Information Services and Access Mechanism of Mobile Web for the Under-privileged

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Abstract
To eradicate digital divide and to allow Mobile Web accessible to the under-privileged, Web facility needs to be available through all mobile media like voice, data, and SMS. Unlike voice or data, SMS-data does not interoperate. This paper presents a technology named USRS (Universal/Ubiquitous SMS Routing Service) that enables SMS-data interoperability. The proposed USRS technology is also mobile number portability neutral. This position paper proposes that USRS technology should be made standard so that Mobile Web can proliferate in the deep corners of the world over cellular networks.

Keywords: Digital divide; Online Transactions; SMS-data; SMS-data interoperability; GSM

1. Introduction
Mobile phones changed the lives of common people in a major way across the world from Bangladesh to Congo. There are more than 2.5 billion mobile phones today that are expected to grow to 4 billions by the end of 2010. It took 12 years for the mobile phone industry to reach the first billion connections. The second billion has been achieved in just two and a half years through growth in emerging markets like China, India, Africa and Latin America, which accounted for 82% of the second billion subscribers [1]. A large percentage of these new mobile subscribers are under-privileged individuals; they use budget phones and mostly prepaid connections. As GPRS (General Packet Radio Service) and TCP/IP are not available in all part of the world over prepaid connections or over budget phones, we need to look at Mobile Web over SMS. When SMS is used as data bearer, there is no interoperability.

It is well established fact that mobile number portability (MNP) [2] helps the economy and the consumers. In emerging economies where infrastructure is scarce, mobile phones play the role of storefronts of businesses. In this scenario MNP becomes a business accelerator. Therefore, all Mobile Web services need to be MNP safe. Procedures have been recommended for voice and point-to-point SMS portability [3]. However, there is no technology or procedure defined for portability of SMS-data. As a result with current technologies, SMS-data will cease to operate when a mobile number is ported to another network.

Appetite for lifestyle based online transactions is growing world over – from advanced economies to emerging economies. Examples are formation of Mobile Payment Promotion Council in Japan for contact-less payment [4]; farmers in Kenya gathering market information on agricultural produce through mobile phones using SMS [5]; in Korea, Mobile Web over SMS is helping to take diabetic healthcare to wider population base at a cheaper cost [6]. For overall growth of under-privileged we need to look at information exchange over mobile phones where the user can directly interact with the service provider. This will include healthcare, financial applications, weather alerts, agricultural exchange, emergency services, telematics, telemedicine, business specific online transactions, payment applications, e-governance, and of course entertainment.

In this position paper, we present Ubiquitous SMS Routing Service (USRS) technology that allows SMS-data interoperability. Using USRS technology, SMS-dada can be routed from any mobile phone (roaming in any network) to any SMS-based Web service hosted in any data network. In this position paper, we also present the Universal SMS Routing Service (USRS) technology that is number portability safe, so that when the subscriber ports the mobile number to another network, Mobile Web services over SMS will continue to operate without any interruption. This position paper also proposes that USRS technology should be adopted as a standard for interoperable SMS-data.

2. Media for Online Transactions with Thin Content
Online transactions are interactive interactions with computer applications where the OLTP (OnLine Transaction Processing) system simplifies and abstracts complex business processing distributed over

multiple systems and multiple distributed databases by maintaining integrity of data as a unit of work (or transaction). Common Internet applications like file transfer, email, or music download work in a client-server mode where results are static or precompiled and transferred to the same point as the point of request. However, in online transactions every result is dynamically generated and required to be peer-to-peer. In a simple rural contact-less mobile payment situation where there is no POS (Point of Sale) terminal, the merchant will initiate the payment request; the customer will be required to confirm the payment through unsolicited message (notification). In another example, during crop cutting, one farmer sends a message to an application requesting help for 5 labors; labors from the same region registered in the service receive notification. In another example, if the weather bureau expects a storm, it needs to send alerts to fishermen and people living in the coastal area.

There is a general consensus that TCP does not perform well in wireless environment [7]. Because of fading, multipath, or channel unavailability following handover, packets are lost in the cellular network; TCP incorrectly interprets this packet loss as an indication of congestion and reduces its congestion window resulting overall throughput reduction. In vehicular condition when the mobile station is moving at high speed, there will be frequent handovers resulting call drops and connection termination. OLTP applications especially financial applications like payment will demand multi phase commits; therefore, any connection breakdown will have serious impact on the transaction.

