server. If desired by the design objective, the

same text without conversion to speech can also be sent to the (wireless) destination device directly along with key for secured view. This service is different and more secured than using SMS. Another flexibility present in the architecture is the link between dialing server and the destination. The destination device primarily is landline phone. Alternatively, the text message can be sent over wireless destination device, the device here being the part of a secured group.

Benefits: Having discussed the flexibilities in the architecture, we are ready to summarize the benefits and services. Figure 2 shows such listing in tabular format. It also compares the services under proposed architecture with those of current systems. Since our proposed system is an overlay network onto a GSM network, hence overhead is very small except those of downloading of client software and registration procedure. It should also be noted that since sending of either text or speech (converted from text) involves additional set of servers, hence extra services can also be devised for such a system.

Development Strategies: Based on our objectives, development tools were selected to experimentally judge the functions of the architecture. As next generation phones are widely expected to work over TCP/IP, the next generation of technologies for such applications will introduce a new level of security and compatibility to wireless world. Since we adopted i-mode as an interface, hence we used J2ME (Java 2 Micro Edition) for application development, as it is protocol independent, inherits Java security features, suited for small devices, and flexible. The web server development was carried out using Java Servlets, where as text-to-speech conversion was carried out using Microsoft engine with Java API. The dialing server used Microsoft TAPI with wrapper of Java.

Technology versus Impairments: As there are not much cross-platform interfaces, hence problems to be faced for such an architectural solution are minimal. The only problem highlighted is the preference of i-mode interface. Since i-mode interface is only used in

Japan, hence benefits forecasted because of its use may not be available until its global acceptance or a similar global solution. Similar statements can also be made about WAP (Wireless Application Protocol), as it is also a new technology.

System	Service	Degree of Security	Flexibility	Overhead
Proposed	Text	High	High	Nominal
	Text-to-Speech	High	High	Nominal
Current Approaches	Text/SMS	Low	Moderate	Zero
	Text-to-Speech	Low	Moderate	Small

Figure 2: Comparison of services (Proposed versus Current Systems)

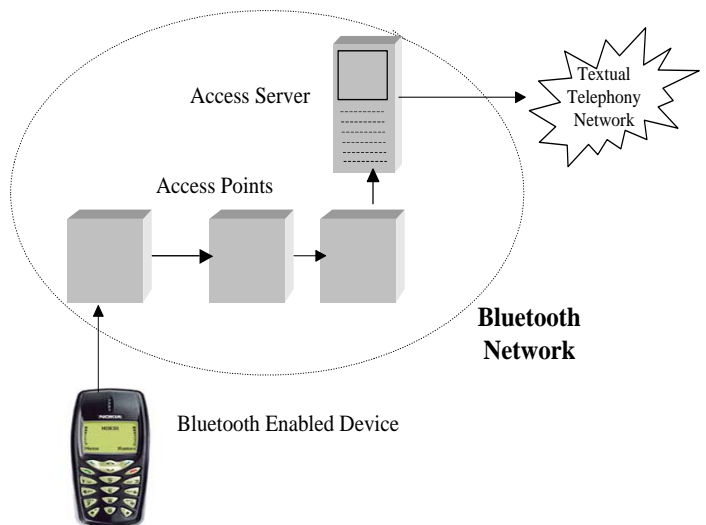


Figure 3. Bluetooth Platform for Textual Telephony

3. Domain Analyses and Discussions

The work reported here does not consider distance as a metric for evaluation since GSM has been the main platform for connectivity. If such a scenario develops, where short range service is to be needed, Bluetooth technology can be used to access textual telephony system network, as shown in Figure 3.

The Figure 3 clearly shows the difference with Figure 1. Obviously, the client now is more versatile in the sense that it can now connect to textual telephony network with added security with low cost in addition

to connecting its own directory-listed devices (of various known compatible destinations). The added security will be there in a sense that the message does not have to pass through GSM service providers. The obvious result is more flexibility in terms of destination clients and security level, and in turn more closer to our first objective of having independence of creating networks within itself.

4. Conclusions

We have described an implementable textual telephony network using different possible platforms with added security, less cost, low overhead, and high degree of flexibility. The development strategies used are common and available globally. It was shown that desired objectives of the system can be achieved with state of the art current technologies with no impairments.

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