SMS meets all criteria for potential data bearer for information exchange for the under-privileged; it is cheap, no license fee, and pay as you use. Moreover there is a very thin messaging client available on every mobile phone to access SMS. However, the major challenge for SMS based applications is that there is no interoperability of SMS-data. Also, SMS-data is not MNP neutral. A voice or data call in a mobile network is switched by the serving MSC (Mobile Switching Center) or SGSN (Serving GPRS Serving Node) respectively; however, an SMS is always switched by the home SMSC (SMS Center). A subscriber connected to cellular network "A" can talk to another subscriber in network "B". A subscriber connected to an ISP (Internet Service Provider) "A" can access a Web service connected to ISP "B". A subscriber from network "A" can send point-to-point SMS to another subscriber in network "B". However, a subscriber from network "A" cannot access an SMS-based Web service connected to another network, say network "B". This is against the fundamental philosophy of telecommunications and data communications.

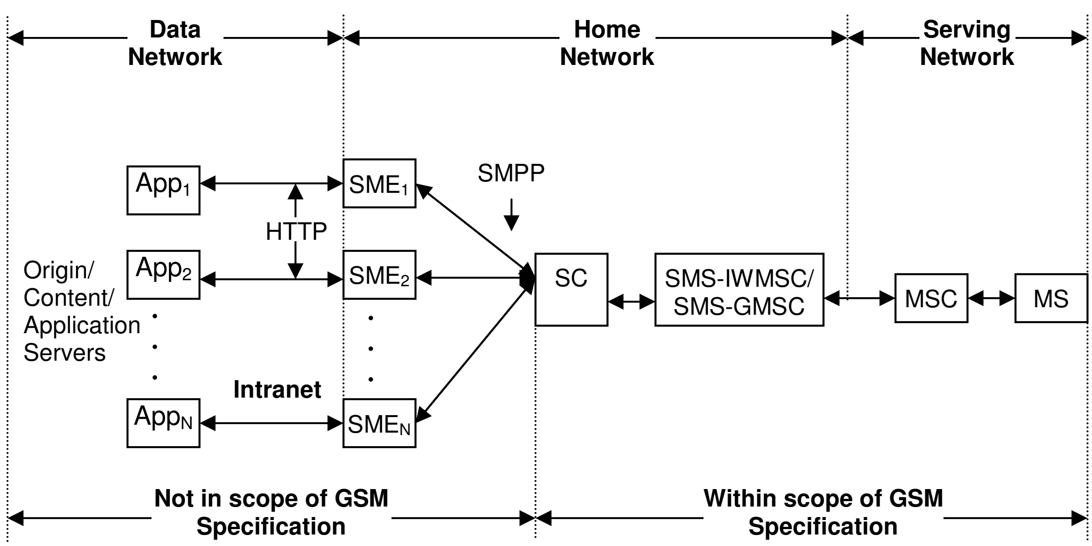

Figure 1: SMS-data architecture (GSM 03.40)

3. Seamless Mobility with Mobile Web Applications

In seamless mobility user will be able to move transparently between network boundaries without any interruption in service – while the service is in progress. For traveling individuals, for productivity and business continuity, availability of information anywhere anytime is critical. Seamless mobility is critical for any telematics, OLTP, or payment applications; also, it is critical for nomadic people in rural setup. One of the major challenges for seamless mobility is that the AAA (Authentication, Authorization, and Accounting) functions need to be implicit.

SS#7 signaling network is common to GSM, GPRS, and 3G carrying signal and SMS. SMS is error resistant to a large extent. As SS#7 network is generally not busy, even in congested zones SMS has higher chances of success compared to voice or data. On September 11, 2001 following the twin tower attack at New York City, telephone lines became inaccessible; it was SMS that was used for communication between emergency service personnel [8]. The SMSC within the core network works in a store and forward manner. This exhibits fault tolerance towards latency. Even if a voice call or data call cannot be serviced due to low signal strength or channel unavailability, SMS can be serviced. Moreover, SMS works in a vehicular state at high speed of mobility and handover. Other advantages of SMS are that it is self-configurable. Without user intervention AAA functionality of SMS is addressed by the network in roaming. SMS is always ON (SMS cannot be barred or diverted to another mobile device). This makes SMS the perfect bearer for push, unsolicited messages, or peer-to-peer communications. Unlike TCP, SMS messages are memoryless and independent in space and time. Therefore, if there is a blackout (in a tunnel or low signal area) TCP session will fail but SMS will continue to work. This helps SMS to operate transparently across operator/network boundaries.

SMS point-to-point where both endpoints are mobile phones – interoperates [9]. However, SMS-data where one endpoint is always a computer application, it does not interoperate. SMS applications use short operator proprietary codes like 1234, 7557, 333 etc as SMS-data service identifier (SDSI). These short codes are port addresses in the SMSC in the home network where an SMS gateway is connected through SMPP (Short Message Peer-to-Peer) protocol. There is no technology available today to route an SMS-data from one network to a Web service deployed in another network (Figure 1). In the US, there is a facility by which the availability of one unique SMS short code across cellular operators can be searched and reserved through http://www.usshortcodes.com. The advantage here is that a uniform code is available across USA, where all operators assign and configure this address as the SDSI for a Web service. Such facility is not available in most countries outside of the US. This results into same service in different networks carrying different SDSI with different user interfaces – making it user unfriendly and sometime confusing. For Indian Railways for example, there are about 16 sort codes varying from network to network within India [10]. Pity is – as there is no SMS-data interoperability, these services are not available in cellular networks outside of India. Such services will even be unavailable in mobile number portability. An SMS sent to any of these addresses will be routed to an application connected to the home SMSC through content specific gateway configured with these addresses (Figure 1). This mechanism prohibits SMS-data from one network to be routed to a Web service deployed in another network.

4. SMS-data Interoperability through USRS Routing Algorithm

In this section we present a routing algorithm that makes SMS-data interoperable and MNP neutral. This routing algorithm is tested in an Indian cellular network. We propose that this is made a standard for Mobile Web access through SMS. This technology is named Ubiquitous/Universal SMS Routing Service (USRS). Through USRS routing algorithm and Web API (Application Programming Interface) – it is possible to route SMS-data to any service in a private operator centric intranet or to any service in public Internet from any SMSC without having to configure the SMSC or the SMS gateway.

We explain the USRS routing algorithm here. For interoperable SMS-data, the SMS service identifier will have a global title in E.164 format like +919830692265 (+91983MYBANK) in addition to usual proprietary short codes like 692265, or vanity shortcode like MYBANK (682265), so that transient networks can route the SMS-data. As there is no concept of toll-free SMS number yet, these SDSIs are taken from some number range holder network. This number range holder network is defined as *foster network* (Figure 2). MyBank in UK for example, will have an SDSI as +447720692265; in India same bank will have an SDSI as +919830692265. These SDSIs are issued by different foster networks. The USRS server functions like an SCP (Service Control Point) and does the global title translation. The USRS has an E.164 address and a Signaling Point Code. This global title and point code is taken from the number range of a network that is called *host network* (Figure 2). The USRS is physically installed within the host network. The host network and the foster network need to have roaming agreement to access the HLR (Home Location Register).

The USRS routing procedure for online transaction is shown in Figure 2. The USRS server periodically sends MAP_UPDATE_LOCATION message [11] to various foster networks. This location update message from USRS masks the SDSI and modifies the VMSC (Visited MSC) of the foster network for these respective SDSI numbers (e.g., 919830692265 in India and 447720692265 in the UK). VMSC address corresponding to the SDSIs in these HLRs points to the E.164 address of the USRS server that will be used by the SMS-GMSC (SMS Gateway MSC) to route the SMS-data. Through location update message, the SDSI is masked so that it appears to be roaming in the host network. The USRS server functioning as global title translation node, an SDSI call is converted into another global title or to an Internet URL through Web API. The USRS server is not controlled by any cellular network. This will be managed by independent authorities similar to DNS (Domain Name Servers) in IP networks or SMS/800 (Service Management System/800) in telecommunications networks. The USRS will also have SDSI to foreign SMSC mapping for these services that are connected to services through proprietary SME with short-code and not accessible through URL.

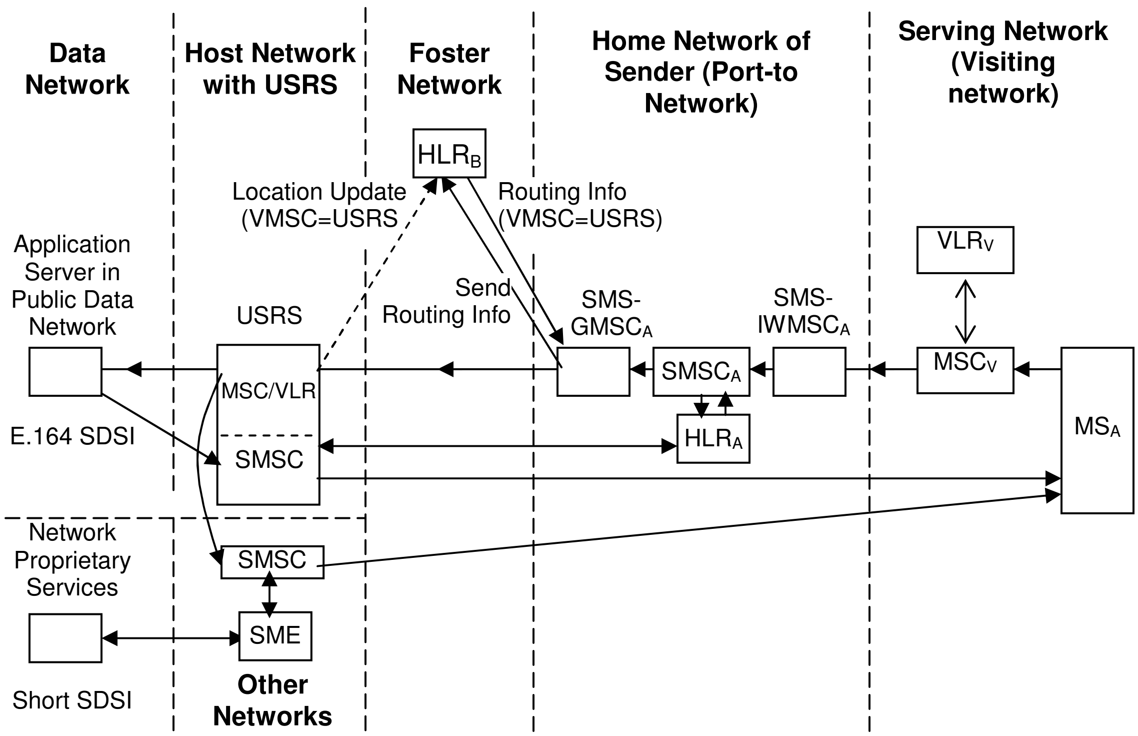

Figure 2: The USRS Routing Algorithm

When user sends an online transaction request SMS from MS_A to an SDSI (Figure 2), it is validated by the VLR_V and routed to the home $SMSC_A$ through the serving network MSC_V. $SMSC_A$ enquires the HLR_B of the SDSI to find the routing path. The VMSC address in the HLR_B for this SDSI is masked to indicate that the SDSI is roaming in another network named as host network. The SMS-data is routed by the SMS-$GMSC_A$ to the USRS server. The USRS server converts the SMS into an HTTP URL request through Web API to fetch the content from the Web. There will be also services through short codes like 692265 that is accessible only through an operator's SMSC through proprietary SMS gateway; in such case the USRS server converts the SM MT (Short message Mobile Terminated) into an SM MO (Short message Mobile Originated) message, converts the target address to the short number and tunnels the SMS-data to the foreign SMSC where the service is connected. This request will then be forwarded by the proprietary SMS gateway to the private application. This is depicted in the lower part of Figure 2.

The overall Mobile Web application architecture is depicted in Figure 3. Using the budget mobile phone user will send a request to an SDSI. The user input can be in English or any local language (if supported by the budget phone). To make the Mobile Web user-friendly, a multi phase stateful transaction needs to be converted into a single phase stateless transaction where user sends only one SMS as request and will receive one SMS as response. Application middleware with transcoding capability will handle the stateless to stateful translation. To facilitate the under-privileged users, a SSO (Single Sign On) interface can also be added in the middleware application server.

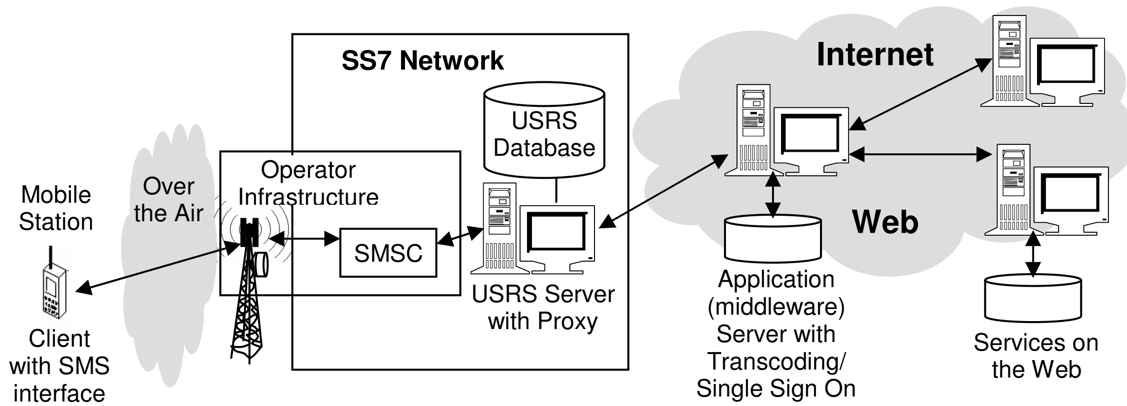

Figure 3: Architecture for Mobile Web access over SMS infrastructure

5. Security Usability and Conclusion

Security has always been a concern in TCP/IP. In wireless environment, the security concern is even higher. However, USRS algorithm can be used to route SMS from any point to any other point. The transport bearer of SMS is SS#7 network that is physically secured. Therefore, USRS can be used for multifactor authentication and security where part of the key is transported over SMS.

In this position paper we presented USRS technology that allows interoperability of SMS-data. USRS technology is also mobile number portability safe. USRS technology combined with an application server and transcoding allow Mobile Web for the masses and under-privileged. This will also help eradicate the digital divide. We therefore propose that this technology is made standard.

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